The Vessel Schedule Recovery Problem
Disruption management in liner shipping

Brouer, Berit Dangaard; Plum, Christian Edinger Munk; Vaaben, Bo; Pisinger, David; Dirksen, Jakob

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Citation (APA):
1 - Challenges in the Application of Mathematical Programming in the Enterprise-wide Optimization of Process Industries

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Enterprise-wide optimization (EWO) is a new emerging area that lies at the interface of chemical engineering and operations research, and has become a major goal in the process industries due to the increasing pressures for remaining competitive in the global marketplace. EWO involves optimizing the operations of supply, production and distribution activities of a company to reduce costs and inventories. A major focus in EWO is the optimization of manufacturing plants as part of the overall optimization of the supply chain. Major operational items include production planning, scheduling, and control. This talk provides an overview of major modeling and computational challenges in the development of deterministic and stochastic linear/nonlinear mixed-integer optimization models for planning and scheduling for the optimization of plants and entire supply chains that are involved in EWO problems. We illustrate the application of these ideas in four major problems: a) integration of planning and scheduling in batch processes that lead to large-scale mixed-integer linear programs, b) optimization of responsive process supply chains that lead to large-scale bicriterion mixed-integer optimization problems, c) optimization of distribution-inventory planning of industrial gases that lead to integration of planning and vehicle-routing models, d) optimization of oilfield infrastructures under uncertainty that lead to multistage stochastic programming problems with endogenous uncertain parameters. We outline the solution methods that have been developed. Also, these problems have been addressed in collaboration with industry, and have led to substantial economic savings.

2 - Scheduling malleable tasks with arbitrary processing speed functions

Maciej Machowiak, Poznan University of Technology, Poland, maciej.machowiak@cs.put.poznan.pl, Mikhail Y. Kovalyov, Jan Weglarz, Maksim Barketau

The problem of scheduling n tasks in a system with m processors to minimize the makespan is considered. Task are malleable when can be executed by several processors at a time, its processing speed depends on the number of assigned processors, and a set of processors assigned to the same task can change over time. The processing speed of a task is a strictly increasing function of the number of processors allocated to this task. We present results for arbitrary n and m, polynomial time algorithms for convex and concave functions and an enumerative algorithm for arbitrary functions.

3 - Fast Truck-Packing of 3D boxes

Grzegorz Pawlak, Institute of Computing Science, Poznan University of Technology, ul. Piotrowo 2, 60-965, Poznan, Poland, grzegorz.pawlak@cs.put.poznan.pl, Joanna Jozefowska, Erwin Pesch, Dawid Kowiński, Michał Morze

The practical 3D container packing problem was considered. The problem was formulated for the real packing constrains appearing in the sales and logistics departments of household equipment factory. The formal MIP formulation has been presented and fast heuristic algorithm was proposed. The appropriate computational experiment has been performed. The solution can be implemented in the real container packing problem for the rectangular boxed products.

4 - Genetic Algorithm Supporting Supply Process in Charitable Organizations

Małgorzata Sterna, Institute of Computing Science, Poznan University of Technology, Piotrowo 2, 60-965, Poznan, Poland, Malgorzata.Sterna@cs.put.poznan.pl, Mateusz Cichenski, Mateusz Jarus, Michal Misikiewicz, Jaroslaw Szymczak

We study the optimization problem arising in charitable organizations during supply process. Such institutions are especially interested in minimizing the total cost of purchase which consists of the prices at which particular products are bought and the cost of their transportation. We present the formal mathematical model of the problem, which is NP-hard, and propose list heuristics as well as the genetic algorithm solving it. The efficiency of implemented methods was checked in extensive computational experiments.
MA-04  
Monday, 8:30-10:00  
RB-L2  

Optimization of shared urban transportation systems

Stream: Optimization in Public Transport  
Invited session

Chair: Gonçalo Correia, Department of Civil Engineering, University of Coimbra, Faculdade de Ciências e Tecnologia. Dep. Eng. Civil, sala SA 2.8 Rua Luis dos Reis Santos, 3030, Coimbra, Portugal, gcorreia@dec.uc.pt

1 - Strategic design of public bicycle sharing systems with service level constraints

Jenn-rong Lin, Department of Transportation Science, National Taiwan Ocean University, 2, Pei-Ning Road, 20224, Keelung, Taiwan, jrlin@mail.ntou.edu.tw, Ta-hui Yang

We formulate and analyze a strategic design model for public bicycle sharing systems with service level considerations. In considering the interests of users and investors, the proposed model attempts to determine the number and locations of bike stations, the network structure of bike paths connected between the stations, and the travel paths for users between each pair of origins and destinations. A numerical example is created to illustrate the proposed model. Sensitivity analysis is performed to gain better insights into knowing how important parameters affect the design of the system.

2 - Testing the validity of the MIP approach for locating carsharing stations in one-way systems

Diana Rita Ramos Jorge, Department of Civil Engineering, University of Coimbra, Rua Luis dos Reis Santos, 3030-788, Coimbra, Portugal, diana.jorge@student.dec.uc.pt, Gonçalo Correia, Cynthia Barnhart

Previous research has proposed using a mixed integer programming (MIP) model for choosing the location of stations in one-way carsharing systems as an approach to solve vehicle stock imbalance. However, MIP models have difficulties including reality-based factors that can have a substantial impact on carsharing. Thus we test the validity of those solutions developing a simulation model including demand variability and relocation operations. The first tentative results show that these factors influence the company profit, affecting significantly the performance of the deterministic solutions.

MA-05  
Monday, 8:30-10:00  
RB-L3  

Maritime fleet size and mix

Stream: Maritime Transportation  
Invited session

Chair: Trond A. V. Johnsen, MARINTEK, SINTEF, Otto Nielsen veg 10, 7052, Trondheim, Norway, trond.johnsen@marintek.sintef.no

1 - Containership speed and fleet size optimisation with semi-elastic demand: an application to northern europe-south america trade

Ali Cheaitou, College of Engineering - Industrial Engineering and Management Department, University of Sharjah, Sharjah University City, 27272, Sharjah, United Arab Emirates, ali.cheaitou@graduates.centraillens.net, Pierre Carrou

Increasing the number of vessels in a container liner service while reducing speed, known as slow steaming strategy, is modelled in this paper. We focus on the case of optimal speed under semi-elastic demand, for which containerized perishable product transport is sensitive to time. This paper investigates if slow steaming is still optimal when working to maximise the total profit on the cycle. Furthermore, a numerical application is carried out for a direct Northern Europe to East Coast of South America container service, a route selected due to the high volume of perishable products.
2 - On solving the feeder containership network design problem via metaheuristic approaches
Olçaay Polat, Production Management, TU Berlin, TU Berlin (H95-H9157), Straße des 19. Juni 135, 10623, Berlin, Germany, olcaay@gmail.com, Hans-Otto Guenther, Osman Kulak

Feeder ports serve as regional hubs from where containers are distributed in the respective region by use of feeder ships. The feeder network design problem (FNDP) determines the smallest ship fleet size with routes to minimize total travelled distance with time, capacity and service frequency restrictions. In this study, a mathematical model is proposed and metaheuristic approaches are developed to solve the FNDP. The developed approaches have been tested using case studies from Turkey. The numerical results of the study show that Turkish ports have great potential as hub ports in its region.

3 - Fleet size and mix in liner shipping
Trond A. V. Johnsen, MARINTEK, SINTEF, Otto Nielsen veg 10, 7052, Trondheim, Norway, trond.johnsen@marintek.sintef.no, Lars Magne Nonås, Kjetil Fagerholt, Bjarne Egil Asbjornseth

Fleet size and mix is a core decision for all shipping companies. In any given market situation, the number of vessels and the variety of vessel types will determine the profit potential for the company. We present an optimization model for improved support for strategic fleet size and mix decision-making. The model has been implemented and tested in cooperation with a world-leading liner shipping company.

MA-07

Monday, 8:30-10:00

MA-07

Novel and emerging VRPs

Invited session

Chair: Jorge E. Mendoza, Institute of Applied Mathematics, Universidad Católica de l’Ouest, 3 Place André Leroy, 49008, Angers, France, jorge.mendoza@uco.fr

1 - A Multiple Plan Approach for the Dynamic Technician Routing and Scheduling Problem
Victor Pillac, Automatique - Producitech, Ecole des Mines de Nantes, 4 Rue Alfred Kastler, La Chantrerie, 44300, Nantes, France, victor.pillac@gmail.com, Christelle Gueret, Andre Medagli

The Dynamic Technician Routing and Scheduling Problem (DTRSP) deals with a crew of technicians that serves dynamically appearing requests. In the DTRSP, each technician has a set of skills, tools, and spare parts, while requests require a subset of each. The problem is then to design a set of tours of minimal total duration such that each request is visited exactly once, within its time window, by a compatible technician, and to dynamically insert new requests into existing tours. We propose a Multiple Plan Approach to solve the DTRSP and illustrate its performance on benchmark instances.

2 - Capacitated Vehicle Routing Problem with Loading Constraints: A Case in the UK
Nasrin Asgari, Mathematics, University of Portsmouth, United Kingdom, Nasrin.Asgari@port.ac.uk, Xiang Song, Dylan Jones, Tim Pigden

Recently it has been raised to solve Capacitated vehicle routing problem (CVRP) considering loading and unloading conditions like sequential loading (Last-First-First-Out), vehicle capacity and items fragility. We have dealt with a real case in the UK that distributes consumer items like dairy, food and fruit. Each depot covers 100-150 customers. The case is solved with respect to existing limitations including loading constraints; drivers rules, shift and pattern; and customer time-window. Order splitting is allowed in the case, whilst no split on deliveries has been allowed in the literature.

3 - The Minimum Duration Truck Driver Scheduling Problem
Asvin Goel, Telematique.eu, Germany, goel@telematique.eu

Truck driver scheduling problems are important subproblems of real-life vehicle routing and scheduling problems because rest periods are required by government regulations have a significant impact on travel and arrival times. This paper identifies common constraints imposed by hours of service regulations world wide and presents a mixed integer programming formulation for the truck driver scheduling problem. A dynamic programming approach is presented and its effectiveness is demonstrated for working hour regulations in the United States and in the European Union.
4 - A GRASP with heuristic concentration for the vehicle routing problem with stochastic demands

**Jorge E. Mendoza**, Institute of Applied Mathematics, Université Catholique de l’Ouest, 3 Place André Leroy, 49008, Angers, France, jorge.mendoza@u-aco.fr, Juan G. Villegas

The vehicle routing problem with stochastic demands consists in designing transportation routes of minimal expected cost to satisfy a set of customers with random demands of known probability distributions. This paper proposes a GRASP that uses randomized route-first, cluster-second heuristics, a variable neighborhood descent, and a post-optimization procedure specially tailored for the problem. Experiments on standard instances show that our approach is competitive with the state-of-the-art method in terms of both accuracy and efficiency.

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**MA-08**

**Network Optimization 1**

Stream: Network Optimization

**Invited session**

Chair: Ana Bautzer, ISCAL / CIO, Av. Miguel Bombardia, 20, 1069-035, Lisboa, Portugal, aapedro@iscal.ipl.pt

1 - Recent developments in the Ring Spur Assignment Problem

**Paula Carroll**, Management Information Systems, UCD, Quinn Business School, Belfast, 4, Dublin, paula.carroll@ucd.ie, Bernard Fortz, Martine Labbé, Scén McCarraghy

We consider the Ring Spur Assignment Problem (RSAP), an NP-hard survivable telecommunications network design problem. It arises in the context of exploiting existing resources efficiently in strategic network development and complements the Sonet Ring Assignment Problem (SRAP) of determining the set of link capacities to install. We propose a complete IP formulation and present recent developments and the results of a cutting plane implementation on benchmark test data.

2 - ILP Models for the PON Access Network Design Problem

**Maria João Lopes**, Departamento de Métodos Quantitativos, University Institute of Lisbon (ISCTE - IUL) and CIO, Av. das Forcas Armadas, 1649-026, Lisboa, Portugal, mjl@iscte.pt, Lars Gouveia, Amaro de Sousa

A PON is an optical access network connecting a Central Office to a set of terminals using splitters installed on intermediate nodes. In the PON access network design problem, terminals are clustered in a minimum number of PONs and we have to define for each PON where to install splitters and how to connect all elements through fibres. There are costs associated with intermediate nodes, splitter types and fibre connections. We define the minimum cost design problem in the context of densely populated urban areas, proposing different formulations and valid inequalities for this problem.

3 - Robust optimization of optical fiber access networks deployments

**Cédric Hervet**, Orange Labs/CNAM, France, cedric.hervet@orange.com, Marie-Christine Costa, Faye Alain, Matthieu Chardy, Stanislas Franchot

Due to the recent increase in bandwidth requirements, telecommunication operators have to plan the deployment of optical fiber networks through Gigabit Passive Optical Network technology (FTTH GPON). One great challenge is to design this network while not knowing who and where the future subscribers will be. We focus on the problem of the robust optical fiber network deployment under demand uncertainty. A two-stage robust optimization model is proposed for this problem, as well as two robust solution methods extending classical results from Ben-Tal et al. and Babonneau et al.

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**MA-09**

**Cutting and Packing 1**

Stream: Cutting and Packing

**Invited session**

Chair: A. Miguel Gomes, INESC TEC, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias s/n, 4200-465, Porto, Portugal, agomes@fe.up.pt

1 - Heuristics for the three-dimensional loading capacitated vehicle routing problem

**Leonardo Junqueira**, Department of Production Engineering, Federal University of São Carlos, Rua Dona Alexandrina, Num. 2471, Apto. 8, 13566-290, São Carlos, São Paulo, Brazil, leo_junqueira@yahoo.com, Reinaldo Morabito

In this work we present heuristics for the capacitated vehicle routing problem with three-dimensional loading constraints. The problem consists in finding minimum cost delivery routes for a set of identical vehicles that, departing from and returning to the depot, visit all customers only once, while considering constraints related to cargo stability, load bearing and multi-droping. The routing and loading modules of the method are built on classical heuristics of the vehicle routing and container loading literatures. The results of some computational experiments are presented and discussed.

2 - A heuristic for the vehicle routing problem with backhauls and three-dimensional loading constraints

**Andreas Bortfeldt**, Dept. of Information Systems, University of Hagen, Profilstrasse 8, 58084 Hagen, Germany, 58084, Hagen, FR Germany, Germany, andreas.bortfeldt@fernuni-hagen.de, Lars Moench

In the vehicle routing problem with backhauls (VRPB) there are deliveries and pick up customers. We consider the 3L-VRPB, i.e. a combination of the VRPB and 3D loading. The given vehicles have a 3D loading space and the cargo of a customer consists of 3D boxes. A heuristic is proposed including a variable neighborhood search algorithm for routing and a tree search algorithm for packing boxes. Results are presented for 95 test instances.

3 - Inter-depot transportation planning involving palletisation and truck loading

**Maria Teresa Alonso Martinez**, Department of mathematics, University of Castilla-La Mancha, Edificio Infante Don Juan Manuel, Avda.de España s/n, 02071, Albacete, Spain, maria.teresa.alonso@uclm.es, Ramon Alvarez-Valdes, Joaquim Gromichio, Francisco Parreno, Gerhard F. Post, Jose Tamarit

In a large logistic company the inter-depot planning problem has to be solved every day. The products are placed on pallets and then the pallets loaded into trucks. The main objective is to send the fewest number of trucks, covering the demand of each depot and satisfying a number of constraints concerning the way in which pallets are built and placed into the truck. Our proposal is to solve the problem using a metaheuristic in two phases, one for building a feasible solution and the other for improving the solution. In both phases palletisation and truck loading are simultaneously considered.
4 - A study on multiobjective rectilinear packing problems
A. Miguel Gomes, INESC TEC, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias s/n, 4200-465, Porto, Portugal, agomes@fe.up.pt, Marisa Oliveira, Mª Eduarda Pinto Ferreira

In many application areas, like in Facility Layout and in VLSI design, one wishes to pack, without overlap, a set of rectilinear polygons while minimizing simultaneously more than one objective, leading to the Multi-objective Rectilinear Packing Problem. The most common objectives are the minimization of the enclosing rectangle area and the minimization of the sum of the distances between a subset of the pieces. The purpose of this work is to study and analyze the relationship between these two objectives, i.e. to study if they really are conflicting objectives.

1 - Determining means of serial processors and parameters of lot rectifying inspection plan
Ashraf El-Ga’aly, Systems Engineering, King Fahd University of Petroleum & Minerals, KFUPM P.O. Box 5008, 31261, Dhahran, Eastern, Saudi Arabia, ash.gaaly@yahoo.com, Shokri Selim

We consider determining the optimal means of a set of machines in series. Production is in lots. A lot is processed on each machine sequentially. After each machine, a sample of the lot is examined. If the number of defectives does not exceed a threshold the lot is forwarded to the next machine; otherwise, the lot is rectified and sold. Current solution methods are slow and may not get an optimal solution. We exploit a special structure of the problem that is used to design a fast solution method. We also determine the parameters of the rectification inspection plan for each machine.

2 - High speed methods for volume computation and applications to robust optimization in Supply Chain Management
Rahul Paul, Computer Science, International Institute Of Information Technology, Bangalore, 26/C, Electronic City, Hosur Road, 560100, Bangalore, Karnataka, India, rahul.paul@iiitb.org, G. N. Srivinasa Prasanna, Kundan Kumar, Subhrajit Debnath

Randomized polynomial time polyhedral volume algorithms (Lovasz-Vempala, 2003) are complex and difficult to implement. We extend existing algorithms (Vinci, B. Büeler and K. Fukuda), to introduce a chebyball variant of Direct Monte Carlo with affine transformations, extending their applicability from 9 to 20 dimensions. The volume is used in an information theoretic framework to estimate the information content under uncertainty of a polytope/scenario in a robust optimization framework for Supply Chain Management.

3 - Optimal replenishment policy for deteriorating items with time dependent demand
Shivraj Singh, Mathematics, D.N. College, Shivraj Singh, Dept. of Mathematics, D.N.(P.G.) College, Meerut, U.P., 250001, Meerut, Uttar Pradesh, India, shivrajpundir@gmail.com

This paper considers the impact of learning on set up cost on the Economic Order Quantity model for deteriorating items subject to trapezoidal type consumption rate and shortages. Deterioration models consider gradual reduction in quality and quantity of products over time. In this study the deterioration rate is a Weibull distribution function of time. A model where each cycle begins with shortages and ends without shortages is proposed. The model is developed over an infinite time horizon to determine optimal replenishment policy by minimizing total system running cost.

4 - Optimization of the processing times of cyclically repeated intersecting operation sets
Boris Rozin, Operations research laboratory, United Institute of Informatics Problems of NAS of Belarus, Surganov Str. 6, 220012, Minsk, Belarus, rozin@newman.bas-net.by, Genrikh Levin

A cyclically repeated sequence of intersecting sets of operations is executed in a system and the operations of each set are activated simultaneously. The expenses for each operation decrease with the increase of its processing time, the expenses for the whole cycle are proportional to its time. The problem is to determine the processing times of the operations to minimize the total expenses under the constraint on the cycle time. The proposed method uses decomposition techniques and dynamic programming. Examples of such systems are presented.

MA-10
Monday, 8:30-10:00
RB-Theta

Applications

Stream: Production and the Link with Supply Chains

Chair: Hicham Chehade, ICD- LOSI, University of Technology of Troyes, 12 Rue Marie Curie, 10000, Troyes, France, chehadeh@utt.fr
Chair: Lionel Amodeo, Charles Delaunay Institute, University of Technology of Troyes, 12 Rue Marie Curie BP2060, 10000, Troyes, France, lionel.amodeo@utt.fr

1 - Determining means of serial processors and parameters of lot rectifying inspection plan
Ashraf El-Ga’aly, Systems Engineering, King Fahd University of Petroleum & Minerals, KFUPM P.O. Box 5008, 31261, Dhahran, Eastern, Saudi Arabia, ash.gaaly@yahoo.com, Shokri Selim

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This paper considers the impact of learning on set up cost on the Economic Order Quantity model for deteriorating items subject to trapezoidal type consumption rate and shortages. Deterioration models consider gradual reduction in quality and quantity of products over time. In this study the deterioration rate is a Weibull distribution function of time. A model where each cycle begins with shortages and ends without shortages is proposed. The model is developed over an infinite time horizon to determine optimal replenishment policy by minimizing total system running cost.

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A cyclically repeated sequence of intersecting sets of operations is executed in a system and the operations of each set are activated simultaneously. The expenses for each operation decrease with the increase of its processing time, the expenses for the whole cycle are proportional to its time. The problem is to determine the processing times of the operations to minimize the total expenses under the constraint on the cycle time. The proposed method uses decomposition techniques and dynamic programming. Examples of such systems are presented.

MA-11
Monday, 8:30-10:00
RB-Iota

Incursion of foreign transportation ressources

Stream: Transportation Planning

Chair: Jörn Schönberger, University of Bremen, 28359, Bremen, Germany, jsb@uni-bremen.de

1 - Heuristic Strategies for Bundle Bidding in Transport Auctions
Tobias Buer, Department of Business Studies & Economics, Chair of Logistics, University of Bremen, Wilhelm-Herbst-Str. 5, 28359, Bremen, – Please Select (only U.S. / Can / Aus), Germany, tobias.buer@uni-bremen.de, Herbert Kopfer

The procurement of transport services via a combinatorial auction is considered from a freight carrier’s point of view. The freight carrier has to decide on which subsets of the tendered freight requests to place a bid. This problem is denoted as the bid generation problem (BGP). To solve the BGP, we propose heuristic bidding strategies based on synergies between requests. By means of a computational study, the strategies are compared to a brute-force strategy which generates all possible bundle bids. Based on this comparison, trade-offs are discussed.

2 - Benefits of a heterogeneous fleet — the ecological perspective
Herbert Kopfer, Department of Business Studies & Economics, Chair of Logistics, University of Bremen, Wilhelm-Herbst-Strasse 5, 28359, Bremen, Germany, kopfer@uni-bremen.de, Heiko Kopfer, Jörn Schönberger

Road haulers are more and more enforced to integrate emission-related issues in their daily operations planning. We present an innovative approach that aims at exploiting the ecological benefits of a heterogeneous fleet. Vehicles are classified by their fuel consumption with respect to their dead weight and actual payload. Here, the linearity between traveled distances and cargo weight becomes void. We demonstrate the predominance of a heterogeneous fleet over a homogeneous fleet with respect to the reduction of green house gas emissions.
3 - Collaborative Transportation Operations Planning in a Real-world Scenario - Handling of Backhauls
Andrea Nagel, Information Systems Research Group, FernUniversität - University of Hagen, 58084, Hagen, Germany, andrea.nagel@fernuni-hagen.de, Giselher Pankratz, Hermann Gehring

In this contribution we examine a cooperation of four producers in the food and beverages industry, which decided to coordinate their distribution activities by inter-organisational transportation planning. We modeled this scenario as a Rich Vehicle Routing Problem. One of the real-world restrictions is the occurrence of backhauls. Different needs for the transportation of the goods induce different backhaul policies that have to be covered by the model. We identify and characterize these policies and propose a strategy for an improved handling of backhauls in a real-world scenario.

4 - Enrichment of Mobile Freight Auctions with Location Sensitivity: Systemic Design Considerations
Dimitrios Emiris, Industrial Management & Technology, University of Piraeus, 80 Karaoli & Dimitriou Street, 18534, Piraeus, Greece, emiris@unipi.gr, Charis Marentakis

The use of the Auction Classification Ecosystem (ACE) recently presented enabled the systemic design of many auction types, including B2B ones that are widely used in trading of freight services. The present proposal secures the systemic design of advanced auctions and capitalizes on the ACE for shaping a progressive and evolutionary approach to implement advanced auctions with mobility and location sensitivity and to incorporate additional sources of information such as customers' behavior. The model parameters are fine-tuned using observations from actual or experimental findings.

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MA-12
Monday, 8:30-10:00
RB-Omicron

Fuzzy Goal Programming and Optimization Methods

Stream: Fuzzy Systems, Neural Networks & Artificial Intelligence
Invited session
Chair: Mariano Jimenez-Lopez, Economia Aplicada I, University of the Basque Country, Plaza de Oñati 1, 20018, San Sebastian, Spain, mariano.jimenez@ehu.es

1 - Soft computing applied to portfolio selection with uncertain data
Carlos Cruz Corona, DECSAI, Universidad de Granada, Spain, carloscruz@decsai.ugr.es, Ricardo Coelho Silva, José L. Verdegay

Nowadays, Soft Computing is employed with great success in the design, construction and utilization of a wide range of products and systems whose functioning is directly based on the human beings reason ways. This is specifically patent in the case of the real-life optimization problems. In this work a novel approach that solves quadratic programming problems under different kind of uncertainties in its data is proposed. As an illustration, a portfolio selection problem with uncertain data is formulated and solved as a fuzzy quadratic programming problem.

2 - Fuzzy goal programming for material requirement planning under uncertainty and integrity conditions
Josefa Mula, Research Centre on Production Management and Engineering, Universitat Politècnica de València, Escuela Politécnica Superior de Alcoy, Plaza Ferrándiz y Carbonell, 2, 03801, Alcoy, Alicante, Spain, fmula@cigip.upv.es, Manuel Díaz-Madroño, Mariano Jimenez-Lopez

To solve a material requirement planning problem of a first tier supplier in an automobile supply chain a fuzzy goal programming model is proposed. The goals are to minimize production and inventory costs, idle time and backorder quantities. The epistemic uncertainty is considered in the demand, available and required capacity. The integrity conditions for the main decision variables are considered. To model the relative importance between goals, instead of a crisp weight structure, fuzzy binary relations are used. An example based on modifications of real-world industrial problems is shown.

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MA-13
Monday, 8:30-10:00
RB-Tau

Lot-sizing and Related Topics 1

Stream: Lot-sizing and Related Topics
Invited session
Chair: Bernardo Almada-Lobo, Industrial Engineering and Management, Faculty of Engineering of Porto University, Rua Dr. Roberto Frias s/n DEIG, 4200-465, Porto, Portugal, almada.lobo@fe.up.pt

1 - Integrated scheduling of continuous casters and hot strip mills in the steel industry: a block planning approach
Pedro Amorim, Industrial Engineering and Management, Faculty of Engineering of Porto University, Rua Doutor Roberto Frias, 4200-465, Porto, Portugal, amorim.pedro@fe.up.pt, Imke Mattik, Hans-Otto Guenther

This work addresses the joint scheduling of continuous caster and hot strip mill processes in the steel industry. Traditionally, slab yards are used to decouple these two stages. However, the rising importance of energy costs gives motivation for an integrated scheduling. For each of the processes a mixed-integer optimization model based on the block planning principle is presented. This approach develops production schedules that take technological sequences of steel grades and rolling programs into account. Instances from a real-world steel plant are solved and the results are discussed.
2 - Lot sizing and scheduling of chemical commodity products: An evolutionary block planning application

Nowadays companies in many industries are faced with an increased product variety and the need to quickly respond to short-term customer orders. Hence a specific challenge is to continuously adapt production schedules in a cost-efficient way when new customer orders arrive. Evolutionary planning is proposed as a general concept supporting the continuous development of production schedules. Specifically, we adopt the block planning principle as a practical tool for scheduling variant products in a predetermined sequence. As a case study the production of chemical commodities is considered.

3 - Combining column generation and metaheuristics for solving a parallel machine scheduling problem with job splitting
Carina Pimentel, DEGEI, University of Aveiro/Algoritmi Research Center, Campus Universitário de Santiago, Portugal, 3810-193, Aveiro, Aveiro, Portugal, carina@dps.uminho.pt, Filipe Alvelos, Diogo Alves

In this talk we present the problem of scheduling n independent jobs on m identical parallel machines with the objective of minimizing total tardiness, considering jobs release dates, sequence independent setups and lot splitting. A time indexed mixed integer programming compact model and a decomposition model will be presented. The decomposition model is solved by a SearchCol algorithm. SearchCol is a recently proposed general framework for decomposable integer programming/combinatorial optimization problems based on the hybridization of column generation and metaheuristics.

4 - Neighbourhood-based hybrid algorithm for pulp and paper production planning
Gonçalo Figueira, Industrial Engineering and Management, Faculty of Engineering of Porto University, 4200-465, Porto, Portugal, goncalo.figueira@fe.up.pt, Maristela Santos, Bernardo Almada-Lobo

Motivated by a real-world case study in the pulp and paper industry, we tackle the short-term production planning and scheduling in an integrated mill. Our approach combines a Variable Neighborhood Search procedure (which manages the setup variables), a specific heuristic (to determine the discrete production speeds constrained to a maximum variation) and an exact solver for the optimization of production and flow movement decisions. We explore different strategies to speed up the solution procedure and test alternative variants with instances based on real data from the case study.

MA-14
Monday, 8:30-10:00
RB-Omega

Scheduling

Stream: Scheduling under Resource Constraints
Invited session
Chair: Wieslaw Kubiak, Faculty of Business Administration, Memorial University, Prince Philip Drive, A1B 3X5, St. John’s, NL, Canada, wkubiak@mun.ca

1 - Product Rate Variation problem on parallel machines and divisor methods of apportionment
Joanna Jozeowska, Institute of Computing Science, Poznañ University of Technology, Piotrowo 2, 60-965, Poznañ, Wielkopolska, Poland, j. jozeowska@cs.put.poznan.pl

House monotone methods of apportionment may be successfully applied to solve the PV problem defined on a single machine. House monotonicity on multiple parallel machines may be defined in two ways: either the product rate is related to the total production volume or it is related to schedule length. We show that the divisor methods of apportionment may fail in constructing an optimal solution in case of volume oriented product rate.

2 - An Efficient Algorithm for Finding Ideal Schedules
Dariusz Dereniowski, Department of Algorithms and System Modeling, Gdańsk University of Technology, ul. Gabriela Narutowicza 11/12, 80-233, Gdańsk, Poland, deren@eti.pg.gda.pl, Ed Coffman, Wieslaw Kubiak

In this talk we address the problem of scheduling UET jobs with release dates and precedence constraints on two identical processors. We say that a schedule is ideal if it minimizes both maximum and total completion time simultaneously. We give an instance of the problem showing that ideal schedules do not exist in general when preemptions are allowed. If preemptions are not allowed, then ideal schedules do exist for general precedence constraints, and we describe an algorithm for finding ideal schedules in O(n^3) time, where n is the number of jobs.

3 - Coordinating Subcontractor Scheduling with Divisible Jobs and Private Information
Behzad Hezarkhani, Faculty of Business Administration, Memorial University, General Office, Faculty of Business Administration, Memorial University of Newfoundland, A1B 3X5, St. John’s, Newfoundland and Labrador, Canada, b.hezarkhani@mun.ca, Wieslaw Kubiak

We consider a decentralized setting with several manufacturer agents and a subcontractor where subcontracting is done to reduce the makeups. We show that the VCG mechanism with Clarke pivot rule gives rise to a simple closed-from formula for payments. Next, we introduce pricing schemes that support the efficient solution, i.e. agents individually choose their allocations in the efficient solution. We show that subcontractor’s revenue with such supporting prices are at least as much as that in the VCG mechanism with Clarke pivot rule and can be arbitrarily close to the maximum possible.

4 - Time auction as a tool for solving multiagent scheduling problems
Piotr Modlinski, Institute of Control and Computation Engineering, Warsaw University of Technology, ul. Nowowiejska 15/19, 00-665, Warsaw, Poland, p.modlinski@ia.pw.edu.pl

The problem of scheduling disjoint, indivisible tasks takes on a new meaning in a situation when a number of agents have contradictory requirements. Attempts to centralized solving the problem do not produce satisfying results because agents are utilitarian. Bilateral negotiations are not sufficient mechanism in the general case, and multilateral ones are too complex. In the paper we consider usability of the time auction. It bases on multi-commodity auction mechanism. Issues of effectiveness and incentive compatibility are considered.

MA-16
Monday, 8:30-10:00
RB-2103

Advances in Nonsmooth Optimization

Stream: Nonsmooth Optimization
Invited session
Chair: Adilson Elias Xavier, Graduate School of Systems Engineering and Computer Sciences, Federal University of Rio de Janeiro, P.O. Box 6851, Ilha do Fundão - Centro Tecnologia - H319, 21941-972, Rio de Janeiro, RJ, Brazil, adilson@cos.ufrj.br

1 - A Simple Resilient Backpropagation Algorithm for Non-Smooth Optimisation Problems
Apostolos Kotsialos, School of Engineering and Computing Sciences, Durham University, South Road, DH1 3LE, Durham, United Kingdom, apostolos.kotsialos@durham.ac.uk
This paper reports on a non-smooth optimisation algorithm based on non-continuous gradient functions. The resilient backpropagation algorithm is employed. Results from test problems in their unconstrained, bound constrained and non-smooth constrained versions, are presented. The suggested algorithm’s performance is compared with those of the more sophisticated bundle methods, that have appeared in the literature; better performance is shown in some cases. Further positive features include the algorithm’s scalability and simple implementation requirements.

2 - Solving the Continuous Multiple Allocation p-Hub Median Problem by the Hyperbolic Smoothing Approach: Computational Results

Adilson Elias Xavier, Graduate School of Systems Engineering and Computer Sciences, Federal University of Rio de Janeiro, P.O. Box 68511, Ilha do Fundao - Centro Tecnologia - H319, 21941-972, Rio de Janeiro, RJ, Brazil, adilson@cos.ufrj.br, Claudio Gesteira

This paper considers the problem of finding the least expensive hub locations, given demands between pairs of cities. The problem leads to a min-sum-min formulation that is strongly non-differentiable. The proposed method overcomes this difficulty with the hyperbolic smoothing strategy, which has been proven able to solve different non-smooth problems. The most important feature of the methodology is the low dimension of the subproblems. The robustness and the efficiency of the method are shown through a set of computational experiments with large problems with up to 1000 cities.

3 - Solving the Minimum Sum of L1 Distances Clustering Problem by Hyperbolic Smoothing and Partition into Boundary and Gravitational Regions

Sergio B. Villas-Boas, PESC, UFRJ / COPPE, Department of Systems Engineering and Computer Science (PESC), Graduate School of Engineering (COPPE), Federal University of Rio de Janeiro, 21.941-972, Rio de Janeiro, Rio de Janeiro, Brazil, sbvb@sbvb.com.br, Vinicius Layter Xavier

It is considered the minimum sum of distances clustering problem, for distances measured using the L1 or Manhattan metric (MSDC-L1). It is a min-sum-min problem, strongly non differentiable. It is proposed the AHSC-L1 method, by combining 2 techniques that drastically simplify the computational tasks. (1) Use Hyperbolic Smoothing Clustering (HSC), that adopts a smoothing strategy using a special C∞ function totally differentiable function. (2) Partition of the sets of observations into two non-overlapping groups: “data in frontier” and “data in gravitational regions”.

4 - Solving the Fermat-Weber Problem with the Hyperbolic Smoothing Method

Vinícius Layter Xavier, Systems Engineering and Computer Sciences Depart., Federal University of Rio de Janeiro, CT - Bloco H - sala H319, Ilha do Fundão, 21941-972, Rio de Janeiro, RJ, Brazil, viniciuslx@gmail.com, Felipe França, Adilson Elias Xavier, Priscila Lima

The minimization of the sum of the distances of observations to their cluster centroids, a non-differentiable and a non-convex problem with a large number of local minima, is tackled. The hyperbolic smoothing strategy solves a sequence of low dimension differentiable unconstrained optimization sub-problems, which gradually approaches the original problem. The reliability and the efficiency of the method are illustrated via a set of computational experiments. It must be emphasized that the proposed methodology can be analogously applied to the solving of the Fermat-Weber location problem.

1 - On the Feasibility of Establishing a Northern Western Australian Beef Abattoir as a Facility Location Problem

Rodolfo Garcia-Flores, Mathematics, Informatics and Statistics (CMIS), Commonwealth Scientific and Industrial Research Organisation (CSIRO), 71 Normanby Rd., Clayton, 3168, Melbourne, VIC, Australia, Rodolfo.Garcia-Flores@csiro.au, Andrew Higgins, Andreas Ernst

The trade of livestock from north Western Australia (WA) has recently become more vulnerable to policy changes, whereas the feasibility of building and operating local abattoirs has become highly sensitive to construction costs and prices of slaughtered meat. We formulate a facility location problem that selects segments of the road network to upgrade, and abattoirs from a set of potential sites in the Pilbara region of WA. The model provides insight on the trade off between resource allocation to facilities and links. We present initial results and propose an algorithm based on decomposition.

2 - Design of a pooled distribution network: a case study

Olivier Péton, Automatic Control and Industrial Engineering, LUNAM Université, Ecole des Mines de Nantes, IRCCyN UMR CNRS 6597, 4 rue alfred castler, 44307, NANTES, France, olivier.peton@mines-nantes.fr, Fabien Lehuédé, Christian Leroux, Xavier Perraudin

We consider a cluster of neighboring competing companies which wish to pool their distribution network. These companies frequently deliver small quantities of goods to hundreds of common retailers spread in a large territory. Their main goal is to reduce transportation cost and environmental footprint thanks to full truckload transportation. We model this problem as a sequence of MILPs with the following steps: location of one consolidation warehouse and several regional cross-docks, design of truckload routes, assignment of retailers to regional warehouses and loading of trucks.

3 - Comparing classical performance measures for a multi-period logistics network design problem

Teresa Melo, Business School, Saarland University of Applied Sciences, Waldhausweg 14, D-66123, Saarbrücken, Germany, teresa.melo@htw-saarland.de, Isabel Correia, Francisco Saldanha-da-Gama

A two-echelon network design problem is studied. Location and transportation decisions are considered together with the sizing of storage areas for product families. A finite set of capacity levels for each family is available at each potential location. Two mixed-integer linear models are proposed that differ in their objective functions: cost minimization vs. profit maximization. Valid inequalities are developed to strengthen the formulations. The impact of these performance measures on network design are investigated through a numerical study. An extension to a bi-objective case is studied.

MA-17
Monday, 8:30-10:00
RB-2105
Location and Supply Chain Management
Stream: Applications of Location Analysis
Invited session
Chair: Teresa Melo, Business School, Saarland University of Applied Sciences, Waldhausweg 14, D-66123, Saarbrücken, Germany, teresa.melo@htw-saarland.de

MA-18
Monday, 8:30-10:00
RB-2107
Financial Crisis Modelling
Stream: Financial Modelling & Risk Management (contributed)
Contributed session
Chair: Blanka Škrabić Perić, Department of Quantitative Methods, Faculty of Economics, Matica hrvatske 31, Split, Croatia, bskrabic@efst.hr
1 - Spanish savings banks in the credit crunch: could distress have been predicted before the crisis? A multivariate statistical analysis
Marti Sagarrà, Department of Business Economics, Universitat Autònoma de Barcelona, Departament d’Economia de l’Empresa, Facultat d’Economia i Empresa - Edifici B, 08193, Bellaterra (Cerdanyola del Vallès), Spain, Spain, marti.sagarra@ub.cat, Cecilio Mar-molínero
Spanish savings Banks (Cajas) have had a long and distinguished history. However, they have been heavily affected by the banking crisis of 2007. Many of them had to merge with other institutions or were rescued. We show that, before the crisis, there were structural differences between successful Cajas and those that had to be rescued. The technical approach is based on Multidimensional Scaling Analysis (MDS). MDS has the advantage that the main characteristics of the study can be presented in a visual form, and thus facilitate communication of the results.

2 - On the transition of Japanese corporate rating structure under the recent credit crises
Motohiro Hagiwara, School of Commerce, Meiji University, 1-1 Kandasurugadai Chiyoda-ku, 101-0062, Tokyo, Japan, motohiro@kisc.meiji.ac.jp, Yasuhiro Matsushita, Katsuaki Tanaka
The aim of this study is to check the transition of recent bond rating structure under the credit crises based on accounting informations giving Altman Z-score. Japanese corporate bond ratings are transformed to normally distributed variables using published 5-Year actual default probability, and are modeled as functions by key ratios giving Z-score using ANN. This study found some facts concerning the transition of rating structure in recent several years and time consistency of rating informations under the crises are discussed based on models before crises.

3 - Using assignment problem in financial products’ design
Maria Mavri, Business Administration, University of the Aegean, 8 Michalon Street, 82100, Chios, Greece, m.mavri@ba.aegean.gr, Michael Bekiaris
Today, the world economic crises are forcing banks to change their operational internal processes. We argue that a service system can effectively be represented as a manufacturing system, and more specifically that any product or service offered by a bank to its clients could be represented as a manufacturing system, and more specifically that any product or service offered by a bank to its clients could be designed following a procedure similar to those used in ‘production’. In this study we use the concept of assignment problem in order to distribute tasks and jobs to bank units, that develop new products, suitable for satisfying customers’ diverse and different needs.

4 - Recent crisis, credit boom and nonperforming loans in CEE countries-panel data evidence
Blanka Škrabić Perić, Department of Quantitative Methods, Faculty of Economics, Matice hrvatske 31, Split, Croatia, bskrubic@esft.hr, Josip Arneric
The paper investigates impact of credit boom during 2000th and recently crisis on nonperforming loans in CEE counties. Namely, the beginning of 2000th was characterized by many features as the foreign capital inflow, entry of foreign banks and economic growth. This has resulted in increased competition in the banking system and rapid credit growth. Dynamic panel data is used to analyze the impact of rapid credit growth on nonperforming loans in 16 CEE counties during period 1994-2010. Empirical analysis is performed on aggregated data for each country.

MA-19
Monday, 8:30-10:00
RB-2111
Risk management in commodities markets
Stream: Commodities and Financial Modeling
Invited session
Chair: Massimo Panella, University of Rome "La Sapienza", Dpt. of Information Engineering, Electronics and Telecommunications (DIET), Via Eudossiana, 18, 00184, Rome, Italy, massimo.panella@uniroma1.it
Chair: Rita Decclesia, Economic and Social Analysis, Sapienza University of Rome, Piazza Aldo Morto 5, 00185, Rome, Italy, rita.decclesia@uniroma1.it
Chair: Bogdan Iftimie, Applied Mathematics, Academy of Economic Studies of Bucharest, 010374, Bucharest, Romania, Bogdan.Iftimie@cse.ase.ro

1 - Energy commodities: price relationships the key issue
Rita Decclesia, Economic and Social Analysis, Sapienza University of Rome, Piazza Aldo Morto 5, 00185, Rome, Italy, rita.decclesia@uniroma1.it
This paper examines the time series econometric relationship between the fossil fuels and electricity in Europe and in US. When data have unit roots as in this case a cointegrating relationship may provide effective results. An optimization framework is also set to get the correct rolling correlation measure which provides hint on short term relationships. Long run and short term relationship represent the key element to set up effective risk management strategies.

2 - A Mixed Integer Linear Programming Approach to Markov Chain Bootstrapping
Roy Cerqueti, Department of Economics and Financial Institutions, University of Macerata, Via Crescimbeni, 20, 62100, Macerata, Italy, roy.cerqueti@unime.it, Paolo Falbo, Cristian Petizzari, Federica Ricca, Andrea Scozzari
The Markov Chain bootstrap method is one of the most acknowledged tools to make forecasts and study the statistical properties of an evolutive phenomenon. The underlying idea is to replicate the phenomenon on the basis of an available sample, which is assumed to evolve according to a Markov Chain. This paper deals with the relevant problem of reducing the dimension of the transition probability matrix by maintaining the original features of the sample. To this aim, we advance two mixed integer linear programs. We present also some numerical examples based on the electricity market.

3 - Financial Optimization Modeling in R
Ronald Hochreiter, Finance, Accounting and Statistics, WU Vienna University of Economics and Business, Augasse 2-6, 1090, Vienna, Austria, ronald.hochreiter@wu.ac.at
Simplifying the task of modeling financial optimization problems is important. Many commercial products have been created to support the financial modeling process, but none of these products has been adopted by a significantly large number of users. Simplifications are crucial to implement optimization models into business processes successfully. We outline an approach on how to simplify financial optimization modeling using R and external optimization modeling languages as well as by building model generators for specific application problems.

MA-20
Monday, 8:30-10:00
RB-2113
Financial Time Series Analysis and Forecasting
Stream: Data Mining in the Financial Sector
Invited session
Chair: Marcus Hildmann, Information Technology and Electrical Engineering, ETH Zurich, ETI G 24.2, Physikstrasse 3, 8092, Zürich, Switzerland, hildmann@ech.ee.ethz.ch
1 - Carbon Price Sensitivity and Sectoral Analysis  
Omer Kayhan Seyhun, Banking and Financial Institutions Department, Risk Centralization Division, Central Bank of Turkey, İstiklal Street No 10, Ulus, 06100, Ankara, Turkey, kayhan.seyhun@tcmb.gov.tr  
We examine the fundamental drivers of carbon prices and their sensitivity to various sectors; we investigate various related interactions. Multivariate statistical techniques are used to attest the link between carbon prices and sectoral level variables. It is not clear how to price the future damages of the climate change and the increasing natural disaster occurrence. It is expected that the correlation will be a significant tool to observe the sensitivity of carbon prices with energy and agricultural sectors.

2 - Online Financial Data Streams Value at Risk Segmentation Methods  
Dina Alberg, Industrial Engineering and Management, SCE Sami Shamoon College of Engineering, Bazel/Bialik Sts, 84100, Beer-Sheva, Israel. albergd@gmail.com  
Two novel algorithms FISW and FISWAB for an efficient segmentation of financial data streams are presented. The proposed algorithms implement adaptive sliding window approach whose size recomputed online according to the rate of change observed from the data itself. The main advantages of the algorithms that they are time and memory efficient, use the Value at Risk as a tuning parameter and do not require choosing lot of input parameters. The accuracy and computation time of the proposed algorithms will be compared to real financial stream data.

3 - Modeling the market decision problems for electrical energy balancing systems  
Mariusz Kaleta, Institute of Control & Computation Engineering, Warsaw University of Technology, Nowowiejska 15/19, 00-665, Warsaw, Poland, mkaleta@ii.pw.edu.pl  
Our work is a step for standardization of balancing problems description (similarly to notation in theory of queues) for electrical energy markets, what in effect should facilitate understanding and comparing research works, exchanging data cases and mechanism implementation. We formulate an abstract model of balancing problem, which consists in so called market decision problems and balancing mechanism. We provide a parametrization of the market decision problems space. To prove our concept we apply it to build an expressive market simulation tool.

2 - Time series forecasting and optimal stopping problem in market index portfolio  
Lukas Pichl, Department of Information Science, International Christian University, Osawa 3-10-2, Mitaka, 181-8585, Tokyo, lukas@icu.ac.jp  
Time series forecasting of a single stock title, within an entire market index, and across different markets is an active area of operations research ranging from artificial neural networks across econometric models to information compression methods in symbolic analysis models. We survey the recent developments and present our findings on the correlations in the dynamics of stock index and its individual constituents in Japan, using high frequency tick data aggregated at various time scales, and demonstrating the presence of stylized facts.

3 - Portfolio Optimization with Hybrid Uncertainty  
Alexander Yazenin, Applied Mathematics Department, Tver State University, Zholubova, 33, 170100, Tver, alexander.yazenin@tversu.ru  
In the paper the mathematical model of the minimal risk portfolio with hybrid uncertainty (possibility/probability) is presented and investigated. In the model the profitabilities are explicated with fuzzy random variables. Their second order moments those form the portfolio risk function are non-fuzzy. In the model the expected value level is presented with possibility/probabilistic restrictions. The behavior of the investment possibilities set is investigated depending on the level of possibility/necessity and probability. The results are demonstrated on the model example.

4 - Multicriteria decision making in comparison of objective and subjective criteria of companies’ success  
Branka Marasovic, Faculty of Economics Split, 21000, Split, Croatia, branka.marasovic@efst.hr, Ivana Tadic  
Although, financial indicators usually are taken as the most important indicators of success, lately authors argue about the same relevance in usage of subjective indicators. The aim of paper is to research whether the most successful companies regarding financial ratios (objective group of criteria) show the similar results by other groups of criteria, as human resource management evaluation and evaluation of entire companies’ success (subjective groups of criteria). Selected companies will be ranked by each group of criteria using multicriteria decision making method PROMETHEE II.
2 - A Multi-item Fuzzy Economic Production Quantity Problem with Backorders and Limited Storage Space
Magnus Westerlund, Economics, IT and Media, Arcadia, Jan-magnus.jansonsplatz1 1, 00550, Helsinki, Finland, magnus.westerlund@arcada.fi, Kaj-Mikael Bjork, Józef Mezei

We extend a fruitful fuzzy EOQ (Economic Order Quantity) track of research with a multi-item model that takes storage limitation and backorders into consideration. In the paper, finite production rate is considered (i.e. the products are produced to stock and not purchased which is a typical situation in process industry). In the model, the order cycle time, the demand and the backorders are represented by triangular fuzzy numbers which allows for taking expert opinion into account when modeling uncertainties. Signomial global optimization (SGO) algorithm is employed to find the optimal solution.

3 - Systems of (max, min)-linear equations and inequalities
Martin Gavalec, Department of Information Technologies FIM, University of Hradec Kralove, Rokitanského 62, 50003, Hradec Kralove, Czech Republic, martin.gavalec@uhk.cz, Karel Zimmermann

By (max, min)-linear equation (inequality) we understand an equation (inequality) between two (max, min)-linear functions of n variables. Properties of the solution sets of finite systems of (max, min)-linear equations and inequalities are investigated in the contribution. The obtained results are then used for solving optimization problems with max-separable objective function and constraints described by a system of (max, min)-linear equations and inequalities. Applications to some multiple fuzzy goal decision problems as well as some generalizations are discussed.

4 - Measuring transitivity of fuzzy pairwise comparison matrix in DM problems
Jaroslav Ramík, Dept. of Math. Methods in Economics, Silesian University, School of Business, University Sq. 1934/3, 73340, Karvina, Czech Republic, ramik@opf.shu.cz, Petr Korviny

A pair-wise comparison matrix is the result of pair-wise comparison a powerful method in multi-criteria optimization. When comparing two elements, DM assigns the value representing the element of the pair-wise comparison matrix. The consistency ratio is defined in AHP. In some situations another interpretation is convenient. The DMs preferences can be represented by a fuzzy preference relation. We investigate relations between several types of transitivity of fuzzy relations and multiplicative preference relations. We also define the grade of transitivity.

Exhausters were defined by Demyanov (1999). Then, relationships between exhausters and generalized subdifferentials were given by Demyanov and Roshchina (2006, 2008). In this work, a special class of exhausters is obtained by using weak subdifferentials defined by Azimov and Gasimov (1999). Some examples of positively homogeneous functions whose upper and lower exhausters calculated by weak subdifferential are given. Moreover, some properties of this class of exhausters are examined.

2 - Exhausters, Weak Subdifferentials and Optimality Conditions
Didem Tozan, Department of Mathematics, Anadolu University, Anadolu University Yirin University Campus, Fen Fakultesi Matematik Bolumu, 26470, Eskisehir, Turkey, dtokaslan@anadolu.edu.tr, Mahide Kucuk, Ryszard Urbanski, Jerzy Grzybowski, Yalcin Kucuk, Ilknur Atasever, Mustafa Soyertem

Demyanov defined the concept of exhausters (1999) and then optimality conditions in terms of proper and adjacent exhausters were given by Demyanov and Roshchina (2006, 2008). In this study, we give some examples of evaluating exhausters of positively homogeneous functions via weak subdifferentials defined by Azimov and Gasimov (1999). Furthermore, some optimality conditions are examined by using relationships between exhausters and weak subdifferentials.

3 - Relationships between gw-subdifferentials and radial epiderivatives for nonconvex vector functions
Ilknur Atasever, Department of Mathematics, Anadolu University, Anadolu University Yirin University Fen Fakultesi Matematik Bolumu, 26470, Eskisehir, Turkey, iatasever@anadolu.edu.tr, Yalcin Kucuk, Mahide Kucuk

The notion gw-subdifferential for vector valued functions was defined and necessary and sufficient conditions for gw-subdifferentiability of nonconvex vector valued functions were given by Küçük et al. (2011). In this work, we examine relations between radial epiderivative defined by Kasimbeyli (2009) and gw-subdifferential of vector valued functions. Furthermore, under some assumptions, we proved that the radial epiderivative of a vector valued function is an element of the supremum of the set which is defined by using gw-subgradients of the given function.

4 - Minkowski-Radstrom-Hormander cone and reducing infinite exhausters
Jerzy Grzybowski, Faculty of Mathematics and Computer Science, Adam Mickiewicz University, Wieniawskiego 1, 61-712, Poznan, Poland, jgrz@amu.edu.pl, Ryszard Urbanski, Mahide Kucuk, Yalcin Kucuk, Ilknur Atasever, Mustafa Soyertem, Didem Tozan

We introduce the notion of generalized Minkowski-Radstrom-Hormander cone. We also embed the convex cone C(X) of all nonempty closed convex subsets of real Hausdorff topological vector space X and the convex cone W(Rn) of all nonempty convex subset of Rn into respective Minkowski-Radstrom-Hormander cones. We also present equivalent conditions for reducing infinite exhausters of closed convex sets to a pair of convex sets (an element of Minkowski-Radstrom-Hormander cone).

MA-23
Monday, 8:30-10:00
RB-Delta

Generalized Differentiation
Stream: Generalized Differentiation and Optimization
Invited session
Chair: Alexander Kruger, School of Science, Information Technology & Engineering, University of Ballarat, University Drive, Mount Helen, P.O. Box 663, 3353, Ballarat, Victoria, Australia, a.kruger@ballarat.edu.au
Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

1 - On Weak Subdifferentials and Exhausters
Mustafa Soyertem, Mathematics, Anadolu University, Anadolu University Yirin University Campus Department of Mathematics, 26470, Eskisehir, Turkey, soyertem@gmail.com, Mahide Kucuk, Ryszard Urbanski, Jerzy Grzybowski, Yalcin Kucuk, Ilknur Atasever, Didem Tozan

MA-24
Monday, 8:30-10:00
CC-A11

Cooperation and Logistics
Stream: Game Theory and Logistics
Invited session
Chair: Ignacio Garcia-Jurado, Department of Mathematics, Coruna University, Faculty of Computer Science, Campus de Elvina, 15071, Coruna, Spain, igjurado@udc.es
1 - A polynomial expression for the Owen value in the maintenance cost game
Julian Costa, Faculty of Computer Science, Universidade da Coruña, Campus de Elviña, 15071, A Coruña, Spain, julian.costa@udc.es
The maintenance cost games are a class of cooperative games with transferable utility where the main issue is how to share the maintenance costs of a facility among the agents. We propose the use of the Owen value for the cost allocation problem associated with a game in this class when there is a system of a priori unions. In the general case, the Owen value has exponential complexity. In this paper, we provide a cubic polynomial expression for the Owen value of a maintenance cost game with a priori unions.

2 - Minimum cost Steiner tree problems
Silvia Lorenzo-Freire, Department of Mathematics, Universidade da Coruña, Campus de Elviña, 15071, A Coruña, Spain, s Lorenzo@udc.es, Gustavo Bergantinos, Leticia Lorenzo, Juan Vidal-Puga
Consider a group of agents located at different geographical places that are interested in some resource provided by a common supplier. Agents can be served directly from the supplier or indirectly through other agents or public switches. The first problem that we need to solve is how to provide all the agents with the resource with a minimal cost. This problem is known as the Steiner tree problem and it is NP-hard. So, in order to find a solution, heuristics need to be applied. In this paper, we allocate the cost of constructing this approximated tree among the agents in a stable way.

3 - Scheduling jobs with a common due date via combinatorial games
Irinel Dragan, Mathematics, University of Texas, 411 S.Nedderman Dr., Pickard Hall, 76019-0408, Arlington, Texas, United States, dragan@uta.edu
Scheduling jobs with a common due date as a sequence that has a minimal total deviation from the due date can be done in the simplest case, by means of J.J.Kanel's algorithm (1981). Assuming that it is known how to do it for a given set of jobs and its subsets, we generate a cooperative cost game with transferable utilities. As recommended by H.P. Young in his paper included in Handbook of Game Theory, vol.2, some efficient values are fair solutions and we discuss the fairness by means of the cost excesses. The nucleolus is the most fair solution.

4 - On graphs which can or cannot induce Chinese Postman games with a non-empty core
Daniel Granot, University of British Columbia, Vancouver, Canada, daniel.granot@sauder.ubc.ca
We study the Chinese postman (CP) cooperative game induced by a connected, weighted, undirected graph G, wherein players reside at edges of G and a postman, starting from a post-office location (i.e., vertex of G), needs to traverse all edges before returning to the post-office. We provide a complete characterization of all connected graphs for which there does not exist a positive edge-cost function such that the induced CP game has a non-empty core, and, consequently, we derive a complete characterization of all connected graphs for which there does exist a positive edge-cost function which induces a CP game with a non-empty core. Membership in these classes of graphs can be verified in strongly polynomial time.

1 - Unit Commitment optimisation through matheuristics
Ana Viana, INESC TEC/ISEP, Campus da FEUP, Rua Dr. Roberto Frias, 4220-465, Porto, Portugal, aviana@inescporto.pt, Dewan Fayzur Rahman, Joao Pedro Pedroso
Unit Commitment is a classical problem in power production planning, consisting of deciding which electric generators must be committed to production in each period of a given planning horizon, and defining the production level at which each generator should operate. In this work, two approaches are explored: one based on “Local Branching” and another where a Particle Swarm Optimisation (PSO) algorithm cooperates with the MIP solver. Thorough computational tests in a well-known set of benchmark instances show the effectiveness of the approaches.

2 - Optimising Distributed Energy Operations in Buildings
Afzal Siddiqui, Statistical Science, University College London, Gower Street, WC1E 6BT, London, United Kingdom, afzal.siddiqui@ucl.ac.uk, Markus Groissböck, Somayeh Heydari, Ana Mera Vazquez, Eugenio Perea Olabarria, Michael Stadler
Deregulation of the energy sector has created new markets for producers as well as opportunities for consumers to meet their needs in a more customised way. However, to realise economic and energy efficiency gains, small-scale consumers at the building level require more tailored decision support. We model the effect of active equipment control on the zone temperature taking into account the external temperature, solar gains, the building’s shell and internal loads. These serve as constraints in a cost-minimisation problem, providing an optimal dispatch for installed equipment.

3 - Compatibility of optimized distributed storage profiles for grid operators and energy traders
Stefan Nykamp, University Twente, NL / RWE Deutschland, Bad Bentheim, Germany, stefan@nykamp.de
The implementation of storage capacities in power grids is seen as an essential element for a successful integration of PV and wind generation. Also on distribution grid level storage capacities are evaluated and installed in pilot projects to overcome massive reinforcement needs. In this talk, the optimal storage profile of a distribution grid operator with real measured energy profiles is presented. This peak shaving scenario is compared to an optimal storage profile of an energy trader with arbitrage purposes. The correlation analysis reveals complementary or supplementary operating modes.

4 - A hybrid genetic algorithm for the optimal allocation of remote controlled switches in radial distribution system
Lauris Assis, DENSIS, Universidade Estadual de Campinas, Avenida Albert Einstein n 400 – Cidade Universitária Zefiro Vieira Vaz – Barão Geraldo – Campinas – São Paulo – Brazil, 13081-970, Campinas, SP, Brazil, lauris.assis@gmail.com, Fábio Ushberti, Christiano Lyra, Fernando J. Von Zuben, J osé Federico Vizcaíno
Regulatory agencies define target reliability indices to increase the quality of electrical power supply. These indices can be improved with the solution of specific combinatorial optimization problem. This work tackles the problem of finding the best number, location and type of switches to be installed in a radial power distribution network. The objective is to improve system reliability, while minimizing the total cost of the solution. An effective hybrid genetic algorithm that evaluates and optimizes the allocation of remote controlled sectionalizers and tie switches is proposed.
1 - Stochastic MIP modeling of a natural gas-powered industrial park
Gerardo Perez Valdes, IOT, NTNU, Trondheim, Norway, gerardo.valdes@iot.ntnu.no, Kjetil Midtun, Michal Kaut, Vibeke Narstebo
We present an investment decision model for a natural gas-based industrial park. The model is a stochastic MIP model with random prices of raw materials. The potential plants in the park are modeled from a case study from Norway, whose motivation is to consider the potential for increasing the domestic use of natural gas. Natural gas is abundant in the country, but its domestic use is limited due to both availability of other energy sources and concerns over carbon emissions. Our results have an emphasis on showing model properties in terms of model size and solution times.

2 - Strategic behaviour in the crude oil market - one-stage vs. two-stage oligopoly models
Daniel Huppmann, DIW Berlin, Mohrenstraße 58, 10117, Berlin, Germany, dhupmann@diw.de, Clemens Haftendorn
Oligopoly-fringe models are used to investigate market power in resource markets, combining Cournot and competitive suppliers in a mixed complementarity setting. While computationally convenient, this may lead to results that are not Nash equilibria. We investigate which situations are particularly problematic, and under which circumstances these results are similar to two-stage games. We also revisit tax models of resource extraction as an alternative approach to model oligopoly-fringe markets. Several model setups are then compared using data on the crude oil market over the past decade.

3 - Stochastic mixed integer programming for integrated portfolio planning in the LNG supply chain
Kristin Tolstad Uğgen, Applied economics and operations research, SINTEF Technology and society, S.P. Andersens v 5, 7465, Trondheim, Norway, ktu@sintef.no, Adrian Werner, Marte Fodstad, Arnt-Gunnar Lium
We present a model to support strategic planning by global players in the liquefied natural gas market. The model takes an integrated portfolio perspective and addresses uncertainty in future price developments. Decision variables include investments and disinvestments in infrastructure and vessels, chartering of vessels, the timing of LNG and natural gas contracts, and spot market trades. Industry-motivated numerical cases are discussed to provide benchmarks for the potential increases in profits that can be obtained.

4 - Modeling gas infrastructure investments under uncertainty
Ozge Ozdemir, ECN, Netherlands, ozdemir@ecn.nl, Jeroen de Joode
A continuous challenge for gas infrastructure companies across Europe is to optimally accommodate the future need for gas infrastructure investments given the uncertainties in gas markets. These uncertainties may originate from the role for gas in the future energy mix, global gas market developments (e.g., shale gas), and the possible cut-offs by a major supplier which threatens security of supply. This paper explores how these uncertainties can be tackled and the outcomes can be translated into robust strategies that prevent undesirable gas market outcomes in a range of possible scenarios.

1 - Exploring IT project managers’ decision making processes in-situ, in-actu, in-toto: an empirical study of day-to-day decision making in medium size software development
Ana Barcus, Management, LSE, 65 Melbourne Ave, M6K 1K6, Toronto, Ontario, Canada, A.Barcus@LSE.ac.uk
This research explores real-time decision-making during the delivery phase of small to medium size software development projects. The epimirical research was conducted in two software companies, recording regular day-to-day project meetings. Twelve software projects were tracked, totaling 144 recorded project meetings, resulting in over 94 hours of data. Seventeen decision episodes, spanning over a number of meetings, were identified in-actu. The study examines in more detail how the perception of contextual factors impacts on project team’s decision making processes.

2 - The impact of need for closure on model-supported group conflict management
Etienne Rouwette, Nijmegen School of Management, Radboud University Nijmegen, 6500 HK, Nijmegen, Netherlands, e.rouwette@fm.ru.nl, L. Alberto Franco
Need for closure, the desire for definite knowledge on some issue, has important impacts on decision making. Decision makers those are high in need for closure seize on information and then freeze on early cues. We focus on the impact of need for closure on conflicts in decision making groups. The groups in our study use Value Focused Thinking to jointly develop a model. We compare groups high and low in need for closure with regard to a) conflicts and how these are resolved; b) how features of the model are used and c) group outcomes such as consensus and satisfaction.

3 - Post-catastrophe decision making
Ian Durbach, Statistical Sciences, University of Cape Town, Department of Statistical Sciences, University of Cape Town Rondebosch, 7701, Cape Town, Western Cape, South Africa, ian.durbach@uct.ac.za, Gilberto Montibeller
Unexpected high-impact events present decision makers with dramatic new information but also highlight their previous state of ignorance about the nature of possible outcomes, termed ‘sample state ignorance’. We examine post-catastrophe decision making using an experiment based on a simplified decision context. In the experiment, decision makers need to predict share prices and experience, for some series, catastrophic falls in prices. We assess the impact of confronting such events on two dimensions of judgement and decision making: the range of future estimates and attitudes towards risk.

MA-28
Monday, 8:30-10:00
CC-A27
OR in Quality Management 1
Stream: OR in Quality Management
Invited session
Chair: Ipek Deveci Kocakoç, Econometrics, Dokuz Eylul University Faculty of Economics and Administrative Sciences, Dokuz Eylul Universitiesesi İkt.İd.Bil.Fak.. Buca, 35160, İzmir, Turkey, ipek.deveci@deu.edu.tr
1 - Dealing with multiple quality characteristics as responses in prediction modeling: An aggregation approach
Leman Esra Dolgun, Industrial Engineering, Anadolu University, 26555, Eskisehir, Turkey, ledolgun@anadolu.edu.tr, Gulser Koksal, Nimetullah Burnak
This study deals with aggregation of multiple quality characteristics (QCs) into a single measure reflecting the decision maker’s expertise. Types of interactions among QCs are identified through structured surveys with quality control experts, designed in this study. Appropriate aggregation models are proposed for the single measure representing the multiple QCs, depending on the identified interactions. Any (single response) prediction model can be used to relate product and process conditions to the resulting measure. Such a model provides valuable feedback for quality improvement.
2 - A supervised learning procedure for monitoring mean and covariance simultaneously
Ipek Deveci Kocakoç, Econometrics, Dokuz Eylul University Faculty of Economics and Administrative Sciences, Dokuz Eylul University, Izmir, Turkey, ipek.deveci@deu.edu.tr, Ezalp Dogu
The signal issued by the simultaneously used mean vector control chart and/or covariance matrix control chart triggers the process professionals to investigate the special cause. This signal does not always indicate that the root cause actually occurred at that particular point in time. Change point methods have been widely used to bridge the gap between monitoring and special cause identification. In this study, a supervised learning approach based on artificial neural networks is proposed to monitor location and dispersion simultaneously in multi-variate domain.

3 - Optimization on selection problem of solder paste inspection machines
Gokce Baysal, Econometrics, Dokuz Eylul University, Iktisadi ve Idari Bilimler Fakultesi, Ekonometri BL, Dokuzce Cesmeleri Kampusu, Buca, 35160, Izmir, Turkey, gokce.baysal@gmail.com, Ipek Deveci Kocakoç
One of the most important factors to give an inspection automation decision is the rate of false decisions made by the inspection machine. This paper aims to provide help in selection of a solder paste inspection machine (SPI) machine for a printed circuit board (PCB) production line. For this purpose, two SPI machines have been tested for the same PCBs. After inspection, false “fail” decisions are reviewed by a qualified human inspector and false rejection rate is determined. By utilizing a minimization model, the machine that gives the lowest false decisions is recommended for buying.

4 - An adaptive Bayesian scheme for joint monitoring of process mean and variance
George Nenes, Mechanical Engineering, University of Western Macedonia, Bakola & Sialvera, 50100, Kozani, Greece, gnenes@uowm.gr, Sofia Panagiotidou
We present a model for the economic optimization of a process operation where two assignable causes may occur, affecting both the process mean and the variance. Thus, the process may operate in control, under the effect of either one of the assignable causes, or under the effect of both of them. The Bayes theorem is used to determine the probabilities of operating under the effect of each assignable cause, at each sampling instance. Based on these probabilities, the parameters of the control scheme are optimized economically. The proposed model is significantly superior to simpler approaches.

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2 - Cutting Planes from a Convex Quadratic Relaxation of the Stable Set Problem
Fabrizio Rossi, Ingegneria e scienze dell’Informazione e Matematica, University of L’Aquila, Via Vetoio, I-67010, L’Aquila, Italy, fabrizio.rossi@uniAQ.it, Monia Giudomenico, Adam Letchford, Stefano Srraggi
A great deal of research has been focused on finding both linear and semidefinite relaxations for the Stable Set problem, but the resulting branch-and-bound algorithms have not been completely successful in practice. We propose an approach based on the construction of an ellipsoid that contains the Stable Set Polytope, and its whooses associated upper bound equals the Lovász theta number. This ellipsoid is then exploited to derive strong (linear) cutting planes. Extensive computational results demonstrate that embedding these cutting planes in a branch-and-cut framework can be profitable.

3 - Nonstandard Semidefinite Bounds For Solving Exactly 0-1 Quadratic Problems
Frederic Rouspin, LIPN, CNRS-MR 7030, Université Paris 13, France, frederic.roupin@lipn.univ-paris13.fr, Nathan Krislock, Jerome Malick
We present an improved algorithm for finding exact solutions to Max-Cut and other binary quadratic programming problems. The algorithm uses a branch-and-cut-and-bound paradigm, using standard valid inequalities and nonstandard semidefinite bounds. More specifically, we add a quadratic regularization term to the strengthened semidefinite relaxation in order to use a quasi-Newton method. The ratio of the tightness of the bounds to the time required to compute them can be controlled by two real parameters.

4 - On the Gap Inequalities for the Max-Cut Problem
Adam Letchford, Department of Management Science, Lancaster University, Management School, LA1 4YX, Lancaster, United Kingdom, A.N.Letchford@lancaster.ac.uk, Laura Galli, Konstantinos Kararis
The gap inequalities, introduced by Laurent and Poljak, form an extremely general class of cutting planes for the max-cut problem. Recently, we have made several advances in the study of these inequalities. First, we have adapted them to general mixed-integer quadratic programs. Second, we have proved various results concerning the complexity of the inequalities. Third, we have designed and coded the first ever cutting-plane algorithm for the max-cut problem based on gap inequalities. Preliminary computational results are promising. In particular, the upper bounds obtained are very strong.

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MA-29
Monday, 8:30-10:00
CC-A29
Mixed-Integer Quadratic Problems

Stream: Mixed-Integer Non-Linear Programming

Invited session

Chair: Adam Letchford, Department of Management Science, Lancaster University, Management School, LA1 4YX, Lancaster, United Kingdom, A.N.Letchford@lancaster.ac.uk

1 - A New Separation Algorithm for the Boolean Quadric and Cut Polytopes
Michael Sørensen, Dept. of Economics and Business, Aarhus University, Fuglesangs Alle 4, 8210, Aarhus V, Denmark, mim@asb.dk, Adam Letchford
We present separation algorithms for the polytopes associated with zero-one quadratic programming and the max-cut problem. Our approach is based on separation of 0,1/2-cuts. We present a system of inequalities and nonstandard semidefinite bounds. More specifically, we add a quadratic regularization term to the strengthened semidefinite relaxation in order to use a quasi-Newton method. The ratio of the tightness of the bounds to the time required to compute them can be controlled by two real parameters.

2 - Cutting Planes from a Convex Quadratic Relaxation of the Stable Set Problem
Fabrizio Rossi, Ingegneria e scienze dell’Informazione e Matematica, University of L’Aquila, Via Vetoio, I-67010, L’Aquila, Italy, fabrizio.rossi@uniAQ.it, Monia Giudomenico, Adam Letchford, Stefano Srraggi
A great deal of research has been focused on finding both linear and semidefinite relaxations for the Stable Set problem, but the resulting branch-and-bound algorithms have not been completely successful in practice. We propose an approach based on the construction of an ellipsoid that contains the Stable Set Polytope, and its whooses associated upper bound equals the Lovász theta number. This ellipsoid is then exploited to derive strong (linear) cutting planes. Extensive computational results demonstrate that embedding these cutting planes in a branch-and-cut framework can be profitable.

3 - Nonstandard Semidefinite Bounds For Solving Exactly 0-1 Quadratic Problems
Frederic Rouspin, LIPN, CNRS-MR 7030, Université Paris 13, France, frederic.roupin@lipn.univ-paris13.fr, Nathan Krislock, Jerome Malick
We present an improved algorithm for finding exact solutions to Max-Cut and other binary quadratic programming problems. The algorithm uses a branch-and-cut-and-bound paradigm, using standard valid inequalities and nonstandard semidefinite bounds. More specifically, we add a quadratic regularization term to the strengthened semidefinite relaxation in order to use a quasi-Newton method. The ratio of the tightness of the bounds to the time required to compute them can be controlled by two real parameters.

4 - On the Gap Inequalities for the Max-Cut Problem
Adam Letchford, Department of Management Science, Lancaster University, Management School, LA1 4YX, Lancaster, United Kingdom, A.N.Letchford@lancaster.ac.uk, Laura Galli, Konstantinos Kararis
The gap inequalities, introduced by Laurent and Poljak, form an extremely general class of cutting planes for the max-cut problem. Recently, we have made several advances in the study of these inequalities. First, we have adapted them to general mixed-integer quadratic programs. Second, we have proved various results concerning the complexity of the inequalities. Third, we have designed and coded the first ever cutting-plane algorithm for the max-cut problem based on gap inequalities. Preliminary computational results are promising. In particular, the upper bounds obtained are very strong.

MA-30
Monday, 8:30-10:00
CC-A31
Fat Tail Models in Finance

Stream: Emerging Applications of Fat Tail Models in Financial Modeling and Engineering

Invited session

Chair: Audrius Kabasinskas, Dept. of Mathematical Research in Systems, Kaunas University of Technology, Studentu 50-220, LT-51368, Kaunas, Lithuania, audrius.kabasinskas@ktu.lt

1 - Application of estimates of alpha-stable distribution to distress forecast
Audrius Kabasinskas, Dept. of Mathematical Research in Systems, Kaunas University of Technology, Studentu 50-220, LT-51368, Kaunas, Lithuania, audrius.kabasinskas@ktu.lt, Zivilė Kalsyte
Application of alpha-stable distribution parameters to train a specific neural network is presented. Trained neural network was used to forecast behavior of distress in the US Healthcare sector. Distress value of a company is calculated from financial ratios Gross Margin (GM), Current Ratio (CR) and Total Asset Turnover (TAT). Indicators for prediction of distress value were selected by genetic algorithm. Our results shows that neural network trained with alpha-stable parameters of given indicators has smaller forecast error comparing to trained with 31 financial ratios.
2 - Hurst coefficient and alpha-stable parameter for analysis of financial series
Roman Rodriguez Aguilar, Economy, Instituto Politecnico Nacional, kopoloma 523, toletes 166, C-1013, 14100, Mexico, Distrito Federal, Mexico, roman_econnmat@yahoo.com.mx
This paper analyzes the relationship between the parameter alpha of alpha-stable distribution and the Hurst coefficient. It seeks to explore the violation of two major assumptions in the modeling of financial series (assume that the series are normally distributed and that the successive returns are independent) by estimating the Hurst coefficient and the parameter alpha. One of the main results was the presence of fractal features and heavy tails in the series of exchange rate peso-dollar for some periods in different magnitudes, such differences are accentuated during periods of crisis.

3 - Xpress-Mosel: Modelling support for distributed, remote, and cloud computing with applications in Finance
Susanne Heipcke, Xpress team, FICO, 54 rue Balthazar de Montrou, 13004, Marseille, France, susanneheipcke@fico.com, Oliver Bastert, Yves Colombani Xpress-Mosel is a modelling and programming language that offers advanced functionality for the implementation of optimization algorithms and also for the design of complete applications. Among the prominent features of Mosel figures its support for distributed modeling and problem solving on heterogeneous computing environments (including virtual environments). We shall discuss examples of optimization applications, particularly from the finance sector, that have been deployed using these advanced functionalities of the Mosel environment.

4 - High-Frequency Financial Data: A Mixed-Stable approach
Audrius Kabasinskas, Dept. of Mathematical Research in Systems, Kaunas University of Technology, Studentu 50-220, LT - 51368, Kaunas, Lithuania, audrius.kabasinskas@ktu.lt, Igoris Belovas, Leonidas Sakalukas
With the introduction of electronic trading an enormous quantity of trading data became available. High-frequency financial data can reveal events and laws that are impossible to identify with monthly, weekly or daily data. We propose a mixed-stable approach to model intra-daily data from German DAX component stocks returns. In practice we often observe a large number of zero returns in high-frequency return data due to the underlying asset price does not change at a given very short time intervals. Our model is designed to capture these unique features observed in high-frequency return data.

2 - Centrality in Weighted Social Networks. A Game Theoretic Approach.
Conrado M. Manuel, Statistics and Operation Research III, Complutense University of Madrid, Avenida Puerta de Hierro sn, 28040, Madrid, Spain, conrado@estad.ucm.es, Enrique González-Arangüena
We consider the case of networks in which ties are not just either present or absent, but have some weight attached to them, that we will interpret as a function of duration, intimacy or intensity of the relations. Moreover, we will suppose that actors in the network are also players in a cooperative TU game representing the interests that motivate their interactions. We propose as centrality measure for each node its probabilistic Myerson value (Calvo et al., 1999 and Gómez et al., 2008) assuming that the game is a symmetric one and thus, no a priori differences among players exist.

3 - Clustering networks by a new edge betweenness measure: A cooperative game theoretical approach
Daniel Gomez Gonzalez, Estadistica e Investigacion Operativa I, Complutense University, Av Puerta de Hierro, 28040, Madrid, Spain, dagomez@estad.ucm.es, Javier Castro
The Girvan-Newman algorithm is one of the most used algorithms in clustering networks. This algorithm is based on the edge betweenness measure. In this work we present a new centrality measure based on game theory that fixes the bad performance (in terms of modularity) that presents the classical edge betweenness measure when it is applied to the Girvan-Newman algorithm. We test this new measure in some well-known examples in clustering network as: the Karate Club network, the author network, the dolphin network and Les miserables network.

4 - Computing centralities and the Myerson value in large social networks
Juan Tejada, Estadistica e Investigacion Operativa I, Complutense University of Madrid, Universidad Complutense de Madrid, Plaza de Ciencias, 3, 28040, Madrid, Spain, jtejada@mat.ucm.es, Javier Castro, Daniel Gomez Gonzalez, Elisenda Molina
We present an approximate, but surprisingly accurate, method for calculating the Myerson value. This value is computable in polynomial time for most of the games used to measure the centrality or importance of a node in a network. The proposed method will be used in known problems in order to measure the error and in real large problems in order to prove its usefulness. The methods presented here can calculate, with the same accuracy, the Myerson value of any type of game. The complexity is polynomial if the calculation of the characteristic function is computable in polynomial time.

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**MA-31**

Monday, 8:30-10:00
CC-A33

**Game Theory and Social Networks 1**

Stream: Game Theory and Social Networks
Invited session

Chair: Juan Tejada, Estadistica e Investigacion Operativa I, Complutense University of Madrid, Universidad Complutense de Madrid, Plaza de Ciencias, 3, 28040, Madrid, Spain, jtejada@mat.ucm.es

1 - Analysis of Network Formation with Learning Dynamics
Michiharu Masui, Business Administration, Ishinomaki Senshu University, 1 Shimimoto Minamizakai, 9868580, Ishinomaki, Japan, masui@isenshu-u.ac.jp
In a game theoretic context, it is assumed that the decision maker has perfect rationality. However, recently, many studies have restricted the perfect rationality or the structure of the game. These restrictions are called bounded rationality by learning dynamics and complex networks. Learning dynamics and complex networks are widely used to describe the real world. The purpose of this study is to examine the behavior of the decision maker with learning dynamics and the formation of networks by the interaction of decision makers.

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**MA-32**

Monday, 8:30-10:00
CC-A34

**Combining Methods & Multimethodology**

Stream: Soft OR and Problem Structuring Methods
Invited session

Chair: Alberto Paucar-Caceres, Business School, Manchester Metropolitan University, Aytoun Building, Aytoun Street, M1 3GH, Manchester, United Kingdom, a.paucar@mmu.ac.uk

1 - Combining hard-soft OR for generative design thinking
Polyxeni Vassilakopoulou, Mechanical Engineering, National Technical University of Athens, Heroon Politechniou 9., Zografou, 15780, Athens, Greece, xvasil@central.ntua.gr, Vassilis Tsagkas, Nicolas Marmaras
We aim to contribute to design research combining hard-soft OR to support circles of convergent-divergent thinking. We build upon systems approaches (Churchman 1971; Ackoff 1974; Checkland 1981) and use established OR techniques to nurture explorative, generative design (Martin 2009). We illustrate with a case from banking. Unlike
1 - Mining Industrial Transformations and Resource Reallocation Using a New MCDM Model – Case of Taiwan and Poland
Mei-Chen Lo, National United University, 360, Miaoli, Taiwan, meichen_lo@yahoo.com, Gwo-Hsiuang Tseng, Tian-Jong Hwu, Jerry Michnik, Tadeusz Trzaskalik, Maciej Nowak
Technology change dynamically and rapidly, therefore the industrial transformation become an important issues for appropriate resource allocations as well as rearrangement of its usefulness. In this study, the related concerns are discussed, and a hybrid MCDM model based on DANP is used to assess the mining industrial transformation relative performance viewed by different groups of experts from Taiwan and Poland. The procedures find the improvement directions and efficient allocations of resources for the mining industrial transformations to achieve the aspiration levels.

2 - Using DEA to Inform an Integrated Response to Policy Change: The Case of the South African Private Hospital Industry
Shivani Ramjee, Actuarial Science, University of Cape Town, Room 5.40, Robert Leslie Commerce Building, 7700, Cape Town, Western Cape, South Africa, shivani.ramjee@uct.ac.za
The private hospital sector in South Africa has been criticized for their perceived role in rising private medical expenditure and the associated health-system inefficiencies. We use DEA to aid this sector in formulating an integrated response to National Health Insurance policy proposals. Operational, financial and clinical data for 43 hospitals for 2007-2009 was used. It is clear that case-mix and quality of care data are critical to engaging with policymakers. We identify the need for private hospitals to be permitted to employ doctors and highlight the constraint posed by nurse attrition.

3 - Determining the Position of E7 Countries among Developing Countries by Kohonen Networks
Hüseyin Tatlidil, Statistics, Hacettepe University, Hacettepe Universitesi Beytepe Kampusu Istatistik Bolumu, Beytepe, 06532, Ankara, Turkey, tatlidil@hacettepe.edu.tr, Nurbanu Bursa
In this study, developing 100 countries, grouped as low-middle and upper-middle income categories on the database of the World Bank, are clustered to their infrastructure investment sizes between the data of years 1990 and 2011 by using Kohonen Networks and it is found in which clusters Brazil, China, India, Indonesia, Mexico, Russia and Turkey known as E7 countries are. As Kohonen Networks cannot form a set of rules, C&R Decision Tree is applied. Also, it is aimed to find the geometric locations of E7 countries and the countries in the same clusters as them through Multidimensional Scaling.

4 - Does Latvia use its advantageous location? - Developing Countries by Kohonen Networks
L. Alberto Franco, Alberto Franco-Caceres, Business School, Manchester Metropolitan University, Aytoun Building, Aytoun Street, M1 3GH, Manchester, United Kingdom, a.paucar@mmu.ac.uk, Diane Hart, Ricardo Rodriguez-Ulloa
We introduce the use of Ulrich’s Critical Systems Heuristics to organize second order critical reflection in systems practice and action research. The paper draws on critical systems thinking and illustrates its application in the context of an intervention using Soft Systems Methodology (SSM) and Systems Dynamics (SD) to evaluate the environmental impact of mining operations in southern Peru. We sketch the context in which the systemic intervention was carried out reporting on the initial SSM and SD stages to outline a 2nd order boundary critique tool for systemic interventions.

5 - Structuring Community Issues - working with community members to identify and (re)structure local problematic issues
Rebecca Herron, Community Operational Research Unit, University of Lincoln, LN6 7TS, Lincoln, United Kingdom, rherron@lincoln.ac.uk
Problem Structuring Methods often take as their starting point a stakeholder group and an issue requiring exploration. Community OR specifically works with groups of community members — taking as one of its meta-goals the establishment of community-based activities that explore and develop problematic notions such as ‘the common good’. We give an example, highlight how workshops can be developed flexibly in community settings, and the issue of how we can measure the impact of our interventions.

MA-33
Monday, 8:30-10:00
OR for Business and Industrial Development
Stream: OR for Development and Developing Countries
Invited session
Chair: Honora Smith, School of Mathematics, University of Southampton, Highfield, SO17 1BJ, Southampton, Hampshire, United Kingdom, honora.smith@soton.ac.uk.
Chair: Tatjana Staube, Institute of Civil Construction and Real Estate Economics, Riga Technical university, 1/7 Meza Street; Room 210, LV1048, Riga, Latvia, tatjana.staub@gmail.com

MA-34
Monday, 8:30-10:00
Game Solutions
Stream: Cooperative Game Theory
Invited session
Chair: Encarnación Algabe, Applied Mathematics II, Seville University, C/Camino de los Descubrimientos s/n, Isla de la Cartuja, 41092, Sevilla, Spain, galgaba@us.es
1 - Equilibria in Load Balancing Games
Bo Chen, Warwick Business School, University of Warwick, Gibbet Hill Road, CV4 7AL, Coventry, United Kingdom, b.chen@warwick.ac.uk

A Nash equilibrium (NE) in a multi-agent game is a strategy profile that is resilient to unilateral deviations. A strong Nash equilibrium (SE) is one that is stable against coordinated deviations of any coalition. We show that, in the load balancing games, NEs approximate SEs well in the sense that the benefit of each member of any coalition from coordinated deviations is quantifiably quite limited. Furthermore, an easily recognizable special subset of NEs exhibit even better approximation of SEs. To establish the above results, we introduce and apply a powerful graph-theoretic tool.

2 - Dealing with time issues in testing revealed preference axioms
Fabrice Talla Nobibon, Decision Sciences and Information Management, KU Leuven, Naamsestraat 69, 3000, Leuven, Belgium, fabrice.tallanobibon@econ.kuleuven.be, Yves Crama, Fract Spieksma

This paper proposes a graph-coloring approach for dealing with the problem of testing revealed preference axioms while taking into account the timing of the observations. We translate well-known axioms of the revealed preference theory into graph properties leading to a generalized graph coloring problem with an additional vertex ordering constraint. We derive a greedy algorithm for solving the problem when the obtained graph property is hereditary, and a dynamic programming algorithm when the property is not hereditary. In both cases if the property can be verified in polynomial time then these algorithms also run in polynomial time.

3 - Equilibrium, coalitive and computational aspects of Pareto-Nash-Stackelberg Games
Valeriu Ungureanu, Department of Applied Mathematics, State University of Moldova, Gh. Asachi str., 58, ap.38, MD-2009, Chisinau, Moldova, Republic Of, v.a.ungureanu@gmail.com

Equilibrium Principles for Hierarchical and Mixture of Hierarchical and Simultaneous Games are defined and examined by the means of reaction sets, efficient reaction sets and its intersection. The set of equilibria normally consists by more than one element and may have the cardinality of the continuum. If all players form a coalition, they apply usually the criterion of Pareto optimality. Otherwise, there are a lot of other possibilities. So, equilibrium, coalitive and computational aspects of Pareto-Nash-Stackelberg Games are treated.

4 - Harsanyi power solutions for union stable systems
Encarnación Algaba, Applied Mathematics II, Seville University, C/Camino de los Descubrimientos s/n, Isla de la Cartuja, 41092, Seville, Spain, ealgaba@us.es, Jesus-Mario Bilbao, Rene van den Brink

This paper analyzes solutions for games in which partial cooperation is based on union stable systems. In this context, we provide axiomatic characterizations of the Harsanyi power solutions which distribute the Harsanyi dividends proportional to weights determined by a power measure for union stable systems. Moreover, the Myerson value is the Harsanyi solution for the equal power measure and on a special subclass the position value coincides with the Harsanyi solution obtained for the influence power measure.
2 - Performance Measurement Tools for HR Management related Processes based on System Identity Analysis
Jitka Cividina, Department of Informatics and Telecommunications, Czech Technical University, Czech Republic, Jitka.Cividina@seznam.cz
System identity method is a tool enabling the identification of operational critical subjects and parameters. The aim of this paper is to design a set of measurement techniques to control these potential weak points in the process related to the knowledge management and to provide the best solution to stabilize them. The term stable system defines a system that can be for its reliability and objectivity applied repeatedly without scattering resulting values. By monitoring individual elements of the process, the optimization of complex process is achieved.

3 - One-stage and two-stage DEA estimation of the effects of contextual variables
Timo Kuosmanen, Aalto University School of Economics, 00100, Helsinki, Finland, timo.kuosmanen@aalto.fi, Andrew Johnson
In two-stage data envelopment analysis (2-DEA) efficiency scores are regressed on z-variables representing operational conditions. We show consistency of 2-DEA under more general conditions than earlier studies. However, the finite sample bias of DEA carries over to the second stage, causing bias in the regression coefficients. Using the fact that DEA is a special case of convex nonparametric least squares, a new one-stage estimator (1-DEA) is developed to directly incorporate z-variables to standard DEA. Monte Carlo simulations show that 1-DEA performs systematically better than 2-DEA.

4 - Estimation Efficiency of Teachers through Data Envelopment Analysis
Venkata Hrd, Business Management, C/O. Prof. Ramana, S.V. University, TIRUPATI, School of Commerce, Management and Computers, 2H/3B, Mayura Apartments, V.V. Plaza, Reddy & Reddy Colony, TIRUPATI, 517501, TIRUPATI, Andhra Pradesh, India, professorhrd@yahoo.com
Data Envelopment Analysis to evaluate the efficiency of faculty based on various faculty attributes and outputs at the student and institute level. The inputs are research grants, feed-back forms, IT infrastructure, staff assistance, incentives for case-book writings, number of hours spent on seminars or conferences. Outputs are consistency of ranking of institute or teacher, number of books, research papers, case studies published, number of presentations in conferences and seminars and fund development. DMUs are faculty members.

MA-37
Monday, 8:30-10:00
CC-Act
Bioinformatics I
Stream: Computational Biology, Bioinformatics and Medicine
Invited session
Chair: Jacek Blazewicz, Institute of Computing Science, Poznan University of Technology, ul.Piotrowo 2, 60-967, Poznan, Poland, jblazewicz@cs.put.poznan.pl
Chair: Metin Turkay, Department of Industrial Engineering, Koc University, Rumelifeneri Yolu, Sarayi, 34450, Istanbul, Turkey, mturkay@ku.edu.tr

1 - A data mining case study on brain cancer patients
Fadime Uney-Yuksektepe, Industrial Engineering, Istanbul Kultur University, E5 Karayolu Londa Asfalti Uzeri, Atakoy Kampusu, 34156, Istanbul, Turkey, f.yuksektepe@iku.edu.tr
A data mining study is carried out in order to analyze the brain cancer patients. Previous brain cancer patients’ data is taken from an oncologist who works in a neurosurgery department of a private hospital. The aim of the study is to find out useful information that will help the doctors to predict the survival status and survival length of patients. The data set on hand is studied by different data classification algorithms. The most suitable and efficient method is determined and useful rules and models that will help the doctors are obtained.

2 - Markov models of voltage gating of gap junction channels
Henrikas Pranevicius, Business Informatics, Kaunas University of Technology, Studentu 50, Kaunas, Lithuania, henrikas.pranevicius@ktu.lt, Felikas Bukauskas, Mindaugas Pranevicius, Osvaldas Pranevicius, Saulius Vaičeliūnas
The major goal of this study was to create a continuous time Markov models of voltage gating of gap junction (GJ) channels formed of connexin protein. This goal was achieved using the piece linear aggregate (PLA) formalism to describe function of GJs and transforming PLA into Markov process. Proposed method was implemented to creating models of voltage gating of GJ channels containing in each hemichannel of GJ channel fast and slow gating mechanisms, operating between open and closed states.

MA-38
Monday, 8:30-10:00
HH-Colombus
Integer Linear and Linear Multiobjective Optimization
Stream: Multiobjective Optimization
Invited session
Chair: Walter Habenicht, Business Administration, University of Hohenheim, Lst. fuer IBL(580 B), 70593, Stuttgart, Germany, walter.habenicht@uni-hohenheim.de

1 - Enumerative Cuts in Integer Linear Vector Optimization
Walter Habenicht, Business Administration, University of Hohenheim, Lst. fuer IBL(580 B), 70593, Stuttgart, Germany, walter.habenicht@uni-hohenheim.de
This paper deals with a conceptual framework of a hybrid method for solving linear integer vector optimization problems. It combines cutting planes with an enumeration approach. The concept is based on enumerative cuts, which is well established approach in (single criterion) integer linear optimization. In this paper we show how enumerative cuts can be integrated in an interactive procedure for solving integer linear vector optimization problems.

2 - Graphical exploration of the weight space in multiobjective integer linear programming
Maria Joao Alves, Faculty of Economics, University of Coimbra / INESC-Coimbra, Av. Das da Silva, 165, 3004-512, Coimbra, Portugal, mjalves@if.ue.pt, Joao Paulo Costa
We present an approach that determines, at each time, a subset of the indifference region in the weight space associated with an efficient solution of a multiobjective integer linear programming (MOILP) problem. Based on the graphical exploration of these regions, we propose an algorithm to compute all supported efficient solutions “around” an already known solution, or even all the supported efficient solutions, of a tri-objective problem. We also show a computer implementation of the algorithm.
3 - A multicriteria linear programming model for measuring efficiency in productive processes

David Alcalde Lopez de Pablo, Estadistica, Investigacion Operativa y C., Universidad de La Laguna, Avda. Astrofisico Francisco Sanchez, 38206, La Laguna, Tenerife, Spain, dalcalde@ull.es, Ralfeisa Dios-Palomares, Angel M. Prieto

The efficiency in production has been usually analysed with the production frontier function. Efficiency scores are based on distances to the frontier. Improvements regard to the total consumption of each input. However, in many cases, each input is detached in its stages and trade—off among them is possible. Such analysis provides the total optimal consumption of each input, as data envelopment analysis does, and the most efficient assignment in each stage. This paper studies technical efficiency with this perspective. A non—parametrical methodology and a multicriteria model are proposed.

4 - Factoraggregation and its application for solving bilevel linear programming problems.

Pavela Orlovs, Department of Mathematics, University of Latvia, Zelzs street 8, LV-1002, Riga, Latvia, pavela.orlovs@gmail.com, Olga Montvida

We introduce the notion of a factoraggregation, which is a special construction of a general aggregation operator, based on an ordinary aggregation operator. We apply the factoraggregation for analysis of optimal solution of bilevel linear programming problems. The aggregation observes lower level objective functions considering the classes of equivalence generated by an objective function at the upper level. The proposed method is illustrated with numerical and graphical examples.

MA-39

Monday, 8:30-10:00

MA-40

Monday, 8:30-10:00

Hwa-Rong Shen, International Business, National Dong Hwa University, 1, Sec. 2, Da-hsueh Rd. Shou-feng, 974, Hualien, Taiwan, cbchen@mail.ndhu.edu.tw

1 - A storage location assignment problem for a pick-and-pass warehousing system with multiple pickers and congestion considerations

Jason Chao-Hsien Pan, Department of Business Administration, Taikung University of Science and Technology, No.56, Sec.1, Huanshun Rd., Neihu District,Taipei City, Taiwan 11451, R.O.C., Taiwan, jpanbox@gmail.com, Ming Hung Wu

This paper develops a performance evaluation method for a pick-and-pass system by describing the operation of a picker as a GI/G/1 open queueing network to estimate the expected response time of the picker in a picking zone. Based on the proposed method, this study provide storage assignment algorithm to balance the workload of each zone so that the performance of the system can be improved. A simulation model is used to implement the proposed algorithm and to compare the throughput for different polices as well. The results indicate that the proposed algorithm outperforms existing policies.

2 - The Effects of Individualism/Collectivism Orientations

Kuo-chung Chang, International Business, National DongHwa University, Taiwan, kcchang@mail.ndhu.edu.tw

The purpose of study was to examine the relationship between individualism/collectivism orientations, self-construals, and quality motivation. Participants were chosen from three Industrial Parks in Taiwan. The findings indicated that collectivism orientation not only had significant effect on the technological dimension of quality motivation, but also had indirect effect through the individuals’ interdependent self-construal. The study also found that independent self-construal mediated the relationship between individualism orientation and the humanistic dimension of quality motivation.

3 - An EOQ Model with Defective Items and Imperfect Inspection Process

Chia-Huei Ho, Business Administration, Ming Chau University, 250 Zhong Shan N. Rd.,Sec. 5, 111, Taipei, Taiwan, chiahueih@gmail.com, Liang-yuh Ouyang, Chia-Hsien Su

This paper considers an EOQ model with defective goods in inward purchases and imperfect inspection process. We assume that screening errors (including type I and type II) may occur due to imperfect inspection quality, and retailer invests capital to improve inspection quality. The objective is to find the optimal order quantity and the power of the test such that total cost per unit time is minimized. Mathematical analysis is used to find the optimal solution. Numerical examples and sensitivity analysis will be presented as well to demonstrate the results of the proposed model.

4 - Market Effectiveness and Reinstatement of Top Managers

Chin-Tsai Lin, Department of Business Administration, Ming Chuan University, 5F, No.130, Jhee Rd., Shihlin District., 11111, Taipei, Taiwan, ctlin@mail.mcu.edu.tw, Yi-Hsien Wang, Jung-Ho Lu, Hwa-Rong Shen, Yang-Sheng Wang

This study investigated the impact of the reinstatement of former CEO on the stock market reaction of listed corporations in Taiwan. Therefore, corporate decision often to reinstate former CEO, because expected former CEO with experience in managerial practices can improve corporate performance. The aim of this study is to provide practical guidelines to companies for decision making, and helpful information for adjust expectations of investors to alter portfolio allocation.

1 - The study on the festival event experience benefit structure relationship model — a case of Kaohsiung Zuoying Wannian Folklore Festival

Tang-Chung Kan, Department of Travel Management, National Kaohsiung University of Hospitality and Tourism, 1, Sung-ho Rd. Hsia-Kang, 81267, Kaohsiung, Taiwan, kan@mail.nkuht.edu.tw, Hung-ju Chien, Vivien YC. Chen

Event’s place attachment and tourist’s experience quality, are the important key factors of festival event success and event benefits. The purpose of this research is to investigate the relationships among the place attachment, experience quality and events benefits of the Kaohsiung Zuoying Wannian Folklore Festival. Use LISREL, analysis system to investigate linear structure relation model. The result can be develop the relationship model among place attachment, experience quality and event benefits’s aspect.

2 - Dealer selection for an automotive company using ELECTRE I and TOPSIS methodologies

Elih Mac, Industrial Engineering, Kocaeli University / Natural and Applied Sciences, Turkey, elilykaraca@gmail.com, Zerrin Aladag
Sales & After sales network is of vital importance for customer satisfaction with automotive companies. New technologies, competitive price and charming design increase new customer potential and of course customer satisfaction; but these are not enough to sustain long term satisfaction and loyalty. Companies have to select accurate contacts for dealer role. Multicriteria analysis is meaningful to integrate various aspects into a uniform evaluation process. We propose to use ELECTRE I and TOPSIS to choose one dealer among 6 dealership applicants for an automotive company in Turkey.

3 - An empirical analysis between Japanese Government and NPOs in the New Period
Kuo Tzu-hsuan, Department of Applied Japanese, National Kaohsiung University Of Hospitality And Tourism, Taiwan, NO.311 sonchung street Kaohsiung, NO, 807, Kaohsiung, Taiwan, kaku322@gmail.com, Vivien Y.C. Chen, Tang-Chung Kan

After the 1990s, Japan has been deeply influenced by international trends as well as its own political and economic development. This dissertation constructs a society-centered theory to explore and to analyze the relationship between the Japanese government and NPOs during the new period. I examine the change and the development by dividing the progress into "traditional period" and "new period" with after the cold war in the 1990s. This study is emphasized on showing how important Japanese government and NPOs cooperative partnership.

4 - A multi-objective strategy for Pareto set refinement
Adriano Lisboa, ENACOM - Handcrafted Technologies, 31255530, belo horizonte, minas gerais, Brazil, adriano.lisboa@enacom.com.br, Felipe Santos, Douglas Vieira, Rodney Saldanha, Marcus Lobato

This paper introduces a strategy for Pareto set refinement in order to allow where there will be more samples of the Pareto set. The fundamental idea is to find the Pareto set vertices and then use refinement criteria in order to generate new seeds for extra Pareto set samples. The strategy is especially efficient when coupled to intrinsic multi-objective optimization algorithms. The strategy is tested in analytical benchmarking problems and real world applications.

2 - Automatic Design of Multi-Objective Optimizaton Metaheuristics
Manuel López-Ibáñez, IRIDIA, Université Libre de Bruxelles, Av. F. Roosevelt 50, CP 194/46, 1050, Bruxelles, Belgium, manuel.lopez-ibanez@ulb.ac.be, Thomas Stützle

We propose to automatically instantiate multi-objective ant colony optimization (MOACO) algorithms from a flexible framework that encapsulates most of the design alternatives found in the literature. This approach allows us to generate, with little effort, new MOACO algorithms that are designed for specific multi-objective problems. The automatically generated MOACO algorithms are able to outperform MOACO algorithms from the literature. The proposed approach can be easily extended to other multi-objective metaheuristics, such as multi-objective evolutionary algorithms.

3 - Anytime Local-Search Algorithms for Multi-Objective Optimization
Jerémie Dubois-Lacoste, IRIDIA, Université Libre de Bruxelles, 50, av. F. Roosevelt, 1050, Bruxelles, Belgium, jeremie.dubois-lacoste@ulb.ac.be, Manuel López-Ibáñez, Thomas Stützle

Many optimization algorithms are designed to deliver the best possible outcome after a given computation time. However in many real-life situations, the available computation time may be unknown a priori. "Anytime" algorithms, on the other hand, are designed to obtain the best possible results whenever the algorithm is stopped. In this work we present anytime variants of two algorithms for multi-objective optimization, Two-Phase Local Search and Pareto Local Search, which are essential components of state-of-the-art algorithms for well-known bi-objective problems.

4 - Multi-objective combinatorial benchmark problems and search space structure
Arnaud Liefooghe, LIIFL - CNRS - INRIA, Université Lille 1, Lille, France, arnaud.liefooghe@lifl.fr

We first discuss the issues of designing and analyzing multi-objective combinatorial optimization problem instances, and we identify existing attempts of defining such benchmark for different domains. Next, we propose a possible alternative in the form of a multi-objective variant of NK-landscapes with objective correlation. We define and analyze a number of problem features that impact the search space characteristics, and we give guidelines for the design of evolutionary multi-objective optimization algorithms and other metaheuristics, based on the main search space features.
2 - The impact of a waiting-time threshold in overflow systems with impatient customers
Michael Manitz, Technology and Operations Management, Chair of Production and Supply Chain Management, University of Duisburg-Essen, Mercator School of Management, Lotharstr. 65, 47057, Duisburg, Germany, michael.manitz@uni-due.de, Raik Stolletz

We analyze the performance of call centers with impatient customers, two levels of support, and an overflow mechanism. Waiting calls from the front-office queue, if not, reneging are sent to the back office if at least one back-office agent is available and if a certain threshold on the waiting time is reached. We approximate such systems via a continuous-time Markov chain that allows for overflow immediately upon arrival. Two different approaches for the derivation of the respective probability of an overflow are developed the reliability of which is shown by numerical experiments.

3 - Value analysis of healthcare asset tracking systems using simulation
Ece Arzu Demircan, Industrial Engineering, TOBB University of Economics and Technology, 06560, Ankara, Turkey, eademircan@etu.edu.tr, Nilgun Fescioglu-Unver

Healthcare systems try to improve the quality of patient care and safety, and reduce their costs by use of new technologies such as Radio Frequency Identification (RFID) based asset tracking systems. Some hospitals abstain from using this technology because they are not sure how much value the system will bring. The aim of this research is to generate a value analysis framework for healthcare asset tracking systems, and develop a simulation model which can measure the benefits of asset tracking in hospitals of different scales and patient arrival-rates.

2 - Ambiguity in multistage stochastic programming and worst case trees
Georg Pflug, Department of Statistics and Decision Support Systems, University of Vienna, Universitätsstraße 5, A-1010, Vienna, Austria, georg.pflug@univie.ac.at

We consider the multistage ambiguity problem, i.e. a multistage decision model, where the governing probability is only known to lie in a set of models. These ambiguous models are defined through balls w.r.t. the nested distance of tree processes.

The ambiguity problem is formulated and solved as a minimax problem. A subproblem is to find tree processes, which belong to the ambiguity set, but give worst values for the optimization problem. We give some algorithm to identify this worst case tree process and show some illustrative examples.

2 - Measures of information in multistage stochastic programming
Marida Bertocchi, Department of Mathematics, Statistics, Computer Science and Applications, University of Bergamo, Via dei Caniana 2, 24127, Bergamo, BG, Italy, marida.bertocchi@unibg.it, Francesca Maggioni, Elisabetta Allevi

Multistage stochastic programs are usually hard to solve in realistically sized problems. Providing bounds for their optimal solution, may help in evaluating whether it is worth the additional computation for the stochastic program versus simplified approaches. In this talk we generalize the value of information gained from deterministic, pair solutions and rolling-horizon approximation in the two-stage case to the multistage stochastic formulation. We show that theorems proved for two stage case are valid also in the multistage case. Numerical results on a case study illustrate the relationships.

3 - Stochastic programming formulations of coherent multiperiod risk measurement
Martin Densing, Energy Economics, PSI, Paul Scherrer Institut, 5232, Villigen, Switzerland, martin.densing@psi.ch

Coherent risk measurement is related to stochastic optimization. An example is the single-period risk measure Conditional-Value-at-Risk (CVaR) that can be formulated as a stochastic linear program. The favorable properties of CVaR led to recent interest in multi-period extensions. We consider the case of coherent multi-period risk measurement for a value process. We discuss an extension of CVaR to the product space of state and time, and a time-consistent recursive definition. In a finite setting on a scenario tree, we consider duality relations, and integration in mean-risk optimization.

4 - Decomposition of Risk Measures
Alois Pichler, Statistics and Operations Research, University of Vienna, Universitätstraße 5, 1010, Wien-Vienna, Austria, alois.pichler@univie.ac.at

We provide a new identity for the multistage Average Value-at-Risk and selected, other risk measures.

The identity is based on the conditional Average Value-at-Risk at random level, which is introduced. It is of interest in situations, where the information available increases over time, so it is – among other applications – customized to multistage optimization. The identity relates to dynamic programming. We elaborate further dynamic programming equations for specific multistage optimization problems and derive a characterizing martingale property for the value function.
Preference values. For measuring the values, we apply a choice based conjoint analysis model. With empirical analysis on the survey data for air travelers in Korea, we will show airlines can offer various kinds of air ticket products with a high selecting possibility.

3 - A continuous-time dynamic pricing model knowing the competitor’s pricing strategy

Kimitoshi Sato, Graduate School of Finance, Accounting and Law, Waseda University, 103-0027, Tokyo, Japan, k-sato@aoni.waseda.jp, Katsushige Sawaki

We consider a dynamic pricing model for a firm knowing that a competitor adopts a static pricing strategy. We establish a continuous time model to analyze the effect of the dynamic pricing on the improvement of revenue. Customers arrive to purchase tickets in accordance with a geometric Brownian motion. We derive an explicit closed-form expression for optimal pricing policy to maximize the expected revenue. It is shown that when the competitor adopts a flat rate pricing policy, a dynamic pricing is not always effective in terms of the expected revenue compared to the fixed pricing strategy.

4 - Dynamic pricing of flight passes

Yuri Levin, School of Business, Queen’s University, 143 Union str, K7L 3N6, Kingston, Ontario, Canada, ylevin@business.queensu.ca, Mikhail Nediak, Huseyin Topaloglu

Many airlines have recently introduced a “flight pass” which targets customers in a frequent traveler segment. This product permits its holder to obtain a seat on a specified number of flights at a fixed price. Dynamic pricing of passes is contingent upon pricing of individual flights and how customers choose between passes and individual bookings. Customers in this setting are inherently forward-looking. We present a stochastic dynamic programming formulation for this problem and analyze the properties of the pricing policy.

MA-45
Monday, 8:30-10:00
BW-Water

Advertising decisions in the supply chain

Stream: Revenue Management
Invited session
Chair: Salma Karray, Faculty of business & IT, UOIT, 2000 Simcoe Street North, L1H7K4, Oshawa, Ontario, Canada, salma.karray@uoit.ca

1 - Bilateral Cooperative Advertising

Marcus Kunter, Faculty of Business & Economics, Aachen University, Kackertstr. 7, D-52064, Aachen, Germany, mk@lum.rwt-aachen.de

We study channel coordination in a manufacturer-retailer channel with bilateral moral hazard. We argue that existing approaches involve assumptions that contradict reality or require instruments that are often not adopted by managers (ex-post bargaining, per-unit cost sharing, introduction of a third party). As an alternative, we show that channel coordination is achieved by contracting on bilateral cooperative advertising and wholesale pricing. However, the channel may not be coordinated by this contract since it is dominated by other contracts from channel members’ individual perspectives.

2 - Cooperative Advertising in a Dynamic Retail Market Duopoly

Suresh Sethi, School of Management, SM30, University of Texas at Dallas, 800 W. Campbell Rd., 75080, Richardson, TX, United States, sethi@utdallas.edu, Anshuman Chutani

Cooperative advertising is a key incentive offered by a manufacturer to influence retailers’ promotional decisions. We study cooperative advertising in a dynamic retail duopoly where a manufacturer sells his product through two competing retailers. We model the problem as a Stackelberg differential game in which the manufacturer announces his shares of advertising costs of the two retailers or his subsidy rates, and the retailers in response play a Nash differential game in choosing their optimal advertising efforts over time.
Monday, 10:30-12h00

■ MB-01

Monday, 10:30-12h00
RB-Alfa

IFORS Invited Tutorial: Professor Erhan Erkut

Stream: Keynote, Tutorial and Plenary Lectures
Tutorial session
Chair: Elena Fernandez, Universitat PolitAVINGtica de Catalunya, Barcelona, Spain, e.fernandez@upc.es

1 - How to Make OR the Most Liked Course in the Curriculum?

Erhan Erkut, Rector, Ozyegin University, Kusbakisi Cad. No:2, Istanbul, Turkey, erhan.erkut@ozyegin.edu.tr

As teachers of OR, many of us would like to think that OR is one of the most valuable topics in university education. However, past experience shows that some of the students in our classrooms may not agree with this. How do we close this perception gap, and attract the best students to OR? This is just another problem, and if we think we are the best-trained problem solvers in the world, we should be able to overcome it easily. Unfortunately, while we may have exceptional training in analytical thinking and quantitative analysis, many of us lack the tools necessary for strategic planning, brand creation, and reputation management. Furthermore, most of us lack formal training in teaching, which makes matters worse.

My colleagues at the University of Alberta and I have experimented with various methods and tools over two decades, and we established that an OR curriculum can be very successful even in a business school—a considerably more challenging environment than an engineering school. The winning recipe includes ingredients such as case-based teaching, real-time modeling (“slow learning”), course management system, web tools, on-line communication, large classes, labs, student assistants, videos, guest speakers, on-line exams, and group projects; all delivered with a heavy emphasis on applications, and with a student-centered pedagogical approach. The results have been very positive; the reputation of the introductory course became "most useful," many of the best students took our electives, all members of our team won teaching awards, and through our collaboration with the industry we established a know-how transfer unit called Centre for Excellence in Operations.

In this tutorial, I will describe the problem we faced, and our attempts to solve it with examples of what worked and what did not, with an emphasis on what audience members could transfer to their institutions. The focus is not only on making one course popular, but on managing the entire student supply chain, complete with a student club, competitions, conferences, internships, and graduate programs. If you are interested in improving the perception and image of OR in your institution through teaching (and strategic planning), you are welcome to attend this session.

■ MB-02

Monday, 10:30-12h00
RB-Beta

New scheduling models and algorithms

Stream: Scheduling
Invited session
Chair: Dirk Briskorn, University of Siegen, Germany, dirk.briskorn@uni-siegen.de

1 - A tactical approach to skill management

Murat Firat, Mathematics and Computer Science, Eindhoven University of Technology, Postbus 513, 5600 MB, Eindhoven, Netherlands, m.firat@tue.nl, Cor Hurkens, Alexandre Laugier

In multi-skill workforce planning, employees are specialized in different fields. We consider a time horizon in which several projects, each with a target makespan, are to be completed. If a makespan is not achievable with available skills, an option is outsourcing some jobs by using a fixed budget. We investigate another option of increasing the available amount of skills with the aim of saving some near-future outsourcing costs. This study addresses a center question: “how to evaluate the value of a skill?”.

2 - Integrated planning of jobs and maintenance activities on a single machine

Dirk Briskorn, University of Siegen, Germany, dirk.briskorn@uni-siegen.de, Stefan Bock, Andrei Horbach

We focus on single machine scheduling subject to machine deterioration. The maintenance level specifies the machine’s current maintenance state. While jobs are processed the maintenance level drops by a certain - possibly job-dependent - amount. A maintenance level of less than zero is associated with the machine failure. Consequently, scheduling maintenance activities that raise the maintenance level may become necessary in order to prevent maintenance level being becoming negative. We present complexity results and approaches considering two types of maintenance activities.

3 - A labeling algorithm for scheduling deliveries with e-vehicles

Sleman Saliba, Corporate Research Germany, ABB AG, Wallstader Str. 59, 68526, Ladenburg, Germany, sleman.saliba@de.abb.com, Sven Krumke, Andre Chassein

In this presentation, we solve a real-world scheduling problem occurring for courier services employing electrical vehicles. E-vehicles are requested to make deliveries during given time windows while they need to be flexibly re-charged at certain re-charging points during the delivery trips. The objective is to make as many deliveries as possible while minimizing the travel cost. This problem can be formulated as a Resource Constraint Shortest Path Problem (RCSPSP). Since the RCSPSP is NP-hard, we present a fast Labeling Algorithm that can be employed in real-world scheduling systems.

4 - Hybrid method for minimizing earliness and tardiness penalties in a single-machine problem with a common due date

Christophe Wilbaut, LAMIH, University of Valenciennes, Le Mont Houny, ISTV2, 59313, Valenciennes, France, christophe.wilbaut@univ-valenciennes.fr, Said Hanafi, Rachid Bennamoun, Mustapha Ratli, Rita Macedo

In this paper we deal with the single machine earliness and tardiness scheduling problem against common due dates. We propose a hybrid method mixing heuristics and mathematical programming to solve it. The approach reaches strong upper bounds and lower bounds using relaxation techniques; a temporary setting of variables to generate and solve reduced problems; the generation of pseudo-cuts to strengthen the problem formulation. Heuristics can be integrated at different levels to enhance the approach. The efficiency of the method is shown through its results on a set of available instances.

■ MB-03

Monday, 10:30-12h00
RB-L1

Business Excellence in Logistics: Future Transport and Production

Stream: Business Excellence in Logistics
Invited session
Chair: Martin Josef Geiger, Logistics Management Department, Helmut-Schmidt-University, Holstenhofweg 85, 22041, Hamburg, Germany, m.j.geiger@hsu-hh.de

1 - A Scheduling heuristic for surface treatment process planning

Ceyhun Arat, Corporate Logistics, Corporate Research Germany, ABB AG, Wallstader Str. 59, 68526, Ladenburg, Germany, ceyhun.arat@de.abb.com, Olcay Arat, Corporate Logistics, Corporate Research Germany, ABB AG, Wallstader Str. 59, 68526, Ladenburg, Germany, olcay.arat@de.abb.com, Andrey Pankratov, EADS, Germany, a.pankratov@eads.de

In surface treatment, the bulk material undergoes changes in their physical and chemical properties. These changes may not be observed in the short term, and can only be evaluated upon the final product. Therefore, surface treatment tends to be a shielding last process of a production line. In this paper, we present a scheduling heuristic to surface treatment process planning. The heuristic is an integrated approach that takes into account the scheduling requirements on the two types of maintenance activities. It is employed in real-world scheduling systems.
The paper deals with the sequencing problem for the surface treatment process of steel coils in a Turkish Fastener Company. Our problem is to sequence the steel coils waiting for surface treatment process and schedule a single crane which performs material handling within stages for minimizing the total tardiness of jobs. A scheduling heuristic is proposed that is capable of handling special constraints about material types and material handling requirements. The performance of the heuristic has been tested by an application on the surface treatment line in Norm Fasteners Co., Turkey.

2 - Future Transport Demand Analysis for Turkey
Fusun Ulengin, Industrial Engineering, Dogus University, Dogus Universitesi, Mahmutbeylik Fak. Endustri Muh. Bol, Acibadem, Kadikoy, 34722, Istanbul, Turkey, fulengin@dogus.edu.tr, Sule Onsel, Burc Ulgtein, Ozay Ozaydin, Ozgit Kabak

The main objective of this study is to conduct a demand analysis to identify whether the capacity expansion plans will be in line with the likely development of transport demand, given expected trends of the drivers of transport demand. An integration of multiple regression and the Bayesian Net (BN) is used for this purpose. Scenario analysis is also conducted in order to see the impact of different investment strategies to reach different target in transport mode demand. The time horizon is in line with planned durations of concession contracts for transport infrastructure.

3 - Multi-criteria analysis of transport policy targets with the help of telematic services
Gideon Mbiyedzeny, Computing, Blekinge Institute of Technology, Biblioteksgatan 4, 374 24, Karlshamn, Sweden, gmb@bth.se

The aim of this paper is to assess how the choices of telematic systems through service offers can enable our understanding of different possibly competing transport policy goals in the context of road freight. Since such goals are aimed at different targets, we consider the achievement of different transport policy goals using different telematic systems as a multi-criteria decision analysis problem. Further, the paper uses a constraint-based approach to determine a satisfactory solution. The results suggest the contribution of different telematic services to different transport policies.

4 - Measuring Cost Effects of Supply Chain Stockouts: An Interactive Approach with Fast Cost Function Convergence
Sebastian Langton, Logistics Management Department, Helmut-Schmidt-University, 22041, Hamburg, Germany, langton@hsu-hh.de, Martin Josef Geiger

Measuring cost effects of stockouts is a crucial aspect in Supply Chain Management. In our talk, we present an interactive approach for obtaining cost function estimations from a decision maker/planner. First, a questioning strategy for the fast convergence of the computed cost functions is implemented in the interactive phase (similar techniques are known from Robust Ordinal Regression). Second, function approximations are derived by employing Genetic Programming, a modern metheuristic. A decision support system integrating both aspects is presented, and numerical results are discussed.

1 - USEmobility: Why do people switch to environmentally friendly modes of transport?
Jolanta Skalska, EU projects, Allianz pro Schiene e.V., Reinhardtstr. 18, 10117, Berlin, Germany, Germany, jolanta.skalska@allianz-pro-schiene.de

The EU project USEmobility applies a novel approach that directly identifies the reasons for behavioural change of European citizens in local and regional transport where rail is the backbone of the mobility chain. In 6 European countries and 10 regions people who changed their individual mobility-mix were interviewed to find out factors that influence the choice of transport mode. Recommendations for political decision makers and transport companies will be made on how to achieve the change towards eco-friendly mobility and better adapt the transport services to what the customers want.

2 - Social Costs and Benefits of Sustainable and Healthy Mobility Patterns
Claus Doll, Sustainability and Infrastructures, Fraunhofer-Institut for Systems and Innovation Research ISI, Breslauer Str. 48, 76139, Karlsruhe, Germany, claus.doll@isi.fraunhofer.de

As many other industrialised world regions, Europe is facing an aging and declining population, more tight public households and changes in peoples’ concerns on lifestyles and sustainability. However, more eco-friendly mobility must pay off for the individual user as well as for local authorities and public transport providers. In this paper we thus look at direct costs, time budgets, health impacts, safety, environmental indicators, GDP and employment of alternative forms of mobility patterns from the individual’s perspective as well as for the economy in total.

MB-04
Monday, 10:30-12h00
RB-L2
Public Transport Perspectives within a Changing Mobility Environment

Stream: Optimization in Public Transport
Invited session
Chair: Claus Doll, Sustainability and Infrastructures, Fraunhofer-Institut for Systems and Innovation Research ISI, Breslauer Str. 48, 76139, Karlsruhe, Germany, claus.doll@isi.fraunhofer.de

1 - An Integrated Model for Ship Routing with Transshipment and Berth Allocation
Jiyin Liu, School of Business and Economics, Loughborough University, Ashby Road, LE11 3TU, Loughborough, Leicestershire, United Kingdom, j.y.liu@lboro.ac.uk,
King-Wah Pang

We consider the operation of shipping companies that operate container vessels and company-owned terminals. An integrated model is developed to make coordinated decisions on container ship routing, berthing time allocation at the terminals, as well as transshipment of containers so that the overall cost can be minimized. To obtain a solution efficiently, we propose a decomposition-based heuristic approach. Computation experiment results show that significant benefit can be achieved by integrating the decisions on ship routing, berthing time allocation, and transshipment of containers.

2 - Stochastic Optimal Positioning of Tramp Vessels: A Markovian Approach
Evangelos Magirou, Informatics, Athens University of Economics, Patission 76, N/A, Athens, Greece, efm@aueb.gr

Determining the optimal sequence of ports that maximizes the time average profit of a tramp vessel dates back to Dantzig who solves it for constant rates. The model was extended to periodic charter rates and then to rates being random variables independent in time using DP. We relax this assumption by introducing a state of the charter market Markov chain, specific rates depending stochastically on the state. The formulation differs from the traditional MDP models; solution methods are developed and illustrated. The charter selection rules are intuitive and appealing to practitioners.
3 - A taxonomy and survey of speed models in maritime transport

Harilaos Psarratis, National Technical University of Athens, Evrotas 20, 15451, Neo Psychico, Greece, hnpasar@mail.ntua.gr

Ship speed is important for economic reasons, as it is a key determinant of fuel cost, a significant component of the operating cost of ships. Moreover, speed is an important parameter of the overall supply chain. However, as emissions are directly proportional to fuel consumed, speed is also very much connected with the environmental dimension of shipping. This paper presents a taxonomy and survey of speed models in maritime transport, that is, models in which speed is one of the decision variables.

4 - Maritime transport as an important link in the global supply chain

Algirdas Sakalys, Competence Centre of Intermodal Transport and Logistics, Vilnius Gediminas Technical University, Plytins st. 27, LT-10105, Vilnius, Lithuania, algirdas.sakalys@vgtu.lt

The East West Transport Corridor, connecting northern Europe with Russia and Far East is an excellent platform to develop an innovative pilot testing ground where modern technology and information systems contribute to increased efficiency, traffic safety and security as well as reduced environmental impact in the corridor. The corridor stands out as green transport corridor which will reflect an integrated transport concept where Short See Shipping, rail, inland water ways and road complement each other to enable the choice of environmentally friendly transport.

**MB-06**

Monday, 10:30-12h00
RB-Gamma

Design and parameter tuning of metaheuristics

Stream: Metaheuristics
Invited session

Chair: Mike Wright, The Management School, Lancaster University, Dept. Of Management Science, LA1 5AG, Lancaster, Lancashire, United Kingdom, m.wright@lancaster.ac.uk

1 - Scheduling cricket umpires using neighbourhood search — The dramatic impact of a simple change in neighbourhood definition

Mike Wright, The Management School, Lancaster University, Dept. Of Management Science, LA1 5AG, Lancaster, Lancashire, United Kingdom, m.wright@lancaster.ac.uk

This paper reports on the dramatic effect of a relatively simple change in definition of neighbourhoods for a cricket umpire scheduling system used in practice for amateur leagues in England. After further analysis of the results, the neighbourhood definition was changed, with dramatically improved effect. Results will be presented for data from both leagues. These results serve to emphasise the value of good neighbourhood definition for neighbourhood search methods — probably much more important than the specific choice of metaheuristic technique.

2 - Online Parameter Tuning: Another Aspect of Learning for Metaheuristics

Arif Arin, Engineering Management & Systems Engineering, Old Dominion University, 241 Kaufman Hall, 23529, Norfolk, VA, United States, arin@odu.edu, Ghaitih Rabadi

Metaheuristics are effective approaches in solving large scale optimization problems. However, most metaheuristics have several parameters that need to be tuned before they can reach good results. In this study an online parameter tuning method where parameters are changed during search process is proposed. The method memorizes and stores the information about the search process to determine the probability of selecting each parameter setting for future iterations. To evaluate the proposed algorithm it will be applied to Meta-RAPS in solving 0-1 multidimensional knapsack problem.

**MB-07**

Monday, 10:30-12h00
RB-Eta

Neighborhood reduction strategies for vehicle routing

Stream: Vehicle Routing and Logistics Optimization
Invited session

Chair: Wout Dullaert, Faculty of Economics and Business Administration, VU University Amsterdam, De Boelelaan 1105, 1081 HV, Amsterdam, Netherlands, wout.dullaert@vu.nl

1 - A Simple Parameter-free Heuristic for the Fleet Size and Mix Problem with Time Windows

Olli Bräysy, Procom Solutions Ltd, Kiviharjuntie 11, FI-90220, Oulu, Finland, olli.braeysy@procom.fi, Wout Dullaert

We suggest a new metaheuristic for the fleet size and mix vehicle routing problem with time windows. The suggested metaheuristic is based on simple random-sized jumps. The key idea is to set a random maximum percentual limit for each move and a random limit to the number of accepted moves that worsen the solution. The actual search is based on known segment relocation operations. Computational testing on the benchmark problems show that suggested new metaheuristic is competitive to previous best approaches, providing a significant number of new best-known solutions.

2 - Efficient local search methods for the large-scale Vehicle Routing Problem

Onne Beek, Mgt Information Science & Operations Mgt, Ghent University, Tweekerkenstraat 2, 9000, Gent, Belgium, Onne.Beek@ugent.be, Birger Raa, Wout Dullaert

Even after 60 years of research, state-of-the-art (meta)heuristics often perform poorly for solving very large instances of the Vehicle Routing Problem. This paper therefore deals with analyzing, redesigning and testing local search methods that are the building blocks of these metaheuristics. It focuses on efficient data structures and parallel algorithms suited for modern multicore systems, with an emphasis on simplicity and scalability, aiming to create new “best practices” for more efficiently solving large-scale VRP instances.
3 - Incorporating constraint preservation in GA operators for VRPTW problem
Gintaras Vaira, Vilnius University, Institute of Mathematics and Informatics, Akademijos St. 4, 08663, Vilnius, Lithuania, gintaras@vaira.net, Olga Kurasova
In this research we investigate the constraint handling approaches used in genetic algorithm for VRPTW problem. The investigation deals with feasibility preservation operators in GA. These operators are responsible to identify feasible parts in chromosome and reuse them in the offspring. Possible chromosome encoding approaches are investigated to reduce the complexity of GA operators while identifying and reusing feasible parts. Results of this research are compared to other GA feasibility handling approaches used in VRPTW including penalty based and repair based techniques.

4 - Exploiting geometry of large-scale topologies for routing operations
Dimitri Papadimitriou, Bell Labs, Alcatel-Lucent, Copernicuslaan 50, 2018, Antwerp, Antwerp, Belgium, dimitri.papadimitriou@alcatel-lucent.com
Geometric routing aims at providing a competitive tradeoff between the memory space required to store the routing tables, the computational complexity and the stretch of the routing paths it produces. This paper proposes a distributed procedure to characterize the graph curvature and to assign node coordinates for geometric routing to properly operate. Indeed, existing procedures for verifying sufficient conditions holds globally results in computational challenges, in particular if we assume that global topology information is not available at each node and central processing is inapplicable.

Network Optimization 2
Stream: Network Optimization
Invited session
Chair: Dimitri Papadimitriou, Bell Labs, Alcatel-Lucent, Copernicuslaan 50, 2018, Antwerp, Antwerp, Belgium, dimitri.papadimitriou@alcatel-lucent.com

1 - Single Source Tree Network Design Under Convex Costs
Henrique Luna, Instituto de Computação, Universidade Federal de Alagoas, Rua Eng. Mario de Gusmao 1230/1202, Ponta Verde, 57035000, Maceio, Alagoas, Brazil, hpluna@gmail.com, Gilberto Miranda, Ricardo Camargo
The single source tree network design problem under convex costs is a referential problem in networks for materials, energy or data transportation. The model is a hard large scale mixed-integer nonlinear program. In order to overcome the difficulties, two methods are deployed: Generalized Benders Decomposition and a combination of Outer Approximation with Benders Decomposition. The new scheme is effective on solving instances up to 702 edges in a few seconds. Properties of price unicity and differentiability are also studied to cope with the continuous relaxation of the problem.

2 - SearchCol algorithms for unsplittable multicommmodity flow problems
Filipe Alvelos, Departamento de Produção e Sistemas, Universidade do Minho, Campus de Gualtar, 4710-057, Braga, Portugal, falvelos@dps.uminho.pt, Amaro de Sousa, Dorabella Santos
SearchCol, short for ‘metaheuristic search by column generation’, is an algorithmic framework for approximately solving integer programming / combinatorial optimization problems with a decomposable structure. We apply SearchCol algorithms to two multicommmodity flow problems. In the problems addressed, the commodities, associated with origin/destination pairs, must be routed through a single path. We consider two different objectives: (i) minimize the total cost and (ii) minimize the maximum load of an arc. We present computational results for different variants of the SearchCol algorithms.

3 - Ultra-fast meta-heuristic for the spectrum reallocation problem in flexgrid optical networks
Marc Ruiz, Computer Architecture, Universitat Politècnica de Catalunya, c/ Jordi Girona 1-3, 08034, Barcelona, Spain, mruiz@ac.upc.edu, Alberto Castro, Luis Velasco, Jaume Comellas
The performance of future flexgrid optical networks can be improved reducing spectrum fragmentation. To improve capacity performance, spectrum re-allocation of already established traffic is performed in very short running time (e.g., 1 second), thus minimizing their impact over network operation. To produce near-optimal solutions within that stringent time period, we propose a randomized multi-constructive procedure followed by a path-relinking intensification. Its benefits against single-constructive procedures are evaluated. This research was funded by the TEC2011-27310 ELASTIC project.

Cutting and Packing 2
Stream: Cutting and Packing
Invited session
Chair: Maria Antonia Carravilla, INESC TEC, Faculty of Engineering, University of Porto, R. Dr. Roberto Frias s/n, 4200-465, Porto, Portugal, mac@fe.up.pt

1 - A hybrid metaheuristic for the nesting problem
José Fernando Oliveira, INESC TEC, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200–465, Porto, Portugal, jfo@fe.up.pt, Ramon Alvarez-Valdes. Antonio Martinez Sykora, Maria Antonia Carravilla, A. Miguel Gomez, Jose Tanaria
The 2-dimensional nesting problem involves the placement of a given set of polygons, not necessarily convex, into a container. In our problem, the container is a strip of fixed width and the objective is minimizing the required length. In this work we develop a metaheuristic scheme in which local search and other heuristic tools are combined with the use of an exact procedure for solving some specific subproblems. The efficiency of the proposed procedure is assessed by solving a set of instances from literature and comparing the results with the most recent and successful heuristic approaches.

2 - Optimization Containment Problem of Arbitrary Shaped Objects into a Circular Container
Alexander Pankratov, Department of Mathematical Modeling and Optimal Design, Institute for Mechanical Engineering Problems of the National Academy of Sciences of Ukraine, 61046, Kharkov, Ukraine, impankratov@mail.ru, Yuri Stoyan, Tatiana Romanova
We consider a containment problem for irregular shapes into a circular container of minimal radius. Each shape is formed by circular arcs and line segments and may be free translated and rotated. As an efficient tool of mathematical modeling of non-overlapping, containment and distance constraints we use phi-functions. We provide a mathematical model as a nonlinear constraint optimization problem. Each terminal node of the solution tree corresponds to a system of inequalities involving infinity-differentiable functions. A solution algorithm is outlined.

3 - Tetris-like Item Packing with Balancing and Additional Conditions: an MIP-based Heuristic Approach
Giorgetto Fasano, Space Infrastructures & Transportation, Thales Alenia Space Italia, Str. Antica di Collegno 253, 10146, Turin, Italy, giorgetto.fasano@thalesaleniaspace.com
This work focuses on the orthogonal packing of tetris-like items inside a convex domain. Additional conditions, such as the presence of separation planes, are taken into account and particular attention is given to the balance (e.g., issue, in the presence of filling material. A Mixed Integer Programming formulation and a heuristic approach are considered to tackle real-world instances efficiently. Some case studies are looked into to provide significant insights. In spite of this work originating within the context of space engineering, it can be extended to a number of different implementations.
4 - The Dotted-Board Model, a promising MIP model for the Nesting Problem
Maria Antónia Carravilla, INESC TEC, Faculty of Engineering, University of Porto, R. Dr. Roberto Frias s/n, 4200-465, Porto, Portugal, mac@fe.up.pt, Franklina Toledo, Cristina Ribeiro, José Fernando Oliveira, A. Miguel Gomes

In the Nesting Problem the aim is to position, without overlap, a set of 2-dimensional small pieces of different shapes over a rectangular piece of material with a known width and infinite length. The objective is to minimize the used length of the rectangular piece. The decision variables in the Dotted-Board model are the dots of the board. The 1-dimensionality of the dots in the Dotted-Board allows a straightforward use, in the MIP model, of the constraint programming concepts of "domain of a variable" and of "domain reduction".

MB-10

Monday, 10:30-12h00
RB-Theta

Performance Analysis and Inventory

Stream: Production and the Link with Supply Chains Invited session
Chair: Frédéric Dugardin, LOSI, University of Technology of Troyes, 12, rue Marie Curie, 10010, Troyes, France, frederic.dugardin@utt.fr
Chair: Christophe Duhamel, ICD - LOSI, CNRS, 12 rue Marie Curie, BP 2060, 10010, Troyes, France, christophe.duhamel@utt.fr
Chair: Olga Nazarenko, NTUU "KPI", Mayakovskogo avenue 17c, fl.72, 02225, Kiev, Ukraine, onazzzaro@gmail.com

1 - Performance evaluation of a merge system: A distribution centre with multiple random suppliers
Michael Vidalis, Business Administration, University of Aegean, Sachtouri 19 Agios Dimitrios, 17341, Athens, Greece, mvid@ath.forthnet.gr, Stelios Koukouniálos

A two echelon discrete flow merge supply network consists of a number of non identical reliable suppliers that feed a distribution center (DC) with a shared buffer. The active lead times and service time at DC are exponential distributed. The supply network is modeled as a continuous time Markov process with discrete states. The transition matrices of these specific systems are explored and a computational algorithm is developed to generate performance measures for different values of system characteristics. The algorithm is used as a design tool to optimize system’s behavior.

2 - Does greater company size lead to better performance? Evidence from Greek food supply chain
Emel Aktas, Brunel Business School, Brunel University, UB8 3PH, Uxbridge, United Kingdom, Emel.Aktas@brunel.ac.uk, Michael Bourlakis, George Maglara, Christos Fotopoulos

We analyze performance differences within the food supply chain (SC) by examining its key members (growers, manufacturers, wholesalers and retailers) with respect to company size (micro, small, medium and large). Greek food companies evaluated their food SC performance based on key indicators (efficiency, flexibility, responsiveness, product quality and total supply chain performance). The findings suggest that Greek food SC cannot be characterized as agile since the results indicate low performance in flexibility indicators. Manufacturers are chain champions in terms of total SC performance.

3 - Inventory management optimisation in multi-echelon enterprise
Olga Nazarenko, NTUU "KPI", Mayakovskogo avenue 17c, fl.72, 02225, Kiev, Ukraine, onazzzaro@gmail.com, Yuriy Pasenchanko

The optimal inventory management is vital for production or trading enterprises. Distribution network is based on the principle of hierarchical structure. Its elements are independent companies operating in their own interests, trying to optimize their own stocks. It is more effective to optimize inventory in such multi-echelon distribution network as integral system through application of VMI approach. Results of simulation show behavior strategies of the center, resellers, and retailers that lead to an optimal level of inventory in the system as a whole and each of elements in particular.

1 - Logit models incorporating driving styles variables for representing gap-acceptance behavior
Riccardo Rossi, Department of Environmental Engineering, University of Padova, Via Marzolo, 9, I35131, Padova, - Italy, riccardo.rossi@unipd.it, Massimiliano Gastaldi, Claudio Meneguzzo

The paper proposes an analysis of Logit models for representing gap-acceptance behavior at priority intersection. Differently from other studies, in this work gap-acceptance data were collected from driving simulator tests. The effectiveness of the data collected from experiments with driving simulators is highlighted: the use of driving styles variables not detectable from direct observations (on site) in driver gap-acceptance models can positively affect the accuracy of operational analysis (micro simulation, maneuver capacity and LOS assessment).

2 - An integrated fleet assignment model with supply-demand interactions
Bilge Atasoy, Transport and Mobility Laboratory, École Polytechnique Fédérale de Lausanne (EPFL), CH-1015, Lausanne, Switzerland, bilge.kuckul@epfl.ch, Michel Bierlaire, Matteo Salani

We integrate an itinerary choice model into a fleet assignment model so that price and demand interaction is endogenously included in the model. The decisions of the integrated model are the fleet assignment, seat allocation for each cabin class, schedule design and the pricing of the itineraries. We analyze the impact of including the demand model on the profits and transportation capacity from the airlines point of view. To deal with the complexity of the resulting mixed integer nonlinear problem, we build a heuristic method based on Lagrangian relaxation and subgradient optimization.

3 - Ship route modelling for traffic pattern analysis
Ronald Pelot, Industrial Engineering, Dalhousie University, 5269 Morris St., PO Box 15000, B3H 4R2, Halifax, Nova Scotia, Canada, Ronald.Pelot@Dal.ca, Dong Lin, Casey Hilliard

Ship movement tracking is improving due to various satellite and ground-based systems. This point data is sufficient for individual ship tracking or visual traffic patterns. But there are applications where maritime traffic analysis requires vector information on typical shipping routes and densities along each segment of these routes. We developed a method for aggregating the individual vessel trajectory data into routes and paths, that can be used to identify outliers in real-time, whether due to deliberate deviation from normal routes or for some accidental or nefarious purposes.

4 - The sensor location problem
Jaume Barceló, Statistics and Operations Research, Universitat Politècnica de Catalunya, Jordi Girona salvado 1-3, Campus Nord, Edifici C5, Office 215, 08034, Barcelona, Spain, jaume.barcelo@upc.edu

The main input for traffic models are Origin-Destination matrices, describing traffic patterns across the network, critical in Traffic Management supported by Dynamic Traffic Assignment models. OD matrices
are not directly observable, a seed matrix is adjusted from link flow counts provided by traffic counting stations. The adequacy of the detec-
tion layout strongly determines the quality of the adjusted OD. We 
present two alternative formulations as set covering models with side 
constraints exploiting the advantages of new technologies, and propose 
a tabu search heuristic to solve it.

MB-12
Monday, 10:30-12h00
RB-Omicron
Fuzzy Relations & Neural Networks

Stream: Fuzzy Systems, Neural Networks & Artificial Intelligence

Invited session
Chair: Martin Gavalec, Department of Information Technologies 
FIM, University of Hradec Kralove, Rokitanskeho 62, 50003, 
Hradec Kralove, Czech Republic, martin.gavalec@uhk.cz

1 - Eigenproblem of Circulant and Toeplitz matrices in 
extremal algebra
Hana Tomaskova, Information Technologies, Faculty of 
Informatics and Management, University of Hradec Kralove, 
Rokitanskeho 62, 50003, Hradec Kralove, Czech Republic, 
hana.tomaskova@uhk.cz, Martin Gavalec

Eigenproblem of circulant and Toeplitz matrices in extremal algebra 
are studied. Both types of matrices have a special form. Toeplitz ma-
trix is determined by vector of inputs in the first row and first column. 
Circulant matrix is special case of Toeplitz matrix and is determined 
by vector of inputs in the first row. Investigation of eigenvectors in 
max-min algebra is important for applications connected with reliabil-
ity of complex systems or with fuzzy relations. For special types of 
matries the computation of the eigenproblem can often be performed 
in a simpler way than in the general case.

2 - Learning Effect Approach for Scheduling Problem 
with Fuzzy Processing Time and Fuzzy Due Date
Merve Kayaci Çodur, Industrial Engineering, Ataturk 
University, Ataturk University Engineering Faculty, Industrial 
Engineering, 25200, Erzurum, Turkey, 
mkayaci@atauni.edu.tr, Vecihi Yigit

In scheduling problems, by considering the imprecision of the durations 
in the reality of manufacturing, processing times and due dates are in-
troduced as fuzzy numbers. In most studies, fuzzy processing times of 
a job are assumed fixed. However in many realistic settings, the actual 
processing time of a job maybe more or less than its normal processing 
time when it is scheduled later. This phenomenon is known as the “Learning Effect”. So we indicate study in which the uncertainty of a 
job processing time not only defines fuzzy numbers, but also defines 
scheduled position. According to the complex property of the prob-
lem, a heuristic approach of Genetic Algorithm is applied to solve this 
NP-hard problem.

3 - Mean-Partial moments models for portfolio selection 
with fuzzy returns
Mbairadjiim Moussa Alfred, Université Montpellier 1 - 
Lameta, France, moussa_all@yahoo.fr, Sadeko Kandem 
Jules, Terraza Michel

Since financial risk relates only to loss, lower partial moment is 
a more suitable risk measure compared to variance. In order to mea-
sure the risk of fuzzy portfolio return, a concept of partial moment for 
fuzzy variable, is defined in this paper. As extensions of the fuzzy 
mean-semivariance model, some mean-partial moments models are 
presented and the corresponding variations are discussed. In order 
to solve the proposed models, PSO algorithm integrating fuzzy sim-
ulation is designed. Finally, several numerical examples are given in 
orde to illustrate the effectiveness of our modeling idea.

4 - Simulation of Stochastic Linear Queuing Systems
Richard Cimler, Information Technologies, University of 
Hradec Královo, Rokitanskeho 62, 500 02, Hradec Královo, 
Czech Republic, Czech Republic, richard.cimler@uhk.cz, 
Martin Gavalec

Cost optimization in stochastic linear queueing systems is considered in 
the contribution. Simulation approach is used because the exact pre-
diction is not possible in stochastic systems. The simulated system is 
linear, i.e. it consists of a series of servers. The aim of simulation is 
to find the best way of controlling the server capacities due to sys-
tem setup. The optimization is oriented to minimizing the total costs, 
which are divided into four parts: working costs, idle costs, queuing 
costs and change costs.

MB-13
Monday, 10:30-12h00
RB-Tau
Lot-sizing and Related Topics 2

Stream: Lot-sizing and Related Topics
Invited session
Chair: Christian Almeder, Chair for Supply Chain Management, 
European University Viadrina, Große Scharrnstr. 59, 15230, 
Frankfurt (Oder), Germany, Almeder@europa-uni.de

1 - The impact of major factors in food processing ind-
ustry on the capacitated lot-sizing and scheduling 
problem
G.D.H. (Frits) Claassen, Operations Research and Logistics, 
Wageningen University, Hollandseweg 1, 6706 KN, 
Wageningen, Netherlands, frits.claassen@wur.nl, J.C. 
Gerderssen, M.J. Patck

Traditional lot sizing and scheduling models violate crucial issues in 
food processing industry. We develop models that relax all assump-
tions regarding changeover matrices including the triangular setup con-
ditions; take into account effects of deterioration due to perish ability 
of inventory; have the flexibility to take issues for physical distribution 
into consideration. Optimal production schemes become significantly 
different when these issues are considered. We apply a time-based 
decomposition heuristic and show that near-optimal solutions can be 
found in reasonable time.

2 - A multicommodity lotscheduling model for the soft 
drink production process
Socorro Rangel, UNESP - São Paulo State University, Rua 
Cristóvão Colombo, 2265, 15054-000, S.J. do Rio Preto, São 
Paulo, Brazil, socorro@ibilce.unesp.br, Michelli Maldonado

The production of soft drinks involves two main stages: syrup prepara-
tion and bottling. Two main approaches have been used in the literature 
to model the scheduling decisions of the bottling stage. The first one 
is a small bucket approach in which each period is divided into subpe-
riods. The second is a big bucket one. The objective of this work is to 
discuss the use of a multicommodity formulation for the asymmetric 
traveling salesman problem to model the scheduling decisions in the 
big bucket approach. The proposed model is studied and compared to 
others presented in the literature.

3 - Modeling the multi-level lot-sizing and scheduling 
problem - a comparison
Renate Traxler, European University Viadrina Frankfurt 
(Oder), Germany, traxler@euro-uni.de, Christian Almeder

In this work we compare different models from the literature for inte-
grating the lot-sizing and the scheduling decisions in multi-stage sys-
tems. For that purpose, we show their abilities and limitations in de-
scribing relevant aspects of a production environment. Furthermore, 
we show the computational behavior of the models by applying them 
to benchmark instances. The structural and numerical comparisons 
show that there are considerable differences between the approaches.
They allow us to provide a guideline for selecting the right modeling 
approach for different planning situations.
Discrete-continuous scheduling

Stream: Scheduling under Resource Constraints

Invited session

Chair: Jan Weglarz, Institute of Computing Science, Poznan University of Technology, Piotrowo 2, 60-965, Poznan, Poland, jan.weglarz@cs.put.poznan.pl

1 - Metaheuristics for discrete-continuous project scheduling with discounted cash flows and various payment models
Grzegorz Waligora, Institute of Computing Science, Poznan University of Technology, Piotrowo 2, 60-965, Poznan, Wielkopolska, Poland, grzegorz.waligora@cs.put.poznan.pl

Discrete-continuous project scheduling problems with discounted cash flows are considered, in which the number of discrete resources is arbitrary, and there is one continuous, renewable and limited resource. The processing rate of each nonpreemptable activity is a continuous, increasing function of the amount of the continuous resource allotted to the activity at a time. A positive cash flow is associated with each activity, and the objective is to maximize the net present value (NPV). Metaheuristic approach to the considered problems is proposed under various payment models.

2 - Metaheuristic approaches for power-aware scheduling problem
Rafal Rozyczki, Institute of Computing Science, Poznan University of Technology, ul.Piotrowo 2, 60-965, Poznan, Poland, rafal.rozyczki@cs.put.poznan.pl

We consider the problem of scheduling power driven jobs on parallel identical processors. Jobs are preemptive and related. Each job is characterized by the size and the processing speed function. Power and energy limits have to be respected in a feasible schedule. The problem is to find both: a sequence of jobs on processors as well as an allocation of power to jobs that minimize the schedule length. We propose some metaheuristic approaches that produce suboptimal solutions of the problem in a reasonable time. The effectiveness of the approaches has been compared experimentally.

3 - Multimode resource-constrained project scheduling problem with setup costs
Marek Mikula, Institute of Computing Science, Poznan University of Technology, ul.Piotrowo 2, 60-965, Poznan, Poland, Marek.Mikula@cs.put.poznan.pl

In the multimode resource-constrained project scheduling problem a set of activities has to be scheduled in such a way that precedence and resource constraints are met. Each activity can be performed in one of several execution modes differing between themselves in resource requirements and processing times. Some of the resources required by an activity have to be set up before the execution of this activity. Both the setup time and the setup cost depend on the execution mode. The objective is to minimize the total cost of all setups. A heuristic approach is proposed to solve the problem.

4 - Optimal resource allocation in virtual datacenters — a multidimensional continuous bin packing approach
Holger Schrödl, Otto-von-Guericke University Magdeburg, Germany, holger.schroedl@ovgu.de

The optimized use of resources in IT datacenters is of vital interest for IT service providers. Abundance of resource is cost-intensive, reducing IT resources leads to bottlenecks. Resource factors in datacenters are processor schedules, storage space and computing time. Existing approaches are limited how these resource factors are considered. First, the authors study multidimensional bin packing models to describe resource allocation in IT datacenters. Second, resource factors are described through general continuous functions which represent the behavior of certain resource classes.

Nonlinear Optimization and Applications 1

Stream: Nonlinear Programming

Invited session

Chair: Simone Göttlich, School of Business Informatics and Mathematics, University of Mannheim, A 5, 6, Mannheim, 68131, Germany, goettlich@uni-mannheim.de

1 - Range Approximation of Multivariate Polynomials for Global Optimization
Martin Stöcker, Fakultät Mathematik, Professur Wirtschaftsmathematik, Technische Universität Chemnitz, Reichenhainer Str. 41, Zimmer 727, 09107, Chemnitz, Germany, martin.stoecker@mathematik.tu-chemnitz.de

We consider polynomials in an arbitrary number of variables which frequently occur in optimization problems. A common challenge is to find bounds for the range of polynomials. We introduce two approaches which generate lower and upper bounds of multivariate polynomials over an n-dimensional box. The first method is based on the estimation of the contribution of the polynomial’s summands, while the second one uses an expansion into Bernstein polynomials to obtain the desired bounds. We apply the methods to a real-world problem which occurs in the development process of vehicle transmissions.

2 - Linear least squares with different types of constraints: effectiveness of methods
Arnaud Vandaele, Mathematics and Operations Research, University of Mons, rue de Houdain, 9, 7000, Mons, Belgium, arnaud.vandaele@gmail.com

In this work, we study different approaches used to solve the well-known Linear Least Squares problem, used in many fields of OR. Specifically, we focus on this problem with two types of constraints on the variables: either they must be positive, or they must be located between bounds. Different techniques exist to solve these problems. In this work, we compare these methods on different points of view, paying a particular attention to their effectiveness of determining the optimal active set, which is the set of variables reaching one of their bounds at the optimal solution.

3 - Optimization Techniques: Combinatorial Optimization and Adjoint Calculus
Simone Göttlich, School of Business Informatics and Mathematics, University of Mannheim, A 5, 6, Mannheim, 68131, Germany, goettlich@uni-mannheim.de

The focus is on optimization problems arising in the continuous modeling of network applications such as production systems and traffic flow. We present an adjoint calculus for solving the optimality system and discuss suitable discretizations of this system. For particular discretizations the resulting problem is in fact a mixed-integer program. To speed up the solution procedure, we introduce presolve techniques that are inspired by the continuous dynamics.

4 - An improved approach to subset selection for parameter estimation in online applications
Diana López, Chair of Process Dynamics and Operation, Berlin Institute of Technology, Sekr. KWT-9, Str. Des 17, Juni 135, 10623, Berlin, Germany, diana.lopez@mailbox.tu-berlin.de, Tilman Barz, Harvey Arellano-Garcia, Günter Wozny

Subset selection is a systematic approach to system identification in nonlinear least squares parameter estimation. Ill-conditioned parameters are fixed at prior estimates and a well-conditioned parameter estimation problem is solved to determine the active parameters. The procedure permits to determine the parameters whose effects are unique and have a strong effect on the output measurements. The experimental results correspond to a biological system (ion-exchange high performance liquid chromatography column for protein separation) where transport and adsorption parameters are determined.
**MB-16**

**Monday, 10:30-12h00**

**RB-2103**

**Hybrid Algorithms & Nonsmooth Optimization**

**Stream: Nonsmooth Optimization**

**Invited session**

Chair: Ángel A. Juan, Computer Science, Open University of Catalonia, Rambla Poblenou, 156, 08018, Barcelona, Spain, ajuanp@gmail.com,

Chair: Albert Ferrer, Dpt. of Applied Mathematics I, Technological University of Catalonia, Av. Doctor Marañon, 44-50, 08028, Barcelona, Catalunya, Spain, alberto.ferrer@upc.edu

1 - Successive Approximations of the SimuRoute Procedure to solve the Heterogeneous Vehicle Routing Problem

Javier Faulín, Department of Statistics and OR, Public University of Navarre, Los Maginolios Builing. First floor, Campus Arrosadia, 31006, Pamplona, Navarra, Spain, javier.faulin@unavarra.es, Ángel A. Juan, Alba Agustín, Miguel Ángel Llorente

We propose a Successive Approximations Method (SAM) for solving the Heterogeneous Vehicle Routing Problem (HVRP) in real scenarios. Our approach solves, in each iteration, the Capacitated Vehicle Routing Problem (CVRP) for the non-served nodes and the maximum capacity of unused vehicles. We used the so-called SimuRoute Procedure via Generalized Clarke and Wright (SR-GCW) to solve the associated CVRP. Thus, the largest routes which are generated from the CVRP solution are saved as a partial solution for the HVRP. Finally, competitive results have been obtained in reasonable computing times.

2 - Solving non-smooth problems through biased randomization of heuristics

Ángel A. Juan, Computer Science, Open University of Catalonia, Rambla Poblenou, 156, 08018, Barcelona, Spain, ajuanp@gmail.com, Albert Ferrer, Javier Faulin, Helena Ramalhinho Lourenço

We discuss the use of probabilistic algorithms for solving combinatorial optimization problems with non-smooth objective functions. Our approach employs non-uniform probability distributions to add a biased random behavior to well-known heuristics. By doing so, a large set of alternative good solutions can be quickly obtained in a natural way and without complex configuration processes. This approach does not need to assume any particular property of the objective function. The procedure can be especially useful in problems where properties such as non-smoothness or non-convexity lead to a highly irregular solution space.

3 - A Randomized Algorithm for the Heterogeneous Fixed Fleet Vehicle Routing Problem

José Caceres Cruz, IN3 - Computer Science, Open University of Catalonia, Roc Boronat, 117, 7th floor, Mediatic, 08018, Barcelona, Spain, Spain, jcaceresc@uoc.edu, Ángel A. Juan, Daniel Riera, Helena Ramalhinho Lourenço

The academic point of view for the Vehicle Routing Problem (VRP) has undergone significant theoretical advances. Several techniques are enabling for solving real-world scenarios like the heterogeneous fixed fleet VRP. In this study, we present an approach for the HHFVRP using a hybrid algorithm combining a randomized Clarke & Wright heuristic, a memory, and a random policy for preassignment of vehicles. The Java implementation is compared over classical datasets against other saving heuristic implementation. So far, the obtained results are promising and other policies are being considered.

4 - Solving a real application of the Time-Constrained Capacitated Open Vehicle Routing Problem

Helena Ramalhinho Lourenço, Department of Economics and Business Q-5850017D, Universitat Pompeu Fabra, R. Trias Fargas 25-27, 08005, Barcelona, Spain, helena.ramalhinho@upf.edu, Luciana Pessoa, Alex Grasas, Ángel A. Juan, Mauricio Resende

This work considers a real application of the Capacitated Time-constrained Open Vehicle Routing Problem in the health care sector, the blood sampling collection problem. The problem is COVRP with an additional constraint: the time between the first collecting point and the laboratory must be smaller or equal that a maximum time. The main objective is to minimize the number of vehicles used. We propose a Bias Random Key-Genetic Algorithm, and present results for real instances and classical ones. For the real instances, we could reduce significantly the number vehicle significantly.

**MB-17**

**Monday, 10:30-12h00**

**RB-2105**

**Location and GIS**

**Stream: Applications of Location Analysis**

**Invited session**

Chair: Burçin Bozkaya, Sabanci School of Management, Sabanci University, Orhanli, Tuzla, 34956, Istanbul, Turkey, bbozkaya@sabanciuniv.edu

1 - A fast spatial query algorithm for location analysis

Horónica Smith, School of Mathematics, University of Southampton, Highfield, SO17 1BJ, Southampton. Hampshire, United Kingdom, honora.smith@soton.ac.uk

The use of new spatial query capabilities in relational databases combined with specific heuristics has allowed us to create an algorithm that can process very large location modeling problems at high speed. The program was developed to tackle a healthcare modeling problem in South Africa that had over 3,200 demand points and 220 possible service locations. Using a version of Microsoft® SQL Server, possible solutions for this problem have been found in a few minutes. Visualization of travel to nearest service locations is facilitated by Google Maps route finding capabilities.

2 - Location Survey and GIS (Geographic Information System) for Shopping Centers Across the Country (Turkey)

Ceren Erdin Gundogdu, Business Administration, Yildiz Technical University, Barboros Bulvari Besiktas, 34349, Istanbul, Turkey, ceren.erdin@yahoo.com

Being a part of social life, Shopping Centers (SCs) become more popular and represent the environments where consumption comes into prominence. In this study a model based on geographical information system was created and decision making process was analyzed with the purpose of location survey of SCs to be opened across the country by taking population, economic and social data, geographical and spatial data. In analysis, ESRI, ArcGIS software pack, ArcCatalog, ArcMap, ArcToolbox tool boxes and software required for topology development, data conversion and geographical analysis were used.

3 - Locating Temporary Shelter Areas After a Large-Scale Disaster

Burçin Bozkaya, Sabanci School of Management, Sabanci University, Orhanli, Tuzla, 34956, Istanbul, Turkey, bbozkaya@sabanciuniv.edu, Firat Kılıc, Bahar Yetis Kara

In this study, we develop a mathematical model that decides on the location of shelter areas and the population assignment to these areas. Our formulation is based on Turkish Red Crescent’s criteria on shelter area selection. We employ a GIS-based decision support system to implement our model. The system retrieves the distance data from ArcGIS and obtains a solution with the help of Gurobi optimization software. The resulting solutions are visualized on a map that is generated by ArcGIS. We perform a case study on Kartal, a district of Istanbul, Turkey, using our decision support system.
1 - Designing a combinatorial auction for real estate


Real estate auctions are not uncommon, but typically involve a sequential and individual auctioning of properties, with bidders facing the exposure problem. Further, in a real estate setting, there may be various constraints on the allocation, and bidders are often inexperienced. Taking this into account, we discuss the design of a combinatorial auction (choices with respect to e.g. pricing, feedback, and activity rules), resulting from a simulation with students. We also present complexity results for the winner determination problem.

2 - A Stochastic Volatility Cointegration Model in Continuous Time

Susanne Griebsch, School of Finance and Economics, University of Technology Sydney, PO Box 123 Broadway, 2007, Sydney, NSW, Australia, susanne.griebsch@uts.edu.au, Kay Pilz

We investigate the valuation of spread options written on futures contracts which exhibit co-movement over large time periods. In general, co-moving futures display certain characteristics when deviating from their normal spread level due to changes from usual market conditions, e.g. the mean-reversion of spreads. However, we detect a new property between co-moving futures in the empirical data and propose a model that allows for a representation of this property. In a second step, we derive pricing formulas for European and spread options. We conclude with a discussion of numerical results.

2 - An inspection of Energy and Agricultural Markets after Fukushima

Angelica Gianfreda, Florence School of Regulation, EUI, Italy, angelica.gianfreda@eui.eu, Giacomo Scandolo

After the earthquake occurred in Fukushima in March 2011, the hypothesis of replacing nuclear generation with alternative sources has been explored. Then considering the need to mitigate climate change and reduce carbon emissions, renewable sources have attracted an increasing interest. However, wind, solar and wave energy show serious limitations, hence biofuels are becoming an interesting issue with implications on agricultural commodities and consequently on world population. Therefore, this contribution is aimed to understand the impact of Fukushima on energy and agricultural markets.

3 - Forecasting Volatility with Interday or Intraday Data: A Case Study on Istanbul Stock Exchange 30 National Index

Alper Inkaya, Middle East Technical University, Institute of Applied Mathematics, METU Universitätsh. Dahulupunar Biv. No:1, Çankaya, 06800, Ankara, Turkey, ainkaya@metu.edu.tr

Finding a proper volatility model that forecasts true volatility accurately lies in the heart of risk management and asset valuation. We compare forecasting performance of time series models, such as ARCH type models and ARFIMA model, by estimating one-day ahead daily volatility of the Istanbul Stock Exchange 30 National Stock Index using historical and realized volatility measurements. We control whether ISE 30 daily close series has long memory, and compare the forecasting ability of long memory models by several penalty criteria with traditional models.

1 - Estimation of Stochastic Volatility Models for Commodities with few Options

Gonzalo Cortazar, Ingeniería Industrial y de Sistemas, Pontificia Universidad Católica de Chile, Vicuna Mackenna 4860, Santiago, Chile, gcortaza@ing.puc.cl, Federico Alonso

Stochastic volatility specifications are required to adequately model the dynamics of commodity prices. To obtain good parameter estimates, prices for non-linear derivatives with different maturities are necessary, but some commodities trade only futures and short-term options. This paper proposes a three-factor multicommodity model with stochastic volatility and shows how to use long-term options written on one commodity to help estimate the dynamics of another. The model is implemented for Brent and WTI commodities with excellent results.

2 - Data cleansing of implied volatility surfaces

Dejan Stokic, tbd, 60386, Frankfurt, Germany, sdeyan@gmail.com

Data cleansing of implied volatility surfaces is one of the most important topics in managing the risk of options portfolios. We set the focus on the static arbitrage checks and assume that implied volatility surfaces are already cleaned of outliers and missing data points. We focus on the impact of EUAs on the optimal policy of a competitive electricity producer. The effect of grandfathering is consistently shown to introduce significant distortions to the system. It is theoretically shown that there is a threshold value of carbon price so that, for prices above this, the EUA becomes an incentive for reduced production rather than a penalty for inefficient producers. These theoretical results are supported by the data of one producer from Italy and one from Germany.
3 - A Linear Programming Model for Enhanced Indexation based on Strong Stochastic Dominance
Renato Bruni, Dip. Ingegneria Informatica, Automatica e Gestionale, University of Roma “Sapienza”, Via Ariosto 25, 00185, Roma, Italy, renato.bruni@dis.uniroma1.it, Francesco Cesaroni, Andrea Scozzari, Fabio Tardella

In the field of Portfolio Optimization, Enhanced Indexation is the problem of selecting a portfolio that generates excess return with respect to a benchmark index. In this work, we propose a linear programming model for Enhanced Indexation that selects an optimal portfolio according to a generalization of strong stochastic dominance. Since our model has an exponential number of constraints, we solve it through a constraint generation procedure. Some experimental results are presented for well-known financial data sets showing good out-of-sample performance of our model.

4 - Pump Storage Hydro Plant Valuation under Risk Constraints
Marcus Hildmann, Information Technology and Electrical Engineering, ETH Zürich, ETL G 24.2, Physikstrasse 3, 8092, Zürich, Switzerland, hildmann@ehe.cc.ethz.ch, Florian Herzog, Sebastiano Rossi

For power producers, the valuation of pump storage hydro plants becomes an important task for investment decisions, capacity market participation and operation planning. We propose a scenario based linear programming approach, which maximizes the profit by calculating the optimal plant operation schedule on hourly basis with CVaR as risk constraint. In addition, capacity markets, such as control energy reserves in a computational efficient way.

MB-21
Monday, 10:30-12h00
RB-2115
Financial Mathematics and OR 2

Stream: Financial Mathematics and OR
Invited session
Chair: Tansel Avkar, Department of Mathematics, Middle East Technical University, 06531, Ankara, Turkey, tanselavkar@gmail.com

1 - Recently crisis, credit boom and nonperforming loans in CEE countries-panel data evidence
Blanka Škrabic Perić, Department of Quantitative Methods, Faculty of Economics, Matice hrvatske 31, Split, Croatia, bskrubic@esft.hr, Josip Arneric

The paper investigates impact of credit boom during 2000th and recently crisis on nonperforming loans in CEE counties. Namely, the beginning of 2000th was characterized by many features as the foreign capital inflow, entry of foreign banks and economic growth. The rapid credit growth and lenient credit standard in the period before the crisis have caused an increase in nonperforming loans during the crisis. Dynamic panel data is used to analyze the impact of rapid credit growth on nonperforming loans in 16 CEE countries during period 1994-2010 on aggregated data for each country.

2 - A Technology Credit-Scoring Model for Service Industry
So Young Sohn, ISE, Yonsei university, Shinchon-dong, 134, Sudaemoon-gu, 137-049, Seoul, Korea, Republic Of, sohns@yonsei.ac.kr, Moooyeob Lee

A technology credit guarantee fund is established to support the growth and innovation of small and medium enterprises (SMEs) based on their technology. A technology credit-scoring model has been introduced to select applicants in a manner intended to reduce their loan default rate. However, this model was heavily influenced by the manufacturing industry, although the role of the service industry has been growing. In this paper, we propose a new technology credit-scoring model for the service industry by applying a logistic regression model to empirical data.

MB-22
Monday, 10:30-12h00
RB-2117
Multiple-criteria evaluation and decision-making under fuzziness: theory and applications

Stream: Fuzzy Sets and Soft Computing
Invited session
Chair: Jana Talasova, Dept. of Mathematical Analysis and Applications of Mathematics, Faculty of Science, Palacky University Olomouc, tr. 17. listopadu 1192/12, 771 46, Olomouc, Czech Republic, jana.talasova@seznam.cz

1 - A multi-agent multiple-criteria approach to fraud detection under fuzziness
Mario Fedrizzi, Department of Computer and Management Sciences, Universita di Trento, Via Inama 5, 38122, Trento, Italy, mario.fedrizzi@unitn.it, Alessandro Buoni, Alessandro Buoni

We introduce a multi-agent system (FIDES) aiming at offering to a team of auditors an innovative way to manage fraud schemes, assuming that the judgments of auditors are represented by fuzzy preference relations. First we introduce a dynamical group decision model to achieve a consensual design of the attack tree, the basic component of the system. Then, starting from a linguistic valuation of the nodes of the attack tree, we show how to propagate the values up the tree through an aggregation process based on multiple-criteria techniques.

2 - Multiple criteria evaluation of creative work outcomes
Jana Talasova, Dept. of Mathematical Analysis and Applications of Mathematics, Faculty of Science, Palacky University Olomouc, tr. 17. listopadu 1192/12, 771 46, Olomouc, Czech Republic, jana.talasova@seznam.cz, Jan Stoklasa

The Register of Artistic Performances is currently being developed in the Czech Republic that contains information on works of art originating from creative activities of art colleges. Outcomes in various fields of artistic production are divided into 36 categories. The abstract categories are scored according to the significance, size, and international
reception of corresponding works of art. The Saaty’s matrix of pairwise comparisons is applied to determine the scores of categories. A new view to the scores calculation and a notion of week consistency of the Saaty’s matrix were introduced.

3 - Linguistically oriented model for academic staff performance evaluation
Jan Stoklasa, Dept. of Mathematical Analysis and Applications of Mathematics, Faculty of Science, Palacky University Olomouc, tr. 17, listopadu 1192/12, 771 46, Olomouc, Czech Republic, jan.stoklasa@upol.cz, Jana Talasova, Pavel Holeček

The information system for academic staff performance evaluation (IS HAP) currently used at Palacky University in Olomouc will be presented. The core of IS HAP is a multiple criteria evaluation model based on linguistic fuzzy rule bases. The apparatus of linguistic fuzzy modelling enables us to describe complex aggregation functions in a way comprehensible to the evaluators and academic staff members that are being evaluated. Innovative ways of interpreting the outputs of the evaluation and using them for classification purposes will also be presented.

4 - Multicriteria analysis of teacher’s managerial competencies
Helena Brozova, Dept. of Systems Engineering, Czech University of Life Sciences, Kamýcká 129, 165 21, Prague 6 - Suchdol, Czech Republic, brozova@pf.czu.cz

This article deals with identification and evaluation of the students’ expectation of teacher’s competencies at the Faculty of Economics, Czech University of Life Sciences in Prague. In this research we do not intend to evaluate the teacher’s scientific ability which can’t be subjective of students’ evaluation. The key characteristics of the managerial competencies of teachers are set according to the Cassellmann typology of teacher’s roles. Than the students pairwise comparisons of various teacher’s characteristics and competencies were analysed using the Analytic Hierarchy Process.

MB-23
Monday, 10:30-12h00
RB-Delta
Optimality Conditions and Stability

Stream: Generalized Differentiation and Optimization

Invited session

Chair: Alexander Kruger, School of Science, Information Technology & Engineering, University of Ballarat, University Drive, Mount Helen, P.O. Box 663, 3353, Ballarat, Victoria, Australia, a.kruger@ballarat.edu.au

Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

1 - First and Second Order Optimality Conditions for Vector Optimization Problems with Non-solid Positive Cone
Valentin Gorokhovik, Institute of Mathematics, National Academy of Sciences of Belarus, ul. Surganova, 11, 220072, Minsk, Belarus, gorokh@im.bas-net.by

The talk deals with a nonlinear vector optimization problem with non-solid ordering cone. The main purpose is to present a unified approach to deriving first and second order optimality conditions, both necessary and sufficient, for solutions of this problem. Our approach includes two stages. At first, we reduce the vector optimization problem to the variational system consisting of the scalar inequality and the operator equality, and then, analyzing this system with variational (convex and nonsmooth) methods, we obtain optimality conditions.

2 - Risk-Sensitive Average Optimality in Finite and Denumerable Markov Decision Chains
Karel Sladky, Department of Econometrics, Institute of Information Theory and Automation, Academy of Sciences of the Czech Republic, Pod Vodárenskou vezi 4, 18208, Prague 8, Czech Republic, sladky@utia.cas.cz

The contribution is devoted to the risk-sensitive optimality criteria in finite or denumerable state Markov Decision Chains, where expectation of the stream of one-stage rewards generated by a Markov chain is evaluated by exponential utility function. Then even for unichain models risk-sensitive average optimality may depend on the starting state and be optimal only if the process starts in transient state. Explicit formulae and optimality conditions for the growth rates of expected utility as well as for mean value of the corresponding certainty equivalent will be discussed.

MB-24
Monday, 10:30-12h00
CC-A11
Centralized Inventory and Production

Stream: Game Theory and Logistics

Invited session

Chair: Ana Meca, Operations Research Center, Universidad Miguel Hernández, Avda. Universidad s/n, Edificio Torretamarit, 03202, Elche, Alicante, Spain, ana.meca@umh.es

1 - Cooperation in Assembly Systems: the Role of Knowledge Sharing Networks
Fernando Bernstein, The Fuqua School of Business, Duke University, 100 Fuqua Drive, 27708, Durham, NC, United States, fernando@duke.edu, Gurhan Kok, Ana Meca

We consider an assembly system with a buyer purchasing components from several first-tier suppliers. Suppliers incur variable inventory costs and fixed setup production costs, and invest in process improvement activities which have a direct impact on their fixed costs. The assembler establishes a knowledge sharing network, modeled as a cooperative game among suppliers. As a result of cooperation, all suppliers achieve a level of cost reduction equal to that of the most efficient supplier. We investigate the resulting impact on the investment process and cost structure for the assembly system.

2 - Cost allocation in inventory transportation systems
Ignacio García-Jurado, Department of Mathematics, Coruna University, Faculty of Computer Science, Campus de Elvina, 15071, Coruna, Spain, igjurado@udc.es, Mª Gloria Fiestras-Janero, Ana Meca, Manuel Alfredo Mosquera Rodríguez

We deal with the cost allocation problem arising in an inventory transportation system with a single item and multiple agents that place joint orders using an EOQ policy. The fixed order cost of each agent is defined and the assumptions are stated. For these inventory transportation systems we introduce and characterize a rule which allows us to allocate the costs generated by the joint order. We show that our rule has good properties from the point of view of stability.

3 - Capacity sharing: capacity or labor division? A cooperative game approach
Shoshana Anily, Faculty of Management, Tel Aviv University, 69978, Tel Aviv, Israel, anily@post.tau.ac.il

In this talk we discuss two types of capacity sharing approaches to model various service/production systems as cooperative games with transferable utility, and we analyze their core. The literature on cooperative games usually assumes that total capacity is divisible and allocable additively. This premise is reasonable in some settings, but in others it may yield unacceptable solutions. We suggest another approach, which is aligned with the concept of division of labor, where total processing time, rather than total capacity over all resources, is allocated additively.
4 - k-norm Cost Games with Critical Players
Ana Meca, Operations Research Center, Universidad Miguel Hernández, Avda. Universidad s/n, Edificio Torretamarit, 03202, Elche, Alicante, Spain, ana.meca@umh.es, Greys Sosic

In this talk, we present some special classes of cost games that satisfy k-norm property and possess players who contribute to cost reduction of all members of the alliance that they belong to (which we call critical players). This type of games can be found in knowledge-sharing games, inventory games, holding cost games, etc. While papers analyzing these games study specific examples of k-norm cost functions and analyze how players can reduce their cost through cooperation, our goal is to provide an analysis of stability for more general classes of k-norm games with critical players.

■ MB-25
Monday, 10:30-12h00
CC-A23
Practical Issues of Environmental Management
Stream: Energy, Environment and Climate 1
Contributed session
Chair: Carmen Anido, Economic Analysis: Quantitative Economy, Autonoma University of Madrid, Faculty of Economics, Cantoblanco, 28049, Madrid, Spain, carmen.anido@uam.es

1 - Dynamic Modelling of Climate Change Adaptation Pathways: The Case of Surf Life Saving Australia
Oz Sahin, School of Engineering, Griffith University, Gold Coast Campus, 4222, Griffith University, Qld, Australia, o.sahin@griffith.edu.au, Marcello Sano, Russell Richards, Shauna Sherker
Surf Life Saving Australia (SLSA) is Australia’s major water safety and rescue authority whose assets and operations are threatened by extreme events and sea level rise. This research aims to explore adaptation pathways and enhance the capacity of SLSA to tackle these threats. To achieve this aim, systems dynamics is used to test conceptual models developed by stakeholders. These models are designed to connect climatic drivers, impacts on assets, operations and communities, and strategies to improve adaptive capacity. The initial outcomes of 4 case studies across Australia will be presented.

2 - Materials and Technologies for Industrial Heritage Sustainability
Michal Ganobjak, Institute of History and Theory of Architecture and Monument Restoration, Slovak university of technology, Faculty of architecture, Námestie slobody 19, 812 45, Bratislava, Slovakia, Slovakia, ganobjakm@gmail.com, Eva Králova
We study the efficient use of brownfield sites, buildings of manufacturing process converting to the new alive features. The adaptation of the industrial heritage to the new features while maintaining the values must be chosen thoughtfully. Our study shows the optimization of intervention choices through simulation and visualization of local resources and their interactions. It comprehensively sees the issue of social sustainability, ecology of abandoned industrial environment and its economic aspect.

3 - Impacts of Climate Change on the Slovak Economy
Tomas Domonkos, Institute of Economic research, Slovak Academy of Sciences, Sancova 56, 81105, Bratislava, Slovakia, tomas.domonkos@savba.sk, Ivan Lichner
Climate change represent one of the most challenging issues humanity has to face, because they could critically affect all areas of our life. We aim to analyze and determine the impact of climate change on the Slovak economy. Integrated Assessment Model which comprise of three sub-models was designed. Basic principles of the AD-DICE model developed by de Bruin, Dellink and Tol (2007) are incorporated into a recursive-dynamic CGE model which analyzes the impact of climate change under various adaptation intensive policies.

■ MB-26
Monday, 10:30-12h00
CC-A24
Recent Research Advances in the Oil Sector
Stream: OR in the Oil and Gas Sectors
Invited session
Chair: Irina Dolgopolova, Economics and Administrative Sciences, Middle East Technical University, Odu Kent, Konuk Evi 1, B Block, 108, Ankara, Turkey, 06420, Ankara, Turkey, irina.dolgopolova@gmail.com

1 - From a decoupled to an integrated planning approach in the supply chain of specialty oils
Mario Guaardo, Finance and Management Science, NHH Norwegian School of Economics, NHH Institutt for Foretaksøkonomi, Helleveien 30, 5045, Bergen, Norway, Mario.Guajardo@nhh.no, Martin Kylinger, Mikael Rönqvist
We propose linear models for decoupled and integrated planning in a divergent supply chain for specialty oils. The optimization problem involves decisions on production, inventory, transportation, sales and distribution. The integrated objective is to maximize contribution. In the decoupled approach, an internal price system pursues to align sellers with this objective. While the total contribution is higher in the integrated solution, the sellers’ contribution may be lower. We suggest contribution sharing rules to make both the company and sellers better off under the integrated planning.

2 - Dynamic pricing application in the energy market
Gamze Oğcu, Industrial engineering, Fatih University, Buyukcekmece, 34500, Istanbul, Turkey, gamzeogcu@gmail.com, Ozlem Cosgun
The recent rise in world oil prices and the consequent run-up in gasoline prices provide a useful analog for illustrating the role of dynamic pricing in electricity markets. In this study, we consider a dynamic pricing problem in one of the private energy companies in Turkey. In the competitive market electricity prices change very frequently, so pricing is the most important tool to response demand. We resort stochastic dynamic programming to decide on the optimal policy. The results show that the dynamic pricing policy provides more revenue than the policy applied currently.

3 - Revenue management and pricing: A case study for a natural gas supplier
Ozlem Cosgun, Industrial Engineering, Fatih University, Fatih Universitesi endustri mühendisliği bolumu, Hadımköy Kampüsü Buyukçekmece, 34500, buyukcekmece, Istanbul, Turkey, ozlem_ince@hotmail.com, Emre Mete, Abdullah Kivrak, Yunus Sartık, Seniye Ümit Oktay Firat
In this study, the dynamic pricing problem of a natural gas supplier in Istanbul is considered. The natural gas consumption is varied according to the months and cities since the weather condition and revenue levels of the people in these cities are important factors in consumption amount. Clustering analysis is used for determining clusters which show similar consumption behavior. Our goal is to find optimal prices for each cluster by using stochastic dynamic programming. We try to search whether the revenue levels increase by applying dynamic pricing policy instead of fixed pricing or not.

■ MB-27
Monday, 10:30-12h00
CC-A25
MCDA and Decision Processes
Stream: Decision Processes
Invited session
Chair: K. Nadia Papamichail, Manchester Business School, University of Manchester, Booth Street East, M15 6PB, Manchester, United Kingdom, nadia.papamichail@mbs.ac.uk
1 - Design and evaluation of MCDA interventions
K. Nadia Papamichail, Manchester Business School, University of Manchester, Booth Street East, M15 6PB, Manchester, United Kingdom, nadia.papamichail@mba.manchester.ac.uk, Theodor Stewart

This paper presents a framework for analyzing and evaluating multi-criteria decision analysis (MCDA) interventions. The framework is applied to two case studies to illustrate the process of designing and implementing such interventions. We reflect on the process, the way it was managed, the composition of the decision body, the tools employed, the information exchanged between actors and the duration of the process. We discuss the outcomes and impacts of the two MCDA interventions and provide lessons learned.

2 - Criteria definition and weight assignment in MCDA: a review on environmental problems
Miguel Morgado, INESC Coimbra and Faculty of Economics - University of Coimbra, Portugal, miguel.morgado@sapo.pt, Luis C. Dias

Environmental decisions processes involve usually a large number of stakeholders with conflicting interests. Multi-Criteria Decision Aiding (MCDA) methods have demonstrated to provide more insight and increase the transparency of the decision process. We present a literature review to analyze and understand how social actors are being involved in such decision processes, the roles of the experts and the roles of the researchers involved. We focus on two questions: who and how defines the criteria to evaluate the alternatives, and who and how assigns the weights to each criterion.

3 - Introduction to a new evidential reasoning rule for decision analysis
Jian-Bo Yang, Manchester Business School, The University of Manchester, Booth Street East, M15 6PB, Manchester, United Kingdom, jian-bo.yang@manchester.ac.uk

In the paper, a recently discovered ER rule is reported that provides a general process to combine multiple pieces of independent evidence in the form of belief distribution under the common condition that every piece of evidence plays a limited role equal to its relative weight. It generates total belief from combination of any two pieces of evidence as the addition of the bounded average of individual support from each of them and the orthogonal sum of joint support from both of them. A numerical example is examined and its significance for decision analysis and processes are discussed.

4 - Supporting the restoration of historical portable organ with a new hybrid MCDM model
Tian-Jong Hwu, Business Management, National United University, 36003, Miaoli, Taiwan, tjwu@nuu.edu.tw, Mei-Chen Lo, Jerzy Michnik, Tadeusz Trzaskalik, Maciej Nowak, Gwo-Hshiung Tzeng

The physical state of any historical object exacerbates with time. An impression it makes on the public becomes effete and its value decreases. To counteract the influence of time, the conservation and restoration of historical objects are undertaken. Before starting conservation, the research to determine its range and to choose the best conservation, the research to determine its range and to choose the best approach is applied. An aim of this study is to apply the new hybrid MCDM model DANP (DEMATEL-based ANP) to assessing the relative values of the historical portable organ and to rank the potential methods and range of conservation and restoration.

1 - Optimum 2k-p factorial experiment sequencing: A bi-objective mathematical model
Vitoria Parezza, Production Engineering, Universidade Federal de Sao Carlos, Via Washington Luiz, km 235, 13564-090, Sao Carlos, Sao Paulo, vpureza@depm.ufscar.br, Pedro Oprime, Antonio Bravo Costa

Sequencing experiments with good statistical properties and low costs is a key challenge for both researchers and practitioners. We address the problem by proposing a mathematical programming formulation that aims to generate minimum cost run orders with the best statistical properties for 2k full-factorial and fractional-factorial designs. Results for designs of up to 64 experiments indicate that the approach is capable of producing optimal or sub-optimal solutions regarding the objectives addressed for a given design matrix.

2 - Observer scheduling for quality monitoring
Satyaavet S. Chauhan, John Molson School of Business, Concordia University, MB 11-317, 1445 de Maisonneuve, Blvd. west, H3G 1M8, Montreal, Quebec, Canada, sschauha@alcor.concordia.ca, Anjali Awasthi, Anna Guinzborg

We propose a decision tool for scheduling observers to access the service quality in the field. The location of service professional changes dynamically but known. An observer should spend a predefined time with the service professionals. Services are provided 24 hrs basis but the observers are scheduled during the daytime. The goal is to observe every staff for a given number of times during the planning horizon. The overall problem is similar to travelling salesman problem and we develop a heuristic approach and tested on the real data set. The experimentation results will be presented.

3 - A two-stage stochastic programming model for p-chart design
Elit Elin Gunay, Industrial Engineering, Sakarya University, Sakarya, Sakarya, Turkey, ekabelaoglu@gmail.com, Ufuk Kula, Tülin Aktın

Car manufacturing is performed in three shops called body, paint and assembly. To control the painting operations it is common to use an attributes (p-chart). Determination of chart parameters affects the paint shop objectives (minimizing the color-changeover, or maximizing the capacity). Therefore, it is important to consider paint shop constraints and objectives in the design of a p-control chart. Problem formulated as a two-stage stochastic programming problem, and solved by using sample approximation algorithm. We provide managerial insights on the problem by performing a numerical study.

1 - Cutting Planes for the Network Loading Problem with Stochastic Demands
Konstantinos Karpiris, Managementen Science, Lancaster, United Kingdom, k.karpiris@lancs.ac.uk, Adam Letchford, Stein W. Wallace

We consider a stochastic variation of the Network Loading Problem. The demand is uncertain and its realisation depends on a finite number of scenarios. We model this problem as a 2-stage stochastic mixed-integer program with complete recourse. We introduce the new class of probabilistic metric inequalities and we describe a heuristic separation algorithm. Finally, we report our computational results from the application of the proposed scheme on a set of test instances.
2 - Robust Integer Non-Linear Optimization
Ruth Hübner, Institut für Numerische und Angewandte Mathematik, Georg-August-Universität Göttingen, Lotzestr. 16-18, 37083, Göttingen, Germany, r.huebner@math.uni-goettingen.de, Anita Schöbel

Finding robust solutions of an optimization problem is relevant for applications since for most practical problems the input data is not known exactly but depends on some unknown scenario. The concept of strict robustness asks for the best solution which is feasible for every scenario. This is in particular hard for integer optimization problems. We investigate the level sets of the robust problem and identify which properties of the original problem still hold for its robust counterpart. In particular, we show in which cases an optimal integer solution can be obtained by rounding techniques.

3 - A concave programming approach for Sparse Principal Component Analysis and Sparse representation of signals
Francesco Rinaldi, Dipartimento Informatica e Sistemi Diretti, Sapienza, via A. Mura 53, 00185, Roma, Italy, rinaldi@di.uniroma1.it, Giampaolo Liuzzi

We consider Sparse Principal Component Analysis (SPCA) and sparse representation of signals. SPCA is important for data analysis and compression and has applications in science and engineering. The goal is obtaining principal components with only a few nonzero coefficients, which are usually easier to interpret. The second problem is studied in signal analysis and consists in finding a sparse representation of a signal in terms of a given dictionary. We propose an algorithm based on concave programming formulations of the problems and present numerical results on test problems and real data.

4 - Separable underestimators for Quadratic Combinatorial Optimization.
Emiliano Traversi, Fakultät für Mathematik, Technische Universität Dortmund, Germany, emiliano.traversi@gmail.com, Christoph Buchheim

We propose a method to obtain separable underestimators for Quadratic Combinatorial Optimization Problems. By exploiting separability we can provide lower bounds by solving an Integer Linear Problem and use them in a Branch and Bound scheme. This is useful in practice when the underlying linear counterpart is easy to solve. We investigate the tightness of the bounds and their effect on the running time of the algorithm. Computational results are provided concerning the Quadratic Binary Unconstrained Problem and the Quadratic Spanning Tree Problem.

MB-30
Monday, 10:30-12h00
CC-A31

Emerging Applications in Finance
Stream: Emerging Applications in Finance and Logistics
Invited session
Chair: Amparo Soler-Dominguez, Universitat Jaume I, Spain, amparo.soler@uji.es

1 - Assessing the role of managers as determinants of mutual fund efficiency: a nonparametric approach
Amparo Soler-Dominguez, Universitat Jaume I, Spain, amparo.soler@uji.es, Emil Tirtosa-Ausina, Juan Carlos Matallin-Saez

This study contributes to an incessant intent of achieving conclusions from the manager decision-making and its implications for the portfolio efficiency. We apply non-parametric techniques for measuring mutual fund’s performance and we extend the methodology in order to isolate the manager’s influence on the degree of efficiency reached. Results shed light both on investors and practitioners’ concerns because differences among managers do actually arise. This work provides a guide for evaluating managers’ forecasting ability and how they perform covering ex ante investors’ expectations.

2 - Optimal stopping rules for the random horizon duration problems
Mitsushi Tamaki, Business Administration, Aichi University, 370 Kurozasa Miyoshi, 470-0296, Nishikamo, Aichi, Japan, tamaki@vega.aichi-u.ac.jp

As a variation of the secretary problem, Ferguson et al. considered a problem called duration problem whose objective is to maximize the time of possession of a relatively best object when a known number of objects appear. We here generalize this problem into two directions by allowing the number N (of objects) to be a random variable with a known upper bound n and also allowing the objects to appear in accordance with Bernoulli trials. We give a sufficient condition for the optimal rule to be a threshold rule.

3 - The Effects of Topology and Behavioral Canon on Network Equilibria
Abhijit Deshmukh, School of Industrial Engineering, Purdue University, 241 Grissom Hall, 47907, West Lafayette, IN, United States, abhi@purdue.edu, Brandon Pope

Network topology has far ranging implications on the presence of contagion effects and existence of equilibria in networks of agents. Behavioral canon, which determines how decisions are made and the evolution of states in the network, is defined by the interaction mechanism between agents through the network topology. This presentation considers two behavioral canon paradigms, bargaining and diffusion. We study the impact of each paradigm on the speed and quality of the equilibria reached on networks. Specifically, we study hybrid networks of Poisson random graphs and scale-free networks.

MB-31
Monday, 10:30-12h00
CC-A33

Game Theory and Social Networks 2
Stream: Game Theory and Social Networks
Invited session
Chair: Elisenda Molina, Statistics, Universidad Carlos III de Madrid, Madrid, Spain, elisenda.molina@uc3m.es

Enrique Gonzalez-Arangüena, Statistics and Operation Research III, Complutense University of Madrid, Avda. Puerta de Hierro s/n, 28040, Madrid, Spain, egaran@estad.ucm.es, Anna Khmelnitskaya, Conrado M. Manuel

The notion of social capital appeared initially to highlight the importance of social networks relations as a valuable resource for social and/or economic affairs. We define an index of social capital using game-theoretical concepts. We assume that interests of individuals are modeled by a (undirected) graph. The social capital of each actor is then measured as the difference between his Myerson value and his Shapley value.

2 - A Game-theoretic Approach to Networks
Martha Saboya, Análisis Económico: Economía Cuantitativa, Universidad Autónoma de Madrid, Paseo de la Chopera 206, 1º-B, 28100, Alcobendas (Madrid), Madrid, Spain, martha.saboya@uan.es, Guillermo Owen, Susana Lopez

We consider teams whose members are represented as nodes of a graph. By cooperation, the several members can accomplish much more than by acting individually. This collaboration is however only possible if the several members can communicate, and this requires links in the graph. The links can be more or less effective; being effective links generally more costly. We use the Myerson approach to games on graphs to represent the amount of work that can be done, and the method of multilinear extensions to represent more or less efficient links. This allows us to look for optimal links.
3 - Average Forest Value for Directed Graph Restricted Games
Elisenda Molina, Statistics, Universidad Carlos III de Madrid, Madrid, Spain, elisenda.molina@uc3m.es, Ramon Flores, Anna Khmelnitskaya, Juan Tejada
We propose a value for cooperative TU games with partial action, when influence relations are directional: the Average Forest Value. Based on this concept, we also propose an index of global Social Network Efficiency which measures the ability of the network to promote efficient coalition structures to form. We analyze their properties and show their behavior by means of some illustrative applications (hierarchies, symmetric games, ...).

4 - On the roles, uses, and effects of models in Soft OR workshops
L. Alberto Franco, Hull University Business School, University of Hull, Management Systems, Cottingham Road, HU6 7RX, Hull, United Kingdom, alberto.franco@hull.ac.uk
This presentation pays attention to how groups use models within the context of soft OR interventions. Models are conceptualised as artefacts with specific roles, uses and effects according to the relative complexity of different ‘boundaries’ faced by workshop participants during interaction. This conceptualisation is illustrated via a series of case vignettes drawn from an ongoing research programme studying the impact of soft OR interventions in multi-organisational settings. The conceptual and prescriptive value of the conceptual framework is then discussed, as well as its implications for research into the evaluation of soft OR interventions.

MB-32
Monday, 10:30-12h00
CC-A34
Understanding the Practice of Soft OR Interventions I
Stream: Soft OR and Problem Structuring Methods
Invited session
Chair: L. Alberto Franco, Hull University Business School, University of Hull, Management Systems, Cottingham Road, HU6 7RX, Hull, United Kingdom, alberto.franco@hull.ac.uk

1 - The emergence of agreements within facilitated modelling workshops
Thanos Papadopoulos, Hull University Business School, University of Hull, HU6 7RX, Hull, United Kingdom, a.papadopoulos@hull.ac.uk, L. Alberto Franco
The paper focuses on the emergence of agreements in facilitated modelling workshops. We address the literature gap concerning the dynamics and mechanisms that underpin trajectories and outputs of soft OR interventions using Actor-Network Theory (ANT). Our analysis suggests that the trajectories and outcomes of such interventions are socially constructed, emerging from associations of humans and non-humans. We also argue that in practice ANT offers ‘translation’ to explain the emergence of agreement in the workshop, whereas the workshop offers models and space for translation to occur.

2 - Exploring dialogue in problem structuring workshops
Elena Tavella, Institute of Food and Resource Economics, University of Copenhagen, Denmark, eta@foi.dk
The use of Problem structuring methods (PSMs) is claimed to have positive effects on the quality of dialogue. In this presentation I explore this by examining the dialogue from a PSM workshop held with members of a local food network in the UK. Drawing on Tsoukas’ (2009) Dialogical Model of Organizational Knowledge Creation, I discuss the characteristics of productive dialogue, and assess the extent to which they were present in the workshop and how they related to the outputs. Implications of the use of a dialogue lens for research into and practice of PSM workshops will also be discussed.

3 - Exploring the communicative impact of Problem Structuring Methods: Results of an interaction-analysis based research.
Orestis Afandokas, Warwick Business School, University of Warwick, CV4 7AL, Coventry, United Kingdom, orestis.afandokas@gmail.com
This paper presents the results of an interaction analysis based research, examining non-experimental groups engaging in strategic conversations, while employing a facilitated PSM. The different elements of the research framework will be examined with particular emphasis on the methodological aspects of interaction analysis. Results in the areas of conflict management and model appropriations will be presented. The presentation will conclude with a discussion on the interpretation of the results.

MB-33
Monday, 10:30-12h00
CC-A37
OR and Modelling for Sustainable Development
Stream: OR for Development and Developing Countries
Invited session
Chair: Subhash Datta, Institute of Management Technology, 35 Km Milestone, Katol Road, 441502, NAGPUR, Maharashtra, India, subhash.datta@gmail.com

1 - OR/MS Models for Sustainable Development in India
Subhash Datta, Institute of Management Technology, 35 Km Milestone, Katol Road, 441502, NAGPUR, Maharashtra, India, subhash.datta@gmail.com
The problems of sustainability can be resolved through OR/MS methods. However, there are major constraints like corruption, infrastructure inadequacies, bureaucratic deficiencies and long gestation periods in implementation. We discuss the possibility of future transformation of the society through continuous interactions and result-oriented methodologies based on DSS, simulation and connectivity. Once the common people are assured about the benefits in terms of more production, distribution and employment they have no hesitations in implementation of the OR/MS models.

2 - Multicriteria decision making in comparison of objective and subjective criteria of companies’ success
Branka Marasovic, Faculty of Economics Split, 21000, Split, Croatia, branka.marasovic@efst.hr, Ivana Tadic
Although financial indicators usually are taken as the most important indicators of success, lately authors argue about the same relevance in usage of subjective indicators. The aim of this paper is to research whether the most successful companies regarding financial ratios (objective group of criteria) show similar results by other groups of criteria, whether the most successful companies regarding financial ratios, lately authors argue about the same relevance in usage of subjective indicators. Selected companies will be ranked by each group of criteria using multicriteria decision making method PROMETHEE II.

3 - Revised ICI as a leading indicator of Croatian industrial production during a recession
Mirjana Cirmesija, Faculty of Economics, Dept. of Statistics, University of Zagreb, J.F.Kennedy Square 6, 10000, Zagreb, Croatia, mcizmesija@efzg.hr, Natasa Erjavec, Vlasta Babovec
With the aim to improve its forecasting properties, especially during a recession, we modified a standard composite leading indicator (ICI) in Croatia. Two revised ICIs are proposed and their predictive powers were analysed on the bases of several econometric models with variables: standard ICI, two revised ICIs and Croatian industrial production (y-o-y growth rate). As for a Croatian industrial production during the recession it is recommended to forecast only one quarter ahead and revised leading indicator, calculated with negative manager’s answers, showed the best forecasting properties.
4 - Flexible approach in planning of infrastructure development
Jerzy Pasławski, Civil and Environmental Eng., Poznan University of Technology, Institute of Construction, Budowlanych, ul. Piotrowo 5, PL 60-965, Poznan, Poland, jerzy.paslawski@put.poznan.pl

Flexible approach seems very useful in planning and design when environment is very difficult to predict and forecast. A special attention must be paid in design and planning of infrastructure in developing countries. Analysis of different types of infrastructure (highways, airports, bridges) demonstrates high potential to expand but real demand (traffic) is very difficult to forecast in typical time periods (years). The sudden development of low cost airline carriers is an example of this problem. In countries in transition a special attention must be paid on investment decision.

■ MB-34
Monday, 10:30-12h00
CC-A39
Cooperative games: dynamics, robustness and related topics
Stream: Cooperative Game Theory
Invited session
Chair: Ehud Lehrer, Tel Aviv University, 69978, Tel Aviv, Israel, lehrer@post.tau.ac.il

■ MB-35
Monday, 10:30-12h00
CC-A41
Assortment and Replenishment Planning
Stream: Demand and Supply in Consumer Goods and Retailing
Invited session
Chair: Michael Sternbeck, Supply Chain Management and Operations, Catholic University of Eichstaett-Ingolstadt, Auf der Schanz 49, 85049, Ingolstadt/Donau, Germany, Michael.Sternbeck@ku-eichstaett.de

1 - Joint product assortment, inventory and price optimization
Argyro Katsifou, TOM, École Polytechnique Fédérale de Lausanne (EPFL), Odyssee 1.16 - Station 5, 1015 Lausanne, Switzerland, 1015, Lausanne, Switzerland, argyro.katsifou@epfl.ch, Ralf W. Seitter, Jean-Sébastien Tancrez

We study a retailer's joint problem of product assortment, pricing and inventory management optimization given limited shelf space. The product assortment is composed of "standard" and "variable" products. We propose an iterative heuristic to find the combined product assortment as well as the inventory level and the price for each product that maximizes retailer's overall profit. The results of our study are illustrated by numerical examples.

2 - Selecting order packaging units for store delivery in grocery retailing
Michael Sternbeck, Supply Chain Management and Operations, Catholic University of Eichstaett-Ingolstadt, Auf der Schanz 49, 85049, Ingolstadt/Donau, Germany, Michael.Sternbeck@ku-eichstaett.de, Heinrich Kuhn

In store operations are responsible for the highest share of operational costs within the internal retail network. The order packaging unit (OPU) per stock keeping unit is regarded as one driver of in store efficiency. This is the number of consumer units that are combined to one order and distribution unit for supplying the individual stores. We consider a replenishment cycle system that is used by grocery retailers for non-perishable, non-seasonal and non-promotional items. For that setting, we present an approach with which appropriate OPUs can be selected to support packaging decisions.

3 - Scheduling in-store replenishments under service-level and capacity constraints
Rob Broekmeulen, OPAC, TU Eindhoven, P.O. Box 516, Pav. E10, 5600 MB, Eindhoven, Netherlands, r.a.c.m.broekmeulen@tue.nl

Almost half of the shelf allocations in planograms of retail stores are insufficient, resulting in overflow stocks in the backroom and frequent additional replenishments after the order delivery from the outside supplier. We propose a procedure to reduce the number of additional replenishment trips by clustering the products in schedules for joint in-store replenishment based on the service level target, the allocated store space on the shelves and the available handling capacity. The procedure can also assist planogramming decisions from a cost perspective.

■ MB-36
Monday, 10:30-12h00
CC-A43
DEA and Performance Measurement: Methodology 2
Stream: DEA and Performance Measurement
Invited session
Chair: Dimitris Despotis, Department of Informatics, University of Piraeus, 80, Karaoli & Dimitriou Street, 18534, Piraeus, Greece, despotis@upi.gr

1 - Two-stage data envelopment analysis: A slacks-based measure procedure for the upper bound performance
Fuh-Hwa Liu, Industrial Engineering & Management, National Chiao Tung University, 1001 Ta Shueh Road, Dept. IE&M, 300, Hsin Chu City, Taiwan, Taiwan, fliu@mail.nctu.edu.tw, Yu-Cheng Liu

We introduce a three-phase procedure to measure upper performance bound of 2-stage DEA problems. Phase I uses a slacks-based measure (SBM) model to assess the process of converting inputs into outputs, and treats the intermediate items as non-discretionary. The intermediate items are then classified as to-be-decreased (TBD), not-to-be-changed (NC), and to-be-increased (TBI). Phase II employs another SBM model to assess the process of converting inputs into outputs. Phase II repeats until no NCs are identified. Phase III is a SBM model, similar to Phase II but without NCs.

2 - Cost efficiency when prices are not fixed: Disentangling quantity and price efficiency
Emmanuel Thanassoulis, Aston Business School, Aston University, Operations and Information Management, B4 7ET, BIRMINGHAM, United Kingdom, e.thanassoulis@aston.ac.uk, Maria Portela

We propose an approach to compute and decompose cost efficiency in contexts where both input quantities and their prices can be adjusted to minimise the aggregate cost of the outputs produced. The models developed can accommodate situations where the degree of control over input prices is minimal. We introduce a novel decomposition of the overall measure of cost efficiency into a quantity and a price efficiency component. The efficiency measures are expressed in terms of percentage cost savings that can be attained through changing prices and quantities towards the overall minimum cost target.

3 - Value-based DEA: A piece-wise linear programming approach
Dimitrios-Georgios Sotiros, Department of Informatics, University of Piraeus, 18534, Piraeus, Greece, dsotiros@uni.pirg.gr, Dimitris Despotis
Value-based DEA is a general approach to incorporate preferences in DEA efficiency assessments. One among the different methods proposed is to convert the raw input/output data into values (utilities). In this context, we present a piece-wise linear programming approach to DEA efficiency assessments, based on a data transformation-variable alteration technique and assurance-region constraints. Our developments are applicable in both oriented and non-oriented DEA models. We illustrate our approach with a data set drawn from the literature.

4 - An alternative approach to two-stage DEA with a series-relationship between the stages
Gregory Koronakos, Informatics, University of Piraeus, Kapetan Zaxariaian 39, 18757, Keratsini, Greece, gkoron@unipi.gr, Dimitiris Despotis

The two fundamental approaches to efficiency assessment in two-stage DEAs are the multiplicative and the additive. Both approaches assume a series relationship between the two stages and differ in the way they conceptualize the decomposition of the overall efficiency to the efficiencies of the individual stages. We present in this paper an alternative approach to additive efficiency decomposition in two-stage DEA. We test our models with data sets taken from previous studies and we compare the results with those reported in the literature.

MB-38
Monday, 10:30-12h00
HH-Colonbus
Duality in Multi-objective Optimization
Stream: Multiobjective Optimization
Invited session
Chair: Andreas Löhne, Institut für Mathematik, MLU Halle-Wittenberg, Theodor-Lieser-Straße 5, 06099, Halle (Saale), Germany, andreas.loehne@mathematik.uni-halle.de

1 - Alternative generalized Wolfe type and Mond-Weir type vector duality
Emilia-Loredana Pop, Faculty of Mathematics and Computer Science, Babes-Bolyai University, 1 M. Kogalniceanu, 400084, Cluj-Napoca, Romania, pop_emilia_loredana@yahoo.com, Sorin-Mihai Grad

To a general vector optimization problem we attach two new vector duals by means of perturbation theory. These vector duals are constructed with the help of the recent Wolfe and Mond-Weir scalar duals by means of perturbation theory. These vector duals are constrained and unconstrained vector optimization problems, seen as special cases of the general vector optimization problem.

2 - Lagrange necessary conditions for Pareto minimizers in Asplund spaces and applications
Christiane Tammer, Mathematics, and Computer Science, Martin-Luther-University Halle-Wittenberg, Theodor-Lieser-Str. 5, D-06120, Halle, Germany, christiane.tammer@mathematik.uni-halle.de, Truong Q. Bao

In this talk, new necessary conditions for Pareto minimal points of sets and Pareto minimizers for constrained multiobjective optimization problems are established. Our approach is based on a version of the separation theorem for nonconvex sets and the subdifferentials of vector-valued and set-valued mappings. Furthermore, applications in mathematical finance and approximation theory are discussed.
3 - Applications of duality in multiobjective optimization
   Andreas Löhne, Institut für Mathematik, MLU Halle-Wittenberg, Theodor-Lieser-Straße 5, 06099, Halle (Saale), Germany, andreas.loehne@mathematik.uni-halle.de

   Two applications of duality in multi-objective optimization are discussed. First, duality is essential to develop dual algorithms to solve linear and convex problems. In particular, we focus on the potential of dual algorithms to solve certain classes of multi-objective combinatorial problems efficiently. The second part deals with applications in Mathematical Finance. Multi-objective optimization and duality play a role in market models with transaction costs.

MB-39

Monday, 10:30-12h00
HH-Cousteau

MADM Applications II

Stream: MCDA: New Approaches and Applications
Invited session

Chair: Chin-Tsai Lin, Department of Business Administration, Ming Chuan University, 5F, No.130, Jihe Rd., Shihlin District, 11111, Taipei, Taiwan, ctlin@mail.mcu.edu.tw
Chair: Chie-bein Chen, International Business, National Dong Hwa University, 1, Sec. 2, Da-hsueh Rd. Shou-feng, 974, Hualien, Taiwan, cbchen@mail.ndhu.edu.tw

1 - Evaluating Information Quality and Validity of Value Line Stock Ratings
   Shih-Yun Wang, Department of Finance, National Dong Hwa University, Taiwan, gracew@mail.ndhu.edu.tw, Po-Lung Yu

   Investment in stock market involves many decision rules and variables; hence investors are increasingly relying on ratings provided by rating agencies to guide their stock selections. However, do these stocks ratings have information value? Are rating agencies’ ratings valid? We research these questions by analyzing the performance of rating agencies. We provide empirical evidence on the performance of rating services by analyzing the performance of Value Line. We introduce the concepts of domination cones, domination structures and non-dominated solutions.

2 - Selecting the Optimal Foreign Dramas for Commercial TV Stations in Taiwan Using Delphi and AHP
   Pi-Fang Hsu, Department of Communications Management, Shih Hsin University, No.1, Lane 17, Mu-Cha Road, Sec.1, 11604, Taipei, Taiwan, celinia9@ms26.hinet.net, Shu-Yu Lin

   This study develops a model for selecting foreign dramas based on Commercial TV station manager’s perceptions. First, the proposed model adopts the Modified Delphi Method to find out the suitable evaluative criteria of foreign dramas. Next, the model apply the Analytic Hierarchy Process (AHP) to determine the relative weights of criteria, then ranks the alternatives and selects the optimal foreign dramas. The results indicated that concerns think highly of criteria in order are drama content perspective, cast perspective, advertising budget perspective, foreign data of origin perspective.

3 - Developing a Selection Model for Newspaper Integrated Marketing Communication Service
   Ya-Han Lin, Department of Communications Management, Shih Hsin University, No.1, Lane 17, Mu-Cha Road, Sec.1, 11604, Taipei, Taiwan, beth6677@gmail.com, Pi-Fang Hsu

   This research develops a model for selecting newspaper integrated marketing communication (IMC) service. The proposed model comprises two parts, with the first part using the modified Delphi method to identify suitable evaluative criteria of IMC service, while the second part applies Analytic Hierarchy Process (AHP) to calculate and rank the optimal IMC service. Additionally, the model is then tested by a newspaper IMC service selection case for advertisers. The proposed model helps advertisers to effectively select newspaper IMC service, making it highly applicable for academia and commerce.

MB-40

Monday, 10:30-12h00
HH-Livingstone

MADM Applications VI

Stream: MCDA: New Approaches and Applications
Invited session

Chair: Chin-Tsai Lin, Department of Business Administration, Ming Chuan University, 5F, No.130, Jihe Rd., Shihlin District, 11111, Taipei, Taiwan, ctlin@mail.mcu.edu.tw
Chair: Chie-bein Chen, International Business, National Dong Hwa University, 1, Sec. 2, Da-hsueh Rd. Shou-feng, 974, Hualien, Taiwan, cbchen@mail.ndhu.edu.tw

1 - A qualitative model for collective intelligence analysis
   Jiang-Liang Hou, Dept of Ind. Eng. & Eng. Mgt., National Tsing Hua Univ., No. 101, Section 2, Kuang-Fu Road, 300, Hsinchu, Taiwan, adamhout2@gmail.com, Hung Lung Lin, Shih-Ting Yang, Yu-Min Chiang

   Based on the concept of CI, a three-stage tendency determination model of community opinions is proposed to develop a platform for gathering public opinions, determining tendency of the community opinions and supporting decision makers with decision conclusions. The three stages include “analysis of opinions contents”, “representation of formatted opinion contents”, and “analysis of opinions tendency and representation of conclusions.” The proposed model is to extract text-based opinions of individuals into a generally accepted decision-making reference for the decision maker.

2 - Taiwan Health Communication Research: Application and Impact of New Media
   Rose Hung, Department of Communications Management, Shih Hsin University, Taiwan, rose@jetgo.com.tw, Pi-Fang Hsu

   With the rise of social networks and mobile media, health communication models also come with each passing day, compared to traditional media, new media more effectively to achieve the dissemination of health knowledge and help people or patients to implement lifestyle adjustment? This study analysis of the Taiwan government and private health communication activities in recent years, through the combination of interviews and questionnaires, the results are analyzed to find out the health communication effect and construct a health dissemination pattern.

3 - Hybrid MCDM Approach for Company Growth Strategy Selection in Marketing
   Tuncay Gürbüz, Industrial Engineering, Galatasaray University, Ciragan cad. No.36, Ortakoy, 34357, Istanbul, Turkey, tuncaygurbuz09@gmail.com, Y. Esra Albayrak

   In today’s competitive markets, one can easily see that the importance is not producing goods and services but being able to sell what one produces. Nowadays, the concept of marketing is customer-oriented and aims to meet the needs and expectations of customers to increase
their satisfaction. While creating a marketing strategy, an enterprise must consider many factors and decide to perform either target determination or company growth strategies. In this study, company growth strategies are analyzed by a hybrid MCDM method consisting of Analytic Network Process and Choquet Integral.

A crucial problem in the analytic hierarchy/network process is how to derive priorities from pairwise comparison matrices. The most popular methods for deriving priorities are eigenvector, proposed originally by T. Saaty, logarithmic least square and least square method. The paper deals with other alternative approaches using methodology of goal programming — one is based on minimization of sum of absolute or relative deviations and another on minimization of maximum deviation. Results are compared on a set of randomly generated matrices of different sizes and different levels of consistency.

1 - Determinants of customers satisfaction in the Nigerian aviation industry using AHP model
Adebola Adebayo, Business Administration, University of Lagos, Room 111, Dept. of Bus. Admin., Faculty of Bus. Admin., University of Lagos, Akoka, Yaba, 234, Akoka, Yaba, Lagos, Nigeria, agadekoya@unalag.edu.ng, B.e.a. Oghojafor, Emmanuel O. Oyatoye

The airline industry in Africa’s most populous nation has witnessed explosive growth in recent years with older domestic airlines being in competition with new entrants. The expansion has given Nigerians a wider choice of airlines. This research is designed to apply the Analytic Hierarchy Process to find out the determinants of customers satisfaction in the Nigerian aviation industry. This is an exploratory study with focus on primary data which will be collected using convenience sampling and snowballing techniques. A quantitative approach is used to analyze data provided.

2 - Performance evaluation of inmetro: a contribution of multicriteria decision aid
Lorena Bezins, ibmec, Rua Ipanema, 99/902, 22631390, Rio de Janeiro, RJ, Brazil, lberzinsmestrado@gmail.com, Luís Rangel

A performance appraisal program, when well structured, is a useful tool to measure organization performance. The performance of an employee is measured under multicriteria, and this work uses AHP, a Multicriteria Decision Aiding tool, to structure PA. The study was tested in a governmental organization in Brazil, INMETRO. The method is flexible because it can be adjusted to the needs of each department. But at the same time has the same structure and criteria to the whole organization, so it is possible to evaluate the performance of the company and compare results between different departments.

3 - Combine ANP and Fuzzy integral approaches for supplier evaluation and selection
James Liou, Industrial Engineering and Management, National Taipei University of Technology, No. 1 Chung-Hsiao E. Rd. Sec. 3, 106, Taipei, Taiwan, jamesjlou@gmail.com, Yin-Ching Chuang, Gwo-Hshiung Tzeng

In this study, we propose a novel fuzzy integral-based model, which addresses the dependent relationships between the various criteria and the non-additive weighted gap analysis. The relations-structure among the criteria and the weights of the criteria are built with the aid of the Decison Making Trial and Evaluation Laboratory and Analytical Network Process (DANP) method. The fuzzy integral is then used to aggregate the gaps and weights. The proposed model remedies prior shortcomings and should be more reasonable. The method is demonstrated using data from a Taiwanese company.

4 - Comparison of methods for deriving priorities in the analytic hierarchy process
Josef Jablonsky, Dept. of Econometrics, University of Economics Prague, W.Churchill sq. 4, 13067, Prague 3, Czech Republic, jablon@vse.cz

A crucial problem in the analytic hierarchy/network process is how to derive priorities from pairwise comparison matrices. The most popular methods for deriving priorities are eigenvector, proposed originally by T. Saaty, logarithmic least square and least square method. The paper deals with other alternative approaches using methodology of goal programming — one is based on minimization of sum of absolute or relative deviations and another on minimization of maximum deviation. Results are compared on a set of randomly generated matrices of different sizes and different levels of consistency.

2012)

Monday, 10:30-12h00

Invited session

Stream: Analytic Hierarchy Process, Analytic Network Process

Chair: Josef Jablonsky, Dept. of Econometrics, University of Economics Prague, W.Churchill sq. 4, 13067, Prague 3, Czech Republic, jablon@vse.cz

EURO Doctoral Dissertation Award (EDDA 2012)

Chair: Jacques Teghem, Mathuros, Faculté Polytechnique/UMons, 9, rue de Houdain, Rue de Houdain 9, 7000, Mons, Belgium, jacques.teghem@umons.ac.be

Chair: Silvano Martello, DEIS, University of Bologna, Viale Risorgimento 2, 40136, Bologna, Italy, silvano.martello@unibo.it

Chair: Hartmut Stadler, Institute for Logistics and Transport, University of Hamburg, Von-Melle-Park 5, 20146, Hamburg, Germany, h.stadler@t-online.de

Chair: Ahiti Salo, Systems Analysis Laboratory, Aalto University School of Science and Technology, P.O. Box 11100, Otakaari 1 M, 00076, Aalto, Finland, ahiti.salo@aalto.fi

Chair: Stéphane Daureze-Peres, Manufacturing Sciences and Logistics, Ecole des Mines de Saint-Etienne, 880 avenue de Minet, 13541, GARDANNE, France, daureze-peres@emse.fr

Monday, 10:30-12h00

BW-Granite

Stochastic Programming - Stability, Estimation

Chair: Petr Lachout, Dept. Probability and Statistics, Charles University in Praha, Sokolovská 83, 186 75, Praha, Czech Republic, lachout@karlin.mff.cuni.cz

1 - Empirical Estimates via Heavy Tails
Vlasta Kanková, Econometrics, Institute of Information Theory and Automation of ASCR, Pod Vodárenskou věží 4, Praha 8, CZ 18208, Prague, Czech Republic, Czech Republic, kankova@uia.cas.cz

Optimization problems depending on a probability measure correspond to many economic and financial applications. Since this measure is often unknown, a solution has to be usually determined on the data basis, underlying distribution function is replaced by empirical one. Many efforts have been paid to the investigation of the corresponding empirical estimates of an optimal value and an optimal solution. It was mostly done for the underlying distribution with thin tails. The aim of the contribution is to focus on the case of heavy tails, including shape parameter in (1,2).
2 - Stochastic program with additional information
Petřík Lachout, Dept. Probability and Statistics, Charles University in Prague, Sokolovská 83, 186 75, Prague, Czech Republic, lachout@karlin.mff.cuni.cz

Treating a stochastic program we usually possess an additional information about the subject and background which should be incorporated in the program. Typically, there are historical observations of the system, recently observed data, expert suggestions and forecasts, knowledge about smoothness of the program, etc. We intend to describe structure of such programs together with a stability discussion.

3 - Universal Confidence Sets - Estimation and Relaxation
Silvia Vogel, Mathematics and Natural Sciences, Ilmenau University of Technology, Postfach 100565, 98684, Ilmenau, Thuringia, Germany, Silvia.Vogel@tu-ilmenau.de

The derivation of universal confidence regions for constraint sets, optimal values and solutions sets of decision problems usually assumes concentration-of-measure properties for the objective and/or constraint functions and some knowledge about the true problem, such as values of a growth function. If these values are not available, one can estimate them relying on the concentration-of-measure inequalities for the true functions. We show how such estimates can be derived and incorporated. Furthermore, we investigate confidence sets which are obtained via relaxation of certain inequalities.

4 - Stability and convexity of chance-constrained problems with structural dependence
Michal Houda, Econometrics, Institute of Information Theory and Automation of the ASCR, Pod Vodárenskou věží 4, Praha 8, CZ 18208, Prague, Czech Republic, houda@eiu.cas.cz

In chance-constrained problems, the convexity of the constraint set is important. It is known that a suitable combination of a concavity property of the probability distribution and concavity of constraint mappings are sufficient conditions to the convexity of the constraint set. We assume further that a structural dependence assumption: constraint rows not required to be independent. The resulting constraint set is non-convex but can be approximated by a convex one. We show that, applying stability results on optimal values and optimal solutions, these remain stable under common assumptions.

MB-44
Monday, 10:30-12h00
BW-Marble

Inventory, Pricing, and Customer Behavior
Stream: Revenue Management
Invited session
Chair: Qing Li, Dept. of ISOM, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, imqli@ust.hk

1 - Group buying mechanisms
Rachel Zhang, IELM, Hong Kong UST, Clear Water Bay, 00000, Kowloon, Hong Kong, rzhang@ust.hk

When a seller offers quantity discounts, interested buyers may either self-organize or rely on a third party to aggregate their purchasing quantities to obtain lower prices. This paper concerns group buying among heterogeneous buyers given a seller’s quantity discount schedule under both the uniform price and non-uniform price group buying mechanisms. We show that the latter have a direct impact on the buyers’ payments, purchase quantities, and the seller’s revenue. We also compare buyers’ purchasing quantities and surplus under different group buying mechanisms and when buyers buy alone.

2 - Optimal pricing policy for recyclable short life-cycle products
Hsiao-Fan Wang, IEME, Natl Tsing Hua University, 101 Sec.2, Kuang-Fu Rd., 30043, Hsinchu, Taiwan, hsiaofanw@gmail.com

Because of the environmental degradation, producing green products is necessary. Since green products are market driven, proposing a method for pricing on a short-life, green product in market so that an enterprise or a retailer can make profit from producing and selling the green products is our primal intention. Under a given market scale and recycling principle, the optimal pricing policy based on Game Theory was proposed by a developed DP model for two kinds of products which have different degrees of greenness from different manufacturers sold by one retailer.

3 - Managing perishable goods under different customer preferences
Qing Li, Dept. of ISOM, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, imqli@ust.hk, Xiaoli Wu

The shelf lives of perishable goods are influenced by decisions made along the supply chains and on shelves. How should firms coordinate shelf life decisions and inventory decisions? We show that the answer depends critically on customers’ sensitivity to freshness. We consider two classes of customers and measure sensitivity to freshness by the percentage of customers who purchase only new items, and whether the customers who accept both new and aged items retrieve items FIFO or LIFO.

MB-45
Monday, 10:30-12h00
BW-Water

Applications of Pricing and Revenue Management
Stream: Revenue Management
Invited session
Chair: Luce Brotcorne, INRIA, Parc Scientifique de la Haute Borne, 40 avenue Halley, Bat a Park Plaza, 59650, Villeneuve d’Ascq, France, luce.brotcorne@inria.fr

1 - Revenue management in sequential distribution: An application to the Hindi Movie Industry
Megha Sharma, Operations Management, Indian Institute of Management Calcutta, A-306, Academic Block, JIM Calcutta, Joka, DH Road, Kolkata, 700104, Kolkata, West Bengal, India, megha@iimcal.ac.in, Sumanta Basu

With about 125 movie releases in a year, Hindi movie industry is one of the largest producers of movies in the world. Over the years the life cycle of movies has shortened significantly and a movie is typically premiered on TV within 4 months of its release. While a movie’s earnings from TV premier are significant and decrease sharply with time, an early release cannibalizes revenue from other channels. This work attempts to determine the optimal timing of TV premier using statistical methods and mathematical modeling in light of video piracy, and movie reviews through social media.

2 - Dynamic pricing with predefined tariff constraints
Kris Meyers, Vlerick Leuven Gent Management School and Ghent University, Reep 1, 9000, Gent, Belgium, krismeyers@vlerick.com, Mario Vannoucke, Behzad Samii

We develop a discrete dynamic pricing model for electricity (but also for applications like mobile communication, car rental) to maximize profit under fluctuating demand, in a discrete finite time horizon. The seller has an agreement with the buyers to sell at preset tariffs. He can charge the highest tariffs for a limited amount of periods. Cost is a piecewise linear function of the quantity sold. We propose an IP formulation, test the model with numerical experiments and develop algorithms for several extentions like multiple customer segments, cost for changing tariffs, stochastic demand.
3 - An efficient heuristic approach for a dynamic pricing problem in telecommunications
Jean-robin Medori, OrangeLabs, France, jeanrobin.medori@orange.com, Mustapha Bouhtou, Michel Minoux

We consider a new pricing problem where a carrier wants to set dynamic prices to maximize daily revenue from a voice service. A Mixed Integer Quadratic Program (MIQP) is proposed to model this problem. Because of network load constraints, finding an optimal solution is challenging. To bypass this computational limitation we propose a heuristic which solves easier MIQP sub-problems. The heuristic guarantees a feasible solution whenever the original pricing problem is feasible. Experimentations show that it consistently produces solutions close to exact optimum within reduced computation times.

4 - A Bilevel Approach for a Long Haul Freight Transportation Pricing Problem
Luce Brotcorne, INRIA, Parc Scientifique de la Haute Borne, 40 avenue Halley, Bat a Park Plaza, 59650, Villeneuve d’Ascq, France, luce.brotcorne@inria.fr, Diaby Moustapha, El-ghazali Talbi

In this talk we consider a pricing problem involving two long-haul full load freight carriers (A,B) operating similar markets. We assume that carrier B cannot serve all the demand addressed to him with its own transportation fleet. He thus needs to use outsourcing: carrier A or its competitors. Carrier A, which unused capacity, has thus to define prices to carrier B transportation requests to maximize revenue and balance the load. This sequential and non-cooperative decision-making process is represented as a bi-objective bilevel program. Numerical results are given.
3 - Scheduling Flowline Manufacturing Cells with Inter-cellular Moves: The Cell Scheduling Problem

Janis Sebastian Neufeld, Industrial Management, TU Dresden, TU Dresden, Fakultät Wirtschaftswissenschaften, 01062, Dresden, Germany,
Janis_Sebastian.Neufeld@tu-dresden.de, Udo Buscher

The scheduling of multiple manufacturing cells with intercellular moves has not received much attention so far. Analogously to group scheduling, for the so called cell scheduling problem a sequence of jobs within each cell as well as a sequence of part families are determined. We point out some major differences between the cell and group scheduling problem. Furthermore, specific problem structures are identified and two simulated annealing algorithms are presented to solve the permutation as well as non-permutation cell scheduling problem more effectively than existing heuristic approaches.

4 - A New Hybrid Algorithm for Solving the Resource-Constrained Project-Scheduling-Problem (RCPSP).

Luis Moreno, Sistemas, Universidad Nacional de Colombia, Cra. 80 65-223, Bloque MSA of., 207, Medellin, Antioquia, Colombia, lfmoreno@unal.edu.co, Javier Díaz, Gloria Peña

The RCSPS is an NP-hard problem, for which numerous heuristic methods have been proposed for a solution. Our research presents an algorithm that is a combination of a known exact branch and bound algorithm, with a new heuristic manner of ‘uniformly’ visiting, a pre-defined number of times, all of the areas for the feasible space of solutions, and skipping branches in the solution tree, while making additional search efforts in promising areas. The algorithm is evaluated based on 480 different instances of 30 activities from the PSPLIB library which is available online.

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**MC-03**

**Monday, 12:30-14:00**

**RB-L1**

**Business Excellence in Logistics: Advanced Vehicle and Inventory Routing**

**Stream: Business Excellence in Logistics**

**Invited session**

Chair: Martin Josef Geiger, Logistics Management Department, Helmut-Schmidt-University, Holstenhofweg 85, 22041, Hamburg, Germany, m.j.geiger@hsu-hh.de

1 - Cyclic Delivery Schedules for Inventory Routing Problem

Gultekin Kuyuz, Industrial Engineering, TOBB University of Economics and Technology, Sogutozu Caddesi No:43, Sogutozu, 06560, Ankara, Turkey, gkuyzu@etu.edu.tr, Ali Ekici, Okan Ozener

We consider an inventory routing problem where a common vendor is responsible for replenishing the inventories of several customers over a perpetual time horizon. The objective of the vendor is to minimize the total cost of transporting a single product from a single depot to a set of customers with deterministic and stationary consumption rate over a planning horizon while avoiding stock-outs at the customer locations. We focus on constructing a repeatable (cyclic) delivery schedule for the product delivery.

2 - Multi-Objective Inventory Routing: Recent Advances

Martin Josef Geiger, Logistics Management Department, Helmut-Schmidt-University, Holstenhofweg 85, 22041, Hamburg, Germany, m.j.geiger@hsu-hh.de, Thibaut Barthelemy, Marc Sevaux

We consider a multi-objective generalization of the inventory routing problem, in which inventory levels and routing costs are not combined into an overall evaluation function but treated separately. The problem is solved by local search, and numerical results are computed and reported. Particular emphasis has been laid on the representation of solutions from a practical point of view. In detail, individual frequency values are derived for each customer, implementing a recurring delivery policy. Our findings show that there is great potential for tradeoffs between the two objectives.

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**MC-04**

**Monday, 12:30-14:00**

**RB-L2**

**Optimal Control I**

**Stream: Optimal Control**

**Invited session**

Chair: Erik Krohat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.krohat@uniwb.de

Chair: Ekaterina Kostina, Department of Mathematics and Computer Science, University of Marburg, Hans-Meerwein-Str., 35032, Marburg, kostina@mathematik.uni-marburg.de

1 - Direct Optimal Control Methods for a Centralized Approach to Separation Management

Ekaterina Kostina, Department of Mathematics and Computer Science, University of Marburg, Hans-Meerwein-Str., 35032, Marburg, kostina@mathematik.uni-marburg.de

A key element of future Air Traffic Management concepts are automation tools helping to separate aircrafts in a tactical environment. This work investigates optimal control approach to separation. Our optimization framework has full information of the traffic situation in an airspace volume and hence generates conflict-free trajectories for all aircrafts within a regarded airspace. Real-time simulations showed that compared to human solutions the method could yield a significant decrease of delay, flight track excess, as well as fuel savings. Joint work with M. Poppe and L. Walter.

2 - Optimal control models of renewable energy production under fluctuating supply

Gernot Tragler, OR and Control Systems, Vienna University of Technology, Argentinierstr. 8/105-4, A-1040, Vienna, Austria, tragler@os.tuwien.ac.at, Elke Moser, Dieter Grass, Alexia Prskawetz

We consider optimal control models with infinite horizon, in which fossil and renewable energy cover production-related energy demand. The main focus lies on the investigation how prices and policy interventions (e.g. taxes, subsidies, quotas) can affect the attractiveness of
To cope with increasing traffic, network resource extension may be traded against congestion based costs. We focus on game theoretic methods applied on scenarios for constrained transport corridors, like canals in maritime shipping or similar bottlenecks in other traffic systems. Real-world traffic corridors are analyzed to obtain information on restrictions at bottlenecks and corresponding behavior of their users. In particular, the change of delay and costs when switching from decentralized to centralized models is of interest as well as an analysis of the interaction between both positions.

4 - Competition and efficiency in the container liner shipping industry
Christa Sys, Transport and Regional Economics, University of Antwerp, Prinstraat 13, 2000, Antwerp, Belgium, christa.sys@ua.ac.be

The present paper examines a model-based measure of competition. This measure of competition based on Boone’s theoretical work quantifies the impact of marginal costs on performance. Boone shows that when profit differences are increasingly determined by marginal cost differences, this indicates increased competition. The evolution of competition will be calculated using a pooled data set of 20 liner operators. After correcting for industry-specific effects (i.e. number of services, average ship size), the findings suggest that over the 2000-2008 period the competition has intensified.

MC-05
Monday, 12:30-14:00
RB-L3
Liner shipping optimization
Stream: Maritime Transportation
Invited session
Chair: Fernando Alvarez, Goteborggata 9, 0566, Oslo, Norway, jfa2@cornell.edu

1 - A Multi-period Planning Model for Liner Shipping’s Bunker Management
Xiaoyu Wang, School of Civil and Environmental Engineering, Nanyang Technological University, School of CEE, NTU, 50 Nanyang Avenue, Singapore, 639798, Singapore, Outside US, Singapore, wang0519@e.ntu.edu.sg, Chee Chong Teo

This paper considers bunker risk management for container lines. A nonlinear finite horizon optimization program is developed to simultaneously optimize liner network planning and bunker hedging. The model captures the uncertainty of bunker price and the associated tolerance for bunker risk exposure. As a rolling-horizon model, it allows the updating of the market information and forecast, such as bunker prices, over the planning horizon. The insights gained from our analysis would be useful for the container shipping industry in improving their bunker risk management.

2 - The Vessel Schedule Recovery Problem - disruption management in liner shipping
Berit Dangaard Brouer, DTU Management Engineering, Technical University of Denmark - DTU, Bygningsgade 426, 2800, Kongens Lyngby, Denmark, blof@man.dtu.dk, Christian Edinger Munk Plum, Bo Vaaben, David Pisinger, Jakob Dirksen

Maritime transportation is the backbone of world trade and is accountable for around 3% of the world’s CO2 emissions. We present the Vessel Schedule Recovery Problem (VSRP) to evaluate a given disruption scenario and to select a recovery action balancing the trade-off between increased bunker consumption and the impact on the remaining network and the customer service level. The model is applied to real cases from Maersk Line. Solutions are comparable or superior to those chosen by operations managers. Cost savings of up to 58% may be achieved.

3 - Decision Support to Overcome Traffic Congestion in Constrained Transport Corridors
Stefan Voss, Wirtschaftsinformatik/Information Systems, University of Hamburg, Von-Melle-Park 5, 20146, Hamburg, Germany, stefan.voss@uni-hamburg.de, Silvia Schwarze, Xiaoning Shi

The single row facility layout problem (SRFLP) is the NP-hard problem of arranging facilities on a line, so as to minimize the weighted sum of the distances between all pairs of facilities. We present a genetic algorithm to solve large SRFLP instances. Our computational experiments show that an appropriate selection of genetic operators can yield high quality solutions in spite of starting with an initial population that is largely randomly generated. Our algorithm improves on the previously best known solutions for 24 of 43 benchmark instances and is competitive for the remaining ones.
3 - A genetic approach for planning elective surgeries in a Portuguese hospital

Mariá Eugénia Captivo, Departamento de Estatística e Investigação Operacional, Universidade de Lisboa, Faculdade de Ciências e Centro de Investigação Operacional, Campo Grande, Bloco C6, Piso 4, 1749-016, Lisboa, Portugal, mecaptivo@fc.ul.pt, Inês Marques, Margarida Pato

Reduced budgets in the healthcare sector pressure health institutions to an efficient use of resources. The operating theatre represents a great proportion of the hospital budget. Furthermore, it is a central service with connections and implications in the service of many other hospital units. A more efficient use of the operating room becomes of great relevance within the hospital administration. This talk presents a genetic approach developed to address the elective surgery planning problem arising in a hospital in Lisbon. Some results obtained with the hospital’s data are presented.


Athanasios Nikolakopoulos, Chemical Engineering, National Technical University of Athens, Heroon Polytechnieiniou, 9, 15780, Athens, Greece, nikolak@mail.ntua.gr, Ioannis Ganas, Ioannis Konstantaras, Konstantina Skouri

This work introduces an ILP formulation of the problem of throughput time minimization of order picking and sorting warehouse operations. It includes due times, sorting times and TSP sub-problems with bin packing constraints. An Evolutionary Threshold Accepting algorithm and a Dynamic Programming part are combined into a hybrid solution method. Results are produced for artificial and real life instances and compared to the results of the algorithmic simulation of conventional practices. Computational experience shows a 10% reduction of average total makespan in affordable computational times.

3 - Milk Collection in Western Norway Using Trucks and Trailers

Arild Hoff, Molde University College, P.O.Box 2110, 6402, Molde, Norway, arild.hoff@himolde.no

Milk collection is a problem which is well known in rural areas all around the world. This talk considers a real world problem for a Norwegian dairy company collecting raw milk from farmers. Most farms are inaccessible for a large truck carrying a trailer. Thus the routes are organized as a main tour between larger parking spots where the trailer is left behind, and the truck drives sub-tours from this spots to visit the actual farms. The talk will present heuristics for constructing such tours and computational results comparing our result with the current plan of the company.

4 - Intermodal flexible liner shipping

Johan Oppen, Molde University College, P O Box 2110, 6402, Molde, Norway, johan.oppen@hiMolde.no

We present a maritime transportation problem dealing with the transport of frozen fish from Russia and Norway to terminals in Norway, the Netherlands and the UK. The problem can be viewed as a flexible liner shipping problem, as both the first and the last port, as well as some terminals along the route, are fixed, while other terminals may also be served by truck via another terminal to save time, or to relieve vessel capacity restrictions. We present a mathematical model and show that small problem instances can be solved to optimality using standard software.

Network Optimization 3

Stream: Network Optimization

Invited session

Chair: M. Emre Keskin, Industrial Engineering, Bogazici University, Bogazici Universitesi Endustri Muhendisligi, Hisarustu / Besiktas, 34470, Istanbul, Turkey, m.emre.keskin@gmail.com

1 - DiffServ Aware Routing Optimization in Telecommunication Networks

Amaro de Sousa, Universidade de Aveiro, Instituto de Telecomunicações, Campus Universitário de Santiago, VAT Nr. PT502854200, 3810-193, AVEIRO, Portugal, asou@ua.pt, Carlos Lopes, Dorabella Santos, Filipe Alvelos

Differentiated Services (DiffServ) aim to provide different QoS levels to different service classes. We propose the implementation of bandwidth based DiffServ where traffic flows of higher QoS classes are routed by less loaded network links. We define the routing problem as an Integer Programming Model, which let us obtain lower bounds, and propose heuristics to compute feasible solutions. We present computational results showing that the heuristics compute good routing solutions and that proper routing optimization can efficiently achieve service differentiation.

2 - Optical Fiber Network Design with Real Life Constraints and Cost Function

Stanislas Francfort, CORE/M2V, Orange Labs, 38-40 rue du general de leclerc, issy les moulineaux, France, stanislas.francfort@orange.com, Frederic Moulis, Cédric Hervet, Matthieu Chardy

The deployment of Fiber To The Home (FTTH) is crucial to telecommunication operators for both economical and quality of service reasons. This presentation deals with a Passive Optical Network (PON) design problem focusing on real-life optical cabling constraints. A large set of expenses, such as labor expenses, is also considered into the cost function we wish to minimize. This optimization problem is formulated as an integer linear program (ILP) and several solving approaches are designed. Tests performed on real instances assess the efficiency of the proposed solution algorithms.
3 - The Package Server Location Problem
Arnaud Malapert, Laboratoire IIS - UMR7271 - UNS CNRS, 2000, route des Lucioles - Les Alambiques - bât. Euclide B, BP 121, 06903, Sophia Antipolis, France, arnaud.malapert@unice.fr, Mohamed Régui, Jean-Charles Régis, Jean Parpaillon, Yvan Manon
We introduce the package server location problem. A number of package servers are to be located at nodes of a network. Demand for these package servers is located at each node. The objective is to minimize the number of package servers while maximizing the efficiency and the reliability of the broadcast of packages to clients. These objectives are clearly contradictory: the broadcast becomes more efficient as the number of servers increases. The problem is formulated and analyzed as a multi-objective optimization problem. Results for exact approaches using MILP are reported.

4 - An integrated approach to lifetime maximization in wireless sensor networks
M. Emre Keskin, Industrial Engineering, Bogazici University, Bogazici Universitesi Endustri Muhendisligi, Hisarustu / Besiktas, 34470, Istanbul, Turkey, m.emre keskin@gmail.com, I. Kuban Altinel, Necati Aras, Cem Ersoy
Mathematical programming provide a very utilizable tool for optimizing some Wireless Network (WSN) performance metrics by concentrating on some of the decision instruments such as, sensor placement, sensor scheduling, data, and mobile sink routing. In this work, we introduce two new mathematical programming models, which integrate all the decision instruments. We quantify the effect of our integrated approach by comparing results of our models with the results of some mathematical models from the literature.

MC-09
Monday, 12:30-14:00
RB-Zeta
Cutting and Packing 3

Stream: Cutting and Packing
Invited session
Chair: Ramon Alvarez-Valdes, Statistics and Operations Research, University of Valencia, Faculty of Mathematics, Doctor Moliner 50, 46100, Burjassot, Spain, ramon.alvarez@uv.es

1 - An analysis of the problem instances and the data sets used for computational experiments in the Identical Item Packing Problem
Elsa Silva, INESC TEC, Porto, Portugal, emsilva@inescporto.pt, José Fernando Oliveira, Gerhard Wässcher
The two-dimensional rectangular Identical Item Packing Problem (IIPP) consists in placing the maximum number of identical rectangular items onto a single rectangular pallet. This problem has been widely studied in the last forty five years, and different problem instances pointed out, highlighting the direction for different approaches proposed to solve the problem. In this work, these problem instances and data sets are analyzed and the hardest and unsolved problem instances pointed out, highlighting the direction for future research in the IIPP.

2 - Optimizing Shelf Space in Retail Stores
Teresa Bianchi-Aguiar, INESC TEC, Faculty of Engineering, University of Porto, Portugal, mtaguiar@fe.up.pt, Maria Antónia Carravilla, José Fernando Oliveira
In retail stores, the number of available products is constantly increasing, leading to a continuous need for space management. To do so, retailers rely on planograms, designs of fixtures (e.g. shelves) showing the desired products allocation. Driven by the case of a Portuguese supermarket chain, we will present a hierarchical approach to planogram generation, a Placement C&P Problem known in literature as Shelf Space Allocation Problem. The proposed approach splits the problem into two main levels: allocation of space to each product and placement of product items into each allocated space.

MC-10
Monday, 12:30-14:00
RB-Theta
Non-deterministic models

Stream: Production and the Link with Supply Chains
Invited session
Chair: Farouk Yalaoui, Institut Charles Delaunay, ICD LOSI, University of Technology of Troyes, 12, Rue Marie Curie BP 2060, 10000, Troyes, France, farouk.yalaoui@utt.fr
Chair: De Souza Mauricio, Departamento de Engenharia de Produção, Universidade Federal de Minas Gerais, Av. Presidente Antônio Carlos, 6627, Belo Horizonte, Brazil, mauricio.souza@pq.cnpq.br
Chair: Y. Ilker Topcu, Industrial Engineering, Istanbul Technical University, Istanbul Teknik Universitesi, Isetme Fakultesi, Macka, 34357, Istanbul, Turkey, ilker.topcu@itu.edu.tr

1 - Manufacturing flexibility in an oligopoly competition with demand uncertainty
Liu Yang, Business School, University of International Business and Economics, Business School, University of International Business and Economics, No. 10, Hui Xin Dong Jie, Chao Yang District, Beijing, 100029 China, 86-010, Beijing, China, liuyangliu@gmail.com, Chi To Ng
This paper investigates manufacturing flexibility in an oligopoly competition with demand uncertainty. We consider a general oligopoly model consisting of a firms who adopt either flexible capacity strategy or in-flexible capacity strategy to compete in a same market. We characterize the equilibrium of the competition. We find that the equilibrium is classified into four situations, when FCS is dominant; IFCS is dominant; two strategies coexist; and none is profitable, respectively. We also conduct sensitive analyses of the key influential factors and provide some managerial insight.
2 - Designing a robust supply chain for competition against existing competitors in retailer level
Ghasem Rajabloo, Industrial Engineering, Urmia University of Technology, Band Ave, Urmia, Iran, Urmia, West Azarbayjan, Iran, Islamic Republic Of, gh.rajabloo@ine.uut.ac.ir, Shabnam Rezapoor, Maghsud Solimanpur

We present a model for robust design of the network of an entrant supply chain in markets with price dependent demands and a pre-existing competing chain. The model assumes dynamic competition between new and existing supply chains, probabilistic customers’ behavior and probability of disruption in facilities and transportation links. We consider extra capacity, strategic stock and substitutable facility strategies to mitigate the effects of possible disruptions and the impact of facility location decisions. We illustrate and discuss the obtained results through several numerical examples.

3 - A decision analysis on cooperative advertising
Sebnem Burnaz, Management Engineering, Istanbul Technical University, ITU Isetime Fakultesi, Macka, 34357, Istanbul, Turkey, burnaz@itu.edu.tr, Esin Ekmecki, Y. Ilker Topcu

Today competition takes place among supply chains. Therefore, it is critical for the companies to sustain collaborative relationships with their stakeholders. At this point, cooperative practices gain more importance to build competitive advantage. Manufacturers use cooperative (co-op) advertising to strengthen the image of their brands and to motivate consumers in their buying decisions. This study aims to analyze the changes in the portions of manufacturer and distributor in sharing co-op advertising in sectors represented by different levels of substitution rate and competition intensity.

4 - Development of an optimisation framework for scheduling of street works
Rahman Pilvar, Institute for Transport Studies, University of Leeds, LS2 9JT, LEEDS, WEST YORKSHIRE, United Kingdom, r.pilvar03@leeds.ac.uk

Urban transportation networks are subject to various capacity-degrading events due to road maintenance and utility works activities. All so often a conflict of interest prevails among the stakeholders regarding the underlying street works details such as the timing, suitable level of capacity occupation, etc. The present article provides a Network Design Problem framework for optimum scheduling of street works in a transportation network. A multi-objective bi-level program formulation is presented to minimize the total costs associated with delays to road users and utility companies while ensuring that the accessibility level of the network would be minimally affected.

4 - Optimal Bus Route Frequency Allocation in a Large-Scale Urban System
Hani Mahmassani, Transportation Center, Northwestern University, 600 Foster St, 60208, Evanston, Illinois, United States, masmah@northwestern.edu, Ismail Omer Verbas

This study develops new formulations for the bus frequency allocation problem. Existing bus frequency allocation in the literature maximizes ridership and waiting time savings subject to budget, fleet, policy headway and maximum load constraints by solving for route frequencies. The formulations consider routes with multiple service patterns, and include cost minimization with minimum ridership constraint, bus size selection as an additional decision variable, and maximum load as a penalty function. The approach is demonstrated in an actual large-scale system.
Due to the limited capital sources, municipalities have to be careful about defining the investment priorities. Thus, in this study the extension of TOPSIS method and interval type II fuzzy sets is suggested to guide municipalities. A survey conducted on strategic planning experts is used as initial information for the proposed model. As a case study suggested method is tested to rank several alternatives in Istanbul. The results reveal insights for feasibility and effectiveness of proposed methodology. Finally, sensitivity analysis is performed to test the stability of the rankings.

3 - Quantifying expected benefits from investment projects with the fuzzy pay-off method
Mikael Collan, Department of Business Economics and Law, Lappeenranta University of Technology, Raivaanjankatu 5 as. 3, 24100, Salo, Finland, mikael.collan@lut.fi

The pay-off method is a simple new method for framing the investment profitability analysis problem and for enhancing the support for investment decision making. The method is based on directly deriving a fuzzy number from a set of cash-flow scenarios that is then used as a basis for derivation of descriptive numbers. These descriptive numbers include, e.g., the real option value. The method is a complement to the profitability analysis toolpack of managers and is very robust and can be used for all types of investments, it is “excel compatible” and fully transparent all the way.

4 - Numerical Patent Analysis with a Fuzzy Compound Real Option Model
Xiaolu Wang, Åbo Akademi University, Finland, xiwang@abo.fi

Patent valuation has always been a difficult task due to the great uncertainties involved in patent exploitation process, which provides us with the incentive to use fuzzy estimator for the volatility of the expected future monopoly profits. It is also recognizable that investing in patent application buys the investor an right, but not an obligation, to commercialize the innovation, we therefore present how the proposed fuzzy compound real option model can be used to generate decision-support for deciding whether to go ahead with a patent application or not.

MC-14
Monday, 12:30-14:00
RB-Omega

Resource allocation and scheduling in practice: further complexity

Stream: Scheduling under Resource Constraints

Invited session

Chair: Sacramento Quintanilla, Economia Financiera y matematica, University of Valencia, Avda. Naranjos s/n, 46071, Valencia, Spain, Maria.Quintanilla@uv.es

1 - Balancing the use and distribution of warehouse resources: a scheduling pre-processing procedure
M. Angeles Pérez, Mathematics for Economy, University of Valencia, Avda Naranjos s/n, 46012, Valencia, Spain, angeles.perez@uv.es, Francisco Ballestin, M.Pilar Lino, Sacramento Quintanilla, Vicente Valls

Scheduling warehouse storage/retrieval orders is a complex process that assigns to each order a location, a forklift and a start time, taking into account pallet specifications, traffic restrictions and forklift capabilities. Locations are previously selected maximizing total free storage space but, their spatial distribution and forklift requirements influence the total time required to complete the orders. We present a multi-objective heuristic algorithm that re-assigns locations balancing spatial distribution and forklift workloads. Computational results are also presented.

2 - Simultaneous allocation of medical resources and scheduling of visits in a Hospital at Home service
Sacramento Quintanilla, Economia Financiera y matematica, University of Valencia, Avda. Naranjos s/n, 46071, Valencia, Spain, Maria.Quintanilla@uv.es, Francisco Ballestin, M.Pilar Lino, M. Angeles Pérez, Vicente Valls

In a Hospital at Home Service, patients are at home and have to be visited regularly by a team comprising a doctor and a nurse. The Service has a pool of doctors and nurses with different specializations. The team that visits a patient has to have the expertise required to treat the patient. The Service daily determines the teams and vehicles that will visit patients and also establishes the sequence of visits for each team with the objective of cost minimization. We present a solution procedure for this resource allocation and task scheduling problem and some computational results.
3 - Approximate algorithms for simultaneous project scheduling and resource allocation with controllable processing times
Jose M. Framinan, Industrial Management, School of Engineering, University of Seville, Avda. de los Descubrimientos s/n, Seville, Spain, jose@esi.us.es, Victor Fernandez-Vargas Escudero

This paper presents several heuristics for an integrated Project Scheduling and Staff Assignment (PSSA) problem where tasks have precedence relations and release times. The processing time of each task depends on the amount of resources assigned (over- and under-coverage is allowed). Furthermore, the employee can perform certain task only feasible if he/she possesses the appropriate skill. The objective is to minimize the makespan of the project. A GRASP and an Iterated Greedy algorithm have been designed and successfully tested on a test-bed based on the well-known library PSPLIB.

4 - Project Resource Leveling and Robustness Optimization using ANP
Elena Rokou, Industrial Management & OR, Mechanical Engineering, National Technical University of Athens, Heronο Polytexneion 9 9, Athens, Greece, Greece, erokou@mail.ntua.gr, Konstantinos Kirytopoulos

The paper presents a DSS for multi-objective project scheduling under precedence and resource constraints. It handles both preemptive and non preemptive and not scheduling, multiple performing modes and partial or full allocation of resources to activities. Project performance criteria are makespan minimization, resource leveling and robustness. Firstly the decision maker sets the weighting factors for each component using ANP and a linear value function is formed. Secondary, backward and forward SGS along with priority rules generate initial feasible schedules that are further exploited by an adaptive GA.

Nonlinear Optimization and Applications 2

Stream: Nonlinear Programming
Invited session
Chair: Editie M.G.P. Fernandes, Algoritmi R&D Centre, University of Minho, School of Engineering, Campus de Gualtar, 4710-057, Braga, Portugal, emgpf@dps.uminho.pt

Benjamin Ivorra, Matematica Aplicada, Universidad Complutense de Madrid, Plaza de ciencias, 3, 28040, Madrid, Spain, ivorra@mat.ucm.es, Juan M. Bello Rivas, Jerôme Harmand, Angel Manuel Ramos, Alain Rapaport

We envision global optimization as finding a suitable initial guess of a considered optimization algorithm. One can imagine that this possibility improves the existing optimization methods. To do so, we present a methodology that consists in the resolution of a sub-optimization problem by using a multi-layers line search algorithm. We check the efficiency of this approach by considering benchmark and industrial problems. In particular, we focus on the optimization of the shape and hydrodynamic properties of a bio-reactor in which a wastewater substrate is degraded by a microbial ecosystem.

2 - Comparing two MINLP models for the Hydro Scheduling Problem: The case of a head-dependent cascaded reservoir system in Portugal
Javier Diaz, Sistemas e Informatica, Universidad Nacional de Colombia, Cra 80 65-223, Facultad de Minas Bloque m8A oficina 212, 1, Medellin, Antioquia, Colombia, javidiaz@unal.edu.co, Luis Moreno

Two mixed-integer non-linear programming (MINLP) models for the optimal short-term hydro-scheduling (STHS) are compared. These two models include the following features: head-dependency, start/stop of units, discontinuous operating regions, and discharge ramping constraints. Furthermore, they consider hydroelectric power generation as a nonlinear function of both the water discharge and the net head. In order to compare assumptions and results of both models, we adjusted the first one in order to apply it in the case of the second, the main cascaded hydro systems in Portugal.

3 - Continuous optimization using a biologically-motivated multilevel system
JongChen Chen, Information Management, National YunLin University of Science and Technology, 123 University Road, Section 3, Douliu, Taiwan, Taiwan, jcchen@yuntech.edu.tw

Our group had previously developed a multilevel system operating across a wide spectrum of organizational levels. The interactions among different levels of information processing expand its problem solving capability. To address the continuous optimization problems, we used the system to control the motions of a walking robot. The experimental results showed that the robot was capable of learning in a continued manner in a physical environment. We then made some change in the robot’s structure, and the results showed the system possessed continuous optimization capability.

4 - Nonlinear Optimal Control of Spacecraft Attitude Using Internal Momentum Rotors
M. Navabi, Shahid Beheshti University, GC, Iran, Islamic Republic Of, civil.space.edu@gmail.com, Mina Tavana

In this paper, attitude of a satellite is controlled by internal momentum rotors utilizing a nonlinear optimal control method. This method is based on State Dependent Riccati Equation. It is difficult to solve a nonlinear system optimally with state and control constraints. The capabilities of State Dependent Riccati Equation technique are illustrated in producing control design for spacecraft attitude control with quadratic constraint on quaternion. The simulation results show that the mentioned method have desired accuracy for spacecraft attitude nonlinear control problems.

Numerical methods of nonsmooth optimization

Stream: Nonsmooth Optimization
Invited session
Chair: Albert Ferrer, Dpt. of Applied Mathematics I, Technological University of Catalonia, Av. Doctor Marañon, 44-50, 08028, Barcelona, Catalunya, Spain, alberto.ferrer@upc.edu

1 - Hyperbolic smoothing function method for minimax problems
Adil Bagirov, School of Science, Information Technology & Engineering, University of Ballarat, University Drive, Mount Helen, P.O. Box 663, 3353, Ballarat, Victoria, Australia, a.bagirov@ballarat.edu.au

In this talk, we discuss an approach for solving finite minimax problems. This approach is based on the use of hyperbolic smoothing functions. In order to apply them we reformulate the objective function in the minimax problem. Based on these results an algorithm for solving the finite minimax problem is proposed. We present results of numerical experiments and compare the proposed algorithm with the algorithm that uses the exponential smoothing function as well as with the algorithm based on nonlinear programming reformulation of the finite minimax problem.
2 - Integrating forward and reverse flows: a generic model for remanufacturing activity
Neslihan Demirel, Industrial Engineering, Gazi University, Turkey, neslihanoguz@gazi.edu.tr, Hadi Gökçen

The importance of the recovery of used products has been widely recognized in the literature and practice. This is mainly due to the environmental deterioration and the limited capacities of disposal areas. To plan a closed loop supply chain strategically and to coordinate production, remanufacturing, disposal and outsourcing operations efficiently, we proposed a multi-level, multi-product, multi-period mixed integer linear programming (MILP) model. We illustrated the model on a numerical example and carried out sensitivity analyses.

3 - Multi-Period Reverse Logistics Network Design
Sibel A. Alumur, Industrial Engineering Department, TOBB University of Economics and Technology, Sogutozu cad. No:43, Sogutozu, 06560, Ankara, Turkey, salumur@etu.edu.tr, Stefan Nickel, Francisco Saldanha-da-Gama, Vedat Verter

In this paper, we propose a profit maximization modeling framework for reverse logistics network design problems. We present a mixed-integer linear programming formulation that is flexible to incorporate most of the reverse network structures plausible in practice. The proposed general framework is justified by a case study in the context of reverse logistics network design for washing machines and tumble dryers in Germany. We conduct extensive parametric and scenario analysis to illustrate the potential benefits of using a dynamic model, and also to derive a number of managerial insights.

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**MC-17**

**Monday, 12:30-14:00**

**RB-2105**

**Reverse Logistics Network Design**

**Stream: Applications of Location Analysis**

**Invited session**

**Chair:** Sibel A. Alumur, Industrial Engineering Department, TOBB University of Economics and Technology, Sogutozu cad. No:43, Sogutozu, 06560, Ankara, Turkey, salumur@etu.edu.tr

**1 - Sustainable Reverse Logistics Network Design for Multi-modal Transport of Household Plastic Waste**

Jacqueline Bloemhof, Operations Research and Logistics, Wageningen University, Hollandseweg 1, 6700 EW, Wageningen, Netherlands, jacqueline.bloemhof@wur.nl, Xiaoyun Bing, Jack van der Vorst

Household plastic waste can be collected, separated and treated to be used as recycled plastics again. This is both an economically and environmentally attractive option, although transportation of the plastic waste also causes extra environmental and economic costs. This paper studies the reverse logistics network of plastics in the Netherlands and adopts multi-modality transportation to deal with future increase of plastic waste. We use an MILP model-based scenario study taking into account transportation, processing and emission costs to develop a sustainable logistics network design.

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**MC-18**

**Monday, 12:30-14:00**

**RB-2107**

**Financial Modelling**

**Stream: Financial Modelling & Risk Management (contributed)**

**Contributed session**

**Chair:** Tatjana Sljepcevic-Manger, Faculty of Civil Engineering, University of Zagreb, Fra Andrije Kacic-Miosica 26, 10000, Zagreb, Croatia, tmanger@grad.hr

**1 - Moment-matching method with monomial approach**

Alessandro Staino, Business Science Department, University of Calabria, Via Pietro Bucci Cubo 3c, 87036, Arcavacata di Rende (CS), Italy, alessandro.staino@unical.it, Andrea Consiglio

Moment-Matching methods are often used to find an approximated solution to stochastic programming problems where the uncertainty is modeled through continuous distributions. In this paper we present a moment-matching method coming from the monomial method which is a technique to solve systems of algebraic equations iteratively. Specifically, we show how to generate distributions of financial returns so that some statistics are matched. A very valuable feature of our method is its capability of generating arbitrage-free financial markets.

**2 - Stratified Sampling Implementations in Financial Simulation**

Ismail Basoglu, Industrial Engineering, Science Institute, Industrial Eng. Dept. Engineering Faculty, Bosphorus University South Campus Bebek, 34342, Istanbul, Turkey, ismail.basoglu@boun.edu.tr, Wolfgang Hörmann

Monte Carlo methods are applicable to most of the rare event financial problems. Yet, the yielding variance is large for this type of stochastic events. One can use stratified sampling, which is based on the decomposition of the sampling domain and conditional sampling within each stratum and simulation results are combined throughout the strata. Our research is mainly focused on optimal construction of strata structures and implementing stratified sampling in an automatic and efficient manner for different type of financial problems.
3 - Modeling Hedge Fund Performance Using Neural Network Models
Joseph Paradi, Chemical Engineering and Applied Chemistry, University of Toronto, 200 College Street, M5S3E5, Toronto, Ontario, Canada, paradi@mie.utoronto.ca, Marinos Tryphonas

New neural network model evaluates monthly mutual fund using backwards elimination regression for explanatory variable selection. The case study on 293 N/A hedge funds between 1998 and 2010. 25 risk factors including equity, fixed income, foreign exchange, and commodity factors were employed as explanatory variables. Two main conclusions: 1) the new neural network model delivered better out-of-sample performance compared to linear regression models; 2) risk factor selection based on backwards elimination regression consistently improved the model performance across the whole time period.

4 - Ruin probability functions with N intersections
Tatjana Slijepevic-Manger, Faculty of Civil Engineering, University of Zagreb, Fra Andrije Kacic-Miosica 26, 10000, Zagreb, Croatia, tmanger@grad.hr

In this paper we show that for any positive integer N we can construct two spectrally negative Levy processes such that their ruin probability functions have at least N positive intersections. This means that in some cases the optimal ruin strategy can be very unstable.

MC-19
Monday, 12:30-14:00
RB-2111
Quantitative approaches to bank performance and asset evaluation

Stream: Operational Research and Quantitative Models in Banking
Invited session
Chair: Enrique Ballestero, Escuela Politecnica Superior de Alcoy, Technical University of Valencia, 03801, Alcoy (Alicante), Spain, eballe@esp.upv.es
Chair: Mila Bravo, ALCOY SCHOOL, TECHNICAL UNIVERSITY OF VALENCIA, 03801, ALCOY, Spain, mibrasel@epsa.upv.es

1 - Ranking funds offered by the Spanish CaixaBank: A compromise approach to performance
Enrique Ballestero, Escuela Politecnica Superior de Alcoy, Technical University of Valencia, 03801, Alcoy (Alicante), Spain, eballe@esp.upv.es

The CaixaBank offers funds to customers. To evaluate their performance a linear-quadratic compromise programming model is developed. This measure can be extended to many investment criteria while the traditional ratio-based and leverage-based measures are essentially limited to profitability and risk. It also avoids negativity in the ratio values. Sophisticate compromise programming models prove superior to the simple use of ratios. Customers’ profiles of The CaixaBank are defined by weighting systems. Each one leads to coherent results which are compared to the results from domination analysis.

2 - Evaluating artistic assets: A multicriteria method
Paloma Pareja, Independent consultant, Spain, arenilas.pal@gmail.com, Sonia Zendehzaban

To assess painting assets of bank collections in terms of quality, a multicriteria model is developed relying on domination analysis and moderate pessimism decisions under uncertainty. As preferences for the artistic criteria change from a decision maker to another, they are considered unknown. The criteria are features such as theme originality, drawing and color. As a result, the assets are ranked by quality indexes, which is a previous step to determine quality to price ratios. Data from collections as well as the computational process and results are tabulated and analysed.

3 - Multicriteria ranking of Spanish banks from the 2011 European Banking Authority wide stress test
Mila Bravo, ALCOY SCHOOL, TECHNICAL UNIVERSITY OF VALENCIA, 03801, ALCOY, Spain, mibrasel@epsa.upv.es, Antonio Benito

This paper aims at ranking 25 Spanish banks from external information published by the Bank of Spain, which provides financial criteria from the European Banking Authority (EBA)-wide stress test in 2011. As a previous step, each bank is characterized from the criteria as non-dominated or dominated by convex combinations of the other banks. Weighted goal programming (which requires assuming preferences for the criteria) and the moderate pessimism decision making model under uncertainty (which does not require assumptions on preferences) are used to rank the non-dominated banks.

MC-20
Monday, 12:30-14:00
RB-2113
Risk Analysis and Credit Scoring

Stream: Data Mining in the Financial Sector
Invited session
Chair: Cristian Bravo, Department of Industrial Engineering, University of Chile, Republica 701, Santiago, 8370439, Santiago, Chile, cibravo@ing.uchile.cl

1 - Improving Credit Scoring by Differentiating Defaulter Behavior
Cristian Bravo, Department of Industrial Engineering, University of Chile, Republica 701, Santiago, 8370439, Santiago, Chile, cibravo@ing.uchile.cl, Lyn Thomas, Richard Weber

In this work, we formalize the common notion that there are two types of defaulter, those who do not pay because of cash flow problems, and those that do not pay because of lack of willingness to pay. We propose to differentiate them using a game theory model to describe their behavior, and from this model construct a set of constraints for a semi-supervised constrained clustering algorithm that creates a new target variable. We benchmark several multiclass supervised models to test the approach, finding significant improvement in classification accuracy, and strong insights about defaulters.

2 - Intensity models and transition probabilities for credit card loan delinquencies
Jonathan Crook, University of Edinburgh Business School, University of Edinburgh, Credit Research Centre, 50 George Square, EH8 9AL, Edinburgh, Lothian, United Kingdom, jonathan.crook@ed.ac.uk

We estimate the probability of delinquency and default for a sample of credit card loans using intensity models, via semi-parametric multiplicative hazard models with time-varying covariates. These models allow for insights into the factors that affect movements towards (and recovery from) delinquency, and into default (or not). Results indicate that different types of debtors behave differently while in different states. The probabilities estimated for each type of transition are then used to make out-of-sample predictions over a specified period of time.

3 - Comparative Analysis of Dynamic Models Specification for Behavioral Scoring in a Microfinance Portfolio
Jose Pizarro, Department of Industrial Engineering, University of Chile, Santiago, Chile, jopizar@gmail.com, Cristian Bravo

Traditional approach in the analysis and estimation of the probability of default is based on static frameworks. It has been shown that these models can be improved using panel data, in which the model is built considering the observed dynamic of the included variables. We study if the traditional dynamic logistic model can be improved if we modify the specification using a neural network model, and test if the dynamic aspect of the model improves classification capacity. We conclude analyzing if these changes improve the prediction capability of the model.
4 - Dynamic affordability assessment
Katarzyna Bijak, School of Management, University of Southampton, Highfield, SO17 1BJ, Southampton, United Kingdom, k.bijak@soton.ac.uk, Lyn Thomas
In the credit decision making process, both applicant’s creditworthiness and affordability should be assessed. Affordability is often checked on the basis of declared current income, assumed standard expenditure and existing debts. In contrary, a dynamic affordability assessment is proposed by us. The affordability at a given moment in time is defined as a total amount of money which the applicant can use to service their debts. It depends on the applicant’s income and expenditure which both vary in time. The suggested model can contribute to responsible lending.

Financial Mathematics and OR 3
Stream: Financial Mathematics and OR
Invited session
Chair: Tansel Avkar, Department of Mathematics, Middle East Technical University, 06531, Ankara, Turkey, tanselavkar@gmail.com
Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr
1 - A Rank-based Approach to Cross-Sectional Analysis
Ludovic Cales, HEC - Department of Finance, University of Lausanne, Dorigny, 1015, Lausanne, Switzerland, ludovic.cales@unil.ch, Monica Billio, Dominique Guegan
This paper studies the cross-sectional effects present in the market using a new graph theoretic framework. We model the evolution of a dynamic portfolio, i.e., a portfolio whose weights change over time, as a function of cross-sectional factors where the predictive ability of each factor is described by a variable. This modeling permits us to measure the marginal and joint effects of different cross-section factors on a given dynamic portfolio. Associated to a regime switching model, we are able to identify phases during which the cross-sectional effects are present in the market.
2 - Bayesian approach for stochastic models with conditional heteroscedasticity in the analysis of the return volatility of an agricultural commodity
Sandra Cristina Oliveira, Business Administration, UNESP - Univ. Estadual Paulista, Av. Domingos da Costa Lopes, 780, 17602-496, Tupã, São Paulo, Brazil, Sandra@tupa.unesp.br
The volatility of returns generated by commodities has implications and of characterization of solutions.
3 - Solving Large Two-Stage Stochastic Optimization Problems with Portfolio Safeguard
Izzy Uryasev, Director of Risk Management and Financial Engineering Lab, University of Florida, FL 32611-6595, Gainesville, 303 Weil Hall, Florida, United States, izzy.uryasev@ufl.edu
Although the solving two-stage stochastic optimization problems is well developed, there are few practical examples of applications. Mostly, example calculations were done by researchers in stochastic optimization area to exemplify new efficient mathematical programming approaches. Few engineers have such extensive expertise. These complications lead to the development of special meta-commands in Portfolio Safeguard (PSG) software for efficient coding. To be less conservative than maximum loss, but more conservative than average, you can use the CVaR operator.
4 - Corporate Control with Cross-Ownership
Marc Levy, CEB, ULB, 50, av. F.D. Roosevelt, 1050, Brussels, Belgium, marc.levy@ulb.ac.be, Ariane Szafarz
In cross-ownership structures, existing methods are unable to evaluate control stakes. This is because cross-ownership induces circularity, and makes it impossible to identify winning coalitions among shareholders. To fill this gap, this paper proposes a novel theoretical approach. This approach generalizes the Banzhaf index from game theory and combines it with Markov voting chains. From a governance standpoint, we show that cross-ownership may favor shareholder expropriation. To illustrate this point, we revisit the case of the German Allianz Group. This paper also puts forward an algorithm.

Generalized Convexity and Optimization
Stream: Generalized Differentiation and Optimization
Invited session
Chair: Alexander Kruger, School of Science, Information Technology & Engineering, University of Ballarat, University Drive, Mount Helen, P.O. Box 663, 3353, Ballarat, Victoria, Australia, a.kruger@ballarat.edu.au
Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr
1 - On the pseudoconvexity of a wide class of generalized fractional functions
Laura Carosi, Statistics and Applied Mathematics, University of Pisa, Via Ridolfi, 10, 56124, Pisa, Italy, lcarosi@ec.unipi.it, Laura Mateen, Alberto Cambini
Even though pseudoconvexity plays an important role in optimization, very few classes of pseudoconvex functions are known. We consider a wide class of generalized fractional functions: the sum between a linear one and a ratio which has an affine function as numerator and the p-th power of a positive affine one as denominator; p can be any positive number different from 1. Provided nonnegativity conditions and these functions to be not pseudocvx, we study pseudoconvexity on the nonnegative orthant. We derive necessary and sufficient conditions expressed in terms of the initial data.
2 - Continuous-time nonlinear programming under generalized type I invexity
Andrea Madalina Stancu, Institute of Mathematical Statistics and Applied Mathematics, The Romanian Academy, Calea 13 Septembrie, nr 13, RO-050711, Bucharest, Romania, andrea_madalinas@yahoo.com, Ioan Stancu-Minasian
We consider a continuous-time programming problem (P) with nonlinear operator equality and inequality constraints. This problem belongs to the area of generalized convex optimization. In fact, we establish sufficiency optimality criteria under generalized type I invexity conditions.
3 - Weak pseudo-invexity, generalized Fritz-John optimality and duality in nonlinear programming
Hachem Slimani, Laboratory of Modeling and Optimization of Systems LAMOS, Computer Science Department, University of Bejaia, 06000, Bejaia, Algeria, haslimani@gmail.com, Mohammed Said Radjef
We use a generalized Fritz-John condition and weak invexity to derive optimality conditions and duality results for a constrained nonlinear programming. A new concept of Fritz-John type stationary point is defined and a characterization of solutions is established. Moreover, we prove several duality results for a Mond-Weir type dual. It is shown, that the introduced generalized Fritz-John condition combining with the invexity with respect to different functions are especially easy in application and useful in the sense of sufficient optimality conditions and of characterization of solutions.
OR in Human Resources

Stream: OR in Human Resources

Invited session

Chair: Irina Kazina, Telematica and Logistica, TTI, Lomonosova str.1, Riga, Latvia, irinakazina@yahoo.com
Chair: Majda Bastic, Faculty of Economics and Business, University of Maribor, Razlagova 14, 2000, Maribor, Slovenia, majda.bastic@uni-mb.si

1 - The influence of individual factors and work environment on creativity

Majda Bastic, Faculty of Economics and Business, University of Maribor, Razlagova 14, 2000, Maribor, Slovenia, majda.bastic@uni-mb.si, Gabrijela Leskovar-Spacapan

The main aim of the present study was to answer the question which factors significantly contribute to individual commitment to creativity. Questionnaire was administered to MBA and part-time students with working experience in Slovenian organizations. Methods used included instrument development, an exploratory analysis, a confirmatory factor analysis, and a test of a structural model. The results show that individual characteristics and leadership have a positive affect on creativity. The relationship between knowledge management and creativity was not found as significant.

2 - Functionality of self-assessment in 360 degree feedback method

Gözde Kubat, Kazan Vocational School, Başkent University, Ankara, Turkey, gozer@baskent.edu.tr, Sükran Öktem, Hakan Turgut, Ismail Tokmak

The importance of human factors is increasing in quality improvement. Companies are directed to Total Quality Management to establish a standard structure. In this research, human resources researched in various aspects. A questionnaire has been applied in various sectors in Ankara-Turkey as a dimension of individual performance measurement as the size of the self assessment. Information from multi-sector employees has been obtained with the Snowball Method. Self-assessment of the data obtained as a result of the analysis is aimed to reveal the size of the 360 (DFM) functionality.

3 - Research of control systems within the limits of the educational program

Irina Kazina, Telematica and Logistica, TTI, Lomonosova str.1, Riga, Latvia, irinakazina@yahoo.com, Rostislav Kopytov

The purpose of the present work consists in showing as it is possible to conduct research of a control system on the basis of studying of its characteristics. In process of studying extend representation about a control system. That representation is formed at the expense of system characteristics. In process of studying extend representation about a control system. That representation is formed at the expense of system characteristics.

4 - Is there a place for OR in the HR Metrics World?

Gregory Lee, Wits Business School, University of the Witwatersrand, #2 St David’s Place, Parktown, 2000, Johannesburg, Gauteng, South Africa, gregory.lee@wits.ac.za

HR metrics has taken the human resources world by storm, with an explosion of business analytics, data, and financial analysis. The HR metrics field has largely been shaped through industrial psychology. Does modern operational research have new insights to offer HR metrics over and above the current standards? I argue that OR does have much to offer, including the shaping of metrics systems through problem-based methods, the incorporation of data mining and simulation techniques, optimisation possibilities, and others. Implications for human resource thinking and implementation are suggested.
other parts. We develop a mixed integer linear programming model for this problem and illustrate how the use of this model has a positive impact in the company revenue.

**MC-27**

**Monday, 12:30-14:00**

**CC-A25**

**Decision Analysis and Group Decision Making**

Stream: Decision Processes

*Invited session*

Chair: Jeffrey Keisler, Management Science & Information Systems, University of Massachusetts Boston, 100 Morrissey Blvd, M/S-249, 02125, Boston, MA, United States, jeff.keisler@umb.edu

1. **Decision analysis with function-valued variables**
   Jeffrey Keisler, Management Science & Information Systems, University of Massachusetts Boston, 100 Morrissey Blvd, M/S-249, 02125, Boston, MA, United States, jeff.keisler@umb.edu

   DA models typically include uncertain real and discrete state variables. In principle, state variables could themselves be functions. This is useful for incorporating frameworks from various fields of knowledge. While theoretically allowed, this extension presents practical challenges throughout the DA process. Model structure determines required assessments and calculations. The latter may involve simplifying assumptions, e.g., restricting to the space of quadratic functions. To implement this idea, we must balance precision of results against ease and speed of assessment and computation.

2. **On the notion of dictatorship in group utility functions**
   Luis C. Dias, Faculdade de Economia / INESC Coimbra, INESC Coimbra, Rua Antero de Quental, 199, 3000-033, Coimbra, Portugal, lmcdias@fe.uc.pt, Paula Sarabando

   Keeney proposed a cardinal utility axiomatization for the problem of aggregating utility functions of members of a group. One of the assumptions in this axiomatization was nondictatorship. We propose stronger formulations for this condition introducing the concept of strategic dictator and presenting the corresponding characterization of compliant group cardinal utility functions. We also characterize an extension to extend this notion of dictator to groups of individuals. An example using robustness analysis will illustrate the application of these nondictatorship principles.

3. **Individual heuristics and group decision effectiveness**
   Matthias Seifert, Operations & Technology, IE Business School, Maria de Molina 12, 5th Floor, 28006, Madrid, Spain, matthias.seifert@ie.edu, Manel Baucells

   We use reduced ordered binary decision diagrams (ROBDDs) to study the link between individual heuristic processes and group decision effectiveness. Exploiting the concept of cumulative dominance in multiattribute choice contexts, we start out by analyzing the probability that individuals identify dominant alternatives if they make errors during the evaluation of the choice set. We then demonstrate how such individual inefficiencies influence the effectiveness of group decisions relying on majority voting.

**MC-28**

**Monday, 12:30-14:00**

**CC-A27**

**Nonsmooth Optimization I**

Stream: Structured Optimization and Applications

*Invited session*

Chair: Dominik Dorsch, Dept. Mathematics, RWTH Aachen University, Templergraben 55, 52056, Aachen, NRW, Germany, dorsch@mathc.rwth-aachen.de

1. **Lower Level Chance Constraints in Robust Portfolio Optimization**
   Marcel Sinske, Institute of Operations Research, Karlsruhe Institute of Technology, Kaiserstraße 12, 76131, Karlsruhe, Germany, sinske@kit.edu

   We combine the well-known mean-variance approach by H.M. Markowitz and the robust counterpart for a convex optimization problem, introduced by A. Ben-Tal and A. Nemirovski, to achieve a robust portfolio optimization problem. Further we consider for the uncertain parameters a minimum volume ellipsoid as the uncertainty set. Such problems can be formulated as bilevel problems with a chance constraint in the lower level problem. We show some properties of this type of problem and develop an approach to solve it.

2. **Generalized derivatives of the projection onto the cone of positive semidefinite matrices**
   Anna-Laura Wickström, Universität Zürich, Switzerland, anna-laura.wickstrom@business.uzh.ch

   We are interested in sensitivity and stability analysis of solution sets of optimization problems under set or cone constraints. A main motivation behind our work is the analysis of semidefinite programs (SDPs). We wish to explore the sensitivity analysis of SDPs with help of generalized derivatives.

3. **Nonsmooth versions of Sard’s theorem**
   Tomas Bajbar, Institute of Operations Research, Karlsruhe Institute of Technology, Kaiserstraße 12, 76131, Karlsruhe, Germany, tomas.bajbar@kit.edu, Vladimir Shikhman

   We present a comparison between some versions of Sard’s Theorem which have been proven recently for special function classes with different definitions of critical points. Considering the class Ck, the class of min-type or min-max functions, the motivation for the definition of critical point is the topological structure of the inverse image. We compare topological critical points and critical points defined via metric regularity in the class of min-type and min-max functions. We illustrate the whole problematic by some examples.

4. **Express Line Queues and Space-Time Geometry**
   Eitan Bachmat, Computer Science, Ben-Gurion U., 1 Ben Gurion Ave, 84105, Beer Sheva, Israel, ebachmat@cs.bgu.ac.il

   We consider queues in which jobs are sent to servers according to size cutoffs, as with express lines in supermarkets. We show that the optimal choice of cutoffs is governed by an equation which is similar to the geodesic equation. We prove the optimality of cutoffs via the analysis of semidefinite programs (SDPs). We consider the queueing theoretic consequences of this relation and exhibit a queueing theoretic analogue of curvature.

**MC-29**

**Monday, 12:30-14:00**

**CC-A29**

**Algorithms and Methods for MINLP problems**

Stream: Mixed-Integer Non-Linear Programming

*Invited session*

Chair: Sonia Cafieri, Lab. MAIAA, Dept. de Mathematiques et Informatique, Ecole Nationale d’Aviation Civilie, 7 Ave. Edouard Belin, 31055, Toulouse, France, sonia.cafieri@enac.fr

Chair: Claudia D’Ambrosio, LIX, CNRS - Ecole Polytechnique, route de Saclay, 91128, Palaiseau, France, dambrosio@lix.polytechnique.fr
1 - Mixed-integer programming under the presence of uncertainty: On the solution of multi-parametric MILP problems
Martina Wittmann-Hohlbein, Imperial College London, United Kingdom, m.wittmann-hohlbein09@imperial.ac.uk, Efstratios Pistikopoulos

We consider multi-parametric MILP problems with uncertainty simultaneously present in the coefficients of the objective function and the constraints. We present two-stage methods for the approximate solution such that the computational burden to derive explicit solutions is reduced. The first approach combines robust optimization and multi-parametric programming. In the second approach we exploit the special structure of the problems and employ suitable relaxations of bilinear terms. In particular, we embed novel MILP-relaxations of bilinear terms in the proposed procedure.

2 - GloMIQO: Global Mixed-Integer Quadratic Optimizer
Christodoulos Floudas, Chemical Engineering, Princeton University, 08544, Princeton, NJ, United States, floudas@princeton.edu, Ruth Misener

The Global Mixed-Integer Quadratic Optimizer, GloMIQO, is a numerical solver addressing mixed-integer quadratically-constrained quadratic programs (MIQCP) to epsilon-global optimality. Algorithmic components are presented for: reformulating user input, detecting special structure, generating tight convex relaxations, dynamically generating cuts, partitioning the search space, bounding the variables, and finding feasible solutions. We extensively test GloMIQO using a suite of 399 problems from process network applications, computational geometry problems, and standard performance libraries.

3 - A new Branch and Bound algorithm for MIQPs
Amélie Lambert, CEDRIC, CNAM, 292 rue saint martin, 75141, paris, France, amelie.lambert@cnam.fr, Alain Billionnet, Sourour Elloumi

Let (MQP) be a MIQP that consists in minimizing a quadratic function subject to linear constraints. Our approach to solve (MQP) is first to consider (MQP), an equivalent MQP that has a convex objective function, additional variables and constraints, and additional quadratic constraints. Then, we propose a new Branch and Bound based on the relaxation of the quadratic constraints to solve (MQP'). We perform experiments on pure-and mixed-integer instances of medium size, and show that their solution times are improved by our Branch and Bound in comparison with two existing approaches.

4 - Optimistically Approximating Non-linear Optimization Problems through MILP
Claudia D’Ambrosio, LIX, CNRS - Ecole Polytechnique, route de Saclay, 91128, Palaiseau, France, dambrsio@lix.polytechnique.fr, Andrea Lodi, Silvano Martello, Riccardo Rovatti

We present a new piecewise linear approximation of nonlinear functions. It can be seen as a variant of classical triangulations with more degrees of freedom to define any point as a convex combination of the samples. For example, in the case of functions of 2 variables, each point is approximated as convex combination of 4 samples instead of 3 like in the traditional triangulation approach. When embedded in MILP models it results in a smaller number of binary variables. We show theoretical properties of the approximating functions and provide computational evidence of the impact of the method.

1 - Assigning experts to tasks in a project
Stanislaw Walukiewicz, Systems Research Institute, Polish Academy of Sciences, ul. Newelska 6, 01-447, Warsaw, Poland, Stanislaw.Walukiewicz@ibspan.waw.pl, Jakob Krarup

The problem of assigning experts to tasks in a project can be modeled with the so-called Virtual Production Line (VPL) proposed by Walukiewicz in 2006. VPL appears to be a natural extension of the Classical Production Line (CPL) dating back to the car manufacturer Ford in 1913. Our approach is based on the concepts of social capital and proximity where social capital is defined as formal or informal relations between at least two experts. The proximity refers to specific interrelations linking experts on VPL. Comparisons of the assignments of experts to VPL and workers to CPL are considered.

2 - An inventory model with time dependent demand rate, trade credits and partial backlogging
Vikram jeet Singh, MATHEMATICS, Lovely Professional University, Jalandhar-Delhi G.T Road(NH-1), 144402, Phagwara, Punjab, India, vikram31782@gmail.com

In this paper we developed an inventory model for deteriorating items with time dependence of demand. Many inventory models in past were developed under the assumption that the holding cost is constant for the entire inventory cycle. But this is particularly false in the storage of deteriorating and perishable items such as food products. The holding cost is assumed to be varying over time in only few inventory models. Partially backlogged shortages are permitted and backlogging rate is waiting time for the next replenishment.

3 - Whole Life Costing (WLC) model in asset management
Wenjuan Zhang, Warwick Business School, Warwick University, ORMS Group, CV4 7AL, Coventry, United Kingdom, wenjuan.zhang@wbs.ac.uk

A Whole Life Cost (WLC) approach has been developed for determining capital expenditure requirements for asset management. This approach has addressed the problem caused by uncertainty associated with the maintenance cost and their timing by modelling asset degradation (timing to performance loss and boundary condition intervention stages) capital and maintenance costs, risks and their probabilities, using Bayesian statistics, for each Maintainable Item (MI).

MC-30
Emerging Applications in Production Management
Stream: Emerging Applications in Finance and Logistics
Invited session
Chair: Jakob Krarup, Dept. of Computer Science, University of Copenhagen, Ydervang 4, DK-3460, Birkerød, Denmark, krarup@diku.dk

MC-31
Mathematical methods for decision support in energy and industrial sectors
Stream: Iterative Methods for Economic Models
Invited session
Chair: Elisabetta Allevi, Quantitative Methods, University of Brescia, Contra Santa Chiara, 50, 25122, Brescia, Italy, allevi@eco.unibs.it
Chair: Adriana Gnudi, Mathematics, Statistics, Computer science and Applications, University of Bergamo, Via dei Caniana, 2, 24127, Bergamo, Italy, adriana.gnudi@unibg.it
Chair: Igor Konnov, University of Kazan, Kazan, Russian Federation, Igor.Konov@ksu.ru

1 - The steel industry: a mathematical model under environmental regulations
Rossana Riccardi, Quantitative Methods, University of Brescia, Contra Santa Chiara, 50, 25122, Brescia, Italy, riccardi@eco.unibs.it, Elisabetta Allevi, Adriana Gnudi, Francesca Bonenti, Claudia Avanzi

In this work, a spatial equilibrium problem is formulated for analyzing how the price of electricity can influence investment decisions in the steel sector under EU ETS. In this light, two main processes for steel making have to be considered: integrated mills (BOF) and Electric
Arc Furnace (EAF) in minimills. Integrated mills produce high levels of direct emissions while emissions in EAF are indirect emissions in the form of electricity. A technological representation of the market will be introduced and the possibility of electricity auto-production in integrated mills will be analyzed.

2 - Evaluating the Impacts of the EU-ETS on Prices, Investments and Profits of the Italian Electricity Market
Giorgia Oggioni, University of Brescia, Italy, Contrada Santa Chiara 50, 25122, Brescia, Italy, oggioni@eco.unibs.it
Francesca Bonenti, Elisabetta Allevi, Giacomo Marangoni

This paper investigates the economic impacts of the European Emission Trading Scheme (EU-ETS) on the Italian electricity market by a power generation expansion model where generators behave either as Cournot or perfectly competitive players. The developed models are used to measure the effects of the EU-ETS on electricity prices and demand, investments and generators’ profits taking also into account the implications of the third phase. The solution of the overall system is found by exploiting the mixed complementarity theoretical framework and the implementation is conducted in GAMS.

3 - Electricity markets under linear price/demand and quadratic costs: Equilibrium à la Cournot and Supply Function Equilibrium
Francesca Bonenti, Quantitative Methods, University of Brescia, Contrada Santa Chiara 50, 25122, Brescia, Italy, francesca.bonenti@eco.unibs.it, Magali E. Zuanon

The Supply Function Equilibrium approach in an electric market takes place whenever firms compete in offering a schedule of quantities and prices. On the other hand, in the Cournot equilibrium each firm chooses the optimal output by maximizing its own profit. Bonenti and Zuanon presented the explicit expressions characterizing analytically the Cournot equilibrium and the Supply Function equilibrium values for the produced quantities, the market-clearing price and the profits in a particular version of the models under linear price/demand and quadratic costs.

4 - Splitting Methods for Dynamic Auction Problems With Set Valued Mappings
Adriana Gnudi, Mathematics, Statistics, Computer science and Applications, University of Bergamo, Via dei Caniana, 2, 24127, Bergamo, Italy, adriana.gnudi@unibg.it, Elisabetta Allevi, Igor Konnov

We present a spatial price equilibrium model for the dynamic case with set valued cost functions. The model describes the behavior of a system of auction markets joined by transmission lines subject to joint balance and capacity flows constraints for a certain time period. We treat this model as an extended primal-dual system of variational inequalities. Some splitting type methods are proposed to find its solution with inexact and exact optimization algorithms.

The purpose of the ‘NATO Guide for Judgement-based OA in Defence Decision Making’ is to create an understanding of what judgement-based OA is, to clarify what this type of analysis can do to help address problematic situations; and, to provide guidance on how a judgement-based OA study should be carried out to maximise the validity, credibility and acceptance of such a study and its outcomes. In three volumes the Guide addresses analysts, clients and executives. The presentation will focus on its Code of Best Practice volume which is considered to be relevant to a general analyst audience.

2 - Planning Soft Workshops: getting the right people in the room
Sue Merchant, Blue Link Consulting, 4,Shepherd’s Way, WD3 7NJ, Rickmansworth, Hertfordshire, United Kingdom, suemerchant@hotmail.com

Soft OR has many techniques available now, along with much practical advice, for the successful running of a range of different types of workshop or decision conference. A critical aspect of planning a workshop involves making sure that the right people attend the workshop in the first place. This presentation looks at the questions which organisers need to ask themselves regarding participants when arranging a workshop, notes some of the advice available in the literature, and reports on good practice recently distilled from a group of practitioners.

3 - Enhancing the Dimensions of Procedural Justice in Focus Group Workshops using Facilitated Group Decision Software
Parmjit Kaur, De Montfort University, LE19BH, Leicester, United Kingdom, pkcor@dmu.ac.uk, Ashley Carreras

This paper examines the way in which causal mapping aided by group decision software adheres to the tenets of procedural justice. The workshops utilise a dual facilitation process that allows a more authentic participant voice to be heard. We seek to explain why this process of investigation surfaces more authentic qualitative data by aligning the process of investigation with the principles of procedural justice as found in organisational justice literature.

4 - Mapping Collective Intentions
Ashley Carreras, Leicester Business School, De Montfort University, Marketing, The Gateway, LE19BH, Leicester, United Kingdom, acarreras@dmu.ac.uk

An integral part of Strategy Workshops utilising causal mapping is the movement towards acollected set of actions that participants in that workshop commit themselves to. This paper outlines one approach to understanding this degree of collectiveness by utilising the concept of intentionality, proposed by Searle and refined by Velleman, to match content of one person’s agreement to action with another’s. After outlining this approach to collective intentions the paper looks at examples of such agreements in the maps of workshops facilitated by the author.
A fully precise numerical evaluation of disasters’ effects is unrealistic in the time-pressured, highly uncertain decision context taking place just after a disaster strike. Instead of a numerical evaluation, here it is considered that it is rather more plausible and realistic to classify the severity of the consequences of a disaster in terms of the relevant scenarios for NGO’s decision makers. However, some features of that context entail the necessity of considering and assuming an structure over the set of classes, somehow modelling those features inside of the classification model.

2 - Uncertainty and Robustness in Humanitarian Supply Chains for Disaster Relief

Alistair Clark, Dept of Engineering Design and Mathematics, University of the West of England, Fanchy Campus, Coldharbour Lane, BS16 1QY, Bristol, United Kingdom, Alistair.Clark@uwe.ac.uk

A bidirectional supply chain network model to get humanitarian aid quickly to needy recipients in a natural disaster is formulated mathematically, and then discussed in the context of uncertainty about transportation resources, aid availability, and the suddenness and degree of demand. Poor information feedback and multiple decision-makers in different aid agencies. How can robust and stable plans be maintained and disruption limited when new events or information necessitate the revision and updating of existing plans and decisions?

3 - Decision Aid Models on Preparedness Operations on Disaster Management

Begoña Vitoriano, Estadística e Investigación Operativa I, Fac. Matemáticas, Universidad Complutense de Madrid, Plaza de Ciencias, 3, Ciudad Universitaria, 28040, Madrid, Spain, bvitoriano@mat.ucm.es, M. Teresa Ortuño, Federico Liberatore, Celeste Pizarro Romero, Clara Simon de Blas

Natural disasters can strike a population suddenly and unexpectedly or being slower and repeated. Especially in this second case that forecasting is possible, it becomes crucial for an effective response having prepared population, emergency protocols, resources location, and planning operations. Decision aid models in this context should consider not only the immediate response but also the subsequent treatment of victims. A multicriteria model for shelters location taking into account the evacuation operations and the later distribution of humanitarian aid will be presented.

4 - Model to validate the quality of data sources in a ubiquitous crowd-sourcing context

Jose Robledo, Sistemas de Información, Universidad de Guadalajara, PERIFERICO NORTE 799 MOD L 305, LOS BELENES, 45100, ZAPOPAN, JALISCO, Mexico, jrobledo@ dip.udp.mx, Laura Plazola Zamora

Gathering data by a crowd-sourcing method through the use of ubiquitous computing is a relatively new approach for acquiring and processing data related to real issues such as vehicle traffic, epidemic spread and in general incidence of alerts. A concern that arises when data is acquired by this manner in order to be used to feed a decision support system is to ensure that data collected complies with certain quality criteria. This work proposes the use of a model to validate the quality of data sources through mechanisms of redundancy, trust and reputation in order to meet the set requirements.

1 - Enumerations of voting systems: Fibonacci sequences and the gold number

Josep Freixas, Applied Mathematics 3, Technical University of Catalonia, Av. Bases de Manresa, 61-73, E-08242 MANRESA, Spain, 08242, Manresa, Spain, josep.freixas@upc.edu, Sascha Kurz

Voting systems are structures which are enumerable as a function of the number of voters. The Fibonacci sequences appear regularly for games with some few types of equivalent players and many of them just differ asymptotically by a multiplicative factor, which is the golden ratio or its square. The paper summarizes enumerations of voting structures which follow some patterns. Additionally, we also point out some problems, related to values of cooperative games, where the number of possible rankings for the Shapley value in different games is the k-dimensional Catalan numbers.

2 - Finding extremal voting systems via integer linear programming

Sascha Kurz, Mathematics, Physics and Computer Science, University of Bayreuth, Universitätsstraße 30, 95440, Bayreuth, Bavaria, Germany, sascha.kurz@uni-bayreuth.de

Different types of yes/no voting systems are frequently studied. Using integer linear programming we determine extremal voting systems. As examples we consider voting systems whose Shapley-Shubik vector has minimal distance to a given power distribution; whose Public Good Index maximally violate local monotonicity; or which are farthest away from weighted voting games with respect to a recently introduced hierarchy of simple games. We present the general underlying ideas and computational results for instances where exhaustive enumeration of all voting systems is infeasible.

3 - Success and decisiveness on symmetric games

Montserrat Pons, Applied Mathematics 3, Technical University of Catalonia, Av. Bases de Manresa 61-73, 08242, Manresa, Spain, montserrat.pons@upc.edu, Josep Freixas

The notion of success has usually been considered just a secondary aspect of decisiveness, due partially to the fact that success and decisiveness show a linear relationship when all vote configurations are equally probable.

In our work we analyze the relationship between success and decisiveness for anonymous and independent probability distributions on symmetric games.

4 - A model for players’ tendencies when playing a cooperative game

M. Albina Puente, Applied Mathematics III, Technical University of Catalonia, Av. Bases de Manresa-61-73, Manresa, Spain, M.Albina.Puente@upc.edu, Francesc Carreras

We present the theory for multibinary probabilistic values on cooperative games. As they are defined by tendency profiles, new tools are provided to encompass situations due to the influence of players’ personality when playing a given game. When the profile is positive, the multilinear extension is a potential function and gives a computational tool. We also adapt to these values some properties, concerning null and nonnull players, balanced contributions, dominance and monotonicity, and regularity arises as a convenient condition. The subject falls within the topic of restricted cooperation.
1 - Development of a multi-layer ANFIS model for the prediction of tertiary scale formation in the steel industry
Jonathan Kennedy, Specific, Swansea University, Baglan Bay Innovation & Knowledge Centre, Baglan Energy Park, Central Avenue, SA12 7AX, Baglan, Port Talbot, Wales, United Kingdom; jon.ian.kennedy@gmail.com
Scale is an oxide that forms on steel during the hot mill process that has a detrimental effect on the surface quality of surface critical products. Scale formation is dependent on numerous factors such as thermomechanical processing routes, chemical composition, thickness and rolls used. This paper describes the early development of a 3 layer Adaptive Neuro Fuzzy Inference System (ANFIS) model, which predicts the formation of scale on steel from various input criteria. The ANFIS model deployed in this work is purely spreadsheet based with Excelx Solver used for optimising the weights.

2 - Design of a RFID Based Real Time Warehouse Management System for Steel Industry
Ozgur Eski, Industrial Engineering Dept., Celal Bayar University, 53.Sok. No:5 Daire:20, Baki Aktugu Apt. Bornova, 35040, IZMIR, Turkey, ozgur.eski@cbu.edu.tr, Ceyhun Araz, Levent Bayoglu, Filiz Turan
In steel industry, the efficient storage of steel coils is important. In traditional systems, coils are randomly placed on the floor and the performance of the storage operations depends on operator’s experience. This results in inefficient use of warehouse and mistakes. In this study we proposed an RFID based real-time warehouse management system (RWMMS). RWMMS helps the warehouse managers to achieve better inventory control and to improve the efficiency of operations. We also developed a heuristic for efficient placement of steel coils. A case study is conducted in Norm Fasteners Co, Turkey.

3 - Damage characteristic of hybrid composite plaques in 2m/s speed impact
Levent Bozkurt, Ilgin Vocational School of Higher Education, 42600, Ilgın/Konya, Turkey, bozlev@hotmail.com
Hybrid composite can be defined as having more than one staple within same composite. However, in stratified composite materials, generally low velocity impacts are considered as impacts which are lower than 100 m/s. In this study, characteristics of hybrid composite stratifies which are exposed to low velocity impact are studied. Low velocity impact experiments are done in testing device which is developed for weight fall. After experiments which are done under different border conditions, dynamical answer of the material, rising damages and elastical specifications are searched.

4 - Conjoint analysis for Concept Design of Commercial Diesel Engine
Jae-su Jeon, Information&Industrial Engineering, Yonsei University, 134 Shinchon-dong, Seoul, Korea, Republic Of, jae-su.jeon@yonsei.com, So Young Sohn
Commercial diesel engine is a main component for various application domains such as excavator, commercial vehicle, generator, etc. The regulation concerning green management along with various customers’ needs has to be reflected on the design of diesel engine. However, diesel engine manufacturers rarely produced customer-oriented products. In this paper, we apply adaptive conjoint analysis to identify the most sensitive design attribute for commercial diesel engine design and forecast the ideal product for China market which has the highest share in the world.

1 - Measuring the efficiency of a pharmacy chain by means of Advanced DEA
Ludmila Neumann, Institute of Management Control and Business Accounting, TU Braunschweig, Pocketstrasse 14, 38106, Braunschweig, Lower Saxony, Germany; lneumann@tu-bs.de, Heinz Ahn
The Advanced DEA is a methodological enhancement of the traditional DEA that allows the inclusion of a hierarchical goal structure into the analysis. This approach does not only consider inputs and outputs, but also their impact on the relevant objectives. The present study provides an application of Advanced DEA to measure the efficiency of a European pharmacy chain with 49 DMUs. The results show to be particularly appropriate for identifying partial inefficiencies that are not recognized by traditional DEA models.

2 - Benchmarking on Spanish University libraries
Clara Simon de Blas, Statistics & Operations Research, Rey Juan Carlos University, Departamental II, Desp. 042, C/ Tulipan s/n, 28933, Mostoles, Madrid, Spain; clara.simon@urjc.es, Jose Simon Martin, Alicia Arias
In 47 Spanish university libraries, efficiency is computed in the use of human resources in the execution of internal library processes. DEA and outlier detection methods are combined to assess management on benchmarking efficiency. DMUs that are primarily identified as efficient are submitted to a complementary analysis to detect the number of times they perform as peer. If the number of reference units is low, then other evidences for establishing the superiority of its performance is realized through the analysis of results excluding an output, as the roll of the output in the variables set.

3 - Service Benchmarking in the Portuguese Hospitals: An Application of Data Envelopment Analysis
Ricardo A. S. Castro, Faculdade de Engenharia, Universidade do Porto, Portugal, ricardo.alves.castr0@fe.up.pt, Maria Portela, Ana Camanho
In this study we present an evaluation model of hospital services in Portugal, using an efficiency of care perspective. Multiple inputs and outputs were chosen based on their impact on the total costs incurred by all clinical services. A DEA model was applied to a specific service and constraints on the weights were imposed to avoid efficient units with an injudicious choice of them. Results show the factors where the biggest possible savings can be made. A comparison between best-practice services and inefficient services is also presented, revealing the reasons for a superior performance.

4 - Using DEA to evaluate Brazilian Institutions of Higher Education
Armando Zefetino Milioni, Departamento de Organizacao, Instituto Tecnologico de Aeronautica, CTA ITA IEMB, 12228-900, Sao Jose dos Campos, Sao Paulo, Brazil, milioni@ita.br, Diego Geraldo, Joyce Teixeira, Luciene Alves
Every year Brazilian institutions of higher education are evaluated and the final result of the evaluation is a number called GIC - general index of courses. The GIC is calculated from the weighted sum of the results of the evaluation of undergraduate and postgraduate (masters and doctorate) courses of each institution. The weighting factors, which take into account the number of enrolled students, are often an object of long discussions. We show that, indeed, the ranking of institutions according to GIC can vary widely according to the weighting factors. We use DEA to discuss this issue.
1 - An optimization framework for intensity modulated proton therapy treatment planning

Gino Lim, Industrial Engineering, University of Houston, E206, Engr. Bldg 2, 77204, Houston, TX, United States, ginoлим@uh.edu, Wenhua Cao, Xiaodong Zhang

Intensity modulated proton therapy (IMPT) has rapidly emerged as an advanced type of radiation therapy for cancer patients because it can achieve precise dose to the tumor volume while greatly sparing the normal tissues. However, use of mathematical programming techniques has not been widely addressed for optimizing treatment parameters. Therefore, we introduce an optimization framework to optimize beam angles, spot positions and corresponding spot intensities simultaneously. Benefits of proposed methods are demonstrated by several case studies on clinical prostate cancer patients.

2 - On the selection of images and determining the age of acquisition of words for a recognition test using exploratory data analysis

Gastão Gomes, Métodos Estatísticos, Universidade Federal do Rio de Janeiro, Rua Dois de Dezembro, 15/804, Flamengo, Rio de Janeiro, 22220-040, Rio de Janeiro, Brazil, gastao@im.unj.br, Sergio Camiz, Christina Gomes, Fernanda Senna

We are concerned about the evaluation of images to be used in a test with aphasic patients. Correspondence Analysis (CA) was applied to evaluate 38 subjects, in order to understand to what extent they identify the image. As a result 161 words were selected. These new selected words were now submitted to two sets of judges with differently suggested scales of age of acquisition: a free-scale one and another with the suggested slots of ages. The effect of the scale was studied by PCA. Multiple CA and Multiple Factor. The results indicate a good agreement between the two scales.

3 - Benchmarking and proposed improvements of the database of Clusters of Orthologous Genes (COG)

Farzana Rahman, Computational Biology Group, University of Glamorgan, United Kingdom, frahman1@glam.ac.uk, Mehedi Hassan, Tatiana Tatarinova, Alexander Bolshoy

We developed a non-parametric Bayesian method for validation of consistency of COG database. We were motivated by the observation that for at least 35% clusters from COG database, the distribution of gene length cannot be approximated using hierarchical Poisson-Gamma distribution, but as a mixture of distributions. In the framework of Non-parametric Bayesian approach, model parameter distributions consist of multiple discrete 'support' points, up to one per subject in the population. Each support point is a set of point estimates of each model parameter value, plus probability of that set.

1 - Efficient Approximation of Convex and Non-Convex Pareto-Frontiers with Application to Chemical Process-Optimization

Chair: Jacek Blazewicz, Institute of Computing Science, Poznan University of Technology, ul.Piotrowo 2, 60-965, Poznan, Poland, jblazewicz@cs.put.poznan.pl

Uwe Nowak, Optimization, Fraunhofer ITWM, Fraunhofer-Platz 1, 67663, Kaiserslautern, Germany, uwe.nowak@itwm.fraunhofer.de, Michael Bortz, Karl-Heinz Kiefer

In many practical simulation-based optimization problems, an efficient approximation of the (possibly non-convex) Pareto frontier is highly desirable. We consider this problem for very involved simulation schemes: The weighted sum sandwiching algorithm for convex is very fast. In contrast, the slower Pascoal-Serafini hyperboxing algorithm is applicable to non-convex Pareto sets. Furthermore, we present a combination of both algorithms, suited for practical problems with only small non-convex parts of the Pareto frontier.

2 - A multicriteria optimization approach for radiofrequency ablation (RFA) planning

Katrin Teichert, Optimization, Fraunhofer ITWM, Fraunhofer-Platz 1, 67663, Kaiserslautern, Germany, katri.teichert@itwm.fraunhofer.de, Philipp Süss, Karl-Heinz Kuefer

In RFA treatment planning, high-frequency current is applied to locally heat up and destroy cancerous tissue. A placement of the needle-shaped applicator is considered good if it leads to complete tumor destruction and also avoids specific treatment risks. In the modeling of this multicriteria optimization problem a main difficulty lies in the disconnectedness of the feasible set, as the applicator must not intersect with bones or organs. We investigate how the Pareto set is affected and, based on our findings, propose a method to interactively navigate on the set of non-dominated solutions.

3 - Multicriteria decision support for photovoltaic power plant design

Kai Plociennik, Optimization, Fraunhofer ITWM, Germany, kai.plociennik@itwm.fhg.de, Hendrik Ewe, Ingmar Schüle, Karl-Heinz Kuefer

Finding a good photovoltaic power plant design is a complex task with many decisions to be made. The right electrical component types and amounts (PV modules, inverters, cables) and the best component layout and electrical design have to be found. Since a multitude of (partially conflicting) objective functions like "minimize construction costs" or "maximize energy yield" is present, the problem is strongly multicriteria. We present software which proposes a set of reasonable plant designs, from which the engineer chooses the best in a multicriteria decision support system.

4 - Multicriteria Rolling Wave Planning and Scheduling

Bastian Bludau, Optimization, Fraunhofer ITWM, Germany, bludau@itwm.fraunhofer.de, Sebastian Velen, Karl-Heinz Kuefer

In real-life industrial applications of production planning and scheduling, new tasks and unforeseen events force a once computed schedule to be adjusted over and over again. A common way to deal with such dynamic problems in practice is rolling wave scheduling. We present a periodic rescheduling model that uses flexible bounding constraints to simultaneously control multiple objective criteria such as resource utilization, adherence to delivery dates, and schedule stability. Particular emphasis is given on the adjustment of the bounding constraints.
1 - Identifying Reasons of Customer Waiting
Chih-Chin Liang, Department of Business Administration, National Formosa University, Taipei, Taiwan, lgcwow@gmail.com
Customers may become angry and leave after waiting an intolerably long time, leading to marketing opportunities being lost. Once a service sector understands the factors driving customers to join a line, that company might adopt marketing strategies targeting waiting customers. To identify factors, this study uses principal component analysis to identify the importance of each factor. Finally, the weight of each component is also found and assigned to help understand the importance of each component in decisions about joining a queue.

2 - Identifying Hierarchical and Simultaneous Multiplayer Game-solution for (Non-)cooperative Advertising in Manufacturers and Retailers Using MOPSO-CD or NSGA II
Chie-bein Chen, International Business, National Dong Hwa University, 1, Sec. 2, Da-hsueh Rd. Shou-feng, 974, Hualien, Taiwan, cbchen@mail.ndhu.edu.tw, Jung-Ho Lu, Yuanchau Liour
This research is to solve the vertical (non-)cooperative advertising problem under different market response functions using MOPSO-CD or NSGA II integrated the Stackelberg game or Nash game to identify their equilibriums (or solution) by considering the policies in long-term branding investments by manufacturers and in short-term promotion efforts by retailers. Finally, this research will implement some cases and their numerical results will demonstrate the feasibility and their different numerical results of the vertical cooperative advertising in supply chain.

3 - Application of Fuzzy Subsethood Measure as the Filter for Outliers in Likert's Questionnaire Analysis
Cheng-Chuang Hon, Department of Industrial Engineering and Management, Minghsin University of Science and Technology, 1 Hsin-Hsing Road, Hsin-Fong, Hsinchu, Taiwan, 304, Hsinchu, Taiwan, cchon@must.edu.tw, Ning-Lang Tang
In order to avoid deviations caused by autocratic and subjective attitudes in decision making process, bringing decision makers together to obtain group consensus is one of the best choices for achieving accurate performance. For collection of individual judgment was used Likert Scale questionnaire. We propose Fuzzy Subsethood Measure as the “Outlier Elimination” method for fuzzy data analysis expressed in types of triangular fuzzy number, which can adjust the calculated results escaping from the bias. Also an empirical example, data collection through Likert’s questionnaire is provided.

4 - An Evaluation Model of Implementing RFID for 3PL's Service Agility and Value
Ling-Lang Tang, School of Management, Yuan Ze University, 135 Yuan-tung road., 320, Chung-Li, Taoyuan, Taiwan, balttang@saturn.yzu.edu.tw, Cheng-Chuang Hon, Ming-Tsang Lu
This paper builds up an evaluation model for company using RFID system and finds how RFID affects organization’s agility and service value. We use system dynamics to evaluate and explain the complicated nonlinear and dynamic business process. Through this model, we found that corporation’s agility, advance visibility of RFID and IT assistants could bring higher business benefits and reduce customers waiting time. It proves that adopting RFID system has ability to boost agility capability. The 3PL implementing RFID makes process more efficient and save more cost than before.

Chair: Chie-bein Chen, International Business, National Dong Hwa University, 1, Sec. 2, Da-hsueh Rd. Shou-feng, 974, Hualien, Taiwan, cbchen@mail.ndhu.edu.tw

1 - Efficiency and Productivity of Human Resources in Science and Technology in Innovation and Efficiency Driven Nations
Ying-Chyi Chou, Department of Business Administration, Tunghai University, 181 Taichung-kang Rd., Sec. 3, Taichung, Taiwan, R.O.C., 407, Taichung, Taiwan, rosechyi@yahoo.com.tw, Hsin-Yi Yen
Data Envelopment Analysis (DEA) was applied to assess the relative efficiency of HRST and determine productivity variation of each nation using the Malquist model. The empirical results demonstrate that the efficiency of HRST differs among nations, depending on the level of economic development. From Malquist model estimates, productivity indices were calculated and decomposed into two categories: technological change and efficiency change of productivity variation. A benchmark for nations aiming to improve their HRST efficiency and productivity has been established.

2 - An Assessment of Taiwan’s Solar Water Heater Subsidy Policy Using Logistic Diffusion Curves
Pao-Long Chang, Department of Business Administration, Feng Chia University, 100, Wenhu Road, Seatwen,Taichung, Taiwan, R.O.C. 407, Taichung, Taiwan, paolong_chang@yahoo.com.tw, Chiu-Wen Hsu
As many countries are implementing policies to achieve carbon reduction, assessing the effectiveness of measures is important. Using installation area data from the non-subsidized period (1992—1999) and subsidized period (2000—2010), logistic curves are used to model the adoption of solar water heating and assess the effectiveness of Taiwan’s solar water heater subsidy policy. The result showed that the government’s average annual investment of NT $1,052 for solar water heaters led to a 1-ton carbon emission reduction in 10 years. Thus, only 57% of the goal by 2020 can be achieved.

3 - Investigation of feature dimension reduction based GLCM/SVM for color filter defect classification
Yu-Min Chiang, Industrial Management, I-Shou University, No.1, Sec. 1, Syuecheng Rd., Dashu District., 84001, Kaohsiung City, Taiwan, Taiwan, ymchiang@isu.edu.tw, Yau-Chang Lin, Jiang-Liang Hou, Shih-Ting Yang
This paper presents an efficient color filter (CF) defect recognition system, based on gray-level co-occurrence matrix (GLCM) and support vector machines (SVM). GLCM is used to extract textural information first. The extracted features are further selected by F-score, information gain and individual feature accuracy selection methods. The idea is to reduce dimensionality of CF defect space. The selected features are used as features for the SVM classification process. Experimental results indicate the proposed method achieves outstanding performance for CF defect classification.

4 - Environmental Fuzzy Multi-Attribute Decision-Making in Integrated Wastewater Management
Hojjat Mianabadi, Faculty of Civil Engineering and Geosciences, TU Delft, Room 4.92.2, 23, Stevinweg 1, 2628 CN, Delft, Netherlands, h.mianabadi@gmail.com, Mehrdad Mirabi, Erik Mostert, Mohammad Bagher Shariati
One of the important challenges of modern human life is increasing production of urban wastewater in metropolises. Hence, selection the best method to collect and reuse of wastewater is important. There are different methods to run sewage systems; the best method of which should be selected considering structural conditions, economic, social, and political criteria. Wastewater management of the Niasar city, Iran, is investigated as a real case study using two risk based MADM methods. The results show that MADM methods are necessary to reach sustainable development in waste water management.

Chair: Chie-bein Chen, International Business, National Dong Hwa University, 1, Sec. 2, Da-hsueh Rd. Shou-feng, 974, Hualien, Taiwan, cbchen@mail.ndhu.edu.tw
1 - Combination of DEMATEL and ANP for the cargo shipping company selection problem
Nilsen Kundakci, Business Administration, Pamukkale University, Pamukkale University, Faculty of Economics and Administrative Sciences, Department of Business Administration, 20070, Denizli, Turkey, nkarakasoglu@pau.edu.tr, Esra Aytaç, Ayşegül Tuş Isık

Cargo shipping is a vital part of logistic functions but selecting the right cargo shipping company is a difficult task for companies. This selection can be handled with the help of multiple criteria decision making (MCDM) methods. This paper attempts to solve the cargo shipping company selection problem by adopting MCDM model that combines Decision Making Trial and Evaluation Laboratory (DEMATEL) and Analytical Network Process (ANP). DEMATEL is employed to compute the effects between selection criteria and ANP is used to determine the best cargo shipping company considering all alternatives.

2 - Utilization of Multi-Criteria Decision Making Methods at the Phase of Compare and Contrasting of the Course of Actions within the Military Decision Making Process.
Erman Atık, war academy, Turkey, ermanatik@yahoo.com

It is concluded that using Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP), one of the methods of Multi-Criteria Decision Making, will provide an important benefit at the phase of compare and contrasting the course of actions, evaluated as the poor point of AKVES. The criteria which have to be used for AHP and ANP, being applied in a military operation, have been established. In the light of established criteria, how a model of ANP can be set up, has been showed.

3 - Analysis of course selection using ahp and discrete choice analysis
Anamarija Jazbec, Mathematic and Technical Basics, Faculty of Forestry, University of Zagreb, Svetok&86553;imunska c.25, 10000, Zagreb, Croatia, jazbec@sumfak.hr

The main objective of this paper is to determine the importance of the criteria in the selection of courses at the graduate level at Faculty using the AHP method and discrete choice analysis, compare and contrasting the course of actions, evaluated as the poor point of AKVES. The criteria which have to be used for AHP and ANP, being applied in a military operation, have been established. In the light of established criteria, how a model of ANP can be set up, has been showed.

4 - An AHP/DEA hybrid model for the evaluation of Croatian research institutes performances
Tihomir Hunjak, The Faculty of Organization and Informatics, Croatia, thunjak@foi.hr

The purpose of the analysis was to compare the research institutes from two aspects: accountability toward their mission and their autonomy. For research outputs assessment, an indicator was developed using the appropriate AHP model and in consultations with an expert for bibliometrics. As a measure of autonomy, the ratio between own income and the amount of funding gained from the state budget was used. As a part of the research, cross efficiency analysis was conducted and the sensitivity analysis was performed by weight restrictions.

1 - Clearance Pricing Optimization at Zara
Felipe Caro, UCLA Anderson School of Management, 110 Westwood Plaza, Suite B420, 90095, Los Angeles, CA, United States, fcaro@anderson.ucla.edu, Jérémie Gallien

Until 2007, Zara used a manual process for determining price markdowns. This is a challenging problem due to the variety of unsold articles with few price data points. In collaboration with Zara’s pricing team, we developed an alternative process relying on a formal forecasting model feeding a price optimization model. As part of a controlled field experiment conducted in Belgium and Ireland during the 2008 Fall-Winter season, this new process increased clearance revenues by approximately 6%. Zara is currently using this process worldwide for its markdown decisions during clearance sales.

2 - Scheduling the German Basketball League
Stephan Westphal, Institute for Numerical and Applied Mathematics, University of Goettingen, Lotzestr. 16-18, 37083, Göttingen, Germany, s.westphal@math.uni-goettingen.de

Each season, the German First Division Basketball League (Beko BBL) is faced with the problem of scheduling the games among their teams. In addition to the typical constraints that arise in creating a schedule, the league is faced with several special constraints. As the classical schedules and models applied so far have caused numerous problems, resulting in postponed games, lost ticket sales and unbalanced standings, we developed a new approach taking all these requirements into account. This approach was first used by the BBL to generate the schedule for the season 2011/2012.

3 - Optimization of advertisement revenue for the French TV group TF1
Thierry Benoist, e-lab, Bouygues SA, 32 avenue Hoche, 75008, PARIS, France, benoist@bouygues.com, Frédéric Gardi, Antoine Jancian, Bouygues’operations research team (the e-lab) has been working with the leading French TV channel TF1, for the past 15 years. This talk presents our achievements in working with this advertising broadcaster and identifies the practical keys to success in this partnership. The selected projects, which cover the Internet and television businesses, gave TF1 a competitive advantage by allowing it to provide quicker and better answers to advertisers’requests and to better use its limited and perishable airtime inventory. TF1 estimates the resulting revenue increase at 20 million euros per year.

1 - Stochastic Programming: Applications to the energy sector
Chair: Marida Bertocchi, Department of Mathematics, Statistics, Computer Science and Applications, University of Bergamo, Via dei Canianna 2, 24127, Bergamo, BG, Italy, marida.bertocchi@unibg.it
Chair: Maria Teresa Vespucci, Department of Information Technology and Mathematical Methods, University of Bergamo, via Marconi, 5a, 24044, Dalmine (BG), Italy, m.vespucci@it.uni.it

The purpose of the analysis was to compare the research institutes from two aspects: accountability toward their mission and their autonomy. For research outputs assessment, an indicator was developed using the appropriate AHP model and in consultations with an expert for bibliometrics. As a measure of autonomy, the ratio between own income and the amount of funding gained from the state budget was used. As a part of the research, cross efficiency analysis was conducted and the sensitivity analysis was performed by weight restrictions.
1 - Operating fully renewable power systems: biomass and wind case
Ruth Dominguez, Electrical Engineering, Universidad de Castilla - La Mancha, Avda. Carlos III, s/n, 45071, Toledo, Spain, Spain, ruth.dominguez@uclm.es, Miguel Carrión, Antonio J. Conejo

Renewable energy sources play an increasingly significant role in current power systems. Despite of the numerous advantages of renewable sources, most of them are non-dispatchable and cannot be continuously controlled by the system operator. This complicates the operation of power systems with large renewable integration. We propose an operational tool to be used in power systems including wind farms and biomass units. Opposite to wind units, biomass plants are dispatchable and can be used to counteract the wind power uncertainty. An example is presented to illustrate the proposed model.

2 - A multi-stage stochastic programming model for investments in natural gas infrastructure
Asgeir Tomasgard, Applied economics and operations research, Sintef Technology and society, Trondheim, Norway, asgeir.tomasgard@sintef.no

We present a multistage stochastic model that evaluates investments in natural gas infrastructure, taking into account existing and planned design. The uncertainty facing the decision makers include both upstream and downstream uncertainty, such as: reservoir volumes, the composition of the gas in new reservoirs, market demand and price levels. The model integrates analysis of long-term and short-term uncertainty.

3 - A multistage stochastic model for the electric power generation capacity expansion problem under different risk measures.
Maria Teresa Vespucci, Department of Information Technology and Mathematical Methods, University of Bergamo, via Marconi, 5a, 24044, Dalmine (BG), Italy, mtvespucci@tin.it, Marida Bertocchi, Laureano Fernando Escudero, Stefano Zigrino

We consider the electric power generation capacity expansion problem, over a long horizon of a price-taker power producer, who has to choose among thermal power plants and power plants using renewable energy sources (RES), while considering regulatory constraints on CO2 emissions, incentives to generation from RES and risk. The maximization of the expected profit will be subject, alternatively, to CVaR, to first-order stochastic dominance constraints (SDC), and to second-order SDC. Results of a computational comparison between the above risk measures will be reported.

1 - Incorporating uncertainty in Energy Management Optimization Problems: A long and winding road
Stream: Stochastic Programming
Chair: Sandrine Charousset-brignon, OSIRIS, EDF, 1 Avenue du Général de Gaulle, 92141, CLAMART Cedex, France, sandrine.charousset@edf.fr
Chair: Wim van Ackooij, OSIRIS, EDF R&D, 1 Avenue du General de Gaulle, 92141, Clamart, France, wim.van-ackooij@edf.fr

Uncertainty plays a key role in Energy management optimization problems. The difficulty of incorporating it in decision making tools resides in the intractability of fully general stochastic optimization problems. Even stochastic dynamic programming struggles for realistically sized models. For this reason many heuristics are used in practice. In this talk, we will discuss some of these and emphasize the importance of properly integrating uncertainty.

2 - Towards a Multi-stage Robust Formulation for the Nuclear Reactor Outage Scheduling Problem
Nicolas Dupin, univ Bordeaux1 - EDF R&D, 33405, Talence, France, Nicolas.Dupin@math.u-bordeaux1.fr, Marc Porcheron, Pascale Bendotti

Each month EDF staff computes nuclear reactor outage dates and refueling quantities over a multi-year forecast. The schedule has to comply with various constraints. Problem data is subject to uncertainty in generation capacity as well as outage duration, and monthly updates lead to uncontrolled changes in the forecast not compatible with stability requirements. A multi-stage robust formulation with “adaptive” recourse on dates is proposed for a simplified problem involving uncertainty on outage duration.

3 - Modeling the residential electrical load curve: a stochastic algorithm for realistically starting the domestic appliances
Arnaud Grandjean, Enerbat, EDF R&D, Site des Renardières, Avenue des Renardières, Bâtiment W 49-51, 77818, Moret sur Loing, France, arnaud-2.grandjean@edf.fr

The electrical load curve is an essential tool in the electricity supply field. The power demand curve of the domestic sector is particularly interesting because a series of technical and behavioural breaks are going to impact on it in a near future. In order to enhance the knowledge of the residential load curve, we built a bottom-up, technically explicit reconstitution model. One of its key points is the way electrical ends are launched within the day. We propose a new stochastic algorithm that realistically starts the domestic appliances without “simply” reproducing metered data.

MC-45
Monday, 12:30-14:00
BW-Water
Management accounting and management control 1

Stream: Simulation in Management Accounting and Management Control
Invited session
Chair: Stephan Leitner, Dept. for Controlling and Strategic Management, Alpen-Adria-Universität Klagenfurt, Universitätsstrasse 65-67, 9020, Klagenfurt, Austria, stephan.leitner@uni-klu.ac.at

1 - Agent-based simulation analysis of performance measurement systems considering uncertainties of a learning model
Yusuke Goto, Dept. of Software & Information Science, Iwate Prefectural University, 152-52, Sago, 020-0193, Takizawa, Iwate, Japan, y-goto@iwate-pu.ac.jp, Shingo Takahashi

The agents’ learning model is considered highly contingent on organizational culture, various environmental factors, individual characteristics, etc. It is difficult to specify the agents’ learning model by an empirical investigation into the real organization to be modeled, while the agents’ learning model is an essential module of the agent-based model to analyze the effectiveness of performance measurement systems (PMSs) under a given situation. We conduct scenario analysis of PMSs considering uncertainties of agents’ learning model. Several learning models are to be analyzed.

MC-44
Monday, 12:30-14:00
BW-Marble
Incorporating uncertainty in Energy Management Optimization Problems: A long and winding road

Stream: Stochastic Programming
Invited session
Chair: Sandrine Charousset-brignon, OSIRIS, EDF, 1 Avenue du Général de Gaulle, 92141, CLAMART Cedex, France, sandrine.charousset@edf.fr
Chair: Wim van Ackooij, OSIRIS, EDF R&D, 1 Avenue du General de Gaulle, 92141, Clamart, France, wim.van-ackooij@edf.fr

1 - Incorporating uncertainty in large scale Energy Management Optimization Problems in practice.
Sandrine Charousset-brignon, OSIRIS, EDF, 1 Avenue du Général de Gaulle, 92141, CLAMART Cedex, France, sandrine.charousset@edf.fr

1 - Agent-based simulation analysis of performance measurement systems considering uncertainties of a learning model
Yusuke Goto, Dept. of Software & Information Science, Iwate Prefectural University, 152-52, Sago, 020-0193, Takizawa, Iwate, Japan, y-goto@iwate-pu.ac.jp, Shingo Takahashi

The agents’ learning model is considered highly contingent on organizational culture, various environmental factors, individual characteristics, etc. It is difficult to specify the agents’ learning model by an empirical investigation into the real organization to be modeled, while the agents’ learning model is an essential module of the agent-based model to analyze the effectiveness of performance measurement systems (PMSs) under a given situation. We conduct scenario analysis of PMSs considering uncertainties of agents’ learning model. Several learning models are to be analyzed.

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2 - A computational tool for performing production and warehouse budgets in an environment with uncertainty and seasonality

Jairo Coronado-Hernandez, Ingeniería Industrial, Universidad Tecnológica de Bolívar, 130001, Cartagena de indias, Bolívar, Colombia, jcoronado@unitecnologica.edu.co, José P. Garcia-Sabater

Our problem is framed in a multi-product, -period and a limited production and storage capacity. We intend that the generated budget is robust to fluctuations and seasonality of demand subject to the limitations of system and requirements. We propose a method of 3 stages: i. the demand is time-disaggregated; ii. objective stock levels are calculated with a fuzzy linear programming model with the aim of providing a long-term vision to the three stage models; iii. developing the budget structured in a set of scenarios as a consequence of a simulation/optimization in rolling horizon.

3 - Simulation comparison of relative and absolute operators for the inference of criteria weights from discordance related information

Andrej Bregar, Informatika, Vetrinjska ulica 2, 2000, Maribor, Slovenia, andrej.bregar@informatika.si

Several methods/operators exhibiting various levels of relativeness are introduced for the automatic derivation of criteria weights according to selective effects of veto. They are applicable to outranking and MAUT based methods, whereby in the case of MAUT a special criterion type is proposed to allow for veto modeling in the form of global discordance functions. Absolute and relative measurements are studied with a simulation based experiment, which considers sensitivity to inputs, rank reversals, richness of information and ability to discriminate conflicting alternatives.

4 - Financial structure optimization by using an adapted goal programming method

Tunjo Peric, Bakeries Sunce, Komedini 1, 10090, Zagreb, Croatia, tunjo.peric1@zg.t-com.hr, Zoran Babic

This paper proposes an adapted goal programming method for solving multiscriteria fractional linear programming models. The proposed methodology is tested on the example of company’s financial structure optimization. The obtained results indicate the possibility of efficient application of the proposed methodology for company’s financial structure optimization as well as for solving other multiscriteria fractional programming problems.

Monday, 14:30-16:00

■ MD-01

Monday, 14:30-16:00

RB-Alfa

Tutorial Lecture: Professor Kenneth Sörensen

Stream: Keynote, Tutorial and Plenary Lectures

Tutorial session

Chair: Marc Sevaux, Lab-STICC - CNRS UMR 3192, Université de Bretagne Sud - UEB, Centre de Recherche - BP 92116, 2 rue de Saint Maude, 56321, Lorient, France, marc.sevaux@univ-ubs.fr

1 - Metaheuristics - the metaphor exposed

Kenneth Sörensen, Faculty of Applied Economics, University of Antwerp, Prinsstraat 13, 2000, Antwerpen, Belgium, kenneth.sorensen@ua.ac.be

In recent years, the field of combinatorial optimization has witnessed a true tsunami of ‘new’ metaheuristic methods, most of them based on a metaphor of some natural process. The behavior of virtually any species of insects, the flow of water, musicians playing together, it seems that no ideas are too far-fetched to serve as inspiration to launch yet another metaheuristic. In this tutorial, we will critically investigate whether the resulting methods are truly original, or just a repackaging of old ideas. In general, the usefulness of metaphor-based methods will be put to the test.

On the other side of the spectrum, researchers in metaheuristics are picking up ideas traditionally found in exact methods only, such as an intelligent decomposition of the problem and the use of exact methods to solve subproblems. In some problem domains such as vehicle routing or scheduling, a consensus is starting to condense on which ideas and which methods work and which do not. This is the result of many years of development of ever more powerful metaheuristics, combined with a careful study of the combinatorial properties of the problem. Additionally, deconstructing of a method, combined with statistical testing of the components and parameters of a metaheuristic can reveal those components and parameter settings that truly contribute to the performance.

The main aim of this talk is to provide some guidelines on how to develop an efficient and effective metaheuristic. We will show that the way forward is through the rigorous use of scientific methods, rather than through the indiscriminate introduction of yet another metaphor.

■ MD-02

Monday, 14:30-16:00

RB-Beta

Scheduling models in Logistics

Stream: Scheduling

Invited session

Chair: Dirk Briskorn, University of Siegen, Germany,
dirk.briskorn@uni-siegen.de

1 - Determining crane areas for balancing workload among interfering and non-interfering cranes

Nils Boysen, Lehrstuhl für ABWL/ Operations Management, Friedrich-Schiller-Universität Jena, Carl-Zeiß-Str. 3, 07743, Jena, Germany, nils.boysen@uni-jena.de, Malte Fliedner, Simon Einde

This paper treats the problem of subdividing an area for storing containers, such that the workload is evenly shared among the cranes operating the resulting subareas. We consider two crane sets: while non-crossing constraints between cranes of the same set need to be observed, cranes of different sets do not interfere. This problem is, for instance, relevant for scheduling the (un-)loading of vessels by parallel quay cranes operating on opposing berths. We formalize the resulting optimization problem, prove computational complexity, and present exact and heuristic solution procedures.
2 - Packing chained items into bins with applications to container handling and project scheduling
Malte Fliedner, TU Darmstadt, Hochschulstrasse 1, 64289, Darmstadt, Hessen, Germany, fliedner@bwl.tu-darmstadt.de, Dirk Briskorn

In this work we study a variant of the well-known bin packing problem where items are subject to chaining constraints. The problem is encountered in rail container terminals, but can also be seen as a basic scheduling problem under partially renewable resources. We provide complexity results for its decision version and develop exact solution approaches with (pseudo-)polynomial runtime for specific subproblems. We further investigate two optimization versions of the problem and provide efficient approximation algorithms.

3 - A dynamic programming approach to the aircraft landing problem with aircraft classes
Alexander Lieder, Chair of production management, University of Mannheim, Schloss, Schneedekhof Ost, 68131, Mannheim, Germany, lieder@uni-mannheim.de, Raik Stolletz, Dirk Briskorn

The static aircraft landing problem is to find a minimum-cost schedule of aircraft landings while assuring that the necessary separation time between two landings is kept. By assuming a limited number of aircraft classes with common separation times and cost functions, the problem can be solved to optimality in polynomial time. We present a dynamic programming approach which is able to solve medium-sized problem instances (30-50 aircraft), that take hours to be solved by a MIP solver and could be solved within seconds. To cope with larger instances, a CPS-heuristic has been implemented.

4 - Scheduling of the batch annealing process in a fastener company
Ceyhun Araz, Industrial Engineering Dept., Celal Bayar University, Turkey, ceyhun.araz@cbu.edu.tr, Oguz Eski, Levent Bayoglu, Filiz Turan

This study deals with the scheduling problem for the batch annealing process in the heat treatment of steel coils. It is a parallel-machine multi-product scheduling problem with constraints on products including material type and size. The multiple objectives in scheduling the batch annealing process are to minimize total tardiness of steel coils and to maximize coil stacks throughput. The scheduling algorithm developed was applied to the batch annealing shop in Norm Fasteners Co., Turkey. The industrial application shows the effectiveness of the developed scheduling algorithm.

2 - The Line Traveling Salesman with partial ordering
Thierry Benoist, e-lab, Bouygues SA, 32 avenue Hoche, 75008, PARIS, France, tbenoist@bouygues.com, Antoine Jeanjean, Vincent Jost

The Line Traveling Salesman with Partial Order is a variant of the Traveling Salesman Problem, where the cities to be visited lie on a line, the distance between two cities is the absolute difference between their abscissae and a partial ordering is given on the set of cities. We prove that this problem, encountered on linear construction schemes, is NP-complete. Using key dominance properties and lower bounds, we design a call-based dynamic program able to solve instances with up to 450 cities.

3 - Degrees of freedom in calculating inventory-carrying costs: a simulation study
Christoph Siepermann, Faculty of Mathematics and Economics, Ulm University, Helmholtzstr. 22, 89081, Ulm, Germany, christoph.siepermann@uni-ulm.de

The determination of inventory-carrying costs causes serious problems which result amongst others from different ways of calculating the average capital tied up in storage. The paper tries to estimate, by means of a simulation study, the extent of differences between the various ways of determining the average value of inventory as they can occur in practice. It will be shown that, under certain circumstances, the different formulas for calculating the average value of inventory can lead to quite different results and therefore to degrees of freedom in determining inventory-carrying costs.

4 - The Target Visitation Problem
Achim Hildenbrandt, Computer Science, Ruprecht-Karls-University Heidelberg, Im Neuenheimer Feld 368, Room 104, 69120, Heidelberg, Baden-Württemberg, Germany, achim.hildenbrandt@informatik.uni-heidelberg.de, Gerhard Reinelt

The target visitation problem (TVP) is concerned with finding a route to visit a set of targets starting from and returning to some base. In addition to the distance travelled a tour is evaluated also by taking into account preferences which address the sequence in which the targets are visited. The problem is thus a combination of two well known optimization problems: the travelling salesman and the linear ordering problem. In our talk we point out some properties of the complex but nevertheless interesting polyhedral structure and show approaches to solve the TVP to optimality.

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**MD-03**

**Monday, 14:30-16:00**

**RB-L1**

**Logistics, Transportation, Traffic - 1**

**Stream:** Logistics, Transportation, Traffic

**Contributed session**

**Chair:** Thierry Benoist, e-lab, Bouygues SA, 32 avenue Hoche, 75008, PARIS, France, tbenoist@bouygues.com

1 - Two-stage vehicle routing problem with dynamic selection of entrepots

Juraj Pekář, Department of Operations Research and Econometrics, University of Economics, Dolnozemská 1, 85235, Bratislava, Slovakia, pekar@euba.sk, Ivan Brezina, Zuzana Čičková

The paper presents two-stage vehicle routing problem with dynamic selection of entrepots. The goal is to carry the goods from a central store to the entrepots with the use of different types of vehicles as from entrepots to final customers. The problem could not be decomposed into two separate one-stage problems, since the selection of entrepots is realized dynamically from the selected set of nodes. The object is to construct a mathematical model, so that the total costs of delivery of goods were as low as possible.

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**MD-04**

**Monday, 14:30-16:00**

**RB-L2**

**Optimal Control II**

**Stream:** Optimal Control

**Invited session**

**Chair:** Gernot Tragler, OR and Control Systems, Vienna University of Technology, Argentinierstr. 8/105-4, A-1040, Vienna, Austria, tragler@eos.tuwien.ac.at

1 - Normality of the maximum principle for the Bolza problem under state and end point constraints

Daniela Tonon, Institut de mathématiques de Jussieu, Universite Pierre et Marie Curie Paris 6, 4 Place Jussieu, 75252, Paris, France, tonondaniela83@gmail.com, Helene Frankowska

It is well known that every strong local minimizer of the Bolza problem under state constraints satisfies a constrained maximum principle. Its normality is very useful for investigating the Lipschitz continuity of local minimizers, for regularity of the adjoint state and optimal controls and for derivation of higher order optimality conditions. We present sufficient conditions for normality of optimal trajectories in the presence of general state and end point constraints. This is accomplished thanks to a new inward pointing condition applicable to unbounded control systems.
2 - Network based computing environment for solving optimal control problems
Radoslaw Pytlak, Mechatronics, Institute of Automatic Control and Robotics, Warsaw University, of Technology, 02-525, Warsaw, Poland, r.pytlak@mchtr.pw.edu.pl, Tomasz Tarnawski, Mariusz Kaleta, Tomasz Stawinski
The aim of the presentation is to show the current state of work on computing environment IDOS (Interactive Dynamic Optimization Server) which enables solving optimal control problems by using Internet services. The computing environment is equipped with dynamic optimization modeling language — DOML which is an extension of Mod elica language. The presentation will focus on optimization solvers for optimal control problems with integer valued controls; elements of DOML language; mechanism of adding new solvers to the environment. Also the use of the environment IDOS will be discussed.

3 - Dynamic Programming Approach to Optimal Control Problems with Pure State Constraints
Daniel Hoehener, Institut de Mathematiques de Jussieu, Universite Pierre et Marie Curie, 4 place Jussieu, 75005, Paris, France, hoehener@math.jussieu.fr, Giancarlo Facchi
We consider an optimal control problem with pure state constraints. It is well-known that the dynamic programming principle allows to prove that the value function is a generalized solution of the HJB equation. By using viability techniques, we show that the value function is actually the unique solution of the HJB equation, even if the dynamics are discontinuous in the time variable. The main novelty of the proof is an approximation result of feasible trajectories by trajectories lying in the interior of the constraints. Such approximations have also other applications in control theory.

4 - Determining the optimal strategies for stochastic control problem with finite time horizon
Dmitrii Lozovanu, Institute of Mathematics and Computer Science, Academy of Sciences of Moldova, Academiei 5, IMI, MD-2020, Chisinau, Moldova, Moldova, Republic Of, lozovanu@math.md
The stochastic version of classical discrete optimal control problem with finite set of states and finite time horizon is formulated and studied. In the considered problem we assume that the dynamic system may admit states in which the vector of control parameters is changed randomly and we are seeking for a strategy that minimize the expected total cost during a given number of state transitions. We show that the optimal solution of the stochastic problem can be found by the backward dynamic programming method.

2 - Heuristics for Stochastic and Dynamic Maritime Pickup and Delivery Problems
Lars Magnus Hvattum, Dept of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Alfred Getz veg 3, Sentralbygg 1, N-7491, Trondheim, Norway, lars.m hvattum@iot.ntnu.no, Gregorio Tirado, Kjetil Fagerholt, Jean-François Cordeau
Recent years have shown that static and deterministic vehicle routing problems can be solved to near optimality with acceptable computational times using metaheuristics. However, many real world applications are dynamic and include stochastic aspects, such as unknown future customer requests. Explicitly taking into account available stochastic information may yield benefits in these cases. Here, three different heuristics are considered and evaluated in terms of their ability to minimize transportation costs in a dynamic and stochastic maritime planning problem.

3 - Modeling ballast water in container stowage planning
Dario Pacino, IT-University of Copenhagen, Rued Laangaard Vej 7, 2300, Copenhagen, Denmark, dpacino@itu.dk, Alberto Delgado, Rune Jensen
Automated stowage planning has come to the attention of the industry. Published work in this area assumes constant displacement of the vessels, which simplifies the linearization of the hydrostatic calculation. In those models ballast tanks are not taken into account. Since ballast water can contribute up to 25% of the total displacement, ignoring it could become a great source of error. We present a model for stowage planning with ballast tanks and show how to handle the non-linearities that variable displacement forces on the model. Preliminary results show the feasibility of this approach.

4 - Fleet deployment with speed optimization
Henrik Andersson, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Gløshaugen, Alfred Getz vei 3, NO-7491, Trondheim, Norway, Henrik.Andersson@iot.ntnu.no, Kjetil Fagerholt, Kirsti Hobbesland
We will present a rolling horizon heuristic for a fleet deployment problem with speed optimization. The heuristic is tested on real world instances from one of the largest car transporters of the world and shows good results.

MD-05
Monday, 14:30-16:00
RB-L3
Maritime Transportation 2
Stream: Maritime Transportation
Invited session
Chair: Henrik Andersson, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Gløshaugen, Alfred Getz vei 3, NO-7491, Trondheim, Norway, Henrik.Andersson@iot.ntnu.no

1 - Maritime transport as an important link in the global supply chain
Algirdas Sakalys, Competence Centre of Intermodal Transport and Logistics, Vilnius Gediminas Technical University, Pyltyns st. 27, LT-10105, Vilnius, Lithuania, algirdas.sakalys@vgtu.lt
The East West Transport Corridor, connecting northern Europe with Russia and Far East is an excellent platform to develop an innovative pilot testing ground where modern technology and information systems contribute to increased safety and security as well as reduced environmental impact in the corridor. The corridor stands out as green transport corridor which will reflect an integrated transport concept where Short Sea Shipping, rail, inland water ways and road complement each other to enable the choice of environment friendly transport.

2 - Heuristics for Stochastic and Dynamic Maritime Pickup and Delivery Problems
Lars Magnus Hvattum, Dept of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Alfred Getz veg 3, Sentralbygg 1, N-7491, Trondheim, Norway, lars.m hvattum@iot.ntnu.no, Gregorio Tirado, Kjetil Fagerholt, Jean-François Cordeau
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4 - Fleet deployment with speed optimization
Henrik Andersson, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Gløshaugen, Alfred Getz vei 3, NO-7491, Trondheim, Norway, Henrik.Andersson@iot.ntnu.no, Kjetil Fagerholt, Kirsti Hobbesland
We will present a rolling horizon heuristic for a fleet deployment problem with speed optimization. The heuristic is tested on real world instances from one of the largest car transporters of the world and shows good results.
2 - Comparing metaheuristics for the Time-Dependent Orienteering Problem
Cédric Verbeeck, Industrial management, Gent University, Technologypark 903, B-9052, Zwijnaarde, Belgium, cedricverbeeck@gmail.com, Pieter Vansteenwegen
This research focuses on developing and comparing efficient solution methods to solve time-dependent orienteering problems (TD-OP) in real time. A time dependent local search move and local evaluation metric have been successfully implemented together with three basic metaheuristic frameworks. Two instances were developed in a way to simulate real life congestion patterns. Comparing the results proves that obtaining solutions in real-time is feasible. Currently, instances are being developed so that the optimal solution is known, providing more insight in the obtained results.

3 - A Tabu Search Method for a Cement Delivery Problem
Marc Uldry, Département d’Informatique, Université de Fribourg, Boulevard de Pérolles 90, 1700, Fribourg, Switzerland, marc.uldry@unifr.ch, Alain Hertz, Marino Widmer
We consider a cement delivery problem with a heterogeneous fleet of vehicles and several depots. The orders are often larger than the vehicle capacity; consequently, most customers are visited several times. This is a split delivery vehicle routing problem with additional constraints. A Tabu Search resolution method is first described. Experiments on real life instances are then performed. Comparisons between these results, those obtained using a MILP formulation and those given by the cement supplier company are also presented. Tabu Search produces better results in a few minutes.

4 - A multi-objective inventory routing problem for sustainable waste management under uncertainty
Pamela Nolz, Department of Information Systems and Operations, Vienna University of Economics and Business, Nordbergstrasse 15, 1090, Vienna, Austria, pamela.nolz@wu.ac.at, Nabil Absi, Dominique Feillet
We formulate a stochastic inventory routing problem for infectious medical waste collection minimizing two criteria: (i) distribution costs comprising routing costs and fixed costs incurred each time a tour is planned, (ii) expected inventory costs reflecting social objectives, specifically the satisfaction of pharmacists and patients, as well as the minimization of public health risks. We develop a hybrid multi-objective solution approach integrating an adaptive large neighborhood search into an evolutionary algorithm. Computational experiments are performed for real-world problem instances.

2 - The effects of inaccurate information on the queue joining policy
David Raz, Management of Technology, Holon Institute of Technology, Holon, Israel, davidra@hit.ac.il
The efficiency aspects of the queue joining policy were thoroughly studied, starting probably with Winston (1977). It is widely accepted that the Shortest Queue (SQ) policy is optimal, with some counterexamples noted by Whitt in 1986. However, the body of research assumes information is fully available and accurate, which is not always the case. In this work we study the effects of inaccurate or missing information on the efficiency and fairness of the queue joining policy. The results show that SQ may not always be the optimal policy to use, if the information is incomplete.

3 - Free Riding Solution for Hybrid P2P Networks
Amad Mourad, LAMOS, Bejaia University, Bejaia, Algeria, amad.mourad@gmail.com, Djamil Aïssani, Moumen Hamouuna
Free riding is an important problem in P2P networks in which nodes take without giving, they benefit from shared resources without sharing their own. The objective of our study is to ensure the collective participation of P2P members, by encouraging them to be more active. For this, we introduce a new solution against free riders; it is based on friend’s lists in each peer, adding only peers that share interesting contents. A queuing mechanism with priority is also used at each super peer. This priority is calculated based on the number of peer’s friends and their free times.

4 - Optimizing energy consumption of telecommunication networks
Axel Werner, Optimization, Zuse Institut Berlin (ZIB), Takustr 7, D-14195, Berlin-Dahlem, Germany, werner@zib.de
Already today, a considerable part of energy worldwide is spent on the operation of telecommunication networks. With steadily growing internet traffic this share will further increase, unless energy consumption of future networks is optimized and adapted to switched traffic instead of provided capacity. We present mixed integer programming models for the optimization of multi-layer telecommunication networks using load-adaptive equipment and dynamic energy management. We discuss preliminary results of computations, based on snlplib instances, as well as networks by Deutsche Telekom.
2 - A Circle Covering approach to the Nesting problem

Pedro Rocha, INESC TEC, Faculdade de Engenharia, Universidade do Porto, 4200-465, Porto, Portugal, pmonteirorocha@sapo.pt, Rui Rodrigues, A. Miguel Gomes

Circle Covering (CC) problems aim to completely cover a region with the minimum number of circles. With an efficient coverage, the region can be accurately represented by the set of circles. In Nesting problems, pieces need efficient collision detection for their placement. We propose to solve Nesting problems with an approach based on circle covering to represent irregular shapes and non-linear models to compute placement positions.

3 - Packing spherical caps in high dimensional spaces

Cristiano Torezzan, School of Applied Sciences, University of Campinas, Brazil, cristiano.torezzan@fca.unicamp.br, Sueli Costa

We consider the problem of packing a large number of equal spherical caps on the surface of the unit sphere. This problem is closely related to the kissing number problem and applications have appeared in different areas. Although good approaches are known, most of them become infeasible when either the number of caps or the dimension grows. We present a new modeling which allows to reduce the problem to the one of packing circles in a box in the half of the dimension. Several examples are presented, some of them are the biggest known constructive solutions in high dimensions (e.g. 16, 24).

4 - A comparative study of 2D irregular object geometry modelling solutions for cutting and packing problems

Ozgur Kulak, Çorlu Engineering Faculty, Namuk Kemal University, N.K.Ü. Çorlu Mühendislik Fakültesi, Silahtar Mahallesi, Sinan Dede Mvkk 15 Hrist. Yolu 3. km, Çorlu, 59860, Tekirdağ, Turkey, okulak@nku.edu.tr

Industrially applicable packing and cutting solutions need to achieve both a tightly fitting irregular object geometry modeling and a fast placement optimization by computationally effective intersection, translation and rotation operations. Modeling scalability is also important for different approximation requirements of concurrent optimization algorithms. In this study, classical object boundary geometry modeling and alternative quad tree modeling technique are compared with respect to representation quality, scalability, processing time per intersection, rotation and translation operation.

2 - A single-period inventory placement problem for a supply system with the satisfying objective

Piotr Stalinski, Department of Quantitative Methods in Management, WSB-NLU, ul. Zielona 27, 33-300, Nowy Sacz, Poland, piotr_stalinski@yahoo.com, Chia-Shin Chung, James Flynn, Roelof Kuik

Consider the inventory placement problem in an N-stage supply system facing a stochastic demand for a single planning period. Each stage is a stocking point holding some form of inventory that after a suitable transformation can satisfy demand. Stocking decisions are made before demand occurs. The objective is to maximize the probability of achieving a given profit level. We prove the existence of optimal stocking decisions that utilize at most three stages in the supply system. We characterize properties of the optimal stocking decisions and provide an efficient algorithm for computing them.

3 - An inventory model with partial backorders assuming uniform demand

Joaquín Sicilia, Dpt. de Estadística, Investigación Operativa y Computación, Universidad de La Laguna, Facultad de Matemáticas, Avda. Astrofísico Francisco Sánchez s/n, 38271, La Laguna, Tenerife, Canary Islands, Spain, jsicilia@ull.es, Valentín Pando, Luis A. San-José, Juan García-Laguna

In this work a stochastic inventory problem with additional order is studied. If the system is out of stock at the selling period, the vendor orders an extra lot size to satisfy a percentage of unmet demand. We assume the backorder rate depends on the amount of shortage and the fraction of demand served with delay is described by a co-sinusoidal non-increasing function of the unmet demand. Our objective consists of determining the optimal order size that maximizes the expected total profit when demand is uniformly distributed. Sensitivity analysis and numerical examples are also presented.

4 - Inventory Control Under The Carbon Emission Trading Scheme

Marthy Stivaliz García Alvarado, Departement of Automated Manufacturing Engineering, École de technologie supérieure, 1100, rue Notre-Dame Ouest, H3C 1K3, Montreal, Quebec, Canada, marthy-stivaliz.garcia-alvarado.1@ens.etsmtl.ca, Marc Paquet, Amin Chaabane

Inventories have proven to be crucial in logistics. While new trends force the integration of sustainable development into supply chain operations, the carbon emission trading scheme seems to be a good way to achieve sustainable development efficiently. This integration has raised new questions related to how inventory methods should be adapted to include carbon trading. In this talk will discuss the challenges of inventory modeling. Moreover, through a stochastic inventory model, we show the direct link between the sustainability objective and inventory control policies.
Reduction of vehicle emissions is related to the improve of life quality and sustainability. To estimate emissions on large scale urban network, approaches based on aggregated traffic estimates are followed, without considering temporal variations of traffic conditions. The study wants to develop a method to estimate pollutant emissions taking into account the within-day variations of traffic conditions and parameters related to the different state of vehicles and that can easily be applied to evaluate the results of off-line and on-line traffic management strategies in large urban network.

2 - Implementation of variable speed systems in an access road (c 31 n) to barcelona

M. Antonia de los Santos, Mechanical Engineering, UPC, Diagonal 647, 08028, Barcelona, Spain, tania.santos@upc.edu, David Gallegos, Francisco Liesa

The city of Barcelona was the first in Spain to introduce variable speed systems as a strategic tool to improve traffic conditions in 2009, in the roads C32 and C31S. The C31N is a main access road to Barcelona where these systems could be installed. The present work evaluates potential benefits that the implementation of these intelligent systems involves. In order to achieve this target, a virtual model of the road is created, analysing and defining the traffic flow running in the road. To check global potential benefits, 3 more cases are analysed including specific traffic jam situations.

3 - Green timing and scheduling: an approach based on genetic algorithms

Giulio Ernesto Cantarella, Dept of Civil Engineering, University of Salerno, via Ponte Don Melillo, 1, 84084, Fisciano (SA), Italy, g.cantarella@unisa.it, Roberta Di Pace

This paper proposes an approach to traffic light optimization at a single junction through genetic algorithms. Decision variables are green times and their scheduling. Maximization of capacity and minimization of delay are considered as objectives, also taking into account maximum queue length constraints. This approach seems relevant since it can be extended to signal synchronization with optimization of green scheduling, differently from current practice. This research is a part of a project aiming at urban network design including optimization of traffic lights and street lane allocation.

4 - Estimation of traffic flow conditions through data fusion techniques

Livia Mannini, Dep. of Civil Engineering, Roma Tre University, Italy, lmannini@uniroma3.it, Ernesto Cipriani, Stefano Gori

Starting from the application of the procedure reported in Wang, Papa-georgiou (2005) based on the correction through the Extended Kalman Filter (EKF) of the second order traffic model, also probe vehicles measurements have been taken into account, added to the conventional fixed ones. Several simulations have been carried out with Matlab. Different data fusion techniques have been analyzed, specifically, the fusion of measurements, rather than the fusion of estimations, has revealed to be more effective in improving EKF estimation.

Lot-sizing and Related Topics 4

Stream: Lot-sizing and Related Topics

Invited session

Chair: Luis Guimarães, Industrial Engineering and Management, Faculty of Engineering of Porto University, FEUP, Portugal, luis.santos.guimaraes@gmail.com

1 - The integrated lot sizing and scheduling problem in the brewery: model and MIP-based heuristic

Maristella Santos, Department of Applied Mathematics and Statistics, University of São Paulo, Av. Trabalhador São-carlense, 400 - Centro, Caixa Postal: 668, 13560-970, São Carlos, São Paulo, Brazil, mari@icmc.usp.br, Tamara Baldo, Reinaldo Morabito, Bernardo Almada-Lobo

This paper addresses the lot-sizing problem in the brewery industry. This problem is composed of two stages: the preparation and bottling of the liquids. The first stage may span over several days due to

Consistency of preferences is usually a desirable situation in decision making processes based on preference relations, e.g. the AHP. A relatively large number of inconsistency indices has been proposed in literature in order to estimate inconsistency of preference. We propose a study of inconsistency with respect to consensus where we analyze how the inconsistency of the consensual preference relation is affected by the inconsistency of the single decision makers. In particular, we will reason and dwell on the positive effects of consensus on the consistency of preferences.

2 - Error based decision making on approximation methods under fuzziness

Svetlana Amsuss, Department of Mathematics, University of Latvia, Zellu street 8, LV-1002, Riga, Latvia, svetlana.amsuss@lu.lv, Vecislavs Ruza

We present a methodology of decision making on approximation methods under uncertainty given by fuzzy sets. We consider approximation of real valued functions when a set we approximate over is fuzzy, meaning that our interest is more focused at some parts of the set. In order to estimate the quality of algorithms, we introduce an appropriate fuzzy analogue of a norm using a fuzzy valued integral and describe a method of its evaluation. In this context, for approximation methods we obtain fuzzy valued error bounds for some classes of functions and discuss criteria of the error optimal decision.

3 - Indirect sociomapping

Cyril Höschl, QED GROUP, Czech Republic, cyril.hoschl@qedgroup.cz, Radvan Bahbouh

Indirect sociomapping enables comparison of people as to similarity of their data profiles. The degree of belonging to the fuzzy set of similarity is determined by the p-values for the statistical test comparing both of the individual data profiles. Results are represented in the form of a landscape, with the distances corresponding to the degree of similarity and the heights showing the overall similarity to the other units in the system. This landscape can be used as an interactive interface to formulate statistical tests and visualize their results.

4 - Sociomapping of communication

a radvan bahbouh, QED GROUP, Czech Republic, radvan.bahbouh@qedgroup.cz, Cyril Höschl

Sociomapping makes it possible to analyse and visualise communications in teams and organizations. This method is based on representing the communication interconnectedness through the degree of belonging to the fuzzy sets of communication nearness. The obtained fuzzy models can be mutually compared; this allows capturing of stable communication patterns, as well as of developmental trends. Subsequently, the data are depicted in the form of a landscape. Sociomapping is used in preparing teams for foreign military missions, in experiments simulating flight to Mars, and in management teams, etc.
to the fermentation process which complicates the synchronization of both stages. We propose a new mixed integer model for it considering multiple tanks and bottling lines. The model differs from those of the literature on the first stage decisions and requirements. A MIP-based heuristic is developed to obtain solutions capable of addressing the process and preliminary results are presented.

2 - Dynamic lot sizing problem with minimum order quantities and remanufacturing option
Irena Okhrin, Juniorprofessor in Information & Operations Management, European University Viadrina, Grosse Scharrnstrasse 59, 15230, Frankfurt (Oder), Germany, irena.okhrin@europa.uni.de, Knut Richter

We focus on a special uncapacitated lot sizing problem where a manufacturer can meet demand by either producing new items or by remanufacturing used items. Additionally, a minimum order quantity restriction, instead of the setup cost, guarantees a certain level of production lots. A general model of this problem is formulated and several useful properties of the optimal solution structure are investigated. Finally, we develop a one-dimensional dynamic programming procedure for the originally two-dimensional dynamic model that generates the optimal production plan for some special cases.

3 - Simultaneous production-distribution planning to coordinate multi-plant supply chains
Luis Guimarães, Industrial Engineering and Management, Faculty of Engineering of Porto University, FEUP, Portugal, luis.santos.guimaraes@gmail.com, Diego Klabin, Bernardo Almada-Lobo

Inspired by a real case, we present a model and solution approach for production-distribution planning in multi-plant, multi-warehouse supply chains. The model assigns and schedules production lots to a set of machines, available at each plant, determining overtime, inventory and transportation quantities. The objective is to minimize overall cost while satisfying a deterministic demand triggered at the warehouses. The solution approach is based on the model using VNS to fix and improve lots allocation guided by the sensitivity analysis of the LP solved to determine the remaining decisions.

4 - Scheduling jobs with values dependent on their completion times
Moshe Kaspi, Management, Ben-Gurion University of the Negev, POB 653, 81054, Beer Sheva, Israel, dvirs@bgu.ac.il, Liron Yedidson, Moshe Kaspi

We extend the linear sum assignment problem to the case where the assignment cost is a function of the amount of resource allocated to the agent. A solution is defined by the assignment of agents to tasks and by a resource allocation vector. The quality of a solution is measured by two criteria: the total assignment cost and the total weighted resource consumption. We address these criteria via four problem variations and prove that three of them are NP-hard. In addition, we find that our problem is equivalent to a large set of scheduling problems whose complexity has been an open question.

2 - Parallel machine scheduling with a variable common due window
Mikhail Y. Kovalyov, United Institute of Informatics Problems, National Academy of Sciences of Belarus, Surganova 6, 220012, Minsk, Belarus, kovalyov_my@yahoo.co.uk, Adam Janiak, Wladyslaw Janiak, Erhan Kozan, Erwin Pesch

We study problems of scheduling jobs on identical parallel machines, with a common due window to be assigned to all jobs. The objective is to minimize the sum of job earliness, job tardiness, due window location and size costs, which are nondecreasing job independent functions. Solution properties are established and dynamic programming algorithms are derived. Polynomial algorithm is given for the single machine case, in which the due window size cost is a discrete convex or concave nondecreasing function and all the other cost functions are linear.

3 - Structural properties of time-dependent scheduling problems with the lp norm objective
Stanislav Gawiejnowicz, Faculty of Mathematics and Computer Science, Adam Mickiewicz University, Umultowska 87, 61-614, Poznan, Poland, stgawiej@amu.edu.pl, Wieslaw Kurc

We consider structural properties of single-machine time-dependent scheduling problems with linearly deteriorating jobs and the lp norm objective. We prove that the V-shape property, previously known only for p=1, still holds for infinite many p≥1, while the symmetry property does not hold for p>1. We show that for p>1 the problems possess a kind of matrix convexity. Finally, we express the complexity of the problems as a function of index p of the norm.

4 - Scheduling jobs with values dependent on their completion times
Tomasz Krysiak, Institute of Computer Engineering, Control and Robotics, Wrocław University of Technology, Janiszewskiego 11/17, 50-372, Wrocław, Poland, tomasz.krysiak@pwr.wroc.pl, Adam Janiak

We consider two scheduling problems with job values and losses of job values (costs) dependent on job completion times. In the first problem, we consider scheduling jobs with stepwise values deteriorating over time. We prove strong NP-hardness of a single processor case and construct a pseudo-polynomial algorithm for a special case with unrelated processors. The second problem is a single processor one with piecewise linear losses of job values increasing over time. We prove strong NP-hardness of the problem and existence of a pseudo-polynomial algorithm for its special case.

MD-14
Monday, 14:30-16:00
RB-Omega

Scheduling with variable parameters I

Stream: Scheduling under Resource Constraints
Invited session
Chair: Mikhail Y. Kovalyov, United Institute of Informatics Problems, National Academy of Sciences of Belarus, Surganova 6, 220012, Minsk, Belarus, kovalyov_my@yahoo.co.uk
Chair: Adam Janiak, Institute of Computer Engineering, Control and Robotics, Wrocław University of Technology, Janiszewskiego 11/17, 50372, Wrocław, Poland, adam.janiak@pwr.wroc.pl

1 - Complexity analysis of an assignment problem with controllable assignment costs and its implications in scheduling
Dvir Shabtay, Dept. of Industrial Engineering and Management, Ben-Gurion University of the Negev, POB 653, 81054, Beer Sheva, Israel, dvirs@bgu.ac.il, Liron Yedidson, Moshe Kaspi

We extend the linear sum assignment problem to the case where the assignment cost is a function of the amount of resource allocated to the agent. A solution is defined by the assignment of agents to tasks and by a resource allocation vector. The quality of a solution is measured by two criteria: the total assignment cost and the total weighted resource consumption. We address these criteria via four problem variations and prove that three of them are NP-hard. In addition, we find that our problem is equivalent to a large set of scheduling problems whose complexity has been an open question.

MD-15
Monday, 14:30-16:00
RB-2101

Nonlinear Optimization and Applications 3

Stream: Nonlinear Programming
Invited session
Chair: Max Demenkov, Institute of Control Sciences, Lab 16, Russian Academy of Sciences, 65 Profsoyuznaya str., 117997, Moscow, Russian Federation, demenkov@ipu.ru

1 - Multistart Coupled with a Derivative-Free Filter Local Search for Locating Multiple Solutions
Florbela P. Fernandes, Department of Mathematics - ESTIG, Polytechnic Institute of Bragança, Bragança, Portugal, fflor@ipb.pt, M. Fernanda P. Costa, Ana I. Pereira, Edite M.G.P. Fernandes

A multistart technique coupled with a derivative-free filter local search algorithm for locating all the optimal solutions of a nonconvex constrained optimization is presented. To reach fast convergence to optimal solutions, the local search procedure is based on descent directions. The filter-set concept is introduced to handle the constraints of the problem. The direction vector is descent for the objective function if the point is feasible; otherwise, it is descent for the constraint violation. Numerical experiments with benchmark problems and a comparison with other methods are included.
2 - Bilevel optimization in stability analysis of nonlinear dynamical systems
Max Demenkov, Institute of Control Sciences, Lab 16, Russian Academy of Sciences, 65 Profsoyuznaya str., 117997, Moscow, Russian Federation, demenkov@ipu.ru

We consider region of attraction for a dynamical system - a set of points from which system trajectories go to a stable equilibrium. One can estimate it via the sublevel sets of a positive definite Lyapunov function, which is decreasing along any trajectory in the region. We formulate this task as a bilevel optimization over the function parameters and system state variables. On the lower level we have minimization of the function with nonconvex equality constraint. On the upper level a size estimation of a sublevel set needs to be maximized. Local improvement algorithm is discussed.

3 - Numerical solution of nonlinear optimal control problems, A comparative study
M. Navabi, Shahid Beheshti University, GC, Iran, Islamic Republic Of, civil.space.edu@gmail.com, E. Meshkifam

The aim of this paper is to compare four different iterative numerical techniques using in determination the optimal control law. The methods are: Steepest Descent (SD), Variation of Extremals (VE), Quasi-linearization (QL) and Collocation (CL).
The Maximum radius orbit transfer in a given time problem is solved utilizing these methods and comparisons are made in the terms of accuracy, the rate of convergence, sensitivity to initial guess and the time of computer processing. The results show that, CL method has the least error, VE has the most sensitivity to initial guess.

4 - Performance Analysis of Partial Use of Local Optimisation Operator on Genetic Algorithm for TSP
Milan Djordjevic, UP DIST, UP FAMNIT, Glagoljaska 8, Slovenia, 6000, Koper, State, Slovenia, milan.djordjevic@student.upr.si, Andrej Brodnik

We study the influence of hybridization of a genetic algorithm with a local optimizer on instances of a TSPLIB. In tests we applied hybridization at various percentages of genetic algorithm iterations. Less frequent application of hybridization decreased the average running time, whereas the quality of solution on average deteriorated only from 0.21% till 1.40% worse than the optimal solution. We studied at which iterations to hybridize. We applied it at random iterations, at the initial iterations, and the ending ones, and proved where being the best.

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MD-16
Monday, 14:30-16:00
RB-2103

Uncertainty Analysis in Energy and Water Resources
Stream: Uncertainty and Perturbations in Optimization and in Environmental and Energy Modelling

Invited session
Chair: John Boland, School of Mathematics and Statistics, University of South Australia, Mawson Lakes Blvd., 5095, Mawson Lakes, South Australia, Australia, john.boland@unisa.edu.au, Julia Piantadosi

1 - Reconciling rainfall modelling on differing time scales
John Boland, School of Mathematics and Statistics, University of South Australia, Mawson Lakes Blvd., 5095, Mawson Lakes, South Australia, Australia, john.boland@unisa.edu.au, Julia Piantadosi

Rainfall perform well for the time scales on which they are produced but for other time scales, a model’s performance can be erratic. Previous experience in estimating five minute variance of wind farm output derived from modelling ten second output series (Agrawal et al 2010) has led us to be able to perform a similar exercise with modelling daily rainfall series in a fashion that preserves the monthly variance. We develop an AR(3) model for daily rainfall (after multiplicative deseasoning), and through standard transformations for stationary time series, develop estimates for variances for monthly rainfall series that match the observed monthly variances.

2 - Catching uncertainty of wind
Yulia Gel, Statistics and Actuarial Science, University of Waterloo, 200 University Ave., N2L 3G1, Waterloo, ON, Canada, ygl@math.uwaterloo.ca

Sustainable wind energy has long been recognized as one of the most attractive options but its generation is still found to be much easier than its integration into liberalized electricity markets due to a highly volatile nature of wind. In this talk we propose a new approach to probabilistic wind power forecasting which delivers competitive forecasts while imposing minimal requirements on observed data. This is especially critical as lack of expertise and related costs in wind farm site selection still remain one of the key barriers to tapping wind resources in developing countries.

3 - SVM Models and Auction Protocols in Electricity Markets
Carlo Lucheroni, School of Science and Technologies, University of Camerino, via M. delle Carceri 9, 62032, Camerino (MC), Italy, carlo.lucheroni@unicam.it, Renato De Leone

Modelling of hourly electricity prices is mostly made by stochastic difference equations, assuming a causal relation between succeeding hours. Because of the power market structure, in fact this assumption is true only at the level of several days, since un-causal autocorrelations can appear within each day, due to technical constraints enforcement by system operators. Support Vector Machines used as autoregressive estimators on daily price hourly profiles offer a new way for price modelling, able to take into account intra-day correlations without mixing them with inter-day correlation.

4 - Mathematical methods for rainfall modelling
Julia Piantadosi, Centro for Industrial and Applied Mathematics, School of Mathematics and Statistics, University of South Australia, Mawson Lakes Campus, Mawson Lakes Boulevard, Mawson Lakes, 5095, Adelaide, South Australia, Australia, julia.piantadosi@unisa.edu.au

A major challenge for future management of water resources is to optimize economic, social and environmental outcomes subject to sustainable usage in a changing and highly variable climate. Historical records provide only one realisation and generation of realistic synthetic data is an important objective to assess the impact of rainfall variability on water systems. The aim of this work is to propose new mathematical models for rainfall simulation to inform analysis of current rainfall patterns and enable better projections for a comprehensive range of future scenarios.

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MD-17
Monday, 14:30-16:00
RB-2105

Further Applications of Location Analysis
Stream: Applications of Location Analysis

Invited session
Chair: Mercedes Landete, Departamento de Estadística y Matemática Aplicada, University Miguel Hernández of Elche, Avda. del Ferrocarril s/n, 03202, Elche, Alicante, Spain, landete@umh.es

1 - Assessing Optimal Routes in the Natural Park of Doñana (Spain)
Eva Barrena, Applied Mathematics I, University of Sevilla, Avda. Reina Mercedes s/n, 41012, Sevilla, Spain, ebarrena@us.es, Francisco A. Ortega Riejos, Isabel Ternero, Miguel Angel Pozo

This paper explores the compatibility between a successful management of environmental conservation and a sustainable development through rural tourism by designing optimal routes along environmental units (cells) in a Natural Park. Two types of scenarios are assumed: Safaris route, where the objective is to minimize the total distance travelled during supervising all the cells (appropriate for ranger’s route), and Zookeeper’s route, where a representative sample of cells must be visited (for a touristic route) (supported by Spanish/FEDER projects MTM2009-14243 and P09-TEP-5022).

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2 - A polyhedral study on location models with knapsack constraints
Roberto Javier Catavate Bernal, Métodos Cuantitativos e Informáticos, Technical University of Cartagena (UPCT), Calle Real, 3, Facultad Ciencias Empresa, 30201, Cartagena, Murcia, Spain, r.canastrate@upct.es, Mercedes Landete

In this paper we consider set packing location problems with knapsack constraints. We propose to study the intersection polyhedron of the two well-known problems: the classical knapsack problem (KP) and the set packing problem (SP). We give conditions for some valid inequalities of the KP polytope and the SP polytope to be facets for the KP-SP problem. The obtained results also generalize polyhedral properties of some knapsack related problems in the literature.

3 - Delocation Models for Closing and Resizing Redundant Branches during Bank Restructuring
Diego Ruiz-Hernandez, Quantitative Methods, CUNEF, c/ Serrano Anguita 9, 28004, Madrid, Spain, d.ruiz@cunef.edu, David Delgado-Gomez, Laureano Fernando Escudero, Joaquin Lopez-Pascual

During restructuring processes due to mergers, banks face the problem of closing down branches and competing with each other for customers. As important as it is, the problem of closing down branches has not been fully addressed in the literature. In this paper we introduce a new branch closing and resizing model based on the capacitated facility location problem. The model considers closing down and costs, and addresses the problem of closing open branches to accommodate customers displaced from closed branches. We motivate the problem with an example from the Spanish saving banks sector.

4 - Different ways of locating spanning trees in a network
Mercedes Landete, Departamento de Estadística y Matemáticas Aplicadas, University Miguel Hernández of Elche, Avda. del Ferrocarril s/n, 03202, Elche, Alicante, Spain, landete@umh.es, Alfredo Marín

In this work we present different formulations for the ordered minimum spanning tree problem. We propose one formulation based on the flow variables and another based on the Miller-Tucker-Zemlin sub tour elimination constraints. We distinguish between positive and negative values for the elements of the weight function. Finally, we develop a computational study for comparing both formulations. It illustrates how much the difficulty of the problems differs depending on the weight function. The Conclusions section gives some advises for choosing the best formulation at each case.

2 - Herding behavior of agents as a background of financial fluctuations
Aleksiejus Kononovicius, Institute of Theoretical Physics and Astronomy, Vilnius University, Lithuania, aleksiejus.kononovicius@gmail.com, Vygintas Gontis, Bronislavos Kauliakys

We focus on the universal nature of herding behavior leading to the macroscopic description by nonlinear stochastic differential equations applicable to the finance and other complex systems. Approach with two groups of agents appears to be too crude to reproduce the details of financial markets. Thus we extend Kirman’s model to include three groups of interacting agents. This improvement provides more opportunities to reproduce sophisticated power law statistics of returns in financial markets.

3 - Bayesian statistical analysis of herding behaviours: an application to the Spanish equity mutual funds
Pilar Gargallo, Facultad de Economía y Empresa, Universidad de Zaragoza, Gran Vía 2, 50005, Zaragoza, Spain, pigarga@unizar.es, Laura Andreu, José Luis Sarto, Manuel Salvador

This paper proposes a Bayesian rolling window estimation procedure applied to the three factor model of Fama and French (1993) to analyse the herding behaviour in the style exposures of mutual funds. This procedure let dynamically select the length of the estimation window by means of weighted likelihood functions that discount the loss of information due to time. The method is very flexible and allows us to consider different approaches to detect herding behaviour by taking into account the uncertainty associated to the estimation of the style coefficients.

MD-19
Monday, 14:30-16:00
RB-2111
Financial Decision Making: Application of Mathematical Optimization

Stream: Operational Research and Quantitative Models in Banking
Invited session
Chair: Katsumasa Nishide, International Graduate School of Social Sciences, Yokohama National University, 79-4 Tokiwadai, Hodogaya-ku, 2408501, Yokohama, Japan, knishide@ynu.ac.jp

1 - Competition and the Bad News Principle in a Real Options Framework
Katsumasa Nishide, International Graduate School of Social Sciences, Yokohama National University, 79-4 Tokiwadai, Hodogaya-ku, 2408501, Yokohama, Japan, knishide@ynu.ac.jp, Kyoko Yagi

We consider the investment timing problem where each firm knows when the economic condition changes in advance. When firm faces an investment competition, the strategy significantly differs depending on whether the firm is a leader or a follower. More concretely, a follower firm follows the so-called bad news principle proposed by Bernanke(1983) near maturity, while a leader firm optimally invest in an application to the Spanish equity mutual funds.

2 - Equilibrium in the Presence of Transaction Costs
Masaaki Kijima, Graduate School of Social Sciences, Tokyo Metropolitan University, 1-1 Minami-Ohsawa, 192-0397, Hachiohji, Tokyo, Japan, kijima@tmu.ac.jp

We consider an equilibrium model in the presence of transaction costs. Such problems have been considered quite extensively in the complete market setting (no transaction costs). In the presence of proportional transaction costs, however, we need to know the quantities of buying and selling assets. For the case of single risky asset, it will be shown that the buy price increases and the sell price decreases as the cost increases under some reasonable conditions. The trading volume is also decreasing with respect to the cost.
3 - Optimal Life Insurance Coverage and Annuities with Borrowing and a Leverage Constraint

Teryoshi Suzuki, Graduate School of Economics, Hokkaido University, Nishi 7 Kita 9, Kitaku, 060-0809, Sapporo, Hokkaido, Japan; suzuki@econ.hokudai.ac.jp

This paper presents the optimal policies of life insurance coverage and annuities for a retired agent using the investment/consumption model with borrowing. One of features in our model is imposing non-negativity constraints on the insurance coverage and annuities considering positive premium loading in the insurance market. It was found from our analytical result that there is an interval of the bequest intensity where the agent has no demand for both insurance and annuities.

4 - Robust Portfolio Optimization with Copulas

Iakovos Kakouris, Computing, Imperial College London, Imperial College London, Exhibition Road, SW7 2AZ, London, United Kingdom; iak05@ic.ac.uk, Berc Rustem

Conditional value-at-risk (CVaR) is widely used in portfolio optimization as a measure of risk. CVaR is clearly dependent on the underlying probability distribution of the portfolio. We show how copulas can be introduced to any problem that involves distributions and how they can provide solutions for the modelling of the portfolio. We use this to provide the copula formulation of the CVAR of a portfolio. Given the critical dependence of CVaR on the underlying distribution, we use a robust framework to extend our approach to Worst Case CVaR through the use of rival copulas.

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MD-20

Monday, 14:30-16:00

RB-2113

Energy consumption and price forecasting

Stream: Data Mining in the Financial Sector
Invited session
Chair: Richard Weber, Department of Industrial Engineering, University of Chile, Republica 701, 2777, Santiago, Chile, rweber@die.uchile.cl

2 - Foreign Direct Investment Trends and Comparative Analysis for Chosen Transition Countries

Snjezana Prcic, Faculty of Economics, University of Split, Department of Quantitative Methods in Economics, Matice hrvatske 31, 21000, Split, Croatia, spivic@efst.hr

Foreign direct investments (FDI) have high positive impact on economic impetus especially in transition countries. So in the focus of this paper are the structure and forms of FDI and their influence on crucial macroeconomic variables. In the FDI inflow analysis the country risk rating estimation has been essential. FDI efficiency analysis is enriched with correlation between Incremental Capital Output Ratio (ICOR) and GDP increase. Multivariate classification of ten transition countries has been carried out according to all regarding indicators.

3 - A mathematical solution to the Nigerian petroleum products supply crisis

Adewoye Olabode, mathematics, yaba college of technology, yaba, lagos, +234, yaba, lagos state, Nigeria, boka152002@yahoo.com

Nigeria is the largest oil exporter in Africa and rank sixth in the world. The country for more than two decades has found itself in petroleum products supply crisis. With thorough investigation, necessary parameter is developed to run the policy iteration techniques on continuous semi—Markov Decision Process. The solution to the model is obtained by selecting an arbitrary stationary policy that governs the problem.

4 - Stochastic Dominance in economic and financial context, overview and applications

Elena Almaraz Luengo, Estadística e Investigación Operativa, Facultad de Ciencias Matemáticas (UCM), c/Arroyo de la Media Legua 68, 2ºB, 28030, Madrid, Spain, ealmarazluengo@mat.ucm.es, Eduardo Almaraz Luengo

We analyze different types of Stochastic Dominance (SD) and its principal applications in different knowledge areas, with special interest in economic and financial context. Some points discussed are: SD concepts in connection with particular and interesting random variables in Economy; Consistency of Mean-Variance rules and its application in weighted random variables; SD in particular economical and financial stochastic processes; SD in context of assets valuation. We finish with the concept of Almost Stochastic Dominance and its possible applications in economical and financial context.

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MD-21

Monday, 14:30-16:00

RB-2115

Financial Mathematics and OR 4

Stream: Financial Mathematics and OR
Invited session
Chair: Tansel Avkar, Department of Mathematics, Middle East Technical University, 06531, Ankara, Turkey, tanselavkar@gmail.com

1 - A Parallel Procedure for Dynamic Multi-objective TSP

Weiqi Li, School of Management, University of Michigan-Flint, 303 East Kearsley Street, 48502, Flint, Michigan, United States, weli@umflint.edu

This paper proposes a new parallel search procedure for dynamic multi-objective TSP. We design a multi-objective TSP in a stochastic dynamic environment. The proposed procedure first uses parallel processors to identify the extreme solutions of the search space for each of k objectives individually at the same time. These solutions are merged into a matrix E. The solutions in E are then searched by parallel processors and evaluated for dominance relationship. The proposed procedure was implemented in two different ways: a master-worker architecture and a pipeline architecture.

3 - Optimal Life Insurance Coverage and Annuities with Borrowing and a Leverage Constraint

Teryoshi Suzuki, Graduate School of Economics, Hokkaido University, Nishi 7 Kita 9, Kitaku, 060-0809, Sapporo, Hokkaido, Japan, suzuki@econ.hokudai.ac.jp

This paper presents the optimal policies of life insurance coverage and annuities for a retired agent using the investment/consumption model with borrowing. One of features in our model is imposing non-negativity constraints on the insurance coverage and annuities considering positive premium loading in the insurance market. It was found from our analytical result that there is an interval of the bequest intensity where the agent has no demand for both insurance and annuities.

4 - Robust Portfolio Optimization with Copulas

Iakovos Kakouris, Computing, Imperial College London, Imperial College London, Exhibition Road, SW7 2AZ, London, United Kingdom; iak05@ic.ac.uk, Berc Rustem

Conditional value-at-risk (CVaR) is widely used in portfolio optimization as a measure of risk. CVaR is clearly dependent on the underlying probability distribution of the portfolio. We show how copulas can be introduced to any problem that involves distributions and how they can provide solutions for the modelling of the portfolio. We use this to provide the copula formulation of the CVAR of a portfolio. Given the critical dependence of CVaR on the underlying distribution, we use a robust framework to extend our approach to Worst Case CVaR through the use of rival copulas.

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MD-23

Monday, 14:30-16:00

RB-Delta

Various Advances in Generalized Differentiation and Optimization

Stream: Generalized Differentiation and Optimization
Invited session
Chair: Alexander Kruger, School of Science, Information Technology & Engineering, University of Ballarat, University Drive, Mount Helen, P.O. Box 663, 3353, Ballarat, Victoria, Australia, a.kruger@ballarat.edu.au
Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

1 - Interior Epigraph Method for Nonsmooth and Nonconvex Optimization via Generalized Augmented Lagrangian Duality

Wilhelm Pfister, Mathematics, Federal University of Juiz de Fora, Campus Universitário – Bairro Martelos, Juiz de Fora – MG, Brasil, 36036-900, Juiz de Fora, Minas Gerais, Brazil, wilhelmfreire@yahoo.com.br, Regina Burachik, C. Yalcin Kaya
We propose a new method (IEM) for constrained nonsmooth and non-convex optimization which uses a generalized augmented lagrangian duality scheme. The new method takes advantage of the special structure of the epigraph of the dual function. We present numerical experiments using test problems from the literature. In particular, we study several instances of the kissing number problem. Our experiments show that the quality of the solutions obtained by IEM is comparable with those obtained by other solvers.

2 - A Novel Approach for Solving the Geometric Distance Problem
Helder Venceslau, Federal University Rio de Janeiro - UFRJ, Brazil, helder.venceslau@gmail.com, Leonardo Nascimento, Addison Elias Xavier, Gerhard-Wilhelm Weber

The geometrical distance problem in graphs is characterized by determining the nodes’ positions in a Euclidian space, according to the given distances associated with the arcs. It is a non-convex and non-differentiable problem. It has a relevant application in the determination of proteins’ geometrical structures. It is solved by the Hyperbolic Smoothing Technique connected to a speed-up extrapolation scheme. Computational results obtained in the resolution of large instances of a difficult canonical problem show the efficiency and robustness of the method.

3 - Generalized Solutions and Optimal Investment in Infinite Horizon Control Problem in Capital Accumulation Model
Marta Kornafel, Department of Mathematics, Cracow University of Economics, Poland, marta.kornafel@uek.krakow.pl

Control problem in capital accumulation model with vintage structure in Neoclassical framework is presented. Model is described by transport equation on bounded domain. Coefficients of the state equation are allowed to be discontinuous functions, what differs our approach from the considerations in the existing literature. Problem of existence and uniqueness of solution for the state equation is discussed in our presentation. It is shown that among generalized solutions there exists viscosity one to the state equation on extended domain. Optimal investment is obtained via direct method.

### MD-25

**Renewable Energies**

**Stream:** Energy, Environment and Climate 2

**Invited session**

**Chair:** Mario Ragwitz, FhG-ISI, 76139, Karlsruhe, Germany, mario.ragwitz@isi.fhg.de

1 - A new perturbing parameter for interior point methods applied to short term hydroelectric scheduling
 Aurelio Oliveira, Computational & Applied Mathematics, State University Of Campinas, DMA IMECC Unicamp, C. P. 6065, 13081-970, Campinas, SP, Brazil, aurelio@ime.unicamp.br, Lilian Carvalho

The short term hydroelectric scheduling problem can be formulated as a network flow model and efficiently solved employing interior point methods. In this work, a new approach to compute the perturbing parameter in the primal-dual interior point method is presented. Numerical results for short term hydroelectric scheduling applied to IEEE test systems and actual Brazilian systems are presented and compared to those obtained early. The experiments show that both approaches are attractive for both: running time and robustness and that the new one requires less iterations to achieve convergence.

2 - Optimal Underground Pumped Hydroelectric Storage Design
Amir José Daou Pulido, Chair of Energy Systems and Energy Economics, Ruhr - Universität Bochum, IB 4 - 32, Universitätsstr. 150, 44801, Bochum, Germany, daoupulido@lee.rub.de, Hermann-Josef Wagner, Marco K. Koch, Eugen Perau, Ulrich Schreiber, André Niemann

Optimal design of utility scale energy storage systems has been strongly researched in the last decades. However, there are few studies addressing Underground Pumped Hydroelectric Storage (UPHS). In Germany, UPHS has become an interesting technology for both energy system flexibility and mining sector. We propose an optimization model for UPHS design, i.e., reservoirs, waterways and turbo machinery configuration. The model aims to find the UPHS design that maximizes long-term profit, given a certain power market development scenario.

3 - Investment Incentives under the Influence of Capacity Aggregation in Regulated Industries
Sabine Pallas, TU München, Germany, sabine.pallas@tum.de

The purpose of this paper is to investigate the influence of cost based remuneration on a regulated company’s investment behavior when capacity aggregation occurs and investments overlap. To this end a discrete-time optimization model is solved analytically for both parties. For an expansion of renewable energy large investments in the grid are necessary. Network operators are subject to a governmental cost-based remuneration, which can set disincentives to invest. However, this effect has not been investigated for two-stage overlapping investments with stepwise capacity expansion.
4 - Pollution permits, Strategic Trading and Dynamic Technology Adoption
Luca Taschini, Grantham Research Institute, London School of Economics, Houghton St, WC2A 2AE, London, United Kingdom, l.taschini1@lse.ac.uk
This paper analyzes the dynamic incentives for technology adoption in a transferable permits system, which allows for strategic trading on the permit market. Technology adoption and allowance prices are generated endogenously and are inter-dependent. It is shown that the non—cooperative permit trading game possesses a pure—strategy Nash equilibrium, where the allowance value reflects the level of uncovered pollution (demand), the level of unused allowances (supply), and the technological status. The proposed policy generates a price floor and restores the dynamic incentives to invest.

4 - Impact of carbon sequestration over the optimum forest rotation problem
Yavuz Gunalay, Faculty of Economics and Administrative Sciences, Bahcesehir University, Besiktas, 34353, Istanbul, Turkey, yavuz.gunalay@bahcesehir.edu.tr, Ethun Kafa
The threat of climate change, which is also backed by the Kyoto Protocol, has given rise to the importance of the forestry sector. One of the important problems of the sector is to determine the optimum rotation age of the forest. The problem is first introduced in 1849 and still keeps its challenge among economists and silvicultrists. Based upon Samuelson’s work the optimum felling age occurs at a time when the net marginal benefits fall below the current rate of interest. We incorporate the carbon sequestration benefits and re-calculate the optimum cutting age using a multiple rotation model.

MD-26
Monday, 14:30-16:00
CC-A24
OR in Forestry I
Stream: OR in Agriculture, Forestry and Fisheries
Invited session
Chair: Concepcion Maroto, Applied Statistics, Operations Research and Quality, Universitat Politecnica de Valencia, Camino de Vera S/N, 46071, Valencia, Spain, cmaroto@eio.upv.es

1 - A comparison of multiple criteria methods for group decision making in forest management
Concepcion Maroto, Applied Statistics, Operations Research and Quality, Universitat Politecnica de Valencia, Camino de Vera S/N, 46071, Valencia, Spain, cmaroto@eio.upv.es, Marina Segura Maroto, Concepcíon Ginestar, Baldomero Segura, Juan Uriol
Analytic Hierarchy Process, Goal Programming and Outranking Methods have been the approaches most applied to problems of sustainable forest management. It is well known that the results depend on the method used and one of the main uses of these approaches is to obtain consensus or as negotiation tools. Thus, robust results or conclusions need to be derived from the use of several techniques. This paper presents a comparison of several methods for aggregating stakeholder preferences as applied to the regional planning of Mediterranean forest. Finally, we will discuss the results obtained.

2 - Multi-criteria optimization method for designing a harvesting and cableway layout for a given road network for wood extraction
Leo Bont, ETH Zurich, CH-8092, Zurich, Switzerland, leo.bont@env.ethz.ch, Hans Rudolf Heimann, Richard Church
Cable-based technologies are a backbone when designing forest harvesting systems for steep slopes. However, layout and placement of the cableways is challenging. To guarantee that wood harvesting costs are minimized and that the process has the least environmental impact on the remaining forest, one must carefully locate both cable towers and cableways. We developed an approach of mixed integer linear programming for planning an optimal harvesting and cableway layout. The model delivered for terrain units up to 35 ha results within a reasonable timeframe.

3 - EcoForest — A fictive problem for teaching spatially-explicit, multi-objective optimization in forestry
Jochen Breschan, Department of Environmental Sciences, ETH Zurich, CHN K73.1, Universitaetstr. 22, 8092, Zurich, Switzerland, breschan@env.ethz.ch
We present the EcoForest problem, designed to teach spatially-explicit, multi-objective optimization. A fictive parcel of open land is represented as a grid raster of 8x8 cells. 40 cells must be re-forested such that the resulting pattern produces lots of ecological niches. Forest edges and forest core area indicate ecological niches. The corresponding (multi-objective Integer Linear) optimization model identifies the optimal pattern by concurrently maximizing forest edges and forest core area. Non-Inferior Set Estimation method is applied to compute an approximate Pareto-frontier.

MD-27
Monday, 14:30-16:00
CC-A25
Agent-based Modeling of Diffusion Processes
Stream: Decision Processes
Invited session
Chair: Christian Stummer, Department of Business Administration and Economics, Bielefeld University, Chair of Innovation and Technology Management, PO Box 10 01 31, 33501, Bielefeld, Germany, christian.stummer@uni-bielefeld.de

1 - The impact of customer dissatisfaction and negative word-of-mouth on the diffusion of innovations and the repurchasing behaviour: an agent based simulation
Markus Günther, Department of Business Administration and Economics, Bielefeld University, Universitaetstr. 25, 33615, Bielefeld, Germany, markus.guenther@uni-bielefeld.de, Jana Sonnberger
Customer expectations towards a new product, which are composed of individual demands, product information via personal communication and marketing measures, form the basis of customer satisfaction or discontent. We introduce an agent-based model which contributes to a better understanding of discontented customers communicating negative product information and their impact on the diffusion of an innovation. Additionally, repurchasing decisions, which differ from the initial adoption, positive network effects and individual agent traits like extraversion and neuroticism are taken into account.

2 - New product diffusion and supply chain production-sales policies: a comparative study
Tina Wakolbinger, WU (Vienna University of Economics and Business), Nordbergstraße 15, Vienna, Austria, tina.wakolbinger@wu.ac.at, Mehdi Amini, Michael Racer, Mohammad G. Nejad
This paper analyzes the impact of alternative production—sales policies on the diffusion of a new product and the generated NPV of profit. The key features of the ABMs model are: (i) supply chain capacity is constrained; (ii) consumers’ new product adoption decisions are influenced by marketing activities as well as positive and negative word-of-mouth (WOM) between consumers; (iii) interactions among consumers taking place in the context of their social network are captured at the individual level; and (iv) the new product adoption process is adaptive.
3 - De-commoditization of a convenience product: an agent-based simulation of its market diffusion
Christian Stummer, Department of Business Administration and Economics, Bielefeld University, Chair of Innovation and Technology Management, PO Box 10 01 31, 33501, Bielefeld, Germany, christian.stummer@uni-bielefeld.de, Elmar Kiesling, Markus Günther, Rudolf Vetschera, Lea M. Wolkinger
The de-commoditization of a convenience product poses an interesting challenge for innovation management that has to decide on proper strategies for advertising, pricing, and roll-out of the new product. In markets in which information is largely disseminated through word-of-mouth, an agent-based simulation may provide decision-makers with forecasts of the diffusion process. In this talk we will present such an approach and illustrate its application for the case of introducing a second generation biofuel on the Austrian market.

4 - Existence of a pure strategy equilibrium in finite symmetric games where payoff functions are integrally concave
Takahiro Watanabe, Graduate School of Social Sciences, Tokyo Metropolitan University, Minamiososawa 1-1, Hachioji_city, 1920397, Tokyo, Japan, contact_nabe08@nabenavi.net, Takuya Limura
In this paper we show that a finite symmetric game has a pure strategy equilibrium if the payoff functions of players are integrally concave (the negative of the integrally convex functions due to Favati and Tardella, 1990). Since the payoff functions of any two-strategy game are integrally concave, this generalizes the result of Cheng et al. (2004). A simple algorithm to find an equilibrium is also provided.

MD-28
Monday, 14:30-16:00
CC-A27
Nonsmooth Optimization II
Stream: Structured Optimization and Applications
Invited session
Chair: Dominik Dorsch, Dept. Mathematics, RWTH Aachen University, Templergraben 55, 52056, Aachen, NRW, Germany, dorsch@mathc.rwth-aachen.de

1 - Equilibrium investments in a common value auction environment with endogenous signals
Eleftherios Couzoudis, Economics, University of Zurich, Chair for Quantitative Business Administration, Moussoonstrasse 15, 8044, Zurich, Switzerland, eleftherios.couzoudis@business.uzh.ch, Markus Bürgi
The presented normal form game is a common value auction where each bidder gathers an independent endogenous private signal about the offered good. We allow signal precision to be scaled continuously in correspondence to the investment. In addition the seller can offer a costly signal to the public, which leads to signal combinations. Through reformulation and the use of a Newton-type method this model is solved for more than two players. Furthermore, the implications of our findings can support the financial regulation and the policy-making process.

2 - Local models in equilibrium optimization
Vladimir Shikhman, Dept. Mathematics C, RWTH Aachen University, Templergraben 55, 52056, Aachen, Germany, shikhman@mathc.rwth-aachen.de, Hubertus Th. Jongen, Dominik Dorsch
We study equilibrium optimization problems (EOPs) from a structural perspective, i.e. up to the smooth coordinate transformations locally at their solutions. The latter equivalence relation induces classes of EOPs. We focus on the stable classes corresponding to a dense set of data functions. We prove that these “basic classes” are unique. Their simplest representatives are called local models. For particular EOPs basic classes and their local models are elaborated. The latter include bilevel optimization, general semi-infinite optimization and Nash optimization.

3 - On the structure of Nash equilibrium sets
Dominik Dorsch, Dept. Mathematics, RWTH Aachen University, Templergraben 55, 52056, Aachen, NRW, Germany, dorsch@mathc.rwth-aachen.de, Hubertus Th. Jongen, Vladimir Shikhman
A Nash equilibrium problem (NEP) consists of simultaneous optimization of N players’ objective functions under constraints. In a GNEP and each player’s constraint functions might depend on the opposing players’ choices. The number of these common constraints becomes crucial for a qualitative analysis of the solution sets: for GNEPs without common constraints and for classical NEPs we show that generically all Nash equilibria are jointly nondegenerate KKT points. Effects like kinks, boundary points, and nonclosedness might occur. Analytical results are given in detail.

MD-29
Monday, 14:30-16:00
CC-A29
Selected Topics on Mixed-Integer Non-Linear Programming
Stream: Mixed-Integer Non-Linear Programming
Invited session
Chair: Dennis Michaels, Institute for Operations Research, ETH Zuerich, Raemistrasse 101, 8092, Zuerich, Switzerland, dennis.michaels@ifor.math.ethz.ch

1 - Minimizing convex functions over integer points
Michiel Baes, IFOR, ETH, HG.G.22.1, Ramistrasse 101, 8092, Zurich, Switzerland, michiel.baes@ifor.math.ethz.ch, Alberto Del Pia, Yuri Nesterov, Shmuel Otn, Robert Weismantel
We consider the problem of minimizing a smooth and strongly convex function over integer points in a polytope. We assume that a black-box procedure that solves some special quadratic integer problems with a constant approximation factor. Despite the generality of our problem, we prove that we can find efficiently, with respect to some assumptions on the encoding of the problem, a feasible solution with an objective value close to the optimum. We describe a few situations where we can implement the needed black-box procedure efficiently.

2 - Solving MINLPs with SCIP
Stefan Vigerske, Mathematics, Humboldt University Berlin, Unter den Linden 6, 10099, Berlin, Germany, stefan@math.hu-berlin.de
We discuss recent extensions of the constraint integer programming framework SCIP for solving mixed-integer nonlinear programs. Nonlinear constraints (convex or nonconvex) are handled within an LP-based branch-and-cut algorithm by reformulation, linear relaxation, and domain propagation. In an extensive computational study, we compare the performance of our implementation with state-of-the-art solvers for MINLP and analyze the impact of various solver components on the overall performance.

3 - RedNLP - Heuristic Approach to Large-Scale MINLPs in Gas Transportation
Ralf Gollmer, Mathematics, University of Duisburg-Essen, Forsthausweg 2, D-47057, Duisburg, NRW, Germany, gollmer@math.uni-duisburg.de, Rüdiger Schultz, Claudia Stangl
Detecting feasibility of transportation orders (nominations) in gas networks is a problem of growing practical interest due to the unbundling of gas trading and network operating companies. We consider an approach and illustrate its application for the case of introducing a second generation biofuel on the Austrian market.
4 - Convex underestimation of edge-concave functions by a simultaneous convexification with multi-linear monomials
Dennis Michaels, Institute for Operations Research, ETH Zuerich, Raemistrasse 101, 8092, Zuerich, Switzerland, dennis.michaels@ifor.math.ethz.ch, Martin Ballerstein

We address the construction of tight convex underestimators for an edge-concave function over a box. In contrast to common relaxation methods we derive the underestimators by a simultaneous convexification of one edge-concave function together with the set of all multi-linear monomials. We show that the tightest underestimators are polyhedral and give a complete facet-description. A computational case study demonstrates the usefulness of the proposed relaxation technique in global optimization.

MD-30

Monday, 14:30-16:00
CC-A31

Emerging Applications in Logistics

Stream: Emerging Applications in Finance and Logistics
Invited session

Chair: Paul Trodden, School of Mathematics, University of Edinburgh, United Kingdom, paul.trodden@ed.ac.uk

1 - An MINLP approach to forming secure islands in electricity networks
Paul Trodden, School of Mathematics, University of Edinburgh, United Kingdom, paul.trodden@ed.ac.uk, Waqquas Ahmed Bukhsh, Andreas Grotthey, Ken McKinnon

Intentional islanding is attracting an increasing amount of attention as a means of preventing large-scale blackouts in electricity transmission networks. In this talk, a mathematical formulation for islanding is presented, in which suspected unhealthy components of the network are isolated while the load shed is minimized. To achieve balanced, feasible islands, nonlinear AC power flow equations should be included, resulting in an MINLP. In the proposed MILP formulation, these terms are approximated by piecewise linear functions. The approach is demonstrated by results on test networks.

2 - Multiperiod Optimal Power Flow Using Cross Decomposition
Antonio Marmolejo, DAIC, INFOTEC, COPILCO 300. COYOACAN, 04350, CIUDAD DE MEXICO, DISTRITO FEDERAL, Mexico, marmolejo.antonio@hotmail.com

This work addresses Multiperiod Optimal Power Flow. The mathematical model is a Mixed Integer Non Linear Problem with binary variables. We use Generalized Cross Decomposition to exploit the problem structure and reduce the computational time. Original problem is divided into a primal subproblem (Non Linear Problem), a dual subproblem (Mixed Integer Non Linear Problem) and a Master Problem (Mixed Integer Problem). The approach is compared with Lagrangean Relaxation and Generalized Benders Decomposition. We present numerical results which show Cross Decomposition performance.

3 - Optimum Renewable Energy Portfolio for Regional Heating
Secil Ercan, Industrial Engineering, Istanbul Technical University, Turkey, ercans@itu.edu.tr, Zeynep Bektaş, Gulgun Kayakutlu

This study analyses the renewable energy resources for constructing an energy portfolio that would best respond to the regional demand and conditions. Heating of an organized site of manufacturing SMEs (small and medium enterprises) is targeted. Because of the continuous and non-deterministic structure of the renewable energy sources, nonlinear programming (NLP) is used in optimization. The proposed model aims to maximize the energy capacity of renewable energy replacing the current fossil energy resources. The achievements will be guiding the policy makers in reducing energy dependence.

4 - Strategic Capacity Planning in Knowledge Intensive Organizations
Manuel Mateo, Department Business Administration, Universitat Politècnica Catalunya, Avda Diagonal, 647, 7th, E-08028, Barcelona, Spain, manel.mateo@upc.edu, Ernest Benedeto, Rocio de la Torre, Amaya Lusa, Carme Martinez, Marta Mas

Strategic capacity planning is a key decision in knowledge intensive organizations (KIOs). It is basically related to determining the size and composition of the workforce in the long term, which means taking decisions on hiring, firing, promotion, transfers and training of skilled people, considered as the main limiting factor. To the best of our knowledge, there are no formalized procedures to deal with strategic capacity planning in KIOs. The present study aims to define the problem, identify the most relevant characteristics and propose a classification scheme in order to later develop specific solving methodology and procedures.

MD-32

Monday, 14:30-16:00
CC-A34

Theoretical developments in Soft OR

Stream: Soft OR and Problem Structuring Methods
Invited session

Chair: Jose-Rodrigo Cordoba-Pachon, School of Management, Royal Holloway, University of London, Egham Hill, Egham, Surrey, United Kingdom, j.r.cordoba-pachon@rhul.ac.uk

1 - Comparing and Contrasting the formal modelling techniques from Soft Systems Methodology and JOURNEY Making
Giles Hindle, Management Systems, Hull University Business School, University of Hull, Cottingham Road, HU6 7RX, Hull, United Kingdom, giles.hindle@hull.ac.uk

Soft OR contains a family of approaches that support groups in a range of tasks including tackling complex problem situations and making strategy. Two popular approaches are Soft Systems Methodology (SSM) and JOURNEY Making. Both approaches use formal modelling techniques — purposeful activity system modelling in SSM and cognitive mapping in JOURNEY Making. This paper compares and contrasts these two modelling techniques. The techniques are found to have fundamentally different theoretical make-ups, whilst synchronously allowing overlapping modelling strategies in practice.

2 - Decision Structures in Project Management
Cathal Brugha, Management Information Systems, University College Dublin, Quinn School of Business, Belfield, 4, Dublin 4, Ireland, Cathal.Brugha@ucd.ie

We use meta-theory to show how Project Management structures derive from four General Decision Activities: Proposition, Perception, Pull and Push. Project Development is shown to be made up of three Committing Phases: Analysis, Design and Implementation, each of which has three Convincing Others Stages: Self/Technical, Others/Contextual, World/Situational. These form nine stages, each of which is focused on one of Four Decision Drivers: Committing Self, Convincing Others, Adjusting Others and Adjusting Self.

3 - Critical awareness of worldviews in organisational change
Mike Yearworth, Systems Centre, University of Bristol, Queens Building, University Walk, BS8 1TR, Bristol, United Kingdom, mike.yearworth@bristol.ac.uk, Charlotte Dunford, Darren York, Patrick Godfrey

Systems Practice is the application of a particular way of perceiving and composing the workforce in the long term, which means taking decisions on hiring, firing, promotion, transfers and training of skilled people, considered as the main limiting factor. To the best of our knowledge, there are no formalized procedures to deal with strategic capacity planning in KIOs. The present study aims to define the problem, identify the most relevant characteristics and propose a classification scheme in order to later develop specific solving methodology and procedures.
1 - Expanding the Hydroelectric Power Capacity of the Kwanza River  
Javier Cano, Rey Juan Carlos University, Spain, javier.cano@urjc.es, Kiombo Jean Marie, David Rios-Insua

The increasing demand and prices of crude oil and its derivatives are forcing authorities to use more efficiently the current sources of energy, and to invest in alternative sources and new infrastructures. We have analyzed the situation in Angola, proposing a strategic (and financially viable) planning for the expansion of the hydroelectric power capacity of the Kwanza River, in order to cope with different and realistic scenarios of future demands, avoiding the collapse of the Angolan Energy Reference System (ERS). The decision making problem includes mixed nonlinear-integer terms.

2 - Valorization of riverbanks in the urban area  
Tomás Hanáček, PhD, Student, Faculty of architecture, STU, Institute of Urban Planning and Land-Use Planning, Lidická 3, 91101, Trenčín, Slovakia, hanacek.tomas@gmail.com

Degraded river waterfront areas become the subject of revitalization in many European cities. Many cities dispose of the attribute of the city on the water. How can we evaluate the potential of the area, which combines the natural with the artificial environment? Cultural benefit and historical reference of the point based on water mean added value in this mathematical equation. Analytical method SKETCH and GO searches opportunities how to optimize solutions for design urban space through multisensual perception of the environment. An important aspect of the method is its multidisciplinary applicability and possibility of comparison of each research element.

3 - Export Diversification and Resource-based Industrialization: The Case of Natural Gas  
Olivier Massol, Center for Economics and Management, IFP School, 228-232 Avenue Napoléon Bonaparte, 92852, Rueil-Malmaison, France, olivier.massol@ifpen.fr

For a small economy, the ownership of natural gas resources is usually described as a blessing, but past performances reveal a curse caused by the large variability of export revenues. A modified mean-variance portfolio model is thus proposed to design a diversification strategy centered on resource-based industries. Using a time series model of commodity prices, this model is put to work, to analyze the efficient frontier, and evaluate the policies implemented in nine economies.

4 - Multicriteria Decision Aid for Equitable Water Distribution Network  
Jose Luis Castaño Cabrales, Rey Juan Carlos University, 28943, Fuenlabrada, Spain, cabrales@web.de, Angel Udias, David Rios-Insua, Javier Cano, Hocine Fellag

This work describes an equitable problem, the multiobjective management (equity vs. efficiency) of water resources in the region of Kabila, in Algeria. External factors, as pumping operational schedules, strategic planning, pipes leakages, village’s geographical location, and network constraints make difficult to distribute water fairly in a reliable and cost-efficient manner. We have developed a decision support system that implements different optimization algorithms (egalitarian, utilitarian, Kalai-Smorodinsky), to help water companies to take reliable and feasible decisions.
1 - The Efficiency Measure Over Time with Undesirable Outputs: A Case of Auto and Auto Component Industry in Taiwan
Yi-Chuan Lai, Business Administration, Providence University, 200 Chung-Chi Rd., Shalu District, 43301, Taichung, Taiwan, yclai@pu.edu.tw, Chir-Min Hsu
Operation performance is used to measure operation results of a decision making unit. A DEA model that measures efficiency according to undesirable outputs is proposed. Several factors are included in the model. Input items include fixed assets, current assets, R&D cost, and number of employees. The desirable output is net sales, and the undesirable output is defined as loss on inventories. Window analysis is used to discuss the efficiency change over time. Data were collected from auto and auto component industries in Taiwan. We identify various issues that affect the operation efficiency.

2 - An application of canonical correlation analysis for the econometric estimation of the stochastic production frontier
João Silveira, Applied Social Sciences, University Regional Integrated High Uruguay and Missions, URI - Santiago Campus - Brazil - RS, 97700-000, Santiago, RS, Brazil, joaotusi@hotmail.com, Attus Moreira
Since the stochastic frontier production model emerged in 1977, interest in econometric analysis of productive efficiency has been increasing. Yet this kind of analysis is troublesome with regards to multiple outputs. The multiple-equation approach is not well developed and the single equation approach is subject to special conditions that are not always fulfilled. A methodological alternative is proposed. The estimation process treats each one of the multiple outputs as an independent variable and can be estimated by canonical correlation analysis.

3 - Evaluation of the efficiency of investments in the host cities of the Olympic Games using Data Envelopment Analysis (DEA)
Paula Guimaraes, Industrial Engineering, UFF; Paulo Silva Araujo number 95 apt 302, 20735230, Rio de Janeiro, Rio de Janeiro, Brazil, paulasguima@yahoo.com.br, Nissia Bergiante
The main idea of the Olympic Games is to create an atmosphere of global solidarity. However, behind it there is a financial plan applied to the host cities to support generated impacts. As a result is expected an increment in the number of visitors providing a financial return from services related to tourism, in addition to the revenue generated by the games themselves. In this context, this study aims to evaluate the efficiency of the last five host cities using DEA. As input we chose the games themselves. In this context, this study aims to evaluate the efficiency of the last five host cities using DEA. As input we chose the games themselves.

4 - A holistic approach for assessing the performance of maternity and newborn services
Olga Li, Economics, UAlg, Campus de Gambelas, 8005-139, Faro, Algarve, Portugal, leeolya@gmail.com, Sérgio Santos, Carla Amado
The integration of health care services as a potential solution to improve their efficiency has attracted considerable interest in recent years. This paper proposes a conceptual framework for integrated maternal and newborn services and explores the use of network data envelopment analysis to assess the performance of the holistic system proposed. By using data from several countries, an international comparison is discussed.

5 - The assessment of livability in European cities
Andrea Zanella, Faculdade de Engenharia da Universidade do Porto, Rua Dr. Roberto Frias, s/n, 4200-465, Porto, Portugal, andreia.zanella@fe.up.pt, Ana Camanho, Teresa Galvão Dias
In this study we address the assessment of livability in European cities. In a first stage, the cities were evaluated taking into account two components of livability: human well-being and environmental quality. The assessment is based on a Data Envelopment Analysis model specified with a Directional Distance Function. The second stage involves exploring the exogenous factors that may promote livability in an urban context. A decision tree is used to identify the main factors that characterize the cities and that may explain differences in performance.

6 - Towards sustainability in construction: a DEA assessment at an urban level
Isabel Horta, Faculdade de Engenharia, Universidade do Porto, R. Dr. Roberto Frias, 4200-465, Porto, Portugal, ihorta@fe.up.pt, Ana Camanho, Teresa Galvão Dias
The purpose of this research is to assess construction performance at a municipality level, focusing on resource consumption. The best and the worst practices are investigated using two types of DEA frontiers: the frontier of the production possibility set and an inverted frontier. In addition, the factors associated with good levels of performance are explored using truncated regression. In a second stage, the change in performance over time is analyzed applying the Malmquist index. To illustrate the methodology developed, the data related to Lisbon municipalities between 2002-2006 is used.

7 - An Application of Categorical Models of Data Envelopment Analysis
Luka Neralic, Faculty of Economics and Business, University of Zagreb, J. F. Kennedy 6, Stefaniceva 7, 10000, Zagreb, Croatia, lneralic@etrg.hr, Dubravko Hunjet, Richard E. Wendell
This paper studies the efficiency of 127 selected towns in the Republic of Croatia using categorical models of Data Envelopment Analysis (DEA). The towns, represented as Decision Making Units (DMUs), are characterized into four categories according to their respective populations. Using the number of employed workers and employed assets as inputs and income as an output, we consider a categorical input-oriented (output-oriented) model with constant (variable) returns-to-scale. The paper presents and analyses computational results on efficiency of the towns.

4 - Benchmarking in maintenance and repairing in electricity distribution networks using an additive DEA model with incorporation of preferences
Maria Gouveia, IPC/INESCC, Quinta Agricola - Bencantar, 3040-316, Coimbra, Portugal, mgouveia@iscsp.pt, Luis C. Dias, Carlos Henggeler Antunes
Benchmarking studies provide a rational for quantifying the differences in performance, grasping the reasons for these differences, comparing with excellence targets, and developing ways the organization should follow to achieve them. This work uses a two-phase method based on the weighted additive model that explores links between DEA and Multi-Criteria Decision Analysis incorporating managerial preferences to perform a benchmark study of network areas of an electricity distribution company concerning maintenance and interruption repairing.
1 - Protein structure quality assessment and modeling support framework
Maciej Antczak, Institute of Computing Science, Poznan University of Technology, ul. Marii Sklodowskiej-Curie 5, 60-965, Poznan, Poland, m.maczak@cs.put.poznan.pl, Piotr Lukasiak, Jacek Blazewicz, Krzysztof Fidelis
Protein structure prediction using computational tools is great interest of humanity. Moreover, reliable computational methods designed to evaluate protein models quality is relevant in the context of protein structure refinement as currently available computational models outnumber experimentally derived. The proposed method allows to identify and visualize possible stereochemical, folding, packing inconsistencies of protein structure. It is also particularly suited to assess applicability of the target sequence to structural template alignments, a major source of comparative modeling errors.

2 - OR applications for protein structure modelling and docking
Maciej Milostan, Poznan University of Technology, pl. M. Skłodowskiej-Curie 5, 60-965, Poznan, Poland, m.milostan@cs.put.poznan.pl
We show a pathway paved by a number of computational extensive analysis that lead us through a forest of genomic and structural data towards successful models of DCL proteins from Arabidopsis Thaliana and their interactions with RNA. The applied protocol include database searches, to find potential homologous sequences, followed by multiple sequence alignments generation, identification of conserved regions, identification of structural templates in PDB, secondary structure prediction, MD simulations, protein-RNA docking and evaluation of structures. We put emphasis on OR techniques.

3 - Quality assessment methodologies in analysis of structural models
Piotr Lukasiak, Institute of Computing Science, Poznan University of Technology, ul.Piotrowo 2, 60-965, Poznan, Poland, Piotr.Lukasiak@cs.put.poznan.pl
Proteins and RNA are the most important molecules in all living organisms. In the crowded space of 3D structural models, the development and improvement of reliable computational methods designed to evaluate the quality of protein and RNA models is relevant in the context of tertiary structure refinement. The correct identification of good models and recognition of good methodologies against misleading ones generate higher level of confidence in results obtained by different methodologies. This aspect can influence the quality and usefulness of 3D structure prediction in the nearest future.

4 - Rule extraction for pre-eclampsia based on Genetic Algorithm
Shohreh Alimohammadi, Perinatology, Medical faculty of Hamedan, Hamedan, Hamedan, Iran, Islamic Republic Of, dr_alimohammadi@yahoo.com, Amene Alimohammadi, Mahdi Ashrafi
In this article data about pregnant women with pre — eclampsia and mothers without pre-eclampsia were studied in order to determine the rules of the disease with the help of Genetic Algorithms and to obtain understandable knowledge on the disease areas. Information about the disease, including 543 cases was divided in three categories: healthy, low risk and high risk group. After pre-processing, Genetic Algorithms have been used for rule extraction of pre-eclampsia. The three rules with the help of Genetic Algorithms (for each disease class, a rule) for pre-eclampsia have been extracted.

1 - Pareto Set Approximation for the Multiobjective Set Covering Problem
Margaret Wieczek, Department of Mathematical Sciences, Clemson University, Martin Hall O-208, 29634, Clemson, SC, United States, wmaltar@clemson.edu
The Pareto set of the multiobjective set covering problem is approximated within a specified accuracy. Two methods are proposed: one based on the weighted-sum scalarization and the other based on the max-ordering. The algorithms approximate all (weakly) Pareto solutions with the accuracy resulting from the problem size and data. Computational results are included.

2 - Multiobjective combinatorial optimization for selecting treatment regimes in forestry
Dmitry Podkopaev, Dept. of Mathematical Information Technology, University of Jyväskylä, P.O. Box 35 (Agora), FI-40014, University of Jyväskylä, Finland, dmitry.podkopaev@jyu.fi, Artti Juutinen, Kaisa Miettinen, Mikko Monkkonen, Pasi Reunanen, Olli-Pekka Tikkanen
We consider an approach to managing large forest landscapes by selecting for each small forest stand an individual treatment regime, i.e., a set of management rules depending on forest’s current characteristics. The impact of treatment on the forest is determined through simulation. We consider both economic and nature preservation aspects and formulate the problem of selecting treatment regimes as a combinatorial multiobjective optimization problem with linear and quadratic objectives. We present experiences of solving a computationally challenging real-life problem with 30K forest stands.

3 - A bi-objective approach to reschedule new jobs in a one machine model
Jacques Teghem, Mathro, Faculté Polytechnique/UMons, 9, rue de Houdain, Rue de Houdain 9, 7000, Mons, Belgium, jacques.teghem@umons.ac.be, Daniel Tuytens
We consider a one machine scheduling model with a classical objective - either total completion time or maximal tardiness - and two sets of jobs: one with initial jobs already scheduled and one with new jobs which must be inserted in the schedule. As this reschedule can create a disruption, a second disruption objective is considered, which can be formulated in four different manners. In this paper the aim is to obtain the set of efficient schedules in regard of the two objectives. Algorithms are provided for the eight possible bi-objective problems.

4 - Immune Algorithm for Multi-Objective Schedule Optimization in Railway Transport
Anatoly Levchenkov, Riga Technical University, 1658, Riga, Latvia, anatolij.levchenkov@rtu.lv, Ivars Alps, Mikhail Gorobetz
This paper presents dual population immune algorithm for multi-objective optimization of railway transport schedule. The target is to minimize the risk of collisions between railway and auto transport to reduce the human factor and prevent accidents and to minimize idle time for road transport on level-crossing by increasing its capacity. Mathematical model and target function to prevent collisions and crashes in railway transport is presented. Immune algorithm is proposed for optimization problem solution. Algorithm is tested using computer model of the transport system.
1 - The study of the university students consumer behavior tea-shops as example
Yuan-Du Hsiao, Department of Business Administration, Chungyu Institute of Technology, No.40, Yi7th Rd., Keelung, 20103 Taiwan, R.O.C., 20103, Keelung, Taiwan, R.O.C., Taiwan, yudhsia@cit.edu.tw, Jen-Chia Chang, Mu-Hui Lai, Liang-Yuan Hsiung

This study main purpose are 1. To discuss the subjects who get drinks from consumer behavior. 2. Testing the difference from the consumer of tea-shops. The study finding 1. More than half consumer is choosing the shop criterion "important" of the project. 2. Consumer general does not costs at fixed shop. 3. The ones often go shopping at the noon. 4. Almost ones always go to "Dou Di Tea-shops". From findings, the suggestions for the tea-shop boss or studies experts reference related.

2 - The Study on Teachers’ Willingness to Adopt Computer-Aided Instruction in Public Vocational High Schools
Jen-Chia Chang, Institute of Technology & Vocational Education,, National Taipei University of Technology, 10608, Taipei, Taiwan. jc5839@ntut.edu.tw, Yuan-Du Hsiao, Mu-Hui Lai, Liang-Yuan Hsiung

The study with 126 sampled subject in mid-Taiwan. The reliability and validity of the questionnaire have been rendered positive, upon verification. The mean value of teachers' willingness to adopt CAI is 3.97, ranged as moderate. Teachers are generally dissatisfied with the CAI software, hardware facilities support and promote CAI in school; however, these three factors have no significant connection with teachers’ willingness to apply CAI. The researcher is to offer various suggestions, based on this study, to schools and the education administrative departments.

3 - A study on relationship model among travel motivation, travel type, travel involvement, and travel benefit of Facebook users: A case of Taiwan domestic tourism
Pei-Ting Chen, Travel Management, National Kaohsiung University of Hospitality and Tourism, 81267, Kaohsiung, Taiwan, tober770831@hotmail.com, Tung-Chung Kan, Kuo Tzu-hsuan

This study aims to discuss the relation among travel motivation, travel involvement, and tourism benefit of Facebook users. It also uses travel type as the intervening variable to further explore its influence in relation to travel pattern, travel involvement and tourism benefit. We expect this research result will help understand Facebook users to understand characteristics of Taiwan domestic tourism. This study is expected to build an appropriate social networking users’ travel behavior model to develop distinctive and customized community tourism products.

4 - Multi-Criteria Comparison of Catering Service Companies Using Grey Relational Analysis: The Case of Turkey
Alper Hanmadzaydi, Dokuz Eylul University, Turkey, alper.hanmadzaydi@deu.edu.tr, Singe Yelkenci Kose, Sener Akpinar, Atabak Elmi, Hanlii Okan Isguder

Catering is the business of providing food and beverage at a remote site or a site like business meetings and other social occasions. Selecting catering is an important multi-criteria decision making problem. In this study grey relational analysis (GRA) is used for the aim of selecting the best catering firm providing the most firm satisfaction. Due to the importance of criteria weights in decision making, Analytic Hierarchy Process is used to find best values of criteria weights in GRA process. A case study is demonstrated and evaluated using the developed multi-criteria methodology.

MD 40
Monday, 14:30-16:00
HH-Livingstone

MDM Applications VIII
Stream: MCDA: New Approaches and Applications
Invited session
Chair: Chiu-Tsai Lin, Department of Business Administration, Ming Chuan University, 3F, No.130, Jhe Rd., Shihlin District,, 11111, Taipei, Taiwan, ctitlin@mail.mcu.edu.tw
Chair: Chie-bein Chen, International Business, National Dong Hwa University, 1, Sec. 2, Da-hsueh Rd. Shou-feng, 974, Hualien, Taiwan, cbchen@mail.ndhu.edu.tw

1 - A Radial Basis Function Neural Network (RBFNN) Approach for Multi-label Text Categorization Problems
Tai-Yue Wang, Dept. of Industrial and Information Management, National Cheng Kung University, 1 University Road., 70101, Tainan, Taiwan, tywang@mail.ncku.edu.tw, Hui-Min Chang

This paper presents an automatic text categorization model based on the RBFNN and utilizes valuable discriminative information in the training dataset and incorporates background knowledge during model learning. The Reuters 21,578 News dataset is utilized to demonstrate the application of the proposed model and to compare its performance with that of other models. The results vindicate that the performance of the proposed model is comparable to that of other models for different performance indices.

2 - Fuzzy MCDM technique for planning the wetland environment
Vivien Y.C. Chen, Institute of Leisure and Health Business, Taipei Chengshih University of Science and Technology, No. 2, Xueyuan Rd., Peitou, 112, Taipei, Taiwan, chen.vivien@gmail.com, Kuo Tzu-hsuan, Tang-Chung Kan

This paper presents a fuzzy multi-criteria analysis approach for selecting the best plan alternatives in wetland environment. A questionnaire was used to find out from three related groups comprising 15 experts. The subjectivity and vagueness is dealt with the criteria and alternatives for selection process by using fuzzy numbers with linguistic terms. Incorporated the decision makers’ attitude towards preference, overall performance value of each alternative can be obtained based on the concept of Fuzzy Multiple Criteria Decision Making.

3 - Improving the quality of leisure and tourism for Theme Parks with a MCDM Model
Gwo-Hsiuung Tseng, College of Management, Hsinchu 300, National Chiao Tung University, Kaimin University, Taiwan 338, Taiwan, gh.tseng@cc.nctu.edu.tw, Vivien Y.C. Chen

The purpose of this paper is to probe how to use qualitative and quantitative measurements of Theme Parks to create plan indexes and criteria, as well as how to help these indexes achieve the optimal levels for each criterion. Previous efforts to measure leisure and tourism evaluations and plans have assumed that the criteria are independent, but this assumption does not hold in real-world applications. In this study, a hybrid multiple criteria decision-making model is used to address dependent relationships among various criteria.

4 - Using F-PROMETHEE for evaluating and ranking constructive projects contractors (A Case Study of Mehr Housing Project of Hashtgerd New City - Iran)
Mahdi Nasrollahi, no.82 dehkodka Ave. masjed St., 36161, hashtgerd new town, tehran, mahdi1484@yahoo.com

In this paper a model for evaluating and ranking constructive projects will be presented. This model is based on six key criteria (good history, Equipment, Management & technical staff, Economic - Financial, experience, and technical capabilities) and a conceptual framework. These criteria and their weights were derived from previous studies. The vagueness of the linguistic terms in the evaluation process required employment of fuzzy numbers. F-PROMETHEE was used for the ranking projects. To test the model and as a case study, contractors of housing projects in Iran were ranked.
**MD-41**

Monday, 14:30-16:00
HH-Heyerdahl

**AHP/ANP 3**

*Stream: Analytic Hierarchy Process, Analytic Network Process*

*Invited session*

**Chair:** William Wedley, Faculty of Business Administration, Simon Fraser University, 8888 University Drive, V5A 1S6, Burnaby, BC, Canada, wedley@sfu.ca

**1 - Correct Derivation Of Ratio Scale Preference Values From Pairwise Comparison Matrices***

*Eng Choo, Faculty of Business Administration, Simon Fraser University, 8888 University Drive, V5A 1S6, Burnaby, BC, Canada, choo@sfu.ca, William Wedley*

We consider the problem of deriving ratio scale preference values of n alternatives from pairwise comparison matrix elicited from the decision maker. We characterize the underlying ratio-relevant information. This leads to a necessary condition for using the ratio-relevant information in T correctly. The multiplicative form is shown to be the only simple row by row method that uses the ratio-relevant information in T correctly. The geometric mean method is the only well-known method that satisfies the necessary condition for using the ratio-relevant information in T correctly.

**2 - Using Analytic Network Process (ANP) in Four Links Model***

*Ihsan Yüksel, Business Administration, Kirikkale University, Kirikkale University, IBIF, 71450, Kirikkale, Turkey, yuksel@kku.edu.tr, Erdem Aksakal, Metin Dagdeviren*

The aim of this study is to evaluate the strategic environment of an organization within the framework of Lynch’s Four Links analysis by using Analytic Network Process (ANP). In the study, firstly factors which have an impact on the organization performance were determined and then inner dependencies between models and factors were examined. The weights of factors were determined on the basis of these examined dependencies and weights were used for a case study to evaluate the strategic environment. As result it was seen that analyzing the strategic environment can be performed by ANP.

**3 - A hybrid MCDM approach to assess the sustainability of students’ preferences for university selection***

*Kabak Mehmet, Department of Industrial Engineering, Turkish Army Academy, Kara Harp Okulu Dekanlığı, End. ve Sis.Müh.Böl., 06654, Ankara, Turkey, mkabak@kho.edu.tr, Metin Dagdeviren*

An integrated approach which employs ANP and PROMETHEE together is proposed. It is concerned with criteria influencing student choice in Turkey to establish a model for predicting students’ preferences for universities. The ANP is used to analyze the structure of the problem and to determine weights of the criteria, and the PROMETHEE is used to obtain final ranking, and to make a sensitivity analysis. The results indicate that three factors, future career prospects and opportunities, scholarship and university’s social life, are at the top in the university selection.

**4 - Ahp matrix convergence — a unit interpretation***

*William Wedley, Faculty of Business Administration, Simon Fraser University, 8888 University Drive, V5A 1S6, Burnaby, BC, Canada, wedley@sfu.ca, Eng Choo*

Raising the paired comparison matrix to powers is efficient for calculating the principal eigenvector. The disadvantage is that higher order calculations are difficult to comprehend. This paper suggests a modification-to interpret convergence of cell values as the simple average of many conversion estimates. Invariance of ratios irrespective of the unit of measure is a trait of ratio scales. The eigenvector achieves this trait, as the geometric mean that is used in group aggregation and has many desirable properties, and the simple mean of unit sum columns has proved to be quite accurate.

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**MD-42**

Monday, 14:30-16:00

**EEPA 2012 - 2**

*Stream: EURO Excellence in Practice Award 2012*

**Invited session**

**Chair:** Michel Bierlaire, ENAC INTER TRANSPOP, École Polytechnique Fédérale de Lausanne (EPFL), GC B 454, Station 18, CH-1015, Lausanne, Switzerland, michel.bierlaire@epfl.ch

**1 - SPRINT: Optimization of Staff Management for Desk Customer Relations Services***

*Daniele Vigo, DEIS, University of Bologna, Via Venezia 52, 47023, Cesena, Italy, daniele.vigo@unibo.it, Claudio Caremi, Angelo Gordini, Sandro Bosso, Giuseppe D’Aleo, Beatrice Beleggia*

Staff Management (SM) is a critical issue in the design and management of modern Desk Customer Relation Services (DCRss) due to the large amount of resources involved and the increasing pressure towards maintaining a very high level of service. We illustrate a Decision Support System for SM, called SPRINT, developed for a large multi-utility company in northern Italy. After one year of service SPRINT has introduced a considerable improvement in the process and achieved relevant savings in terms of resource consumption and very high level of service.

**2 - Logistic planning using DSS FlowOpt***

*Mikael Rönqvist, Département de génie mécanique, Université Laval, G1V 0A6, Québec, Canada, mikael.ronqvist@nih.no, Patrik Flisberg, Mikael Frisk*

Skogforsk is the central research body for the Swedish forestry sector. Skogforsk has developed the decision support system FlowOpt. A central part is a powerful optimization engine which has been a key contribution to the success of the system. It makes use of a flexible network model with extensions including backhauling and cost sharing possibilities. The system has been used in many case studies and implementations during the last 10 years. It has been used to evaluate the performance and suggest improvements at single companies as well as several companies making collaborative schemes.

**3 - Flood Prevention by Optimal Dike Heightening***

*Kees Roos, EWI, TU Delft, Melkweg 4, 2628CD, Delft, ZH, Netherlands, c.roos@tudelft.nl, Dick den Hertog, Ruud Brekelmans, Carel Eigenraam*

The Dutch government is very much aware of the flooding risks that The Netherlands is exposed to. This research tries to answer the fundamental questions of when and how much to invest in which parts of the constituent segments of a dike ring protecting a certain area of land. This problem is solved by using Mixed-Integer Nonlinear Programming techniques. For homogeneous dike-rings explicit formulas for periodic solutions have been obtained. Dutch government agencies use the model to analyze the main dike rings and to propose new safety standards to be incorporated in the Dutch Water Act.

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**MD-43**

Monday, 14:30-16:00

**Probabilistic Programming**

*Stream: Stochastic Programming*

**Invited session**

**Chair:** Tamas Szantai, Institute of Mathematics, Budapest University of Technology and Economics, Muegyetem rkp. 3., 1111, Budapest, Hungary, szantai@math.bme.hu

**Chair:** Andras Prekopa, RUTCOR, Rutgers University, 640 Bartholomew Road, 08854-8003, Piscataway, New Jersey, United States, prekopa@rutcor.rutgers.edu
1 - A probabilistic constrained stochastic programming problem, where the technology coefficients in the stochastic constraints are normally distributed random variables
Andras Prekopa, RUTCOR, Rutgers University, 640 Bartholomew Road, 08854-8003, Piscataway, New Jersey, United States, prekopa@rutcor.rutgers.edu, Tamas Szantai

A hybrid algorithm will be presented for the solution, where the (outer) supporting hyperplane algorithm is combined with a (inner) cutting plane method. We report about the numerical experience in connection with the solution method presented. Special emphasis will be put on the calculation of the function and gradient values.

2 - Solution of probabilistic constrained stochastic programming problems with discrete random variables and mixed decision variables
Kunikiizu Yoda, RUTCOR, Rutgers Center for Operations Research, Rutgers University, 640 Bartholomew Rd, 08854-8003, Piscataway, NJ, United States, kyoda@rutcor.rutgers.edu, Andras Prekopa

We consider the probabilistic constrained stochastic programming problem where the decision variables are integers and the random right-hand side vector follows an r-concave discrete distribution. Useful formulations of related problems are presented with the concept of p-efficient points of a probability distribution. We present a cutting plane type algorithmic solution to the problem.

3 - Single commodity network design under probabilistic constraint with continuous random variables
Olga Myndyuk, Rutgers, The State University of New Jersey, 640 Bartholomew Rd, 08854, Piscataway, NJ, United States, olgamyn@eden.rutgers.edu, Andras Prekopa

We formulate and solve problems to find optimal node and arc capacities in a network, where demands are random, under probabilistic constraints that ensures reliability on a high level. After elimination of the redundant feasibility inequalities the problem is reduced to an LP that is solved by the combination of an inner and outer algorithm providing us with both lower and upper bounds for the optimum in each iteration. The possible applications include power systems, water supply, traffic, evacuation networks.

4 - Parallelisation of the so-called Cluster Benders Decomposition algorithm for solving two-stage stochastic linear problems
Francesc Solsona, Computer Science, University of Lleida, Jaume II, 69, 25001, Lleida, Catalunya, Spain, francesc@dei.udl.cat, Lluís M Pla, Josep Lluís Lerida, Jordi Mateo

L-shaped is a decomposition method used to solve stochastic linear problems via scenario analysis. This algorithm is made up of three steps: the first solves the master problem, the second checks for feasible cuts and the third checks for optimality cuts. These cuts are sequentially added to the master problem to be solved whenever each new cut is appended. When there is no more cuts, the optimal solution is found. The cuts are identified by solving auxiliary submodels derived from the scenarios. In this paper we propose the parallelisation of the algorithm named Cluster Benders Decomposition.

1 - Illustrating the need to integrate pricing and supply chain decision-making
Peter Bell, Richard Ivey School of Business, University of Western Ontario, N6A 3K7, London, Ontario, Canada, pbell@ivey.ca

This presentation will use three cases that describe real company situations to illustrate the role of pricing in supply chain management. I will try to make the point that good pricing decisions make managing a supply chain much easier: often supply chain issues (such as bottlenecks, too much or too little inventory or capacity) can be resolved through more informed pricing.

2 - Optimal pricing and production decision in the presence of substitution
Sang Won Kim, College of Business Administration, University of Ulsan, 93 Univ. Road, Meung-Dong, Nam-Gu, 680-749, Ulsan, Korea, Republic Of, studyksw@yahoo.co.kr, Peter Bell

Many firms take into account the fact that the creation of price differences between market segments leads to price-driven substitution. This effect will impact the firms’ price and production decisions. In this paper, we consider the impact of price-driven substitution on a firm’s pricing and production decisions for a single period. We investigate the impact of the symmetrical and asymmetrical demand substitution on optimal prices, production levels and revenue.

3 - New results concerning probability distributions with increasing generalized failure rates
Mihai Banciu, School of Management, Bucknell University, 119 Taylor Hall, 17837, Lewisburg, PA, United States, mb018@bucknell.edu, Prakash Mirchandani

The generalized failure rate is defined as the extension of the hazard rate of a continuous random variable. If the valuation distribution of a product has an increasing generalized failure rate (IGFR), then the associated revenue function is unimodal. Assuming the IGFR property is thus very useful in pricing applications. In this talk we prove closure on optimal prices, production levels and revenue.

4 - Retail Selling with All-Pay Auctions
Fredrik Odegaard, Richard Ivey School of Business, University of Western Ontario, 1151 Richmond Street North, N6A 3K7, London, Ontario, Canada, fodegaard@ivey.uwo.ca, Chris Anderson

In the fixed list price channel consumers can purchase the item at p1. In the all-pay auction consumers place a bid b, which they forfeit regardless of the outcome, and the highest bid wins the item. We consider both modifications where consumers can use their sunk bid as a credit and the highest bid is for the item. We consider a modification where consumers can use their sunk bid as a credit and the highest bid wins the item. We consider both modifications where consumers can use their sunk bid as a credit and the highest bid wins the item. We consider both modifications where consumers can use their sunk bid as a credit and the highest bid wins the item. We consider both modifications where consumers can use their sunk bid as a credit and the highest bid wins the item. We consider both modifications where consumers can use their sunk bid as a credit and the highest bid wins the item.

MD-45
Monday, 14:30-16:00
BW-Water
Management accounting and management control 2
Stream: Simulation in Management Accounting and Management Control
Invited session
Chair: Stefan Leitner, Dept. for Controlling and Strategic Management, Alpen-Adria-Universität Klagenfurt, Universitätsstrasse 65-67, 9020, Klagenfurt, Austria, stefan.leitner@uni-klu.ac.at
1 - Dynamic pricing & seat control problem with cancellation and refund policy in airlines
Moon-Gil Yoon, Business Administration, Korea Aerospace University, 200-1 hwajum-dong, 471-712, Koyang-shi, Kyunggi-do, Korea, Republic Of, mgyoon@kau.ac.kr, Hwi Young Lee

Changing customer behavior and airline market environments in airline industries require a new mechanism for improving the revenue management. We consider a dynamic pricing and seat control problem for discrete time horizon with cancellation and refund policy in the context of the airline industry. Applying the linear approximation technique and given the price set for each time, we suggest a mixed Integer Programming model to solve our problem efficiently. From the simulation results, we can find our model makes good performance and can be expanded to other comprehensive problems.

2 - Product cost distortions in full cost accounting - A Monte Carlo simulation-based analysis
Catherine Grisar, Institute of Management Control and Accounting, Hamburg University of Technology, Schwarzenbergstraße 95 D, 20173, Hamburg, Germany, catherine.grisar@tu-harburg.de, Matthias Meyer

This paper presents a systematic approach to quantify the effect of alternative costing system designs on product costs. Starting with a stochastic full cost accounting system, we identify design parameters and their possible specifications that are within the scope of cost accountants. The impact of these parameters on product costs is investigated via simulation. Through experimental design, we can determine the main and interaction effect of each design parameter. This paper contributes to research and practice as it illustrates the interdependencies within a full cost accounting system.

3 - Interactions among biases in costing systems: A Monte Carlo simulation-based approach
Stephan Leitner, Dept. for Controlling and Strategic Management, Alpen-Adria-Universität Klagenfurt, Universitätsstrasse 65-67, 9020, Klagenfurt, Austria, stephan.leitner@uni-klu.ac.at

This simulation study presents results on effects of distortions in raw accounting data on the quality of information provided by costing systems. Results give insights into interactions among biases and indicate that multiple biases do not necessarily affect information quality negatively. Surprisingly, in some setups interactions among multiple biases lead to mitigation, or even compensation among biases. Results indicate where (not) to tolerate biases and how to prioritize actions regarding data quality with respect to accuracy and cost of accuracy.

Monday, 16:30-17:30

ME-01
Monday, 16:30-17:30
Opera

Plenary Lecture: Professor Finn Kydland

Stream: Keynote, Tutorial and Plenary Lectures

Plenary session
Chair: Marielle Christiansen, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Alfred Getz vei 3, N-7491, Trondheim, Norway, marielle.christiansen@iot.ntnu.no

1 - Dynamic Programming and Economics
Finn Kydland, University of California, Santa Barbara, United States, kydland@econ.ucsb.edu

All interesting phenomena in macroeconomics are dynamic in nature. An overstatement, perhaps, but only a slight one. As a consequence, over the past three or four decades, dynamic programming has been an essential tool, including in my own research. In quantitative aggregate economics, dynamic programming plays a key role from model formulation to model calibration to computation of model outcomes. In the process, for example, of calibrating a model economy, its steady-state relations are an essential part of what it takes to work backwards from empirical relations among variables to what the model parameters must be in order to be consistent with them. With advances in the development of theory and computers becoming much more powerful, the set of interesting questions that can be addressed with such models has expanded dramatically in the past decade or two. This is true especially for questions that dictate the inclusion of important heterogeneity across current generations and/or across individuals more generally.

In models with a role for the government, anticipated future policy affects economic behavior in earlier periods. For example, future tax policy affects investment behavior today. If we imagine policy to be selected so as to optimize an objective (welfare) function, the resulting policy, in the absence of a commitment mechanism, is generally time inconsistent. Aside from questions about its implementation, then, a consequence is that the formulation of the optimal-policy problem is not recursive. But one can generally convert such a model into a recursive structure by introducing an additional pseudo-state variable — a shadow price — which is subject to its own constraint implied by the model. Similar issues about recursivity, potentially resolved in an analogous manner, arise in many dynamic contracting environments.
Tuesday, 8:30-10:00

**TA-01**
Tuesday, 8:30-10:00
RB-Alfa

**Tutorial Lecture: Professor Anita Schöbel**

Stream: Keynote, Tutorial and Plenary Lectures

Tutorial session

Chair: Gerhard Wächter, Fakultät für Wirtschaftswissenschaft, Otto-von-Guericke Universität Magdeburg, Postfach 4120, 39016, Magdeburg, Germany, gerhard.waescher@ww.uni-magdeburg.de

  Anita Schöbel, Institute for Numerical and Applied Mathematics, Georg-August Universität Goettingen, Lotzestrasse 16-18, 37083, Göttingen, Germany, schoebel@math.uni-goettingen.de

  The talk consists of two parts: In the first part, a state-of-the-art survey about finding lines and timetables in the strategic planning of a public transportation system will be provided, and the problem of delay management, i.e. how to update the system in case of delays will be explored. The second part will discuss ongoing research questions, namely how the routing of the passengers can be included in the planning phases, how an integration of the planning phases can be simulated, and how robustness issues can be integrated. Theoretical and experimental results on these topics will be shown.

  Part 1 gives an overview on line planning, timetabling, and delay management. Given an existing public transportation network with its stops (or stations) and direct connections, the first step in the strategic planning of a transport system is to define lines and their frequencies. A line is a path in the public transportation network along which regular service is offered. We discuss various optimization models minimizing either the costs of the lines or maximizing the convenience for the passengers.

  If the lines have been found, the next step is to design a timetable. There are two different models: Periodic timetables which are repeated on e.g. an hourly basis and aperiodic timetables. The usual aim is to minimize the travel time for the passengers. Integer programming formulations will be provided for both problem types and algorithmic approaches for finding timetables will be reviewed.

  Coming to the operational phase, the question of the delay management problem is how to react in case of delays such that the passengers’ travel times do not increase too much. This concerns the decision if a punctual bus or train should start for a delayed feeder bus or train or if it should better depart on time. In railway traffic also the limited capacity of the tracks has to be taken into account, i.e. priority decisions have to be made. Also here, the state-of-the art of delay management will be presented.

  The three problems discussed in Part 1 can be solved more or less efficiently. However, the algorithms and approaches are still not suitable for solving real-world problems. In part 2 we will hence discuss features that are missing, identify the resulting research questions and show some first solution approaches aiming at making the algorithms work in practice.

  A first problem concerns the decision of the passengers. In many papers on line planning, time tabling, and delay management it is assumed that it is already known how the passengers travel, i.e. a passenger’s weight is assumed to be known for every edge or activity in the system. This is an unrealistic assumption since the route choice of the passengers depends on the lines, the timetable and on the delay management strategy. We will discuss how the passengers’ decisions may be integrated into the optimization process.

  Another issue is robustness. It is not helpful to have an exact optimal solution that might get totally meaningless if a small disturbance occurs. Hence, the aim should be to have a robust transportation system which performs well even if the scenario or the input data changes. We exemplarily illustrate different concepts on how robustness can be integrated for the timetabling phase.

  Specialized algorithms for every single planning phase in public transportation are known. However, the best line plan is not helpful if it only allows bad timetables. Hence, some effort should be made to find integrated solutions.

Using our toolbox LinTim we illustrate how decisions made in earlier planning steps can influence the subsequent planning phases. Among others we show how the quality of a timetable depends on decisions made in the line planning phase, how good the approximation of the passengers’ weights fits to the real behavior of the passengers, and how the robustness of a public transport system may be simulated.

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**TA-02**
Tuesday, 8:30-10:00
RB-Beta

**Graph Models in Logistics and Scheduling**

Stream: Scheduling

Invited session

Chair: Maksim Barketau, United Institute of Informatics Problems, Academy of Sciences of Belarus, 220012, Minsk, Belarus, barketau@mail.ru, Erwin Pesch, Yakov Shafrainsky

- Minimizing maximal weight of subsets in a bipartite graph
  Maksim Barketau, United Institute of Informatics Problems, Academy of Sciences of Belarus, 220012, Minsk, Belarus, barketau@mail.ru, Erwin Pesch

  In a bipartite graph $G=(U,V,E)$ with weighted edges, set $U$ of vertices is partitioned into disjoint subsets called components. The aim is to find a complete matching that minimizes the maximal weight of the component (sum of the weights of the edges that have ends in the component). We prove the strong NP-hardness of the problem and the absence of a polynomial approximation algorithm with a worst-case ratio less than 2 (unless P=NP). We develop heuristics that find solutions that are on average 2 percent away from the optimum. The problem is motivated by a production planning in a railway hub.

- Batch scheduling and transfer line design problems
  Alexandre Dolgui, IE & Computer Science, Ecole des Mines de Saint Etienne, 158, cours Fauriel, 42023, Saint Etienne, France, dolgui@emse.fr, Sergey Kovalev, Mikhail Y. Kovalyov, Jenny Nossack, Erwin Pesch

  We study a transfer line design problem, in which there are several types of operations to be assigned to stations. If a station is assigned at least one operation of a certain type, it induces a type dependent cost. Precedence relations on the set of operations are given by an arbitrary digraph. The primary objective is to minimize the number of stations and the secondary objective is to minimize the total type dependent cost. An equivalent batch scheduling model is presented. Obtained results include computational complexity, heuristics, ILP formulations and computer experiments.

- Periodic Scheduling for Wireless Access Networks to the Internet
  Celia Glass, Cass Business School, City University, 106 Bunhill Row, EC1Y 8TZ, London, United Kingdom, c.a.glass@city.ac.uk

  Wireless Access Networks provide low cost internet and broadband access, but have distinct limitations for scheduling. The access points, used e.g. for WiFi, cannot multi-task. This disposes them to perfect periodic scheduling, which offers both reliability of service, and energy saving. We consider binary tree access networks with local transmission. We compare optimised and heuristic solutions, to demonstrate the difficulty of co-ordinating network transmissions without periodicity, and the efficiency of perfect periodic scheduling.

- New Bounds and Constraint Propagation Techniques for the Clique Partitioning Problem
  Erwin Pesch, FB 5, University of Siegen, Hoelderlinstr. 3, 57068, Siegen, Germany, erwin.pesch@uni-siegen.de, Florian Jaehn
We consider the Clique Partitioning Problem that has several real life applications such as groupings in flexible manufacturing systems, in biology, in flight gate assignment, etc. We present tighter upper bounds for each search tree node than those known from literature, improve constraint propagation techniques for fixing edges in each node, and present a new branching scheme. The theoretical improvements are reflected by computational tests with real life data.

### TA-03
**Tuesday, 8:30-10:00**
**RB-L1**

**Logistics, Transportation, Traffic - 2**

**Stream: Logistics, Transportation, Traffic**
**Contributed session**

Chair: Erwin van der Laan, RSM Erasmus University, P.O.Box 1738, 3000DR, Rotterdam, Netherlands, elaan@rsm.nl

1 - The efficiency improving of traction drive test bench with supercapacitor energy storage system

**Genadijs Zaleskis**, Faculty of Power and Electrical Engineering, Institute of Industrial Electronics and Electrical Engineering, Riga Technical University, 1 Kronvalda Blvd., LV-1010, Riga, Latvia, genadijs.zaleskis@rtu.lv, Viesturs Brazis

In this article the results of computer modeling for the optimization of traction drive test bench with supercapacitor energy storage are described. Test bench operation is considered in cases of the energy storage system working at various selected supercapacitor initial voltages. Maximal increasing of possibility of vehicle test bench regenerative braking with minimal decreasing of autonomous power supply mode possibility is investigated. There is estimated the energy storage system efficiency improving measures dependence from supercapacitor operational voltage ranges.

2 - How to place products in a warehouse to minimize forklifts worktime — a simple data mining based algorithm

**Grzegorz Tarczynski**, Department of Operational Research, Wrocław University of Economics, ul. Komandorska 118/120, 53-345, Wrocław, Poland, grzegorz.tarczynski@ue.wroc.pl

Based on historical data, using data mining techniques, probability distributions and conditional probability distributions of goods purchase can be determined and used to plan the allocation of goods in the warehouse. The Volume-Based Storage Strategies focus on how to put goods with the highest rotation in locations most easily available to warehouseman. However, often customers buy goods in sets. This paper presents an algorithm that takes into account the most purchased product sets. The effectiveness of the algorithm was verified using simulation tool.

3 - How the NPV and average cost criterion lead to different decisions in the vending machine problem

**Erwin van der Laan**, RSM Erasmus University, P.O.Box 1738, 3000DR, Rotterdam, Netherlands, elaan@rsm.nl

The net present value (NPV) criterion is widely seen as an appropriate approach to deal with financial decision. In literature, however, it is mainly the average cost (AC) criterion that is used. We analyze the NPV and AC approach for the logistics of replenishing vending machines: every R time units the machine is inspected and replenished up to its capacity, where R should be chosen optimally. We show that there may be significant implications of using the AC criterion over the NPV criterion in terms of profit expectations and realizations.

### TA-04
**Tuesday, 8:30-10:00**
**RB-L2**

**Air Transportation and Propagation**

**Stream: Optimization in Public Transport**

**Invited session**

Chair: Claus Gwiggner, Information Systems, FU Berlin, Garystr. 21, 14195, Berlin, Germany, claus.gwiggner@fu-berlin.de

1 - Optimizing the Staff Schedule for Airport Immigration

**Phi Doan**, Aeronautics and Astronautics, University of Tokyo, 4-6-1 Komaba, Meguro-ku, RCAST building 4, room 515, 153-8904, Tokyo, Tokyo, Japan, ppdoan@hotmail.com

The objective of this research is to shorten the waiting times at an international airport by optimizing the staff schedule. First, an arrival model predicts the arrival rates at the immigration desks by using the flight schedule. Second, a queuing model estimates the waiting times for given service times and staff schedule. Last, an optimization model that uses an evolutionary algorithm estimates the number of staff over the day with the goal of minimizing the staff hours while meeting a targeted maximum waiting time.

2 - Improvement of Static Runway Assignment Using Queueing Model

**Ryota Mori**, Air Traffic Management Department, Electronic Navigation Research Institute, 7-42-23, Jindaiji-Higashimachi, Chofu, 182-0012, Tokyo, Japan, r-mori@enri.go.jp

Congestion is a critical issue at most hub airports. This paper tackles this problem occurring at the airport with most passengers in Japan, i.e. Tokyo International Airport. It has four intersecting runways which interfere with each other. Although the runway an aircraft uses is determined by its destination or departure airport to reduce air traffic controllers’ (ATC) workload, this general rule can increase aircraft waiting time. To make runway operations more efficient, a queuing model is implemented and the possible improvement is discussed with keeping minimum increase of ATC workload.

3 - Optimal Trajectory Design by Infinite Dimensional Optimization

**Daniel Delahaye**, French Civil Aviation University, 7 avenue Edouard Belin, 31055, Toulouse, France, delahaye@recherche.enac.fr, Stephane Puechmorel

Trajectories are infinite dimensional objects. There are mainly two classes of algorithms for trajectory design. The first class is based on optimization and the second one on propagation algorithms. In this work we present two examples of such algorithms for aircraft trajectory design. Both address the conflict resolution problem. The first one manipulates B-splines and the second one uses a light propagation analogy to generate optimal geodesic trajectories. Results are presented on a real day of traffic over France for which all conflicts are successfully solved.

4 - Sequencing and Swapping Probabilities for Traffic Synchronization

**Sakae Nagao**, Air Traffic Management, Electronic Navigation Research Institute, 7-42-23 Jindaiji Higashi-machi, Chofu-shi, 182-0012, Chofu, Tokyo, Japan, nagao@eni.go.jp, Claus Gwiggner, Yutaka Fukuda

In air traffic flow planning processes, estimated times of arrival are based on information from departure times at the origin airport. However, uncertainties about this information vary from aircraft to aircraft. We propose a probabilistic method for adjusting the scheduled time of arrival for aircraft pairs assuming that rough information on the distributions of estimation errors is available. We discuss the probability of swapping aircraft pairs and the conflict probability in relation to the size of the separation buffer often imposed to the separation minimum.
Maritime Transportation in Offshore Industry

Stream: Maritime Transportation
Invited session
Chair: Irina Gribkovskaia, Faculty of Economics, Informatics and Social Sciences, Molde University College - Specialized University in Logistics, Postbox 2110, 6402, Molde, Norway, irina.gribkovskaia@himolde.no

1 - A simulation study of the fleet sizing problem for offshore supply vessels
Yauhen Maisiuk, Faculty of Economics, Informatics, and Social Sciences, Molde University College - Specialized University in Logistics, Britvegen 2, 6411, Molde, Norway, yauhen.maisiuk@himolde.no, Irina Gribkovskaia

The supply vessels provide offshore installations with supplies from an onshore base according to weekly sailing plans. The goal is to decide the cost-optimal fleet of vessels on the long-term hire. The problem is stochastic as sailing speed and service time depend on uncertain weather conditions. Due to delays some installations may not be served within the planned route duration, and not received supplies have to be delivered later. We propose a discrete-event simulation model which evaluates alternative fleet size configurations depending on several strategies of later delivery of supplies.

2 - Routing and scheduling of offshore supply vessels with fuel consumption minimization through determining the best discrete value of sailing speed on each leg
Tatsiana Barysavets, Molde University College - Specialized University in Logistics, Norway, tatsiana.barysavets@himolde.no, Irina Gribkovskaia, Mikalai Mikhalaiu

We consider the offshore supply vessel routing and scheduling problem with incorporated speed decisions where the aim is to minimize the fuel consumption. The value of the vessel speed on each sailing leg is assumed to be taken from a given set. The problem is formulated as a MIP model. Two heuristic approaches are proposed: two-phase approach where the set of feasible voyages is generated a priori; and the problem is solved with a set partitioning like model; and a large neighbourhood search heuristic where the speed on each sailing leg is determined simultaneously with the vessels schedule.

3 - Routing of supply vessels to offshore installations with deliveries and pickups of multiple commodities
Eugen Sopot, Molde University College, Kirkebakken 27, 6413, Molde, Vestland, Norway, eugen.sopot@gmail.com, Irina Gribkovskaia, Gilbert Laporte

Offshore installations are dependent on periodic deliveries of various goods from an onshore supply base and continuously generate pickup demands. We consider the problem of routing supply vessels to offshore installations as a multi-commodity vehicle routing problem with pickups and deliveries. To guarantee the existence of a feasible solution to the problem it is assumed that each installation may be visited once or twice. We propose a variable neighborhood search heuristic algorithm for the single vessel variant of this problem.

4 - Speed strategies for green supply vessel planning
Ellen Karoline Norlund, Faculty of Economics, Informatics and Social Sciences, Molde University College - Specialized University in Logistics, Britvegen 2, 6402, Molde, Norway, ellen.k.norlund@himolde.no, Irina Gribkovskaia

We study how to reduce emissions in supply vessel activities through speed optimization when planning vessel schedules by solving a MIP model for a pre-generated set of voyages. Several speed strategies, determining speed for the entire voyage or optimizing speed for each voyage leg, are proposed. These strategies are applied either a priori during voyage generation or a posteriori to the voyages in the constructed schedule. Results of tests on several real-life instances show that emissions can be significantly reduced when using speed optimization in supply vessel planning.

Engineering and Hybrid search

Stream: Metaheuristics
Invited session
Chair: Said Hanafy, ISTV2, LAMIH-SIADE, University of Valenciennes, Le Mont Houy, 59313, Valenciennes, France, said.hanafi@univ-valenciennes.fr

1 - Local search methods for conflict-free routing in a multi-processor system on chip
Marc Sevaux, Lab-STIC - CNRS UMR 3192, Université de Bretagne Sud - UEB, Centre de Recherche - BP 92116, 2 rue de Saint Maude, 56321, Lorient, France, marc.sevaux@univ-ubs.fr, Boureima Zerbo, André Rossi, Jean-Charles Crepet

We present a combinatorial optimization problem for conflict-free routing in a Network-on-Chip. Based on time division multiplexing and cyclic emission, the problem consists in finding a set of k-shortest paths, such that packets will never conflict through the network but can use shared communication links in an efficient way. On a time-expanded graph, a set of shortest paths computation operators are presented. Then, based on such operators, three iterated local search schemes are presented and compared to address the problem.

2 - A PSO-based Heuristic for energy-aware scheduling of Workflow applications on cloud computing
Sonia Yassa, Val d’oise, EISTI, Avenue du Parc, 95000, Cergy, France, sonia.yassa@eistl.eu, Rachid Chelouah, Hubert Kadima, Bertrand Granado

We investigate the problem of scheduling workflow applications on cloud computing infrastructures. The cloud workflow scheduling is a complex optimization problem which requires considering various scheduling criteria. Traditional researches mainly focus on optimizing the time and cost without paying much attention to energy consumption. We propose a new approach based on hybrid PSO heuristic to optimize the scheduling performance. Our method is based on dynamic voltage scaling (DVS) technique to minimize energy consumption. Simulation results emphasize the robust performance of our approach.

3 - Software Interfaces for Heuristic Solvers and the Future of Hyflex
Andrew J. Parkes, School of Computer Science, University of Nottingham, Jubilee Campus, Wollaton Road, NG9 1BB, Nottingham, United Kingdom, ajp@cs.nott.ac.uk, Matthew Hyde, Gabriela Ochoa, Ender Özcan

Stochastic local search is often highly effective; however, many practical applications remain unexploited, not because known algorithms would fail, but simply because the development cost is too high. We discuss recent Computer Science work at the University of Nottingham to address this challenge; and to support rapid prototyping and component-based development by increasing the modularisation of heuristic search tools. In particular, we will discuss future extensions to Hyflex, an API to separate adaptive search techniques from specific details of the problem domain.

Hassan Taheri, Mathematics, Khayyam University, 91775-1159, Mashhad, Khorasan, Iran, Islamic Republic Of, taheri@math.um.ac.ir
In this paper we proposed an efficient algorithm for solving system of nonlinear Fredholm integral equations (SNFIEs) by using the Electro-magnetic Meta-Heuristic method (EM). First we choose an approximate solution for SNFIE. Then we will have a system of nonlinear equations (SNEs). If we cannot compute this integral because of the integrands involves some unknowns, then we choose a value for each constant. But the question have is how do we select these values to achieve a good solution for the SNFIE? To ensure this question we try to solve the problem by EM method. For solving the SNEs we proposed a hybrid of the Newton-GMRES and EM methods.

**Vehicle routing in practical settings**


Invited session

Chair: Jorge E. Mendoza, Institute of Applied Mathematics, Université Catholique de l’Ouest, 3 Place André Leroy, 49008, Angers, France, jorge.mendoza@uco.fr

Chair: Victor Pillac, Automatique - Productique, Ecole des Mines de Nantes, 4 Rue Alfred Kastler, La Chantrerie, 44300, Nantes, France, victor.pillac@gmail.com

1 - Solving an Industrial Waste Collection Problem using a Hybrid Column Generation Algorithm

Jesper Larsen, Department of Management Engineering, Technical University of Denmark, Produktionsstovret, Building 426, 2800, Kgs. Lyngby, Denmark, jesla@man.dtu.dk, Kristian Milo Hauge

We present a problem of collection industrial waste. In this problem waste collection is handled by a fleet of vehicles. Each vehicle can carry up to eight skip containers of which a maximum of two can be full at the same time. We present an approach to route the vehicles based on a combination of column generation (CG) and metaheuristics. The performance is assessed by comparing the results that it achieves to results achieved by an algorithm that is based purely on metaheuristics. The results show that the hybrid CG algorithm finds superior solutions than the purely heuristic algorithm.

2 - Multi-stage, multi-period distribution planning with inventory and routing considerations

Dmitry Ivanov, Supply Chain Management, Berlin School of Economics and Law, Germany, divanov@hwr-berlin.de, Boris Sokolov, Alexander Pavlov

A real case-study of distribution planning is considered. An original approach of combining static inventory-routing and optimal control models is proposed to optimal planning of a multi-stage, multi-commodity distribution network in the multi-period mode with adaptive update of demand, capacity, and supply information. Optimal distribution plans are calculated for optimistic and pessimistic scenarios. Subsequently, these plans are analyzed subject to different disturbances and regarding distribution network design and sourcing planning decisions.

3 - Extending the Periodic Vehicle Routing Problem: A Case Study in Beverage Logistics

Dominik Pfeifer, Chair for Information Systems and Supply Chain Management, University of Münster, Leonardo-Campus 3, 48149, Münster, NRW, Germany, Dominik.Pfeifer@ercis.de, Bernd Hellingrath

This paper deals with a variant of the Periodic Vehicle Routing Problem which allows multiple tours to be run per vehicle and day, delivering each customer no more than once a day, respecting driving time constraints, and distributing multiple deliveries to the same customer in the planning period as easily as possible. We develop algorithms solving the instances of the case studied. The results are validated against historical data from the case at focus. We are able to realize considerable cost reductions and evaluate the algorithms with respect to the solution quality and efficiency.

4 - A real-life Inventory Routing Problem

Benoît Tricoire, Institut de Mathématiques Appliquées, Université Catholique de l’Ouest, 3 Place André Leroy, 49008, Angers, France, benoittr96@gmail.com, Eric Pinson

We focus on a real-life problem that integrates stock constraints into the VRP. This problem, motivated by routing problems faced by retail companies, can be related to Inventory Routing Problems. Our aim is to build a planning of pick-ups (to suppliers) and deliveries (to customers), desired at minimum cost by a set of vehicle activities (routing verifying complex real-world operative constraints). We propose a three-step method for our problem, using Lagrangian relaxation, GRASP, column generation, and tabu search. We compare our results to those of end-users.

**Supply Chain Design**

Stream: Supply Chain Planning

Invited session

Chair: Alparslan Serhat Demir, Industrial Engineering, Sakarya University, Sakarya University Etenetepe Kampusu Endustri Muh. Binasi M5 Kat 3-311, 54100, Sakarya, Turkey, alparslanserhat@hotmail.com

1 - Use of decomposition method in forest fuel supply chain

Amirhossein Sadoghi, Finance Department, Frankfurt School of Finance & Management, Sonnenmansiõrfe 9-11, 60314, Frankfurt am Main, Germany, a.sadoghi@fs.de, Helene Lidestam

In this research, we address the capacitated, multi-commodity, multi-period, multi-stage facility location problem regarding production, distribution and allocation in the case that forest residues are to be converted into fuel. With increased number of facilities, products and time periods, the model becomes large and large scale optimization techniques are necessary to get a solution within limited time. A heuristic solution based on a computationally efficient decomposition method is proposed. Numerical results and comparison with other possible methods are presented.

2 - Modular Supply Chain Optimization in the Construction Industry: An Application

Pedro Rijo, DECEivil, IST, Rua Comandante Cousteau, lot 4.04.02.B 3°D, 1990-067, Lisboa, Portugal, pedro@rijo.me, Amilcar Arantes

Globalization and the need for product differentiation at a fair price made supply chain a particularly relevant issue for the construction industry. The companies have to look for decisions that optimize the supply chain system and integrate in the process their suppliers and clients. Issues like facility location, inventory and transport management must be considered. In this work we focus on the optimization of the supply chain of a complete prefabricated kitchen module using linear programming techniques. The results show guidelines concerning supply chain configurations and operations.

3 - Robust Supply Chain Network Design by Considering Different Risk Mitigation Strategies

Faeghe Mohamad Doost, Industrial engineering, urmia university of technology, Band Ave, Urmia, Iran, Urmia, West Azarbayjan, Iran, Islamic Republic Of, mohamaddust_f@yahoo.com, Shahnam Rezapour

This paper develops a stochastic mathematical formulation for designing the network of a supply chain comprising several production facilities, distribution centers and retailers in markets under uncertainty. In this model, we consider reserving extra capacity, holding strategic stock and keeping substitutable facility strategies to mitigate the effects of possible disruptions. We use a path-based formulation that helps us consider supply-side uncertainties. We illustrate the model outputs and discuss the results through several numerical examples.
4 - Determining Multiple Warehouse Locations and Customers to be Served by Using Genetic Algorithm
Alparslan Serhat Demir, Industrial Engineering, Sakarya University, Sakarya University Esentepe Kampüsü Endüstri Muh. Binasi M5 Kat 3-311, 54100, Sakarya, Turkey, alparslanserhat@hotmail.com

In this study, distribution network of a tire manufacturing factory is addressed. In the distribution network, customers are at the different geographical locations and warehouses have to be established in different places to meet the product demand of customers. The problem is the determination of the locations where the warehouses are established and which warehouse will meet the customers’ demands to minimize total transportation cost. The problem is modeled and solved by using genetic algorithm technique.

TA-09
Tuesday, 8:30-10:00
RB-Zeta
Cutting and Packing 5

Stream: Cutting and Packing
Invited session

Chair: José Fernando Gonçalves, Faculdade de Economia do Porto, Universidade do Porto, Rua Dr. Roberto Frias, s/n, 4200-464, Porto, Portugal, jfgoncal@fep.up.pt

1 - A Comparison of Approaches for Solving the 3D Container Ship Loading Planning Problem by Representation by Rules
Aníbal Azevedo, Production engineering, State University of Campinas, Rua dos Aimorés, 480, Apt. P.34, 13081-030, Campinas, São Paulo, Brazil, atanibal@yahoo.com, Cassilda Ribeiro, Galeno Sena, António Chaves, Luiz Salles Neto, António Moretti

The proposed paper presents two contributions: a new 3D Container Ship Loading Planning Problem modeled as a bi-objective framework that minimizes two criteria: the number of movements and also the instability measure computed as the distance between gravity and geometric center. A new representation that allows a compact and efficient encoding which enables the solution of large-scale problems properly related with real-life scenarios. For example, an instance problem which demands a total of 40,545,000 binary variables will need only 30 variables with the proposed approach.

2 - A global optimization approach for three dimensional rectangular packing problems
Pei-Chian Wang, Graduate Institute of Industrial and Business Management, Taipei University of Technology, No. 1, Sec. 3, Chung Hsiao E. Road, Taipei 106, Taiwan, 106, Taipei, Taiwan, t5749005@ntut.edu.tw

The problem addressed in this paper aims to pack a set of rectangular boxes into a large rectangular container in such a way that the occupied volume space is minimized. The boxes can be any rectangular stackable objects with different sizes and may be rotated. This paper transforms the packing problem into a mixed integer linear program by an improved piecewise linearization technique which uses fewer extra 0-1 variables and constraints. The reformulated model can be solved to obtain a global optimum and is more computationally efficient than previous studies with deterministic approaches.

3 - Constraint programming approaches, search strategies and bounds in problems of orthogonal packing
Marat Mesyagutov, Numerical Mathematics, Dresden University of Technology, Zellescher Weg 12 - 14 (C 319), 01069, Dresden, Germany, mmesyagutov@goooglemail.com, Gleb Belov, Guntram Scheithauer

Constraint programming is an effective approach for discrete optimization problems. Since it allows the non-linear modeling, we consider some known higher dimensional approaches within that new paradigm. In the talk we discuss different know and new strategies, pruning rules based on linear programming and some further amplification of the constraint propagation, which are followed by the results of experimental study.

TA-10
Tuesday, 8:30-10:00
RB-Theta
Inventory Management 2

Stream: Production Management & Supply Chain Management (contributed)
Contributed session

Chair: Farouk Yalaoui, Institut Charles Delaunay, ICD LOSI, University of Technology of Troyes, 12, Rue Marie Curie BP 2060, 10000, Troyes, France, farouk.yalaoui@utt.fr
Chair: Christian Larsen, Econometrics, CORAL, Aarhus School of Business, Aarhus University, Fuglesangs Alle 4, DK-8210, Aarhus V, Denmark, chl@asb.dk

1 - Dynamic supply chain inventory management: a generic mathematical programming approach
Joaquim Jorge Vicente, CEG - IST, Portugal, joaquim.jorge.vicente@gmail.com, Susana Relvas, Ana Paula Barbósa-Póvoa

Inventory management plays an important role in supply chains. This is explored in the present work where a flexible Inventory Management (IM) policy is modeled through a mixed-integer linear programming model. This dynamically optimizes a multi-period, multi-warehouse/retailer and multi-product supply chain under deterministic and uncertain demands. Continuous and Periodic Review policies are also modeled and tested over the same system for comparison. The results show that the proposed IM policy outperforms the others leading to lower operational costs.

2 - The relationship between purchasing strategy, manufacturing performance and financial performance
Ahmed Attia, business management, damanhour university, elgomohoria st., 000, damanhour, elbehera, Egypt, ahmed-attia2005@hotmail.com

Purchasing is one of the logistics activities playing a major role for getting a competitive advantage through reducing the total cost, reducing the number of suppliers, building partnership with the suppliers, etc. The purchasing strategy will be the effective tool for achieving such benefits. The current study examines the direct effect of the purchasing strategy on the financial performance of the company, and also the indirect effect through manufacturing performance.

3 - Spare parts sharing with joint optimization of maintenance and inventory policies
Christian Larsen, Econometrics, CORAL, Aarhus School of Business, Aarhus University, Fuglesangs Alle 4, DK-8210, Aarhus V, Denmark, chl@asb.dk, Hartanto Wong, Lars Relund Nielsen
We consider a collaborative arrangement where a number of companies are willing to share expensive spare parts, required for both failure replacement and preventive maintenance purposes. We develop a discrete-time Markov decision model for the joint optimization of maintenance and spare parts inventory policies for both a single- and a multi-company problem. The cost savings obtained as a result of sharing are evaluated. A number of cost allocation schemes, making all the companies involved being better off by sharing the spare parts rather than acting independently, are developed.

**TA-11**

**Tuesday, 8:30-10:00**

**RB-Iota**

**Transport Networks**

**Stream: Transportation and Logistics**

*Invited session*

Chair: Anna Sciomachen, DIEM, University of Genova, Via Vivaldi 5, 16126, Genova, Italy, sciomach@economia.unige.it

1. **Feeder bus network design problem: a new solving procedure and real size applications.** Francesco Ciaffi, Dipartimento di Scienze dell’Ingegneria Civile, Università Roma Tre, Via Vito Volterra 62, 00146, Roma, Italy, fciaffi@uniroma3.it, Ernesto Cipriani, Marco Petrelli

The present research deals with a methodology for solving the feeder bus network design problem in a real size large urban area. The solving procedure is articulated in 2 phases: generation of two different and complementary sets of feasible routes, using a heuristic algorithm, and the optimal network design using a GA, calculating simultaneously optimal routes and frequencies, in order to provide a good balance between maximization of the service coverage area and minimization of the overall travel time. The proposed procedure has been applied on two real-life networks, Winnipeg and Rome.

2. **Delivery splitting problem with multiple origins.** Tomas Subrt, Dept. of Systems Engineering, Czech University of Life Sciences, Kamycka 129, 165 21, Prague 6 - Suchdol, Czech Republic, subrt@psf.czu.cz

This problem deals with logistic network design issues and is focused on optimal splitting of deliveries from multiple sources to multiple destinations. It is supposed to have a logistic network where the summary supply of all destinations can be satisfied by sources’ capacities. Every arc of such network is weighted by cost per item shipment function. Due to the common effect of flow scale economies such function is generally concave. This article demonstrates possible solution methods and results implementation using mathematical programming tools.

3. **Freight terminal location in multimodal networks.** Anna Sciomachen, DIEM, University of Genova, Via Vivaldi 5, 16126, Genova, Italy, sciomach@economia.unige.it, Daniela Ambrosino

In this work we present a heuristic method for evaluating possible locations for freight intermodal terminals, that are dry ports. Aspects coming from both classical simple plant location problems and shortest path ones on multimodal graphs are combined in a two phase procedure. We first select the possible dry ports by analysing their position in the network and their communication capabilities with the other nodes by using a multimodal connectivity criterion. Then we apply a heuristic algorithm for finding optimal multimodal O-D routes in network. Preliminary results are given.

**TA-13**

**Tuesday, 8:30-10:00**

**RB-Tau**

**Semiconductor and Pharmaceuticals Production**

**Stream: Manufacturing and Warehousing**

*Invited session*

Chair: Lars Moench, FernUniversität in Hagen, 58097, Hagen, Germany, lars.moench@FernUni-Hagen.de

1. **Stochastic Programming for New Product Introduction in the Pharmaceutical Industry.** Klaus Reinholdt Nyhuus Hansen, Section for Supply Chain Management and Production, TU Munich, Arcisstrasse 21, 80333, Munich, Germany, klaus.hansen@tum.de, Martin Grunow

Due to limited patent protection, pharmaceutical companies are focusing more on the new product introduction process and addressing the risks found prior to product launch. Where the widespread pipeline and capacity planning models address R&D risks, we here focus on exogenous risks arising from the negotiations with the authorities such as e.g. delayed market authorization. We present how these risks can be addressed via two-stage stochastic modeling for effective launch planning and also how capacity can be improved to consider these risks.

2. **Enhancing standard mid-term planning in semiconductor manufacturing.** Phillip Kriett, Technical University Munich, Germany, phillip.kriett@tum.de, Martin Grunow

Enterprise-wide tactical planning determines a capacity-feasible product mix. State-of-the-art tactical planning frameworks aggregate resource information and neglect the assignment of jobs to machines. Yet, certain semiconductor manufacturing steps such as testing can be performed on flexible, parallel, and in particular non-identical resources. Here, this aggregation results in low capacity utilization and infeasible production plans. We propose an exact solution approach which captures resources and is compatible with current software. The approach is tested on real-world data.

3. **Order release planning by iterative linear programming and simulation: An analysis of the underlying coordination mechanism.** Hubert Missbauer, Information Systems, Production and Logistics Management, University of Innsbruck, Universitätstrasse 15, 6020, Innsbruck, Austria, hubert.missbauer@uibk.ac.at

We deal with order release planning algorithms in manufacturing planning and control that allow time-varying lead times by iterating between a release models with fixed lead times and a simulation model that updates the lead times. Convergence is a critical issue here, and a theoretical foundation has not been provided up to now. We present an analysis of the theory behind this iterative mechanism that should help to explain the convergence problems and to improve the methods. The analysis is performed using a single-stage order release model in discrete and continuous time.

4. **A Scheduling Approach for Complex Job Shops with Transportation.** Lars Moench, FernUniversität in Hagen, 58097, Hagen, Germany, lars.moench@FernUni-Hagen.de, Rene Driessel

We consider a scheduling problem for complex job shops with automated material handling systems (AMHS). Scheduling problems of this type are important in semiconductor manufacturing. The performance measure is the total weighted tardiness. We present a modified shifting bottleneck heuristic for the integrated scheduling problem. The heuristic is applied in a rolling horizon setting. We study the performance using simulation. In addition, we change the number of vehicles to see the impact of the capacity of the AMHS on the overall performance.
Scheduling with variable parameters II

Stream: Scheduling under Resource Constraints
Invited session
Chair: Yakov Shafrainsky, United Institute of Informatics Problems, National Academy of Sciences of Belarus, Surganov str. 6, 220012 Minsk, Belarus, 220012, Minsk, Belarus, shaf-04@yandex.ru
Chair: Stanislaw Gавiejnowicz, Faculty of Mathematics and Computer Science, Adam Mickiewicz University, Umultowska 87, 61-614, Poznań, Poland, stgage@amu.edu.pl

1. Minimizing Maximum Lateness for Single Machine under Uncertain Due Dates and Precedence Constraints
Dzmitry Sledneu, Lund University, Sweden, dzmitry.sledneu@gmail.com, Yakov Shafrainsky
Problem of minimizing maximum lateness for one machine under precedence constraints is considered. For each due date we have an interval of its possible values and the due date may take any value from this interval regardless of the will of the decision maker. A feasible schedule is called globally optimal schedule if it remains optimal under any possible values of the due dates. We formulate necessary and sufficient conditions for a schedule to be globally optimal and propose an algorithm for constructing such a schedule. As a by-product, we formulate necessary and sufficient conditions for the optimality of a schedule for the deterministic version of the problem.

2. Scheduling precedence-constrained jobs with mixed processing times and maximum cost criterion
Marek Dębczyński, Faculty of Mathematics and Computer Science, Adam Mickiewicz University, Umultowska 87 Street, 61-614, Poznań, Wielkopolskie, Poland, mdeb@amu.edu.pl, Stanislaw Gавiejnowicz
We consider single-machine scheduling problems with arbitrary precedence constraints and maximum cost criterion. We show how to solve the problems in polynomial time when job processing times are variable and mixed, i.e. some of them are fixed, while the other ones are variable and take into account the effects of learning, ageing or job deterioration.

3. Scheduling jobs on unrelated parallel machines with general positional deterioration to minimize the total processing cost
Yakov Shafrainsky, United Institute of Informatics Problems, National Academy of Sciences of Belarus, Surganov str. 6, 220012 Minsk, Belarus, 220012, Minsk, Belarus, shaf-04@yandex.ru
Set of independent jobs is to be processed on unrelated parallel machines. The processing time of a job is the product of its basic processing time and a deterioration coefficient that depends on the job, on the machine and on the position of the job in the job sequence on this machine. Each of the coefficients is a non-decreasing function of the position number. For each machine, we have a cost of processing a job for one time unit on the machine. The aim is to construct a schedule that minimizes the total cost of processing all the jobs. We propose a polynomial algorithm to solve the problem.

4. Multicriteria optimisation of construction project schedules
Grzegorz Ginda, Faculty of Materials and Environment Sciences, University of Bielsko-Biała, INSTITUTE OF TEXTILE ENGINEERING AND POLYMER MATERIALS, PL.Fabryczny 5, 43-300, Bielsko-Biała, Poland, gg.ginda@gmail.com, Miroslaw Dytczak, Tomasz Wojtkiewicz
Complexity of optimal construction project scheduling results from numerous feasible orders of technological operations, availability of different operation realisation modes and possible concurrency among operations due to limited availability of resources. Efficient approach is discussed which allows identification of the most suitable project schedule instances. It applies simultaneous generation and evaluation of representative population of schedule instances. A criteria hierarchy is applied with this regard. The approach also facilitates identification of desirable schedule features.

Semi-infinite methods and applications

Stream: Semi-Infinite Optimization
Invited session
Chair: Ana I. Pereira, Department of Mathematics - ESTIG, Polytechnic Institute of Braganca, Campus de Sta Apolonia, Apartado 134, 5301-857, Braganca, Portugal, apereira@ipb.pt
Chair: Vicente del Raspeig, Alicante, Spain, mgoberna@ua.es

1. Strong duality in robust linear semi-infinite programming
Miguel Gobena, Estadística e Investigación Operativa, Universidad de Alicante, Ctra. San Vicente s/n, 03080, San Vicente del Raspeig, Alicante, Spain, migoberna@ua.es
In this talk, we propose a duality theory for semi-infinite linear programming problems under uncertainty in the constraint functions, the objective function, or both, within the framework of robust optimization. We show that robust duality holds whenever a robust moment cone is closed and convex. We formulate sufficient conditions for a schedule to be globally optimal and propose an algorithm for constructing such a schedule. As a by-product, we formulate necessary and sufficient conditions for the optimality of a schedule for the deterministic version of the problem.

2. General semi-infinite programming
Vladimir Shikhman, Dept. Mathematics C, RWTH Aachen University, Templergraben 55, 52056, Aachen, Germany, shikhman@mathc.rwth-aachen.de, Hubertus Th. Jongen
We consider general semi-infinite programming (GSIP) from a topological point of view. We focus on the description of the closure of the feasible set, the Symmetric Mangasarian Fromovitz Constraint Qualification, the Nonsmooth Symmetric Reduction Ansatz, appropriate notion of Karush-Kuhn-Tucker points and critical point theory.

3. Reduction method with multistart technique for semi-infinite programming problems
Ana I. Pereira, Department of Mathematics - ESTIG, Polytechnic Institute of Braganca, Campus de Sta Apolonia, Apartado 134, 5301-857, Braganca, Portugal, apereira@ipb.pt, Florbela P. Fernandes, M. Fernanda P. Costa, Edite M.G.P. Fernandes
Semi-infinite programming problems can be efficiently solved by reduction type methods. In this work a new global reduction method for semi-infinite programming is presented. The multilocal optimization is carried out with a multistart technique and the reduced problem is approximately solved by a primal-dual interior point method combined with a two-dimensional filter line search strategy. The filter strategy is used to promote the global convergence of the algorithm. Numerical experiments with a set of well-known problems are shown and comparisons with other methods are presented.

4. Study of optimization problems with analytic constraint functions
Tatiana Tchemisnova, Department of Mathematics, University of Aveiro, Campus Universitario de Santiago, 3810-193, Aveiro, Portugal, tatiana@ua.pt, Olga Kostykova
For convex SIP problems with analytic constraint functions, we apply our approach based on the notion of immobile indices and their immobility orders. Implicit Optimality Criterion proved for the general case of problems with 1-dimensional index set allows to replace testing optimality in the convex SIP by testing in a special nonlinear problem. We study some specific properties of this problem and prove new optimality conditions. Special attention is paid to the case when the constraints of the original SIP are presented by analytic functions and do not satisfy the Slater condition.
1 - Long-term asset maintenance optimization at Scottish Water
Travis Poole, Scottish Water, United Kingdom, Travis.Poole@scottishwater.co.uk, Thomas Archibald, Robert Murray

A Knowledge Transfer Partnership between Scottish Water and the University of Edinburgh has produced an asset maintenance optimization tool which produces long-term (25-year) maintenance plans for Scottish Water's assets. The optimizer implements a number of optimization techniques, and addresses a set of different planning scenarios. By using a common currency for risks and costs, it is able to consider multiple asset types simultaneously. Scottish Water spends over £700m maintaining assets each year, so even a modest improvement in efficiency of plans will lead to significant savings.

2 - Practical Issues in Asset Management within UK Water Industry
Jake Ansell, Business Studies, The University of Edinburgh, 29 Buccleuch Place, EH8 9JS, Edinburgh, United Kingdom, J.Ansell@ed.ac.uk

Water companies are large complex organisations which deliver fresh water to households and industry, and take away waste water from both. The paper will review many aspects of managing within this context including the nature of the data, intervention actions, the possibilities of implementing optimal maintenance actions and impact of delays. It will explore issues around condition grade and time based models.

3 - Modelling Asset Deterioration using Structured Expert Judgement
Graeme Blair, Scottish Water, United Kingdom, Graeme.Blair@scottishwater.co.uk, Deborah Gee, Matthew Revie, Lesley Walls

This work is motivated by an industry problem; a utility seeks to model asset deterioration to predict future failures. Model estimates inform strategic investment and are subject to scrutiny by the regulator. A model is developed for an asset class which has limited historical statistical records. Modelling deterioration with respect to time or state is explored. Using the theory of structured expert judgement, a process for eliciting probabilities is designed. The model validation approach and the value of a subjective, state-based approach to asset deterioration modelling are described.

1 - Multi-criteria covering-based location of volunteer fire departments
Brigitte Werners, Management and Economics, Ruhr-University Bochum, Universitätsstr, 44780, Bochum, Germany, or@rub.de, Dirk Degel

Timeliness is one of the most important objectives that reflect the quality of emergency services such as firefighting systems. Sufficient firefighting facilities must be established and located to provide high quality services over a wide area with spatially distributed demands. To optimize their location, the objectives minimizing the average travel time and minimizing the longest travel time are in conflict with minimizing costs. Different multi-criteria methods are used to compare solutions for an urban area with several volunteer firefighting departments.

2 - Non-full coverage facility location problems
Maria Cortinhal, Quantitative Methods, ISCTE - CIO, Av. da Forças Armadas, 1649-026, Lisbon, Portugal, mscc@iscte.pt

We present new discrete facility location problems. These new models broaden the generic setting for the single source facility capacitated problem and for the single source modular facility capacitated problem by allowing a non-full coverage of customer demands. Additionally, it is considered a penalty function that allows doing a cost-full coverage trade-off. For each problem, two models are suggested. Computational experiments with CPLEX showed that reformulated models give better results. To enhance the quality of the results, some valid inequalities were developed and tested.

3 - Locating Undesirable Facilities
H. a. Eiselt, University of New Brunswick, P.O. Box 4400, E3B 5A3, Fredericton, NB, Canada, haeselt@unb.ca, Vladimir Marianov

We locate undesirable facilities for nonhazardous materials, such as landfills, given an objective that minimizes a combination of costs and pollution. In contrast to most models that consider the effects of pollution only near the facilities, we assume that there are undesired effects on wider areas, as those caused by trucks transporting the waste. Our model includes not only locations, but also facility sizes as parameters. The model is formulated, its properties are investigated, and some preliminary computational evidence is presented.

4 - Using Clustering Heuristics to Solve a Family of Demand Covering Models
Ioannis Giannikos, Business Administration, University of Patras, University of Patras, GR-26500, Patras, Greece, I.Giannikos@upatras.gr, Basilis Boutsinas, Antiopi Panteli

We discuss demand covering models to determine locations for servers that optimally cover a given set of demand points. Our clustering heuristic processes the input data to determine clusters that result in smaller problems. It is based on the concept of bi-clusters, which are special sub matrices of a given coverage matrix. The algorithm starts by identifying appropriate bi-clusters of the coverage matrix and then combines them to define an aggregate solution, which is improved with a local search heuristic. The proposed algorithm is tested in a series of widely known test problems.
2 - Organization of a public service through the solution of a Districiting Problem
Carmela Piccolo, Department of Business and Management Engineering, University of Naples Federico II, via Cristoforo Colombo 19, 80030, Castello di Cisterna, Italy, carmela.piccolo@unina.it, Giuseppe Bruno

A districiting problem consists in subdividing a region into districts on the basis of an objective function. Districiting models can also be used to describe problems when a service has to be organized in a region. The decision about the number of districts and the allocation of the users can be performed considering the conflicting objectives of two actors: the planner aiming at minimizing the total costs and the users interested to reduce a measure of accessibility. We propose a general mathematical formulation and an application to a real case study. The results are analyzed and discussed.

3 - Inventory Location and Transshipment Problem
Dmitry Krass, Rotman School of Mgmt, University of Toronto, 105 St. George st., M5S 3E6, Toronto, Ontario, Canada, krass@rotman.utoronto.ca, Oded Berman, Alex Shlakhter

We analyze an inventory location problem where facilities are allowed to satisfy some of the demand by transshipping available inventory between each other and customers may change the shopping patterns based on stock availability at the facilities. These features make the model much more difficult than either the inventory location or transshipment models in the literature. By applying Infinitesimal Perturbation Analysis (IPA) algorithm — a form of approximate dynamic programming we show how realistic-size versions can be solved and obtain some interesting managerial insights.

4 - Allowing for Tail Risk, and Aversion to Tail Risk, in Optimal Portfolios for Long-Horizon Investors
Iqbal Owadally, Faculty of Actuarial Science and Insurance, Cass Business School, City University, London, EC1Y 8TZ, London, United Kingdom, M.I.Owadally@city.ac.uk, Zinoviy Landsman

Asset return distributions are heavy-tailed and investors, particularly nearing retirement, are sensitive to extreme market events in the tail of these distributions. The tail mean-variance model proposed in insurance risk management involves a criterion focusing on the risk of rare but large losses. It does not satisfy the property of positive homogeneity, and the optimal solution typically requires numerical methods. We use a convex optimization method and a mean-variance characterization to find an explicit and easily implementable solution with and without a risk-free asset.

Pension Funds
Stream: Actuarial Sciences and Stochastic Calculus
Invited session
Chair: Elena Vigna, Dipartimento di Scienze Economico-Sociali e Matematico-Statistiche, Università di Torino and Collegio Carlo Alberto, corso Unione Sovietica 218 bis, 10135, Torino, Italy, elena.vigna@econ.unito.it

1 - A risk-based premium: What does it mean for DB plan sponsors?
An Chen, Department of Economics, University of Bonn, Adenauerallee 24–42, 53113, Bonn, NRW, Germany, an.chen@uni-bonn.de, Filip Uzelac

This paper develops a risk-based valuation model for pension insurance provided to defined benefit (DB) plans by the Pension Benefit Guaranty Corporation (PBGC). It takes account of investment policies of the pension fund and of the DB plan sponsor. In addition, our model accounts for the premature termination of the pension fund caused by the underfunding of the plan sponsor, so-called distress termination. To obtain realistic estimates of the PBGC premium and to examine our valuation formula, we calculate risked-based premiums for 25 prominent DB plan sponsors.

2 - Mean-variance optimization in DC plan with stochastic interest rate
Elena Vigna, Dipartimento di Scienze Economico-Sociali e Matematico-Statistiche, Università di Torino and Collegio Carlo Alberto, corso Unione Sovietica 218 bis, 10135, Torino, Italy, elena.vigna@econ.unito.it, Francesco Menoncin

We solve a mean-variance optimization problem of a defined contribution pension scheme in the accumulation phase. The financial market consists of: (i) the risk-free asset, (ii) a risky asset following a GBM, and (iii) a bond driven by a stochastic interest rate whose dynamics follows a mean-reverting process. We solve the associated Hamilton Jacobi Bellman PDE and find a closed-form solution for the optimal investment strategy. Numerical applications show how the proportions of bond and risky asset decrease when retirement approaches.

Multicriteria Analysis for Investment Decision Making
Stream: Decision Making Modeling and Risk Assessment in the Financial Sector
Invited session
Chair: Luiz F. Autran M. Gomes, Management, Ibmec/RJ, Av. Presidente Wilson, N°. 118, Room 1110, 20030020, Rio de Janeiro, RJ, Brazil, autran@ibmecrj.br

1 - Frameworks of Strategic Decision Behavior on Investment and Risk Management
Mei-Chen Lo, National United University, 360, Miaoli, Taiwan, meichen_lo@yahoo.com

Effective investment and risk management, as the part of financial system, has strong impact on the performance of the enterprises. In this study, the strategic decision behaviors are discussed, and two MCDM methods were used: 1. Analytic Hierarchy Process method for setting the weights of dimensions criteria; 2. Technique for Order Preference by Similarity to Ideal Solution for assessment the relative performance viewed by different groups of experts. The procedures help to find the improvement directions through the study of the strategic behaviors on the investment and risk management.
2 - An Approach to Multicriteria Sorting within the Verbal Decision Analysis Paradigm
Eugenia Furems, Decision Making, Institute for System Analysis, 9, Prospect of 60 let Oktyabrya, 117312, Moscow, furems-em@mtu-net.ru

Multicriteria sorting (MS) is often used inter alia as a model for investment alternatives assessment, where a class is the subset of alternatives with equivalent feasibility. Verbal Decision Analysis (VDA) is one of approaches for MS problem solving. A number of VDA-based methods use DM’s preferences as the only source of information and ensure obtaining the completeness and consistency of classification rules, while avoiding the exhaustive search. A new dialogue strategy for such methods is proposed to reduce a DM’s cognitive load and to enhance the ways of rules consistency providing.

3 - Comparing decisional maps
Valérie Brison, Mathematics and Operational Research, UMONS, Belgium, valerie.brison@umons.ac.be, Marc Plirat

The purpose of this work is to provide models to compare maps representing the state of a region at different stages of its evolution. We formulate three mathematical models all based on several axioms that make sense in some geographic contexts. We start with a simple one, which doesn’t take into account any geographic aspect. In the second one, we introduce one geographic aspect and then we generalize this model to take into account any finite number of geographic aspects.

4 - Using the Choquet-extended TODIM method for a multicriteria analysis of improvements in a major road in the Southeastern Region of Brazil: the Paraty-Cunha Highway
Luzi F. Autran M. Gomes, Management, Ibmec/RJ, Av. Presidente Wilson, No. 118, Room 1110, 20030302, Rio de Janeiro, RJ, Brazil, autran@ibmec.rj.br, Maria Augusta Machado

Once significantly improved, Paraty-Cunha Highway will be the major road linkage between Paraty and its hinterland of Brazil. A key motivation behind investing in the improvement of this highway has to do with the fact that Paraty is dangerously close to Angra dos Reis. We formulate the investment decision making problem in a multicriteria framework. A behavioral multicriteria decision model is used. The analysis is based on the paradigm of cumulative prospect theory. A synthesis of the analysis leads to recommendations to decision makers.

2 - An EPQ Model for Deterioration Items and Exponential Demand Rate Taking into Account the Time Value of Money
Vikram jeet Singh, MATHEMATICS, Lovely Professional University, Jalandhar-Delhi G.T Road(NH-1), 144402, Phagwara, Punjab, India, vikram31782@gmail.com

In this study we develop an inventory model with exponential demand with Time Value of Money. Deterioration occurs as soon as the items are received into inventory and it follows two parameter Weibull distributions. There is no repair or replacement of deteriorating items during the replenishment cycle. Product transactions are followed by instantaneous cash flow Shortages are allowed and partially backlogged. The system operates for a prescribed period of a planning horizon. Production rate is demand rate dependent. The problem is discussed under the inflationary environment.

3 - Pricing fx forwards in OTC markets - new evidence for the pricing mechanism when faced with counterparty risk
Stefan Stöckl, FIM Research Center Finance & Information Management, University of Augsburg, 86135, Augsburg, Bavaria, Germany, stefan.stoeckl@wwi.uni-augsburg.de, Alexander Leonhardt, Andreas Rathgeber, Johannes Stadler

In line with existing empirical results, this paper demonstrates, using daily foreign exchange (fx) market data for five currencies (CHF, EUR, GBP, USD, YEN), that, since the beginning of the financial crisis, market pricing of fx forwards does not match the pricing formula derived from the covered interest rate parity (CIP). Therefore, the CIP leads to systematic mispricing in relation to future fx spot rates. Overall, four statistically significant factors for this mispricing were identified. The high significance of the counterparty risk demonstrates that pricing models should be reviewed.

4 - Qualitative multi-attribute model for evaluating companies’ interoperability
Borka Jerman Blazic, Laboratory for Open Systems and Companies’ interoperability, Lab of Open Systems and Companies’ interoperability, Institute for System and Technologies, Ljubljana, Slovenia, borka@e5.ijs.si, Vladislav Rajkovic, Jasna Sterc

In the paper a model to support enterprises in improving interoperability will be presented. The methodology considers conceptual, organizational and technological maturity of an enterprise regarding business strategy, processes, services and data. For the evaluation we propose a qualitative hierarchical multi-attribute model. The model is implemented within a DEX framework and will be illustrated by examples.
1 - An inverse function result and some applications to sensitivity of generalized equations
Gabor Kassay, Mathematics, Babes-Bolyai University, I M Kogalniceanu 1, 400084, Cluj, Romania, kassay@math.ubbcluj.ro
We extend an inverse function theorem to set-valued case in metric spaces. Defining a condition number and the concept of well conditioning for parametric generalized equations at a certain initial value of the parameter, our inverse function theorem allows us to determine how much the initial problem can be perturbed in order to preserve its well conditioning. An application to the framework of vector optimization problems is then given. Finally we identify a special class of well conditioned set-valued mappings.

2 - Extensions of Metric Regularity
Alexander Kruger, School of Science, Information Technology & Engineering, University of Ballarat, University Drive, Mount Helen, P.O. Box 663, 3353, Ballarat, Victoria, Australia, a.kruger@ballarat.edu.au, Andrei Dmitruk

The presentation is devoted to some extensions of the metric regularity property for mappings between metric or Banach spaces. Several new concepts are investigated in a unified manner: uniform metric regularity, metric multi-regularity for mappings into product spaces (when each component is perturbed independently), as well as their Lipschitz-like counterparts. The properties are characterized in terms of certain derivative-like constants. Regularity criteria are established based on a set-valued extension of a nonlocal version of the Lyusternik—Graves theorem due to Milyutin.

3 - Frechet and proximal Regularity of perturbed distance functions at points in the target set in Banach spaces
Messaoud Bounkhel, Department of Mathematics, King Saud University, College of Science, PO Box: 2455, 11451, Riyadh, Saudi Arabia, bounkhel@ksu.edu.sa

This talk is devoted to study the Frechet and proximal Regularity at points in the target set of perturbed distance functions \( dJ_S(\cdot) \) determined by a closed subset \( S \) and a Lipschitz function \( J(\cdot) \). Also, we provide some important results on the Clarke subdifferential of \( dJ_S(\cdot) \) at those points in arbitrary Banach space.

4 - Some recent contributions to convex calculus
Marco A. López-Cerdá, Statistics and Operations Research, Alicante University, Ctra. San Vicente de Raspeig s/n, 3071, Alicante, Spain, marco.antonio@ua.es

In this talk we present a general formula for the optimal set of a relaxed minimization problem in terms of the approximate minima of a given data function. This formula is used for deriving explicit characterizations of the subdifferential mapping of the supremum function of an arbitrarily indexed family of functions, exclusively in terms of the data functions. We also discuss on possible alternative approaches and applications to subdifferential calculus.

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1 - Grouping seasonality and the formation of groups
Aris Syntetos, Centre for Operational Research and Applied Statistics - Salford Business School, University of Salford, Maxwell Building, The Crescent, M5 4WT, Salford, United Kingdom, a.syntetos@salford.ac.uk

Demand Forecasting

Stream: Forecasting
Invited session
Chair: Aris Syntetos, Centre for Operational Research and Applied Statistics - Salford Business School, University of Salford, Maxwell Building, The Crescent, M5 4WT, Salford, United Kingdom, a.syntetos@salford.ac.uk, John Boylan, Mona Mohammadipour
Estimating seasonality based on individual seasonal indices (ISI) often leads to unsatisfactory results. An alternative is to use the knowledge of demand at some aggregate/group level to improve forecasts at the individual level. This approach is usually referred to as group seasonal indices (GSI); an important assumption in its application is that a grouping mechanism is available. Our work provides empirical evidence on the comparability of ISI & GSI and the issue of choosing between them. The formation of seasonal groups is also explicitly addressed and linked to performance results.

2 - Forecasting in production planning by adaptive exponential smoothing methods
Frank Herrmann, Innovation and Competence Centre for Production Logistics and Factory Planning, University of Applied Sciences Regensburg, PO box 120327, 93025, Regensburg, Germany, Frank.Herrmann@HS-Regensburg.de

Demands of customers for products and of the production for parts are being forecasted quite often within the operational production planning and control by IT Systems (PPS systems) like the SAP system via exponential smoothing. There parameters need to be changed if the characteristics of the time series has changed. Since a manual change is very time consuming, industrial practice is interested in adaptive exponential smoothing methods. There state of the art, there limitation in terms of unstable forecasts, there performance in empirical studies and there usage in PPS systems are presented.

3 - Forecasting Intermittent Demand by Hyperbolic-Exponential Smoothing
Armanag Tarim, Management, Hacettepe University, Beytepe, 06800, Ankara, Turkey, armtar@yahoo.com, Steven Prestwich, Roberto Rossi, Braham Hinich

Croston’s method is superior to exponential smoothing when demand is intermittent, but is known to be biased. Variants of the method remove the bias, but only the recent variant called TS3 addresses the problem of demand obsolescence. We describe a new forecasting method called Hyperbolic-Exponential Smoothing that handles obsolescence by decaying hyperbolically when demand is zero. In a full factorial design experiment on various smoothing factors, demand distributions and intermittencies, it has similar bias to TS3 and even better forecast accuracy.

4 - Stochastic models for time-dependent intermittent demand
Clint Pennings, Rotterdam School of Management, Erasmus University, Netherlands, cpennings@rsm.nl, Jan van Dalen, Erwin van der Laan

Intermittent demand is characterized by several subsequent periods without demand. Croston developed a popular method for forecasting by assuming independence between inter-arrival time and quantity demanded. However, this seems unnatural in many practical situations (preventive or corrective maintenance) and has been empirically proven to be unrealistic. We developed a stochastic model to forecast demand that explicitly takes into account the time dependency and assessed the potential for performance improvement in inventory management relative to other popular frameworks.

We investigate the stability of a cartel gathering the non-OECD natural gas exporting countries. Our analysis is based on a deterministic, discrete-time, finite-horizon oligopoly model of investment and production equilibrium strategies. We implement a feedback information structure to solve the dynamic inconsistency of the open loop Stackelberg dynamic game. The model is calibrated to represent the world natural gas market under a "business as usual" scenario (projections of economic growth, demography, oil price) and used to formulate some policy recommendations for gas importing countries.

2 - Expectation Formation on Future Markets and Boom-Bust Cycles in Electricity Markets: Evidence from an Agent-Based Simulation
Daniel Ziegler, Chair for Management Sciences and Energy Economics, University Duisburg-Essen, Universitaetsstrasse 12, 45117, Essen, Germany, daniel.ziegler@uni-due.de

Agent-based simulations have the potential to provide insights how risks and disequilibria affect investments and may induce investment cycles. We present a modular agent-based model for the long term analysis of interrelated wholesale electricity markets. A future market translates expectations and spot market outputs into noisy price signals, which serves as inputs. First results indicate that the dynamics of investment cycles strongly depend on the way market participants form their expectations.

3 - Decision problems including limited liquidity in energy markets
Oliver Woll, Universitaet Duisburg-Essen, Universitaetsstraβe 12, 45117, Essen, Germany, oliver.woll@uni-due.de, Christoph Weber

In most energy markets, the liquidity of products with long-term maturity is limited. Standard models for corporate hedging do not cope with this situation. This paper provides an analytical approach for solving the problem by including a liquidity function into the standard mean-variance model going back to Markowitz. The paper then analyses optimal hedging strategies for power generators. It is shown that the optimal hedging strategy not only depends on price volatility and market liquidity but also on the size of the initial open position and on the remaining planning horizon.

4 - Planning of Energy Supply Chains based on Domestic Energy microgeneration
Georgios Kopanos, Department of Chemical Engineering, Centre for Process Systems Engineering, Imperial College London, Roderic Hill Building, South Kensington Campus, SW7 2AZ, London, London, United Kingdom, g.kopanos@imperial.ac.uk, Michael Georgiadis, Efstratios Pistikopoulos

This work addresses an emerging non-classical Energy Supply Chain (ESC) based on decentralized energy production via microgeneration. In particular, several domestic microgenerators are connected so as to form an energy micro-grid that allows residents to interchange energy among each other. Thermal and electrical energy demand of every household must be satisfied, while excessive electricity production can translate expectations and spot market outputs into noisy price signals. A new mathematical programming framework for the energy production planning of this new type of ESC is proposed, and a representative case study is presented.
1. An improved decomposition-based heuristic for the pressurized water irrigation network design problem

Margarida Pato, ISEG (Technical University of Lisbon), CIO (University of Lisbon) and ISEG (Technical University of Lisbon), Rua do Quelhas, 6, 1200-781, Lisboa, Portugal, mpato@iseg.utl.pt, Graça Gonçalves, Luis Gouveia

Designing a pressurized water distribution network for irrigation purposes (WDNP) is a highly complex problem that aims at minimizing costs while obeying many technical constraints. A mixed binary non-linear programming model for WDNP will be presented along with an improved decomposition-based heuristic based on a linearization of the model. The computational results obtained from the heuristic with instances simulating a real application will be shown and compared to results from standard software. We conclude that the heuristic is a solid approach to the WDNP.

2. Use of spreadsheet optimization for management in groundwater engineering

Halil Önder, Civil Engineering, Middle East Technical University, Middle East Technical University, Department of Civil Engineering, 06800, Ankara, Turkey, onde@metu.edu.tr

This work presents a groundwater management model that combines analytical solutions of the groundwater flow equation with linear programming to determine the best pumping scheme and optimum configuration for the dewatering system to drain groundwater in a construction site. It is based on spreadsheet application and it is a relatively low cost and rapidly applicable methodology. Using spreadsheets for optimization problems will be beneficial in closing the technology transfer gap between the development of optimization technique and their acceptance and practical use by practicing engineers.

3. Estimation of aquifer parameters in groundwater management using spreadsheet optimization as an inverse problem

Elcin Kentel, Department of Civil Engineering, METU, Orta Dogu Teknik Universitesi, Universiteler Malallesi, Dumulupinar Blv. No:1, 06800, Ankara, Turkey, ekentel@metu.edu.tr, Halil Önder, Cüneyt Taşkın

A spreadsheet optimization using a non-linear error function is utilized for estimation of aquifer parameter as an inverse problem based on an analytical solution of groundwater flow. The values of transmissivity and storage coefficient are determined from measured drawdown values at observation wells. Spreadsheet optimization provides the practitioners, educators, and researchers an efficient and convenient method for determining coefficients of aquifer, and a practical platform for routine evaluations. The proposed development is a relatively low cost and rapidly applicable methodology.

4. A hybrid model for forecasting the streamflow data

Alpaslan Yarar, Civil Engineering, Selcuk University, Turkey, ayarar@selcuk.edu.tr, Mustafa Onucyildiz, Hulya Yarar

In this study, a hybrid model, Wavelet-Neuro Fuzzy (WNF), has been used to forecast the streamflow data of 5 Flow Observation Station (FOS), which belong to Sakarya Basin in Turkey. In order to evaluate the accuracy performance of the model, Linear Regression (LR) model has been used with the same data sets. The comparison has been made by Root Mean Squared Errors (RMSE) of the models. Results showed that hybrid WNF model forecasts the streamflow more accurately than LR model.

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1. Combining equity and utilitarianism in a mathematical programming model

Hilary Paul Williams, Operational Research, London School of Economics, Houghton Street, WC2A2AE, LONDON, United Kingdom, h.p.williams@lse.ac.uk, John N. Hooker

We show how equity and utilitarianism may be combined in a mathematical programming model, which applies particularly to the provision of health care. When the disparity in the cost of care of a particular group exceeds a threshold level the objective gradually moves from one of equity to one of utilitarianism. The resulting formulation, in its unmodified form, is non-convex and its hypergraph is non MIP representable. When reformulated the model is easily solved and demonstrates interesting results on a dataset based on some US and UK data.

2. Equitable preferences: representation and use in practical problems

Nikolaos Argyris, Management, Operational Research Group, London School of Economics and Political Science, Houghton Street, WC2A 2AE, London, United Kingdom, n.argyris@lse.ac.uk

We consider the problem of centralized inequality-averse resource allocation. We first discuss a set of axioms that may characterize "equitable" preferences over allocation profiles. We show that, under mild conditions, an equitable preference ordering over a finite set of allocations can always be represented by a symmetric, non-decreasing and concave function. Further, we show that the set of all such representations compatible with a set of revealed preferences has a succinct polyhedral representation. Finally, we discuss how these results may be used in choice and ranking problems.

3. Incorporating preference information in multicriteria problems with equity concerns

Ozlem Karsu, Management, London School of Economics, Houghton Street, WC2A 2AE, LONDON, United Kingdom, ozlemkarsu@yahoo.co.uk, Alec Morton

We consider Multi Criteria Decision Making (MCDM) problems involving equity concerns which are highly encountered in real life, especially in public sector. From a modelling point of view, preference for equity can be handled by imposing person anonymity and quasi-concavity conditions on the model of the DM’s preferences. One solution approach for MCDM problems is based on taking into account value judgments which the Decision Maker (DM) has provided. We suggest such an approach for problems with equity concerns and introduce substantial new theory.

4. Aversion to health inequalities in healthcare prioritisation: a multiobjective mathematical programming perspective

Alec Morton, Management/ Operational Research, London School of Economics, Houghton St, London, wc2a2ae, London, England, United Kingdom, a.morton@lse.ac.uk

We discuss the prioritisation of healthcare projects where there is a concern about health inequalities. Our analysis begins with a standard welfare economic model of healthcare resource allocation. We show how the problem can be reformulated as one of finding a particular subset of the class of efficient solutions to an implied multiobjective optimisation problem. Algorithms for finding such solutions are readily available, and we demonstrate our approach through a worked example of treatment for clinical depression.
1 - A poisson input queueing system for threshold policy of machine repair problem with degraded failure

Rekha Choudhury, Mathematics Dept., Govt. Engg. College, 110, Swarn Jayanti Nagar, 321001, Bharatpur, Rajasthan, India, rekharopathy2003@yahoo.co.in

This investigation deals with the study of Optimal threshold policy for machine repair problem with R heterogeneous removable repairmen. The first repairman turns on for repair only when K1 failed units are accumulated and starts repair after a setup time, which is assumed to be exponentially distributed. The life time and repair time of failed units are assumed to be exponentially distributed. To obtain steady state queue-size distribution, recursive technique is used. Various performance measures are established using steady-state probabilities. A cost function is also deduced.

2 - Expansion Planning of Storage Technologies in Renewable Generation Systems

Christian Kraemer, Institute of Power Systems and Power Economics, RWTH Aachen University, Schinkelstr. 6, 52064, Aachen, Germany, ck@iaew.rwth-aachen.de, Andreas Schäfer, Manuel Jäkel, Albert Moser

Rising amounts of renewables and the age structure of European generation systems require the planning of new generation units. Storage technologies are supposed to play a significant role for storing renewable energy and providing flexibility. Expansion planning (EP) of storage units needs to consider time-dependencies in order to evaluate future benefits. It is shown that the long-term and large-scale EP problem can be broken down to its most important constraints. The derived model simulates the development of thermal and storage units under all relevant technical and economic constraints.

3 - The Optimality Antisymmetrical rank function in poset

Zahra Yahi, SEGC-LMD, Béjaia University, Faculty of Economic, Management and Trade Sciences, Algeria, zahryahi@yahoo.fr, Sadek Bouroubi

In studying the optimality rank function, several results are given. A sufficient condition is given by Alexiv. The optimality of the rank function depends also on the type of the poset; e.g., for the rank function about a distributive poset, a normal poset is optimal. Our objective are studies of optimality of the Antisymmetrical rank function in a particular poset. We pose some sufficient condition of the Antisymmetrical rank function and some results in relation with the optimality of the rank function in poset.

A mixed 0-1 nonlinear optimization model is presented to solve the Collision Avoidance for Air Traffic Management Problem. We give a new configuration for each aircraft such that every conflict situation is avoided. If some aircraft violate the safety distances, a conflict situation occurs. Due to the difficulty to solve the problem by MINLP engine software in short time, a heuristic way is developed for obtaining good solutions in short time. The main results will be reported by comparing the exact solutions with the heuristic ones for short-scale problems.

2 - Conflict resolution by minor speed adjustments

David Rey, LICIT, IFSTTAR, Bron, France, david.rey@inrets.fr, Christophe Rapine, Rémy Fondacci, Nour-Eddin El Faouzi

We present a reformulation of a nonlinear optimization problem encountered in Air Traffic Management (ATM). A current challenge in ATM is to increase airspace capacity to deal with a growing traffic demand. One way to address the capacity problem is to smoothly regulate the traffic flow by performing minor adjustments on aircraft speeds. To guarantee the required safety standards in ATM, one needs to prevent potential conflicts from occurring. This speed regulation framework can be modeled as a nonlinear optimization problem which we pose to reformulate as a Mixed Integer Linear Program.

3 - Airline tail assignment optimization: the impact of aircraft heterogeneity

Patricia Ribeiro, Technical University of Lisbon, Lisbon, Portugal, patricia.ribeiro@ist.utl.pt, Susana Relvas, Nuno Leal

Operating with low margins in a competitive industry, airlines seek strategies to minimize operating costs and improve operational efficiency. One possible strategy consists in considering heterogeneity among aircraft tails when assigning them to the planned flights. We aim to optimize the tail assignment process of the Airline TAP Portugal by taking into account the different characteristics and performances of each aircraft. The savings achieved by optimizing a mixed integer linear programming model integrating the re-design of lines of flights and the tail assignment process are presented.

4 - Aircraft conflict avoidance: a mixed-integer nonlinear optimization approach

Sonia Cafieri, Lab. MAIAA, Dept. de Matemáticas e Informática, Ecole Nationale d’Aviation Civile, 7 Ave. Edouard Belin, 31055, Toulouse, France, sonia.cafieri@enac.fr

Detecting and solving aircraft conflicts, which occur when aircraft sharing the same airspace are too close to each other according to their predicted trajectories, is a crucial problem in Air Traffic Management. We focus on mixed-integer optimization models based on speed regulation. We first solve the problem to global optimality by means of an exact solver. The problem being very difficult to solve, we also propose a heuristic procedure where the problem is decomposed and it is locally exactly solved. Computational results show that the proposed approach provides satisfactory results.

TA-29
Tuesday, 8:30-10:00
CC-A29
MINLP in Airline and Air Traffic Management applications

Stream: Mixed-Integer Non-Linear Programming

Invited session

Chair: Sonia Cafieri, Lab. MAIAA, Dept. de Matemáticas e Informática, Ecole Nationale d’Aviation Civile, 7 Ave. Edouard Belin, 31055, Toulouse, France, sonia.cafieri@enac.fr

Chair: Claudia D’Ambrosio, LIX, CNRS - Ecole Polytechnique, route de Saclay, 91128, Palaiseau, France, dambrosio@lix.polytechnique.fr

1 - On solving the collision avoidance problem for ATM by solving a Mixed 0-1 nonlinear optimization model heuristically

Laureano Fernando Escudero, Dept. de Estadistica e Investigación Operativa, Universidad Rey Juan Carlos, c/Tulipan, S/n, 28933, Mostoles (Madreid), Spain, laureano.escudero@urjc.es, Antonio Alonso-Ayuso, F. Javier Martin-Campo

1 - On solving the collision avoidance problem for ATM by solving a Mixed 0-1 nonlinear optimization model heuristically

Laureano Fernando Escudero, Dept. de Estadística e Investigación Operativa, Universidad Rey Juan Carlos, c/Tulipan, S/n, 28933, Mostoles (Madreid), Spain, laureano.escudero@urjc.es, Antonio Alonso-Ayuso, F. Javier Martin-Campo

TA-30
Tuesday, 8:30-10:00
CC-A31
Modeling Approaches and Solution Algorithms

Stream: Emerging Aspects of Production Planning in Continuous Process Industries: Theory, Optimization, and Practice

Invited session

Chair: Christoph Schwindt, Institute of Management and Economics, Clausthal University of Technology, Julius-Albert-Str. 2, 38678, Clausthal-Zellerfeld, Germany, christoph.schwindt@tu-clausthal.de
1 - Heuristic decomposition and LP-based scheduling in make-and-pack production

Norbert Trautmann, Department of Business Administration, University of Bern, Ordinariat für Quantitative Methoden der BWL, Schützenmattstrasse 14, 3012, Bern, BE, Switzerland, norbert.tautmann@pqm.unibe.ch, Philipp Baumann

We deal with the short-term scheduling of make-and-pack production processes. The planning problem consists in minimizing the production makespan while meeting a given demand subject to a large variety of technological constraints. The problem size of real-world instances requires the usage of heuristics.

We propose to schedule groups of batches iteratively using a continuous-time MILP formulation; the assignment of the batches to the groups and the scheduling sequence of the groups are determined using a priority rule. We report on computational results for a real-world production process.

2 - Modeling Formulation and Solution Approach for a Continuous Process Problem

Krystsina Bakhrankova, Applied economics, SINTEF - Technology and society, Box 4760 Sluppen, S. P. Andersens veg 5, 7465, Trondheim, Norway, krystsina.bakhrankova@sintef.no, Truls Flathberg

Production planning of continuous systems is less covered in the process industry literature relative to their batch counterparts. This work presents a modeling formulation and a corresponding solution approach for a real-world optimization problem, where bulk chemicals are produced via a completely continuous non-intermittent process. It also provides relevant analysis with respect to model properties and solution times as well as potential economic benefits of applying the proposed methodology in practice.

3 - Planning of a continuous production process in the printing industry

Philipp Baumann, Department of Business Administration, University of Bern, IFM, AP Quantitative Methoden, Schützenmattstrasse 14, 3012, Bern, Switzerland, philipp.baumann@pqm.unibe.ch, Norbert Trautmann

Offset printing is a common method to produce large amounts of printing matter. We consider a real-world offset printing process that is used to imprint customer-specific designs on napkin pouches. The planning problem consists in allocating printing-plate slots to the designs such that a given customer demand is fulfilled, all technological requirements are met and the total printing cost is minimized. We formulate this planning problem as a mixed-integer linear program, and we report on computational results for industrial problem instances.

4 - Comparing models for operational production planning and scheduling in single-stage continuous processes: Process Systems Engineering vs. Operations Research

Ana Paula Barbosa-Póvoa, Dept. De Engenharia e Gestao, IST, Av. Rovisco Pais, 1, 1049-001, Lisbon, Portugal, apovoa@ist.utl.pt, Pedro Amorim, Bernardo Almada-Lobo, Tânia Pinto_Varela

Several researchers from the two communities, Operational Research and Process Systems Engineering, have focused on mathematical formulations for the simultaneous lot-sizing and scheduling of single-stage continuous processes with complex set-up structures. This problem arises in the glass, beer, and dairy production. Although recent research has been performed by both mentioned communities, there is no intense communication between these research efforts. This work attempts a systematic analysis of the recent formulation developments to narrow the gap between both communities on this problem.

Data Mining: Web and Social-Oriented Applications

Stream: Data Mining, Knowledge Discovery and Artificial Intelligence

Contributed session

Chair: Takashi Onoda, System Engineering Lab., CRIEPI, 2-11-1, Iwado Kita, Komae-shi, 201-8511, Tokyo, Japan, onoda@criepi.denken.or.jp
Chair: Anastasia Motrenko, Applied mathematics and management, MIPT, Moscow, Russian Federation, pastt.petrovna@gmail.com

1 - An evaluation of the Generalized Additive Neural Network work spam filtering approach

Tiny Du Toit, School of Computer, Statistical and Mathematical Sciences, North-West University, North-West University, 11 Hoffman Street, 2531, Potchefstroom, North-West, South Africa, Tiny.DuToit@nwu.ac.za, Hennie Kruger

The performance of a Generalized Additive Neural Network on a publicly available corpus is investigated in the context of statistical spam filtering. The impact of different feature set sizes on an automated construction algorithm is studied using cost-sensitive measures. Experiments show high performance where legitimate e-mails are assigned the same cost as spams. Applications where legitimate e-mails are allocated a much higher cost than spams should be avoided. This decrease in performance is caused by the aggressive feature dimension reduction required by the algorithm.

2 - Applying hybrid models to analyze the adoption intention of mobile applications

Yang-Chieh Chin, International Business, Asia University, 500, Lioufeng Rd., Wufeng, 41354, Taichung, Taiwan, jerry110888@gmail.com, Chiao-Chen Chang

Mobile applications are one of the most rapidly growing segments of the software market. The goal of this study is to gain insight into the factors that affect user intention to adopt mobile applications. Firstly, a dominance-based rough set approach (DRSA), a rule-based decision-making technique, is used to determine the adoption intentions associated with decision rules in mobile applications. The second phase of the project uses formal concept analysis (FCA) to infer decision rules and variables. Practical research implications are also offered.

3 - Semantic Web services composition with query rewriting under constraints

Khaled Sellami, LMA Laboratory, Bejaia University / EISTI France, 06000, Bejaia, Algeria, skhalel36@yahoo.fr, Mohamed Ahmed-Nacer, Rachid Chelouah, Hubert Kadima, Nadia Halfoune

The concept of “Web services” is essentially an application available on the Internet by a service provider, and accessible by customers through standard Internet protocols. Examples of services currently available are the booking travel online, banking or the implementation of the management of the supply chain. The purpose of this work is to present, in one hand, a model of semantic annotations for describing the Web services and the user request and in another hand, an algorithm which discovers and composes the Web services using the query rewriting under constraints.

4 - Logical analysis of data for a study of proverbs

Jorge Santos, Matemautica, Univ Evora, Rua Romão Ramalho, 59, 7000-671, Évora, Portugal, jorgensantosp@gmail.com, Luis Cavique, Armando Mendes

A case study of proverbs is presented as a part of a wider project, based on data collected by thousands of interviews and involving a set of thousands Portuguese proverbs. We search the minimum information needed to identify the birthplace of an interviewee in a database with inconsistencies. An approach to data reduction is given by the Logical Analysis of Data (LAD). LAD handicaps, like the inability to cope with the contradiction and the limited number of classification classes, will be overcome in this version of Logical Analysis of Inconsistent Data.
**TA-32**

Tuesday, 8:30-10:00  
CC-A34  

**Soft OR case studies**

*Stream: Soft OR and Problem Structuring Methods*  
*Invited session*

**Chair:** Giles Hindle, Management Systems, Hull University  
Business School, University of Hull, Cottingham Road, HU6 7RX, Hull, United Kingdom, giles.hindle@hull.ac.uk

1 - *Extending WASAN — Case Study of a UK Police Force*

**Chris Smith,** OIM Group, Aston University, Aston Business School, Aston Triangle, B4 7ET, Birmingham, West Midlands, United Kingdom, smithcm2@aston.ac.uk, Duncan Shaw

This paper extends the theoretical and practical application of Waste and Source Matter Analysis (WASAN) methodology beyond its initial conception. Applying WASAN in a case outside of the environment it was designed for begins to show that WASAN has generic properties and can be used in a number of different problem situations. To successfully apply WASAN in the new case significant development of the methodology was required. The development of the methodology will take an action research approach operationalised in a case study environment. This paper will form part of the researchers PhD.

2 - *The secret’s in the mix: using OR to inform learning and teaching developments*

**Jo Smedley,** Centre for Excellence in Learning and Teaching, University of Wales, Newport, Lodge Road, Caerleon, NP1 3QT, Newport, Wales, United Kingdom, jo.smedley@newport.ac.uk

Problem structuring methods help to structure complex problems to gain a common understanding among a group and progress on a committed course of action. This paper illustrates how a combination of soft and hard OR approaches supported the design, development and implementation of an organisational learning and teaching initiative across a UK University. OR as a collaborative learning “language” across disciplines and topics supported effective and efficient engagement helping to achieve successful outcomes and inform continuing developments.

3 - *A conceptual modelling framework for Public Health economic modelling*

**Hazel Squires,** SchARR, University of Sheffield, Regent Court, 30 Regent Street, S1 4DA, Sheffield, South Yorkshire, United Kingdom, h.squires@sheffield.ac.uk, Jim Chilcott, Ron Akehurst, Jennifer Burr

Commonly used methods for health economic modelling are often directly applied to Public Health (PH) interventions. However, an inadequate understanding of these complex PH problems and the resulting implications for model development means that inappropriate model structures may be used. We present a conceptual modelling framework (CMF) to facilitate model development within PH economic modelling, developed from (i) a review of key challenges of PH economic modelling, (ii) a review of CMF’s and (iii) qualitative research to understand modellers’ experiences developing PH economic models.

4 - *Participatory Decision Processes in Rural Communities in Tanzania*

**Joe Kakeneno,** Management Systems, Tanzania Ports Authority, P.O Box 9184, Dar es Salaam, N/A, Dar es Salaam, N/A, Tanzania, United Republic Of, jkakenen@yahoo.co.uk, Cathal Brugha

We discuss the usability of the Structured Multi-Criteria Decision-Making (MCDM) methodology in participatory decision processes for selecting suitable irrigation methods to be implemented by rural communities in Tanzania. An MCDM framework which could be integrated into existing community participatory decision making processes was developed and used to arrive at community preferences. The framework could be used to support distributed decision making in various problem contexts and situations.

**TA-33**

Tuesday, 8:30-10:00  
CC-A37  

**OR and Transportation: Applications in Developing Countries**

*Stream: OR for Development and Developing Countries*  
*Invited session*

**Chair:** Youssef Masmoudi, University of Sfax, High School of Commerce of Sfax, BP 954, 3018, Sfax, Tunisia, youssef.masmoudi@gmail.com  
**Chair:** Habib Chabchoub, LOGIQ, Institut Supérieur de Gestion Industrielle, 3018, Sfax, Tunisia, habib.chabchoub@fsegs.ru.tn

1 - *Static multiclass truck assignment model: an application to Nigeria*

**Precious Ikeem,** Civil Engineering, imperial, Skempton Building, sw7 2az, London, United Kingdom, pi06@imperial.ac.uk, Michael Bell

This paper reports on the development of a traffic model built to estimate the potential impact of a dry port solution on traffic congestion in Lagos. It outlines a conceptual framework for assigning import freight traffic to a road network while considering the characteristics of the freight haulage industry in developing countries, particularly Nigeria. The use of a static multiclass user equilibrium assignment model with an inter-zone container flow survey data is proposed. The classes represent containerized cargo categorized by the type of vehicle carrying the container or its contents.

2 - *New approach to the Single Track Railway Scheduling Problem*

**Maya Laskova,** The Institute of Control Sciences V. A. Trapeznikov Academy of Sciences, Moscow, Russia, Russian Federation, laskovayamaya@moscow-index.ru, Alexander Lazarev, Elena Musatova

We consider the single track railway scheduling problem with two stations. Two subsets of trains are given, where trains from station one go to station two, and trains from station two go to station one. All trains have the same speed. At most one train from station one or two can be on the track at any time. We consider the single track railway scheduling problem with two stations with optimization criteria of minimizing additional completion time for each trains. We propose a heuristic approach to The Single Track Railway Scheduling Problem.

3 - *Humanitarian Operations Research in Southern Africa*

**Hildah Mashira,** Applied Mathematics, National University of Science and Technology, 14407 Inkhaka Circle, Selbourne Park, Bulawayo, Zimbabwe, hilda.mashira@gmail.com

The HIV/AIDS pandemic has reached an unprecedented scale in South Africa. The burden that this has placed on the country is already restricted health care resources place a greater emphasis on the value of Anti Retroviral drug distribution. The aim of my project is to design a distribution model for the department of health in the Limpopo province. This will seek to present major stages applicable to building effective models and routes that are cost effective and ensure that drugs are delivered to almost every part of the province.

**TA-34**

Tuesday, 8:30-10:00  
CC-A39  

**Environment and Sustainable Development - Green Teachers**

*Stream: Optimization for Sustainable Development*  
*Invited session*

**Chair:** Azizah Hanim Nasution, Graduate School of Natural
1 - A Markov-based model in managing coordination relationship of school communities to achieve environmental behaviour

Azizah Hanim Nasution, Grad.School of Env. Manag & Natural Resources, University of Sumatera Utara, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, azizahhanim@yahoo.com, Herman Mawengkang

The world today concerns with environmental problems. Most of the problems might be caused by human behavior. The most effective way to enhance environmental behavior is through education. The communities involved in the educational system of a school can be regarded as a multi-agent system. In this paper we use Markov-based dynamic influence diagram to model the coordination relationships such that agents are able to both represent and infer how their activities affect other agents’ activities in a way to achieve the environmental behavior objective.

2 - A decision analysis approach model to maximize students’ cognition of environmental problems

Hidayati Hidayati, Environmental Protection Board, Government of North Sumatera Province, Jl. Diponegoro, Medan, Indonesia, hidayati6817@yahoo.com, Azizah Hanim Nasution

A learner is a cognitive system that develops by his/her information and knowledge-processing activities. To maximise the learner’s cognitive development, knowledge-intensive environments are essential particularly for achieving environmental knowledge. This paper proposes a model based on a decision analysis approach evaluating students’ cognitive development toward environmental problems.

3 - A Stochastic Programming model for Sustainable Production Planning of Crude Palm Oil Industry

Hendaru Sadyadharma, Grad.School of Env. Manag & Natural Resources, University of Sumatera Utara, PSL USU, 20155, Medan, North Sumatera Province, Indonesia, sadyadharma@yahoo.com, Herman Mawengkang

This paper addresses a multi-objective stochastic programming model of the sustainable production planning of crude palm oil. The model takes into account conflicting goals such as return and financial risk and environmental costs. The uncertainty comes from the price of crude palm oil. Starting from it two single objective models are formulated: a maximum expected return model and a minimum financial risk (pollution penalties) model. We transform the stochastic programming model into a deterministic multi-objective model using sampling average approach.

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**TA-35**

**Tuesday, 8:30-10:00**

**CC-A41**

**Pricing and Supply Chain Management**

**Stream:** Operations/Marketing Interface  
**Invited session**

Chair: Kathryn E. Stecke, University of Texas at Dallas, United States, KStecke@utdallas.edu

1 - Impact of Returns Policies on Retail Assortment and Pricing Decisions

Alex Grasas, Economics and Business, Universitat Pompeu Fabra, Ramon Trias Fargas 25-27, 08005, Barcelona, Spain, alex.grasas@upf.edu, Aydin Alptekinolu

We analyze a retailer’s assortment, pricing and return policy (fraction of price refunded upon return) decisions. The retailer must choose its assortment from an arbitrary set of products, and determine the price and refund amount for every product. We model the consumer choice behavior using a nested-MNL-based choice model, and derive a simple metric to rank products, which reveals the optimal assortment quite efficiently. We compare the optimal policies for this integrated model to the case when the return policy is exogenous, driven by category- or store-wide considerations.

2 - Dynamic Pricing of Fashion Products: The Effects of Demand Learning and Strategic Consumer Behavior

Yossi Aviv, Olin Business School, Washington University in Saint Louis, Campus Box 1133, 1 Brookings Drive, 63130, Saint Louis, MO, United States, aviv@wustl.edu

We propose a dynamic-pricing model of a retailer that sells a product to strategic consumers. The seller learns about the market size through sales observations. This raises an interesting phenomenon: consumers can influence the seller’s perception about the market size. We will discuss the latter point, and examine the effectiveness of price commitment strategies. We will also consider a model of a retailer that does not incorporate learning from early sales. This leads to an interesting question: is it better to become sophisticated (capable of learning) when facing strategic consumers?

3 - The study of a time-dependent Freight Transportation Problem

Xiang Song, School of Mathematics, University of Portsmouth, Lion Gate Building, Portsmouth, United Kingdom, xiang.song@port.ac.uk

Freight transportation is a major component of the supply chain management. We aim to study a ‘time-dependent’ freight transportation problem, which takes varied time between two locations into consideration. The main methodology we adopt is a number of dynamic programming state space relaxation techniques and their applications to solving the time-dependent Freight Transportation Problem. The simulated data from a software-development company, which provides vehicle routing and scheduling solutions to UK-based customers, will be used for evaluating our result.

4 - An Integrated Approach to Green Product and Supply Chain Design

Cornelia Schoen, GISMA Business School, Leibniz University Hannover, Germany, schoen@wiwi.uni-hannover.de

In many industries, product design increasingly requires to integrate economic objectives with environmental thinking – driven by raising ecological concerns, regulatory pressures, and the potential to create a marketing edge through sustainable operations. A major challenge of green design is that it must not only embrace a product’s key features from a consumer perspective but also all underlying supply chain processes that determine a product’s ‘greenness’. We present an integrated optimization approach for green product and supply chain design along with applications.
2 - Cognitive Effects of DEA on Performance Assessment
Nadia Vazquez Novoa, Institute of Management Control and Business Accounting, TU Braunschweig, Pockelsstraße 14, 38106, Braunschweig, Lower Saxony, Germany, n.vazquez-novoa@tu-bs.de, Heinz Ahn

Psychological evidence suggests that the use of DEA efficiency scores may lead to significant cognitive biases. An experimental study considering the representativeness and anchoring effects of DEA scores was conducted. The findings not only confirm that DEA scores act as a strong performance marker when deciding on which DMUs should be awarded for their non-financial performance, but also show that the scores may significantly influence a posterior financial assessment. These results have practical consequences for planning, reporting, and controlling processes that incorporate DEA scores.

3 - More New Features of Data Envelopment Analysis Online Software (DEAOS)
Mohammad-Reza Alirezaee, School of Mathematics, Iran University of Science and Technology, Hengam St., Resalat Sq., 16846, Tehran, Iran, Islamic Republic Of, mralirez@yahoo.com, Ali Niknejad, Nassrin Alirezaee

DEAOS has been presented as a professional web application for data envelopment analysis (DEA) including several available models, multiple time periods facilities, useful features, user friendly interface and reporting, importing data, exporting results and easy to use on internet. Here more new features, added to DEAOS, including categorical selection, analytical hierarchy process (AHP) analysis, and many other items will be presented. DEAOS is available at www.DEAOS.com.

4 - Data Envelopment Analysis software for the advanced users
Ali Emrouznejad, Aston Business School, Aston University, B4 7ET, Birmingham, United Kingdom, a.emrouznejad@aston.ac.uk, Emmanuel Thanassoulis

This paper presents software that takes its features closer to the latest developments in the DEA literature. The new software addresses a variety of issues such as: Assessments under a variety of possible assumptions of returns to scale including NIRS and NDRS; undesirable input/output variables, slack-based measures, truly unlimited number of assessment units (DMUs); analysis of groups of data by estimating automatically separate boundaries by group; Malmquist Index and its decompositions; Super efficiency; Cross efficiency; Allocative efficiency and Bootstrapping.

2 - A simulation-based optimization tool for patient allocation to clinical studies
Stephan Tiesler, University of Jena, Faculty of Business and Economics, Chair of Business Informatics, Carl-Zeiss-Straße 3, 03643, Jena, Thuringia, Germany, stephan.tiesler@uni-jena.de, Johannes Ruhland

In all sorts of clinical studies, patient enrolment and recruitment constitutes both a critical success factor and a scarce resource. In large project settings numerous studies with diverse intake requirements and due dates are carried out simultaneously, creating competing demand for a patient ‘supply’ that is stochastic and subject to numerous legal, structural and medical restrictions. We develop a simulation based optimization tool that will allow for optimal allocation of patients to studies in real time and that can also be used to guide strategic issues of study planning.

3 - Using decision analytic modeling for the optimal dichotomization of diagnostics
Gimon de Graaf, Epidemiology, University Medical Center Groningen, Hanzeplein 1, P.O. Box 30 001, 9700 RB, Groningen, Netherlands, g.de.graaf@umcg.nl, Douwe Postmus

The chosen cut-off on a diagnostic test for clinical decisions has far-reaching consequences on costs and health effects. Surprisingly, this cut-off is almost never chosen based on such downstream consequences, but rather on an arbitrarily chosen balance between false positives and false negatives. We describe how an optimal cut-off based on downstream consequences can be identified with help of multi-state modeling of a patient’s disease progression. We illustrate this method by means of a case study of a diabetes screening program.

4 - Custom contract and the role of Group Purchasing Organizations (GPOs) as information intermediaries
Vera Tilson, University of Rochester, 14627, Rochester, United States, vera.tilson@simon.rochester.edu, Abraham Seidmann, Rajib Saha

Many hospitals in the US join GPOs in order to get deeper group discounts offered by the GPOs. However, some members further negotiate directly with the same vendors. The common perception is that hospitals benefit from such directly-established ‘custom contracts’ as they yield lower prices. Using a game-theoretic model, we find that the provision for custom contracts, in fact, benefits vendors at the expense of hospitals. We show how with the provision for custom contracts, GPOs expectedly act as demand aggregators for small hospitals, and as information intermediaries for the rest.

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**TA-37**

Tuesday, 8:30-10:00

**OR in Health & Life Sciences 1**

Stream: OR in Health & Life Sciences (contributed) Contributed session

Chair: Abraham Seidmann, University of Rochester, 14627, Rochester, NY, United States, seidmannav@simon.rochester.edu

1 - Utility of quantitative methods in strategy — making process for blood donation system — logistics approach
Sebastian Twarog, Department of Business Logistics, University of Economics in Katowice, 1 Maja 50, 40-287, Katowice, Poland, sebastian.twarog@ue.katowice.pl, Anna Ojczyńska, Grażyna Trzpiot, Jacke Szoltyszek

An effective blood donation system is centrepiece to assuring health care in every country. Improvement of such a system is an important task for logistician. This paper aims to point out the possibility of applications of chosen quantitative methods in developing the blood donation system. An important part of our research was multivariate and spatial differentiation of discussed issues. Verified was the usefulness of multivariate method data mining and spatial autocorrelations. Those results are prerequisite for creating a blood donation system model.

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**TA-38**

Tuesday, 8:30-10:00

**HH-Colombus**

Interactive Multiobjective Optimization: Methods and Applications

Stream: Multiobjective Optimization Invited session

Chair: Kaisa Miettinen, Dept. of Mathematical Information Technology, University of Jyväskyla, P.O. Box 35 (Agora), FI-40014, University of Jyväskyla, Finland, kaisa.miettinen@jyu.fi Chair: Jussi Hakanen, Dept. of Mathematical Information Technology, University of Jyväskyla, P.O. Box 35 (Agora), FI-40014, University of Jyväskyla, Finland, jussi.hakanen@jyu.fi

1 - Interactive Gradient Projection and Reference Point Approach for Multiobjective Performance Planning
Dong-Ling Xu, Manchester Business School, The University of Manchester, F37 MBSE, Booth Street West, M15 6PB, Manchester, England, United Kingdom, L.Xu@mbs.ac.uk, Jian-Bo Yang

In the paper, equivalence relationships are explored between data envelopment analysis (DEA) and multiple objective linear programming
models, leading to a hybrid approach in which the two functions of performance assessment and planning can be integrated where DM’s preferences can be taken into account in an interactive fashion. It is proved that the input-oriented DEA dual models are identical to reference point minimax models, both of which can be used for conventional efficiency analysis, whilst the latter can be used to conduct trade-off analysis for performance planning based on a gradient projection approach. A case study for a supplier performance assessment problem is explored in detail.

2 - Decision making in a multi-objective paper mill design problem
Ingrida Steponavice, Dept. of Mathematical Information Technology, University of Jyväskyla, FI-40100, University of Jyväskyla, Finland, ingrida.steponavice@jyu.fi, Sauli Ruuska, Kaisa Miettinen

Application of interactive multiobjective optimization to support decision making in industry where modern production processes necessitate increasingly complex and computationally costly models imposes challenges. A computationally expensive integrated control design problem concerning both flexibility in design and amount of capital invested in paper is considered. A computationally inexpensive surrogate model is prepared with the PAINT method while the interactive IND-NIMBUS tool is used to direct a search in finding the most satisfactory solution according to the DM’s preferences.

3 - Consistent parametric representation of Pareto optimal solutions via geometric criteria
Alberto Lovison, Dipartimento di Metodi e Modelli Matematici, Università degli Studi di Padova, 35121, Padova, Italy, lovison@math.unipd.it, Markus Hartikainen

In many practical multiobjective optimization problems, the set of Pareto optimal (PO) solutions exhibits non trivial manifold structures both in objective and decision spaces. In particular, for nonconvex objective functions, different branches of the set of PO solutions can be mapped onto the other, causing serious problems to approximation algorithms. We propose an algorithm based on geometrical criteria which can discriminate among different branches and produce consistent parametric representations of the set of PO solutions, as is shown by examples.

4 - Parameterized achievement scalarizing functions based approach to solve multicriteria median location problem
Olga Karelkina, Mathematics, University of Turku, Turun Yliopisto, 20014, Turku, Finland, volkar@utu.fi

This research addresses interactive optimization techniques based on parameterized achievement scalarizing functions (ASFs). A decision making process is simulated for multicriteria median location problem to illustrate the way how synchronous usage of ASFs may reduce the number of iterations in an interactive process and speed up its convergence to the most preferred solution. Numerical experiments are performed for the case of three objectives.

TA-39
Tuesday, 8:30-10:00 HH-Crousseau

MCDA: New Approaches and Applications in Financial Markets

Stream: MCDA: New Approaches and Applications Invited session
Chair: Gabriela Fernández Barberis, Quantitative Methods, San Pablo CEU University, 23, Julián Romea St., 28003, Madrid, Spain, Spain, ferbar@ceu.es

1 - Multiple Criteria Decision Aid Methods with New Generalized Criteria: an application to the financial markets

TA-40
Tuesday, 8:30-10:00 HH-Livingstone

Dynamic Pricing

Stream: Revenue Management Invited session
Chair: Mikhail Nediat, School of Business, Queen’s University, 143 Union Street, K7L 3N6, Kingston, Ontario, Canada, mmnediat@business.queensu.ca

1 - Revenue Management with Lifetime Value Considerations: Balancing Customer Acquisition and Retention Spending for Firms with Limited Capacity
Anton Ovchinnikov, University of Virginia, Darden School of Business, 100 Darden Blvd, 22903, Charlottesville, VA, ovchinnikov@darden.virginia.edu

This paper discusses the interaction between revenue management (RM) and customer relationship management (CRM) for a firm that operates in a customer retention situation but faces limited capacity. We present a dynamic programming model for how the firm balances investments in customer acquisition and retention, as well as retention across multiple customer types. We characterize the optimal policy and discuss how the policy changes changing on capacity limitations. We then contrast the modeling results with those of a behavioral experiment.

2 - Use of exact algorithms for Partially Observable Markov Decision Processes in solving a Dynamic Pricing problem
Shahin Abbaszadeh, School of Management, University of Southampton, University of Southampton, University Road, SO17 1BJ, Southampton, United Kingdom, sa14g10@soton.ac.uk

We use Partially Observable Markov Decision Processes (POMDP) to find optimal dynamic pricing policies for a retailer of short-life-cycle products with no replenishment during the season. The objective is to maximize expected profit using predefined prices during the season. We show our problem has a Convex and Piecewise Linear value function and employ three exact POMDP algorithms that make use of that property. We analyse performance of these methods in comparison to common practices and strategies such as myopic pricing and discuss managerial insights and potential future research.
3 - Name-Your-Own-Price sales channels: Can strategic consumers improve their performance with information exchange or collaboration?
Mikhail Nedjatk, School of Business, Queen’s University, 143 Union Street, K7L 3N6, Kingston, Ontario, Canada, mnedjak@business.queensu.ca, Tatsiana Levina, Yuri Levin, Jeff McGill
Supplier reluctance to openly advertise large discounts lead to the creation of opaque name-your-own-price channels, where firms can sell discounted products in generic categories without revealing their identity until a purchase is completed. Prices in these channels are concealed and bid-sampling is restricted. Consumers respond by developing social networking practices aimed at exploiting these services. In this work, we explore several robust bidding strategies and the value of collaboration among consumers in the form of exchange of bid history, coordinated bidding, and risk-pooling.

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TA-41
Tuesday, 8:30-10:00
HH-Heyerdahl
AHP/APN 4
Stream: Analytic Hierarchy Process, Analytic Network Process
Invited session
Chair: Y. Ilker Topcu, Industrial Engineering, Istanbul Technical University, Istanbul Teknik Universitesi, Isletme Fakultesi, Macka, 34357, Istanbul, Turkey, ilker.topcu@itu.edu.tr

1 - Applying ANP to Select Strategic Alliances for International Tourist Hotels in Taiwan
Su-Chuan Shih, Business Administration, Providence University, 200 Chung Chi Road, Business Administration, 43301, Taichung City, Taiwan, Taoyuan, scs@pu.edu.tw
International tourist hotels often adopt strategic alliance to increase their competition advantage. This study employs Analytic Network Process to select strategic alliance types. The result shows the most important key criterion is the performance goal of the alliance. Under the key criterion, the index of profit rate is weighted more than the others. The preference alliance types are ordered as: the complex activities, the electronic channels, and the physical shops.

2 - An Integrated Multi-Criteria Approach for the Evaluation and Control of Strategic Options
Ralf Kaspar, Chair of Managerial Accounting, University of Osnabrueck, 49069, Osnabrueck, Germany, ralf.kaspar@uni-osnabrueck.de
The evaluation and control of strategic options within the strategic management process is fundamentally complicated by multiple and mutually influencing objectives, internal and external factors, lack of transparency, complexity and conflicts of interest. To cope with these difficulties a suitable multi-criteria decision support approach is required. Research has led to the development of an ANP based framework. Supported by a case study it is a contribution to an improved evaluation of strategic options incorporating advanced SWOT, BOCR modeling and group decision making.

3 - A Multi-Criteria Based Evaluation of 'Innovation Strategy Selection'
Ozge Surer, Industrial Engineering, Istanbul Technical University, ITU Isletme Fakultesi, Macka, 34357, Istanbul, Turkey, surer@itu.edu.tr, Sezi Cevik Onar, Y. Ilker Topcu
Innovation is a crucial tool for firms to compete, thus it is necessary to define the factors which affect this process. Containing interrelations among the related factors, a multi criteria approach utilizing network models should be used. In accordance with the iterative steps of Analytic Network Process, innovation strategy types and related factors are identified by opinions of experts and the literature survey. Relations among these factors are revealed and their relative importance and the priorities of the strategies are assessed, based on the pairwise comparison answers of the experts.

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TA-42
Tuesday, 8:30-10:00
BW-Amber
Simulation Models and Decision Analysis
Stream: Stochastic Modeling and Simulation in Engineering, Management and Science
Invited session
Chair: Erik Kropat, Department of Computer Science, Universitat der Bundeswehr Muenchen, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.kropat@uniwb.de
Chair: Silja Meyer-Nieberg, Department of Computer Science, Universitat der Bundeswehr Muenchen, 85577, Neubiberg, Germany, silja.meyer-nieberg@uniwb.de
Chair: Sonia De Cosmis, School of Science and Technology, Università di Camerino, via Madonna delle Carceri 9, 62032, Camerino (MC), ITALY, italy, sonia.decossmis@studenti.unicam.it

1 - Modelling a Distribution Operation Using Discrete Event-Based Simulation
Amílcar Arantes, Civil Engineering-DECivil, IST/Technical University of Lisbon, Av. Rovisco Pais, 1049-001, LISBOA, Portugal, amilcar.arantes@civil.ist.utl.pt
This work considers the development of a simulation model and its applications to a case-study based on realistic inputs from a distribution company. It considers the activities and resources involved in the distribution process and the chain configuration. The model was developed after a literature review and interviews, which were essential for problem characterization and to get realistic data. The results show that event based simulation and the SIMUL8 can work as a valid design tool, especially because it can cope with the real world inevitable randomness.

2 - Generation of EPC based Simulation Models
Christian Mueller, Dep. of Management and Business Computing, TH Wildau, Bahnhofstrasse, D-15745, Wildau, Germany, christian.mueller@th-wildau.de
In this paper, we present a approach, where business processes are formulated in EPC notation with some extensions about simulation relevant data. For EPC modeling Bflow, an Eclipse plugin is used. From this EPC model we generate a Desmod simulation model. A Desmod model contains a set of Java classes that use the Desmod simulation framework. Based on the Java programming language, the generated models can extended in all directions. The generation mechanism supports a technique, so that the modeling extensions are not lost by regeneration. Bflow and Desmod, are both open source projects.

3 - Rare-Event Estimation for Density Dependent Models
Adam Grace, Mathematics, University of Queensland, University of Queensland, St Lucia, 4072, Brisbane, QLD, Australia, adam.grace@uqconnect.edu.au
Many complex systems in chemistry, biology and engineering can be modeled via density dependent models. Applications include chemical reactions, population dynamics and traffic flow in telecommunication networks. Rare-event estimation and simulation for such models can be difficult. We present an alternative approach to this problem which utilizes the limiting behavior of density dependent models. We demonstrate this method requires fewer samples than current methods, and is also more robust to correlation issues.

4 - Adding adaptability to Discrete Event Simulation through parameterisation
Francesco Aggogeri, Department of Mechanical Engineering, University of Brescia, Via Branzo 38, 25123, Brescia, Italy, francesco.aggogeri@ing.unibs.it, Gian Mauro Maneia, Marco Mazzola, Angelo Merlo
A novel approach is proposed aiming to facilitate simulation of manufacturing processes by fast modelling and evaluation. Architecture and validation of a DES-based parametric model are presented. The model consists of a flexible and adaptable solution enabling to simulate either manufacturing cells and complex lines with same structure. So a user can tailor the model on his processes without specific knowledge of simulation software. The authors acknowledge the support of the European Commission through the project COPERNICO (CP-IP 229025-2).

This paper will present an analysis of optimal expansion of generation and transmission capacity for a country-level power system model of Europe. Important driving factors for investments in new infrastructure like annual demand, fuel prices and prices for CO2 emissions, are taken directly from the Global Change Assessment Model (GCAM). As electricity demand in GCAM is only calculated for two regions, Western Europe and Eastern Europe, a disaggregation based on statistical data is used to get country-wise demand. The expansion problem is formulated as a two-stage stochastic linear program.

### TA-43

**Tuesday, 8:30-10:00**

**BW-Granite**

**Stochastic programming in energy**

**Stream: Stochastic Programming**

**Invited session**

**Chair:** Asgeir Tomasgard, Applied economics and operations research, Sintef Technology and society, Trondheim, Norway, asgeir.tomasgard@sintef.no

1. **The value of storage at household level: A smart grid perspective**
   **Stein W. Wallace**, Management Science, Lancaster University Management School, LA1 4YX, Lancaster, United Kingdom, stein.w.wallace@lancaster.ac.uk

   As the percentage of wind power increases, storage of energy will be needed. The purpose of this work is to understand the question of storage bottom-up. Is there any value in storage at residential level, and if so, what is the value? We do not assume behavioural changes, only that the building uses its storage capabilities optimally.

2. **Gas Network Topology Extension for Multiple Scenarios**
   **Jonas Schweiger**, Optimization, Zuse Institute Berlin (ZIB), Takustr. 7, 14195, Berlin, Germany, schweiger@zib.de

   Due to the European regulation gas networks have to become more flexible. Investments are needed to allow the network operator to fulfill different demand scenarios. We developed a model for the network extension problem for multiple demand scenarios. That is, we search cost-optimal network extensions such that a variety of demand scenarios can be realized. The problem is described by a two-stage stochastic program. We propose a decomposition along the scenarios and solve the problem by a Branch&Bound-algorithm. Non-convex MINLP are used to model the gas network and solved as subproblem.

   **Paolo Pisciella**, Department of Information Technology and Mathematical Methods, University of Bergamo, Italy, paolo.pisciella@unibg.it, **Marida Bertocchi**, Maria Teresa Vespucci

   We introduce a model intended for the analysis of the upgrade of the national transmission grid. The problem is modeled as a bilevel program with mixed integer structure in both, upper and lower level. Upper level is defined by the transmission company problem which has to decide on how to upgrade the network so to avoid congestions. Lower level models the reactions of generating companies, which take a decision on new facilities and power output, and market operator which strikes a new balance between demand and supply providing new zonal prices.

4. **Long-term expansion of the European Power System Under Various Emission Mitigation Scenarios**
   **Christian Skar**, Department of Electric Power Engineering, Norwegian University of Science and Technology, 7491, Trondheim, Norway, christian.skar@ntnu.no, **Asgeir Tomasgard**, Gerard Doorman

### TA-44

**Tuesday, 8:30-10:00**

**BW-Marble**

**Computer vision (1)**

**Stream: Machine Learning and its Applications**

**Invited session**

**Chair:** Teofilo deCampos, Center for Vision Speech and Signal Processing, University of Surrey, GU2 7XH, Surrey, United Kingdom, t.decampos@surrey.ac.uk

1. **Anomaly detection in machine perception systems**
   **Josef Kittler**, Centre for Vision, Speech and Signal Processing, University of Surrey, GU2 7XH, Guildford, United Kingdom, J.Kittler@surrey.ac.uk

   Anomaly detection in engineering systems is cast as a problem of detecting outliers to the distribution of observations representing a state of normality. We focus on anomaly detection in machine perception. We argue that in addition to outlier detection, anomaly detection in machine perception systems requires other detection mechanisms. They include incongruence detection, data quality assessment, decision confidence gauging, and model drift detection. These mechanisms are elaborated and their application illustrated on a problem of anomaly detection in a sports video interpretation system.

2. **Learning Optimal Semantically Relevant Visual Dictionary using Evolutionary Algorithms**
   **Ashish Gupta**, CVSSP, University of Surrey, University of Surrey, GU27XH, Guildford, Surrey, United Kingdom, a.gupta@surrey.ac.uk

   We propose a novel optimally discriminative visual dictionary learning method using evolutionary algorithms. Due to large intra-category appearance variation, semantically equivalent descriptors are scattered over feature space. Current methods, using hard or soft assignment, are unable to cluster these equivalent descriptors, inter-leaved with other categories, together. We over partition feature space, generating a huge population of tiny syntactically cohesive partitions, which are optimally assigned, with locality constraints, so as to obtain a maximally discriminative visual dictionary.

3. **Transductive Transfer Learning for Action Recognition**
   **Teofilo deCampos**, Center for Vision Speech and Signal Processing, University of Surrey, GU2 7XH, Surrey, United Kingdom, t.decampos@surrey.ac.uk, **Nazli Faraji Davar**

   In video processing, it is often the case that one video may contain several samples of actions that share a number of low level features (e.g illumination, motion style, etc). Therefore, each video constitutes a domain. We show that, for action classification, a classifier that is trained with one video may lead to poor performance when applied to another video, but if the unlabelled samples of this other video are available, it is possible to apply a transductive transfer learning technique, leading to a significant improvement in performance.
1 - An Approximate Scenario-based Approach to Design Robust Supply Chain Networks under Uncertainty
Walid Klibi, Operations Management and Information Systems Department, BEM / CIRRELT, 680 cours de la Liberté, 33405, Bordeaux, France, walid.klibi@bem.edu, Alain Martel

Supply Chain Networks (SCN) must be designed to last for several years and cope with any plausible future, and thus involve a value maximization problem under uncertainty. The original SCN design model is intractable. We propose some complexity reduction mechanisms to tackle the problem, and the design model is reduced to a bi-criterion, multi-period, two-stage stochastic program with recourse. This model considers future scenarios including high-impact disruptive events and recourse variables anticipating response policies in case of disruptions.

2 - On a strict solution algorithm for a stock replenishment policy with fill-rate constraints in the two-step supply chain
Takashi Hasuike, Graduate School of Information Science and Technology, Osaka University, 2-1 Yamadaoka, 565-0871, Suita, Osaka, Japan, thasuike@ist.osaka-u.ac.jp, Koji Okuhara, Nobuyuki Ueno

This presentation proposes a strict solution algorithm to obtain a stock replenishment policy with fill-rate constraints in the two-step supply chain. In previous researches, it is hard to solve this model strictly, because the model is formulated as a non-deterministic programming problem with several stochastic constraints. In order to overcome the disadvantage and develop a strict and efficient solution approach, the deterministic equivalent transformations in mathematical programming are performed. Then, the strict optimal stock replenishment policy is explicitly obtained.

3 - Stochastic and dynamic patient transportation
Jakob Puchinger, Mobility, AIT - Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H., Giefengasse 3, 1210, Wien, Austria, jakob.puchinger@ait.ac.at, Ulrike Ritzinger, Richard Hartl

We consider a patient transportation problem for an emergency medical service in Vienna. The organization has to perform a large number of patient transports every day and, in addition, has to respond to arising emergency calls. In the considered application, about 60% of transportation requests are known in advance, whereas other requests are occurring throughout operations. Therefore, a stochastic and dynamic variant of the dial-a-ride problem is considered. The problem instances are big, consisting of a fleet of around 120 vehicles serving 800 to 1000 requests a day.

4 - Supply chain coordination with capacity reservation and emergency option
Guillaume Amand, HEC-Ulg, University of Liège, boulevard du rectorat, 7 - Bât. B31, 4000, Liège, Belgium, guillaume.amand@ulg.ac.be, Yasemin Arda

This study analyzes the contractual relation between a retailer and a supplier with the aim of determining possible deviations from the optimal system performance. In order to face a random demand, the retailer submits a contract to the supplier based on the number of units delivered and the capacity used to serve the retailer. Before the uncertainty is resolved, the supplier has to decide of the capacity that he reserves. Once the demand is known, the carrier may request additional capacity from an emergency option at a higher cost. An asymmetric case is also discussed.
Tuesday, 10:30-12h00

**TB-01**
Tuesday, 10:30-12h00
RB-Alfa

**Tutorial Lecture: Professor Guy Desaulniers**

Stream: Keynote, Tutorial and Plenary Lectures

**Tutorial session**

Chair: Marc Sevaux, Lab-STICC - CNRS UMR 3192, Université de Bretagne Sud - UEB, Centre de Recherche - BP 92116, 2 rue de Saint Maude, 56321, Lorient, France, marc.sevaux@univ-ubs.fr

1 - 20 years of column generation for the vehicle routing problem with time windows
Guy Desaulniers, École Polytechnique de Montréal and GERAD, H3C 3AT, Montréal, Canada, Guy.Desaulniers@gerad.ca

Column generation is a well-known mathematical programming technique for solving large-scale optimization linear problems. In the mid-1980s, it was shown that it can be successfully embedded in a branch-and-bound framework (yielding a branch-and-price method) for solving integer programs. Since then, it has become the most popular exact methodology for solving several classes of vehicle routing problems. As a fertile testbed, the vehicle routing problem with time windows (VRPTW) played an important role in this success. It consists of finding a set of least-cost vehicle routes to deliver goods to a set of customers. Each customer must be visited exactly once within a given time window and each route must respect vehicle capacity. In this talk, we survey the evolution of the column generation methods developed for the VRPTW, starting from the seminal work of Desrochers, Desrosiers, and Solomon (1992). In particular, we present various path relaxations proposed to avoid solving the NP-hard elementary shortest path subproblem, labeling algorithms used to generate their corresponding columns, and valid inequalities tightening the lower bounds, including those that are directly defined on the master problem variables. We discuss certain acceleration strategies, report computational results, and highlight current and future challenges.

**TB-02**
Tuesday, 10:30-12h00
RB-Beta

**Scheduling and Logistics**

Stream: Scheduling

**Invited session**

Chair: Vitaly Strusevich, School of Computing and Mathematical Sciences, University of Greenwich, Old Royal Naval College, Park Row, Greenwich, SE10 9LS, London, United Kingdom, sv02@gre.ac.uk

1 - Adding an Extra Machine to a Shop Parallel Identical Machines
Vitaly Strusevich, School of Computing and Mathematical Sciences, University of Greenwich, Old Royal Naval College, Park Row, Greenwich, SE10 9LS, London, United Kingdom, sv02@gre.ac.uk, Kabir Rustogi

We consider the problems of processing jobs on m parallel identical machines to minimize the makespan or the total flow time. We measure the machine impact for m machines to the one with m+1 machines. For the makespan, in the preemptive case the impact is (m+1)/m, while in the non-preemptive case the impact is 2. For minimizing the total flow time, we prove that the impact is (m+1)/m. We present polynomial-time algorithms that determine an optimal number of machines, provided that each machine incurs a cost and the objective function captures a trade-off.

2 - Approximation Schemes for Scheduling on a Single Machine Subject to Cumulative Deterioration and Maintenance
Kabir Rustogi, School of Computing and Mathematical Science/Mathema, University of Greenwich, Old Royal Naval College, Park Row, Greenwich, SE10 9LS, London, United Kingdom, rk1@gre.ac.uk, Vitaly Strusevich, Hans Kellerer

We consider a scheduling problem on a single machine to minimize the makespan. The processing conditions are subject to cumulative deterioration, but can be restored by a single maintenance period (MP). The decision-maker is free to choose when to start the MP. We link the problem to the Subset-sum problem (if the duration of MP is constant) and to the Half-product problem (if the duration of MP depends on its start time). For both versions of the problem, we adapt the existing fully polynomial-time approximation schemes to our problems by handling the additive constants, which are of the opposite sign with the variable part of the objective.

3 - Supply Chain Scheduling in a Competitive Environment
Miguel Zamarripa, Departamento de Ingeniería Química, Universidad Politécnica de Catalunya, Spain, miguel.angel.zamarripa@upc.edu, Antonio Espuña

Some of the published works address Supply chain under uncertainty in the available data, very few of them put the issue in a realistic operational environment, taking into account that the SC of interest will have to compete with other supply chains which, like to work as efficiently as possible to cover the same market demands. This work proposes to introduce into the model information about the expected performance of the competing supply chains (including the SC of interest) to improve the operational decision making in a competitive/cooperative environment using Game Theory optimization.

4 - Scheduling of coupled tasks with high multiplicity
Michael Gabay, Laboratoire G-SCOP, 46 avenue Félix Viallet, 38031, Grenoble, France, michael.gabay@g-scop.grenoble-inp.fr, Gerd Finke, Nadia Brauner

The problem of scheduling tasks on a radar system can be modeled using coupled-tasks. We consider the case where all tasks are identical. This case raises original complexity questions and belongs to so-called high multiplicity scheduling problems. We present some complexity issues and results regarding the problem. We also describe a series of counter-examples showing that this problem is unlikely to be in NP.

**TB-03**
Tuesday, 10:30-12h00
RB-L1

**Logistics, Transportation, Traffic - 3**

Stream: Logistics, Transportation, Traffic

**Contributed session**

Chair: Markus Bohlin, Swedish Institute of Computer Science, Box 1263, SE-16429, Kista, Sweden, markus.bohlin@sics.se

1 - A heuristic solution approach for a real-size hierarchical hub location problem
Julia Sender, Institute of Transport Logistics, TU Dortmund University, Leonhard-Euler-Str. 2, 44227, Dortmund, NRW, Germany, julia.sender@tu-dortmund.de, Uwe Clausen

In wagonload traffic, flows of single wagons with different origins and destinations are consolidated on their routes through the railway network. The specific hierarchical hub-and-spoke-network is built up by several formations yards, which differ, for example, in their size and function. We present a specific hub location model for a strategic network design problem in wagonload traffic, which covers most characteristics of wagonload traffic in German railway logistics, and a new heuristic decomposition approach for solving the problem.
2 - Auto-Carrier Distribution Problem with Highly Variable Daily Demand at Dealers
Tsung-Sheng Chang, Graduate Institute of Logistics Management, National Dong Hwa University, 1, Sec.2, Da-Hsueh Rd., Shou-Feng, 974, Hualien, Taiwan, ts@mail.ndhu.edu.tw, Hao-Ping Jiang

Typically, auto-carriers must return to their original depots after completing their daily duties. However, such an operations strategy is quite ineffective in the presence of highly variable daily demand at dealers. Hence, this research intends to tackle the auto-carrier distribution problem that involves the main characteristics of multiple depots, multiple staging areas, multiple trips, time window constraints, and no fixed home depots. We first mathematically model the distribution problem, and then propose an optimization-based solution algorithm to solve the NP-hard distribution problem.

3 - Monte Carlo Simulation Techniques with Parallel Heuristics applied to solve the Capacitated Vehicle Routing Problem
Thiago Guimarães, Centro Universitario Franciscano do Parana, Rua Mateus Leme, 1244 - Apartamento 201 - Centro Cívico, 80530000, Curitiba, Parana, Brazil, thiangui@gmail.com, Luis Gustavo Pereira, Wesley José Nogueira Medeiros

It presents on this paper a new approach to solve the Capacitated Vehicle Routing Problem. The proposal is based on Cluster First-Route Second strategy, employing Monte Carlo Simulation Techniques to cluster the demand points and Classical Heuristics with permutation 2-opt to generation of the routes. Parallel computing techniques are used to reducing the processing time. An extensive computational experiment with classical instances showed an average deviation of 1,40% compared with its exact results on the other hand a greatly reduced processing time.

4 - Shunting with car mixing using column generation
Markus Bohlin, Swedish Institute of Computer Science, Box 1263, SE-16429, Kista, Sweden, markus.bohlin@sics.se, Florian Dahms, Holger Flier, Matus Mihalak

We consider a specific railway shunting problem that arose in the Hallsberg hump yard, specified formally by Bohlin et al. who showed it to be NP hard. A natural MIP formulation give a weak linear relaxation and consequently a large MIP gap. In our new work we use an extended formulation to model the problem’s specifications while maintaining a tight relaxation. To solve the linear relaxation of our formulation we utilize column generation. The lower bounds provided by our relaxation are close (often exact) to the optimal objective and can be calculated in reasonable time for large instances.

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**TB-04**

**TB-05**

Tuesday, 10:30-12h00

**TB-L2**

Problems on graphs I

Stream: Discrete Optimization, Geometry & Graphs (contributed)

**Contributed session**

Chair: Nair Abreu, Production Engineering, Federal University of Rio de Janeiro, Rua Joao Lira 106/401, Leblon, 22430 210, Rio de Janeiro, Rio, Brazil, nair@veloxmail.com.br

**1 - On rational approximation of geometric graph**

Vladimir Benediktovich, Department of Combinatorial Models and Algorithms, Institute of Mathematics of NAS of Belarus, Surganova str., 11, 220072, Minsk, Belarus, vbened@im.bas-net.by

A geometric graph is rational if all its edges have rational lengths. Kleber (2008) asked for what graph its vertices can be slightly perturbed in their e-neighborhoods so that the resulting graph becomes rational (e-approximation) and in addition vertices have rational coordinates (rational e-approximation). Any geometric cubic graph has a rational e-approximation for any \( e > 0 \). In 2011 Dubickas assumed the existence of up to 4 vertices of degree above 3. We prove that any connected geometric graph with maximum degree 4 and vertex w of \( \deg(w) < 4 \) has a rational e-approximation for any \( e > 0 \).

**2 - New spectral upper bounds on the size of k-regular induced subgraphs**

Domingos Cardoso, Departamento de Matemática, Universidade de Aveiro, Campus Universitario de Santiago, 3810-193, Aveiro, Portugal, dcardoso@ua.pt, Sofia Pinheiro

We consider a set of jobs and a set of parallel identical machines. Every job has: fixed start and finish times, a resource requirement, and a value. Every machine owns R units of a renewable resource and can process more than one job at a time, provided the resource consumption is at most R. Two questions arise: Which is a job subset of maximum total value that can be scheduled on a given number of machines? Which is the minimum number of machines required to schedule all jobs? For both problems we discuss complexity, heuristic and exact approaches, and preliminary computational experiments.
In (Haemers’ Ph.D. thesis, 1980) an upper bound (based on the least and largest adjacency eigenvalues) on the independence number of arbitrary graphs was introduced. Later, in (Lu et al. 2007), upper bounds (using the largest Laplacian eigenvalue) were obtained. For regular graphs, in (Bussemaker et al, 1976) a spectral upper bound on the order of induced subgraphs with average degree d was obtained. This upper bound is herein extended to arbitrary graphs, introducing three new upper bounds, based on adjacency, Laplacian and signless Laplacian eigenvalues, respectively.

3 - Graph spectra and combinatorial optimization

Nair Abreu, Production Engineering, Federal University of Rio de Janeiro, Rua Joao Lira 106/401, Leblon, 22430 210, Rio de Janeiro, Rio, Brazil, nairan@veloxmail.com.br,
Claudia Justel, Domingos Cardoso

Walti (1967), followed by Hoffman (1970), presented the first results on graph spectra in combinatorial optimization by introducing graph eigenvalue bounds to the chromatic number. Later several articles appeared relating eigenvalues to classical invariants of graphs: stability and clique numbers, matching, connectivity and isoperimetric number. Furthermore, some hard combinatorial optimization problems have been approximated by using spectral techniques. We present a survey of significant results about graphs spectra applied to combinatorial optimization.

4 - Algorithm of inspired by virus and bacterium attack:

A meta-heuristic approach as an optimization tool

Mahbdi Bashiri, Shahed University, Iran, Islamic Republic Of, Bashiri@shahed.ac.ir, Masoud Bagheri, Zeinah Rasolinezhad

In this paper, a new meta-heuristic algorithm has been proposed based on virus and bacterium attack (VBA). Actually presented solution approach is inspired by attack of virus and bacterium to human body. In the proposed algorithm, virus and bacteria attack to reach the body cells death. Some numerical examples have been selected from the literature to consider the proposed VBA’s efficiency. Also the algorithm has been compared by the genetic algorithm (GA). The computational results verify its efficiency from computational time and solution quality aspects as well.

Tuesday, 10:30-12h00

RB-Eta

Vehicle Routing and Logistics Optimization

Stream: Vehicle Routing and Logistics Optimization

Chair: Erdener Özçetin, Industrial Engineering, Anadolu University, Iki Eylül Kamp., MMF END 107, 26000, Eskişehir, Turkey, eozcetin@gmail.com

1 - A Parallel Procedure for Dynamic Multi-objective TSP

Weiqi Li, School of Management, University of Michigan-Flint, 303 East Kearsley Street, 48502, Flint, Michigan, United States, well@umflint.edu

We propose a new parallel search procedure for dynamic multi-objective traveling salesman problem. We design a multi-objective TSP in a stochastic dynamic environment. The proposed procedure first uses parallel processors to identify the extreme solutions of the search space for each of k objectives individually at the same time. These solutions are merged into a matrix E. The solutions in E are then searched by parallel processors and evaluated for dominance relationship. The proposed procedure was implemented in two different ways: a master-worker architecture and a pipeline architecture.

2 - Solving the vehicle routing problem with time windows by an interior point branch-price-and-cut framework

Pedro Munari, ICMC, University of Sao Paulo, Sao Carlos, Sao Paulo, Brazil, pedro.munari@gmail.com, Jacek Gondzio

In this talk, we present a branch-price-and-cut framework for the vehicle routing problem with time windows which is based on a primal-dual interior point method for efficiently solving the linear relaxations at each branch node. The interior point method is used to obtain well-centred, non-optimal solutions that are used to improve the generation of columns and valid inequalities. Computational results using the Solomon’s instances show that the proposed approach has a better overall performance than the best branch-price-and-cut framework available in the literature.
3 - A Parallel Algorithm for Vehicle Routing Problem on GPUs

Erdener Özçetin, Industrial Engineering, Anadolu University, Iki Eylül Kamp., MMF END 107, 26000, Eskisehir, Turkey, eozcetin@gmail.com, Gurkan Ozturk

Vehicle Routing Problem (VRP) is a common and difficult logistics problem. To reach a solution with exact methods is mostly hard, several meta-heuristics have been developed. Graphics processing units (GPUs) on enhanced graphics cards are used to solve hard optimization problems with implementing meta-heuristic algorithms by parallelizing. In this paper, a parallel algorithm has been proposed for VRP. The performance of the algorithm, especially in execution time has been shown by solving literature test problems.

4 - Solving Vehicle Routing Problems with Equipment Allocation

Philip Kilby, NICTA and The Australian National University, Locked Bag 8001, 2601, Canberra, ACT, Australia, Philip.Kilby@nicta.com.au, Fabien Tricoire

We look at a routing problem where some tasks require particular equipment (and may require more than one type of equipment). The equipment allocated to a vehicle is a decision variable, and restricts the vehicles that can perform each task.

We look at two methods for solving the combined equipment allocation and vehicle routing problem. One method uses a standard vehicle routing solver, modified in a modular way to incorporate the additional functionality. We also describe a method based on column generation.

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TB-08

Tuesday, 10:30-12h00

RB-Epsilon

VMI and Delivery

Stream: Supply Chain Planning

Invited session

Chair: Marcel Turkensteen, Business Studies, ASB, Fuglesangs Alle 4, 8210, Aarhus V, Denmark, matu@asb.dk

1 - Shipment consolidation by collaborative planning between industrial suppliers under VMI policy

Waldek Kaczmarczyk, Department of Operations Research & Information Technology, AGH University of Science & Technology, al. Mickiewicza 30, 30-059, Krakow, Poland, waldek@agh.edu.pl

In industrial supply chains just-in-time policy forces frequent and small shipments. Transportation costs can be reduced by consolidation of shipments, but this is possible only if shipments can wait until the consolidated shipment is accumulated. The Vendor Managed Inventory system opens another possibility, suppliers may coordinate their shipments in advance. Proposed concept of horizontal collaborative planning enables more frequent consolidation without delivery delays. Presented results show potential benefits of such collaboration.

2 - An Improved Robust Particle Swarm Optimization Algorithm to the Uncertain Inventory Routing Problem

Isa Nakhai Kamalabadi, Department of Industrial Engineering, School of Engineering, Tarbiat Modares University, Jalal Ale Ahmad Highway, P.O.Box: 14115-143, 14115-143, Tehran, Tehran, Iran, Islamic Republic Of, nakhai@modares.ac.ir, Ali Hossein Mirzaei

We address a multi-period multi-product uncertain inventory routing problem where products are produced and delivered from one manufacturer to a set of retailers through a fleet of heterogeneous capacitated vehicles. Here, split delivery is permissible but each vehicle can travel just a tour per period. The uncertainty follows an unknown but bounded pattern. Due to the complexity of the problem, we develop an improved robust particle swarm optimization algorithm to solve the problem. The computational results show that the developed algorithm outperforms the benchmark algorithms.

3 - A vendor managed inventory model with transportation to geographically dispersed retailers

Marcel Turkensteen, Business Studies, ASB, Fuglesangs Alle 4, 8210, Aarhus V, Denmark, matu@asb.dk, Christian Larsen

This study considers a vendor that supplies a set of geographically dispersed retailers and wishes to use a coordinated inventory and distribution policy that minimizes the total costs incurred. Routing considerations, an infinite time horizon, and demand uncertainty make the problem hard to solve for existing approaches. Our solution is to estimate transportation distances with continuous approximation. Using Markov chain modeling, we then derive the delivery zones and vehicle utilization policies in combination with optimal inventory policies at the vendor and the retailers.

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TB-09

Tuesday, 10:30-12h00

RB-Zeta

Cutting and Packing 6

Stream: Cutting and Packing

Invited session

Chair: Andreas Bortfeldt, Dept. of Information Systems, University of Hagen, Profilstrasse 8, 58084 Hagen, Germany, andreas.bortfeldt@fernuni-hagen.de

1 - Optimal cutting of the raw materials

Jaroslav Hanzel, Institute of Control and Industrial Informatics, Slovak University of Technology, Ilkovicova 3, 812 19, Bratislava, Slovakia, jaroslav.hanzel@stuba.sk, Ladislav Jurisica, Anton Vitko, Marian Klucik, Peter Paszto

The contribution deals with optimal utilization of the materials in the industry. The problem is to find and cut out the rectangular part from the metal plate with no defects and a maximal surface. Simple algorithm applicable in the embedded systems with restricted computational resources is proposed. It is able to quickly find solutions close to optimal solution with low computational cost. On the other hand the problem was solved also by means of standard optimization methods. The analysis and comparison of proposed and standard methodology on the basis of computed data is given.

2 - Different criteria to sort the list of pieces in 2D-Orthogonal Strip Packing Problem

Fernando Garcia Perez, Matematicas Aplicadas, Universidad de Alcala de Henares, Edificio de Ciencias. Campus Universitario, Carretera Madrid-Barcelona Km. 33,600, 28805, Alcala de Henares, Madrid, Spain, fernando.garcia@uah.es, Joaquin Aranda Almansa, Miguel Delgado Pineda

In the two-dimensional strip packing problem, 2D-SPP, a set of n rectangular items and a strip of width W and unlimited height are given. Each item has an height and a width. This problem consists of allocating orthogonally all the items, without overlapping, by minimizing the overall height of the packing. It is usual to sort the small pieces in order to improve the result. We study the influence on the outcome of different criteria to sort the list of pieces and how to select the optimal criterion using around 1,000 instances from the literature.

3 - Generation of Two-dimensional Guillotine Cutting Patterns by Genetic Algorithms and Fit-Heuristics

Lilian Caroline Xavier Candido, Federal University of Parana, Avenida Candido de Abreu, numero 304, apartamento 905, 80530000, Curitiba, Parana, Brazil, liliancarolinex@gmail.com, Thiago Guimaraes

This paper proposes a new strategy for generation of two-dimensional guillotine cutting patterns, with non-stages and two stages with the possibility of rotation of the items in both cases. The methodology is divided into two phases: first, the items are selected and grouped into subsets by genetic algorithms. In the second phase, heuristics are employed to determine fitting geometric arrangement of the cutting pattern. Computational experiments performed with classical instances from the literature indicate excellent results for some instances with very low processing time for all of them.
4 - Algorithms Based on Particle Swarm Optimization for the Two-dimensional Knapsack Problem
David Alvarez, São Paulo State University, Brazil, david.unesp@gmail.com, Ruben Romero

This study presents the (un)constrained (un)weighted k-staged fixed and rotated two-dimensional guillotineable single knapsack problem. An encoding based on slicing tree is presented. Four algorithms, based on the Particle Swarm Optimization (PSO) metaheuristic were used: basic PSO, PSO with the mutation operator, a hybrid of Variable Neighborhood Search (VNS) with PSO and a hybrid of VNS and PSO including the mutation operator as a turbulence factor. The computational results on large sets of test cases show that the methodology is very efficient for the two-dimensional knapsack problems.

■ TB-10
Tuesday, 10:30-12h00
RB-Theta

Inventory Management 3

Stream: Production Management & Supply Chain Management (contributed)

Contributed session

Chair: Hicham Chehade, ICD- LOSI, University of Technology of Troyes, 12 Rue Marie Curie, 10000, Troyes, France, chehadeh@utt.fr

Chair: Harry Groenevelt, Simon School of Business, University of Rochester, Wilson Blvd, 14627, Rochester, NY, United States, groenevelt@simon.rochester.edu

1 - An Inventory Model to Determine The Optimal Mix of Owned and Rented Items
Leonardo Epstein, School of Engineering, Universidad Adolfo Ibáñez, Av. Diagonal Las Torres 2640, (of 209 B), Peñalolén, Santiago, Chile, leonardo.epstein@uai.cl, Eduardo González-Császár

Inventory models for rental items may be used to plan operations that involve lending or renting tools, or providing service such as access to telephone lines. We address the situation where the service provider owns an inventory of items, which may not be sufficient to meet demand. Additional items may be obtained by renting them from another provider. Thus, emerges the problem of determining the optimal number of items the provider must own to maximize his expected profit within a time horizon. We consider the situation where the number of users is finite and future demand is uncertain.

2 - Analysis of Supply Contracts with Total Minimum Quantity Commitment and Fixed Order Costs
Frank Y Chen, Department of Management Science, City University of Hong Kong, Hong Kong, China, yhchen@se.cuhk.edu.hk

We study a supply contract that specifies a minimum total (cumulative) order quantity over the planning horizon (e.g., one year). Each replenishment order incurs both fixed and variable costs. We show the optimal policy to be of a modified (s, S) form.

3 - Heuristics for the (Q,R,S) inventory policy
Harry Groenevelt, Simon School of Business, University of Rochester, Wilson Blvd, 14627, Rochester, NY, United States, groenevelt@simon.rochester.edu

We will compare the performance of a number of heuristics for the (Q, R, S) inventory policy. This is a general policy that includes periodic and continuous review base stock and order point-order quantity policies as special cases. The heuristics trade off computational effort and accuracy, and provide estimates for a number of different performance metrics, such as inventory holding and backorder costs, unit fill rate, order fill rate, in-stock probability, etc.

■ TB-11
Tuesday, 10:30-12h00
RB-Iota

Transportation and Logistics

Stream: Transportation and Logistics

Invited session

Chair: Sadegh Niroomand, Industrial Engineering, Eastern Mediterranean University, Turkey; sadegh.niroomand@cc.emu.edu.tr

1 - Developing a sustainable model for city transportation networks
Narges Shahraiki, industrial engineering, koc university, koc university, istanbul, Turkey, nshahraki@ku.edu.tr, Metin Turkay, Ali Fattahi

In this paper, we consider the design and upgrade of city transportation networks using robust and exact optimization methods. The transportation network is represented with a directed graph G(N, A), where N is the set of nodes and A is the set of edges connecting these nodes. In the design and upgrade of the network, it is important to assign demand for different sectors (such as housing, industry, commerce and services) to certain locations in the metropolitan area while achieving a sustainable transportation system. We incorporate economical, social and environmental aspects of triple bottom line of sustainability.

2 - Inventory and Transport Planning of Raw Materials for Steel Enterprises
Hua-An Lu, Department of Shipping and Transportation Management, National Taiwan Ocean University, #2, Pei-Ning Road, 202, Keelung, Taiwan, halu@mail.ntou.edu.tw

Steel enterprises required different kinds of raw materials for smelting their products. For reducing transport costs, maritime carriers are used. The whole inventory and transport planning of raw material imports for a steel company is a complicated problem. This study proposes two models: one for inventory scheduling of raw materials and voyage allocation of different ship types; one for ship assignment in considering of deployment by own carriers or spot charter vessels. This planning procedure was applied to a real case study for China Steel Corporation in Taiwan.

3 - Experimenting a Metaheuristics for a Flexible Transport Service
Pasquale Carotenuto, Istituto per le Applicazioni del Calcolo "M. Picone", Consiglio Nazionale delle Ricerche, via dei Taurini 19, 00185, Roma, RM, Italy, carotenuto@iac.cnr.it, Daniele Monacelli, Marco Turco

A demand responsive transport system (DRTS) is a flexible system in which the stops are fixed and tours are variable. Client takes a reservation about a trip which could be in the same day or in the next. DRTS can be analyzed by two kind of dynamisms. The first is about the way in which requests arrives to the system. In this case DRTS could be static if the algorithm runs after received all the requests, or can be dynamic on line if the algorithm runs while the requests are arriving to the system. The second kind of dynamism is about when the requests are served: on reservation or on service.

4 - Optimal Supermarket Layout
Sadegh Niroomand, Industrial Engineering, Eastern Mediterranean University, Turkey; sadegh.niroomand@cc.emu.edu.tr, Bela Vizvari

The optimal layout of a supermarket is determined. It is well-known that the amount of sales is an increasing function of the length of the customer’s path. To increase the sales, the objective is to increase the travelled path in the shop. Based on real life observations, customers are classified into 16 classes. It is supposed that each customer uses the optimal solution of the relevant TSP when visits departments. The mathematical model maximizes the total weighted length of the 16 TSPs’ optimal solutions. The model uses the dual of DFJ model. Numerical results are presented.
Robustness in Public Transportation

Stream: Optimization in Public Transport
Invited session
Chair: Marie Schmidt, Institut für Numerische und Angewandte Mathematik, Georg-August-Universität Göttingen, Lotzestraße 16-18, 37073, Göttingen, Germany, m.schmidt@math.uni-goettingen.de

1 - Robust Lockmaster’s Problems
Christina Büsing, Operations Research, RWTH Aachen University, Kackertstraße 7, 52072, Aachen, Berlin, Germany, cbuesing@math.tu-berlin.de, Elisabeth Günther
An efficient solution of the lockmaster’s problem (LockP) reduces the transportation time of goods along waterways and thus makes this means of transport a competitive and environmentally friendly alternative to trucks or railways. The LockP is to manage the lockages such that ships arriving from different levels of a waterway get up or down lifted minimizing the total waiting time. Due to delays a predefined schedule may turn infeasible. To deal with these changes, we introduce robust models, obtain compact ILP-formulations and compare their performance on real data of the Kiel Canal.

2 - Robustness in Periodic and Aperiodic Timetabling
Marc Goerigk, Georg-August Universität Göttingen, 37083, Göttingen, Germany, m.goerigk@math.uni-goettingen.de, Anita Schöbel
In public transport timetabling, arrival and departure times need to be scheduled for a set of vehicles, minimizing travel times. This can be done with or without periodically recurring events, resulting in the periodic and aperiodic timetabling problem. Finding timetables that also consider robustness against delays is a recently emerging field of research, with a wide variety of concepts how to define robustness.

In this talk an experimental evaluation of robust timetables on close-to-real-world data is given. Both the aperiodic as well as the harder periodic case are considered.

3 - On the improvement of robustness in railway station areas
Thijs Dewilde, Centre for Industrial Management/Traffic & Infrastructure, University of Leuven, Celestijnenlaan 300A, bus 2422, B-3001, Leuven, Belgium, Thijs.Dewilde@cib.kuleuven.be, Peter Seis, Dirk Cattrysse, Pieter Vansteenwegen
To improve the robustness of a railway system in station areas, we introduce a repetitive procedure to successively optimize the train routing problem and to reinforce this solution by applying timetable changes in a tabu search environment. We introduce the spread of the trains in the objective function for the route choice and timetabling modules. The performance of our algorithms is evaluated based on the case study for Brussels area, using a discrete event simulation. The computational results indicate an improvement in robustness and a reduction in knock-on delay.

4 - Robust bicriteria paths
Marie Schmidt, Institut für Numerische und Angewandte Mathematik, Georg-August-Universität Göttingen, Lotzestraße 16-18, 37073, Göttingen, Germany, m.schmidt@math.uni-goettingen.de, Kenneth Kuhn, Andrea Raith, Anita Schöbel
Finding robust solutions of optimization problems is important in practice and well researched for single-objective problems. However, in many applications one has to deal with several objective functions. Motivated by the application of routing airplanes through convective weather, where two conflicting objective functions are given by the length and the risk of the chosen route, we extend robustness concepts to the bicriteria case and develop new robustness concepts. The concepts are analyzed for different uncertainty sets and relations between the different concepts are identified.
1 - Numerical methods for solving semi-infinite programs with infinitely many conic constraints
Takayuki Okuno, Graduate School of Informatics, Kyoto University, Yoshida-Hommachi, Sakyo-Ku, 606-8501, Kyoto, Japan, t.okuno@amp.i.kyoto-u.ac.jp, Shunsuke Hayashi, Masao Fukushima

The semi-infinite program (SIP) is normally represented with infinitely many inequality constraints, and has been studied extensively so far. However, there have been few studies on the SIP involving conic constraints, even though it has important applications such as Chebyshev-like approximation, filter design, and so on. In this talk, we focus on the SIP with an infinite number of conic constraints. We provide some applications and algorithms for solving it.

2 - Zimmermann-cutting plane algorithm for solving non-symmetric fuzzy semi-infinite linear programming problems
Somayeh Khosravi, Mathematics, Shiraz University of Technology, Shiraz, Iran, Islamic Republic Of, s.khosravi@sutech.ac.ir, Alireeze Fakharzadeh

This paper introduces a solution method for fuzzy semi-infinite linear programming problems, in which the crisp objective function and the infinite number of fuzzy constraints. The solution method is the kind of cutting plane algorithm in which its sub-problem are solved by using the Zimmermann-method. The convergence of the algorithm is proved and some numerical examples are given.

3 - The alpha-BB based cutting plane algorithm for solving semi-infinite program with multi-dimensional index set
Shunsuke Hayashi, Graduate School of Informatics, Kyoto University, Yoshida-Hommachi, Sakyo-Ku, 606-8501, Kyoto, Japan, shunhaya@amp.i.kyoto-u.ac.jp, Kensuke Goumoto

Recently, Shiu and Wu proposed the algorithm for semi-infinite program (SIP) combining the alpha-BB method with the cutting plane method. In this study, we extend their algorithm to the case where the index set in the SIP is multi-dimensional. When the index set is one-dimensional, the “refinement step” in the algorithm is just to divide a closed interval into the left and the right. However, such a division is not unique in the multi-dimensional case. We also apply the algorithm to the three-dimensional design-centering problem, which can be cast as an SIP with a two-dimensional index set.

4 - Weighted Voronoi cells via quadratic systems
Margarita Rodriguez Alvarez, Dpto. Estadistica e Investigación Operativa, Universidad de Alicante, Ctra. Alicante-San Vicente s/n, 03690, San Vicente del Raspeig, Alicante, Spain, margar.rodriguez@ua.es, Miguel Gobena, Virginia N. Vera de Serio

Given a set T such that each point s has assigned a positive weight w(s), the multiplicatively weighted (MW) Voronoi cell of s is the set of points closer to s than to any other point of T for the distance d.(s)/w(t). The MW-Voronoi diagram of T is the family of MW-Voronoi cells of all the elements of T. Recently, we applied the theory of linear semi-infinite systems to get information on the ordinary Voronoi cells and diagrams (with the same weight for all the points of T). In this talk, we apply results on quadratic systems to MW-Voronoi cells and diagrams.
1 - Global emission ceiling versus international cap and trade: a comparison based on normalized Nash equilibria
Jacqueline Morgan, Department of Mathematics and Statistics & CSEF, University of Naples Federico II, Via Cintia, 80126, Napoli, Italy, morgan@unina.it, Fabien Prieur

We model climate negotiations as a two-stage game. In the first stage, players agree on a global emission cap (GEC). In the second one, they non-cooperatively choose either their emission level or their emission quota, under the cap that potentially binds them together. When the emission cap is binding, among the coupled constraints Nash equilibrium, we select a normalized equilibrium. With and without emission trading, there exists a range of values for which a binding cap improves all players’ payoff. Moreover GEC outperforms the ITC system in terms of emission reduction and payoff gains.

2 - Robust Nash Equilibrium in a Class of Multi-Leader-Follower Games
Masao Fukushima, Kyoto University, Japan, fuku@i.kyoto-u.ac.jp

In this paper, we focus on a class of multi-leader-follower games under uncertainty with some special structure. By means of the robust optimization technique, we first formulate the game as the robust Nash equilibrium problem, and then the generalized variational inequality (GVI) problem. We then establish some results on the existence and uniqueness of a robust leader-follower Nash equilibrium. We also apply the forward-backward splitting method to solve the GVI formulation of the problem and present some numerical examples. [This is a joint work with Ming Hu.]

3 - Regulation of pollution in a Cournot equilibrium
Lars Mathiesen, Economics, Norwegian School of Economics, Helleveien 30, 5045, Bergen, Norway, Lars.mathiesen@nhh.no

This paper is concerned with modeling polluters that form an oligopoly in their product market. Adding emission-constraints converts the Cournot-Nash equilibrium into a generalized Nash equilibrium problem (GNEP). When coupling constraints are common and corresponding shadow prices are equal to all players the resulting equilibrium is a complementarity problem (CP). Conditions for convergence of a Newton process to a unique equilibrium of the CP are shown to be similar to those of the Cournot-Nash model. Computational results demonstrate its efficiency compared to other approaches.

4 - Economics of collective monitoring: a study of environmentally constrained electricity generators
Jacek Krawczyk, School of Economics and Finance, Victoria University of Wellington, 6140, Wellington, New Zealand, J.Krawczyk@vuw.ac.nz, Javier Contreras, James Zuccollo

We tackle welfare differences between individual and collective monitoring of pollution. Given a model of emissions propagation the regulator can calculate the optimal emissions quota for each generator and enforce it through individual monitoring. That will maximise welfare, but may be expensive because of implementation costs. An alternative is provided. We use a 3-node network, find that the welfare loss from collective monitoring can be small and that the imposition of transmission and environmental restrictions may benefit the “inefficient” generator and decrease consumer surplus.

1 - P-HUB approach for the optimal park-and-ride facility location problem
Vladimir Marianov, Electrical Engineering, Pontificia Universidad Catolica de Chile, Vicuna Mackenna 4860, 7820436 Macul, 7820436, Santiago, Chile, marianov@ing.puc.cl, Felipe Aros-Vera

We optimally locate Park and Ride (P&R) facilities, modeled as capacitated hubs. P&R usage is maximized. Commuters can either use the service or choose to travel by car only, and their behavior follows a gravitational model. We consider users’ generalized cost and attractiveness of P&R facilities as input for the gravity rule. For small instances of the problem, we propose a novel linearization of the gravity rule. A modification of the Heuristic Concentration Integer procedure is applied to solve larger instances. Numerical results are shown, including a case in Queens, NY.

2 - Hub location under uncertainty
Francisco Saldanha-da-Gama, CIO/DEIO, University of Lisbon, FCUL-DEIO, Bloco C6, Piso 4, 1749-016, Lisbon, Portugal, fsalgama@fc.ul.pt, Sibel A. Alumur, Stefan Nickel

In this work, we address several aspects concerning hub location problems under uncertainty. Two sources of uncertainty are considered: the set-up costs for the hubs and the demands to be transported between the nodes. Generic models are presented for single and multiple allocation versions of the problems. Using a set of computational tests we analyze the changes in the solutions driven by the different sources of uncertainty considered isolated and combined.

3 - Hub and Spoke Network Design with Single-assignment, Capacity Decisions and Balancing Requirements
Stefan Nickel, Institute for Operations Research, Karlsruhe Institute of Technology (KIT), Geb 11.40, 76128, Karlsruhe, Baden-Wuertemberg, Germany, Stefan.Nickel@kit.edu, Isabel Correia, Francisco Saldanha-da-Gama

An extension of the capacitated single-allocation hub location problem is considered in which not only the capacity of the hubs is part of the decision making process but also balancing requirements are imposed on the network. The decisions involve: the selection of the hubs, the allocation of the spoke nodes to the hubs, the flow distribution through the sub network defined by the hubs, and the capacity level at which each hub should operate. A set of computational experiments is performed and the results are reported.

4 - Supermodular Properties in Hub Location
Ivan Contreras, Concordia University, H3G 1M8, Montreal, Canada, icontrer@encs.concordia.ca, Elena Fernandez

In this work we show how a generalized hub location problem, that includes as particular cases well-known hub node and hub arc location problems, can be stated as the maximization of a supermodular function. As a consequence, we obtain worst-case bounds on the performance of a greedy heuristic. Moreover, we present two integer programming formulations for the generalized hub location problem. One of these formulations is derived from the properties of supermodular functions, and involves variables with at most two indices. Computational experiments confirm the efficiency of such formulation.

TB-17
Tuesday, 10:30-12h00
RB-2105

Hub Location I
Stream: Hub Location
Invited session
Chair: Ivan Contreras, Concordia University, H3G 1M8, Montreal, Canada, icontrer@encs.concordia.ca

TB-18
Tuesday, 10:30-12h00
RB-2107

Location Analysis: Advanced Optimization Tools
Stream: Continuous Location
Invited session
Chair: Víctor Blanco, Quant. Methods for Economics & Bussines, Universidad de Granada, Facultad de Ciencias Economicas y Empresariales, Campus Cartuja, 18011, Granada, Spain, vblanco@ugr.es
1 - Expanding Search for a Hider on a Network
Steve Alpern, Mathematics Department, London School of Economics, Houghton Street, WC2A 2AE, London, United Kingdom, s.alpern@lse.ac.uk, Thomas Lidbetter
A Hider H is hidden somewhere on a network Q. A Searcher chooses continuously expanding sets, of total length. Starting at a given point A, he captures the Hider at the first time T with H in set. This new search paradigm models searching by a team of agents. We solve the Bayesian problem on a tree (where the distribution of H is known) and the game where the Hider chooses H and T is the payoff, for certain types of networks. This extends the article S. Alpern, 'Find-and-Fetch on a Tree', Operations Research 59 (2011).

2 - Solving the franchisor-franchisee bi-objective optimisation problem
Pilar M. Ortigosa, Computer Architecture and Electronics, University of Almeria, Ctra. Sacramento s/n, La Cañada de San Urbano, 04120, Almeria, Spain, ortigosa@ual.es, Juanma López-Redondo, Jose Fernandez, Aranzazu Gila Arrendo, Carmen G. Escamilla, Victoria Plaza Leiva
Though the problem of obtaining the Pareto-front for this problem has been previously tackled through exact general methods, they require high computational effort. In this work, we propose a new multi-objective optimization heuristic algorithm, which deals with the problem at hand in a fast and efficient way. It combines ideas from different multi-objective and single-objective optimization evolutionary algorithms, although it also incorporates new devices which help to reduce the computational requirements, and also to improve the quality of the provided solutions.

3 - Optimal Timings of Project Control Points using Facility Location Model and Simulation
Narjes Sabeghi, Applied Mathematics, Ferdowsi University of Mashhad, Faculty of Mathematical Sciences, No10, Iadan10, vakilabad BLV, Mashhad, Iran, Mashhad, Iran, Islamic Republic Of, narjes_sabeghi@yahoo.com, Hamed Reza Tareghian, Hassan Taheri, Mohammad Amini
Approaches with static view to the project control suffer from the fact that the possibility of corrective actions is missing. In this paper, we consider a dynamic view to the project control and use an adapted version of the facility location model to find optimal timings of the control points. A simulation model is then used to predict the possible deviations from the base plan at each control point. Borrowing ideas from disturbance management, corrective actions are taken. This process continues until the timing of the last point of control is obtained.

4 - A hierarchy of SDP-relaxations for multifacility ordered median problems
Víctor Blanco, Quant. Methods for Economics & Bussines, Universidad de Granada, Facultad de Ciencias Economicas y Empresariales, Campus Cartuja, 18011, Granada, Spain, vblanco@ugr.es, Justo Puerto, Safae El Haj Ben Ali
We consider multifacility ordered median continuous location problems with any norm, and in any dimension. We show that there is a sequence of semi definite programming relaxations that converges to the optimal solution of the problem by using a Lasserre’s moment approach. Furthermore, in order to solve larger problems, we prove that we can exploit the sparsity and the symmetry of the original problem to reduce, considerably, the size of the SDP problems in the sequence.

1 - Selecting prospects for cross-selling financial products using multivariate credibility
Fredrik Thuring, Actuarial Science, Cass Business School, 106 Bunhill Row, EC1Y 8TZ, London, United Kingdom, ftr@codan.dk, Jens Perch Nielsen, Catalina Bolance
For many companies a possible way to expand its business is to sell more products to preferred customers in its portfolio. Data on the customers’ past behaviour (e.g. past claiming history, for insurance products, or past information on defaulting, for banking products) is stored in the company’s data base and can be used to assess whether or not more products should be offered to a specific customer. This study implements a method for using historical data of each individual customer, and the portfolio as a whole, to select a target group of customer to whom more products would be offered.

2 - A logistic regression approach to estimating customer profit loss due to lapses in insurance
Ana Maria Perez-Marin, Econometrics and Statistics, University of Barcelona, Av. Diagonal 690, Faculty of Economics, 08034, Barcelona, Barcelona, Spain, amperez@ub.edu, Montserrat Guillén, Manuela Alcaniz
This article focuses on business risk management in the insurance industry. A methodology for estimating the profit loss caused by each customer in the portfolio due to policy cancellation is proposed. Using data from a European insurance company, customer behaviour over time is analyzed in order to estimate the probability of policy cancellation and the resulting potential profit loss due to cancellation in two different lines of business contracts. Implications for understanding customer cancellation behaviour as the core of business risk management are outlined.

3 - Developing customer fidelity programs and strategies within customer relationship management activities
Aras Keropyan, Economics and Business Organization, University of Barcelona, 08034, Barcelona, Spain, arasaral@hotmail.com, Ana Maria Gil-Lafuente
Over the last decade, Customer Relationship Management (CRM) activities have become fundamental for companies. Every time it is being more costly to acquire new customers than retaining the existing business, therefore the big corporations are more disposed to invest more resources for existing customers in order to assure their satisfaction and fidelity with the company. In this study our objective is to implement a fuzzy based Hungarian Method that will allow us to develop efficient customer fidelity programs and strategies for different customer segments within CRM activities.

TB-20

Tuesday, 10:30-12:00
RB-2113

Financial Modeling and Optimization

Stream: Decision Making Modeling and Risk Assessment in the Financial Sector

Invited session
Chair: Hüseyin Tatlıdil, Statistics, Hacettepe University, Hacettepe Universitesi Beytepe Kampüsü İstatistik Bölümü, Beytepe, 06532, Ankara, Turkey, tatlidil@hacettepe.edu.tr

1 - Portfolio optimization with a new quantile-based risk measure
Cristinca Fulga, Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of Romanian Academy, Calea 13 Septembrie No.13, Sector 5, 050711, Bucharest, Romania, fulga@csie.ase.ro

We develop a portfolio selection method which takes into consideration the recent positive evolution of the risky assets that are not comprised in the portfolio available at the moment of the decision by using the Analytical Hierarchy Process. Our model relies on a new quantile based risk measure which is defined using the modified loss distribution according to the decision maker’s loss aversion preferences.
2 - Probability distribution models for European stock index returns
Chris Katris, Engineering Sciences, University of Patras, 26504, Patras, Greece, chriskatris@upatras.gr, Sophia Daskalaki

We study the marginal distributions of daily returns for eight European Stock Market Indices and attempt to fit the Generalized Hyperbolic and mixtures of Normal Distributions. We also create a model that combines the Generalized Pareto for the tails and other distributions for the rest of the data. The above marginal distributions are then considered as static models for parametric estimation of the Value at Risk. Evaluation of the models concludes this work.

3 - A Query for Statistical Arbitrage in Fixed Income Markets for Developing Countries
Sait Satiroglu, Center For Computational Finance, Ozyegin University, Kusbaskisi Cad No:2, Altunizade Uskudar, 34662, Istanbul, Turkey, sait.satiroglu@ozyegin.edu.tr, Emrah Sener, Emrah Ahi

This paper studies the Nelson-Siegel framework driven fixed income arbitrage strategy in three developing countries. We consider the rich cheap analysis and battery trades which historically present abnormal yields to maturity, taking as reference a robust zero-coupon yield curve fitted with bond prices. The main contribution of the paper is the construction-optimization, back-testing and comparison of our fitted yield curve and Z-score based strategies. We show that "intellectual capital" required yield curve arbitrage strategies produce positively skewed returns also in emerging markets.

4 - The Performance of Value at Risk and Expected Shortfall Under Subfamilies of Generalized Hyperbolic Distributions: Evidence from ISE-30

The approach based on normal distribution was used in the studies of guessing the VaR as a standard risk measuring criterion. However, in many researches it is understood that the distribution of return series of financial variables has heavy tails and it is skewed and straight. In this study, we fit subfamilies of generalized hyperbolic distributions and evaluate the performance of quantile-based risk measures such as VaR and Expected Shortfall with a dataset of daily prices of ISE-30 Index and stocks. We also examine the differences between the success rates of the calculated risk measures.

- Invited session

Financial Mathematics and OR 6

Stream: Financial Mathematics and OR

Chair: Tatiana Zolotova, Chair f Applied mathematics, State University of the Ministry of Finance of the Russian Federation, 127006, Moscow, Nastasinsci lane, house 3, case 2, Research financial institutions, 127006, Moscow, Russian Federation, tgold11@mail.ru

1 - The general approach to the modeling of the risk management procedures and its specification for investment problems

- Invited session

Mathematical Models in Macro- and Microeconomics 1

Stream: Mathematical Models in Macro- and Microeconomics

Chair: Marta Kostrzewska, Institute of Mathematics, University of Silesia, ul. Bankowa 14, Katowice, 40-007, Katowice, Poland, martakostrewska83@gmail.com

The work is devoted to the description of the general model of the risk management, including two submodels: the model of an estimation of system effectiveness and the model of an estimation of the risk of its functioning. The general model can be applied to decision-making in conditions of risk for various complex systems and processes. Problems of management are considered for stochastic processes at the strategic and share investment, using various estimations of risk. Methods of these problems are discussed in view of criteria of efficiency and risk offered.

2 - Stochastic Hybrid Dynamical Financial Systems and Their Optimization
Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr, Büsra Temocin, Azar Karimov, Erdem Kılıç, Yeliz Yolcu Okar

We present dynamics in finance under uncertainty and covariance. An emerging representation tool for this is Stochastic Differential Equations. It has become acknowledged that additionally an impulsive part is needed, together amounting for Levy processes. Even these are often composed piecewise with changes happening at thresholds. We present several classes of these Hybrid Systems, discuss problems of identification, keeping them between barriers and optimizing portfolios with regard to them, discussing approaches of Hamilton-Jacobi-Bellman and Maximum Principle.

3 - Parameter Estimation for Stochastic Differential Equations
Tansel Akvar, Department of Mathematics, Middle East Technical University, 06531, Ankara, Turkey, tanselavkar@gmail.com, Gerhard-Wilhelm Weber

Stochastic differential equations play a fundamental role in modeling dynamic phenomena in nature, technology and economy. Models defined via SDEs usually depend on finite or possibly infinite dimensional parameters. To obtain a useful model, it is critical to estimate them. But these equations are hard to represent by a computer and to resolve. We express them in the manner of approximation by a discretization and additive models with splines. Our estimation refers to the linearly involved spline coefficients and the partially nonlinearly involved probabilistic parameters.

4 - A Surrogate Constraint Approach for a Scenario-based Capital Budgeting Model
José Paixão, Dept. Statistics and Operations Research, Faculty of Sciences - University of Lisbon, Bloco C6 - Campo Grande, 1749-016, LISBOA, Portugal, jpaixao@fc.ul.pt, Anabela Costa

Contingent claims analysis can be used for project evaluation when the project develops stochastically over time and the decision to invest can be postponed. In that perspective, a model has been presented in the literature. However, the corresponding linear integer program turns out to be quite intractable even for small size instances. In this talk, we present a surrogate constraint relaxation for the original problem yielding the determination of lower and upper bounds for the optimal value of the problem. Computational experience, allowing the comparison with other approaches, is reported.
1 - Efficiency-Indices for revealed preference tests: Complexity results and algorithms
Bart Sneumlers, Faculty of Business and Economics, KU Leuven, Naamsestraat 69, 3000, Leuven, Belgium, bart.sneumlers@econ.kuleuven.be, Frits Spieksma
In this paper, we prove a number of complexity results regarding efficiency-indices for revealed preference tests. These indices are often used in micro-economics as a measure of consumer rationality. While a number of observations regarding the difficulty of calculating these indices are made in the economics literature, few formal results exist. For one popular efficiency-index we provide exact polynomial time algorithms, whilst for two other common efficiency-indices we prove NP-Hardness for four different axioms of revealed preference.

2 - Who’s Number One? Asymmetric Production Costs as a Determinant of Quality Rankings
Mihkel Tombak, Management, University of Toronto, 3359 Mississauga Rd North, L5L 1C6, Mississauga, Ontario, Canada, mihkel.tombak@rotman.utoronto.ca, Sergio Meza
We examine how production cost asymmetries affect the way firms compete in prices and quality in a vertical differentiation model and obtain an endogenously determined quality ranking. When cost differences grow, quality differentials decrease, and when they grow large enough, we have a unique duopoly equilibrium where the low-cost firm offers high quality. We illustrate the robustness of these results to different costs of quality formulations and find our results are strengthened when adding costs of quality. We conduct a welfare analysis and discuss implications.

3 - Time-varying regression model of gross domestic product
Damir Atygaye, Control/Management and Applied Mathematics, Moscow Institute of Physics and Technology, Russian Federation, atygaye@gmail.com, Vadim Motl
In this paper, we review time-varying linear regression, which is the essence of recovering some hidden dependences (GDP’s components), which are time-varying in the general case. Feature of this model is the assumption of zero presence of noise in the observations and hidden components. This assumption imposes additional constraints on the observations and the functional dependence of the hidden components. The method being proposed is simple in tuning and has linear computational complexity with respect to the signal length.

4 - Games in the network flows
Marta Kostrzewa, Institute of Mathematics, University of Silesia, ul. Bankowa 14, Katowice, 40-007, Katowice, Poland, marta.kostrzewa83@gmail.com, Leslaw Socha
The aim of this presentation is to study the cooperative games related to the network cost flow problem. We consider the network in which the set of arcs is shared between K players. Every coalition is interested in maximizing the value of the preference function together with the set of arcs. This assumption imposes additional constraints on the observations and the functional dependence of the hidden components. The method being proposed is simple in tuning and has linear computational complexity with respect to the signal length.

1 - Robust Optimization in Spline Regression Models for Target-Environment Networks
Ayse Ozmen, Scientific Computing, Institute of Applied Mathematics, Middle East Technical University, Kazimkarabekir Mah. 2048. Sok No:5/5, Etimesgut, 06790, Ankara, Turkey, ayseozmen19@gmail.com, Erik Kropat, Gerhard-Wilhelm Weber
Solutions to optimization problems can represent significant sensitivities to perturbations in the parameters of the problem. So, optimization affected by parameter uncertainty is a focus of the mathematical programming and a need to tackle uncertain data when optimization results are combined within real-life applications. Since the regression models of target-environment networks can be affected by noise, we introduce spline regression models using MARS, Conic MARS (CMARS) and, their robust versions under polyhedral uncertainty by using robust optimization that deals with data uncertainty.

2 - Optimal parameters region for Pulse Width - Pulse Frequency and Pseudo-Rate modulators
M. Navabi, SMARTLAB, Shahid Beheshti University, GC, 1234, NY, Iran, Islamic Republic Of, astronomica.facult@gmail.com, Hamed Ranrang
Pulse Width - Pulse Frequency, the device that translates the continuous commanded torque signal into an on/off signal, is analyzed, the optimal range of its parameters is determined and compared with pseudo-rate modulator. Thrusters used as attitude control actuator operate in on-off mode, but controller create a continuous signal, therefore a unit is needed to translate continuous signal while providing lowest fuel consumption and thruster firing for attitude control of spacecraft. Two modulators are selected and optimized through system analysis.

3 - Economically optimal days open and days dry in high milking cows
Joanna M. Makulska, Department of Cattle Breeding, University of Agriculture in Krakow, al. Mickiewiczicza 24/28, 30-059, Kraków, Poland, rzmakuls@cyf-kr.edu.pl, Andrzej Weglarz, Anna Stygar
Numerous investigations indicate a necessity to change standard recommendations on the optimal length of days open and days dry in high yielding dairy herds. This study presents the solutions obtained from the multi-level hierarchical Markov model developed to support the economically optimal decisions on insemination, drying-off and replacement of high milking cows. The biological, technical and economic parameters of the model were derived based on the empirical data representing the conditions of dairy cattle production in Poland and on the results of a literature review.
2 - Investment models with a VaR constraint
Patricia Xufre, CIO-FCUL and NovaSBE, Edificio C6, Campo Grande, 1749-016, Lisboa, Portugal, pxufre@novasbe.pt, Antonio Rodrigues
We analyse how VaR (Value-at-Risk) can be used directly to design an investment strategy. We propose 2 methods to build an investment model based on the profit maximization with VaR constrained: (i) the distribution of the returns is stationary, (ii) a recursive way to estimate VaR allowing adaptation to new information. The estimation of the quantile is made through a new neurocomputational procedure. Both methods were tested for several price time series, as well as with artifical data generated according to different stochastic models.

3 - Recursive quantile estimation vs. quantiles from recursive density estimation
José Luís Carmo, CIO and University of Algarve, Portugal, jlcarmo@ualg.pt, Antonio Rodrigues
Many decision problems, namely in the areas of financial investing, inventory management or quality control, are approachable by the recursive estimation of quantiles, from (possibly) nonstationary time series. In this work, we compare different recursive quantile estimation methods, and end up concluding, on the basis of empirical evidence, in favour of an alternative approach: the computation of quantiles from recursively estimated probability densities, the latter being accomplished through an original adaptive exponential smoothing method.

4 - How the stochastic problem drives the Brazilian electric sector
Reinaldo Souza, Departamento de Engenharia Elétrica, Pontifícia Universidade Católica do Rio de Janeiro, Rua Marquês de São Vicente, 22453-900, Rio de Janeiro, RJ, Brazil, reinaldo@ele.puc-rio.br, Pedro Ferreira, Fernando Luiz Cyrino Oliveira
This article aims, first of all, at presenting the reader a broad perspec-tive of the Brazilian Electric sector, identifying the process of transformation through which it underwent during the last decades, arriving at the Brazilian Electric Sector’s (BES) New Model. With this New Model, it is shown how a good modeling of the stochastic variable is determinant to the good functioning of the BES’ three fundamental pillars, that is, planning, operation, and accounting and settlement process of the energy transactions in the short term market.

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TB-25
Tuesday, 10:30-12h00
CC-A23

Sustainable Supply Chains
Stream: Environmental Issues in Operations Management
Invited session
Chair: Mehmet Soysal, Operations Research and Logistics, Wageningen University, Hollandseweg 1, 6706 KN, Wageningen, Netherlands, mehmet.soysal@wur.nl

1 - Carbon-Optimal and Carbon-Neutral Supply Chains
Charles Corbett, UCLA Anderson School of Management, 110 westwood plaza, box 951481, 90095-1481, Los Angeles, CA, United States, charles.corbett@anderson.ucla.edu, Felipe Caro, Tarkan Tan, Rob Zuidwijk
We introduce a model of joint production of GHG emissions in general supply chains, decomposing total footprint into processes, each of which can be influenced by any combination of firms. We examine when the supply chain can be carbon-optimal. i.e. when all firms exert first-best emissions reduction effort levels. We find that, to induce carbon-optimal effort levels, emissions need to be over-allocated. This means that the focus in the LCA and carbon footprinting literature on avoiding double-counting is, in the context of setting incentives, misguided.

2 - An application of Revenue Management in remanufacturing: the case of a third party remanufacturer
Joao Quairiguaisi, MACE, University of Manchester, Manchester, United Kingdom, joao.quairiguaisi@manchester.ac.uk, Andy Reade, Azadeh Dindarian
Optimally deciding as to whether recycle, refurbish, remanufacture or retrieve parts from a returned product is no trivial task, and is dictated by a number of factors: the WTP for the remanufactured product, scrap prices, remanufacturer’s idle capacity. Moreover, in the case of large third party remanufacturers, these decisions have to be made hundreds of thousands of times a year. In this paper, using real data obtained from a large remanufacturer in the UK, and drawing on revenue management techniques, we develop an automated system to support such decisions.

3 - Robust design of production networks for second generation synthetic bio-fuel
Grit Walter, Schumpeter School of Business and Economics, Chair of Production and Logistics, Bergische Universität Wuppertal, Rainer-Gruenter-Str. 21, 42119, Wuppertal, Germany, walterh@wiwi.uni-wuppertal.de, Thomas Spengler, Anne Schatka, Laura Hombach
Second generation synthetic bio-fuels can make an important contribu-tion to sustainable mobility. However, there are currently high uncer-tainties with regard to development of production technology, future political requirements, and future demand. We develop a multi-period MIP-model for integrated location, capacity and technology planning for the design of production networks for second generation synthetic bio-fuels. Principle network configurations are developed, and the uncertainties are regarded using a scenario based approach.

4 - An integrated model for sustainable food logistics management
Mehmet Soysal, Operations Research and Logistics, Wageningen University, Hollandseweg 1, 6706 KN, Wageningen, Netherlands, mehmet.soysal@wur.nl, Jacqueline Bloemhof, Jack van der Vorst
Food supply chains (FSCs) require different quantitative models for aiding management decisions, mainly because of the perishability of the product. Addition of sustainability concerns makes models for the FSCs more challenging. In this study, we develop a generic MILP model for the logistics management of FSCs while considering the perishability of the products and the sustainability (GHG emissions) of the transportation modes. The model minimizes various costs, while fulfilling demand requirements and can be used as a decision support tool for improving the sustainability of FSCs.

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TB-27
Tuesday, 10:30-12h00
CC-A25

Decision Analysis in Practice
Stream: Decision Processes
Invited session
Chair: Mara Airoldi, Dept of Management, London School of Economics and Political Science, Houghton Street, WC2A 2AE, London, United Kingdom, mairoldi@lse.ac.uk

1 - Assessing the value for money of UK public services
Tom McBride, National Audit Office, SW1W 9SP, London, United Kingdom, Tom.McBride@nao.gsi.gov.uk
The National Audit Office provides the UK Parliament with independ-ent assurance on the use of public resources. One way we do this is by publishing around 60 Value for Money (VfM) reports per year. These reports are on topics as diverse as dementia services and banking sup-port. OR plays an important role in our work. For example they can be used to construct a counterfactual to assess if VfM has been achieved; or to examine the integrity of Government forecasts. This presentation will give an overview of our role, and present 3 case studies of how we have used OR to analyse UK public services.
2 - Disinvestments in practice
Mara Airoldi, Dept of Management, London School of Economics and Political Science, Houghton Street, WC2A 2AE, London, United Kingdom, mairoldi@lse.ac.uk

A challenge faced by many public sector organisations is how to reduce costs. Disinvesting is more challenging than allocating additional spend, because the staff who know the service best do not see honest presentation of the options as being in their interest. We show how a decision conferencing approach was used to help a health authority make critical decisions about the reconfiguration of an eating disorders service in order to secure cost savings, and discuss lessons learned.

3 - Tackling uncertainties in multi-criteria decision support for sustainable water infrastructure planning
Lisa Scholten, System Analysis, Integrated Assessment and Modelling, EAWAG-Swiss Federal Institute of Aquatic Science and Technology, Ueberlandstr 133, P.O.Box 611, 8600, Dubendorf, Zurich, Switzerland, Lisa.Scholten@eawag.ch, Judit Lienert

To support water infrastructure choices under uncertain scenarios, MAUT is applied to a case study in Switzerland. Different sources of uncertainty from internal and external factors of MCDA will be considered during evaluation. Due to the complexity of elicitation and uncertainty modeling, usually much simplified preference models are used (e.g. risk neutrality, additive aggregation). Knowing (from global sensitivity analysis), which uncertainty really matters, will help to focus on more adapted elicitation design. The overall decision analytic framework and first results will be presented.

3 - Double and One Sided Moral Hazard in the Three-tier hierarchical Organization of the Venture Capital Finance
Ayi Gavirel Ayayi, Science de la gestion, Université du Québec, 3351 Boulevard des Forges, G9A 5H7, Trois Rivières, Québec, Canada, ayi.ayayi@uqtr.ca

The paper studies double-sided moral hazard problem (MHP) between venture capitalists (VCs) and entrepreneurs and one-sided MHP between the investors in the venture capital funds and VCs because of the direct impact of the moral hazard on the performance of the funds as well as on the growth and the success of the investees. I show that an optimal compensation contract can reconcile the different needs and concerns of the three contracting parties; given the information distribution and the behavioral assumptions. Global optimization program is used to solve goal congruence optimal contract.

TB-28
Tuesday, 10:30-12h00
CC-A27
Optimization Modeling
Stream: Structured Optimization and Applications
Invited session
Chair: Marcel Sinski, Institute of Operations Research, Karlsruhe Institute of Technology, Kaiserstraße 12, 76131, Karlsruhe, Germany, sinske@kit.edu

1 - Taxonomy of concepts and terms in administration, OR and management
Erwin Reizes, O.R., Fac.Ing./UdelaR, Uruguay, Luis A.de Herrera 1042,ap.1701 (home), ap.1701, 11300, Montevideo, Uruguay, bereizes@adinet.com.uy

A taxonomy of concepts and terms seems necessary to scope with the "Babel" of synonyms and homonyms in administration, OR and management theory and practice. Based on ideas of Logic, System Theory, Linguistics, Biology, OR and Informatics, a uniform correspondence of concepts and terms is given.

2 - Measuring the Performance of TV Campaigns based on DEA: an Empirical Study
Katsuki Tanaka, Faculty of Business Administration, Setsunan University, 17-8 Ikedanakamachi, 572-8508, Neyagawa, Osaka, Japan, k-tanaka@kjo.setsuman.ac.jp, Yoshinori Matano

Though much efforts have been done to have a understanding of the TV advertising effects, there is no definite standard. The frontier analysis is useful clarifying whether the campaign is efficient or not. DEA is a frontier analysis based on the empirical data. By observing the distance from the frontier, it provides the improvement of the inefficient DMU. In this paper, DEA is employed to measure the performance of TV advertising campaigns. Each campaign is considered as a DMU - the inputs are the advertising expenditures whereas the outputs are the awareness and knowledge of the campaigns.

3 - Gas Network Nomination Validation Problem - An MIP Approach
Bjoern Geissler, Mathematics, FAU Erlangen-Nürnberg, Discrete Optimization, Cauerstraße 11, 91058, Erlangen, Germany, bjorn.geissler@math.uni-erlangen.de, Alexander Martin, Antonio Morsi, Lars Schewe

Nomination validation constitutes kind of a core problem for many optimization tasks in gas economy. It is about to decide whether a certain quantity of gas can be sent through the network from prescribed entries to prescribed exit points. In the stationary case, the physics of gas flow together with technological and commercial side conditions lead to a pretty big (nonlinear, mixed-integer, finite dimensional) inequality system. We present elimination and approximation techniques so that the remaining system gets within the reach of standard NLP-solvers.

2 - The Gas Network Nomination Validation Problem - An MIP Approach
Thorsten Koch, Mathematics, University of Duisburg-Essen, Mathematics, University of Duisburg-Essen, Butlerstrasse 10, 47058, Duisburg, Germany, Claudia Stangl, Mathematics, University of Duisburg-Essen, Claudia.stangl@uni-due.de, Rüdiger Schultz

Checking the feasibility of transportation requests belongs to the key tasks in gas pipeline operation. In its most basic form, the problem is to decide whether a certain quantity of gas can be sent through the network from prescribed entries to prescribed exit points. In the stationary case, the physics of gas flow together with technological and commercial side conditions lead to a pretty big (nonlinear, mixed-integer, finite dimensional) inequality system. We present an alternative approach based on a new kind of MIP-relaxations and provide computational evidence for its suitability even for large real-life instances.

3 - Gas Network Topology Optimization
Jesco Humpola, Optimization, Zuse Institute Berlin, Takustrasse 7, 14159, Berlin, Germany, humpola@zib.de, Thorsten Koch, Thomas Lehmann, Jonas Schweiger

We aim for topology optimization of large-scale, real-world gas transmission networks. Given a nomination, i.e. a balanced allocation of source and sink flows, we look for a suitable setting of all network elements, such that the requested amount of gas can be transmitted through the network without violating physical or operational constraints. The problem can be stated as a non-convex MINLP which we solve by a special tailored combination of the solvers SCIP and IPOPT and a heuristic that makes use of the dual values of the IPOPT calls.
4 - Modeling flow in gas transmission networks using shape-constrained expectile regression
Fabian Sobotka, Economics, Universität Goettingen, Platz der Göttinger Sieben 5, 37073, Göttingen, Niedersachsen, Germany, fabian.sobotka@wwi.uni-goettingen.de. Radoslava Mirkov, Werner Römisch, Thomas Kneib

The gas flow within a gas transmission network is studied with the aim to optimise such networks. A geoadaptive model for describing the dependence between the maximum daily gas flow and the temperature on network exits is proposed. Semiparametric expectile regression provides the possibility to model the upper tail of the response distribution while accounting for the spatial correlation between different exits. The effect of the temperature is modeled with shape constraints to include knowledge about gas load profiles and to allow for a realistic prediction.

Applications and Decision Support Systems

Stream: Emerging Aspects of Production Planning in Continuous Process Industries: Theory, Optimization, and Practice
Invited session
Chair: Jim Everett, Centre for Exploration Targeting, University of Western Australia, 49 Goldsmith Rd, 6009, Nedlands, WA, Australia, jim.everett@uwa.edu.au

1 - A decision-support tool for designing cost-effective biopharmaceutical manufacturing processes
Sotiris Simaria, Biochemical Engineering, University College London, Torrington Place, WC1E 7JE, London, United Kingdom, a.simaria@ucl.ac.uk, Richard Allmendinger, Suzanne Farid

A decision-support tool using genetic algorithms to aid the design of flexible and cost-effective multi-product facilities that can cope with diverse biopharmaceutical drug candidates is presented. Results from an industrially relevant case study show that the most cost-effective purification sequences and equipment sizing strategies that meet demand and purity targets for each product in the facility are identified. Emphasis is also placed on the use of graphical methods to allow the visualisation of trade-offs in the set of optimal solutions so as to enhance the decision-making process.

2 - Optimal Supply Chain Planning: Service Levels and Profitability Scores
Ana Amaro, Applied Mathematics and Informatics, ISCAC, Accounting and Administration College of Coimbra, Quinta Agrícola, Bencanta, 3040-316, Coimbra, Portugal, a.amaro@iscac.pt, Ana Paula Barbosa-Póvoa

Globalization has led businesses to focus on the worldwide markets. To maintain competitive advantage, process industries and associated supply chains (SCs) have to address new challenges. The present contribution develops a Mixed Integer Linear Programming formulation to model different SC performance and planning criteria such as service levels and profitability. These represent efficiency goals and SCs’ ability to manage customers’ expectations. The impact of each planning strategy on the optimal plan is analysed and the applicability is illustrated through an industrial pharmaceutical SC.

3 - Joint lot sizing and routing problem of perishable goods
Márcio Antônio Ferreira Belo Filho, Instituto de Ciências Matemáticas e de Computação, Universidade de São Paulo, Avenida Trabalhador são-carlense, 400 - Centro, São Carlos, São Paulo, Brazil, marciobof@gmail.com, Pedro Amorim, Franklina Toledo, Christian Almeder, Bernardo Almada-Lobo

The joint production and distribution planning problem usually addresses batching of orders disregarding lot sizing. We investigate the value of considering lot sizing versus batching for a multi-customer delivery problem with routing and perishable products. Results show that lot sizing is able to deliver better solutions than batching. Moreover, the flexibility due to lot sizing decisions can reduce production and distribution costs. Finally, these savings are leveraged by customers with tight time windows and production systems with non-triangular setups.

Data Analysis and Its Applications

Stream: Data Mining, Knowledge Discovery and Artificial Intelligence
Contributed session
Chair: Irina Yatsky, Computer Science, Transport and Telecommunication institute, Lomonosova 1, LV-1019, Riga, Latvia, irlv@tsi.lv

1 - Extending Learning Vector Quantization for mixed-type data classification
Chung-Chian Hsu, Dept. of Information Management, National Yunlin University of Science and Technology, 123 University Rd. Sec. 3, 640, Douliou, Yunlin, Taiwan, hsuce@yuntech.edu.tw, Jiang-Shan Wang, Hung-Yi Tsai, JongChen Chen

Real-world data usually consist of categorical and numeric values. Learning Vector Quantization (LVQ), a useful classification technique, however handles only numeric data. Categorical values need to be converted to numeric ones prior to training. Nevertheless, careless conversion schemes can lose semantics inherent in categorical values and may result in reduced classification accuracy of LVQ. In this study, we propose an extended LVQ which incorporates a distance scheme: distance hierarchy for taking into account the semantics. Experimental results demonstrated effectiveness of ELVQ.

2 - Continuous predictor modality multinomial correlated interpretation
Andrew Yatsko, ITMS Dept., University of Ballarat, Mt. Helen campus, 3350, Mount Helen, VIC, Australia, andrewyatsko@students.ballarat.edu.au, Andrew Stranieri, Adil Bagirov, Herbert Jelinek

Compactness of data leads to improved performance of classification algorithms. Discretization of continuous features is also a way to uniform representation of problems with nominal features. Certain reliable, yet simple techniques exist. At the same time, interval optimization of multiple attributes poses a significant challenge. This article explores a subsampling approach based on cluster analysis. The method is being compared to others and appears to be competitive, although limits exist to what can be achieved, imposed by noise, data specifics, and the bias of classification methods.

3 - Assessing Bayesian Network classifiers for software defect prediction
Karel Dejaeger, Faculty of Business and economics, Katholieke Universiteit Leuven, Naamsestraat 69, 3000, Leuven, Belgium, Karel.dejaeger@econ.kuleuven.be, Thomas Verbraken, Bart Baesens

Software testing is a crucial activity during software development and defect prediction models assist practitioners herein by providing an upfront identification of faulty software. While Naive Bayes (NB) is often applied in this regard, citing predictive performance and comprehensibility as its major strengths, alternative Bayesian algorithms boosting the promise of simpler networks remain underexposed. We explored 15 such classifiers, in combination with a Markov blanket feature selection procedure, and found that simpler models can be constructed using Bayesian classifiers other than NB.
4 - A decision support system for ERP implementation in small and medium sized enterprise
Ying Xie, Dept of System Management and Strategy, University of Greenwich, Business School, Park Row, SE10 9LS, London, United Kingdom, Y.Xie@gre.ac.uk

ERP implementation is challenging for small and medium sized enterprises (SMEs) as it is time consuming and risky. An integrated decision support system for ERP implementation (DSS_ERP) is developed integrating analytical regression models, a simulation model and nonlinear programming models. The DSS_ERP offers an analytical model to accurately monitor the progress each critical success factor (CSF) makes along the time horizon and monitor the cost consumed; it determines the priorities of CSFs and facilitates decision makings on resource allocations.

4 - It looks like a PSM and it does what a PSM does but is it a PSM?
Amanda Gregory, Business School, University of Hull, HU6 7RX, Hull, United Kingdom, a.j.gregory@hull.ac.uk, Jonathan Atkins

The defining characteristics of a PSM and the set of approaches to which the label can be applied are generally agreed. This paper focuses on extending the label PSM to approaches that have the characteristics of a PSM but which have been developed outside of the OR/systems field and the potential (dis)advantages of this. The discussion will be illustrated by reference to such an approach, the DPSIR (Drivers — Pressures — State Changes — Impacts — Responses) framework, which is widely used within the particularly ‘wicked’ context of ecosystem management.

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<td>Stream: Soft OR and Problem Structuring Methods</td>
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<td>Chair: Youssef Masmoudi, University of Sfax, High School of Commerce of Sfax, BP 954, 3018, Sfax, Tunisia, <a href="mailto:youssef.masmoudi@gmail.com">youssef.masmoudi@gmail.com</a></td>
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### Developing Methodology in Soft OR

#### Stream: Soft OR and Problem Structuring Methods

#### Invited session

Chair: Amanda Gregory, Business School, University of Hull, HU6 7RX, Hull, United Kingdom, a.j.gregory@hull.ac.uk

1 - Evaluating interventions using a lean systems methodology

Gavin Betts, Hull University Business School, University of Hull, Cottingham Road, HU6 7RX, Hull, East Yorkshire, United Kingdom, g.betts@hull.ac.uk

This research seeks to evaluate the Vanguard Methodology. This methodology has been developed by Vanguard Consulting over thirty years and has been labelled a lean systems methodology in the literature. It has been designed for the service sector and claims improved service at reduced costs. An evaluation framework developed to assess cases using this methodology will be presented.

2 - The use of the CAQDAS (Computer Aided Qualitative Data Analysis Software) to structuring problems in Operations Research

William Vianna, Information Science, Federal University at Santa Catarina - Brazil, Rua Cônego Bernardo, 100. ap. 202, Trindade, 88036570, Florianópolis, Santa Catarina, Brazil, wpwilliam@hotmail.com, Eduardo Hoji, Edinburgh Gifforn

The aim of this study is to propose the use of CAQDAS (Computer Aided Qualitative Data Analysis Software) to support the analysis of qualitative data in structuring problems in Operations Research. The application is given in terms of data integration between postgraduate evaluation system and the Basic Education system evaluation in Brazil. The qualitative data repository favors recursivity and structured return to data at any stage of development of the multicriteria model.

3 - Exploring the use of Collaboration Engineering approaches within the practice of Soft Systems Methodology

Aida Azadegan, Business School, Nottingham University Business School, Apt. 1/3, 1 Rice Street, M3 4JL, Manchester, United Kingdom, aida.azadegan@gmail.com, Giles Hindle

Soft OR contains a family of approaches that support groups in a range of tasks including tackling complex problems situations and making strategy. There has been increased interest in supporting the facilitation of Soft OR approaches in practice. This paper explores the use of Collaboration Engineering ideas within the practice of Soft Systems Methodology. In particular, we examine the use of ThinkLets to script the tools and steps of Soft Systems Methodology.

This talk presents a multi-objective optimization model for combining different transportation modes (such as Road, Rail and Sea) in the design and operation of an intermodal transportation network in a region. The problem is formulated as a mixed-integer optimization problem that accounts for time and congestion dependent vehicle speeds. We represent the modeling approach, data analysis and outline the important characteristics of the mathematical programming problem for minimization of the transportation cost and time simultaneously for the Marmara Region of Turkey.

2 - 3D Container Ship Loading Planning Problem with multiple scenarios

Luiz Salles Neto, Federal São Paulo State University, 12231-280, São José dos Campos, São Paulo, Brazil, luiz.leduno@unifesp.br, Antônio Chaves, Antônio Moretti, Antônio Chaves

The proposed paper presents a new 3D Container Ship Loading Planning Problem with multiple scenarios. This problem is modeled as a bi-objective framework that minimizes two criteria: the number of movements and also the instability measure computed as the distance between gravity and geometric center for every different scenario. To deal with this multiobjective and stochastic problem a new representation that allows a compact and efficient encoding which enables the solution of large-scale problems proper related with real-life scenarios.

3 - Graph Theoretic Properties and Algorithms with Application in Disaster Response

Reza Zanjirani Farahani, Kingston Business School, Kingston University London, Room 330, Kingston Hill, KT2 7QH, Kingston Upon Thames, London, United Kingdom, reza.zanjirani@yahoo.com, Hannaneh Rashidi Baygan

This paper presents a new 3D Container Ship Loading Planning Problem with multiple scenarios. This problem is modeled as a bi-objective framework that minimizes two criteria: the number of movements and also the instability measure computed as the distance between gravity and geometric center for every different scenario. To deal with this multiobjective and stochastic problem a new representation that allows a compact and efficient encoding which enables the solution of large-scale problems proper related with real-life scenarios.
This paper considers directing paths in transportation networks so that all points could be reached. These problems are hard to solve optimally while sometimes even sub-optimal solutions are acceptable provided we find them quickly; this application is evident in disasters. This paper presents two algorithms based on graph theoretic properties to solve such problems; the first utilizes concept of faces in planar graphs and the second uses perfect matching rules. Such quick algorithms do not look for optimal solutions but these methods can also help speed up current optimal algorithms.

**TB-34**
Tuesday, 10:30-12h00
CC-A39

Optimization for Sustainable Development 1

Stream: Optimization for Sustainable Development

*Invited session*

Chair: Herman Mawengkang, Mathematics, The University of Sumatera Utara, FMIPA USU, KAMPUS USU, 20155, Medan, Indonesia, mawengkang@usu.ac.id

1 - A Chance-constrained Optimization Model for a Water Distribution Network Problem
Asrin Lubis, Mathematics, Unimed/Graduate School of Mathematics, University of Sumatera Utara, FMIPA USU, 20155, Medan, Sumatra Utara, Indonesia, lubis.asrin@yahoo.com, Herman Mawengkang

The optimal design of a Water Distribution Network (WDN) consists of the choice of a diameter for each pipe, the pipe line network design, and the pipe length. In this paper we propose a nonlinear stochastic optimization model for tackling a WDN under the consideration of reliability in water flows. The nonlinearities arise through pressure drop equation. We transform the stochastic programming model into a deterministic multi-objective model using sampling average approach. Then we solve the result model using an interactive method.

2 - Land use management problems under uncertainty
Siti Rusdiana, Mathematics, University of Syiah Kuala, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, srusdiana10@yahoo.com

This paper is to find an optimal land portfolio composition through time under market uncertainty. We assume that an optimal land use management program will involve a gradual sequence of conversion decisions through time, evolving as each land allocation value becomes known more accurately. In this paper we formulate stochastic programming model, which takes into account the uncertainty related to the market value of revenues accruing from the land in different states.

3 - How to Determine Optimum Promotions through CLV Maximization?: A Case Study in a Turkish Bank
Fusun Ulengin, Industrial Engineering, Dogus University, Dogus Universitiesi, Muhendislik Fak. Endüstri Muh. Bol. Acibadem, Kadikoy, 34722, Istanbul, Turkey, fulengin@dogus.edu.tr, Yeliz Ekinci, Nimet Uray

The purpose of this study is to develop a methodology to guide managers in determining the optimal promotion campaigns for different market segments in order to maximize the Customers’ Lifetime Value. It aims to find an optimal promotion plan for a service company through stochastic dynamic programming. It also determines the ‘value’ states for the customers using classification and regression tree analysis. An experiment is designed to observe the impacts of different promotion campaigns on customers. It is applied in a private Turkish bank and the improvement of profit is tested.

4 - A stochastic optimization model for multi-product fish production planning problem under uncertainty in raw resources and demand
Intan Syahrini, Mathematics, University of Syiah Kuala, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, isyahrini89@yahoo.com, Herman Mawengkang

A multi-product fish production planning produces simultaneously multi fish products from several classes of raw resources. The quality of raw resources and market demand are uncertain during the planning period. This paper proposes a multi-stage stochastic integer programming to model the production planning problem. A direct search method is used to solve the model.

**TB-35**
Tuesday, 10:30-12h00
CC-A41

Electric Mobility

Stream: Energy, Environment and Climate 2

*Invited session*

Chair: Patrick Jochem, Chair of Energy Economics (IIP), Karlsruhe Institute of Technology (KIT), Hertzstr. 16, 76187, Karlsruhe, Germany, jochem@kit.edu

1 - A framework for modelling the electricity demand by plug-in electric vehicles
Rashid Waraich, Institute for Transport Planning and Systems, ETH Zürich, Wolfgang-Pauli-Str. 15, 8903, Zürich, Zürich, Switzerland, waraich@itv.baug.ethz.ch

Plug-in electric vehicles (PEVs) are envisioned by many as the cure to several current problems, especially environmental ones. What is often neglected in this context is that a large scale penetration of such vehicles may also pose new challenges, as charging these vehicles will result in changes of current electricity demand patterns. The presented work introduces a framework, which models electricity demand by PEVs by extending a transport simulation called MATSim. The framework allows the evaluation of new charging policies and helps pinpoint possible bottlenecks in the electric grid.

2 - Technical and Economical Aspects of Integrating Plug-in Electric Vehicles in Large Scale Power Systems
Miguel Carrión, Electrical Engineering, University of Castilla - La Mancha, Avda Carlos III, s/n, Campus Fábrica de Armas, 45071, Toledo, Spain, miguel.carrión@uclm.es, Luis Sanchez-rodriguez

Plug-in Electric Vehicles (PEVs) are becoming an actual option to replace traditional combustion-engine cars. In this situation, it is a priority to analyze the impact of an extensive usage of electric vehicles in actual power systems. In this work, we study the technical and economical aspects of the integration of PEVs in the Iberian Peninsula power system (MIBEL). Three different approaches modelling the coordination between the system operator and PEVs users are considered. Finally, a realistic case study is solved and sensitivity studies are performed.

3 - Integrating Electric Vehicles into the Germany Electricity Grid — an Interdisciplinary Analysis
Patrick Jochem, Chair of Energy Economics (IIP), Karlsruhe Institute of Technology (KIT), Hertzstr. 16, 76187, Karlsruhe, Germany, jochem@kit.edu, Thomas Kaschub, Alexandra-Gwyn Paetz, Wolf Fichtner

This study analyses the integration of electric vehicles (EV) into the German power grid including different demand respond (DR) approaches from a technical, economical and user perspective. For this an overview of the future German electricity market with the focus on EV integration is given. It is shown that the shortage in the regional and local electricity grid is increased. DR can help to tackle this issue by controlled unidirectional or bidirectional (V2G) charging of EV. From the current perspective especially the first alternative seems to be attractive in all considered disciplines.
1 - Analysing the Research and Teaching Quality Achievement Frontier
David Mayston, Economics and Related Studies, University of York, University of York, YO10 5DD, York, United Kingdom, dm3@york.ac.uk

The paper analyses the achievement possibility frontier between research and teaching quality in higher education. It finds several important reasons why the associated feasible set is likely to be non-convex, making use of the standard performance analysis technique of Data Envelopment Analysis less valid. The paper therefore investigates the alternative Free Disposal Hull technique, and compares the results of using these techniques to the performance evaluation of UK Departments of Economics. See: http://york.ac.uk/media/economics/documents/discussionpapers/2011/1125.pdf

2 - Benchmarking the implementation path to efficiency: The case of small regional airports
Ekaterina Yazhemsky, Business School, Hebrew University of Jerusalem, Mount Scopus, 91905, Jerusalem, Israel, katy1@mscc.huji.ac.il, Nicole Adler, Tolga Ülkü

Small and regional airports suffer from limited traffic, large fixed facilities and insufficient revenues to cover their costs. The question is how these airports should be structured, managed and financially supported in order to survive. Efficient operations contribute to decreasing the financial dependency of airports on subsidies. According to a DEA-based, bound adjusted measure, the efficiency levels of 89 European airports are determined. Due to heterogeneity across the sample, multiple ideal points are applied to identify implementation paths and to highlight managerial best practices.

3 - Performance assessment of wind farms
Clara Vaz, School of Technology and Management, Politecnico of Bragança, Campus da Santa Apolónia, Apartado 134, 5301 - 857, Bragança, Portugal, clvaz@ipb.pt

This study develops a methodology to provide insights regarding the performance of wind farms from a European player in energy sector. Firstly, the DEA is used to measure the performance of wind farms in generating electricity from the resources available and non-discretionary variables such as wind (speed and availability). This analysis enables to identify the benchmarks whose best practices can be emulated by inefficient units and provides useful information for regulators in the sector. Secondly, bootstrap procedures are applied to obtain statistical inference on the efficiency estimates.

4 - Hospitals efficiency in Israel: 1999-2009
Zilla Simuany-Stern, Industrial Engineering and Management, Ben Gurion University, Beer-Sheva, 84105, Beer-Sheva, Israel, zilla@bgu.ac.il, Dov Chemichovsky, Lea Friedman

Data Envelopment Analysis (DEA) is used to measure the efficiency of major general hospitals in Israel, during 1999-2009. The inputs are number of standard beds; the outputs are number of hospitalization days and number of discharges. In the second phase, we used regression analysis, to examine the effect of size, and type of ownership on hospitals efficiency. We found that independent hospitals are the most efficient and have decreasing returns to scale, followed by the governmental and public hospitals which have increasing returns to scale. Also Malmquist analysis was used over time.

1 - A Takt time based resource optimization technique to minimize patient wait time in hospitals
Jyoti R. Munavalli, Computer Science & Engineering, PESIT, India, Ph.D Research Scholar with Maastricht University, Netherlands, Ring Road, BSK III stage, 580083, bangalore, kannataka, India, jyothimunavalli@gmail.com, Frits van Merode, Srinivas A

We propose a technique to address the resource optimization, patient flow balancing and wait time minimization in a hospital set-up. We present a mathematical model for resource optimization which is based on Takt time concept (average time a patient spends in a hospital for treatment) for each department in all the time slots and considers the dependency constraints. The Linear programming solution provides the resource allocation pattern for each department during every time slot within the resource availability to balance the patient flow and achieve higher patient satisfaction levels.

2 - Optimizing the emergency distribution network in the case of epidemic outbreaks response
Tom Dasaklis, Department of Industrial Management, University of Piraeus, 80 Kariaol & Dimitriou str., 18534, Piraeus, Attica, Greece, dasaklis@unipi.gr, Nikolaos Rachseniotis, Costas Pappis

Effective control of an epidemic’s outbreak calls not only for a rapid response but also for the establishment and management of an emergency supply chain. During the control effort huge amounts of medical supplies should be distributed from central warehouses to local areas. In this paper an epidemic diffusion model based on differential equations is coupled with an emergency logistics distribution model. An integrated solution approach is proposed combining epidemics control rules and logistics network design. A numerical example is finally presented illustrating the methodology proposed.

3 - Modelling ambulance location and deployment in Wales
Leanne Smith, School of Mathematics, Cardiff University, Senghennydd Road, CF24 4AG, Cardiff, United Kingdom, SmithL13@cf.ac.uk, Paul Harper, Vincent Knight, Israel Vieira, Janet Williams

Response time targets for the Welsh Ambulance Service Trust (WAST) are not currently being met, particularly for high priority emergencies in rural areas. A discrete event simulation makes use of initial vehicle allocations given by a developed location model, in order to identify the affect demand, number of available vehicles and handover times have on regional response. The aim of these mathematical models is to help WAST make better decisions on locations, capacities and deployments, so that they may provide a more efficient and effective service and achieve the Government set targets.

4 - MetSim: a simulation support tool using meteorological information to improve the planning and management of hospital services
Paul Harper, School of Mathematics, Cardiff University, CF24 4AG, Cardiff, United Kingdom, harper@cardiff.ac.uk, R John Minty

Improved short-term predictions of hospital admissions and bed occupancy offer the potential to plan resource needs more accurately and effectively. The MetSim project explores the relationship between weather and health, building novel Bayesian models that are more sensitive to the weather. Short-term forecasts of the numbers of admissions categorised. In turn, MetSim uses hazard ratios embedded within
a simulation framework to provide forecasts of short-term bed needs. The web-based tool has been piloted in UK hospitals and is supported by the Met Office.

### TB-38

**Tuesday, 10:30-12h00**  
**HH-Co-lombus**

**Hybrid Evolutionary Multiobjective Optimization Algorithms**

Stream: Multiobjective Optimization  
**Invited session**

Chair: Karthik Sindhya, of Mathematical Information Technology, University of Jyväskylä, Finland, karthik.sindhya@jyu.fi

#### 1 - A Preference-based Evolutionary Algorithm for Multi-objective Optimization: The Weighting Achievement Scalarizing Function Genetic Algorithm

Ana Belen Ruiz, Applied Economics (Mathematics), University of Malaga, C/ Ejido, 6, 29071, Malaga, Spain, abruiz@uma.es, Rubén Saborido Infantes, Mariano Luque

We suggest a preference-based EMO algorithm which asks the DM for a reference point (RP) and which is based on the EMO algorithm NSGA-II and on achievement scalarizing functions (ASFs). In practice, an ASF finds the closest efficient solution to the RP, and this solution also depends on a weight vector used in the ASF. The proposed approach modifies the dominance criterion of NSGA-II in order to highlight solutions closer to the RP. The classification of the points into the nondominated fronts is done according to the values that each solution takes on an ASF, using different weight vectors.

#### 2 - Preference-based Evolutionary Algorithm for Multi-objective Bilevel Optimization

Pekka Malo, Information and Service Economy, Aalto University School of Economics, Runeberginkatu 22-24, 00100, Helsinki, Finland, pekka.malo@aalto.fi

We present an evolutionary framework for solving multiobjective bilevel problems, where the upper-level has multiple objectives and lower-level has a single objective. The implementation of the algorithm is based on a new technique for approximating the optimal lower-level solution mapping by a class of smooth and continuous single-valued functions. The algorithm is well-motivated by the recent results obtained for general parametric optimization problems and set-valued analysis. The performance of the algorithm is demonstrated with respect to a collection of scalable test-problems.

#### 3 - A Hybrid Evolutionary Multi-objective Optimization Algorithm for Enhanced Convergence and Diversity

Karthik Sindhya, of Mathematical Information Technology, University of Jyväskylä, Finland, karthik.sindhya@jyu.fi, Kaisa Miettinen, Kalyanmoy Deb

Evolutionary multi-objective optimization (EMO) algorithms are used to find approximate Pareto optimal solutions, though they have slow convergence speed. We present a modular hybrid EMO algorithm including a local search module (involving an achievement scalarizing function) to increase the convergence speed, a diversity enhancement module, etc. It can be connected with various EMO methods like MOEA/D. Numerical tests on test problems indicate the efficacy of our hybrid EMO algorithm, which can also be used to handle dynamic process simulation based multi-objective optimization problems.

### TB-39

**Tuesday, 10:30-12h00**  
**HH-Cousteau**

**MCDA: New Approaches and Applications**

#### 1 - Monotonicity and minimax biproportional apportionments

Paolo Serafini, Dept. of Mathematics and Computer Science, University of Udine, Via delle Scienze 206, 33100, Udine, Italy, paolo.serafini@uniud.it

We deal with biproportional apportionment problems (BAP). On one hand we may approach BAP via the axiomatic approach where some axioms are stated and the assigned seats must satisfy the axioms. Another approach requires the definition of quotas and the seats must minimize an error measure wrt the quotas. It is therefore important to understand to what extent error minimization methods satisfy the most common axioms. In this talk we investigate the axiom of monotonicity and show that minimization of the maximum absolute error with respect to regional quotas satisfies monotonicity.

#### 2 - Multi attribute regional market location problem based on the clustering approach

Mohsen Yahyayi, Shahed University, Iran, Islamic Republic Of, mohsen.yahyayi@gmail.com, Mahdi Bashiri

Regional market location is considered in this paper; a hybrid approach is presented including 3 phases of clustering, elimination and decision making. In the first phase cities are clustered with maximum homogeneity. Then low potential points are eliminated. Finally cities are ranked to be a regional market according to (1) Distance from the cluster median point optimized by SFLP to have less transportation cost, (2) City population, (3) Distance from major transportation corridors, (4) Tourism attractions. Our approach was applied in Iran regional market using 10-means clustering.

#### 3 - A Careful Look at Criterion Importance and Weights

Pekka Korhonen, Aalto University School of Economics, 00100, Helsinki, Finland, pekka.korhonen@aalto.fi, Jyrki Wallenius, Anssi Oorni

We investigate the connection between announced importance of criteria and weights. Our considerations are based on a simple experimental setting, where the subjects were asked to pairwise compare alternatives with two criteria. We used the subjects’ responses to choices to estimate the weights and compared them to ‘direct’ (given) weights. The comparison was based on prediction power of a linear function. Our results point out that there is a reason to question the common belief that the values of the weights have the same rank order as criteria importance.

#### 4 - Rank reversal in the PROMETHEE I and II rankings: a summary of recent investigations

Yves De Smet, SMG - CODE, Université Libre de Bruxelles, Boulevard du Triomphe CP 210-01, 1050, Bruxelles, Belgium, yves.desmet@ulb.ac.be, Céline Verly, Julien Roland

The multicriteria methods based on pairwise comparisons suffer from possible rank reversal occurrences when the set of alternatives is modified. We study this distinctive feature in the scope of the PROMETHEE I and II methods. First, empirical tests are conducted on the basis of artificial data sets in order to quantify the likelihood of rank reversal instances. Then conditions to avoid this phenomenon are provided. Finally, we investigate manipulation risks on a simplified version of PROMETHEE II.
1 - Active learning for preference learning
Nir Ailon, Computer Science, Technion Israel Institute of Technology, Taub Building, Technion City, 32000, Haifa, Israel, nailon@cs.technion.ac.il

Analyzing preferences lies in the intersection of many fields, most notably econometrics (discrete choice theory), combinatorial optimization and machine learning theory and practice. In a typical setting, the ultimate goal is to be able to predict the order of a given set of alternatives given a set of observed, noisy pairwise comparisons. In this work I will discuss the adversarial noise case, and present a new active learning algorithm: ERM (Empirical Risk Minimization) algorithm with an almost optimal preference query complexity and provable guarantees.

2 - Optimal recommendation sets
Paolo Viappiani, Computer Science Dept, Aalborg University, selma lagerfos vej 300, 9000, Aalborg, Denmark, paolo.viappiani@gmail.com

Utility elicitation is an important component of many applications, such as decision support systems. Such systems query users about their preferences and offer recommendations based on the system’s belief about the user’s utility function. We analyze the connection between the problem of generating optimal recommendation sets and the problem of generating optimal choice queries, considering both Bayesian and regret-based elicitation. Our results show that, somewhat surprisingly, under very general circumstances, the optimal recommendation set coincides with the optimal query.

3 - Large-scale training of linear ranking support vector machines
Antti Airola, University of Turku, Finland, ajaroi@utu.fi

We introduce a large-scale training algorithm for the linear ranking support vector machine, which is one of the most widely applied methods for inferring ranking models using machine learning. The method generalizes the most efficient previously known method, which is applicable to ordinal regression problems with a small constant number of classes, to tasks with an arbitrary number of different levels of utility. This is achieved by combining a cutting plane optimization technique with the use of self-balancing binary search trees. The method easily scales to millions of data points.

2 - Research on the comparison of electronic monetary value in the information society
Shunei Norikumo, General Management Department, Osaka University of Commerce, 4-1-10, Mikuniyakae-machi, 577-8505, Higashiosaka, Osaka, Japan, shunei.norikumo@gmail.com

This study considers the social influence that computerization of the money to advance rapidly gives to an existing value of money and compares the value of money using dominant AHP. In late years the money changed from a form printed on paper to electronic money and virtual money. Outwardly the money that the property was totally different from the conventional substantial money and currency in even the same money came to flow on information system.

3 - An Application of Energy Alternative Selection: A Fuzzy AHP-ELECTRE Methodology
Abbt Balin, Industrial Engineering, Yildiz Technical University, Department of Industrial Engineering, Besikteks, 34000, Istanbul, Turkey, abbtbalin@hotmail.com, Özge Nalan Alp Bilisik, Hayri Baraçlı

Energy planning problem is a very complex issue and has a lot of criteria that must be taken into account to solve this problem. The assessment criteria that will be used in this study are technical, economic, environmental and social. All of the criteria must be determined and evaluated carefully because these criteria are critical for governments, human beings and environment. In this study, to make a decision about energy planning problems we use Fuzzy AHP to determine the criteria weights and ELECTRE to determine the best energy resource.

4 - Dominant AHP as Measuring Method of Service Value
Eizo Kinoshita, Urban Science Department, Meijo University, 4-3-3 Nijigaoaka, 509-0261, Kani, Gifu, Japan, kinoshit@urban.meijo-u.ac.jp

The author believes is surpassed by AHP, a measuring method of value of goods in a service economy. This is because a utility function which represents value is expressed based on an absolute scale (best suited for a service economy). This is because a utility function which represents value is expressed based on an absolute scale (best suited for an industrialized society) in utility theory, whereas in AHP, it is expressed based on a relative scale (best suited for a service economy). However, the author mathematically identifies a fundamental flaw of Saaty’s AHP in this paper, and proves that Dominant AHP, proposed by Kinoshita and Nakaniishi, is superior to Saaty’s AHP as a measuring method of value of services.
1 - Research of the methods of stochastic approximation and genetic algorithms for the transport system microscopic simulation models calibration

Elena Yurshievich, Mathematical Methods and Modeling Department, Transport and Telecommunication Institute, Lomonosova str. 1, 1019, Riga, Latvia, elena_y@tsi.lv

It is considered the calibration procedure of traffic flow’s microscopic models as an optimization problem of the vector of the model numerical parameters. The problem is complicated by the absence of the analytical model, capable to describe the relationship between the vector of numerical parameters and objective function. It was considered the capability of the stochastic approximation and heuristic methods application for calibration. The investigation was implemented using the transport system simulation model constructed in VISSIM package and an aggregated data of traffic flow.

2 - Simulation Metamodelling using Bayesian Networks

Kai Virtanen, Mathematics and Systems Analysis, Aalto University, School of Science, Finland, kai.virtanen@aalto.fi

We introduce a novel approach towards simulation metamodelling using Bayesian networks (BNs). A BN represents the joint probability distribution of a set of random variables and enables the efficient calculation of their marginal and conditional distributions. A BN metamodel gives a non-parametric description for the joint probability distribution of simulation inputs and outputs as well as provides various what-if analyses by combining simulation data with expert knowledge. The construction and utilization of BN metamodels are illustrated with a simulation example involving a queuing model.

3 - On the Peter Principle: An Agent Based Investigation into the Consequential Effects of Social Networks and Behavioural Factors

Angelico Fetta, Maths, Cardiff University, United Kingdom, angelico_fetta@hotmail.com, Paul Harper, Vincent Knight, Israel Vieira, Janet Williams

The Peter Principle (PP) is a theory used to describe job incompetence in a hierarchical organisation. It argues that should staff be competent at a given level, their competence may not be implicit at a higher level. Through the use of Agent Based Simulation coupled with social networks and organisational thought, the PP is assessed under previously unexplored conditions. Results show that the PP may not be as detrimental to organisational efficiency as previously thought, while promotion on merit offered the best efficiency trade off in the absence of clear evidence of the PP paradigm.

4 - Hybrid lateral transshipments in multi-item inventory networks

Sandra Rauscher, Management Science, Lancaster University, United Kingdom, s.rauscher@lancaster.ac.uk, Kevin Glazebrook, Colin Paterson, Thomas Archibald

We present a new approach for addressing shortages in multi-location inventory systems facing multivariate, non-homogeneous Poisson demand. A hybrid lateral transshipment policy allows rebalancing of inventory levels along with reacting to stock-outs. We derive this by applying a dynamic programming policy improvement step to a no-transshipment policy. Shipment costs are modelled with a knapsack-like structure to accommodate different item types. We carry out an extensive simulation study showing the benefit of modelling multi-item transshipments against using single item models in parallel.

1 - Robustness in stochastic programs with the first order stochastic dominance and/or probabilistic constraints

Milos Kopa, Department of Probability and Mathematical Statistics, Charles University in Prague, Faculty of Mathematics and Physics, Sokolovská 83, CZ 186 75, Prague, Czech Republic, kopa@karlin.mff.cuni.cz, Jitka Dupacova

The paper presents robustness results for stochastic programs with the first order stochastic dominance and probabilistic constraints. Due to their frequently observed lack of convexity and/or smoothness, these programs are rather demanding both from the computational and robustness point of view. Under suitable conditions on the structure of the problem and for discrete distributions we suggest a new robust portfolio efficiency test with respect to the first order stochastic dominance. We exploit the contamination technique to analyze the resistance with respect to additional scenarios.

2 - Chance constrained problems: reformulation using penalty functions and sample approximation technique

Martin Branda, Department of probability and mathematical statistics, Charles University in Prague, Ke Karlovu 3, 12116, Prague 2, Czech Republic, martin.branda@seznam.cz

We compare basic formulations of stochastic programming problems with chance constraints, generalized integrated chance constraints and penalties in the objective function. It is shown that the problems are asymptotically equivalent. We discuss solving the problems using sample approximation technique. Rates of convergence and estimates on the sample size are derived for problems with mixed-integer bounded sets and/or several constraints. We present applications to an investment problem with real features and to a vehicle routing problem with time windows, random travel times and demand.

3 - Robust Pricing of Monopolistic Cloud Computing Services with Service Level Agreements

Vladimir Roitch, Department of Computing, Imperial College London, 180 Queen’s Gate, SW7 2AZ, London, United Kingdom, vr06@doc.ic.ac.uk, Daniel Kuhn, Yike Guo

We address the optimal pricing of cloud computing services from the perspective of a monopolistic service provider that needs to manage demand responsiveness and uncertainty. We formulate the pricing problem for on-demand based services as a multi-stage stochastic program and model service level agreements via chance constraints. Under weak assumptions about the demand uncertainty we show that the resulting model can be reduced to an equivalent two-stage stochastic program. We state various new results. Finally, we investigate the possibility of selling unused capacity on a spot market.

4 - Tractable Dynamic Model of Price and Volume Given Uninformed Market Maker

Martin Smid, Econometrics, UTIA, Czech Academy of Sciences, Pod Vodarenskou vezi 4, CZ 182 08, Praha 8, Czech Republic, smid@utia.cas.cz

We construct a simple yet realistic model of a market with a market maker, maximizing the expected consumption while keeping the probability of bankruptcy small. The market maker estimates the fair price by means of a proxy. The order sizes are random. We show our model to conform several stylized facts. Further, we describe a dynamics of the price and the traded volume and we show that the price volatility can be decomposed into the part caused by the movements of the fair price, the part due to the order arrivals and the part due to the uncertainty.

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**TB-43**

Tuesday, 10:30-12h00

**BW-Granite**

**Recent Applications of Probabilistic Programming**

**Stream: Stochastic Programming**

**Invited session**

Chair: Milos Kopa, Department of Probability and Mathematical Statistics, Charles University in Prague, Faculty of Mathematics and Physics, Sokolovská 83, CZ 186 75, Prague, Czech Republic, kopa@karlin.mff.cuni.cz

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**TB-44**

Tuesday, 10:30-12h00

**BW-Marble**

**Computer Vision (2) and Machine Learning**

**Stream: Machine Learning and its Applications**

**Invited session**

Chair: Teotito deCampos, Center for Vision Speech and Signal Processing, University of Surrey, GU2 7XH, Surrey, United Kingdom, t.decampos@surrey.ac.uk
1 - Efficient Large Scale Scene Understanding
Ramin Zabih, Computer Science Department, 4130 Upson Hall, 14853, Ithaca, New York, United States, rdz@cs.cornell.edu, Philip Torr

Image understanding can be thought of a discrete labelling problem in which the goal is to decide a per pixel label. Labels might be such things as depth or object labels. This problem is very large scale discrete optimization, with millions of labels needing to be determined in the course of a video. In this talk I will discuss some tricks for making this process efficient.

2 - Skeleton Base and Scalable Boundary-Skeletal Shape Model
Ivan Reyer, Dorodnicyn Computing Centre of RAS, ul. Pererova d. 58, kv. 153, 109451, Moscow, Russian Federation, reyer@forecsys.ru, Ksenia Zhukova

A scalable shape model of an image is presented. It uses a polygonal figure approximating a raster object and its skeleton base. The skeleton base is a subset of the figure's skeleton. It defines a closed planar domain (skeleton core) describing possible position of a skeleton's essential part for any region with Hausdorff deviation from the figure not exceeding the given value. The skeleton base changes steadily and continuously as the admissible deviation increases. The family of skeleton bases defines a scalable boundary-skeletal model reflecting shape features at various levels of detail.

3 - Structured Output Learning for Automatic Analysis of Court Games
Fei Yan, Center for Vision Speech and Signal Processing, University of Surrey, GU2 7XH, Surrey, United Kingdom, f.yan@surrey.ac.uk, Josef Kittler

We investigate the application of structured output learning (SOL) in automatic analysis of court games. We formulate the problem as one of learning a mapping from observations to structured labels, where the labels are event sequences, and employ max-margin Markov networks to achieve a max-margin solution in the joint feature space. We compare closely the more popular generative approach based on a hidden Markov model (HMM) with our discriminative approach, and demonstrate that our approach leads to an improved performance in real world tennis video analysis.

We study periodic review inventory systems with lost sales and capacitated replenishments. This capacity restriction implies that the inventory position may not reach the order-up-to level when placing an order, such that additional safety stock is needed to reach the same service level. To determine the required level of safety stock, a generic iterative procedure based on Markov chain analysis is proposed. Computational experiments illustrate the impact of a limited replenishment capacity on the required safety stock level, and the effectiveness of the proposed iterative calculation method.

4 - Quantification of value of flexibility in a hybrid MTO and MTS system
Beyazit Ocakta, Industrial Engineering, Sakarya University, Balikesir University, Engineering Faculty, Industrial Engineering Department M 5211, 10100, Balikesir, Turkey, bocaktan@gmail.com, Ufuk Kula

We consider a production system which produces products for make-to-order and for make-to-stock. Our objective is to quantify the value of flexible in this system. To achieve this, a production environment consisting of 2 parallel machines is considered. Machine 1 produces product 1 only. The other machine produces product 1 and product 2. Product 2 is produced to order. We formulate this problem as an MDP and use approx. D.P. to determine approximately optimal control policy of such system and quantify the value of flexibility, and provide insight on when such flexibility is most beneficial.
Tuesday, 12:30-14:00

TC-01

Tuesday, 12:30-14:00
RB-Alfa

Keynote Lecture: Professor Bjorn Jorgensen

Stream: Keynote, Tutorial and Plenary Lectures

Keynote session

Chair: Peter Letmathe, Faculty of Business and Economics, RWTH Aachen University, Chair of Management Accounting, Templergraben 64, 52062, Aachen, Germany, Peter.Letmathe@rwth-aachen.de

1 - Accounting

Bjorn Jorgensen, Accounting and Business Law, University of Colorado at Boulder, UCB 419, 995 Regent Drive, 80309, Boulder, CO, United States, bjorn.jorgensen@colorado.edu

This presentation uses optimization and stochastic processes to provide a formal introduction to disclosure, financial accounting, and valuation. Financial accounting produces balance sheets, income statements, and cash flow statements relying on two basic principles: Double entry bookkeeping and the accrual basis of accounting. Disclosure of financial accounting statements is today mandatory for publicly traded firms. A single-period benchmark setting is initially used to establish what disclosures would maximize firm value in the absence of mandatory disclosure. Second, in a multi-period setting, the so-called clean surplus relation ties together consecutive balance sheets through comprehensive income from the income statement. Third, under the accrual basis of accounting, income decomposes into cash flows and accruals. Since accruals arise from the non-cash component of income such as depreciation, accruals must reverse over time in the sense that they add up to zero over the complete life cycle of the firm. I propose to model accruals as a moving average time-series process with a unit root. This modeling approach has implications for how market values relate to earnings, cash flows, and balance sheet book values.

TC-02

Tuesday, 12:30-14:00
RB-Beta

Scheduling in Robotics and Manufacturing

Stream: Scheduling

Invited session

Chair: Seda Hezer, Industrial Engineering, Selcuk University, Department of Industrial Engineering, 420031, Konya, Turkey, sedahezer@gmail.com

1 - The Job Shop with Blocking and a Rail-Bound Transfer System

Reinhard Bürgy, Dept of Informatics, University of Fribourg, Bd de Pélroles 90, 1700, Fribourg, Switzerland, reinhard.buergy@unifr.ch, Heinz Gröflin

Considered is the following Job Shop with no buffers. Jobs are processed on machines and transferred from one machine to the next by robots (or cranes) moving on a single rail. The robots do not pass each other, but can ‘move out of the way’. The objective is to find the starting times for all operations, the assigned robots for all transfer operations and the trajectory of each robot, in order to minimize makespan. We give a disjunctive graph formulation and use the job insertion (sub-) problem as a mechanism for local search. Computational results support the value of the approach.

TC-03

Tuesday, 12:30-14:00
RB-L1

Sustainable Network Design and Railway/Sea Transport

Stream: Sustainable Transport Planning

Invited session

Chair: Joachim R. Daduna, Hochschule für Wirtschaft und Recht Berlin Berlin, Badensche Str. 52, 10825, Berlin, Germany, daduna@hwr-berlin.de

1 - Road-Rail-Sea hub location-allocation with sustainability considerations

Ali Fattahi, Industrial Engineering, Koc University, Rumelifeneri, Sariyer, 34450, Istanbul, Istanbul, Turkey, afattahi@ku.edu.tr, Metin Turak

Integration of different transportation modes in geographical regions offers a number of advantages with respect to cost, environmental impact and some social considerations. Important decisions in this integration include hub location and flow allocation. Although this problem is very important, it has not been examined with sustainability considerations previously. In this paper, the design of intermodal transportation is expressed as a MILP problem including sustainability considerations. The accuracy and efficiency of the model is tested on a number of instances derived from real data.

2 - A special case of the minimization of tool switches problem

Horacio Yanasse, LAC, INPE, Av. dos Astronautas 1758, CP 515 - INPE/CTE, 12227-010, São José dos Campos, SP, Brazil, horacio@lac.inpe.br

Consider the case where the MOSP graph corresponding to a minimization of tool switches problem (MTSP) has some cutting vertex. If we remove this vertex and all edges incident to it, an optimal solution for the original problem can be built from optimal solutions of the connected components of the resulting graph. We can use this result to develop polynomial algorithms for special cases of the MTSP when the corresponding MOSP graph has particular topologies.

3 - Two sided disassembly line balancing problem

Seda Hezer, Industrial Engineering, Selcuk University, Department of Industrial Engineering, 420031, Konya, Turkey, sedahezer@gmail.com, Yakup Kara

The disassembly line balancing problem (DLBP) can be stated as an assignment of disassembly tasks to workstations such that all the precedence relations are satisfied and some measure of effectiveness is optimized. In this study a mathematical model is proposed for two sided disassembly line balancing problem (TSDLBP) in which product flows along a production line with workstations on both sides of the line. To the best of our knowledge, the TSDLBP has not been applied to the DLBP and so this is the first study about TSDLBP. The model’s performance is evaluated using test problems.

4 - Scheduling activities in a research centre to minimize the total energy consumption

Maciej Lichtenstein, Institute of Computer Engineering, Control and Robotics, Wrocław University of Technology, Janiszewskiego 11/17, 50-372, Wrocław, Poland, maciej.lichtenstein@pwr.wroc.pl, Adam Janiak, Tomasz Krysiak, Mateusz Gorczyca

We study the problem of scheduling activities in a research centre with the objective of the total electrical power consumption minimization. The considered research center is powered by some number of ‘green energy’ power plants and the activities conducted in that center deals with the research on those power plants. There are given a time characteristics of the power plants efficiency, and the energy demands of all activities. We present the precise model of the considered research center in terms of scheduling activities, which minimizes the total energy consumption over time.

EURO 25 - Vilnius 2012
2 - Green supplier network design based on customer segmentation

Leyla Ozgur, Industry Engineering, Pamukkale University, Pamukkale Üniversitesi Kampüsu Rektörlük Binasi Bilgi İşlem Daire Başkanluğu, 20070, Denizli, Turkey, Turkey, lozgur@pau.edu.tr, Semih Coskun, Askiner Gungor, Olcay Polat

Customer awareness on environmental issues has increased significantly for the last couple of decades. Despite good intentions, there is a huge variation of demand for green products among customers in the market. For this reason, there is a segmentation requirement for customers' green purchasing trends. Green companies therefore need to redesign their green supplier networks (GSN) according to customer segments. In this study, a mathematical model is proposed to design a GSN based on customer segmentation by including the important criteria of production and marketing in green supply chain.

3 - Designing efficient transportation processes for sustainable city logistics

Joachim R. Daduna, Hochschule für Wirtschaft und Recht Berlin Berlin, Badensche Str. 52, 10825, Berlin, Germany, daduna@hwr-berlin.de

Discussions about City Logistics are mostly concerned with freight transport in urban areas. However, passenger traffic is not taken into account, even though it is essential that customers are able to reach retail locations to make purchases. The objective is therefore to present a concept of a Passenger Traffic and Logistics Service Center that stresses the accessibility of inner-city shopping areas by customers. Here the underlying structures include the reduction of traffic in urban areas by reducing motorized individual traffic as well as delivery processes in the commercial sector.

■ TC-04
Tuesday, 12:30-14:00
RB-L2

Optimization problems on graphs and networks

Stream: Combinatorial Optimization

Invited session
Chair: Ivana LJubic, Department of Statistics and Operations Research, University of Vienna, Brunnenerstr. 72, 1210, Vienna, Austria, ivana.ljubic@univie.ac.at

1 - Minimum Spanning Trees with Generalized Degree Constraints
Pedro Moura, DEIO, Faculty of Sciences University of Lisbon, Ciadle Universitária, Campo Grande, 1749-016, Lisbon, Lisbon, Portugal, pmoura@fc.ul.pt, Luis Gouveia, Amaro de Sousa

We describe a MST problem which arises in the design of wireless networks. In a wireless link, the signal strength on the receiver side decreases with the distance to the transmitter side. To guarantee that the interference on the receiver side is under a given threshold, we impose a maximum amount of interference caused by the frequency channels used by the other links on both ends of the link. Different types of links may be installed between two nodes depending on the distance between them and their degrees. We introduce three models and compare the corresponding LP relaxations.

2 - Layered Graph Approaches for the Hop Constrained Steiner Tree Problem with multiple Root Nodes
Markus Leitner, Institute of Computer Graphics and Algorithms, Vienna University of Technology, Favoritenstraße 9-11, 1040, Vienna, Austria, leitner@ads.tuwien.ac.at, Luis Gouveia, Ivana LJubic

We consider the following generalization of the hop constrained Steiner tree problem: Given an edge-weighted undirected graph whose nodes are partitioned into root nodes, terminals and Steiner nodes, find a minimum-weight subtree that spans all the roots and terminals so that the number of hops between each terminal and an arbitrary root does not exceed a given hop limit H. In this work, we show how to model the problem over layered graphs and introduce a branch-and-cut approach for solving this model. Furthermore, comparisons to previously proposed flow- and path-based models are given.

3 - On a time-dependent formulation for the travelling salesman problem

Luis Gouveia, DEIO, University of Lisbon, Campo Grande, Bloco C6, 1749-016, Lisbon, Portugal, legouveia@fc.ul.pt, Maria Teresa Godinho, Pierre Pesneau

We present an updated classification of formulations for the asymmetric travelling salesman problem (ATSP) where we contextualize a new time-dependent formulation presented in Godinho et al (2010). The new formulation is an improved version of the Picard and Queyranne (PQ) formulation. The PQ formulation uses, as a subproblem, an exact description of the n-circuit problem. The new formulation uses more variables and is based on using, for each node, a stronger subproblem, namely a n-circuit subproblem with the additional constraint that the corresponding node is not repeated in the circuit.

■ TC-05
Tuesday, 12:30-14:00
RB-L3

Problems on graphs II

Stream: Discrete Optimization, Geometry & Graphs (contributed)

Contributed session
Chair: Victor Lepin, Institute of Mathematics, National Academy of Sciences of Belarus, 11 Surganova str, 220072, Minsk, Belarus, lepin@im.bas-net.by

1 - Extremal graphs for the randic index when minimum, maximum degree and order of graphs are odd
Ljiljana Pavlovic, Department of Mathematics, Faculty of Natural Sciences and Mathematics, Radioja Domanovica 12, 34000, Kragujevac, Serbia, pavlovic@kg.ac.rs, Tomica Divinic

Let G(k,m,a) be the set of connected simple n vertex graphs with minimum vertex degree k and maximum vertex degree m. The Randic index of G is the sum of d(u)d(v) raised to the power of -1/2, where d(u) is the degree of vertex u and the summation extends over all edges uv of G. We find for k greater or equal to n/2, and k, m, n are odd, extremal graphs for which this index attains its minimum value. We show that the extremal graphs have only vertices of degree k, m and m-1, the number of vertices of degree m-1 is one and the number of vertices of degree k is at least to n/2 as possible.

2 - Disjoint Path Problem in Mixed Acyclic Graphs
Cong Zhang, Graduate School of Informatics, Kyoto University, sakyoku, higashitkeyamachi, 606-8393, kyoto, Kyoto, Japan, tuyou@amp.i.kyoto-u.ac.jp, Hiroshi Nagamochi
The disjoint path problem asks to find a set of vertex-disjoint paths between \( k \) pairs of source and sink vertices. It is known that the problem is NP-hard in a general undirected/directed graph, and the problem with a fixed \( k \) admits a polynomial time algorithm for an undirected graph or a DAG (directed acyclic graph). In this talk, we show a common generalization of these two results: i.e., the problem with a fixed \( k \) can be solved in polynomial time when a mixed graph becomes a DAG by contracting each component consisting of undirected edges into a single vertex.

3 - Full cycle extendability of \( K(1,4) \)-restricted locally connected graphs

Pavel Izrjavski, Department of Discrete Mathematics and Informatics, Faculty of Applied Mathematics and Computer Science, Belarusian State University, Nezalezhnosti ave., 4, 220030, Minsk, belarus, izrjavski@usu.by, Yury Orlovich

A graph \( G \) is \( K(1,4) \)-restricted if, for any subgraph \( H \) of \( G \) which is isomorphic to the complete bipartite graph \( K(1,4) \), the number of edges of the subgraph induced in \( G \) by all the vertices of \( H \) is at least \( p+(p-2) \).

We prove that a connected locally connected \( K(1,4) \)-restricted graph on at least three vertices is either fully cycle extendable or isomorphic to one of five exceptional (non-Hamiltonian) graphs. This result generalizes several previous results on the existence of Hamilton cycles in graphs.

4 - Biclique partition for graphs with special blocks

Vctor Lepin, Institute of Mathematics, National Academy of Sciences of Belarus, 11 Surganova str, 220072, Minsk, Belarus, lepin@im.bas-net.by, Oleg Duginov

The biclique partition problem is to find a minimum number of edge-disjoint bicliques (complete bipartite subgraphs) that cover all edges of a given graph. We present a linear-time algorithm for the biclique partition problem in graphs whose blocks are complete graphs, cycles, complete bipartite graphs, special bipartite graphs or wheels.

TC-06

Tuesday, 12:30-14:00

RB-Gamma

Rich vehicle routing problems

Stream: Metaheuristics

Invited session

Chair: Jose Brandao, Management, University of Minho, Largo do Paço, 4704 -553, Braga, Portugal, sbrandao@eeg.uminho.pt

1 - The Pickup and Delivery Problem with Cross-Docking Opportunities

Hanne Petersen, Department of Transport, Technical University of Denmark, Denmark, hlp@transport.dtu.dk,

Stefan Ropke

We present a pickup and delivery problem, where a number of requests with time windows must be served. Each request consists of a pickup and/or a delivery, and the aim is to construct a set of feasible vehicle routes at the lowest possible cost. Several cross-docks are available to help carry out the transportation operations, allowing for transfer of goods between vehicles and intermediate storage, and thus one request can be served by one or multiple vehicles. The problem is solved using a Parallel Adaptive Large Neighbourhood Search, on real-life and generated data.

2 - Metaheuristics for the vehicle routing problem with backhauls and soft time windows

Jose Brandao, Management, University of Minho, Largo do Paço, 4704 -553, Braga, Portugal, sbrandao@eeg.uminho.pt

The vehicle routing problem with backhauls and soft time windows (VRPBSTW) contains two distinct sets of customers: those that receive goods from the depot and those that send goods to the depot. To each customer is associated an interval of time (time window), during which each one should be served. This time window is called soft because it can be violated, but this represents an additional cost. We solve the VRPBSTW using iterated local search and iterated tabu search. The performance of these metaheuristics is tested using a large set of benchmark problems from the literature.

TC-07

Tuesday, 12:30-14:00

RB-Eta

Warehouse Operations Optimization

Stream: Vehicle Routing and Logistics Optimization

Invited session

Chair: Hasan Akyer, Industrial Engineering, Pamukkale University, Pamukkale University Engineering Faculty, Industrial Engineering Department, 20070, Denizli, Turkey, hakyer@pau.edu.tr

1 - Development of a systematic method to evaluate packaging areas

Judith Weiblen, Institute for Material Handling and Logistics, KIT, 76131, Karlsruhe, Germany, weiblen@kit.edu, Dominik Berbig, Kai Furmans

Consolidation & packaging areas cause 26% of total costs in a distribution center. Due to a big rate of manual jobs, it is the most important process after storage & picking. But there is hardly any literature concerning packaging areas. Thus we present both a systematic method to structure and evaluate packaging areas including a KPI-System and best-practices to design such areas. Above all, a market study of technical realization is shown. These results help to make tendering simpler, tenders can be compared better and monitoring and evaluation of packing areas gets possible.
2 - Optimal number of vehicles and paths of movement in GridFlow systems with AGVs
Melanie Schwab, Material Handling and Logistics, KIT, Karlsruhe, Germany, melanie.schwab@kit.edu

The new concept GridFlow is an automatic material flow system to buffer, sort and store pallets. The pallets are arranged in a grid with at least one empty location and each can be moved in four directions, if no other pallet is blocking it. Pallets are moved by AGVs which drive underneath the pallets. Sequential movement of pallets allows to retrieve pallets that cannot be accessed directly. As an investment for vehicles is the main cost factor in the system, the optimal number of vehicles and path of movement is derived from a mixed integer optimization model which shall be presented.

3 - Optimization of the order-picking processes in the warehouse
Michal Jakubiak, Logistics, Wrocław University of Economics, Komandorska 118/120, 50-345, Wrocław, Poland, michal.jakubiak@ue.wroc.pl

The order picking problems in a warehouse are an important aspect in improving the productivity of modern logistic hubs. According to various estimates, the costs associated with order picking in the warehouse are from 55 - 65% of the total material handling costs. The author, using simulation tools, examines what factors influence the selection of moving methods during the process of order picking in the warehouse.

4 - A novel heuristic approach for the joint order batching and picker routing problems in warehouses
Hasan Akyer, Industrial Engineering, Pamukkale University, Pamukkale University Engineering Faculty, Industrial Engineering Department, 20070, Denizli, Turkey, hakayer@pau.edu.tr, Osman Kutluh, Mustafa Egemen Taner

A novel heuristic approach is proposed to solve order batching and picker routing problems jointly for multiple cross aisles warehouse systems. The clustering algorithm integrated with GA is developed to provide fast and effective solutions for the order batching problem. We adjust the routing problem of pickers as a TSP and propose efficient TSP heuristics. Numerical experiments are carried out to evaluate the performances of the proposed methods. GANN comes out to be the most attractive method in terms of solution quality and computational efficiency.

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TC-08
Tuesday, 12:30-14:00
RB-Epsilon
Applications

Stream: Supply Chain Planning
Invited session
Chair: Mikael Rönnqvist, Département de génie mécanique, Université Laval, G1V 0A6, Québec, Canada, mikael.ronqvist@nhh.no

1 - Mathematical programming models for master planning in ceramic tile supply chains. Evaluation and comparison of distributed and centralised scenarios.
David Pérez Perales, Organización de Empresas, (CIGIP), Universitat Politècnica de València, Camino de Vera, 46022, Valencia, Spain, dapepe@ump.upv.es, Mareva Alemany

This paper deals with the replenishment, production, and distribution problem in a ceramic tile supply chain. A distributed decision-making approach made up of two decision centers is initially considered in a multi-echelon, multi-facility and multi-level context. For each one, a deterministic MIP model for the multi-period master planning aiming to maximize their own local profits is proposed. Then, an ideal centralized approach is also evaluated as a benchmark. An example based on modifications of real-world industrial problems is presented to evaluate and compare both scenarios.

2 - A Mixed Integer Programming Model for Shelf Life Integrated Planning, Scheduling and Distribution in Yogurt Production
Çağrı Sel, Department of Industrial Engineering, Dokuz Eylul University, Dokuz Eylul University, Department of Industrial Engineering, Buca, 35160, Izmir, Turkey, 35160, Izmir, Turkey, cagri.sel@deu.edu.tr, Bilge Bilgen

In this study, we deal with a supply chain problem on yoghurt production to make production and distribution decisions in an integrated way and focus not only on the packaging stage, but also the fermentation/incubation stage. We introduce a new multi-echelon, multi-period and multi-objective mixed integer linear programming model. Sequence-dependent times and costs, perishability constraints, shelf life, labor and working time restrictions are explicitly taken into account. As a result of the study, optimal solutions are obtained within a reasonable computational time.

3 - A production-inventory problem in pharmaceutical supply chain — mixed integer approach
Paweł Hanczar, Department of Logistics, University of Economics, ul. Komandorska 118/122, 54-608, Wrocław, Poland, pawel.hanczar@ue.wroc.pl

The paper considers the production inventory problem in pharmaceutical supply chains. First the structure of the supply chain being analyzed is presented and the production process is briefly described. Three optimization models were taken into account in the main part of the research. The first two models were used to ensure (only if possible) the feasibility of production and to minimize setup times for one period. The third model takes into account all periods on the planning horizon. The paper finishes with the presentation of results from a real life application of the presented models.

4 - Use of Lagrangian decomposition in coordination of refinery production and sales planning
Jiehong Kong, Department of Finance and Management Science, NHN Norwegian School of Economics, Helleveien 30, 5045, Bergen, Norway, jiehong.kong@nhh.no, Mikael Rönnqvist

The integrated planning model in refinery production is a highly nonlinear problem. The standard decoupled approach is to divide the problem into two subproblems representing refinery production and sales planning. Information such as approximate component and product prices are used to coordinate the solutions. To converge to a solution, restrictions on the volumes are also needed. In this paper we propose a decomposition scheme based on LaGrange decomposition. It generates solutions that are more stable than the existing approaches without requiring additional volume constraints.

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TC-09
Tuesday, 12:30-14:00
RB-Zeta
Colours, Independence and Assignment

Stream: Graphs and Networks
Invited session
Chair: Reinhardt Euler, Informatique, Université de Brest, 20 av. Le Gorgeu, B P 817, 29285, Brest, France, reinhardt.euler@univ-brest.fr

1 - Lessons for finding Mutually Orthogonal Latin Squares (MOLS) for n=10 from new and old proofs for infeasibility of n=6
Gautam Appa, Operational Research, London School of Economics, Houghton Street, WC2A 2AE, London, United Kingdom, g.appa@lse.ac.uk, Reinhardt Euler, Anastasia Kouvela, Dimitris Magos, Yiannis Mourtos
A Latin Square of size $n$ is an $n \times n$ matrix with numbers 1 to $n$ appearing once in each row & column. Two Latin Squares are mutually orthogonal if each of the $n$ square pairs of numbers $(s,t)$ where $s,t$ range in 1,...,$n$, occur exactly once in the $n$ square cells. It is known that there does not exist an orthogonal pair for $n=6$. We review the proofs of this by Tarry (1901), Fisher & Yates (1934), Yamamoto (1954), Stinson (1984), Dougherty (1994), Appa & Magos & Mourtos (2004) and extend the work of Mann (1944). The purpose is to see what can be useful in deciding whether there exist 3 MOLS of size $n=10$.

2 - On the recognition of 2-row orthogonal Latin rectangle circuits
Anastasia Kouvela, Management Science Group, London School of Economics and Political Science, 29 Abercorn Pl, Flat 171, NW89DU, London, United Kingdom, a.kouvela@lse.ac.uk, Gautam Appa, Reinhardt Euler, Dimitris Magos, Yiannis Mourtos

This study focuses on the completablety of incomplete pairs of orthogonal Latin squares to identify all reasons that forbid it. We present this problem as a 3-index assignment problem and as a first step give the complete clutter of 2-row orthogonal Latin rectangle circuits. These are minimal structures that forbid completablety. To identify them in any incomplete pair of orthogonal Latin squares we present a polynomial time recognition algorithm.

3 - Polyhedral aspects of cardinality constraints
Yiannis Mourtos, Management Science & Technology, Athens University of Economics & Business, Greece, mourtos@aueb.gr

A cardinality constraint states that every value of a discrete set must be received by a minimum and a maximum number of variables involved in that constraint. Adopting an IP perspective, we study the polytope defined as the convex hull of vectors satisfying multiple cardinality constraints. We provide families of facets and efficient separation algorithms and establish a convex hull relaxation for the case of 2 constraints. We discuss the relationship of multiple cardinality constraints to some generalizations of graph colouring.

4 - Approximating the multi-level bottleneck assignment problem
Frits Spieksma, Operations Research and Business Statistics, Katholieke Universiteit Leuven, Naamsestraat 69, B-3000, Leuven, Belgium, frits.spieksma@econ.kuleuven.be, Trivikram Dokka, Anastasia Kouvela

We consider the multi-level bottleneck assignment problem (MBA). This problem is described in the recent book "Assignment Problems" by Burkard et al. (2009) on pages 188 - 189. One of the applications described there concerns bus driver scheduling. We view the problem as a special case of a bottleneck m-dimensional assignment problem. We give approximation algorithms and inapproximability results, depending upon the completeness of the underlying graph.

TC-10
Tuesday, 12:30-14:00
RB-Iota

Pricing and Applications

Stream: Production Management & Supply Chain Management (contributed)

**Contributed session**

Chair: M. Güray Güler, Industrial Engineering, Bogazici University, Turkey, guler@boun.edu.tr

1 - A pricing problem in a two-ends model under uncertainty
Alberto A. Álvarez-López, Quantitative Applied Economics II, UNED (Spanish National University of Distance Education), Paseo Senda del Rey, 11, 28040, Madrid, Spain, aalvarez@cee.uned.es, Inmaculada Rodríguez-Puerta

An intermediary firm has to buy some quantity of an output directly from the producer. But the producer has two possible ends to allocate its production between them, one end being certain and the other one being uncertain. The problem of the intermediary firm is a pricing problem: that of determining the price in the certain end in order to get exactly the desired amount of output from the producer. In this paper, we model a situation of this kind, and study some aspects of the behavior both of the producer and of the intermediary firm.

2 - Integrated Pricing and Scheduling for Order Outsourcing in a Supply Network
Woldemar Wedel, Business Information Systems and Operations Research, University of Kaiserslautern, 85050, Zürich, Switzerland, woldemar@w-edel.de, Yike Hu, Oliver Wendt

Our work analyzes various pricing strategies and multiattribute dynamic pricing mechanisms for the outsourcing of manufacturing and logistics service orders in a supply network. Via multi-agent system simulation we investigate how prices should depend on resource availability, the negotiable contract execution time, the cost structure and willingness to pay of the network participants and their market structure. We compare the performance of cost-, competition-, and market/demand-oriented pricing strategies for determining an adequate lower price bound as a basis for interactive pricing.

3 - On Coordination under Random Yield and Random Demand
M. Güray Güler, Industrial Engineering, Bogazici University, Turkey, guler@boun.edu.tr, Taner Bilgic

The aim of this study is to analyze coordination in a supply chain with random yield and random demand. We study five well known contracts from the literature and show that all but the wholesale price contract are able to coordinate the chain under voluntary compliance. We also provide a sensitivity analysis on the optimal policy parameters.

4 - Layout Planning and Shelf Space Allocation in Retail Store: A Case Study for Chain Markets in Turkey
Yelda Cansu Adali, Industrial Engineering, Istanbul Kultur University, Istanbul Kultur University, Ataköy Campus, Istanbul, Turkey, yeldacansuadali@gmail.com, Rifat Gürçan Özdemir, Kayhan Karaman

The study addresses layout planning and shelf space allocation problems simultaneously in a retail store. In the layout planning, placement of category areas is determined on the store floor such that areas do not overlap. In the shelf space allocation problem, space area and location of each unit on the shelf need to be determined. A two stage mathematical model will be developed for solving the above mentioned problem for maximizing total sales revenue in the period. The developed model will be implemented in a real life retailer’s store layout and shelf space allocation problem.

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TC-11
Tuesday, 12:30-14:00
RB-Iota

Exact Methods for Arc Routing Problems

Stream: Arc Routing

**Invited session**

Chair: Claudia Bode, Chair of Logistics Management, Gutenberg School of Management and Economics, Johannes Gutenberg University Mainz, 55099, Mainz, Germany, claudia.bode@uni-mainz.de

1 - Mixed Capacitated General Routing Problem: Exact and Heuristic Methods
Francesca Vocaturo, Dipartimento di Economia e Statistica, Università della Calabria, Via Pietro Bucci - Cubo OC, 87036, Arcavacata di Rende (CS), Italy, vocaturo@unical.it, Adamo Bosco, Demetrio Lagana, Roberto Musmanno
The general routing problem (GRP) arises in contexts where it is needed not only to service some arcs or edges of a graph, but also some isolated vertices. It is common in many real-life applications of waste collection and mail delivery. Despite the importance, relatively few studies have been published on this problem. Moreover, most works deal with the uncapacitated case. We present exact and heuristic approaches for the capacitated GRP defined on a mixed graph. Computational results are also reported.

2 - Modeling the Rural Postman Problem with Time Windows
Ingrid Marcela Monroy Licht, Mathematics and Industrial Engineering, Ecole Polytechnique de Montréal, 2900, boul. Édouard-Montpetit, Chemin de Polytechnique, H3T 1J4, Montréal, Québec, Canada, marcela.monroy@polymtl.ca, Ciro Alberto Amaya, Andre Langelvin

During the winter season it is necessary to monitor the formation of ice on roads. This is the case in Quebec, Canada, where a patrol vehicle must check the status of roads during certain time intervals, depending on weather conditions. To design efficient monitoring, we have modeled this problem as a Rural Postman Problem with Time Windows. We explored three models to formulate the problem: a mixed integer model in arcs, an equivalent problem in nodes and a constraint programming problem. Some results are presented comparing the models on directed and non-directed graphs.

3 - Analysis of Pricing Problem Relaxations for the Capacitated Arc Routing Problem
Claudia Bode, Chair of Logistics Management, Gutenberg School of Management and Economics, Johannes Gutenberg University Mainz, 55099, Mainz, Germany, claudia.bode@uni-mainz.de, Stefan Irmich

We present an in-depth analysis of the pricing problem and possible relaxations in the branch-and-price context for the CARP. Any pricing problem relaxation must be able to handle two sets of tasks for modeling elementary routes and for branching. This complicates the pricing relaxations. We expose the following relaxations of CARP pricing problem: partially elementary tours, NG-route relaxation (including a dynamic version), and k-loop-free pricing. The requirement to construct task-2-loop free tours is rather intricate for k-loop elimination. Finally, acceleration techniques are addressed.

4 - Improving railway infrastructure utilization through pricing mechanisms - Modelling train flows
Michal Kaut, SINTEF Technology and Society, PO Box 4760 Sluppen, 7465, Trondheim, Norway, michal.kaut@sintef.no, Adrian Werner, Arnt-Gunnar Lium, Truls Flatberg, Teodor Gabriel Crainic, Teodor Gabriel Crainic

The goal of the project is to improve the utilization of the Norwegian railway network by creating incentives for train operators to move some of their load to off-peak times, by assigning penalties to the usage of specific sections at given times. This leads to a bilevel problem: in the upper level, we set the prices and in the lower level, the train operators create their routes. We focus on the lower-level optimization problem, in which we have to approximate the way the train operators react to the usage prices, while ensuring that the proposed schedule is feasible in the network.

5 - Computing capacity consumption of railway lines and networks
Rob Goverde, Transport and Planning, Delft University of Technology, Stevinweg 1, 2628 CN, Delft, Netherlands, r.m.p.goverde@tudelft.nl

This paper describes a mathematical model to compute the capacity consumption of a railway line and extends this concept to railway networks. Capacity consumption is measured as the occupation time plus buffer time relative to the scheduled time interval. The occupation time is obtained by compressing the timetable while maintaining feasibility. This is modelled as a critical path problem over precedence graphs. The line capacity problem is based on a microscopic model which gives input to the macroscopic model of the network capacity problem that also includes connections at stations.

TC-12
Tuesday, 12:30-14:00
RB-Omicron

Capacity and Infrastructure
Stream: Optimization in Public Transport
Invited session
Chair: Rob Goverde, Transport and Planning, Delft University of Technology, Stevinweg 1, 2628 CN, Delft, Netherlands, r.m.p.goverde@tudelft.nl

1 - OR in shunt planning
Joel van’t Wout, Netherlands Railways, Netherlands, joel.vantwout@ns.nl

The final planning phase for a railway operator is the shunt planning. This involves the processes within the local station area, mainly choosing parking tracks and finding routes between the station and the shunting yard. OR models for shunt planning can be of great help to the planners of Netherlands Railways, because of limited parking and routing capacity in the Dutch railway network. Moreover, NS would like to make the shunt plans as late as possible, generating time pressure for the planners. We will present a model that solves the problem of matching, parking and routing rolling stock.

2 - A model for balancing price, capacity and crowdedness in public transport
Paul Bouman, Decision and Information Sciences, Rotterdam School of management, Erasmus University, Burgemeester Oudlaan 50, 3062 PA, Rotterdam, Netherlands, PBouman@rsm.nl

In a public transport setting without seat reservations, the typical way peak demand can be balanced against operational and inventory costs by balancing price strategy against rolling stock allocation. Since passengers have to share capacity, the satisfaction of a passenger is influenced by the allocation of other passengers. We will discuss a model where we take individual tolerance levels for crowdedness into account. We aim to optimize a social optimum for this model and then compare the results to a simulation where the passengers try to maximize their own individual satisfaction.

TC-13
Tuesday, 12:30-14:00
RB-Tau

Assembly systems and automotive production
Stream: Manufacturing and Warehousing
Invited session
Chair: Rüdiger Berndt, Computer Science 7, Uni Erlangen-Nürnberg, 91058, Erlangen, Germany, ruediger.berndt@informatik.uni-erlangen.de

1 - Job rotation in assembly lines with disabled workers
Alysson M. Costa, University of São Paulo, Brazil, alysson@icmc.usp.br, Mayron César Oliveira Moreira

We study the problem of planning job rotation schedules in assembly lines with heterogeneous workers. Practical motivation for this study comes from the context of balancing assembly lines in sheltered work centers for the disabled. We propose a new problem in which the tasks are kept fixed in the stations for the whole planning period while each worker rotates within a subset of the stations. A mathematical model and some preliminary results are discussed.
2 - Improving ergonomics by OR methods applied in the planning process: The example of the automobile industry
Alena Otto, Management Science, Friedrich-Schiller University Jena, Carl-Zeiß-Straße 3, 07743, Jena, Germany, elena.otto@gmx.de

Poor workplace ergonomics results in occupational diseases and in high costs for firms, e.g., from absenteeism and errors. It is possible to improve ergonomics at low costs, especially at the earlier steps of planning. Then, mitigation of ergonomic risk factors also goes with raises in productivity and a higher quality. Currently, firms have difficulties to incorporate ergonomic aspects into the planning process. We show examples of how to integrate ergonomic aspects into the planning decisions. We discuss important planning steps, formulate problem settings and point out OR models.

3 - Precomputed Configuration Spaces for the Verification of Consistency in Production Planning Processes
Rüdiger Berndt, Computer Science 7, Uni Erlangen-Nürnberg, 91058, Erlangen, Germany, ruediger.berndt@informatik.uni-erlangen.de, Peter Bazan, Kai-Steffen Hielscher

Highly customizable products and mass customization - as increasing trends of the last years - are mainly responsible for an immense growth of complexity within the digital representations of knowledge. This also applies to the scope of car manufacturing and to the production planning processes and the involved data. We develop a method to detect and analyze inconsistencies by employing a Multi-Valued Decision Diagram (MDD) which encodes the set of all valid product configurations. On this basis, we state a number of rules of consistency that are checked by a set-based verification scheme.

4 - Queue Optimization in Deterministic Linear Manufacturing Systems
Zuzana Němcová, Department of Information Technologies, Faculty of Informatics and Management, University of Hradec Králové, Rokitanského 62, 500 02, Hradec Králové, Czech Republic, Czech Republic, zuzana.nemcovaf@uhk.cz, Martin Gavalec

The contribution describes cost optimization in deterministic linear queueing systems. A manufacturing system is linear if it consists of a series of servers. Knowledge of the development of the queue lengths during the run of the system is useful for controlling the total costs. The method of finding the optimal setup of service capacities of the servers in each time period in which the service times stay unchanged is suggested. It helps the manager of the system in deciding when and how the service times of the servers should be changed. This results in significant cost savings.

2 - Multi-level Decision Support in Rostering and Staffing
Patrick De Causmaecker, Computer Science/CODES, Katholieke Universiteit Leuven, Campus Kortrijk, Etienne Sabbelaan 53, BE-8500, Kortrijk, Flanders, Belgium, Patrick.DeCausmaecker@kuleuven-kortrijk.be, Stefaan Haspeslagh

The connection between rostering software and inter-ward decision making is studied. The assignment of nurses to shifts in a ward is subject to a large numbers of constraints and must allow flexibility in meeting unforeseen circumstances. Often software is available to support the assignment task. We model the impact of the rostering strategy and the ward configuration on its operational platform in terms of demand and occupation. By studying the impact of algorithm behavior on the operational efficiency, a better informed management of load and resource distribution becomes possible.

3 - The Nurse Scheduling Problem: Modelling the Nurses’ Preferences in a Hospital in Turkey
Alejandra Duenas, Management, IESEG School of Management, Soctie de la Grande Arche, 1 Parvis de la Défense, 92049, Paris, France, a.duenas@ieseg.fr, G.yazgi TUT/UNCÜ

The nurse scheduling problem consists of generating a work schedule that considers working days and days off for nursing staff in a Turkish hospital. Schedules meet all hard constraints and consider nurses’ preferences modelled by fuzzy sets and aggregated to determine an overall preference cost function. The schedules are generated by a hybrid approach based on an interactive method which is combined with a multi-objective genetic algorithm (GA). The GA’s fitness function is based on goal and aspiration levels. The results reveal that the proposed approach generates good quality solutions.

4 - From Simplified to Detailed Solutions To The Nurse Rostering Problem
Geetha Baskaran, Computer Science, The University of Nottingham Malaysia Campus, Faculty of Science, Jalan Broga, 43500, Semenyih, Kajang, Malaysia, Geetha.Baskaran@nottingham.edu.my, Andrzej Bargiela, Rong Qu

This paper presents a novel approach to solving the nurse rostering problem through information granulation. Compared to the established scheduling methods, our approach involves judicious grouping (granulation) of shift types that lead to a reformulation of the original problem in a significantly reduced solution space. The schedules are then translated back into the original problem space by considering the constraints that could not be represented in the reduced space. The proposed method has been evaluated on the standard benchmark problems and has shown to be capable of finding high quality schedules.

TC-14
Tuesday, 12:30-14:00
RB-Omega
Nurses Scheduling

Stream: Timetabling and Rostering
Invited session
Chair: Geetha Baskaran, Computer Science, The University of Nottingham Malaysia Campus, Faculty of Science, Jalan Broga, 43500, Semenyih, Kajang, Malaysia, Geetha.Baskaran@nottingham.edu.my

1 - Agent-based Cooperative Meta-heuristic search for Fairness in Nurse Rostering
Simon Martin, Mathematics, University of Portsmouth, Lion Building, Lion Gate, PO1 3HE, Portsmouth, Hampshire, United Kingdom, simon.martin@port.ac.uk, Pieter Smet, Djamila Ouelhadj, Ender Özcan, Greet Vanden Berghe

Traditional approaches to solving the nurse rostering problem have mainly focused on the minimisation of the number of constraint violations across all the nurses. However, these rosters generally fail to ensure that individual nurses are treated fairly and the workload is shared evenly amongst nurses. In this paper, we introduce new fairness measures and propose an agent-based framework for cooperative search that combines the strength of several heuristics and meta-heuristic agents to optimise these measures in order to generate fair nurse rosters.

TC-15
Tuesday, 12:30-14:00
RB-2101
Vector and Set-Valued Optimization I

Stream: Vector and Set-Valued Optimization
Invited session
Chair: Vicente Novo, Matematica Aplicada, Universidad Nacional de Educacion a Distancia, Juan de Rosal no. 12, 28040, Madrid, Spain, vnnovo@ind.uened.es
Chair: Beatriz Hernández-Jiménez, Economics, University Pablo de Olavide, Edificio N° 3, José Moñino - 2 planta-despacho26, Ctra. de Utrera, Km. 1- 41013 Sevilla, 41013, SEVILLA, Spain, mberjerim@upo.es
1 - Variational-like inequality problems and vectorial optimization problems in Banach spaces

Gabriel Ruiz-Garzón, Estadística e I.O., University of Cadiz, Campus de Jerez de la Frontera, Avda. de la Universidad s/n, 11405, Jerez de la Frontera, Cádiz, Spain, gabriel.ruiz@uca.es, Lucelina Batista dos Santos, Antonio Rufián-Lizana, Rafaela Osuna-Gómez

This work is devoted to the study of relationships between solutions of Stampacchia and Minty vector variational-like inequalities and Pareto and weak Pareto solutions of vector optimization problems in Banach spaces under pseudo invexity and pseudo monotonicity hypotheses. We have extended the results given by various authors to Banach spaces and the relationships obtained to weak efficient points in Santos et al. are completed and enabled to relate Pareto points and solutions of the weak and strong Minty, Stampacchia and perturbed vector variational-like inequalities.

2 - Efficiency in multiobjective variational problem under generalizd convexity

Manuel Arana-Jiménez, Estadística e Investigacion Operativa, University of Cadiz, Facultad CCSS y de la comunicacion, Av. Universidad s/n, 11405, Jerez de la Frontera, Cadiz, Spain, manuel.arana@uca.es, Antonio Rufián-Lizana, Rafaela Osuna-Gómez, Gracia M. Nieto-Gallardo

We study efficiency in multiobjective variational problems. For this purpose, we introduce new classes of functions, called V-KT(FJ)-pseudounvex. These functions are characterized in order that all critical points (Kuhn-Tucker/Fritz John) are efficient solutions. That is, we propose the weakest properties on the functions involved in the multiobjective variational problem, such that we can ensure that a critical point is an efficient solution. These new classes of functions and results are a generalization of others recently appeared in multiobjective mathematical programming problems.

3 - The exact l1 penalty function method for vector optimization problems

Tadeusz Antczak, Faculty of Mathematics and Computer Science, University of Lodz, Balanica 22, 90-238, Lodz, lodzkie, Poland, antczak@math.uni.lodz.pl

In our considerations, we use the vector exact l1 penalty function method for solving convex and nonconvex vector optimization problems. The most important property of this method, that is, exactness of the penalization, is examined. We show that, there exists a lower bound of the penalty parameter, above which this value, the equivalence between the set of (weak) Pareto optimal solutions in multiobjective programming problem and the set unconstrained (weak) Pareto optimal solutions in its associated vector penalized optimization problem with the vector exact l1 penalty function holds.

4 - Characterization of weakly efficient solutions for non-regular vector optimization problems with conic constraints

Beatriz Hernández-Jiménez, Economics, University Pablo de Olavide, Edificio N° 3, José Moñino - 2º planta-despacho26, Ctra. de Utrera, Km. 1-41013 Sevilla, 41013, SEVILLA, Spain, mbherjim@upo.es, Rafaela Osuna-Gómez, Marko A. Rojas-Medar

In non-regular problems the classical optimality conditions are totally inapplicable. Meaningful results were obtained for scalar problems with conic constraints by Iznalvor and Solodov. In this paper we give a necessary optimality condition for the non-regular vector optimization problems with conic constraints defined using abstract spaces, and appropriate generalized convexity notions to show that the optimality condition given is both necessary and sufficient to characterize the weakly efficient solutions set. The results that exist in the literature up to now, even for the regular case, are particular instances of the ones presented here.
This paper deals with discrete-time Markov Decision Processes under constraints where all the objectives have the same form of an expected total cost over the infinite time horizon. The existence of an optimal control policy is discussed by using the convex analytic approach. We work under the assumptions that the state and action spaces are general Borel spaces and the model is non-negative, semi-continuous and there exists an admissible solution with finite cost for the associated linear program. Our result ensures the existence of an optimal solution to the linear program given by an occupation measure of the process generated by a randomized stationary policy.

**TC-17**

**Hub Location II**

Stream: Hub Location

Invited session

Chair: Barbaros Tansel, Industrial Engineering, Bilkent University, Bilkent, 6800, Ankara, Turkey, barbaros@bilkent.edu.tr

1 - A new approach to economies of scales in hub location problems

Martin Baumann, Deutsche Post Endowed Chair of Optimization of Distribution Networks, RWTH Aachen University, Kackertstrasse 7, 52072, Aachen, Germany, baumann@or.rwth-aachen.de

Despite economies of scales being one of the main reasons for hub & spoke networks, little attention has been paid to their adequate consideration in hub location models. In most of nowadays models unit transportation costs are assumed to be independent of the actual flow and are discounted by a constant factor on interhub links to take account of economies of scale. We present a new approach where transportation costs are not incurred by flows but by vehicle tours. This way consolidation can be achieved on any link of the network and the number of hubs no longer needs to be constrained.

2 - The ring star hub location problem: A Benders decomposition approach

Ricardo Camargo, Engenharia de Produção, Universidade Federal de Minas Gerais, 30161-010, Belo Horizonte, Minas Gerais, Brazil, camargo.rico@gmail.com, Gilberto Miranda, Henrique Luna, Elisangela Martins de Sá

The ring star hub location problem is the design of a two level hierarchical network: at the top, a ring network linking hubs, which are selected from a node candidates set, while observing scale economies on the links; and, at the bottom, a star network, single allocating exchanging flow customers to a hub. The problem is an extension of hub location problems to rapid transit and telecommunication applications. A new formulation is proposed and tackled by a Benders decomposition algorithm, which efficiently solves large scale instances to optimality, due to a new cut selection scheme.

3 - The p-Hub Median Problem on Incomplete Transportation Networks

Barbaros Tansel, Industrial Engineering, Bilkent University, Bilkent, 6800, Ankara, Turkey, barbaros@bilkent.edu.tr, Ibrahim Akgün

The p-hub median problem has been studied so far under the assumption of a fully connected (complete) network where there is an undirected arc present for each pair of nodes. Transportation networks in the physical world are generally incomplete. That is, many of the arcs may be missing. While an incomplete network problem can always be handled by converting it first to a complete network problem, we strongly deviate from this tradition and give a new formulation that represents the problem directly on the given incomplete network. We present the new formulation and certain modeling advantages related to it.

**TC-18**

**Competitive Location.**

Stream: Continuous Location

Invited session

Chair: Blas Pelegrin, Statistics and Operations Research, University of Murcia, Spain, pelegrin@um.es

1 - Solving a Huff-type location model on networks

Rafael Blanquero, Estadística e Investigación Operativa, Universidad de Sevilla, Faculty of Mathematics, Tarifa S.N. 41012-Seville (Spain), 41012, Seville, Spain, rblanquero@us.es, Emilio Carrizosa, Amaya Nogales, Frank Plastra

In this talk we address the problem of locating a single facility on a network according to the Huff competitive location model, where the nodes of the network represent users asking for a certain service. The objective function of this problem is shown to be multimodal and can be written as the difference of two convex functions. This fact is exploited in a branch and bound procedure which allows us to solve this problem on networks of reasonable size. Computational results are presented.

2 - Location models and GIS tools for franchise distribution

Rafael Suarez-Vega, Metodos Cuantitativos en Economía y Gestion, Universidad de Las Palmas de Gran Canaria, Edificio Departamental de Ciencias Economicas y Empresariales, Campus Universitario de Tafira, 35017, Las Palmas de Gran Canaria, Las Palmas, Spain, rsuarez@dmc.ulpgc.es, Dolores R. Santos-Ventura, Pablo Dorta-González

We consider a competitive location model and GIS tools to make decisions in a franchise distribution system when a single facility has to be located in a planar space. Two normally in conflict objectives are involved, the maximization of the market share of the firm and the minimization of the cannibalization. Maps representing the market share, the cannibalization effect, or a combination of them, are obtained. GIS tools allow the incorporation of forbidden regions and other restrictions, and the visualization of the effects produced by the opening of a new facility into the market.

3 - On a biobjective location model for firm expansion with binary customer behaviour

Algirdas Lančinskas, Institute of Mathematics and Informatics, Vilnius University, Akademijos st. 4, LT-08653, Vilnius, Lithuania, algirdas.lancinskas@mi.vu.lt, Julius Zilinskas, Blas Pelegrin, Pascual Fernandez

We study a bi-objective location model on a network for firm expansion in competition with other firms. The aim of the expanding firm is to maximize its market share and to minimize the cannibalism effect caused by new facilities. Demand in each market is fixed and customers select the most attractive facility while attraction depends on facility quality and distance to the customers. Under general conditions, efficient locations are proved to be in the set of nodes. A heuristic algorithm is proposed to find efficient solutions for a large set of markets. Computational results are discussed.

**TC-19**

**Risk Modeling and Risk Measures**

Stream: Actuarial Sciences and Stochastic Calculus

Invited session

Chair: David Wozabal, TUM School of Management, Technische Universität München, Arcisstraße 21, DE-80333, München, Germany, david.wozabal@univie.ac.at
1 - Modeling the ATM Cash Delivery Problem as a Vehicle Dispatch Problem and Solving It via a New Hybrid Heuristic Algorithm
Kübra Fenerci, Industrial engineering, Boğaziçi University, Mareşal Çakmak Cd. İnçe Su Sk. Abacı Apt 8/1 Şirinevler/IST., İstanbul, Turkey, kubrafenerci@windowslive.com, Ilhan Or, Ekrem Duman
The Savings’ and Sweep algorithms are two classical, but widely used approaches to find good near optimal solutions for vehicle routing problems. A variant heuristic integrating the basic philosophies of these algorithms is developed and applied to the vehicle routing problem arising in the route optimization of ATM cash delivery vehicles. An “angle criterion” (reflecting the spatial tendencies of the sweep approach) is embedded into the “savings criterion” to generate a hybrid algorithm. Relative weights of the “sweep” and “savings” criteria are experimentally determined.

2 - "Jumping Assets", "Timing Effect" and "Systemic Risk" in Portfolio Selection Problems
Sergio Otobelli, MSIA, University of Bergamo, Via dei Caniana, 2, 24127, Bergamo, Italy, sol@unibg.it, Enrico Angelelli
In this paper we propose a comparison among the ex-post sample paths of the wealth obtained optimizing some large scale dynamic portfolio strategies. We use the stock of the main US market of the last 20 years. This empirical portfolio selection analysis has permitted: 1) To identify some assets, called “jumping assets”, that present returns with big oscillations in a very short time. 2) To use portfolio strategies that maximize the time the portfolio reaches a loss and minimize the time the portfolio reaches an earn (Timing effect). 3) To forecast the periods of systemic risk.

3 - Robustifying Convex Risk Measures: A Non-Parametric Approach
David Wozabal, TUM School of Management, Technische Universität München, Arcisstraße 21, DE-80333, München, Germany, david.wozabal@univie.ac.at
We are robustifying convex, version independent risk measures. The robustified risk measures are defined as the worst case portfolio risk over a Kantorovich neighborhood of a reference distribution. We demonstrate that the optimization problem of finding the worst case risk can be solved analytically and consequently closed form expressions for the robust risk measures are obtained. We use these results to derive robustified versions for several examples of risk measures and demonstrate the favorable properties of the resulting robust measures in rolling-window out-of-sample evaluations.

4 - On distributional robust probability functions and their computations
Man Hong Wong, Systems Engineering and Engineering Management, The Chinese University of Hong Kong, Room 609, William M. W. Mong Engineering Building, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong, Hong Kong, edmhwong@gmail.com, Shuzhong Zhang
Consider a random vector, and assume that a set of its moments information is known. Among all possible distributions obeying the given moments constraints, the envelope of the probability distribution functions is introduced in this paper as distributional robust probability function. We show that such a function is computable in the bi-variate case under some conditions. Connections to the existing results in the literature, as well as the applications in risk management, will be discussed.

3 - Recent Features of UK Income Protection Claim Durations
Isabel Cordeiro, Escola de Economia e Gestão, Universidade do Minho/CEMAPRE, ISEG, Escola de Economia e Gestão, Universidade do Minho, Campus de Gualtar, 2710-057, Braga, Portugal, icordeiro@eei.uminho.pt
In this paper we calculate average claim durations conditioned on recovery, on death and not conditioned on any particular mode of claim termination, using the most recent graduations of the transition intensities defined for a multiple state model for Income Protection (IP). These average claim durations are compared with similar durations presented in Cordeiro (2002, 2007), calculated with graduations for an earlier period. We also analyse other features of the distribution of the duration of an IP claim. All this information can be very useful for insurance companies selling IP policies.

4 - Valuation of employee Stock Option with stochastic exercise price for a Brazilian Firm
Tara Keshar Nanda Baidya, Industrial Engineering, PUC-Rio, Rua Marquês de São Vicente 225 — Gávea, 22451-041, Rio de Janeiro, RJ, Brazil, baidya@puc-rio.br, Fernando Visser
Employee Stock Option is being used more and more in Brazil recently. The objective of our research is to propose a model to price this option in the Brazilian context. For this purpose, we have chosen a Brazilian Airline firm called TAM S.A. The exercise price of this option is stochastic, it depends on the General Price Index of Brazil called IGPM. It has another particularity, the stock option can be exercised only after a certain period of time. In our case, there are options issued with a waiting period of 2, 3 and 4 years.
2 - Misperceptions of Long-Term Investment Performance: Insights From An Experiment
Michael Stutzer, Finance, University of Colorado, 419 UCB, 80309, Boulder, CO, United States, michael.stutzer@colorado.edu, Susan Jung Grant

The expected cumulative return is a reasonable long-term result indicator for repeated fixed dollar gambles. But long-term investments are better modeled by cumulating percentage returns, which are highly positively skewed, making the median a far better measure of central tendency. Our experimental findings show that many subjects, including ones who have authored papers in the area, would make long-term investments in highly volatile assets with high expected return, but regret doing so once they are shown the distribution of long-term cumulative returns resulting from the investment.

3 - A Note On Estimating CAPM-Betas
Andreas Loeffler, Banking and Finance, Freie Universität Berlin, Boltzmannstr 20, 14195, Berlin, Germany, al@wacc.de, Thomas Burkhardt

Any CAPM-test uses an ex post formulation of the capital market line. In our note we show that the distribution of the noise has to be endogenously specified. To this end we consider an asset model which follows a multidimensional Brownian motion. Then we propose a model with multiple price path that enables us to simulate the beta evaluation. Such, we are able to determine the distribution of betas. Simulations using a very simple Brownian setup already show that the resulting beta distribution has an enormous range. Even with large R² empirically estimated CAPM-returns should be carefully interpreted.

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**TC-22**

**Tuesday, 12:30-14:00**

**RB-2117**

**Mathematical Models in Macro- and Microeconomics 2**

**Stream: Mathematical Models in Macro- and Microeconomics**

**Invited session**

Chair: Ludmilla Koshlai, Systems analysis and OR, Institute of Cybernetics, Gonchar str., 65-a, apt. 20, 01054, Kiev, Ukraine, koshlai@ukr.net

Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

Chair: Jean-François Emmenegger, Quantitative Economics, University of Fribourg, Bld de Pérolles 90, F440, 1700, Fribourg, Fribourg, Switzerland, Jean-François.Emmenegger@unifr.ch

1 - An empirical assessment of customer lifetime value models
Abdulkadir Hiziroglu, Management Information Systems, Sakarya University, Esentepe Campus M-5 Building, Sakarya, 54187, Sakarya, Turkey, khiziroglu@sakarya.edu.tr, Serkan Sengul

Customer lifetime value plays a key role in customer relationship management and has been carried out many sectors for decades. Researchers have proposed specific models for calculating customer lifetime value. Literature lacks of comparative research on assessing the existing models. We evaluate two customer lifetime value models from segmentation perspective. RFM model and basic structural model were compared and an evaluation from segmentation perspective was done. The results indicated that basic structural model was superior to its peer using the same databases and variables.

2 - On one nonlinear optimization problem for Leontief models
Petro Stetsyuk, Nonsmooth optimization methods, Institute of Cybernetics, 40 Prospect Glushkova, 03187, Kiev, Ukraine, stetsyukp@gmail.com

We consider the nonlinear programming problem for Leontief models (NLPL) with a bilinear objective function and linear constraints both for primal and dual Leontief models and two quadratic constraints which normalize final demand and value added. We show that for productive Leontief matrix the set of solutions of NLPL is determined by the eigenvectors corresponding to the maximum eigenvalues of a certain symmetric matrices. For productive and indecomposable Leontief matrices NLPL has a unique solution. Numerical examples for the aggregated 15 sectors Leontief model of Ukraine are given.

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**TC-23**

**Tuesday, 12:30-14:00**

**RB-Delta**

**Complementarity Problems, Variational Inequalities and Equilibrium**

**Stream: Mathematical Programming**

**Invited session**

Chair: Sándor Zoltán Nemeth, School of Mathematics, The University of Birmingham, The Watson Building, Edgbaston, B15 2TT, Birmingham, United Kingdom, nemeths@for.mat.bham.ac.uk

Chair: Song Wang, Mathematics & Statistics, The University of Western Australia, 35 Stirling Highway, Crawley, 6009, Perth, Western Australia, Australia, Song.Wang@uwa.edu.au

1 - The Influence of Technical, Market and Legislative Factors on E-Waste Flows
Thomas Nowak, Transport and Logistics Management, Vienna University of Economics and Business, Nordbergstrasse 15, 1090, Wien, Austria, thomas.nowak@wu.ac.at, Fuminori Toyasaki, Tina Wakolbinger, Anna Nagurney

In this paper, we analyze how technical, market, and legislative factors influence the total amount and prices of e-waste that is collected, recycled and (legally and illegally) disposed of. We formulate the e-waste network flow model as a variational inequality problem with four tiers: the model covers the behavior of sources of e-waste, collectors, processors, and demand markets for precious and hazardous materials. In the numerical simulation of our model we can quantify the change of prices and quantities when penalties for illegal dumping for example is varied.

2 - Power penalty methods for nonlinear complementarity problems
Song Wang, Mathematics & Statistics, The University of Western Australia, 35 Stirling Highway, Crawley, 6009, Perth, Western Australia, Australia, Song.Wang@uwa.edu.au

Many real-world problems in classical and financial engineering are governed by nonlinear optimization problems with complex derivative constraints called obstacles. Usually, these problems can be formulated as Nonlinear Complementarity Problem (NCP). We present recent advances in the power penalty approach to NCP. Mixed NCP and bounded NCP and prove converges results at an exponential rate. Numerical results will be presented to demonstrate the theoretical exponential convergence rates.
3 - Necessary conditions for variational relation problems
Anulekha Dhara, Mathematics, Indian Institute of Technology Gandhinagar, Vishwakarma Government Engineering College Complex, Chandkheda, Visat-Gandhinagar Highway, 382424, Ahmedabad, Gujarat, India, anulekha.dhara@gmail.com
The model of variational relation problem was introduced recently in 2008 by Luc. It englobes several models of fixed points, optimization, variational and quasivariational inequalities, equilibrium and many others. In literature it is well known that if a point is a solution of variational inequality then it is a solution of a projection problem. But such a condition need not hold for a variational relation problem. In this paper we aim to obtain necessary conditions for a point to solve the variational relation problem.

4 - Change detection training improves time series forecasting
Matt Twyman, Cognitive, Perceptual and Brain Sciences, University College London, United Kingdom, m.twyman@ucl.ac.uk, Nigel Harvey
Participants were asked to judge whether changes had occurred in time series, express confidence in those judgments, and forecast eight data points at the end of each series. Different participants performed the change detection or forecasting tasks (on the same set of time series) in different orders. There were no differences in change detection performance or confidence between the two groups, but participants who were asked to forecast first gave elevated and less accurate forecasts, indicating that change detection training improves forecasting.

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1 - Why do people damp trends when using their judgment to make forecasts from time series?
Nigel Harvey, Cognitive, Perceptual and Brain Sciences, University College London, Gower Street, WC1E 6BT, London, London, United Kingdom, n.harvey@ucl.ac.uk, Stian Reimers
People’s forecasts underestimate the steepness of trends in time series. This trend damping may occur because 1) people anchor on the last data point and make insufficient adjustment to take the trend into account, 2) they adjust towards the average of the trends they have encountered within an experiment, or 3) they are adapted to damped trends in the environment. To eliminate 1), we show anti-damping (the opposite of damping) for series that are negatively accelerated or have shallow slopes. To eliminate 2), we show both damping and anti-damping when people forecast from a single series.

2 - Judgmental interval forecasts: The effects of assessment order and trend direction
Mustafa Sinan Gonul, Business Administration, Middle East Technical University, Universieter Mah. Dunlupinar Blv. No:1, Cankaya, 06800, Ankara, Turkey, mgsongul@metu.edu.tr, Mary Thomson, Dilek Önkal-Atay
To generate judgmental forecasts of point, 90% and 50% intervals, five distinct values need to be assessed: i) 90% upper bound, ii) 90% lower bound, iii) 50% upper bound, iv) 50% lower bound and v) point forecast. The interval bounds can either be assessed in an ordinary manner (i&ii first, followed by iii & iv) or concentrate manner (i&ii first, followed by i&ii) with points generated before or after the intervals. This research aims to explore the effects of assessment order and trend direction on the performance of resultant forecasts. Findings are discussed and implications are given.

3 - An exploration of judgmental forecasting biases using dynamic task environments
Zoe Theocaris, Cognitive, Perceptual and Brain Sciences, UCL, 26 Bedford Way, WC1H 0AP, London, United Kingdom, zoe.theocaris@gmail.com, Nigel Harvey
Judgmental forecasting tasks, which have mainly employed static displays of graphs or tables, have revealed several robust biases in forecasters’ performance. These biases include trend damping, positive autocorrelation illusion and noise introduction. We investigated how people’s forecasts are influenced by presenting the data series as a dynamic display of successive bar charts. We found that both forcast accuracy and the underlying information processing strategies were affected by this. As a result, biases differed substantially from those previously reported.

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1 - Developing the data envelopment analysis model with incorporating the carbon footprint to measure the business operational efficiency
Li-Ting Yeh, Business Administration, National Central University, II-209,NO.300 Jung-da Rd.,Jung-ll City,Taoyuan,Taiwan 320, R.O.C, Hongli, Taiwan, dsw0623@gmail.com, Dong Shang Chang, Wenrong Liu
The three scopes of carbon footprint have become most suitable methods to measure the greenhouse gases from the business operating activities. This environmental perspective is considered by previous studies to measure the business operational efficiency. With incorporating the carbon footprint, the slack-based measure model is developed to evaluate environmental performance of business operations. Research sample is adopted from Carbon Disclosure Project with Fortune 500 Top Companies. The finding is useful to the government for amending the industry and energy policy with sustainability.

2 - Strategic and operational implications of climate change for supply chain management
Costas Pappis, Department of Industrial Management, University of Piraeus, 80 Karaoli & Dimitriou str., 18534, Piraeus, Attica, Greece, pappis@uni.pi, Cristobal Miralles, Tom Dasaklis, Nikos Karacapilidis
Earth’s climate is rapidly changing as a result of increases in emissions of greenhouse gases caused by human activities. Escalation in regulations, market forces and shareholders’ value are paving the way for the decarbonization of supply chains. In this paper the implications of climate change for supply chain management in terms of strategic and operational planning are identified and insights in the means, by which supply chains could be better positioned to cope with climate change hazards in a low carbon economy, are provided.

3 - Resource efficiency in supply chains: a review of network design and operational planning
Gabor Herczeg, Department of Management Engineering, Technical University of Denmark, Produktionstorvet bygn. 424, 2800, Lyngby, Denmark, gahe@man.dtu.dk
Achieving sustainable development in supply chain management by engaging in green operations is receiving increasing attention. Green supply chain operations can be enhanced by increasing resource efficiency, e.g., through sustainable use of finite raw materials, etc.. We review the state-of-the-art on resource efficiency in supply chains from the aspect of supply chain design and operational planning. Furthermore, we develop a conceptual framework that identifies future directions and tools for enhancing theory and practice to improve green operations.
4 - The varied contexts of environmental multicriteria decision support processes

Jutta Geldermann, Chair of Production and Logistics, Universität Göttingen, Platz der Göttinger Sieben 3, D-37073, Göttingen, Germany, geldermann@wiwi.uni-goettingen.de, Meike Schmehl, Katharina Amann

Various tools for analysing the impact of the environmental burden like Life Cycle Assessment have been developed, and the need to apply decision analysis is widely recognised. This paper draws conclusions on the process of multicriteria decision support in various contexts: (1) the development and validation of evaluation criteria for sustainable bioenergy concepts, like a bioenergy village; (2) evolving requirements of electricity supply networks, which arise from projected fluctuating regenerative power generation, from a managerial viewpoint; (3) industrial risk and emergency management.

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4 - Environmental impacts versus driving times - The routing of log-trucks with a new near-exact solution approach

Marco Oberscheider, Institute for Production and Logistics, University of Natural Resources and Life Sciences, Vienna, Feistmantelstrasse 4, 1180, Vienna, Austria, marco.ober scheider@boku.ac.at, Jan Zazgornik, Manfred Gronalt, Patrick Hirsch

The routing of log-trucks is compared for two objectives: minimizing total driving times against minimizing the greenhouse gas emissions of timber transport. A new near-exact solution approach (NE) is introduced for this multi depot vehicle routing problem with pick-up and delivery and time windows. As benchmark a Tabu Search strategy with a dynamically alternating neighborhood is used. The extensive numerical studies with real life data - concerning the supply of biomass power plants - reveal the potential of the NE and show how efficient planning can contribute to climate change mitigation.

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OR in Forestry II

Stream: OR in Agriculture, Forestry and Fisheries

Invited session

Chair: Patrick Hirsch, Institute of Production and Logistics, University of Natural Resources and Life Sciences, Vienna, Feistmantelstrasse 4, 1180, Wien, Austria, patrick.hirsch@boku.ac.at

1 - On the optimal land allocation

Jussi Uusivuori, Finnish Forest Research Institute Metla, Unioninkatu 40 A, FIN-00170, Helsinki, Finland, jussi.uusivuori@metla.fi

Land allocation between productive land and conservation is studied. Private decision-making is described in two cases: when access to conserved land is closed, and when there is an open access to conserved land. In the latter case the land size designated to conservation will be smaller than in the former. Policy rules are derived for a social optimum. When a closed-access regime is opened, optimal policies become dependent on wealth differentials between land-owning and non-landowning members of society. Utility of both groups is increased if willingness-to-pay for conservation is utilized.

2 - Scheduling sawmill operations using robust optimization

Sergio Maturana, Ingenieria Industrial y de Sistemas, P. Universidad Catolica de Chile, Casilla 306 Correo 22, Santiago, Chile, smaturan@ing.puc.cl, Mauricio Varas, Jorge Vera

Scheduling sawmills operations is difficult due to the uncertainty of log supply and product demand. In this work robust optimization approach is used to take into account uncertainties in product demand and raw material availability when scheduling sawmill operations. The performance of the robust solutions was tested using Montecarlo’s method. Numerical evidence shows an interesting relationship between the product’s holding/shortage costs and the level of conservatism, and also provides some insights about the impact of the budgets of uncertainty in the performance of the robust solutions.

3 - Vehicle routing for transporting forest fuel and combined mobile chipper scheduling

Jan Zazgornik, Institute of Production and Logistics, University of Natural Resources and Life Sciences, Vienna, Feistmantelstrasse 4, 1180, Vienna, Austria, jan.zazgornik@boku.ac.at, Manfred Gronalt

This work presents a vehicle routing problem for transporting forest fuel including combined mobile chipper scheduling. A mathematical model was formulated as a multi-depot vehicle routing problem with time windows. Additional constraints were used to model the queuing of trucks at a mobile chipper that chips wood directly into a truck. The objective is to minimize total working times of the drivers, which includes to keep waiting times of trucks low at the mobile chipper. Besides the model formulation a dynamic tabu search with alternating strategy was used to solve larger problem instances.

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Policy Analytics

Stream: Decision Processes

Invited session

Chair: Alexis Tsoukiás, CNRS - LAMSADE, Université Paris Dauphine, 75775, Paris Cedex 16, France, tsoukias@lamsa.de.dauphine.fr

Vivien Kana Zeumo, MIDO, University Paris Dauphine, LAMSADE, University Paris Dauphine, 75775 Paris Cedex 16, 75775, Paris, France, vizkana@yahoo.fr

1 - Policy analytics: what it is and how to distinguish it

Valerie Belton, Dept. Management Science, University of Strathclyde, 40 George Street, G1 1QE, Glasgow, United Kingdom, val.belton@strath.ac.uk, Alexis Tsoukiás

In this talk we discuss the term “policy analytics” as a distinguished field of scientific investigation as well as of decision support practice. We present a policy cycle analysis and we show why decision analysis and analytics need to be specifically conceived in order to take care of the new challenges in this exciting area.

2 - An ANP-based approach for addressing sustainability in urban transformation projects

Valentina Ferretti, Urban and Regional Studies and Planning, Politecnico di Torino, Viale Mattioli 39, 10125, Torino, Italy, valentina.ferretti@polito.it, Marta Bottero, Andrea Di Maggio, Silvia Pomarico, Marco Valle

The paper addresses the problem of sustainability assessment of a new transport infrastructure through the use of the Analytic Network Process. The model takes into consideration the different aspects of the decision-making process, namely, economic, environmental, social, transport and urban planning aspects that have been organized according the categories of Benefits, Costs, Opportunities and Risks. The results of the work are a ranking of alternative solutions and a list of the most important elements of the decision problem that have been represented by means of specific thematic maps.

3 - Poverty measurement: a decision aiding perspective

Vivien Kana Zeumo, MIDO, University Paris Dauphine, LAMSADE, University Paris Dauphine, 75775 Paris Cedex 16, 75775, Paris, Paris, France, vizkana@yahoo.fr, Alexis Tsoukiás

In this paper we present a new methodology aiming at aiding the design, implementation and monitoring of poverty reduction policies. The new methodology extends capabilities theory in a practical way allowing to assess how clusters of similarly “poor” can improve their condition.
4 - InViTo: an integrate approach for supporting the evaluation of transport scenarios
Isabella Lami, Politecnico of Turin, 10125, Turin, Italy, isabella.lami@polito.it, Francesca Abastante, Stefano Pensa, Marta Bottero, Elena Masala

This study presents an innovative approach for integrating the Analytic Network Process (ANP) and the visualisation tools. By the use of Interactive Visualization Tool - InViTo, the work shows the contribution of the proposed approach to the decision-making process in handling the data collected, using specific 2D and 3D maps created by the system. The case study is an application of the ANP and InViTo to a section of the Project CODE24 showing the potentialities of the joint use of two techniques in helping selecting a suitable scenario for transport improvement.

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4 - Dimensions of trust involved in human actions against climate change
Annette Hohenberger, Middle East Technical University (METU), Informatics Institute, Cognitive Science Program, Cankaya Iliesi Universieter Mah, Dumulpinar Bulvari No:1, 06800, Ankara, Turkey, hohenberger@i.metu.edu.tr

This paper explores the spatio-temporal, cognitive, social and emotional dimensions of trust involved in people’s actions against climate change. Due to its vast spatio-temporal scale, climate change is a major challenge that necessitates humans to extend their interfaces with the environment on the above-mentioned dimensions. Trust is an essential precondition in this process. To the extent that we can trust in the various environments that embed us and into the available resources, we can reduce and possibly handle the higher complexity with which climate change challenges us.

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5 - Toward a ‘rationality’ tuned with human life
Marina Alfano, Conservatorio di Musica Girolamo Frescobaldi, Ferrara, Ministero Pubblica Istruzione, Italy, Via Previati 22, 44121, Ferrara, Italy, marina.alfano@conservatorioferrara.it, Rosolino Buccheri

In order to include interaction in physics and to account for the philosophical consequences of Gödel theorems, we have to accept the anthropological datum that, at the dawning of the civilization, human cognition was based on a process of co-oscillatory resonance established by man with his environment as the effect of a hearing amplified by his body and transmitted to his consciousness. By admitting that such ‘subjective’ knowledge is nowadays disregarded but not lost, we look to a more effective rationality by integrating the ‘scientific’ one into a wider, more comprehensive wisdom.
4 - Stochastic nonconvex MINLP models and global optimization for natural gas production network design under uncertainty

Xiang Li, Chemical Engineering, Queen’s University, Dupuis 403, 19 Division Street, K7L 3N6, Kingston, Ontario, Canada, xiang.li@chee.queensu.ca, Asegiir Tomaqvard, Paul I. Barton

Scenario-based stochastic nonconvex MINLP models are developed to facilitate the design of natural gas production networks under uncertainty, where the nonconvexity comes from bilinear, quadratic and power functions involved. As a gas network involves large investments, a small performance gain made in the design can translate into significant increase in profits, it is desirable to solve the problem to global optimality. A novel global optimization method, called nonconvex generalized Benders decomposition (NGBD), is developed to achieve this goal efficiently.

4 - On Generating a Secure, Representative Sample from a Database

Robert Garfinkel, OPIM, University of Connecticut, Box U411M, 06029, Storrs, CT, United States, rgarfinkel@business.uconn.edu

A database manager (DBA) has access to a number of records pertaining to entities. The fields of the database can be partitioned into bins. Each entity can allow its record to be included in a sample, based on a privacy constraint that specifies the minimum number of other participants that satisfy “similarity” conditions. Two measures are given, one local and one global, for the “representativeness” of a sample based on the population of the database. Then it is determined which sample sizes are privacy-feasible, and how to maximize representativeness for these sample sizes.

■ TC-30

Tuesday, 12:30-14:00
CC-A31

Data confidentiality 1

Stream: Data Confidentiality

Invited session

Chair: Robert Garfinkel, OPIM, University of Connecticut, Box U411M, 06029, Storrs, CT, United States, rgarfinkel@business.uconn.edu

1 - Solving L1-CTA in 3D tables by an interior-point method for block-angular problems

Jordi Cuesta, Chemical Engineering, University Rovira i Virgili, Av. Països Catalans 26, Sant Pere i Sant Pau, 43007, Tarragona, Catalonia, Spain, jordicuesta@gmail.com, Jordi Castro

Given a table with sensitive information, CTA looks for the closest safe table. We focus on CTA for 3D tables using the L1 distance between the original and protected tables. The resulting linear programming problems are solved by a specialized interior-point algorithm which solves the normal equations by a combination of Cholesky factorization and preconditioned conjugate gradients (PCG). Quadratic regularizations are used to improve the performance of PCG. Computational results are reported for a set of linear optimization problems of up to 50 million variables and 25 million constraints.

2 - Optimal Data-Independent Noise for Differential Privacy

Josep Domingo-Ferrer, Dept. of Computer Engineering and Maths, Universitat Rovira i Virgili, Av. Països Catalans 26, 43007, Tarragona, Catalonia, Spain, josep.domingo@urv.cat, Jordi Soria-Comas

Differential privacy is a notion offering general and clear privacy guarantees for the individuals in a database. The effect of the presence or absence of any single individual on the response to a query is limited. The response mechanism can be viewed as an output perturbation where the real response is computed and noise-added before release. The usual choice is Laplace noise adjusted to the global sensitivity of the query function. We show that Laplace noise is not optimal, and we construct optimal noise distributions.

3 - Solving L2-CTA by perspective reformulations

Jordi Castro, Statistics and Operations Research, UPC, 08034, Barcelona, Catalonia, Spain, jordi.castro@upc.edu, Claudio Gentile, Antonio Frangioni

Controlled tabular adjustment (CTA) is an emerging technology for the protection of tabular data. CTA minimizes the distance between the (unsafe) original and the protected table. CTA results in challenging MILP or MIQP problems, if, respectively, L1 or L2 distances are considered. We provide a novel analysis of perspective reformulations for the particular MIQP-CTA formulation, with pairs of linked semi-continuous variables. Computational results will be provided, together with a comparison of the utility of the protected tables with L1-CTA and L2-CTA.

■ TC-31

Tuesday, 12:30-14:00
CC-A33

Applications of the Neural Networks

Stream: Data Mining, Knowledge Discovery and Artificial Intelligence

Contributed session

Chair: Yoshifumi Kusunoki, Osaka University, Japan, kusunoki@eie.eng.osaka-u.ac.jp, Chair: Anastasia Motrenko, Applied mathematics and management, MIPT, Moscow, Russian Federation, pastt.petrovna@gmail.com

1 - Supplier’s performance measurement using intelligent clustering

Meltem Gulserin, Industrial Engineering, Istanbul Technical University, Macka, 34367, Istanbul, Turkey, meltem.gulserin@gmail.com, Mine Isik, Gulgun Kayakuthu

This research aims to propose a supplier performance measurement model including the supplier relations. Factors affecting the performance for procurement are accumulated through the literature survey but improved with the expert support. The proposed model clusters the suppliers according to the performance using Self Organized Maps based on Kohonen networks. This model benefits the historical data to support the future plans in a changing business environment. A case study on automotive suppliers is presented. This research will be valuable for designing the roadmap of supplier management.

2 - Modelling the behaviour of masonry walls under out of plane loading by ANN

M. Sami Donduren, Selcuk University, Turkey, sdonuren@selcuk.edu.tr

In this study, out-of-plane failures of two masonry walls having different mortar properties were investigated and the results were modeled with Artificial Neural Networks (ANN). First masonry wall is knitted and plastered by conventional mortar and the second test specimen is knitted and plastered by improved mortar which has Stikalatex as an additive. As a result, the failure strength of the wall increased by 25%, which had improved binding property with additive material. And it has been seemed that the ANN model can produce acceptable results.

3 - Estimating the behaviors of reinforced concrete columns under axial load effect by ANN

M.Tolga Cogurcu, Selcuk University, Turkey, mtolgac@selcuk.edu.tr

The aim of this study is to estimate the load capacity and stress-strain relationship of columns which have the same cross-sectional areas under the effect of axial load by ANN. The results obtained in this study have shown that ANN is a sufficient method to estimate the behaviour of the columns. Results are analyzed with variance analysis on SPSS program and with security edge controls.
4 - Modelling the flexural behaviour of beams by ANN
Mehtem Kamanli, Selcuk University, Turkey, mkamanli@selcuk.edu.tr

In this study artificial neural network method was used to predict the deflection values of beams and compared with the experimental results of a testing series. For that aim, 6 reinforced concrete beams with constant rectangular cross-section were prepared and tested under pure bending. The neural network procedure was applied to determine or predict the deflection values of 1/1 scaled model beams. The analytical results were compared with the test results and further predictions including different mix designs can be possible at the end of the study.

3 - Power Transmission Grid Expansion using Benders Decomposition
David Gunkel, Chair of Energy Economics, TU Dresden, Münchner Platz 3, 01069, Dresden, Germany, david.gunkel@tu-dresden.de, Friedrich Kunz

Power generation and demand of electric power spatially diverge as a result of the proceeding energy transition. Consequently, the network has to be extended to cope with the new requirements. This paper addresses a way to solve large-scaled mixed-integer problems of network expansion planning applying benders decomposition. The results of the algorithm are exemplarily shown in a grid model.

2 - Wind power in Europe: Modeling of wind feed-in time series with an hourly resolution
Alexander von Selasinsky, TU Dresden, Germany, Alexander.von_Selasinsky@tu-dresden.de, Michael Zipf

The research to be presented addresses the modeling of wind feed-in for EU27-countries. Based on six hour time series of wind speed that are publically available, it is shown how time series of hourly wind feed-in can be constructed. In this context, an algorithm is presented that enables the transition from six hour to one hour time series. Whereas modeling wind feed-in on an hourly resolution is especially relevant for energy system analyses, the research to be presented evaluates calculated data by discussing the smoothing of wind power output through the spatial distribution of generation.

1 - An Electricity Market Model with Generation Capacity Investment under Uncertainty
Andreas Schröder, Energy, Transportation, Environment, DIW Berlin, Mohrenstr. 58, 10117, Berlin, Preussen, Germany, aschroeder@diw.de

This article presents an electricity dispatch model with endogenous electricity generation capacity expansion for Germany over the horizon 2035. The target is to quantify how fuel price uncertainty impacts investment incentives of thermal power plants. Results point to two findings which are in line with general theory: Accounting for stochasticity increases investment levels overall and the investment portfolio tends to be more diverse.

To cope with increasing fluctuating renewable infeed, new pump storage capacity needs to be installed to guarantee the stability of the power grid. Whereas recent scientific publications focus on the electricity spot market for the valuation of pump storages, we propose an approach which combines the spot- with a reserve market optimization. We derive the optimal operating strategy theoretically and solve the optimization problem by applying dynamic programming on a (numerical constructed) recombining price tree. In addition, we calculate the value of a representative pump storage.

Risk and Uncertainty in Energy Models

Stream: Emissions Trading and Energy (ETE) Reform of Energy Regulations
Invited session
Chair: Dominik Möst, Chair of Energy Economics, Technische Universität Dresden, Hertzstrasse 16, 01062, Dresden, Germany, Dominik.Moest@tu-dresden.de

- TC-32

Tuesday, 12:30-14:00
CC-A34

Understanding, Modeling and Implementation of OR for Sustainable Development

Stream: OR for Development and Developing Countries
Invited session
Chair: Alexander Makarenko, Institute for Applied System Analysis, National Technical University of Ukraine “KPI”, Prospect Pobedy 37, 03056, Kiev, Ukraine, makalex@i.com.ua

- 1 - Foreign Direct Investment Trends and Comparative Analysis for Chosen Transition Countries
Snjezana Pivac, Faculty of Economics, University of Split, Department of Quantitative Methods in Economics, Matice hrvatske 31, 21000, Split, Croatia, spivac@efst.hr

Foreign direct investments (FDI) have high positive impact on economic impetus especially in transition countries. So in the focus of this paper are the structure and forms of FDI and their influence on crucial macroeconomic variables. In the FDI inflow analysis the country risk rating estimation has been essential. FDI efficiency analysis is enriched with correlation between Incremental Capital Output Ratio (ICOR) and GDP increase. Multivariate classification of ten transition countries has been carried out according to all regarding indicators.

- 2 - Panel data analysis of institutional variables in attracting foreign direct investment in countries of central and south-eastern Europe
Elza Jurun, Faculty of Economics, University of Split, Department of Quantitative Methods in Economics, Matice hrvatske 31, 21000, Split, Croatia, elza@efst.hr, Mario Pecaric, Tino Kusanovic

The aim of the paper is to find out the relevance of institutional factors vis-a-vis traditional variables indicating macroeconomic stability in attracting foreign direct investment as a means of further economic restructuring and international competitiveness improvement. The Arellano-Bond dynamic panel based on multivariate factor analysis of related variables has been carried out for 11 countries from Central and South-Eastern Europe. The results show that after macroeconomic stability is realised institutional reform dynamism gains on the importance.

- 3 - General Sustainable Development Problems and OR
Alexander Makarenko, Institute for Applied System Analysis, National Technical University of Ukraine "KPI", Prospect Pobedy 37, 03056, Kiev, Ukraine, makalex@i.com.ua

The sustainable development (SD) concept is one of general recent development. Finally the new prospects for proposed ideas on SD are described, including OR and education problems.

- 4 - Valuation of Pumped Hydro Storages with respect to the Electricity Spot and Reserve Power Markets
Oliver Woll, Universität Duisburg-Essen, Universitätsstraße 12, 45117, Essen, Germany, oliver.woll@uni-due.de, Bastian Felix, Christoph Weber

Numerical constructed) recombining price tree. In addition, we calculate the value of a representative pump storage.
**TC-34**

**Optimization for Sustainable Development**

**Invited session**

Chair: Herman Mawengkang, Mathematics, The University of Sumatera Utara, FMIPA USU, KAMPUS USU, 20155, Medan, Indonesia, mawengkang@usu.ac.id

Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

**1 - Multi objective stochastic programming model for waste management in crude palm oil industry**

Meslin Silalahi, Mathematics, University of Sisigamangaraja-Tapanuli/Grad School of Mathematics USU, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, meslin_silalahi@yahoo.com, Hendaru Sadyadharma, Herman Mawengkang

The crude palm oil process does not need any chemicals as a processing aid. However, there are a number of environmental problems, such as high water consumption, the generation of a large amount of wastewater with a high organic content, and the generation of a large quantity of solid wastes and air pollution. We include constraints involving random parameters of waste, which are required to be satisfied with a pre-specified probability threshold. In this paper we propose a multi-objective stochastic optimization model for tackling such environmental risk production planning problem.

**2 - Optimization approach for measuring the ecological suitability of product packaging**

Zoran Rakicic, Faculty of Organizational Sciences, University of Belgrade, Jove Ilica 154, 11000, Belgrade, Serbia, zoran.rakicic@gmail.com, Jovana Kojic

Limitation of available resources in the world and the general need of reducing operating costs create a need to review the entire process of creating each element of the product, such as product packaging. This paper presents a new and different approach to the analysis of the ecological suitability of product packaging, using an optimization model that is focused on its dimensions. General method is further applied to some of the most commonly used consumer products. The study shows that suboptimal packaging leads to higher material consumption and increase of prices of the final products.

**3 - Modeling the spread of infectious disease based on dynamic social network**

Firmansyah Firmansyah, Mathematics, University Muslim Nusantara, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, fnasution94@yahoo.com, Herman Mawengkang

The dynamic of human contact can be considered as a potential point for predicting the spread of infectious disease. In this paper we consider the SIRS model. We include the dynamic of human social interaction and social distance in the model such that it would be possible to control the spread of the disease.

**TC-35**

**Innovation in Logistics**

**Invited session**

Chair: Belarmino Adenso-Diaz, Engineering School at Gijon, Universidad de Oviedo, Campus de Viesques, 33204, Gijon, Spain, adenso@epsig.uniovi.es

Chair: Ben Lev, Decision Sciences, Drexel University, LeBow College of Business, 101 N. 33rd st., 19104, Philadelphia, Pa, United States, blev@drexel.edu

**1 - Company-wide Production Planning Using a Multiple Technology DEA approach**

Sebastián Lozano, Dept. of Industrial Management, University of Seville, Escuela Superior de Ingenieros, Camino de los Descubrimientos, s/n, 41092, Seville, Spain, slozano@us.es

The proposed centralized-DEA approach aims at minimizing the input costs incurred to attain specified total, company-wide output levels. Specific features of the proposed approach are the consideration of multiple technologies, lower and upper bounds on the production levels of each plant and the possibility of shutting down a plant, if necessary. The consideration of multiple technologies, in particular, takes into account the existence of heterogeneity within the company’s facilities. In that scenario, grouping all plants within a single technology gives misleading results.

**2 - Bicriteria model for designing a container depots logistic network**

Belarmino Adenso-Diaz, Engineering School at Gijon, Universidad de Oviedo, Campus de Viesques, 33204, Gijon, Spain, adenso@epsig.uniovi.es, Antonio Palacio, Salvador Farió, Sebastián Lozano

The container is a basic tool for all maritime logistic operations. Once unloaded by the importers, containers must be stored in the terminal port or in a depot, waiting for an exporter needing them. The location of these container depots has an impact on the logistic costs, as well as in the environment of the area, given the heavy traffic load inherent to these operations. In this research we propose a bicriteria model for designing the depots network in a hinterland. Results are applied to the case of the Port of Valencia.

**3 - A mathematical model to design an inland network of intermodal terminals**

Carlos Andres, Management Department, Polytechnic University of Valencia, Camino de Vera S/N, 46022, Valencia, Spain, candsres@omp.upv.es, Salvador Farió, Julián Mähut
This paper shows how a mathematical model based on the typical hub location problem has been used to develop a first analysis for the design of a network of inland terminals giving support to main Spanish container seaports and their traffic. The main objective of the model is to reduce total transport costs through the optimal location of a set of inland terminals connected to seaports by railway. The problem has been successfully solved using Gusek software, allowing an interesting analysis about inland terminals location and their influence area.

**TC-36**

**Tuesday, 12:30-14:00**

**CC-A43**

**QMPD Session 1**

**Stream: Quantitative Models for Performance and Dependability**

**Invited session**

Chair: Markus Siegle, Computer Science, Universitaet der Bundeswehr Muenchen, Universitaet der Bundeswehr Muenchen, 85577, Neubiberg, Germany, markus.siegle@unibw.de

**1 - Memory-efficient bounding algorithm for the two-terminal reliability problem**

Minh Le, 110, TU Munich, Boltzmannstraße 3, 85748, Garching b. München, Bayern, Germany, minh@freenet.de

Determining the two-terminal reliability of arbitrary redundancy systems modeled as combinatorial graphs is known to be NP-hard. Thus, bounding algorithms are used to cope with large graph sizes. Still, they have huge demands on memory. We propose a memory-efficient implementation of an extension of the Goben-Dotson bounding algorithm. Without reducing runtime, the compression of relevant data structures allows to use low-bandwidth high-capacity storage. This way, available hard disk space becomes the limiting factor. We can handle graphs with sizes reaching around 100 components.

**2 - An enhanced two-phase MAP fitting method**

András Mészáros, Department of Telecommunications, Budapest University of Technology and Economics, Magyar Tudósok Köriútja 2., 1117, Budapest, Hungary, meszaros@hit.bme.hu, Miklós Telek

Markov arrival processes (MAPs) are used extensively in traffic modeling. A wide variety of fitting procedures have been developed. Most of these are computationally demanding or not general enough. To resolve this problem, two-step procedures of a specific type have been made, which fit a phase-type distribution (PH) to static parameters in the first step, and extend it to a MAP in the second while fitting dynamic parameters. We present a method that aims at providing a good starting point for the second step by optimizing the representation of the PH that was produced by the first step.

**3 - Time-parallel simulation for stochastic automata networks**

Jean-Michel Foumeau, PRISMI, UVSQ, Université de Versailles, 45 avenue des Etats Unis, 78000, Versailles, France, jmfl@prism.uvsq.fr, Franck Quessette, Thu Ha Dao Thi

Time Parallel Simulation (TPS) is the construction of the time-slices of a sample-path on a set of parallel processes (see Fujimoto2000, chap. 6 and references therein). TPS has a potential to massive parallelism as the number of logical processes is only limited by the number of times intervals which is a direct consequence of the time granularity and the simulation length. Stochastic Automata Networks allow the construction of extremely large Markov chains. Here we show how we can use TPS to solve efficiently some SAN models. The approach is based on some notions of monotone models.

**4 - M/G/c/c state dependent travel time models and properties**

J. MacGregor Smith, Mechanical and Industrial Eng. Dep., University of Massachusetts at Amherst, 114 Marston Hall, University of Massachusetts, 1003, Amherst, MA, United States, jmsmith@ecs.umass.edu, F. R. B. Cruz

We show that state dependent M/G/c/c queuing models provide a quantitative foundation for three-phase traffic flow theory. An important property shown with the M/G/c/c model is that the travel time function is not convex, but S-shaped (i.e. logistics curve). Extensive analytical and simulation experiments are shown to verify the S-shaped nature of the travel time function and the use of the M/G/c/c model’s method of estimation of travel time over vehicular traffic links as compared with traditional approaches.

**TC-37**

**Tuesday, 12:30-14:00**

**CC-Act**

**OR in Health & Life Sciences 3**

**Stream: OR in Health & Life Sciences (contributed)**

**Contributed session**

Chair: Yw Chen, DYU, Taiwan, pauldyu57@gmail.com

1 - Planning in a regional blood distribution network

Jose luis Andrade, Industrial Management, School of Engineering, University of Seville, Camino de los Descubrimientos s/n, 41092, Seville, Spain, jlandrade@esi.us.es, Pedro L. Gonzalez-R

We present an optimization model to plan the supply of blood products to hospitals in a regional blood distribution network. Blood units are fixed shelf life resources to be used for the demanded surgeries, considering urgency and blood substitution rules. The model outcomes weekly decisions on the inventory levels of blood products and the amount of units transferred from one location to another, to perform low wastage and shortage levels. Our plan offers a single strategy providing an average good performance with uncertain demands and outcomes the needed level of donation promotion.

2 - A cloud service to allocate emergent patients by affinity set

Yuh-Wen Chen, Institute of IE and MOT, Da-Yeh University, 112 Shan-Jeau Rd., Da-Tsen, Chang-Hwa 51505, Taiwan., 51505, Chang-Hwa, Taiwan, profchen@mail.dyu.edu.tw

A large disaster always generates numerous trauma patients in a very short time. This study develops a cloud service to allocate these patients to appropriate hospitals in order to save their lives and guarantee the service level of emergency medicine. First, the web-platform of capturing vital signs of emergent patients is established. Second, a decision model of multi-attribute decision making based on affinity set is developed. Finally, the decision model is practically launched in the web-platform to aid the transport decision for allocating emergent patients to hospitals.

3 - A business model for synchronized and patient-centered Tele-health service

Jiun-Yu Yu, Business Administration, National Taiwan University, No. 85, Sec. 4, Roosevelt Road., 106, Taipei, Taiwan, jyyu@ntu.edu.tw, Kwei-Long Huang

Tele-health is a promising solution to take care of patients with cardiovascular disease. In this study, an integrated approach is applied to construct a self-sustainable business model for a newly established Tele-Health Center (THC) to dynamically measure and continuously improve its performance. With process analysis, VISOR framework, and balanced scorecard, a business model in the form of key performance indicator (KPI) matrix is constructed. The causal structure of KPIs is investigated so that the growth-stimulating loops are identified, helping THC prioritize its tasks to move forward.
1 - On Nonsmooth Optimality Theorems for Robust Multiobjective Optimization Problems

Gue Myung Lee, Department of Applied Mathematics, Pukyong National University, 599-1 Daejeon 3-dong Nam-gu, 608–737, Busan, Korea, Republic Of, gmlee@pknu.ac.kr

In this talk, we present optimality theorems for the robust counterparts (the worst-case counterparts) of nonsmooth multiobjective optimization problems with uncertainty data, which are called robust multiobjective optimization problems. The involved functions in the problems are locally Lipschitz. Moreover, we give examples showing that the convexity of the uncertain sets and the concavity of the constraint functions are essential in the optimality theorems.

2 - On DC set optimization problems

Daishi Kuroiwa, Shimane University, Japan, kuroiwa@math.shimane-u.ac.jp

Set optimization is a minimization problem whose objective function is set-valued and criteria of solution are based on set-relations. In this presentation, we propose a notion of DC set-valued functions and we study optimization problems with an objective DC set-valued function.

3 - Unified scalarization for sets and Ekeland’s variational principle for set-valued maps

Tamaki Tanaka, Mathematics, Niigata University, Ikarashi 2, 8050, 950-2181, Niigata, Niigata, Japan, tamaki@math.sc.niigata-u.ac.jp

In this paper, we introduce a certain mathematical methodology on the comparison between sets and Ekeland’s variational principle for set-valued maps via several scalarizing functions. The original idea on the sublinear scalarization for vectors was dealt by Krasnosel’ skiǐ in 1962 and by Rubinov in 1977, and then it was applied to vector optimization with its concrete definition by Tammer (Gerstewitz) in 1983. Recently, Kuroiwa, Tanaka, and Yamada define twelve types of unified scalarizing functions for sets based on six kinds of set-relations proposed by Kuroiwa, Tanaka, and Ha in 1997.

A closely related type of problem in MCDA to that of sorting is clustering. As in Data Mining, in MCDA too, no unanimous definition of clustering is given. We address this by formally defining several types of clustering in a MCDA context. We base our definitions on any outranking relation from which different preferential situations can be extracted between the alternatives. We define the ideal result with respect to these definitions and develop a method to find them. We present the implementation of this approach in the diviz software and illustrate it using a well-known problem in MCDA.

1 - Efficient algorithms for robust ordinal regression

Tommi Tervonen, Econometric Institute, Erasmus University Rotterdam, PO Box 1738, 3000 HA, Rotterdam, Netherlands, tervonen@ese.eur.nl, Remy Splet

UTAGMS is an ordinal regression method that evaluates necessary and possible preference relations caused by holistic preference statements on a set of decision alternatives evaluated in terms of multiple criteria. Traditionally the relations are computed by defining appropriate LPs and using a solver. In our presentation we show that the relations’ computation can be formulated differently and asymptotically faster algorithms used. We also present and evaluate an MCMC sampling technique for uniform sampling of the general value functions used in stochastic extensions of UTAGMS.
2. Multicriteria sorting functions using valued assignment examples
Olivier Cailloux, Laboratoire Génie Industriel, École Centrale Paris, Grande Voie des Vignes, 92295, Châtenay-Malabry, France, olivier.cailloux@ecp.fr, Brice Mayag, Vincent Mousseau, Luis C. Dias

We propose to extend a classical elicitation technique for learning MCDA sorting functions. Such a function assigns each alternative from a set of alternatives, evaluated on multiple criteria, to a category in a set of preference ordered categories. We ask the decision maker for a set of assignment examples where each example contains several possible destination categories for an alternative, each associated with a credibility. We propose procedures to deduce from this information several sorting functions, giving more or less precise results depending on the chosen credibility level.

3. On the estimation of the parameters of Electre Tri model in multi criteria ordinal sorting problem: a proposal of new approach in two phases
Valentina Minnetti, Scienze Statistiche, Università La Sapienza, Italy, valentina.minnetti@uniroma1.it

In this paper we are interested in the Multi Criteria Sorting Problem; to solve it we use the Electre Tri method, based on the outranking relation created through the Decision Maker’s preference information in terms of the Assignment Examples (AEs). This method requires the elicitation of preferential parameters (weights, thresholds, profiles, cutting level) in order to construct a preference model which best matches the AEs. We propose a new methodology in two phases, taking into account that the core of the analysis is the profiles’ estimation made by linear programming problem.

4. A ranking approach based on outranking relations using mathematical programming
Selin Ozpeynirci, Industrial Systems Engineering, Izmir University of Economics, Sakarya Cad. No156, 35330, Izmir, Turkey, selin.ozpeynirci@ieu.edu.tr, Ozgur Ozpeynirci, Yigit Kazancoglu

We consider the problem of ranking alternatives evaluated on multiple criteria, which may arise in many real life applications such as ranking countries, projects, universities and students. Several outranking methods in the literature require the explicit definition of all parameters in advance, which can be difficult for the decision maker. In this study, we develop an outranking based ranking method that uses mathematical modeling approach and requires only a subset of the parameters defined by the decision maker. A real life example is used to illustrate the method.

TC-41
Tuesday, 12:30-14:00
HH-Heyerdahl
AHP/ANP 6
Stream: Analytic Hierarchy Process, Analytic Network Process
Invited session
Chair: Pekka Korhonen, Economics and Management Science, Helsinki School of Economics, Runeberginkatu 22-24, 100, Helsinki, Finland, korhonen@hkkk.fi

1. R&D Personnel Selection with Fuzzy Analytic Hierarchy
Erhan Berk, Defence Science, Hava Duragi Lojmanları 4.Blok Daire1, 06790, Ankara, Turkey, erhanberk@hotmail.com

In the 21st century where the competitive environment becomes very tough for companies in parallel with the drastic development in technology, only innovative companies became prominent. The R&D personnel in particular have played the major role in these emerging innovations. In this study a Fuzzy Analytical Hierarchy Process (AHP) method for the selection of R&D personnel has been proposed. A case study has been conducted by using the weights obtained from the Fuzzy AHP method and the results have been compared.

2. Determining effective criteria of Customers’ satisfaction in kitchen worktops by using AHP
Majid Azzizi, Department of Wood and Paper, Faculty of Natural Resources, University of Tehran, Daneshkahdeh St., 31585-4314, Karaj, Tehran, Iran, Islamic Republic Of, mazizi@ut.ac.ir, Vahid Nabavi, Mehdi Faezipour

Determination of effective criteria in customer satisfaction of worktops is very important for any company that produces this product. To identify effective criteria for customers’ satisfaction five major groups which are selling condition and price, delivery condition, guaranty, raw material quality and technological specification were selected. These major groups have 19 sub-criteria. The priority rate of these criteria and sub-criteria was obtained by AHP Sub-criteria of price, payment condition, top veneer quality, MDF quality and fast delivery had the highest priorities, respectively.

3. Analysing numerically three different methods to estimate a priority vector from inconsistent pairwise comparison matrices in AHP
Attila Poesz, Corvinus University of Budapest, Fovam ter 8, 1093, Budapest, Hungary, attila.poesz@uni-corvinus.hu, Pekka Korhonen

In our paper we present a simulation framework in which the performance of the estimating methods used to determine priority vector could be analysed in various inconsistency levels. Furthermore, we study whether the implementation of the “Condition of Order Preservation” (COP) defined by Bana e Costa and Vansnick (2008) could provide a better solution for the decision makers. The importance of our analysis is based on the author’s claim that the COP has to be satisfied by any priority methods, otherwise the method has a fundamental weakness.

TC-42
Tuesday, 12:30-14:00
BW-Amber
Queueing Systems I
Stream: Stochastic Modeling and Simulation in Engineering, Management and Science
Invited session
Chair: Erik Kropat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.kropat@unibw.de
Chair: Bisra Temocin, Middle East Technical University, 06531, Ankara, Turkey, busras@gmail.com
Chair: Devin Sezer, Middle East Technical University, Institute of Applied Mathematics, Eskisehir Yolu, 06531, Ankara, devin@metu.edu.tr

1. The Availability and Separability of Unreliable Networks
Yat-wah Wan, Institute of Logistics Management, National Dong Hwa University, 1 Sec. 2, Da-Hsueh Road, Shou-Feng, 974, Hualien, Taiwan, ywan@mail.ndhu.edu.tw

Many networks of reliable stations have their steady-state distributions in product form. Similar separable results exist for networks with unreliable stations, where arrivals finding stations unavailable are blocked, and the ups and downs of stations are reversible processes independent of numbers of customers at stations. We show that the steady-state distribution of an unreliable network can still be separable when ups and downs of stations are dependent in some strong sense. We also look for general separable results for state-dependent arrivals and ups and downs of stations.

2. Inequality of Stability in the M2/M2/1 Queue with Preemptive Priority
Hamadouche Naima, Recherche Operational, LAMOS, University of Bejaia, Algerie, Bejaia, Algeria, naima_maths@yahoo.fr
This paper studies the M2/M2/1 queue with preemptive priority. We use the strong stability method to approximate the characteristics of the M2/M2/1 queue with preemptive priority by those of the M/M/1 queue. When the arrival intensity of the priority request is sufficiently small. First we give conditions of this approximation, second we give the bound of approximation, in the last, we include a numerical example and simulation results.

3 - Transient queues with correlated arrivals. Algorithmic approach
Claus Gwiggner, Information Systems, FU Berlin, Garsyrstr. 21, 14195, Berlin, Germany, claus.gwiggner@fu-berlin.de, Sakae Nagamaka
We look into a queueing system where customers are pre-scheduled but arrive with a certain delay. This is an old problem with few analytical results. In particular, the arrival count process contains serial correlation. We identify this correlation structure for some special cases. Based on this we obtain transient solutions of the queue length. As an application we derive decision rules for aircraft delay management under uncertainty.

4 - Optimal control by unreliable queueing systems with broadcasting service
Alexander Dudin, Applied Mathematics and Computer Science, Belarusian State University, 4, Independence Ave., Minsk-30, 220030, Minsk, Belarus, dudin@bsu.by, Bin Sun
We consider an unreliable MAP/PH/N type queueing system where each customer may be served in parallel by several available servers. We show such advantages of this service discipline in comparison to the classical service discipline as smaller average sojourn time and higher probability of the correct service. Problem of the optimal choice of the limiting number of servers, which can be involved into the service of an arbitrary customer, is numerically solved. Numerical examples illustrating effect of correlation in arrival process are presented.

In this talk we present a Stochastic Capacitated Traveling Salesmen Location Problem in which a single facility has to be located in a given area. This facility is used to serve a set of customers with unknown position by traveling salesmen. The aim is to determine the service zone that minimizes the expected cost of the traveled routes. We propose a two-stage stochastic second order cone program where scenarios are represented by different sets of customers. Optimal solutions are compared with the Capacitated Traveling Salesmen Location Problem heuristic proposed by Simchi-Levi (1991).

3 - Optimal timing and capacity choice for pumped hydropower storage
Ane Marte Heggedal, ENOVA, 7491, Trondheim, Norway, ane.marte.heggedal@enova.no, Emily Fertig, Gerard Doorman, Jay Apt
Pumped hydropower storage can smooth output from intermittent renewable electricity generators, facilitating their large-scale use in energy systems. Pumped storage ramps quickly enough to smooth wind power and could profit from arbitrage on the short-term price fluctuations wind power strengthens. We consider five capacity alternatives for a pumped storage facility in Norway that practices arbitrage in the German market. Real options theory is used to value the investment opportunity, since unlike net present value, it accounts for uncertainty and intertemporal choice.

4 - Mathematical Optimization of an Industrial-Scale Engineering System
Selis Onel, Chemical Engineering, Hacetetepe University, Department of Chemical Engineering, Beytepe Campus, 06800, Beytepe, Ankara, Turkey, selisoneil@gmail.com
Performance of the drying section of a paper machine is analyzed based on desired production rate while keeping drying parameters within the limits. A steady state analytical model is developed by employing material and energy balances on the system and is solved using data collected for several paper grades to determine the drying parameters most effective on energy consumption and the drying efficiency. A linear programming method is used for the optimization of the parameters minimizing the total cost for electricity, natural gas, and steam while maximizing the efficiency.

Ensemble Learning and Artificial Neural Networks
Stream: Machine Learning and its Applications
Invited session
Chair: Suryya Ozogur-Akyuz, Department of Mathematics and Computer Science, Bahcesehir University, Bahcesehir University, Dept of Mathematics and Computer Science, Cıragan cad. Besiktas, 34353, Istanbul, Turkey, suryya.akyuz@bahcesehir.edu.tr
Chair: Terry Windeatt, Electronic Engineering, Surrey University, Faculty of Engineering & Physical Sciences, University of Surrey, GU2 7XH, Guildford, Surrey, United Kingdom, T.Windeatt@surrey.ac.uk

1 - New Considerations on Bias-variance Decomposition in Ensemble Classifier Fusion
David Windridge, FEPS, University of Surrey, United Kingdom, d.windridge@surrey.ac.uk
Much progress has been made in the area of decision fusion through the separation of the process into its effects on the bias and variance of the ensemble. We investigate a previously unconsidered aspect of this process when feature spaces within the constituent processes are non-overlapping, drawing an analogy between the processes of classifier decision fusion and tomographic reconstruction. We demonstrate that standard classifier fusion introduces a morphological bias at the same time as reducing variance. By taking this into account we can substantially improve classification performance.
2 - Ensemble Pruning via DC Programming
Sureyya Ozogur-Akyuz, Department of Mathematics and Computer Science, Bahcesehir University, Bahcesehir University, Dept of Mathematics and Computer Science, Cagaran cad. Besiktas, 34353, Istanbul, Turkey, sureyya.akyzu@bahcesehir.edu.tr, Terry Windeatt, Raymond Smith
Ensemble learning is a method of combining learners, however the ensemble sizes are sometimes unnecessarily large which causes extra memory usage and decrease in effectiveness. Error Correcting Output Code (ECOC) is one of the well known ensemble techniques for multi-class classification which combines the outputs of binary base learners to predict the classes for multiclass data. We formulate ECOC for ensemble selection problem by using difference of convex functions (dc) programming and zero norm approximation to cardinality constraint. Experiments show that it outperforms the standard ECOC.

3 - Short-term forecasting of light rail passenger demand by artificial neural networks
Gökhan Sürmeli, Management Engineering, Istanbul Technical University, ITU İstiklal Caddesi Oda No: A406, Macka Kampüs-Besiktas, 34357, Istanbul, Turkey, gsurmeli@itu.edu.tr, Dilya Çelebi, Demet Bayraktar
Accurate demand information is a key factor for the scheduling of public transportation systems. In this study, ANN is applied to passenger demand forecasting problem for the light rail service in Istanbul. Due to its success of solving forecasting problems and its simple architecture, an MLP model is preferred. Daily demand data is split into four time slots and neural networks are developed for each of them. The performance of the models is compared to the best fitting ARIMA or exponential smoothing models in terms of root mean squared error and mean absolute percentage error.

4 - Optimizing the Backpropagation Algorithm for Training Artificial Neural Networks
Geraldo Miguel, COPPE / PESC, Universidade Federal do Rio de Janeiro, Brazil, R Mariz e Barros, 652/002, 20270-002, Rio de Janeiro, RJ, Brazil, geraldomiguel@yahoo.com, Nelson Maculan, Adilson Elias Xavier
This paper uses a new activation function, the Bi-Hyperbolic function, which offers a higher flexibility, and a faster evaluation time. It improves the performance of the Backpropagation algorithm acting straight at the topology of the network. Computational experiments with traditional problems of the literature show greater generalization capacity, faster convergence, higher computational speed and smaller number of neurons network architecture. The network configuration is also simplified, making this process faster and easier to be completed.

2 - Confidence-based Optimization for the Newsvendor Problem
Roberto Rossi, Business School, University of Edinburgh, 29 Buccleuch place, EH8 9JS, Edinburgh, United Kingdom, robros@gmail.com, Steven Prestwich, Armagan Tarim, Brahlm Hutch
We consider a Newsvendor problem in which the decision maker is given a set of past demand samples. We employ confidence interval analysis in order to identify a range of candidate order quantities that, with prescribed confidence probability, includes the real optimal order quantity for the underlying stochastic demand process with known distribution and unknown parameter(s). For these order quantities, we also produce cost upper and lower bounds. We apply our approach to Binomial, Poisson, and Exponential demand. For two of these distributions we discuss the case of unobserved lost sales.

3 - Economic order quantity of an inventory control system with order backlog
Eline De Cuypere, TELIN, University Ghent, St-Pietersnieuwstraat 41, 9000, Ghent, Belgium, eline.decuyper@telin.ugent.be, Koen De Turck, Dieter Fiems
We present a mathematical model which evaluates the performance of inventory control systems with order backlog. In terms of cost, we account for holding, set-up and backlog costs. Production of units starts when the inventory level drops below the threshold value and stops when stock capacity is reached. Moreover, orders are backlogged and coupled to the completion of the units. The inventory problem is studied in a Markovian setting. Set-up times are phase-type distributed while order and product arrivals are modelled by a Markovian arrival process.

4 - Two Modified Preventive Maintenance Models in a Finite Time Span with Failure Rate Reduction
Chun-Yuan Cheng, Dept. of Industrial Engineering & Management, Chanyang University of Technology, 168 Gifong E. Rd., Wufeng., 413, Taichung County, Taiwan, cycheng@mail.cuit.edu.tw, Min Wang, Mei-Ling Liu
For a preventive maintenance (PM) model over a finite time span, shorter PM interval can result in a better expected total maintenance cost (TC). However, the original optimal PM policies shown in literature are obtained by searching the optimal PM interval over a constrained range. We propose two modified failure-rate-reduction optimal PM policies: one is developed by releasing the constraint of the PM interval searching range; another is constructed by postponing the constrained range. We propose two modified failure-rate-reduction optimal PM policies: one is developed by releasing the constraint of the PM interval searching range; another is constructed by postponing the starting time of the PM program based on the fact that equipment is not easily fail in the early stage of its useful life.
The development of stochastic programming started six decades ago when Beale (1955), Dantzig (1955), Charnes and Cooper (1959) and others observed that for many linear programs to be solved, the values of the coefficients were not available. To solve these problems, the unknown values of coefficients were mostly replaced by their observed past values. The obtained solutions were then feasible and optimal with respect to some, maybe very rare set of observed coefficients. The suggestion was to replace the deterministic view by a stochastic one and to assume that the unknown coefficients or parameters, say u, are random and that their probability distribution P is known and independent of the decision variables. A decision has to be taken before the realization of the random coefficients is known, using the knowledge of probability distribution P.

The prototype stochastic program (we focus on in the sequel) aims at the selection of the "best possible" decision x belonging to a decision space X subject to certain constraints. To build a decision model means to specify the set of feasible decisions and to define a real objective function which generates, independently of individual realizations of random factors, a preference relation on the set of feasible decisions.

"Hard" constraints are usually reflected in definition of X. The outcome of the decision x which satisfies them depends on realization of random parameter u and is quantified as f(x,u). For different realizations one obtains different optimal values and different optimal solutions and the question is which of these decisions should be accepted. The common way is to use the expectation Ef(x,u) of the random objective function f(x,u) as the overall objective function, which is then independent of realizations of random parameters and exploits solely their probability distribution P. Numerous other criteria of optimality with respect to the uncertainty can be constructed. The risk-adjusted expected return objective function of the Markowitz model, Markowitz (1952), is a well known example. Of course, the choice of the criterion should reflect the purpose of the solved real-life problem.

The first applications appeared already in the fifties of the last century, e.g. Ferguson and Dantzig (1956), Charnes, Cooper, and Symonds (1958). They were based on simple types of stochastic programming models, such as stochastic linear programs with simple recourse and models with individual probabilistic constraints. Moreover, special assumptions about the probability distribution P were exploited.

The significant progress in the seventies happened thanks to Prékopa (1980), a special care to software development was initiated and has resulted in the HASA volume edited by Ermoliev and Wets (1988). Areas of further prospective applications have been delineated.

At present there are standardized types of stochastic programming models (e.g., two-stage and multistage stochastic programs with recourse, models with individual and joint probabilistic constraints, integer stochastic programs) with links to statistics and probability, to parametric and multiobjective programming, to stochastic dynamic programming and stochastic control with relevant software systems available or in progress. We refer to recent monographs and textbooks Birge and Louveaux (1997, 2011), Kall and Mayer (2005, 2011), Shapiro, Dentcheva, and Ruszczyński (2009), handbook edited by Shapiro and Ruszczyński (2003), collection edited by Infanger (2011) and to the stochastic programming bibliography by van der Vlerk (1996-2007).

The first applications appeared already in the fifties of the last century, e.g. Ferguson and Dantzig (1956), Charnes, Cooper, and Symonds (1958). They were based on simple types of stochastic programming models, such as stochastic linear programs with simple recourse and models with individual probabilistic constraints. Moreover, special assumptions about the probability distribution P were exploited.

By now, significant applications of stochastic programming have been made in many areas, such as transportation, production planning and allocation of resources, management of hydro power and water resources, energy production and transmission, optimization of technological processes, telecommunications, financial modeling and risk management.

There are many excellent recent papers on successful large-scale real-life applications of stochastic programming. We refer to collections Ziemba and Mulvey (1990) for a selection of financial problems, Wallace and Zembra (2005) devoted to non-financial applications, to Conejo, Carrión, and Morales (2010) focused on energy markets and collection edited by Bertocchi, Consigli, and Dempster (2011) on applications in finance and energy.

Stochastic programming is an example of a field which connects various areas of optimization, probability and statistics, numerical mathematics and computer science with the broad territory of operations research. The success of applications is conditioned by a close collaboration with users and it benefits from the team work. Even if implementation of real-life stochastic programming models frequently requires simplifications and/or approximations, their outcome may point at new decision strategies.

We shall focus on the modeling issues. From the modeling point of view, stochastic vehicle routing, stochastic networks and stochastic facility location problems have been mostly treated as a natural extension of the stochastic transportation problem with simple recourse, whereas individual probabilistic constraints have appeared in the context of the stochastic nutrition model and in water resources management models. The impressive early collection of case studies related to real-life applications of joint probabilistic constraints was edited by Prékopa (1978, 1985); it reflects the prevailing interest in applications to water resources problems at that time.

To apply stochastic programming means primarily to be familiar with the real-life problem in question, its purpose, constraints, and with the available level of information concerning the influential random factors. It is important to exploit the problem structure and to be aware of alternative models. One can consider different objective functions and to model the same problem using probabilistic constraints or penalizing the constraints violation or to combine both. Very often there is no convincing reason why to prefer one approach to another. The choice of model is tied to the data structure and it is frequently influenced by the decision maker’s individual attitude and the software available. To use the penalized approach means loss caused by the considered discrepancies, which may be a difficult task for the decision maker, who often prefers to assign probabilities ad hoc.
and to solve a stochastic program with individual probabilistic constraints. This model, however, does not distinguish the magnitudes of constraints violations.

We shall illustrate the modeling issues and the interplay between the problem setting and the stochastic programming model building by selected examples related mainly to water resources management and planning; see e.g. Prékopa (1978, 1985), Dupacová (1979), Dupacová et al. (1991), Escudero (2000), Edirisinghe et al. (2000) and references therein.

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Scheduling in Transport

Stream: Scheduling

Invited session

Chair: Jose M. Framinan, Industrial Management, School of Engineering, University of Seville, Avda. de los Descubrimientos s/n, Seville, Spain, jose@esi.us.es

1 - The problem of minimization maximum weighted lateness of orders for two railway stations/

Dmitry Arkhipov, ORSOT, Institute of Control Sciences, Pervomayskaya str., 28a - 53, 141707, Dolgoprudny, Moscow, Russian Federation, mptrafter@gmail.com, Alexander Lazarev

The following scheduling problem is considered. There are two railway stations with double track. In each station there exists a variety of orders. Each order is a wagon with its release date, value(weight) and due date. Wagons are delivered by train. All trains consist of the same number of wagons and overcome the distance between stations in the same amount of time. Dynamical programming algorithm constructing the optimal schedule in compliance with criterion of minimal maximum weighted lateness in O(n6) operations.

2 - Public transport system route reliability estimation using macromodelling

Irina Pucina, Transport and Telecommunication institute, Lomonosova 1, LV-1039, Riga, Latvia, Pucina.I@esi.lv, Irina Yatskiv

The main purpose of this research is to investigate the possibility of estimation the Arrived Time (ATR) and Travel Time Reliability (TTR) for a single route on the macromodel of urban transport system. The experiments were conducted at the macromodel (VISUM) of Riga transport system. The actual travel trip time between stops and between route’s end stops and the vehicle arrived time at the end stop were obtained as the results of the experiments. According to obtained data have been calculated ATR and TTR for the single bus route and for its each stops.

3 - Scheduling interfering jobs in a permutation flowshop

Paz Perez Gonzalez, Industrial Management, University of Seville, Camino de los descubrimientos s/n, 41009, Sevilla, Spain, pazperez@esi.us.es, Jose M. Framinan

Most contributions regarding scheduling interfering jobs refer to one-machine setting. This paper studies the problem of scheduling two sets of jobs on permutation flowshop with the objectives of total completion times for both sets. Since one machine case is known to be NP-hard and there are some approximate algorithms, we analyze their adaptations to the flowshop setting. The methods are compared in an extensive test bed and computational results are provided.

4 - A Variable Neighbourhood Search (VNS) algorithm for solving Read Mix Concrete Production and Delivery Scheduling Problem (RMCPSDP)

Anna M. Coves, Institute of Industrial and Control Engineering, UPC, Diagonal 647, 08028, Barcelona, Spain, anna.maria.coves@upc.edu, M. Antonia de los Santos

In this communication we present a VNS algorithm for solving RMCPDSP. Integration of production and delivery is critical in the case of Ready Mix Concrete, as it expires approximately an hour and a half after it is produced. We propose three rules of VNS based on coding that includes the following aspects: plant order assignment; delivery priority; and time of first delivery for each order. We then combined this VNS algorithm with an MS algorithm that we had previously designed. We have found that using the two algorithms together provides better results by running only the VNS algorithm.
1 - Minimum cost VRP with time-varying speed data and congestion charge
Richard Eglese, The Management School, Lancaster University, Department of Management Science, LA1 4YX, Lancaster, Lancashire, United Kingdom, R.Eglese@lancaster.ac.uk, Liang Wen
A heuristic algorithm is introduced for vehicle routing and scheduling problems to minimize the total travel cost, including fuel, driver and congestion charge costs. The fuel cost depends on the speed for a vehicle to travel along any road in the network and varies according to the time of travel. If a vehicle enters the congestion charge zone during the daytime, a fixed charge is applied. The approach is tested on a constructed data set and also using real traffic data for the London area. The results are also evaluated in terms of the CO2 emissions.

2 - Analysis of optimal vehicle speed: from supersonic wave devices to GPS transceivers
Hiroyuki Kawano, Department of Systems Design and Engineering, Nanzan University, Seirei-cho 27, Seto, 4890863, Seto, Aichi, Japan, kawano@nanzan-u.ac.jp
In Hanshin Expressway Company, vehicle traffic is monitored by supersonic wave detection devices along 500 meter intervals, but it is not possible to observe accurate traffic conditions. Recently, traffic log of highway patrol vehicles equipped GPS transceivers are stored into a database system. We integrate the log data, including vehicle speed, latitude and longitude, and weather data. Based on optimal vehicle speed model, we calculate continuous complement positions of vehicles. We analyze optimal traffic volume and flows depending on different lines and time zones.

3 - A bi-objective Pollution-Routing Problem: trade-offs between fuel consumption and driving time
Ennrad Demir, School of Management, University of Southampton, 67 Kitchener Road, Portswood, SO17 3SF, SOUTHAMPTON, Hampshire, United Kingdom, e.demir@soton.ac.uk, Tolga Bektas, Gilbert Laporte
This paper studies a bi-objective Pollution-Routing Problem, an extension of the Vehicle Routing Problem with Time Windows, where one objective is to minimize fuel consumption, and the other total driving time. A solution method is described where an Adaptive Large Neighbourhood Search algorithm, combined with a specialized speed optimization algorithm, is used as a search engine for the application of four a posteriori methods to generate Pareto-optimal solutions to the problem. Results of extensive computational experimentation show the efficiency of the proposed approaches.

4 - Greenest paths in time-dependent transportation networks
U.Mahir Yildirim, Industrial Engineering, Sabanci University, Sabanci University, Faculty of Engineering and Natural Sciences, Tuzla, 34956, Istanbul, Turkey, mahiryl3dm@sabanciuniv.edu, Bülent Çatay
The literature on the shortest path algorithms (SPA) on time-dependent networks is mainly focused on finding the fastest (minimum time) path. Yet the current approaches are not applicable to determine the greenest (minimum greenhouse gas emitting/fuel consuming) path on a real transportation network. We discuss new approaches to find the greenest path given the speed profile of the network and an appropriate emission function of speed. Computational test using random data show the potential savings and sustainability benefits of the new approaches over the existing time-dependent SPA.

1 - An Adaptive Memetic Algorithm using Large Neighbourhood Search for the Multi-Depot Pickup and Delivery Problem
Pairoj Chaichiratikul, Business School, Imperial College London, 18, Elvaston Place, SW7 5QF, London, United Kingdom, pairoj.chaichiratikul@imperial.ac.uk, Eleni Hadjiiconstantinou
The objective of this NP-hard problem is to minimise the routing cost of the fleet of vehicles serving transportation requests in a large geographical coverage, subject to customer requirements. We propose a new heuristic approach that involves hybridisation between Adaptive Large Neighbourhood Search (ALNS) and Adaptive Memetic Algorithm (AMA). The proposed heuristic is computationally tested on standard benchmark instances from the literature. The preliminary computational results are promising; the proposed heuristic is capable of obtaining improved feasible solutions for some instances.

2 - The capacitated minimum spanning tree problem with time windows
Manolis Kritikos, Department of Management Science and Technology, Athens University of Economics and Business, 76, Patission street, 10434, Athens, Athens, Greece, kmn@aueb.gr, George Ioannou
We address the Capacitated Minimum Spanning Tree Problem with Time Windows (CMSTPTW). The CMSTPTW is an extension of the Capacitated Minimum Spanning Tree Problem (CMSTP). In the CMSTPTW, it is required to form the capacitated minimum-cost tree network such that the time windows constraints on the demand nodes are satisfied. For the solution of the CMSTPTW, we propose a greedy method. Our proposed method outperforms the greedy approach of Solomon for MSTPTW. This is an indication of the quality of our greedy method for the CMSTPTW.

3 - “Snakes and Ladders” heuristic algorithm (SLH) for the Hamiltonian cycles problem
Vladimir Ejov, School of Computer Science, Engineering and Mathematics, Flinders University, Sturt Road, 5042, Bedford Park, SA, Australia, vladimir.ejov@flinders.edu.au, Sergey Rossomakhine
We place the vertices of an undirected graph in some order on a circle. Arcs between adjacent vertices on the circle are called snakes, while other arcs represented by chords are called ladders. The SLH algorithm uses operations inspired by the Lin—Kernighan heuristic to reorder the vertices on the circle so as to transform some ladders into snakes. The use of a suitable stopping criterion ensures that the heuristic terminates in polynomial time. We have observed that SLH is successful even in cases where such cycles are extremely rare. Online demonstration will accompany the presentation.
**TD-05**

Tuesday, 14:30-16:00  
RB-L3  

Problems on graphs III  

Stream: Discrete Optimization, Geometry & Graphs  
(tributed)  

**Contributed session**  

Chair: Peter Recht, OR und Wirtschaftsinformatik, TU Dortmund, Vogelpothsweg 87, 44227, Dortmund, Germany, peter.recht@tu-dortmund.de  

1 - A Coloring Algorithm for Triangle-Free Graphs  
Mohammad Jamall, Mathematics and Statistics, Zayed University, UAE, United Arab Emirates,  
dr.mohammad.shoibjamall@gmail.com  
We give a randomized algorithm that properly colors the vertices of a graph G on n vertices with girth greater than 3 using O(D / log D) colors, where D is the maximum degree of G. The algorithm succeeds with high probability, provided D is large enough. The number of colors is best possible up to a constant factor for triangle-free graphs. The existence of such a proper coloring was established by Kim and Johansson respectively.  

A complete version of our paper can be found at arXiv:1101.5721.  

2 - An Efficient Algorithm for Stopping on a Sink in a Directed Acyclic Graph  
Grzegorz Kubicki, Mathematics, University of Louisville, Natural Sciences 227, 40292, Louisville, Kentucky, United States,  
gkubicki@louisville.edu, Wayne Goddard, Ewa Kubicka  
We consider an unordered version of the classical secretary problem. Vertices of an unknown directed acyclic graph of order n are revealed one by one in some random permutation. At each point, we know the subgraph induced by the revealed vertices. Our goal is to stop on a sink, a vertex with no out-neighbors. We show that this can be achieved with probability inversely proportional to the square root of n. This is best possible because the optimal stopping time on a sink in a directed path has the probability of success of that order of magnitude.  

3 - On the Cubic Dimension of certain Classes of Balanced Binary Trees into Hypercube  
Kamal Kabyl, Laboratory of Modeling and Optimization of Systems LAMOS, Commercial Sciences Department, University of Bejaia, Algeria, 06000, Bejaia, Algeria,  
k_kabyle2000@yahoo.fr, Abdelhatid Berrachedi  
The problem of embedding trees into the hypercube is much studied in graph theory. In fact many efforts have been devoted to find sufficient conditions for which a tree T is a subgraph of the hypercube. In this paper, we introduce some new classes of balanced binary trees by giving their cubical dimensions. Furthermore, these classes of trees satisfy the conjecture of Havel [1984], which states that every balanced binary tree with 2 to the power of n vertices can be embedded in an n-dimensional hypercube.  

4 - A "min-max-theorem" for the cycle packing problem in Euler graphs  
Peter Recht, OR und Wirtschaftsinformatik, TU Dortmund, Vogelpothsweg 87, 44227, Dortmund, Germany,  
peter.recht@tu-dortmund.de, Eva-Maria Sprengel  
We look for a set of edge-disjoint cycles of maximum cardinality in a graph G=(V,E). The problem is tackled by considering local traces T(v) of G. Local Traces are not uniquely defined but their packing numbers are. We prove that if G is is Eulerian every maximum edge-disjoint cycle packing of G induces maximum local traces T(v) or every v in V. In the opposite, if the total size of the local traces is minimal then the packing number of G must be maximum. The determination of such traces leads to multi-commodity flow-problem with quadratic objective function.

**TD-06**

Tuesday, 14:30-16:00  
RB-Gamma  

Relaxation Adaptive Memory Programming  

Stream: Metaheuristics  

**Invited session**  

Chair: Dorabela Gamboa, CIICESI-GECAD, ESTGF, Instituto Politécnico do Porto, Casa do Curral, Rua do Curral, Apte. 205, 4610-156, Felgueiras, Portugal, dgamboa@estgf.ipp.pt  

1 - A RAMP Algorithm for Generalized Assignments  
Cesar Rego, University of Mississippi, University, 38677, Oxford, MS, United States,  
crego@bus.olemiss.edu, Lutfu Sagbanawu  
We introduce a primal-dual RAMP algorithm for the solution of the multi-resource generalized assignment problems. The algorithm combines cross-parametric relaxation with the scatter search evaluationary procedure as a way to create compound memory structures that effectively integrate information from the primal and dual solution spaces. We present extensive computation results that clearly support the merit of the proposed algorithm when compared with the best alternative approaches.  

2 - RAMP for the Capacitated Facility Location Problem  
Telmo Matos, CIICESI, ESTGF, Instituto Politécnico do Porto, Casa do Curral, Rua do Curral, Apte. 205, 4610-156, Felgueiras, Portugal, 80904676@estgf.ipp.pt, Dorabela Gamboa, Cesar Rego  
We present a relaxation adaptive memory programming (RAMP) approach for the capacitated facility location problem (CFLP). The algorithm uses dual ascent with tabu search to explore primal-dual relationships in a RAMP framework. A comparative analysis with the best performing algorithms of the literature is presented and discussed.  

3 - A PD-RAMP Algorithm for the UFLP  
Dorabela Gamboa, CIICESI-GECAD, ESTGF, Instituto Politécnico do Porto, Casa do Curral, Rua do Curral, Apte. 205, 4610-156, Felgueiras, Portugal, dgamboa@estgf.ipp.pt, Telmo Matos, Fábio Maia, Cesar Rego  
We address the well-studied uncapacitated facility location problem (UFLP) aimed at determining the set of possible locations where facilities should be established in order to serve a set of customers with minimum cost. A relaxation adaptive memory programming (RAMP) approach is developed by combining dual relaxation with scatter search. The results obtained on a standard testbed show the advantages of this approach over the current state-of-the-art algorithms for the UFLP.  

4 - A Parallel RAMP Algorithm for the Set Covering Problem  
Tabitha James, Business Information Technology, Virginia Tech, 1007 Pamplin Hall, 24061, Blacksburg, VA, United States,  
tajames@vt.edu, Cesar Rego, José Humberto Ablandedo Rosas  
The relaxation adaptive memory programming (RAMP) framework allows for the combination of (primal) heuristic search methods with exact solution methodologies that solve a (dual) relaxation of the original problem in order to create an algorithm that leverages both approaches for difficult combinatorial optimization problems. In this study, we propose a parallel RAMP algorithm for the solution of large scale set covering problems.  

**TD-07**

Tuesday, 14:30-16:00  
RB-Eta  

Manufacturing Issues  

Stream: Supply Chain Planning  

**Invited session**  

Chair: Ignacio Eguia, School of Engineering. Dpt. of...
Management Science, University of Seville, Camino de los Descubrimientos s/n, 41092, Sevilla, Spain, ies@esi.us.es

1 - Transportation scheduling in assembly lines under storage constraints: A case study of the automobile industry
Masood Fathi, Organización Industrial, TECNUN Universidad de Navarra, School of Engineering (Tecnun), P Manuel Lardizabal 13, 20018, San Sebastián, Guipuzcoa, Spain, fathi.masood@gmail.com, María Jesús Alvarez, Victoria Rodríguez

Study attempts to introduce an integrated model for production, inventory and transportation in assembly lines under storage constraints. An integrated optimization model which is a mixed integer linear programming formulation is presented with multiple objectives such as minimizing the number of tours, inventory level. To validate the presented model, it has been tested in a real case study in Volkswagen Navarra plant, Spain. Given that different priorities for objectives defined in the discussed real case study exist, it has been tried to solve the model through a goal programming framework.

2 - Modelling machine loading problem in reconfigurable manufacturing systems
Ignacio Eguia, School of Engineering, Dpt. of Management Science, University of Seville, Camino de los Descubrimientos s/n, 41092, Sevilla, Spain, ies@esi.us.es, Jesus Racero, Fernando Guerrero

A Reconfigurable Manufacturing System (RMS) is designed to produce a family of parts that share some similarities using modular Reconfigurable Machines. When modules are changed in a RM, different operations can be performed on the new machine configuration. This work is concerned with the loading problem in a RMS. This problem deals with the allocation of the operations and the associated modules of a set of selected parts’ families among the RM, subject to the technological and capacity constraints of the RMS. A MILP model is developed with an objective function of balancing the workload.

3 - Manufacturing process flexibility and capacity expansion using Robust Optimization features in AIMMS
Ovidiu Listes, Paragon Decision Technology, Paragon Decision Technology, Schipholweg 1, 2034 LS, Haarlem, Netherlands, o.listes@aimms.com, Frédéric Babonneau, Christian Van Delft, Jean-Philippe Vial

We address the problem of manufacturing process flexibility and capacity expansion under uncertain demands using Robust Optimization. The model involves binary product-to-plant assignments and decisions for expanding capacity. Affine decision rules are used for capacity expansion and the amounts of processed products. We illustrate how AIMMS can accommodate the model formulation under uncertainty and generate the robust counterpart automatically. We also show how the intuitive modeling concepts in AIMMS allow for flexible experiments and comparison of results based on various uncertainty sets.

4 - Multi-objective synchronized planning in dynamic collaborative manufacturing networks
Şenay Sadıc, University of Porto, Porto, Portugal, shenay@gmail.com, Jorge Pinho de Sousa, José Crispim

In manufacturing networks, collaboration and information sharing may strongly contribute to the global system performance. Dynamic network planning by synchronizing operations and allocating activities is a very hard problem due to its complex nature and increasing product complexity. In this study we develop a multi-objective MILP model tackling this problem to minimize the overall operational costs of the network and provide some flexibility to the units. The main drivers of the model are cost minimization and the concept of flexibility, as a way to deal with different types of uncertainty.
1 - How to deal with alternative cutting lengths in a one-dimensional cutting stock problem
Markus Siepermann, Business Information Management, TU Dortmund, 44221, Dortmund, Germany, markus.siepermann@tu-dortmund.de, Richard Lackes, Torsten Noll

The input material of the tubes production process consists of steel bars that have to be cut into pieces before they are heated and rolled. In order to avoid waste of input material the cuts of the input material have to be optimized which is a classical one-dimensional cutting problem. A special characteristic of the tubes production is that the same output can be reached with different cutting lengths. Thus, the minimization of input material gets more difficult. This paper presents a solution how the optimization and the known algorithms have to be adapted.

2 - A pseudo-polynomial time algorithm for a subclass of the Variable-Sized BPP with Conflicts
Mohamed Maiza, Applied Mathematics Laboratory, Military Polytechnic School of Bordj El Bahri, EMP (Ex-ENITA), BP 17, Bordj El Bahri, 16111, Algiers, Algeria, m_maiza77@yahoo.fr, Mohammed Said Radjef, Sais Lakhdar

We propose a pseudo-polynomial time algorithm for the Variable Sized BPP with Conflicts in the case where the size of the items is at least equal to one third of the largest bin capacity. After assigning each of the three compatible items with size equal to one third of the largest bin to the same largest bin, the algorithm solves the problem as a minimum-weight matching problem in the weighted compatibility graph where nodes are the items and adjacent items are mutually compatible. The weight of a given edge is the minimum cost for packing the corresponding two items in the same or in separate bins.

3 - Multiobjective genetic algorithms to the one-dimensional cutting stock problem
Silvio de Araujo, Departamento de Ciências da Computação e Estatística-DCCE, Universidade Estadual Paulista-UNESP, R. Cristovao Colombo, 2265 - Jd Nazareth, 15054-000, São José do Rio Preto, São Paulo, Brazil, saraujo@ibilce.unesp.br, Hidenori Hashimoto, Koji Nonobe, Michel Vasquez, Yannick Vimont, Mutsunori Yagiura

This paper deals with the one-dimensional integer cutting stock problem. The case in which there is just one type of object in stock available in unlimited quantity is studied. A heuristic method based on the multi objective genetic algorithms concept is proposed to solve the problem considering two conflicting objective functions: minimization of the number of objects and the number of different cutting patterns. This heuristic is empirically analyzed by solving randomly generated instances and the results are compared with other methods from the literature.

4 - Optimization of the outbound boxes dimensions of mobile phones in a factory located in the Industrial Park of Manaus in Amazon State, Northern of Brazil.
Fabricio Costa, Nokia Institute of Technology - INdT, +559232365418, +559281065960, Manaus, Amazon, Brazil, fabricio.costa@indt.org.br

The mobile phone is a device with high value added. Those products are transported by airplane, volume and weight of boxes influences the freight costs. Therefore the dimensions of outbound packages are very important to that business. We considered three different types of constraints, such as dimensions, weight of boxes and operations. The results of new dimensions were: reduction of empty spaces inside boxes and freight costs, reduction of the product damages in operation, transport and collaborate to reduce the environment impacts. This industry is located in Manaus, Amazon state, Brazil.

Chair: Ana Catarina Nunes, Dep. Métodos Quantitativos, ISCTE -
1 - Metaheuristics for household refuse collection
Ana Catarina Nunes, Dep. Métodos Quantiativos, ISCTE - IUL / Centro IO, Portugal, Av. das Forças Armadas, 1649-026, Lisbon, Portugal, catarina.nunes@iscte.pt, Maria Cortinhal, Cândida Mourão

The household refuse collection in large urban areas may be modeled by the sectoring-arc routing problem (SARP). The SARP groups two families of problems: sectoring (or districting) problems and capacitated arc routing problems (CARP). The SARP is defined over a mixed graph. Its aim is to identify a given number of similar sectors (sub-graphs) and to build a set of collecting trips in each sector such that the total duration of the trips is minimized. Metaheuristics are presented, and computational results over a set of benchmark instances are reported.

2 - Solving a location-arc routing problem using a TS-VNS approach
Rui Borges Lopes, Dep. of Economics, Management and Industrial Engineering, CIO / University of Aveiro, Campus Universitário de Santiago, 3810-143, Aveiro, Portugal, rui.borges@ua.pt, Carlos Ferreira, Beatriz Sousa Santos

Within location-routing it is easy to consider scenarios where the demand is on the edges of a network, rather than on the nodes (referred in the literature as location-arc routing problems — LARP). Examples include locating facilities for postal delivery, garbage collection, road maintenance and street sweeping. For the LARP we present an iterative approach (TS-VNS) composed of a tabu search (TS) and a variable neighbourhood search (VNS), respectively, for the location and (arc) routing phases. Results are obtained for a set of test instances and compared with other approaches.

Rescheduling

Stream: Optimization in Public Transport

Invited session
Chair: Leo Kroon, Rotterdam School of Management, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR, Rotterdam, Netherlands, lkroon@rsml.nl
Chair: Anita Schöbel, Institute for Numerical and Applied Mathematics, Georg-August University Goettingen, Lotzestrasse 16-18, 37083, Göttingen, Germany, schoebel@math.uni-goettingen.de

1 - Recovery from disruptions with recovery length controlled
Luis Cadarso, Matemática Aplicada y Estadística, Universidad Politécnica de Madrid, Pz. Cardenal Cisneros, 3, 28040, Madrid, Spain, luis.cadarso@upm.es, Angel Marin, Gabor Maroti

This paper studies the disruption management problem of rapid transit rail networks. The task is to simultaneously adjust the timetable and the rolling stock schedules, also dealing with the dynamic nature of demand. The objective is to minimize passenger inconvenience, operational costs and the length of the recovery period (after which operations are back to the undisrupted schedules). We apply a discrete choice model for computing passenger demand, and we propose an integrated MIP model for timetable and rolling stock recovery. We study problem instances of the Spanish operator RENFE.

2 - Robustness in crew re-scheduling
Dennis Huisman, Econometric Institute, Erasmus University, Rotterdam, Netherlands, huisman@ese.eur.nl, Lucas Veelenturf, Leo Kroon, Gabor Maroti, Albert Wagemans

We present a framework that shows how the re-scheduling problem can be solved in a robust way. This means that the new schedule is to some extent insensitive to further changes in the environment. We demonstrate our framework with a particular application in disruption management, namely the railway crew rescheduling problem. Tests on several instances of Netherlands Railways demonstrate that our approach can be useful: if the crew schedule has to be modified more than once, then the later rescheduling costs are lower.

3 - A geometric approach for rescheduling railway timetables by considering passenger transfers in the system
Francisco A. Ortega Riejos, Applied Mathematics I, University of Seville, 41012, Seville, Spain, riejos@us.es, Juan A. Mesa, Miguel Angel Pozo, Justo Puerto

This paper considers a transit line where trains circulate and stop at the stations according to a predetermined schedule which is known by the users. At any instant, passengers arrive to different stations in order to board these vehicles according to a model of distribution of passenger arrivals that is assumed deterministic. In this scenario, a service rescheduling forced by an incidence is determined in order to minimize the loss of passengers who require transfers between different line runs at the interchange stations (supported by Spanish/FEDER projects MTM2009-14243 and P09-TEP-5022).

4 - Railway crew rescheduling on ultra-short term
Pieter Fioole, PI, Netherlands Railways, stalpaertstraat 56, 3067 XS, Rotterdam, Netherlands, pieterjan.fioole@ns.nl

When extreme weather is predicted, Netherlands Railways switches to a different timetable in order to be more robust. The corresponding rolling stock and crew duties must be changed then as well, which leads to changing over 1,000 crew duties several hours before executing the plan. We will discuss the process of how this is done, as well as the OR techniques that are used to achieve this. We will also discuss the benefits of a changed timetable compared to the original one on a day with extreme weather, as well as the benefits of OR techniques for rescheduling compared to manual dispatching.

Logistics and Manufacturing & Warehousing

Stream: Inventory Management

Invited session
Chair: Luca Bertazzi, Dept. of Quantitative Methods, University of Brescia, C.da Santa Chiara, 50, 25122, Brescia, Italy, bertazzi@eco.unibs.it

1 - Stochastic Dynamic Programming Algorithms for an Integrated Logistic System with Outsourced Transportation
Demetrio Laganà, DEIS, University of Calabria, Ponte Pietro Bucci, 41/C, 87036, Rende, Italy, dlagana@deis.unical.it, Adano Bosco, Luca Bertazzi

We propose an exact dynamic programming and a rollout algorithm for a logistic system with one product, one supplier, a set of retailers and outsourced deliveries over a time horizon. Each retailer has an initial inventory level, a fixed storage capacity and a random demand. An order-up-to level policy is applied. An inventory cost is charged if the inventory level is positive, a penalty otherwise. The supplier has an initial inventory level and a production at each time. The problem is to minimize the expected total cost over the horizon. Experiments were carried out on benchmark instances.
2 - A modelisation for multimodal network design: application to the hinterland of a port
Arnaud Knippel, Laboratoire de Math, INSA Rouen, INSA Rouen - LMI, Avenue de l’Universit, 76801, Saint-Etienne du Rouvray, France, arnaud.knippel@insa-rouen.fr, Sophie Michel, Ibrahima Diarrassouba, Cédric Joncour

We are interested on the evacuation of the containers towards the hinterland of a port. The transport modes tend to evolve by developing the alternative modes with the road- river or railway. The way in which these modes must be organized put the question of the design of a multimodal network. In addition to choosing the mean of transport, one must decide where install the sites of transshipment and their dimensioning. To model the strategic problem, we propose a gadget to transform a multiple non oriented graph to a simple oriented graph. Preliminary numerical results are shown.

3 - Approximated neighborhood evaluation for complex logistics support design problems
Emanuele Manni, Department of Engineering, University of Salento, via per Monteroni, 73100, Lecce, Italy, emanuele.manni@unisalento.it, Abdallah Alalawin, Gianpaolo Ghiani, Cheti Triki

This paper deals with the design of the logistics support of complex systems, based on a Level of Repair Analysis (LORA). We model a multi-echelon and multi-indenture LORA variant with the simultaneous definition of the spare parts at stock and the maintenance resource management policy. The goal is to minimize the life-cycle cost, subject to constraints on the expected availability. The solution approach uses an optimization via simulation method to explore the search space efficiently through an Approximated Neighborhood Evaluation model, relying on the estimation of a number of parameters.

4 - Combinatorial optimization techniques for the design of reconﬁgurable machines
Olga Battaïa, IE & Computer Science, Ecole des Mines de Saint Etienne, Saint Etienne, France, battaia@emse.fr, Alexandre Dolgui, Nikolai Guschinsky, Genrikh Levin

The problem is to design machine modules, such as working positions, turrets and spindle heads, suitable for the given production process. This problem is formulated as a combinatorial optimization problem where a known set of machining operations is partitioned into subsets which are assigned to the pieces of equipment under precedence, inclusion, exclusion constraints among operations as well as productivity and location constraints. The objective is to minimize the total equipment cost. The solution method is based on searching the shortest path in a specific graph.

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**Workforce Scheduling I**

**Stream: Timetabling and Rostering**

**Invited session**

Chair: Jan Lange, TU Dresden, Germany, Lange@avt.et.tu-dresden.de

1 - Ants for the Integrated Vehicle and Crew Scheduling Problem
David Pash, University of Primorska, PINT, 6000, Koper, Slovenia, david.pas@upr.si, Andrej Brodnik

We present an ACO (ant colony optimization) based meta-heuristic for the integrated vehicle and crew scheduling problem. The qualities of the produced solutions are compared to the optimal solutions of an IP based approach. We show on real-world instances that the meta-heuristic finds solutions of better quality than the sequential IP approach. Moreover, our meta-heuristic method can be applied to the integrated vehicle-crew scheduling and rostering problem.

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**Vector and Set-Valued Optimization II**

**Stream: Vector and Set-Valued Optimization**

**Invited session**

Chair: Vicente Novo, Matematica Aplicada, Universidad Nacional de Educacion a Distancia, Juan del Rosal no. 12, 28040, Madrid, Spain, vnovo@ind.uned.es

Chair: Enrico Miglierina, Dipartimento di Discipline Matematiche, Finanza Matematica ed Econometria, Università Cattolica del Sacro Cuore, via Necchi 9, 20123, Milano, Italy, enrico.miglierina@unicatt.it

1 - Lower and upper Ginchev derivatives of vector functions and their applications to multiobjective optimization
Marcin Studniarski, Faculty of Mathematics and Computer Science, University of Lodz, ul. S. Banacha 22, 90-238, Lodz, Poland, marstud@math.uni.lodz.pl, El-Desouky Rahmo
Based on the definitions of lower and upper limits of vector functions introduced in our earlier paper, we extend the lower and upper Ginzhev directional derivatives to functions with values in finite-dimensional spaces where partial order is introduced by a polyhedral cone. This allows us to obtain some new higher-order optimality conditions for a cone-constrained multiojective optimization problem.

2 - Saddle point results for approximate proper efficiency in vector optimization problems
Lidia Huerga, Applied Mathematics, UNED, C/Juan del Rosal, 12, 28040, Madrid, Spain, lhuegra@bec.uned.es, César Gutiérrez, Vicente Novo

We consider a constrained vector optimization problem on a locally convex Hausdorff topological linear space with generalized cone convexity assumptions. We introduce a new concept of approximate proper saddle point based on a new set-valued Lagrangian function and we give necessary and sufficient conditions for a type of approximate Benson proper efficiency through approximate proper saddle point results, where the complementary slack condition is bounded.

3 - Global optimization in Rn with box constrains and applications
Miguel Delgado Pineda, Matemáticas Fundamentales, UNED, Edificio de Ciencias. UNED, C/Senda del Rey. 9, 28040, Madrid, Spain, miguel@mat.uned.es

An algorithm is presented for global optimization of nonconvex nonsmooth multiojective optimization programs, min f(x) with box constraints and all functions f's are Lipschitz. A Maple code is attached for this monotonic set contraction algorithm. It converges onto the entire exact Pareto set and yields its approximation with given precision. Approximations for the ideal point and for the function values over Pareto set are obtained. The code does not create ill-conditioned situations and it is ready for engineering and economic applications. Results of examples are presented, with graphs.

4 - A notion of condition number in multiojective optimization
Enrico Miglierina, Dipartimento di Discipline Matematiche, Finanza Matematica ed Econometria, Università Cattolica del Sacro Cuore, via Necchi 9, 20123, Milano, Italy, enrico.miglierina@unicatt.it, Monica Bianchi, Elena Molho, Rita Pini

We introduce a condition numbers for a multiojective optimization problem. Since, in multiojective optimization, the solution set almost always is not a singleton, we develop an approach where the solution set is considered as a whole. A pseudodistance between function is defined such that the condition number provides an upper bound on how far from a well-conditioned function a perturbed function can be chosen in order that it is well-conditioned also. An extension of classical Eckart-Young distance theorem is proved, even if taking in account only a special class of perturbations.

This paper is an exercise in computational economics, applied to a stochastic game model of climate policy. We aim to demonstrate the numerical implementation of an approximate dynamic programming approach to compute Nash equilibrium solutions in a climate model with two groups of non-cooperating nations, via piecewise deterministic differential games. We characterize equilibrium strategies through the solution of a family of interconnected deterministic equivalent differential games, propose an approximation method and describe its implementation and analyze 2 case studies.

2 - Modeling Climate Negotiations as a Game Design Problem
Guillaume Jean Tarel, Ordecsys, Place de l’Etrier 4, 1224, Chêne-Bougeries, Switzerland, guillaume.tarel@gmail.com, Alain Haurie, Frédéric Babonneau, Marc Vielle

An international emissions trading scheme is implemented and a global safety emission budget is shared according to an equity rule which favors developing or emergent countries with large populations. They have the possibility to use strategically their emission rights to maximize the economic benefit from the supply of the emission rights market. We propose a meta-model built from statistical emulation of a computable general equilibrium model. The optimal design of this game is formulated and solved. The solution is interpreted in terms of stable international agreement.

3 - Meta-modelling of coupled climate-economic dynamics
Frédéric Babonneau, EPFL-ORDECSYS, Switzerland, fbabonneau@gmail.com, Neil Edwards, Phil Holden, Amit Kanudia, Mryse Labriet

This paper applies the oracle-based method ACCPM for the coupling of the climate simulation model GENIE with the world energy model TIAM. The objective is to compute a solution that maximizes the TIAM economic utility function subject to a constraint on global warming. In this paradigm, a meta-model controls the global iteration between the models which are treated as oracles. Here we use emulations in place of the simulation models to permit direct control over the smoothness of data exchanged in the process, while accelerating the overall process (emulated models are very fast).

4 - Climate Statistics for Energy Meteorology
John Boland, School of Mathematics and Statistics, University of South Australia, Mawson Lakes Blvd., 5095, Mawson Lakes, South Australia, Australia, john.boland@unisa.edu.au

This will be a survey of the statistical tools I and my team have employed in evaluating the performance of energy systems subject to the influence of climate variables. It will include the following topics: Probabilistic forecasting of solar radiation time series at daily and hourly time scales; Estimation and forecasting of wind farm output volatility; Construction of a model for prediction of diffuse solar radiation; Interpolation of time series using Fourier Series. Keywords: Time Series, Dynamical Systems, Volatility, Diffuse Solar Radiation, Interpolation Methods

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TD-16
Tuesday, 14:30-16:00
RB-2103
Statistical, Games and Optimization Analysis in Climate Meta-Models
Stream: Uncertainty and Perturbations in Optimization and in Environmental and Energy Modelling
Chair: Alain Haurie, ORDECSYS, Place de l’étier 4, 1224, Chêne Bougeries, Switzerland, ahaure@gmail.com
Chair: Frédéric Babonneau, Ordecsys and EPFL, CH-1224, Geneva, Switzerland, fbabonneau@ordecsys.com

1 - Computational Analysis of a Stochastic Climate Game Model
Alain Haurie, ORDECSYS, Place de l’étier 4, 1224, Chêne Bougeries, Switzerland, ahaure@gmail.com, Olivier Bahn, Roland Malhamé, Julien Thénié

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TD-17
Tuesday, 14:30-16:00
RB-2105
Global Optimization 1
Stream: Global Optimization
Chair: Herman Mawengkang, Mathematics, The University of Sumatera Utara, FMIPA USU, KAMPUS USU, 20155, Medan, Indonesia, mawengkang@usu.ac.id

1 - On solving non-convex mixed-integer nonlinear programming problems using active constraint strategy
Hardi Tambunan, Mathematics, Quality University, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, harditambunan29@yahoo.com, Herman Mawengkang
The nonlinear mathematical programming problem addressed in this paper has a structure characterized by a subset of variables restricted to assume discrete values, which are linear and separable from the continuous variables. The strategy of releasing nonbasic variables from their bounds, combined with the "active constraint" method, has been developed. This strategy is used to force the appropriate non-integer basic variables to move to their neighbourhood integer points. Successful implementation of these algorithms was achieved on various test problems.

2 - Developing an integrated model for river water quality to estimate wastewater removal efficiencies

Syafarid S. Syafarid, Mathematics, University Negeri Medan, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, syafarid79@yahoo.com, Herman Mawengkang

Rivers and streams are an important component of the natural environment, and need to be protected from all sources of pollution. Rivers, however, are increasingly under threat from different pollutants, which include conventional pollutants and hazardous substances. In this paper, dynamic integrated modelling of basic water quality and organic contaminant fate in rivers are explored. In this framework, a basic river water quality model and organic contaminant submodel were developed and then linked in order to estimate the wastewater removal efficiencies at each wastewater discharge site.

3 - Modeling the dynamic interaction of social networks

Maya Silvi Lydia, Computer Science, University of Sumatera Utara, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, Imayasilvi@yahoo.com, Herman Mawengkang

In terms of graph, social interactions can be modeled as networks. The characteristic of the interactions is dynamic, changing continuously over time. Most research are on static social networks. This paper proposes a mathematical model to analyze the dynamic interactions in the social networks.

4 - Comparison of Novel Optimization Algorithms on Intelligent Well Production Performance

Morteza Hassanabadi, Mathematics, Amirkabir University of Technology, 242 Hafez Ave, Tehran, Iran, 15875-441, Tehran, Iran, Islamic Republic Of, m.hassanabadi@aut.ac.ir, Ali Mirhassani, Mahdi Nadri Pari, Seyyed Mahdia Motahhari

A main challenges of oil and gas reservoir management is production optimization. We employed 3 methods of Response Surface, Taguchi and Neural Network to model reservoir behavior. Optimization algorithms were applied over the output of the foregoing methods: Quadratic Programming, NLP as a Gradient optimization algorithm implemented in Response Surface and Taguchi methods, and Particle Swarm Optimization implemented in NN. We present results and a comparison, and we recommend on applicability of our algorithms for other type of reservoirs.

1 - Using neural networks to map beam angles into intensity objective function values in IMRT optimization problems

Joana Matos Dias, FEUC / INESC, University of Coimbra, Av. Dias da Silva, 165, 3004-512, Coimbra, Portugal, joana@fe.uc.pt, Humberto Rocha

In IMRT (Intensity Modulated Radiation Therapy) optimization problems, radiotherapy angles need to be found so that the prescribed radiation doses are reached. The choice of optimization algorithms is limited due to the computational time needed to evaluate a given solution. Neural networks (NN) can be used as a black box mapping from radiation angles to intensity problem objective function values. NN can be used inside several optimization algorithms, providing a fast way of estimating the objective function values, allowing a near optimal solution to be found in reasonable computational times.

2 - A parametric analysis on optimal locations for an entering firm under delivered price competition

Blas Pelegrin, Statistics and Operations Research, University of Murcia, Spain, pelegrin@um.es, Pascual Fernandez, Maria D. Garcia

Facility location is an strategic decision for an entering firm which competes on delivered pricing with some pre-existing firms. In this paper, we analyze the effect on the optimal locations of the entering firm produced by variations of the marginal delivered price. For different scenarios in the transportation network of the Region of Murcia (Spain), we study how optimal locations can change with delivered price, and how the profits obtained by the entering firm and its competitors vary with delivered price. Finally, some conclusions are presented.

3 - Extended Hypercube Queueing Models for Stochastic Facility Location Problems

Burak Boyaci, ENAC, EPFL, EPFL ENAC INTER LUTS, GC C2 406 (Bâtiment GC) Station 18, 1015, Lausanne, Vaud, Switzerland, burakboyaci@gmail.com, Nikolas Geroliminis

In this research, we are modeling the facility location problem for systems with many servers and stochastic demand, such as emergency response and on-demand transportation systems, by using spatial queues, specifically hypercube queuing models (HQMs). We are proposing two extended HQMs and a heuristic method which uses an approach similar to dynamic programming. Briefly, the heuristic solves a sub problem for each sub region which is generated by using similarities in demand and then combines them accordingly. Preliminary analysis gives promising results for some real life instances.

TD-19

Tuesday, 14:30-16:00
RB-2111

Heuristics

Stream: Nonlinear Programming

Invited session

Chair: Edite M.G.P. Fernandes, Algoritmi R&D Centre, University of Minho, School of Engineering, Campus de Gualtar, 4710-057, Braga, Portugal, emgpf@dps.uminho.pt

1 - Using neural networks to map beam angles into intensity objective function values in IMRT optimization problems

Joana Matos Dias, FEUC / INESC, University of Coimbra, Av. Dias da Silva, 165, 3004-512, Coimbra, Portugal, joana@fe.uc.pt, Humberto Rocha

In IMRT (Intensity Modulated Radiation Therapy) optimization problems, radiation angles need to be found so that the prescribed radiation doses are reached. The choice of optimization algorithms is limited due to the computational time needed to evaluate a given solution. Neural networks (NN) can be used as a black box mapping from radiation angles to intensity problem objective function values. NN can be used inside several optimization algorithms, providing a fast way of estimating the objective function values, allowing a near optimal solution to be found in reasonable computational times.

2 - A study of derivative-free optimization techniques for handling the sampling aspect in automated algorithm configuration

Zhi Yuan, IRIDIA, Université libre de Bruxelles, Av. F. Roosevelt 50, CP194/6, 1050, Brussels, Belgium, zyuan@ulb.ac.be, Thomas Stützle
3 - Solving Quadratic 0-1 Knapsack Problem Using an Artificial Fish Swarm Algorithm

**Edita M.G.P. Fernandes**, Algoritmi R&D Centre, University of Minho, Braga, Portugal, cmgpff@deps.uminho.pt, **Md. Abul Kalam Azad**, Ana Maria A.C. Rocha

The quadratic 0-1 knapsack problem finds a subset of items that yields maximum profit without exceeding the knapsack capacity. Some exact as well as heuristic methods have been proposed for solving this type of problem. Recently, a population-based artificial fish swarm (AFS) algorithm that simulates the behaviors of fish swarm inside water has emerged. We propose a binary version of AFS for solving quadratic 0-1 knapsack problems. To make infeasible solutions to feasible ones we use the decoding algorithm. We test the method with a benchmark set of problems available in literature.

**TD-20**

Tuesday, 14:30-16:00
RB-2113

Decision Theory and Analysis

**Stream: Decision Making Modeling and Risk Assessment in the Financial Sector**

**Invited session**

Chair: Tina Comes, Institute for Industrial Production (IIP), Karlsruhe Institute of Technology (KIT), Hertzstr. 16, 76187, Karlsruhe, Germany, comes@kit.edu

1 - Assessing the Impact of Stock Volatility on the Efficiency of Listed Commercial Banks: A Conditional Nonparametric Approach

**AnaMaria Aldea**, Economic Informatics and Cybernetics, The Bucharest Academy of Economic Studies, 010374, Bucharest, Romania, anamalia_aldea@yahoo.com, **Luiza Badin**, Carmen Lipara

In this paper we employ nonparametric conditional methodology to assess the impact of external factors like stock volatility on the efficiency of commercial banks. The approach allows decomposing the impact of external factors in impact on the attainable set in the input-output space, and/or impact on the distribution of the efficiency scores. We analyze listed commercial banks from FactSet database, as their reduced activity on financial markets is usually associated with lower risk. The results provide a perspective on how listed commercial banks performed in 2009, after the crisis.

2 - Explaining Results and Uncertainties of a Robust Scenario-Based Multi-Criteria Decision Support System: Generation of Natural Language Reports

**Tina Comes**, Institute for Industrial Production (IIP), Karlsruhe Institute of Technology (KIT), Hertzstr. 16, 76187, Karlsruhe, Germany, comes@kit.edu, **Frank Schultmann**

In decision support systems, the purpose of generating natural language reports is explaining the results of the analysis and complementing numeric results and visualisations. Natural language reports add transparency and clearness to the evaluation. To extend these approaches for scenario-based decision support, a framework for the characterisation of uncertainties within the scenarios and the identification of the most significant uncertainties that drive the evaluation is presented. This novel approach is used to generate reports, which describe the reliability of scenarios and explain the results and of a scenario-based multi-criteria decision support system.

3 - Implausible alternatives in the elicitation of multi-attribute value functions

**Rudolf Vetschera**, Dept. of Business Administration, University of Vienna, Brunnner Str. 72, A-1210, Vienna, Austria, rudolf.vetschera@univie.ac.at, **Elisabeth Wolfsteiner**, Wolfgang Weitzl

Many elicitation methods for multiattribute value functions require holistic evaluations of hypothetical alternatives. Generation of such alternatives often ignores correlation between attributes present in real alternatives. We conducted an empirical study to test the effect of implausible alternatives on response consistency. Using a constraint-based approach, we found that respondents facing implausible alternatives are more consistent with an additive model, and with stated intra-attribute preferences. All subjects had a low level of consistency with stated inter-attribute preferences.

4 - Modified BIPOLAR Method for Multi-criteria Decision Analyses under Risk

**Olena Sobotka**, Operations Research, Wroclaw University of Economics, Komandorska str., 118/120, 53-345, Wroclaw, Poland, osobotka@poczta.uc.wroc.pl, Ewa Konarzewska-Gubala

The multi-criteria decision problems with uncertainty outcomes of alternatives with known probability distributions are considered. We propose the outranking procedure for such alternatives based on the multi-criteria decision method BIPOLAR. The procedure is: 1) to define the multi-criteria preference relations on the set of all alternative’s outcomes by comparing with sets of “good” and “bad” objects defined by decision maker and 2) to outrank the alternatives according to defined multi-criteria preference relations using the stochastic dominance relations.
3 - Analysis of Measurement Methods of the Utility Function in Context of Prospect Theory

Ulla Hofmann, Institute for Management, University Koblenz, Universitätstraße 1, 50670, Koblenz, Germany, uhofmann@uni-koblenz.de, Thomas Burkhardt

In the literature, we find several experimental methods to measure the value function as well as the probability weighting function of prospect theory. We compare several of those methods with regard to accuracy, practicability, and theoretical foundation. Our aim is to identify accurate and practical methods for individual PT-Utility functions, with a particular focus on the assessment of risk attitudes in investment decisions.

4 - Long-term Investment Behaviour Considering Financial Constraints — An Analysis in the Context of Information Technology

Stefan Plosser, FIM Research Center Finance & Information Management, University of Augsburg, Universitätstraße 12, 86159, Augsburg, Germany, stefan.plosser@wwi.uni-augsburg.de, Vasko Isakovic

In line with existing studies, this paper explains the observable investment behaviour of firms in the context of Information Technology (IT) by considering their financial constraints as well as specific aspects of IT investments. By applying a dynamic optimization model, the scarce financial resources are optimally allocated to IT investments using a cash reserve, so that their value contribution is maximized. Since we show that a financially constrained firm can achieve a higher value contribution by holding cash, we make an important contribution towards making better long term decisions.

3 - Finding a fair cost allocation mechanism in flexible horizontal supply chains

Christine Vanovermeire, University of Antwerp, 2000, Antwerp, Belgium, christine.vanovermeire@ua.ac.be, Kenneth Sørensen

As companies are faced with more stringent demands of clients and environmental laws, new logistics solutions such as horizontal collaboration among shippers are emerging. The total gain of such initiatives ranges from 9%-30%. Moreover, more optimization opportunities exist as companies can be more flexible towards the aspects of delivery (e.g. delivery date) in order to create a better ‘fit’ with their partners. However, one of the main implementation issues of such a collaboration is dividing those gains. The ability of the Shapley value to give incentives to be flexible is investigated.

3 - Artificial Bee Colony Algorithm for Solving Uncapacitated Facility Location Problems

Mustafa Servet Kıran, Computer Engineering, Science, 42075, Konya, Turkey, mskiran@selcuk.edu.tr, Eren Ozceylan, Industrial Engineering, Natural and Applied Sciences, Selcuk University Industrial Engineering Department, Campus, 42031, Konya, Turkey, ozceylan@selcuk.edu.tr

As companies are faced with more stringent demands of clients and environmental laws, new logistics solutions such as horizontal collaboration among shippers are emerging. The total gain of such initiatives ranges from 9%-30%. Moreover, more optimization opportunities exist as companies can be more flexible towards the aspects of delivery (e.g. delivery date) in order to create a better ‘fit’ with their partners. However, one of the main implementation issues of such a collaboration is dividing those gains. The ability of the Shapley value to give incentives to be flexible is investigated.

3 - Artificial Bee Colony Algorithm for Solving Uncapacitated Facility Location Problems

Mustafa Servet Kıran, Computer Engineering, Science, 42075, Konya, Turkey, mskiran@selcuk.edu.tr, Eren Ozceylan, Turan Paksoy

Artificial bee colony (ABC) algorithm is first investigated for solving numerical optimization problems, inspired waggle dance and foraging behaviors of honey bee colonies. In this study, an adapted version of ABC is proposed to solve binary optimization problems such as uncapacitated facility location problem (UFLP). The accuracy and performance of ABC have been examined on well-known twelve small, medium and large sizes UFLPs and compared with particle swarm optimization (PSO). The experimental results show that ABC is better than PSO in terms of solution quality and robustness.
3 - Comparisons of Different Fuzzy Mathematical Programming Approaches on Supply Chain Network Design Problem
Nimet Yapici Pehlivan, Statistics, Selcuk University, Selcuk University Science Faculty, Campus Konya/TURKEY, 42075, Konya, Turkey, nimet@selscu.edu.tr, Eren Ozceylan, Turan Paksoy

In most realistic supply chain network (SCN) design problems, environment coefficients, model parameters and objectives are frequently imprecise. Fuzzy set theory provides an appropriate framework to describe uncertainty. The aim of this paper is investigating the effects of different fuzzy mathematical programming approaches on a SCN design problem. A fuzzy mathematical model is developed for a multi-echelon SCN which has uncertainty in capacity, demand and objectives. A test problem is presented and comparison of results of different approaches is made using proposed problem.

4 - Integration of Reverse Supply Chain Optimization and Disassembly Line Balancing
Eren Ozceylan, Industrial Engineering, Natural and Applied Sciences, Selcuk University Industrial Engineering Department, Campus, 42031, Konya, Turkey, eozceylan@selscu.edu.tr, Turan Paksoy

While reverse supply chain (RSC) optimization includes recycling and disassembly activities through a supply chain, disassembly line balancing (DLB) problem involves determination a line design in which used products are disassembled. The aim of this study is to optimize and design the RSC that minimizes the transportation costs while balancing the disassembly lines in disassembly centers, which minimizes the total fixed costs of opened stations, simultaneously. A numerical example and different scenarios are conducted to illustrate the applicability of the proposed model.

3 - Estimating autoregressive models in the presence of missing data and non-normally distributed error terms
Korneel Bernaert, MOSI, VUB, Pleinlaan 2, 1030, Brussels, Belgium, korneel.bernaert@vub.ac.be, An Peeters

Estimation of the parameters of an autoregressive model in the presence of missing data is typically performed using the Kalman filter to obtain maximum likelihood estimators. These rely on the error term being normally distributed. This paper constructs estimators using the method of moments estimators which do not rely on this normality of the error term. The performance of the method of moments estimator is then compared to the maximum likelihood and some often-used ad hoc (mean imputation, deletion) estimators in a simulation study for a first-order autoregressive model.

4 - Neural networks for streamflow series forecasting: A comparative study between echo state networks and MLP's
Hugo Siqueira, Department of Systems Engineering, University of Campinas, College of Electrical Engineering, Cidade Universitaria Zefirino Vaz, Barão Geraldo District, 13083-970, Campinas, São Paulo, Brazil, hugovaladares@hotmail.com, Levy Boccato, Romis Attux, Christiano Lyra

The forecast of seasonal streamflow series is fundamental for the sustainable use of water resources and it is a key information for hydroelectric generation planning. Echo state networks, recurrent structures characterized by a tradeoff between generation of memory from feedback and straightforwardness, are a contemporaneous alternative to address the problem. However, the possible benefits of this approach in the problem still need proper clarification. This talk gives a contribution by discussing a comparative study of different ESN architectures and a MLP, in several practical scenarios.

TD-24
Tuesday, 14:30-16:00
CC-A11
Forecasting methods
Stream: Forecasting
Invited session
Chair: Aris Syntetos, Centre for Operational Research and Applied Statistics - Salford Business School, University of Salford, Maxwell Building, The Crescent, M5 4WT, SALFORD, United Kingdom, a.syntetos@salford.ac.uk

1 - Boot.EXPOS:Strength and sensibility
Claire Cordeiro, CEAUL, University of Algarve, Campus Gambelas, FCT, DM, 8005-139, Faro, Portugal, ccordei@ualg.pt, Manuela Neves

Exponential smoothing methods are the launch platform for modelling and through bootstrap several sample paths for a time series are created. Since its beginning, Bootstrap algorithm has showed promising results. For dependent data is well-known the bootstrap vocation in obtaining forecast intervals and now we also devote this attention for point forecast proposes. We will illustrate the performance of our procedure for some well-known data sets and will emphasize its recent adaptation for forecasting time series with complex seasonal patterns.

2 - Complexity of exponential smoothing models and its influence on forecast quality in retail
Johannes Püster, University of Münster - ERCIS, Leonardo-Campus 3, 48149, Münster, NRW, Germany, johannes.puest@ercis.uni-muenster.de, Axel Winkelmann, Justus Holler, Jörg Becker

Retail poses several challenges on sales forecasting. The combination of broad assortment and high number of stores leads to a high amount of time series, which need to be forecasted on a daily basis at providers of fast moving consumer goods. Appropriate forecasting models need to be of good forecasting quality and of low complexity in order to allow for fast execution. This work presents a structured overview on complexity-influencing parameters of exponential smoothing models. Based on a data set of 250 retail time series the influence of model complexity on forecast quality is elaborated.

TD-25
Tuesday, 14:30-16:00
CC-A23
Pathways toward low carbon transport
Stream: Long Term Planning in Energy, Environment and Climate
Invited session
Chair: Sandrine Selosse, Centre for Applied Mathematics, MINES ParisTech, Rue Claude Daunèsse, 06904, Sophia Antipolis, France, sandrine.selosse@mines-paristech.fr

1 - GHG emissions cap impact on French biofuel mix using MARKAL/TIMES Model
Paul Hugues, Centre for Applied Mathematics, MINES ParisTech, Rue Claude Daunèsse, BP 207, 06904, Sophia Antipolis, France, paul.hugues@mines-paristech.fr, Edi Assoumou, Nadia Maïzi

One of the main reasons of biofuels development has been carbon mitigation. However, greenhouse gas emissions related to biofuel production are dependent on the whole production pathway as well as land use change. To consider the wide impact of biofuel production in long-term prospective, a full range of diverse but integrated aspects have to be considered, such as: biomass supply, transportation, packaging, and transformation to biofuel. In this work, we investigate how a CO2 emissions cap or a carbon tax would impact the French pathway to low emissions, and the biofuel mix.

2 - Impact of a carbon tax on french transports sector: A TIMES model for mobility
Jean-Michel Cayla, EDF/Mines ParisTech, Paris, France, jeanmichel.cayla@gmail.com

In order provide insights about realistic pathways to low-carbon transports in 2050, we have developed a TIMES model with a strongly detailed module for transports in France. In particular we have developed
an original approach that takes households heterogeneity and household investment behavior as well as daily consumption behavior into account. We are then able to better design realistic technology diffusion curves. Then we study the impact of a carbon tax in transports sector and its ability to reduce CO2 emissions.

3 - The option value of electrified vehicles from a welfare perspective
Adrien Vogt-Schilhé, CIRED, 75011, Paris, France, vogt@centre-cired.fr, Manon Solignac, Céline Guivarch

We evaluate how much it is desirable to pay today to have the option of buying electrified vehicles (EVs) tomorrow. From exogenous fuel and electricity prices distributions, we model total costs of ownership and market shares of a set of technologies. We compare scenarios where EVs are available with scenarios without EVs. We quantify how EV’s availability reduces the expected cost of the automotive system and its exposure to oil prices variability. Adding an economy-wide carbon constraint on the model, we show that EV’s availability also reduces the expected carbon price.

4 - Technology and social factors in passenger transport: a comparative assessment of different leverages
François Briens, Centre for Applied Mathematics, Mines ParisTech, 06904, Sophia Antipolis, France, francois.briens@mines-paristech.fr, Edi Assoumou

This prospective research evaluates and compares the sensitivity of CO2 emissions and energy consumption of the French passenger vehicles fleet up to 2035, to different technological and sociological parameters, such as electric and hybrid technology penetration rates, the shares of the different power class in the fleet, the annual average mileage, and households’ motorisation levels. The results highlight the importance of sociological factors and advocate for integrated approaches to engage in ambitious pathways toward low energy and carbon societies.

■ TD-26
Tuesday, 14:30-16:00
CC-A24

OR in Agriculture, Forestry and Fisheries

Stream: OR in Agriculture, Forestry and Fisheries

Invited session

Chair: Marcela González-Araya, Departamento de Modelación y Gestión Industrial, Universidad de Talca, Merced 437, s/n, Curicó, Región del Maule, Chile, mgonzalez@utalca.cl

1 - Multiple criteria and group decision methods to evaluate ecosystem services

The traditional procedure of economic valuation is based on individual utility maximization. Nevertheless, many ecosystem services are considered as public goods, affecting people and groups in society. Multiple Criteria and Group Decision Making have been used mainly in environmental decision making, more than to explicit economic values for ecosystem goods and services. This paper presents an exhaustive up-to-date review with a classification of approaches and applications, pointing out its main strengths and drawbacks to contribute to the valuation of ecosystem services in the future.

2 - Optimal control models for sustainable fishery management
Joao Lauro D. Faco*, Dept. of Computer Science, Universidade Federal do Rio de Janeiro, Av. do PEPE, 1100 / 203, 22620-171, Rio de Janeiro, RJ, Brazil, jldfaco@ufrrj.br

Sustainable management of fisheries is a pressing need for fish increasing importance as a high quality protein source. Stocks of the last wild food are collapsing in many regions of the ocean. Optimal Control theory is used to build spatial/temporal models for complex marine ecosystems problems. Dynamic population interactions for competitor/predator/prey multispecies are coupled discrete-time nonlinear difference equations. A hyperbolic smoothing Nonlinear Programming method defines specific clusters; a reduced-gradient method is applied to search the solution, and to parameters estimation.

3 - A mixed integer linear model for planning harvest applied to apple orchards
Marcela González-Araya, Departamento de Modelación y Gestión Industrial, Universidad de Talca, Merced 437, s/n, Curicó, Región del Maule, Chile, mgonzalez@utalca.cl, Vladímir Soto-Silva

An optimization model to support planning decisions of harvest in apple orchards is developed. The model seeks to minimize the costs of hiring and firing work labor, machinery use and loss of fruit quality by not harvesting in the maturity date, subject to restrictions demand for packaging plants, processing capacity packing plants, constraints about production in each field of the orchard, time window constraints for the harvest according to the apple variety planted in each field, among others. This model was applied to three apple orchards of Maule Region.

4 - Sustainability of agriculture - only a dream considering the world population growth?
Joern Hamann, Food quality and safety, University of Veterinary Medicine, Hannover, FRG, Platanenring 10, 24119, Kronschagen, Schleswig-Holstein, Germany, jha911@hamann-kronschagen.de

Sustainability of agriculture tries to meet mankind’s needs of the present without compromising the future. The agricultural sector - cornerstone of food security - has to provide for almost 35 % more people globally by mid-century. Without doubt, this can and will be reached. However, the question is whether it is possible with a sustainable agriculture. In any case, a lot of money must be spent on agricultural innovations in order to reach the goal of sufficient food for all especially without any further impairment of biological systems.

■ TD-27
Tuesday, 14:30-16:00
CC-A25

Uncertainties in Decision Processes

Stream: Decision Processes

Invited session

Chair: Ahti Salo, Systems Analysis Laboratory, Aalto University School of Science and Technology, P.O. Box 11100, Otakaari 1 M, 00076, Aalto, Finland, ahtih ellofi.

1 - Sources and management of uncertainty in investment appraisals influenced by corporate social responsibility
Aron Larsson, Computer and System Sciences, Stockholm University, 16440, kista, Stockholm, Sweden, aron@dv.su.se, Sara Vickman, Leif Olsson

In an exploratory study, we assess how managers try to account for corporate social responsibility in investment appraisals. We focus on how they manage uncertainty and the source of the uncertainties they emphasize, and conclude that they are generally exposed to and also consider both aleatory and epistemic uncertainty and need to handle aspects beyond ROI. There is a mix of macro and micro variables to consider, creating a diversified environment where real options in combination with decision analysis modeling could help in structuring the problem and enlighten different areas and aspects.
2 - Bayesian evaluation and selection strategies in portfolio decision analysis
Eeva Vilkkumaa, Department of mathematics and systems analysis, Aalto University, School of science, Systems analysis laboratory, Aalto University, P.O.Box 11100, 00076 Aalt, Espoo, Finland, eeva.vilkkumaa@aalto.fi, Juuso Liesiö, Ahti Salo

In project portfolio selection, the projects’ future values are typically uncertain. We show how the Bayesian modeling of these uncertainties increases the expected value of the selected portfolio, raises the expected number of optimal projects in the selected portfolio and decreases post-decision disappointment. We also show that it pays off to re-evaluate only those projects which can be re-evaluated relatively accurately and which have particularly uncertain initial value estimates that are close to the selection threshold.

3 - Uncertain mine clearance quality and how it affects the decision to perform quality control in humanitarian demining
Tobias Fasth, Department of Computer and Systems Sciences, Stockholm University, Forum 100, SE-164 40, Kista, Sweden, tobi-fas@dsv.su.se, Aron Larsson, Love Ekenberg

The IMAS standard for mine actions conforms to the ISO 2859 standard for quality control of cleared land. ISO 2859 is primarily aimed for use in the sampling of traditional industrial products, and not on cleared land. The sampling plans are dependent on the acceptable quality limit. This quality limit is subject to uncertainty and we specifically address the problem of the deviance in the actual and acceptable quality of cleared land, and how this influences the decision process and the cost of quality control, leading to the question if whether quality control should be conducted at all.

4 - Action Research for assessing the impact of scenario-based multi-criteria interventions on the strategic decision-making process
Camelia Ram, Operational Research Group, London School of Economics, Houghton Street, WC2A 2AE, London, c.ram@lse.ac.uk

The literature on the combined use of scenarios and multi-criteria decision analysis (MCDA) continues to grow. While action research has been advocated as an appropriate method for studying interventions involving MCDA, guidelines on applying the methodology to provide unique insights for future interventions remain limited. This paper explores how action research was used to assess the value of a scenario-based MCDA intervention. The methodology was applied to support the evaluation and enhancement of strategic options for a regional corporation in a developing country.

**TD-28**
Tuesday, 14:30-16:00
CC-A27

Anticipation and Synchronization

Stream: Models of Embodied Cognition

*Invited session*

Chair: Susie Vrobel, The Institute for Fractal Research, Ernst-Ludwig-Ring 2, 61231, Bad Nauheim, Hessen, Germany, Susanne.Vrobel@t-online.de

**1 - Trust as Embodied Anticipation**
Susie Vrobel, The Institute for Fractal Research, Ernst-Ludwig-Ring 2, 61231, Bad Nauheim, Hessen, Germany, Susanne.Vrobel@t-online.de

Trust is defined as a temporal observer-participant extension. This extension is described in terms of succession and simultaneity, i.e. the length and depth of time: mutually exclusive temporal dimensions as defined in my Theory of Fractal Time. While succession increases temporal complexity from an endo-perspective, simultaneity reduces it through embodied anticipation. Successful incorporation of parts of the environment leads to the formation of a new systemic whole.

**2 - Distortions of spatial phase and temporal-synchronism disorders in amblyopia**
Uwe Kämpf, Research Unit, Catema GmbH, Biendorf 78, D-01825, Liebstdorf, Saxon, Germany, uwe.kampf@googlemail.com

Amblyopia is a functional impairment of visual performance which is partially due to coherence losses in the cooperation of visual frequency-filter channels. Chaotic instead of synchronized states in reverberating feed-forward loops (i.e. a lack of perceptual anticipation) induce disorders of temporal synchronism in the visuo-cortical system’s neuronal ‘synfire chains’. The result is a distortion in the visual filters’ spatial phase. Accordingly, a narrow-band frequency-selective pattern stimulation is proposed as a supportive treatment of amblyopia.

**3 - Effects of accuracy feedback on fractal characteristics of time estimation**
Sebastian Wallot, MINDLab, Aarhus University, Jens Chr. Skous Vej 20, 8000, Aarhus C, Denmark, sebastian.wallot@gmail.com, Nikita Kuznetsov

The current experiment investigated the effect of visual accuracy feedback on the variability of time interval estimates. To assess the impact of feedback, the likelihood of receiving visual feedback was manipulated. Inter-tap intervals were analyzed with fractal and multifractal methods to quantify complex long-range correlation patterns in the timing performance. Increased amounts of feedback lead to a decrease in fractal long-range correlations, as well to a decrease in the magnitude of local fluctuations in the performance. Also, most data sets show significant multifractal signatures.

**TD-29**
Tuesday, 14:30-16:00
CC-A29

**DEA and Performance Measurement: Methodology 3**

Stream: DEA and Performance Measurement (contributed)

*Contributed session*

Chair: Chris Tofallis, Business School, University of Hertfordshire, College Lane, AL10 9AB, Hatfield, Herts., United Kingdom, c.tofallis@herts.ac.uk

**1 - Constructing rankings in DEA - a goal programming approach**
Paulo Morais, Engenharia Industrial e Gestão, Faculdade de Engenharia da Universidade do Porto; Universidade Lusófona do Porto, Rua Roberto Frias, Rua Augusto Rosa, 24, 4200-465, Porto, Portugal, pauloteixeirademorais@gmail.com, Ana Camanho

This paper presents a goal programming model that allows comparing units assessed with DEA. In classical models, given the fact that each unit is assessed with a unique set of weights that aims to maximize its efficiency, the construction of rankings is not possible. Weights restrictions to establish a common set of weights is widely discussed in literature. Using the evaluation of quality of life of 206 European cities as an example, we propose a goal programming model that minimizes the deviations in relation to a composite indicator score obtained in a previous stage.

**2 - On the Environmental Variables Analysis in Two Stages DEA**
Rafael C Leme, Federal University of Itajuba, UNIFEI-IEPG, CP 50, 37500-903, Itajuba, MG, Brazil, leme@unifei.edu.br, Anderson Paulo Puiva, Pedro Paulo Balestrassi, Paulo Eduardo Steele Santos

Benchmarking plays a central role under regulatory scene. DEA is a non-parametric efficiency performance technique usually used for benchmark analysis. The frontier is defined by the efficient firms that envelop the less efficient firms, defining efficiency gap. An issue arises when some environmental variables may influence the results. In this...
work, we propose an approach based in Design of Experiments and Desirability method to identify the impact of environmental variables on inefficiency gap, and define which most affect inefficiency. The results are obtained using real Brazilian data.

3 - Value Efficiency for the FDH model
Merja Halme, Information and Service Economy, Aalto School of Economics, PL 11000, 00076, Aalto, Finland, merja.halme@aalto.fi, Pekka Korhonen, Jalka Eskelinen
An approach to supplement preference information in the FDH model is introduced. We assume the Decision Maker (DM) evaluates the units using an implicit value function reaching its maximum at his/her most preferred unit as in Value Efficiency Analysis (VEA). The value function is assumed to be quasi-concave and we use convex cones to approximate its contours. Pairwise comparisons are used as preference information. As in VEA the distance of each unit from the value function’s contour passing through the most preferred unit is approximated. We discuss a real case of bank branches.

4 - Economic efficiency of european air traffic control systems
Kenneth Button, School of Public Policy, George Mason University, 3351 Fairfax Drive, (MS 3B1), 20124, Arlington, Virginia, United States, kbutton@gmu.edu, Rui Neiva
Much analysis has been conducted on the efficiency of airlines, but less has been done on air traffic control systems (ANsMs). The diversity of ANsMs regimes in Europe allows rigorous comparison of 36 European systems from 1998 to 2010. The bootstrapped DEA framework asumes a multifaceted output function (safety and delay objectives) with both physical inputs (traffic volumes, labor, investment, flight hours controlled) and policy (ownership and financing systems). Attention is paid to the relative efficiencies of different types of partnerships and the implications of financial structures.

**TD-30**
Tuesday, 14:30-16:00
CC-A31

Data confidentiality 2

Stream: Data Confidentiality
Invited session
Chair: José Antonio González Alastrué, Dept. Estadística e Investigación Operativa, UPC, Edificio C5, Campus Nord, Jordi Girona 1-3, 08034, Barcelona, Spain, Jose.A.Gonzalez@upc.edu

1 - A Fix and Relax Heuristic for Controlled Tabular Adjustment
Daniel Baena Mirabete, Statistics and Operations Research, Universitat Politècnica de Catalunya, Spain, daniel.baena@upc.edu, Jordi Castro
Controlled Tabular Adjustment (CTA) is an emerging protection technique for tabular data. CTA results in a mixed integer linear programming problem, which can be challenging even for tables of moderate size. In this work the Fix and Relax (FR) strategy, based on partitioning the set of binary variables into clusters to selectively explore a smaller branch and bound tree, is applied to large CTA instances. We report computational results on a set of real and random CTA instances. FR is competitive compared to Cplex in terms of finding a good upper bound in difficult instances.

2 - Potential Breaches of Confidentiality in Statistical Tables containing Magnitude Data
Martin Serpell, Department of Computing, University of the West of England, Frenchay Campus, Coldharbour Lane, BS16 1QY, Bristol, United Kingdom, Martin2.Serpell@uwe.ac.uk, Jim Smith, Alistair Clark
The purpose of this paper is to highlight potential unintended breaches in confidentiality in published statistical tables that have been protected using cell suppression. In order to protect large tables some cell suppression algorithms employ back-tracking heuristics. Tests show that although the back-tracking heuristics can handle multidimensional non-hierarchical tables they fail to adequately protect hierarchical ones. On average having one hierarchical dimension will leave 30% of primary cells unprotected, two will leave 60% unprotected and three will leave 90% unprotected.

3 - On data protection for graphs: application to social networks
Vicenc Torra, IIIA-CSIC, Campus UAB s/n, 08193, Bellaterra, Catalonia, Spain, vtorra@iii.csic.es, Klara Stokes
Graphs are versatile structures that can be used to represent several types of information. In particular, the structure and the content of social networks can be represented in terms of graphs, where nodes correspond to users and edges correspond to the relationships established between them. Data protection for graphs requires a proper definition for disclosure risk and information loss, as well as adequate data protection methods. In this talk we will discuss k-anonymity for graphs, some information loss measures, and the performance of protection methods with respect to the measures.

4 - Improving the solution of CTA through valid inequalities
José Antonio González Alastrué, Dept. Estadística e Investigación Operativa, UPC, Edificio C5, Campus Nord, Jordi Girona 1-3, 08034, Barcelona, Spain, Jose.A.Gonzalez@upc.edu, Jordi Castro
Controlled tabular adjustment solves a mixed integer linear program for protecting statistical tables against the risk of disclosure, which is a key concern for National Statistical Agencies. In this work we obtain some valid inequalities for CTA and show they may be useful in significantly improving exact (branch and bound) and heuristic (block coordinate descent) procedures for CTA. Valid inequalities are derived from a search through the standard constraints of the table, whenever they include some sensitive cells.

**TD-31**
Tuesday, 14:30-16:00
CC-A33

Data Mining in Economics and Ecology

Stream: Data Mining, Knowledge Discovery and Artificial Intelligence
Contributed session
Chair: Ivan Reyer, Dorodnyczyn Computing Centre of RAS, ul. Pererva d. 58, kv. 153, 109451, Moscow, Russian Federation, reyer@forecsys.ru
Chair: Renato Brunì, Dip. Ingegneria Informatica, Automatica e Gestionale, University of Roma "Sapienza", Via Ariosto 25, 00185, Roma, Italy, renato.bruni@dis.uniroma1.it

1 - Predicting the customer churn in Social Network games based on multiple criteria decision making models
Chiao-Chen Chang, International Business, National Dong Hwa University, No. 1, Sec. 2, Da Hsueh Rd., Shoufeng, 97401, Hualien, Taiwan, aka@mail.ndhu.edu.tw, Yang-Chieh Chin
Customer churn has become a critical issue, especially in the competitive and mature social network game industry. This study applies rough set theory, a rule-based decision-making technique, to extract rules related to customer churn; then adopts the Decision Making Trial and Evaluation Laboratory (DEMATEL) technique to analyze the relationship among characteristics in customer churn; and finally uses the flow graph, a path-dependent approach, to present the relationships between rules and different kinds of churn. Practical and research implications are also offered.
2 - Modeling partial customer churn: on the value of first product-category purchase sequences
Vera Miguéis, DEIG, Faculdade de Engenharia da Universidade do Porto, Porto, Portugal,
vera.miguels@fe.up.pt, Dirk Van den Poel, Ana Camanho, João Cunha
Retaining customers has been considered one of the most critical challenges among those included in Customer Relationship Management (CRM). This paper proposes to include in partial churn detection models the succession of first products’ categories purchased as a proxy of the state of trust and demand maturity of a customer towards a company in grocery retailing. We use logistic regression as the classification technique. A real sample of approximately 75,000 new customers taken from the data warehouse of a European retail company is used to test the proposed models.

3 - Electricity consumption and economic growth causality in OECD countries: a panel cointegration approach
Kasirga Yildirak, IAM, METU, 06531, Ankara, Turkey,
kasirgayildirak@gmail.com.tr, Ali Sabit Taylan, Cunhur Ekinçi
This paper examines the long-run, short-run and causal relationship between electricity consumption and economic growth for a set of OECD countries. We also investigate the presence of any directional causality between real economic activity and electricity consumption. For testing the relationship between electricity consumption and economic growth, we make use of panel unit roots, panel cointegration test, panel causality and panel vector autoregressive model.

4 - Predicting the fundamental value of financial assets by ridge regression
Michael Kamp, IAIS.KD.CAML, Fraunhofer IAIS, Schloss Birlinghoven 1, 53754, Sankt Augustin, NRW, Germany,
michael.kamp@iais.fraunhofer.de, Mario Boley, Thomas Gaertner
Assessing the fundamental value of financial assets is crucial for investment as well as for market regulation. This problem is difficult, because present fundamental values depend on disclosed information and future value developments. Therefore, estimating them is essentially a prediction task that can be addressed by machine learning. We show that good predictions can be achieved by performing ridge regression based on novel correlation features that capture intra- and inter-dependencies of market segments. Despite their expressive power, these features can be extracted from public data.

National Integrated Assessment Models
Stream: Emissions Trading and Energy
Invited session
Chair: Magnus Fröhling, Institute for Industrial Production (IIP), Karlsruhe Institute of Technology (KIT), Hertzstraße 16, D-76187, Karlsruhe, Germany, magnus.froehling@kit.edu

1 - Environmental assessment of energy scenarios for the deployment of carbon capture and storage (CCS) on coal fired power plants in the UK
Konstantinos Tzanidakis, Department of Power and Propulsion, Cranfield University, Building 183, Room 803, MK430AL, Bedford, United Kingdom,
k.tzanidakis@cranfield.ac.uk, Tim Oxley, Helen ApSimon
Looking to 2030 and beyond integrated assessment modelling needs to be extended to cover new energy technologies. We describe application of the UKIAM to the introduction of the introduction of capture & storage (CCS) in the UK up to 2050, and investigate greenhouse gas emissions and air quality implications for human health and ecosystems. This involves using a life cycle analysis approach to reflect the emissions arising from the development and operation of CCS and associated storage systems. The scenarios extend to 2050 and include comparison of both pre- and post-combustion CCS

2 - A simulation-based approach for a national integrated assessment model for Germany
Patrick Breun, Institute for Industrial Production, Karlsruhe Institute of Technology (KIT), Hertzstraße 16, D-76187, Karlsruhe, Germany, patrick.breun@kit.edu, Rebecca Ilsen, Magnus Fröhling, Frank Schultmann
The talk describes the otello model, a national integrated assessment model (IAM) to support clean air policy in Germany. The model aims at providing a tool to assess instruments for control of SOX, NOx, NH3, and CO2 emissions from industrial production, energy supply, transport and residential buildings with respect to sustainability. Different types of policy instruments are evaluated considering criteria from the three dimensions of sustainability. The simulation-based model, especially the industry sub model, are introduced and examples of scenario calculations are presented.

3 - Managing without Growth: Italian Scenarios
Simone D’Alessandro, Scienze Economiche, University of Pisa, via Ridolfi 10, 56124, Pisa, Italy, s.dale@ec.unipi.it, Giorgio Gallo, Giovanni Bernardo
This paper presents a structural model for the Italian economy by applying system dynamics to scenario analysis. Government affects the performance of the economy, through the use of instruments such as taxation, labour policies and market regulation. The aim is twofold. First, we investigate the impact of public policies on six main performance indexes: rate of growth, unemployment, poverty, fiscal position, GHG emission, and inequality. Second, we evaluate whether it is possible to disjoint wellbeing and economic growth.

4 - Computer modeling of urban air quality and related health effects
Piotr Holnicki, Systems Research Institute of the Polish Academy of Sciences, Newelska 6, 01-447, Warsaw, Poland, holnicki@ibspan.waw.pl, Zbigniew Nahorski, Marko Tainio
An important application of air pollution models is air quality management and decision support. Modelling techniques allow us to assess ecological impact of emission sources and benefits of emission abatement. Complexity of such forecasting systems involves uncertainty of the model outputs. This paper addresses the problem of uncertainty of emission inventory and the impact on air pollution predictions and adverse health effects. The computational experiment was implemented for Warsaw Metropolitan Area, Poland, with the CALPUFF air dispersion model used as the forecasting tool.

OR for Education and Sustainable Development
Stream: OR for Development and Developing Countries
Invited session
Chair: Alexander Makarenko, Institute for Applied System Analysis, National Technical University of Ukraine “KPI”, Prospect Pobedy 37, 03056, Kiev, Ukraine, makalex@i.com.ua
Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

1 - Self-organization processes in the European Higher Education Area
Marek Frankowicz, Faculty of Chemistry, Jagiellonian University, ul. Ingardena 3, 30-060, Krakow, Poland, marek.frankowicz@gmail.com
Usefulness and applicability of the theory of complexity to characterize evolution and structural changes in European higher education is discussed. Intrinsic dynamics of various processes induced by Bologna reforms is highlighted. Three cases are analyzed in more detail: dynamics of international mobility flows, the concept of self-extracting quality management systems, and sectoral qualification frameworks viewed as complex adaptive systems. Particular attention is paid to possibilities of applying OR techniques to support decision making processes at the national and European level.

2 - Industrial heritage as an educational polygon for development strategies

Vladimir Hain, Institute of History and Theory of Architecture and Monument Restoration, Slovak university of technology, Faculty of architecture, Námestie slobody 19, 812 45, Bratislava, Slovakia, vladimirhain@gmail.com, Eva Králova

Industrial heritage provides one of the most important records on development of cities and towns last two centuries. The basic purpose of the “Educational polygon” is to develop a model and operational tools to raise the awareness of the importance of valuable buildings as a part of the cultural and technological history to stimulate social, economical and political decision to protect them in a new creative way. Its prioritization conservation is a necessary aspect of a city development and study shows example how to set up an appropriate framework for its integration within existing structure.

3 - A hybrid MCDM approach to assess the sustainability of students’ preferences for university selection

Metin Dagdeviren, Department of Industrial Engineering, Engineering Faculty, Celal Bayar Bulvar, Gazi Univ. MMF, Endustri Muh., 06570, Ankara, Turkey, metindag@gazi.edu.tr, Kabuk Metinmet

An integrated approach which employs ANP and PROMETHEE together is proposed. It is concerned with criteria influencing student choice in complex Turkey to establish a model for predicting students’ preference for universities. The ANP is used to analyze the structure of the problem and to determine weights of the criteria, and the PROMETHEE is used to obtain final ranking, and to make a sensitivity analysis. The results indicate that three factors, future career prospects and opportunities, scholarship and university’s social life at the top in the university selection.

4 - Competitive market vs. central planning economy and long-run growth

Kenji Miyazaki, Faculty of Economics, Hosei University, 4342 Aihara, 194-0298, Machida, Tokyo, Japan, miya_ker@hosei.ac.jp

We use a simple model with an endogenous discounting rate and a linear technology to investigate whether a competitive equilibrium has a higher balanced growth path (BGP) than a social planning solution. The implications are as follows. People with an inclination to compare themselves with others have an endogenous discounting rate. Such an inclination affects the economic growth rate in a competitive market economy. A competitive market economy sometimes achieves a higher economic growth than a central planning economy, but it sometimes fluctuates due to self-fulfilling prophecy.

TD-34
Tuesday, 14:30-16:00
CC-A39
OR for Sustainable Living and Development

Stream: Sustainable Living: Cognitive, Social, Economic, Ecological and World View

Invited session

Chair: Pedamallu Chandra Sekhar, Department of Medical Oncology, Dana-Farber Cancer Institute, Institute, Boston, 02115, Ipswich, MA, United States, pcs.murali@gmail.com

Chair: Theodor Stewart, Statistical Sciences, University of Cape Town, Upper Campus, 7701, Rondebosch, South Africa, theodor.stewart@uct.ac.za

Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

1 - Healthy housing environment in small towns in Southeastern Poland

Justyna Kobylarczyk, Cracow University of Technology, Poland, j.kobylarczyk@cp.pl

The threats of contemporary civilization make it more and more difficult to live in the city. Therefore, sustainable development is becoming a profound need of modern times. The author’s environmental research carried out in some small towns of Southeastern Poland made it possible to enumerate the most important needs of the inhabitants of this region. They influence the creation of a healthy housing environment which is the imperative objective of sustainable development. Among other features, they include safety and privacy as well as the nearness of nature.

2 - Combined multicriteria and scenario analysis as aid to sustainable development

Theodor Stewart, Statistical Sciences, University of Cape Town, Upper Campus, 7701, Rondebosch, South Africa, theodor.stewart@uct.ac.za

Evaluation of sustainable policies in the developing world context requires consideration of many divergent criteria related to balancing social, environmental, equitable and economic issues. Furthermore, this occurs typically in a context of major levels of uncertainty, to a larger extent than in the developed world. We critically examine means by which multicriteria decision analysis and scenario planning can be combined into an integrated approach to address all issues. Illustrations of the use of the integrated approach in the development context will be discussed.

3 - The Antecedents and the Benefits of Partnership in PEF (Private Equity Fund) of South Korean Industries: The Sustainability Perspective

Hansuk Lee, Sangmyung University, Korea, Republic Of, hansuk@smu.ac.kr, Seongtae Hong, In-Young Lee

In recent years, Sustainable Operations Management(SOM) has been receiving attention from many researchers. Most of the research on SOM has been limited to conceptual frameworks, case studies and some empirical papers. Social dimension of sustainability is concerned with the well being of people and communities. This paper presents a study aimed at quantifying the antecedents and benefits of partnership in PEF/Private Equity Fund. With this research we made efforts to study the social dimension of sustainability in the corporate social responsibility context.

4 - The effect of organizational communication in intrapreneurship and business performance

Şikran Öktem, Business Administration, Başkent University, Ankara, Turkey, gonga2311@gmail.com, Hakan Turgut, Ismail Tokmak, Gözde Kubat

For achieving a sustainable competitive advantage in global competition, organizational communication for businesses and intrapreneurship has gained importance. To identify the presence of the effect of organizational communication in both intrapreneurship and business performance in Ankara (Turkey), a survey has been carried out in different sectors for manufacturing industry companies. Analysis of data from the survey with the help of the relations between these variables will be conducted.

TD-35
Tuesday, 14:30-16:00
CC-A41
Robust logistic applications

Stream: OR Applications in Industry

Invited session

Chair: Tobias Winkelkotte, IT, zooplus AG, Sonnenstraße 15, 80331, München, Germany, tobias.winkelkotte@zooplus.com
1 - Robust Model for Dynamic Multilevel Capacitated Facility Location under uncertainty

Vincenzo De Rosa, Chair of Business Administration and Logistics, Universität Erlangen-Nürnberg, Lange Gasse 20, 90403, Nürnberg, Germany; Vincenzo.Rosa@wissn.uni-erlangen.de, Marina Gebhard, Jens Wollenweber

A new model formulation for the robust capacitated facility location problem for distribution systems under uncertainty is presented. Minimizing the expectation of the relative regrets across scenarios over a multi-period planning horizon is set as objective. It is achieved by dynamically assigning multi-level production allocations, facility locations and capacity adjustment or uncertain parameter developments over time. The robustness and effectiveness of the MIP-model is shown by comparison to a deterministic planning approach in an exemplary setting where the future is assumed certain.

2 - Scheduling Long Distance Transports in a Postal Distribution Network

Tobias Winkelkotte, IT, zooplus AG, Sonnenstraße 15, 80331, München, Germany, tobias.winkelkotte@zooplus.com, Li Sun

Postal distribution consists of the sorting of big amounts of items and the transporting over long distances. Transports have to be scheduled such that the sortings can be completed in time. The question is, when to send transports from one sorting facility to another, while achieving a certain service level. We present an appropriate mixed-integer linear programming model to schedule transports such that a service level is achieved and the costs are minimal. We present a heuristic approach which searches a wide range of the solution space by systematically varying the desired service level.

3 - New approach to The Single Track Railway Scheduling Problem

Maya Laskova, The Institute of Control Sciences V. A. Trapeznikov Academy of Sciences, Moscow, Russia, Russian Federation, laskovayamaya@moscow-index.ru, Alexander Lazarev, Elena Musatova

We consider the single track railway scheduling problem with two stations. Two subsets of trains are given, where trains from station one go to station two, and trains from station two go to station one. All trains have the same speed. At most one train from station one or two can be on the track at any time. We consider the single track railway scheduling problem with two stations with optimization criteria of minimizing additional completion time for each trains. We propose a heuristic approach to The Single Track Railway Scheduling Problem.

4 - SFERA: A Simulation Framework for the Performance Evaluation of Restart Algorithms in service-oriented systems

Alexandra Danilkina, Institute for Computer Science, Freie Universität Berlin, Takustr. 9, 14195, Berlin, Germany, danilkina@zedat.fu-berlin.de, Philipp Reinecke, Katinka Wolter

Restart is a well-known client-side technique for improving performance and service availability. We illustrate SFERA framework features with an evaluation of the optimal restart timeout in a complex SOA system. We simulate different configurations using workflows and model component response-times by phase-type distributions fitted to measurements from a SOA tested. Several service-policies including ageing servers and infinite servers are considered as well as different arrival processes and restart algorithms. We compare completion times and service availability for different scenarios.
The optimal timing for radical medical procedures as joint replacement must be seriously considered. We show that under deterministic assumptions the optimal timing for joint replacement is a solution of a mathematical programming problem, and under stochastic assumptions the optimal timing can be formulated as a stochastic programming problem. For the case where the patient’s remaining life is normally distributed along with a normally distributed survival of the new joint, the expected benefit function from surgery is completely solved. This enables practitioners to find the optimal timing.

2 - Probabilistic Risk Assessment methods application for medical device reliability

**Robertas Alzbutas**, Lithuanian Energy Institute, Kaunas University of Technology, LT-44043, Kaunas, Lithuania, robertas@mail.lei.lt, **Darius Naujokaitis**, Vytautas Janilionis, Giedri Alzbutien

In this paper the main techniques and methods of Probabilistic Risk Assessment as well as their application for risk and reliability analysis of medical devices are introduced. The focus is set on the Fault Tree Analysis (FTA) technique and related quantification methods based on Minimal Cut-sets (MCS) and Binary Decision Diagram (BDD). Also, an example of probabilistic assessments of simple system failure and comparison of produced outcomes is presented. The main advantages and disadvantages of MCS and BDD as well as FTA application for Risk Informed Decision Making are described too.

3 - Integrating probability distribution elicitation with Markov decision modeling: a case study in the treatment of patients with heart failure

**Qi Cao**, Department of Epidemiology, University Medical Centre Groningen, P.O. Box 30001, 9700 RB, Groningen, Netherlands, q.cao@umcg.nl, **Douwe Postmus**, Hans Hillege, Erik Buskens

Early-stage economic evaluations of novel medical equipment are characterized by evidence scarcity as data from clinical research is still missing. These evaluations must therefore be based on evidence from less direct sources, such as early bench or animal testing and expert judgement. In this study, we discuss how the resulting uncertainty in the model parameters can be incorporated in a probabilistic way by integrating probability distribution elicitation with Markov decision modeling. The method is illustrated in a case study in the treatment of patients with heart failure.

4 - Robust surgery scheduling via simulation optimization

**Fabricio Sperrando**, INESC-TEC, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, s/n, 4200-465, Porto, Portugal, fsperrando@fe.up.pt, **Bernardo Almada-Lobo**, José Borges

Surgery scheduling problems are characterized by strong uncertainty, compromising the results of deterministic optimization methods. This work presents a Simulation Optimization approach to the surgery scheduling problem at the operational level. The system is composed by a multi-objective optimization search procedure and a stochastic simulation model, which is used to estimate the performance of alternative schedules under uncertainty (variable surgery duration, cancellations, and emergencies). The approach aims to devise robust schedules, better fitting the stochastic nature of the problem.

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**TD-39**

**Tuesday, 14:30-16:00**

**HH-Colombus**

**MCDA software for real-world MCDA problems**

**Stream**: Innovative Software Tools for MCDA

**Chair**: Brian Reddy, ScHARR, University of Sheffield, 30 Regent Court, S1 4DA, Sheffield, United Kingdom, b.reddy@sheffield.ac.uk

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**TD-38**

**Tuesday, 14:30-16:00**

**HH-Cousteau**

**Multiobjective Optimization for Decision Support**

**Stream**: Multiobjective Optimization

**Chair**: Heinz Roland Weistroffer, Information Systems Department, Virginia Commonwealth University, 301 West Main Street, 23284-4000, Richmond, VA, United States, hrweistr@vcu.edu

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**1 - IND-NIMBUS Framework for Interactive Multiobjective Optimization**

**Vesa Ojalehto**, Department of Mathematical Information Technology, University of Jyväskylä, P.O. Box 35 (Agora), FI-40014 University of Jyväskylä, Finland, Finland, vesa.ojalehto@jyu.fi, **Jussi Hakanen**, Kaisa Miettinen

We present a framework for interactive multiobjective optimization (IMO) called IND-NIMBUS. IND-NIMBUS is a stand-alone system for solving real-world nonlinear multiobjective optimization problems and contains implementations of several IMO methods. Development principles of IND-NIMBUS have been interaction with the decision maker, computational efficiency, ability to change methods during the solution process and utilization of the same modules with different methods e.g. for visualizing and storing solutions. Applications include radiotherapy treatment planning and chemical engineering.

**2 - State of Multiobjective Optimization Software**

**Heinz Roland Weistroffer**, Information Systems Department, Virginia Commonwealth University, Snead Hall, 301 West Main Street, 23284-4000, Richmond, VA, United States, hrweistr@vcu.edu, **Yan Li**

We present an overview and a comprehensive survey of current multiobjective optimization (MOO) software. The purpose of this work is two-fold. For the academic researcher we provide an annotated compendium of MOO implementations to show what has been done and where there are gaps. For the practitioner interested in solving specific MDDM problems, we provide a selection guideline to find the most suitable software to meet his or her needs.

**3 - On Developing User Interface for Interactive Multiobjective Optimization**

**Jussi Hakanen**, Dept. of Mathematical Information Technology, University of Jyväskyla, P.O. Box 35 (Agora), FI-40014, University of Jyväskyla, Finland, jussi.hakanen@jyu.fi, **Kaisa Miettinen**, **Suvi Tarkkanen**, **Hannakaisa Isonmäki**

By using interactive multiobjective optimization (IMO), a decision maker (DM) progressively provides preference information in order to find the most satisfactory compromise between the conflicting objectives. In this paper, we consider possibilities the research field of visual analytics can provide for supporting the decision making process and information exchange between IMO methods and a DM. The implementation of an IMO method Pareto Navigator is used as an example to demonstrate concrete challenges of interaction design and we describe the incremental development of the user interface.

**4 - Laplacian Regular Multiple Criteria Linear Programming for Semi-supervised Classification**

**Zhiqian Qi**, Graduate University of Chinese Academy of Sciences, 200062, Beijing, China, qizhiquan@gucas.ac.cn

In this paper, inspired by the success of RMCLP, we propose a novel Laplacian RMCLP (called Lap-RMCLP) method for semi-supervised classification problem. Unlike other methods based on graph, Lap-RMCLP is a natural out-of-sample extension, which can classify data that becomes available after the training process, without having to re-train the classifier or resort to various heuristics. Furthermore, by adjusting the parameter, Lap-RMCLP can convert to RMCLP naturally. All experiments on synthetic and real data sets show that Lap-RMCLP is a competitive method in semi-supervised classification.
1 - a MCDA tool for evaluating the overall comfort onboard the French high speed trains (TGV)
Mohamed, Lounes Manneri, Innovation and research, SNCF, 7 square des tilteuls, 92350, le plessis robinson, France, lounes.manneri@gmail.com

Comfort being one of the main reasons why passengers like travelling by train, it is important for railway operators to be able to estimate the overall comfort for various types of trains. We describe the first steps of a study aiming at constructing a tool based on a multiple criteria decision aiding approach. We consider the comfort as a judgment based on a set of complex elements by taking into account the passengers’ point of view. We have proposed a hierarchical model of the comfort components and defined the associated scales and some interactions between components.

2 - Eliciting ElectreTri category limits for a group of decision makers
Vincent Mousseau, LGI, Ecole Centrale Paris, Grande voie des vignes, 92 295, Chatenay Malabry, France, vincent.mousseau@ecp.fr, Olivier Cailloux, Patrick Meyer

Multicriteria sorting assigns alternatives to predefined ordered categories. We consider the Electre Tri method, which involves 3 types of parameters: 1) category limits defining the frontiers between consecutive categories, 2) weights and majority level specifying which coalitions form a majority, 3) veto thresholds characterizing discordance effects. We propose an elicitation procedure to infer category limits from assignment examples provided by multiple DMs. The procedure computes a set of category limits common to all decision makers, with variable weights and vetoes for each DM.

3 - Investigating mcda approaches for the national institute for health and clinical excellence
Brian Reddy, SchHARR, University of Sheffield, 30 Regent Court, S1 4DA, Sheffield, United Kingdom, b.reddy@sheffield.ac.uk

NICE uses evidence-based, health economic approaches to prioritise interventions, reduce variation in levels of treatment between regions and encourage best practice across the NHS. For various reasons it is challenging to quantify, model and describe the multiple effects of public health interventions. As a result there is uncertainty around cost effectiveness, complicating decision processes. This presentation will describe some common problems in this area, explain why MCDA techniques may help and explain where these approaches are currently being further investigated for future use.

2 - A new rule-based method for label ranking
Massimo Gurrieri, University of Mons, Rue du Houdain 9, 7000, Mons, Belgium, Massimo.Gurrieri@umons.ac.be, Xavier Siebert, Philippe Fortemp

This work focuses on an application of preference ranking, where the problem is to learn a mapping from instances to rankings over a finite set of labels. Our approach is based on a learning reduction technique and provides such a mapping in the form of logical rules: if [antecedent] then [consequent], where [antecedent] contains a set of conditions (connected by a logical conjunction operator (AND)) while [consequent] consists in a ranking among labels. This approach comprises five phases: preprocessing, rules generation, post-processing, classification and ranking generation.

3 - Learning preference relations with Kronecker kernels: Some theoretical and algorithmic results
Tapio Paikka, Turku Centre for Computer Science, 20014, Turku, Finland, aatapia@utu.fi

In this talk, we consider a framework for learning various types of preference relations that is based on Kronecker product kernels and their modifications. As case studies, we consider tasks of inferring rankings of objects and learning to predict nonlinear preferences, as well as extensions to more complex preference learning problems. Next, we present theorems about the universal approximation properties of the considered kernel functions. Finally, we present computationally efficient learning algorithms for the considered problems and practical results on several application domains.

4 - Efficient information retrieval in bioinformatics with conditional ranking algorithms
Willem Waegeman, Department of Applied Mathematics, Biometrics and Process Control, Ghent University, Coupure links 653, 9000, Ghent, Belgium, willem.waegeman@ugent.be

In domains like multimedia retrieval, bioinformatics, social network analysis and game playing, one can find retrieval tasks where the goal consists of inferring a ranking of objects, conditioned on a target object query. We recently presented a general machine learning framework for learning conditional rankings from various types of relational data. In this talk we focus on three specific bioinformatics applications: retrieval of enzymes w.r.t. functionality, ranking of ligands for computational drug design and modelling interactions between bacterial species.
2 - A survey analysis on the investment attitudes of individual investors
Belma Ozturkkan, International Trade and Finance, Kadir Has University, Cibali, Istanbul, Turkey, belma.ozturkkan@khas.edu.tr

This study aims to analyze determinants of trading behavior of local investors, where a survey of 55 questions on 85 people is used. The survey is composed of four parts: demographic properties, perceived characters, investment preferences, portfolio diversification. The findings show that investors are subject to home bias and the surveyed investors prefer to invest in local equity market.

3 - Stochastic interventions: Methods to model uncertainty
Shweta Agarwal, Management Science, London School of Economics, New Academic Fields, Lincoln’s Inn Fields, WC2A 2AE, London, Great Britain, United Kingdom, shweta1963@gmail.com, Gilberto Montibeller

Managers frequently associate controlling risk with managing the uncertainty that generates them. One way to represent this in decision models is by not treating uncertainties as exogenous but by allowing the probability distributions of state variables to be altered by stochastic interventions. We define such an intervention using principles of causal reasoning and propose modelling it with generalized conditioning. The ability to model the effects of probability alteration can enhance the prescriptive scope of decision analytic tools in risk management.

4 - Records Properties of Nonstationary Time Series
Ana Elizabeth Garcia Sipols, Estadistica e investigacion operativa, Universidad Rey Juan Carlos, c/Tulipan s/n, 28933, Madrid, Spain, anaelizabeth.garcia@urjc.es, Clara Simon de Blas, M. Teresa Santos Martin

This paper compares the statistical properties of the records from independent and identically distributed time series with those of time series containing a single unit root. It is shown that there are important differences in both the limiting distributions and the convergence rates of the associated record counting processes. We prove some properties for the test statistic in the context of the renewal theory and we suggest two new candidates to test the hypothesis of random walk with positive and negative drift.

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2 - A discrete system simulating an e-shop built bottom up from customer behavior
Peter Vojtas, Software Engineering, Charles University, Faculty of Mathematics and Physics, Malostranske nam. 25, 118 00, Prague, Czech Republic, vojtas@ksi.mff.cuni.cz, Ladislav Peska

Our motivation is modeling a web based e-shop from manager’s perspective. One of problems of such modeling is to find analytical description. We combine database preference querying and our model of learning user preferences for explicit/implicit users’ behavior. We propose a simulation system with stochastic generated artificial users and manager’s decision. In our experiments, distribution of user behavior was collected in a real travel agency and system response contained items based partly on advertisement, partly on popularity and partly on top-k object of each user in person.

3 - Taxonomy of concepts and terms in administration
Erwin Reizes, O.R., Fac.Ing./deLaR, Uruguay, Luis A. de Herrera 1042,ap.1701 (home), ap.1701, 11300, Montevideo, Uruguay, bereizes@adinet.com.uy

A taxonomy of concepts and terms seems necessary to cope with the Babel of synonyms and homonyms which plagues present System and Administration Theory and Practice. Therefore, based on these ideas, on OR and on ideas of Linguistic, Logic and Information, a bijective mapping between concepts and terms is given.

4 - A Hybrid Modelling Approach for Physical Network Design under Demand Uncertainty
Sutthipong Meeyai, Cranfield University, United Kingdom, sutthipong.meeyai@cranfield.ac.uk

We consider a modelling approach for physical network design when it is managed in a decentralised way. An optimization approach generally determines an optimum or near-optimum solution from a ‘top-down perspective.’ Instead of designing only from the standard approach, we examine the results from a ‘bottom-up perspective’ by an agent-based simulation. With the agent properties we can investigate operations by a local objective with a set of degree of freedom. We provide a modelling approach for network design with a numerical result from a real-world example.

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**TD-42**
Tuesday, 14:30-16:00
BW-Amber

**Advances in Stochastic Modeling and Simulation**

**Stream:** Stochastic Modeling and Simulation in Engineering, Management and Science

**Invited session**

Chair: Basak Tanyeri, Bilkent University, Turkey. basak@bilkent.edu.tr

1 - A Comparison of Artificial Neural Network and Multinomial Logit Models in Predicting Mergers
Nilgün Fescioglu-Unver, Industrial Engineering, TOBB University of Economics and Technology, Sogutozu Cad., No.43, Sogutozu, 06560, Ankara, Turkey, nfunver@etu.edu.tr, Basak Tanyeri

Predicting who will propose merger bids and who will receive merger bids is important to measure the price impact of mergers. This study investigates the performance of artificial neural networks and multinomial logit models in predicting bidder and target candidacy. We use a comprehensive dataset that covers the years 1979 to 2004 and includes all deals with publicly listed bidders and targets. We find that both models perform similarly while predicting target and non-merger firms. The multinomial logit model performs slightly better in predicting bidder firms.

**TD-43**
Tuesday, 14:30-16:00
BW-Granite

**Stochastic and robust optimization**

**Stream:** Stochastic Programming

**Invited session**

Chair: Abdel Lisser, LRI, Université de Paris Sud, Bat. 650, 91405, Orsay, France, lisser@lri.fr

1 - Solving SCOPF problems by a new structure-exploiting method
Naiyuan Chiang, School of Mathematics School of Mathematics School of Mathematics School of Mathematics, University of Edinburgh, Room 5620, JCMB, The King’s Buildings, EH9 3JZ, Edinburgh, State, United Kingdom, sorakid507@gmail.com

The aim of this paper is to demonstrate some new approaches to solve the linearized security constrained optimal power flow (SCOPF) problem by OOPS, which is a modern structure-exploiting primal-dual interior-point implementation. Firstly, we present a reformulation of the SCOPF model, in which most matrices only need to be factorized once throughout the IPM iterations. Moreover, we use a preconditioned iterative method to solve the corresponding linear system and suggest several schemes to pick a good and robust preconditioner based on combining different ‘active’ contingency scenarios.
2 - A Second-Order Cone Programming approach for Linear programs with joint probabilistic constraints
Abdel Lisser, LRI, Universite de Paris Sud, Bat. 650, 91405, Orsay, France, lisser@lri.fr
In this talk, we consider a special case of Linear programming problems with joint probabilistic constraints (LPPC). We assume that the constraint matrix is random with normally distributed coefficients and independent rows. To solve this hard problem, we use the piecewise linear approximation and the piecewise tangent approximation to come up with upper and lower bounds respectively. For this purpose, we solve two different second-order cone programming (SOCP) problems. Numerical results on randomly generated data are given.

3 - Robust portfolio optimization - impact of copula and estimation choice
Justyna Majewska, Department of Demography and Business Statistics, University of Economics in Katowice, 1 Maja 50, 40-287, Katowice, Katowice, Poland, justyna.majewska@ue.katowice.pl, Grazyna Trzpiot
The paper deals with estimating risk minimizing portfolios when departures from standard assumption of Gaussianity are present. Its aim is to investigate the impact of different copula on optimal portfolio, when different robust alternatives to the classical variance portfolio optimization problem are used. Especially, we examine some aspects of the relationship of dependence structure and robust estimation. We present applications using a data set based on a global portfolio of an emerging market investors located in Central and Eastern Europe.

4 - On reduction of quantile optimization problems with discrete distributions to mixed integer programming problems
Vladimir Norkin, Operations Research, Institute of Cybernetics, Glushkov avenue, 40, 03187, Kiev, Ukraine, norkin@i.com.ua, Andrey Kibzun, Andrey Naumov
In the report we suggest a method of equivalent reduction of a general quantile optimization problem with discrete distribution of random data to large scale mixed integer programming problems. The latter are supposed to be solved by standard discrete optimization software. As a particular case a two-stage quantile stochastic optimization problem is considered. Our main contribution consists in establishing new conditions of equivalence between two formulations. Some generalizations can be found in http://www.optimization-online.org/DDBTML/2010/05/2619.html

2 - Nonlinear regression model generation and graph transformations
Roman Sologub, Innovations and High Technology, Moscow Institute of Physics and Technology, 508, 86, Altufievskoe sh., Moscow, 127349, Moscow, alucardische@gmail.com
We investigate a problem of non-linear regression model generation. The practical application is to define regression of strike and maturity of a European option towards its volatility. To derive the volatility surface we use symbolic regression. The competitive models are generated as superpositions of expert-given functions. The main problem of the model generation process is to filter the isomorphic models with different structure. The methods of graph transformation are used as solution. The result is a set of models of unique structures. The optimal model is selected from this set.

3 - Multiclass classification of cardio-vascular disease patients with sample size estimation
Anastasia Motrenko, Applied mathematics and management, MIPT, Moscow, Russian Federation, pastt.petrovna@gmail.com
We discuss an algorithm that classifies four groups of patients, divided by their health condition. Concentrations of proteins in blood cells are used as features. Our first objective is to select a set of features that will classify the patients making minimum amount of errors. This selection is implemented by means of exhaustive search. Two classification strategies are investigated, “one versus all” and “all versus all”. The second objective is the sample size. Amount of data is small, so we evaluate minimum sample size, necessary for statistical significance of classification.

4 - Mixture models in the financial time series forecasting
Vadim Strijov, Russian Academy of Sciences, Computing Center, Vavilova 42-268, 119333, Moscow, Russia, Russian Federation, strijov@ccas.ru
To forecast financial time series one needs a set of models of optimal structure and complexity. The mixture model selection procedures are based on the coherent Bayesian inference. To estimate the model parameters and covariance matrix, Laplace approximations methods are introduced. Using the covariance matrix one could split up the data set to form mixture of models and select a model with minimum description length.

TD-44
Tuesday, 14:30-16:00
BW-Marble
Model Generation and Model Selection
Stream: Machine Learning and its Applications
Chair: Michael Khachay, Ural Branch of RAS, Institute of Mathematics and Mechanics, S.Kovalevskoy, 16, 620990, Ekaterinburg, Russian Federation, mkhachay@imm.uran.ru
Chair: Vladim Strijov, Russian Academy of Sciences, Computing Center, Vavilova 42-268, 119333, Moscow, Russia, Russian Federation, strijov@ccas.ru
1 - Search for Optimal Composite Indicators
Miroslav Klucik, Faculty of Economics, VSB-Technical University of Ostrava, Havlickovo nabrezi 38, 701 21, Ostrava, Czech Republic, miroslav.klucik.st@vsb.cz
Contemporary approaches to construct composite leading indicators using economic theory and statistical analysis rely mostly on subjective decisions of researchers and analysts. An artificial intelligence tool — genetic programming — can mine all the information available in large data sets and help to construct models best fitted to the reference data. The composition of indicators and the lead of time series are being searched for by symbolic regression. The structure of associated information between reference series and large data sets is shown.

TD-45
Tuesday, 14:30-16:00
BW-Water
Quantitative Approaches in Managerial and Financial Accounting
Stream: Quantitative Approaches in Managerial and Financial Accounting
Chair: Matthias Amen, Chair for Quantitative Accounting & Financial Reporting, University of Bielefeld, Universitaetsstrasse 25, 33615, Bielefeld, Germany, Matthias.Amen@web.de
1 - Optimizing continuous inventory
Matthias Amen, Chair for Quantitative Accounting & Financial Reporting, University of Bielefeld, Universitaetsstrasse 25, 33615, Bielefeld, Germany, Matthias.Amen@web.de
Physical inventory exists explicitly or implicitly (IFRS, ISA 501) in all accounting systems. The German Commercial Code (Handelsge- setzbuch, HGB) requires an annual physical inventory for each item of the balance sheet. Traditional physical inventory requires a stop of operations of the production plant for a certain period around the balance sheet date. To ensure continuous production continuous inventory is also allowed. We present an optimization approach to determine the schedule of stocktaking in a continuous inventory system during the accounting period.
2 - Meta Managerial Accounting — quantitative approaches for designing managerial accounting systems

Markus Puetz, Chair, Department of Managerial Accounting and Control, WHL Graduate School of Business and Economics, Holbergweg 15 - 17, D-77935, Lahr, Baden-Wuerttemberg, Germany, markus.puetz@whl-lahr.de

Meta Managerial Accounting (MMA) is used to design effective managerial accounting systems for practical applications. In this presentation 3 MMA approaches will be discussed: 1. Analytical and graph theoretical approach for representation of business and control processes with open decision networks. 2. First order predicate logic approach for specification of business and control processes and potentials, including handling of verification and validation tasks which refer to control methods. 3. Approach for implementation of simulation based open decision networks for MMA purposes.

3 - Corporate taxes, capital structure and valuation: Combining Modigliani/ Miller and Miles/ Ezzell

Ulrich Schäfer, Professor für Finanzen und Controlling, Georg-August-Universität Göttingen, Platz der Göttinger Sieben 3, 37073, Göttingen, Germany, ulrich.schaefer@wiwi.uni-goettingen.de, Stefan Dierkes

Valuing a company with Discounted Cash Flow (DCF) approaches requires assumptions about the financing strategy. In general, pure strategies are considered thus far: Either, according to Modigliani and Miller, debt levels or, following Miles and Ezzell, capital structure targets are pre-determined for all periods. In this paper, it is shown how to value a company for an arbitrary combination of these strategies. The familiar approaches are embedded into a common framework. For practical application, a combined financing allows for a more realistic modeling of a company’s financing strategy.

4 - Electronic transfer of financial data to banks - reasons for refusal and possible improvements

Karina Sopp, University of Vienna, Brunnerstraße 72, 1210, Vienna, Austria, karina.sopp@univie.ac.at

Electronic transfer of financial data based on a reporting language like XML or XBRL gets more and more common in multiple areas. However, in the communication between banks and their business customers the distribution of financial information in alternative formats still remains dominant and therefore shows potential for further development. To detect the reasons for the lack of acceptance a survey was carried out among approximately 2000 Austrian accountants. The results of the survey show next to the reasons for the low acceptance the conditions which have to be met for a higher acceptance.

Tuesday, 16:30-17:30

- TE-01

Tuesday, 16:30-17:30

Opera

Celebration of EURO and its Presidents

Stream: Keynote, Tutorial and Plenary Lectures

Plenary session

Chair: M. Grazia Speranza, President of EURO, EURO Office, ULB CP210/01, 1050, Bruxelles, Belgium, president@euro-online.org

Chair: Gerhard Wäscher, President-Elect of EURO, EURO Office, ULB CP210/01, 1050, Bruxelles, Belgium, pe@euro-online.org

1 - 40 Years of EURO: History, Applications, Future Potentials

Hans-Jürgen Zimmermann, Operations Research, Aachen Institute of Technology, KORNELIUSSTR.5, 52076, Aachen, Germany, zi@or.rwth-aachen.de

40 years ago, i.e. in 1972, the world looked quite different from today: Logistism were slower and more complicated: The best way to travel from Europe to the USA by ship, which took between 5 and 13 days. Alternatively one could take a “Super Constellation” and go via Island in 24 hours. There were no electronic booking systems, customs- and passport control at each European border, but no security systems at airports, no terrorism and no hijacking of planes. Communication was as clumsy: No fax, no email, no courier services, a letter between Europe and overseas took two to three weeks, each single letter had to be typed and there were neither social nets nor a www. Professionally there existed three large OR-journals (and a number of small national ones), East and West was separated by the Iron Curtain. “Large” OR-Societies existed in the USA, Japan and Great Britain and in Europe there were a dozen of smaller national OR Societies. There was hardly any communication between these European societies and if one wanted to know what was going on in OR in another European country, the best way was, to ask a colleague in the USA. In the USA Ackoff had stated (in 1979) “American Operations Research is dead though not yet buried”. Under these circumstances the presidents of the European OR societies met at the IFORS conference 1972 in Dublin and came to the conclusion, that this situation of OR in Europe was sub-optimal and should be improved. They met again in 1973 and 1974 and decided to organize the first European OR conference at the end of January 1975 in Brussels. There were 500 participants and the representatives of 10 European countries. In the framework of this conference EURO was founded. 7 European working groups were started, the EURO-bulletins was started and it was decided to prepare the publication of a European OR journal (EJOR). In the meantime EURO has 30 member countries, several professional journals, about 30 working groups, several very successful types of events, several prizes and awards, a very impressive web-page, and has had 25 successful EURO conferences. Hence: EURO has turned out to be a very successful organization. The success of OR can, however, not only be measured by the manifold growth of EURO! As an applied discipline the situation of OR in Europe should also be considered from the point of view of available OR-tools, from its public visibility, the areas of applications, the education in this area, and its relationship to other disciplines that have emerged in the meantime and are relevant for OR. In some of these dimensions OR can certainly also be considered to be very successful. In others there are still or again big challenges that have to be met, if OR is also to be successful in the future. In this presentation some of these challenges will be considered in more detail and some ways suggested, how they can possibly be met.

2 - Celebration of the EURO Presidents

M. Grazia Speranza, President of EURO, EURO Office, ULB CP210/01, 1050, Bruxelles, Belgium, president@euro-online.org, Gerhard Wäscher

EURO is especially pleased and proud to recognise the 17 former EURO presidents with a special celebration as part of this plenary session. To celebrate the 25th EURO conference we look back on the development of the Association and its continued growth and success. This is a perfect time to reflect on our history and thank former presidents for their strong guidance and leadership.
3 - Integer programming and constraint propagation for scheduling under energy constraints

Christian Artigues, LAAS, CNRS, 7 avenue du Colonel Roche, 31077, Toulouse Cedex 4, France, artigues@laas.fr,

Pierre Lopez, David Rivreau

We consider a scheduling problem where activities are subject to time windows and "energy" resource constraints. The amount required by each activity on the energy resource at each time has to be decided such that it lies between a minimum and a maximum once the activity is started and before the activity is finished. The total amount of energy required instantaneously cannot exceed a maximal limit and, for each activity, the total energy brought must fulfill its demand. To solve this NP hard problem we propose integer programming and constraint propagation techniques.

4 - A preprocessing procedure to improve recent exact algorithms for the resource-constrained project scheduling problem

Alexander Schnell, Dept of Management, University of Vienna, Austria, alexander.schnell@univie.ac.at, Richard Hartl

This talk deals with exact algorithms for the standard version of the resource-constrained project scheduling problem assuming a single mode, non-preemption and renewable resources. Thereby, we analyse and enhance Branch and Bound algorithms from the literature combining principles from Constraint Programming, Boolean Satisfiability Solving and Mixed-Integer Programming. In this context, we propose a preprocessing step to two state-of-the-art algorithms to improve their computational performance. The results on instances with 60 (120) jobs show the efficiency of our preprocessing procedure.

1 - Robust eigenvector problem and its application to PageRank

Boris Polyak, Laboratory of adaptive and robust systems, Institute for Control Science, Profsojuznaya 65, 117997, Moscow, Russian Federation, boris@ipu.ru

There are novel approaches to Robust Linear Programming and Robust Least Squares which convert them into nonsmooth convex optimization problems. We provide similar technique for robust eigenvector problem for stochastic matrices. Such robust formulations are natural for numerous ranking problems. The approach is compared with standard ones, such as PageRank. Numerical optimization algorithms for nonsmooth problems arising are addressed.

1 - An integrated solution procedure for project staffing

Bros Maenhout, Business Informatics and Operations Management, Ghent University, Tweekerkenstraat 2, 9000, Gent, Belgium, Bros.Maenhout@UGent.be, Mario Vanhoucke

We study a strategic scheduling problem that integrates project scheduling and personnel staffing in order to determine how to staff and schedule single projects as best as possible. A decision is made on the best mix of resource types (regular workers, overtime and temporary workers) to carry out a single project. In this perspective, we want to determine the project schedule and deadline and the usage of the different resources in order to minimize the total cost.

2 - Variable resource consumption and dynamic activity duration in the resource-constrained project scheduling problem

Torben Schramme, DS&OR Lab Paderborn, University of Paderborn, Warburger Straße 100, 33098, Paderborn, Germany, schramme@dso.de, Leena Suhl, Stefan Bunte

The resource-constrained project scheduling problem (RCPSP) has been discussed in literature for decades, although there was only little focus on handling dynamic resource consumption for activities. We will present an extension of this problem considering dynamic resource allocation for every execution period of an activity which leads to activities with a fixed workload but variable duration. We will show some related practical problems with such requirements, discuss the difficulties of this extension for current solving methods and show some ideas how to deal with them.
2 - Constraint-based large neighborhood search approach based on constraint programming for the machine reassignment problem

Deepak Mehta, Cork Constraint Computation Center, University College Cork, Ireland, d.mehta@4c.ucc.ie, Barry O’Sullivan, Helenm Simons

We use a large neighborhood search approach based on constraint programming (CP) to solve the machine reassignment problem. We repeatedly select a subset of processes and re-optimize the resulting subproblem by reassigning machines to these processes using CP. The algorithm often finds a solution that is significantly better than the initial one. One advantage of our approach is that we can restore the domains of the variables efficiently when a subset of processes are reassembled from a subset of machines. Therefore, there is no need to create new variables or domains for a subproblem.

3 - Combining VNS, Simulated Annealing, and a Greedy Heuristic for the ROADEF/EURO 2012 Challenge

Frederic Roupin, LIPN, CNRS-UMR 7030, Université Paris 13, 99 avenue, Jean-Baptiste Clément, 93430, Villetaneuse, France, frederic.roupin@lipn.univ-paris13.fr, Laurent Allandari, Franck Butelle, Camille Coti, Lucian Finta, Gérard Plateau, Antoine Rozenknop

We describe the resolution method of Senior Team S26 for the ROADEF/EURO 2012 Challenge. There are two main algorithms that are used: Variable Neighborhood Search (VNS) and Simulated Annealing (SA). Both algorithms explore neighborhoods generated via three types of moves: Swap, Shift and Ejection Chain. Initial solution used is either the one provided by Google with the data set, or an alternative initial solution that we produce with a specific greedy heuristic.

4 - A GRASP approach for the machine reassignment problem

Michaël Gabay, Laboratoire G-SCOP, 46 avenue Félix Viallet, 38031, Grenoble, France, michael.gabay@g-scop.grenoble-inp.fr, Sofía Zaourar

We describe our approach to solve the machine reassignment problem. The main idea is to combine different heuristics to find good quality solutions. We apply a GRASP metaheuristic scheme: first, a constructive heuristic inspired by vector bin packing problem builds various solutions. Then we use local search to improve these solutions. We take advantage of problem constraints structure to design moves that keep the solution feasible and are very fast to apply.

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**WA-05**

**Wednesday, 8:30-10:00**

**RB-L3**

**Topics in combinatorial optimization I**

Stream: Discrete Optimization, Geometry & Graphs (contributed)

**Contributed session**

Chair: Eric Bourreau, COCONUT, LIRMM, 161 Rue Ada, 34000, Montpellier, France, eric.bourreau@lirmm.fr

1 - A column generation model for Eternity 2

Eric Bourreau, COCONUT, LIRMM, 161 Rue Ada, 34000, Montpellier, France, eric.bourreau@lirmm.fr

Eternity II is a combinatorial problem: a 2D edge matching puzzle. The goal is to place 256 square tiles on a 16x16 square such that all adjacent tiles have matching colors along their common edge. Despite 2 million dollars proposed by Tomy, nobody, between 2007 and 2010 was able to find a solution. We will show an innovative way to describe the problem: a polyomino packing problem with additional cardinality constraints. We propose a column generation model. We validate it, on smaller instances generated with the same parameter as the original (inaccessible!) instance.

2 - Optimization of a nonlinear workload balancing problem

Stefan Emet, Dept of Mathematics and Statistics, University of Turku, Vesilinnantie 5, FI-20014, Turku, Finland, semet@utu.fi

In road transport it is frequently found that a load of pallets in certain arrangements, contravenes legal axle mass and wheel mass restrictions on a given vehicle. The need thus exists to find legal arrangements. It is possible to determine an optimal position for the target point in arrangement processes. Arrangement for a pallet load centroid to a target point presents a combinatorial problem, which could be very hard to solve to optimality. A method which finds a feasible area (as opposed to a target point) for the load centroid is presented. An algorithm is presented which finds legal arrangements for pallet loads.

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**WA-04**

**Wednesday, 8:30-10:00**

**RB-L2**

**Combinatorial Optimization: Applications**

Stream: Combinatorial Optimization

**Invited session**

Chair: Stephan Visagie, Department of Logistics, University of Stellenbosch, Posbus 3404, Matieland, 7602, Stellenbosch, South Africa, svisagie@sun.ac.za

1 - Selecting subsets of foods to measure nutrient exposure: the max r method

Hannelie Nel, Department of Logistics, Stellenbosch University, Private Bag X1, Matieland, 7602, Stellenbosch, Western Province, South Africa, jhnel@sun.ac.za, Martin Kidd

In human nutrition, the max_r method measures specific nutrient exposure. This method calculates the optimal subset of foods that maximizes the Pearson correlation of a given nutrient intake, for example iron, based on the chosen subset of foods with the total nutrient intake (iron, for example) based on all the foods. This paper illustrates the use of metaheuristics to solve this combinatorial optimization problem.
We consider the optimization of a printed circuit board (PCB) assembly unit. The production unit consists of a number of lines of different machines in series for inserting electronic components on bare PCBs. The objective is to optimize the usage of the lines by optimally allocating the jobs to the machines of each line. The balancing problem is modeled and solved using Mixed Integer Nonlinear Programming (MINLP) techniques. It is shown that the presented model can be convexified in an equivalent linear form. A set of test problems is successfully solved.

3 - Efficient Parallel Algorithm for Solving UNSAT 3-SAT and Similar Instances Via Static Decomposition
Emir Demirović, Mathematics, Faculty of Natural Sciences, Bosnia And Herzegovina, emir.demirovic@gmail.com, Haris Gavranovic

We rework our SAT solver, D-Sat, to work in a parallel environment. As with D-Sat, the solution space is decomposed into simpler pieces, i.e., the original problem is decomposed into smaller problems, which are solved in parallel and combined to obtain the solution of the original problem. Any existing solver may be used to process the newly decomposed pieces, as long as it outputs sufficient information about the solution process. Our experimental results show that significantly lower execution times can be achieved for UNSAT 3-Sat and similar instances.

4 - Clique-Forest partitions of P-4-tidy graphs
Sulamita Klein, COPPE-PESC, Universidade Federal do Rio de Janeiro, Caixa Postal 68511, Cidade Universitária, 21941-972, Rio de Janeiro, RJ, Brazil, sulac@cos.ufrj.br, Loana Nogueira, Raquel Bravo, Fabio Protti

A graph G is a P4-tidy graph if, for any induced subgraph H of G isomorphic to a P-4, there exists at most one vertex outside H forming an induced P4 along with three vertices of H. This work considers the problem of (C,F)-partitions of P4-tidy graphs, that is, the problem of determining if the set of vertices of a P4-tidy graph can be partitioned into 2 subsets C and F such that C induces a complete graph and F induces a forest (acyclic graph). We characterize the P4-tidy-(C,F) graphs by forbidden subgraphs and we present a linear-time algorithm to recognize this class.

WA-06
Wednesday, 8:30-10:00
RB-Gamma

Variable Neighborhood Search and hybrid metaheuristics

Stream: Variable Neighborhood Search
Invited session
Chair: Dauwe Vercamer, Marketing, Ghent University, Dauwe.Vercamer@ugent.be

1 - Variable neighborhood search for Unit commitment problem
Raca Todosijevic, Mathematical Institute of the Serbian Academy of Sciences and Arts, 11000, Belgrade, Serbia, racatodosijevic@gmail.com, Igor Crevits, Said Hanafi, Marko Mladenovic, Nenad Mladenovic

Unit commitment (UC) problem for thermal units consists of finding optimal electricity production plan in long time period of T hours. For the first time Variable neighborhood search based heuristic is suggested in this paper as a mean for solving it. In each hour, economic dispatch (ED) problem which is the problem of convex programming is solved by lambda iteration method. Neighborhood structure NK is defined by opening or closing k thermal units. Extensive computational results are performed on well-known test instances from literature.

2 - A VNS for the Real-Life Asymmetric Large-Scale MTSP with Stochastic Customers
Dauwe Vercamer, Marketing, Ghent University, Tweekerkenstraat 2, 9000, Gent, Belgium, Dauwe.Vercamer@ugent.be, Dirk Van den Poel, Birger Raa

When working in B2C environments, distribution logistics often deal with customers who are not at home. If a customer’s service time is substantial compared to the travel times, it is clear this impacts the number of customers one vehicle can serve in its tour. Taking this into account, we developed in collaboration with a home vending company a VNS meta-heuristic that creates least-cost routes for a fleet of identical trucks. Given the impact of real-world constraints on the solution, we used real travel times. Our method solved instances of up to 30.000 customers within reasonable time.

3 - Environmental unit commitment problem with CO2 taxes
Marko Mladenovic, Numerical Mathematics and Optimization, University of Belgrade Faculty of Mathematics, Serbia, mladja87@gmail.com, Igor Crevits, Said Hanafi, Nenad Mladenovic, Racsa Todosijevic

The unit commitment problem (UC) consists of optimally scheduling electrical power plants to produce sufficient power each hour with minimal fuel expenses. Depending on the fuel used by the plants a certain amount of carbon dioxide (CO2) will be emitted to the atmosphere. Ecological taxes that follow this emission vary from country to country and can be more expensive than the fuel itself. In this paper we offer a new and more realistic model for solving the UC problem including CO2 environmental taxes. To solve this new model we used the VNS metaheuristic.

4 - A system based on ontologies, agents and metaheuristics applied to the multimedia service of the brazilian digital television system
Toni Wickert, Informatic. Unisinos - Universidade do Vale do Rio dos Sinos, Av. Unisinos - 950, São Leopoldo, RS, Brazil, toniwickert@gmail.com, Arthur Gomez

With the advent of the Brazilian Digital Television System the users will be able to have an interactive channel. Thus, will be possible to access the multimedia application server, i.e., to send or to receive emails, to access interactive applications, among others. This paper proposes the development and the implementation of an architecture that includes a module that suggests the content to the user according to his profile and another module to optimize the content that will be transmitted. The implementation was developed using ontologies, software agents and metaheuristics.

WA-07
Wednesday, 8:30-10:00
RB-Eta

Logistics and Vehicle Routing

Stream: Vehicle Routing and Logistics Optimization
Invited session
Chair: Juan José Salazar González, Estadística e Investigación Operativa, Universidad de La Laguna (Tenerife), Av. Astrofísico Francisco Sánchez, s/n, Facultad de Matemáticas, 38271, La Laguna, Tenerife, Spain, jsalazar@ull.es
Chair: Hipólito Hernández-Pérez, Estadística e Investigación Operativa, Universidad de La Laguna (Tenerife), C/ Astrofísico Francisco Sánchez s/n, 38271, La Laguna, Canarias, Spain, hhperez@ull.edu.es

1 - One stage approximation algorithm to solve the 2LCVRP
Javier Faulin, Department of Statistics and OR, Public University of Navarre, Los Magnoliolos Builing. First floor, Campus Arrosadia, 31006, Pamplona, Navarra, Spain, javier.faulin@unavarra.es, Angel, A. Juan, Alba Agustín, Oscar Dominguez

We propose a parameter-less algorithm (MultiRound-2LCVRP metaheuristic) to solve the two-dimensional loading capacitated vehicle problem (2LCVRP). From the biased randomization of the Clarke and Wright saving matrix, the algorithm merges routes that minimize distance costs and ensure loading feasibility. Our remarkable contributions are the next ones: (1) an optimal solution is reached from each
round. (2) the algorithm combine implicitly two completely different heuristics in only one and (3) for the loading part, any considered heuristic can be hold.

2 - Large Neighborhood Search for solving the Newspaper Delivery Problem
Belma Turan, Department of Business Administration, University of Vienna, Chair for Production and Operations Management, Brunner Straße 72, 1210, Vienna, Austria, belma.turan@univie.ac.at, Karl Doerner, Richard Hartl, Verena Schmid

We consider a real-world problem of delivering daily and weekly newspapers. The goal is to find a minimal number of vehicles that serve the stores at minimum travel costs. Fairness regarding the number of stops per driver is obtained by minimizing the number of stops per route. The objective is represented as a weighted sum of these three terms. The problem is formulated as a Multi Depot Multi Period Vehicle Routing Problem with Time Windows. A method inspired by ideas of Large Neighborhood Search is developed to solve the problem. We present results on data based on benchmark instances.

3 - A Multi-commodity Pickup-and-Delivery Problem
Héctor Hernández-Pérez, Estadística e Investigación Operativa, Universidad de La Laguna (Tenerife), C/ Astrofísico Francisco Sánchez s/n, 38271, La Laguna, Canarias, Spain, hhperez@ull.edu.es, Juan José Salazar González

The “multi-commodity Pickup-and-Delivery Traveling Salesman Problem” is a generalization of the well-known TSP in which cities correspond to customers providing or requiring known amounts of m different products, and the vehicle has a given capacity. It is assumed that a specified product collected from a customer can be supplied to any other customer that requires a quantity of this product. We introduce a Mixed Integer Linear Programming model for the m-PDTSP, discuss a decomposition technique and describe some strategies to solve the problem. Computational results are presented also.

4 - The Robust Vehicle Routing Problem with Stochastic Demand
Remy Spliet, Econometric Institute, Erasmus University Rotterdam, Burgemeester Oudlaan 50, 3000DR, Rotterdam, Netherlands, Spliet@ese.eur.nl, Adriana F. Gabor, Rommert Dekker

We consider a vehicle routing problem where a schedule has to be designed before demand is known. Next, demand is revealed and we are allowed to adjust the original schedule to ensure capacity constraints are satisfied. However, it is not allowed to differ too much from the original schedule. Difference is measured by counting arcs that are used in the original schedule, but not in the adjusted schedule. We encountered this problem at Dutch retail chains. Too many adjustments, distortions beyond what managers think is acceptable. We develop a heuristic based on the classical Cluster-First Route-Second principle for the Capacitated Vehicle Routing Problem.

We generalize the concept of an Euler walk to uniform hypergraphs. The problem of deciding if a k-uniform hypergraph has an Euler walk is NP-complete, for k larger than 2. We prove that for a broad class of uniform hypergraphs an obvious necessary condition for existence of an Euler walk is sufficient as well. We also give a linear time algorithm for constructing an Euler walk and an Euler tour (if they exist) in this case. Motivations of studying Euler walks in hypergraphs come from the areas of geographic information systems, computer graphics and integer programming.

2 - Generalized Complexity of Subsumption
Arne Meier, Institut für Theoretische Informatik, Fakultät für Elektrotechnik und Informatik, Universität Hannover, Appelstrasse 4, 30167, Hannover, Germany, meier@ti.uni-hannover.de

Description Logics are a well known concept not only in the area of databases but also in the semantic web in terms of the web ontology language OWL 2. We turn towards the subsumption problem which has been referred to as the key inference problem by Nardi and Brachman. Given two formulas A, B and a terminology T, this problem asks if A implies B in every satisfying model for T. We restrict the allowed quantifiers as well as the Boolean functions and classify the computational complexity of these fragments. The Boolean restrictions are defined through Post’s lattice using the term of clones.

3 - A satisfiability-based approach for generalized tanglegrams on level graphs
Andreas Wotzlau, Institut für Informatik, Universität zu Köln, Köln, Germany, wotzlau@informatik.uni-koeln.de, Ewald Speckenmeyer, Stefan Porschen

A tanglegram is a pair of trees on the same leaf set with matching leaves in the two trees joined by an edge. They are used in computational biology to compare evolutionary histories of species. We present a propositional logic based formulation of two combinatorial problems: the planar embedding and the crossminimizing problem. We show that our approach can handle cases with more than two, not necessarily binary, trees defined on arbitrary leaf sets. We conclude with an experimental comparison of our technique and several known heuristics for solving generalized binary tanglegrams.

4 - Satisfiability thresholds beyond k-XORSAT
Andreas Goerdt, Fakultät für Informatik, Technische Universität Chemnitz, 09107, Chemnitz, Germany, goerdt@fmi.tu-chemnitz.de, Lutz Falke

We consider random systems of constraint equations of length k which are interpreted as equations modulo 3. We show for k greater 15 that the satisfiability threshold of such systems occurs where the 2-core has density 1: The density is the number of equations divided by the number of variables. We show a similar result for random uniquely extendible constraints over 4 elements. Our results extend previous results of Dubois/Mandler for equations mod 2 and k = 3 and Connaenhmek/ Molloy for uniquely extendible constraints over a domain of 4 elements with k = 3 arguments.
bound could be improved for several problems and algorithms. We display some classes of problems and algorithms where we prove that 'Measure and Conquer' analysis cannot be tight as well, and purpose a new strategy to decrease the bound again. This includes, for example, the most straightforward algorithms for maximum clique.

2 - Moderately exponential approximation for Feedback Vertex Set.
Emeric Tourniaire, Lamsade, Paris Dauphine University, 75000, Paris, France, emeric.tourniaire@dauphine.fr

A feedback vertex set of a graph is a set that hits every cycle. Finding a minimal vertex set is one of the original Karp’s problems, it is also APX-complete. On the other hand, some exponential algorithms faster than 2n have recently been issued [Fomin et al., 2009], but the upper bound they found in O(1.74n) remains quite intractable for large instance. Following the paradigm defined by [Bourgeois, Escoffier and Paschos, 2010], we design a branching algorithm which can solve this problem with (1+ε) approximation ratio with smaller exponential time.

3 - Fast algorithms for finding specific subgraphs in Biology
Marc Bailly-Bechet, Biology, LBBE - Université Lyon 1, Lyon, France, marc.bailly-bechet@univ-lyon1.fr

Modern biology generates huge volumes of data that can be integrated using a network framework. One frequent question is to isolate in these networks structures of interest. Finding appropriate connected subgraphs turns out to be a prize-collecting Steiner tree problem, computationally intractable. We develop a message-passing, probabilistic and distributed formalism, inspired from statistical physics, and apply our algorithm to various datasets combination in the baker’s yeast. Our algorithm can deal with large data sets, run in parallel and be adapted to other problems in biology systems.

4 - Bipartite finite Toeplitz Graphs
Sara Nicoloso, IASI-CNR, Viale Manzoni 30, 00185, Roma, Italy, nicoloso@disp.uniroma2.it, Ugo Pietropaoli

Let n, a_1, ..., a_k be distinct positive integers: a finite Toeplitz graph is a graph with n vertices, two of which are connected by an edge iff the absolute value of the difference of their indices is a_1, a_2, ... or a_k. We characterize the whole family of bipartite finite Toeplitz graphs with k=3: the proved result completes the characterization of their chromatic number, and is based on a simple characterization of bipartite finite Toeplitz graphs with k=2. In addition, we characterize some classes of bipartite Toeplitz graphs with k=4.

Non-deterministic models 3
Stream: Production Management & Supply Chain Management (contributed)

Contributed session
Chair: Ernest Benedito, Organizacijo d’Empreses, Universitat Politècnica de Catalunya, C/ Mare de Deu de Nuria, 41-43, 08017 Barcelona, Spain, ernest.benedito@upc.edu
Chair: Frédéric Dugardin, LOSI, University of Technology of Troyes, 12, rue Marie Curie, 10010, Troyes, France, frederic.dugardin@utt.fr

1 - Performance analysis through stochastic OEE simulation
Werner Schroeder, Economics and Business Management, Montanuniversität Leoben, Franz-Josef-Straße 18, 8700, Leoben, Styria, Austria, werner.schroeder@wbw.unileoben.ac.at, Markus Gram

To reduce hidden losses is an important aim of manufacturing companies. The OEE is a well known and widely used operating metric to measure losses. Due to the deterministic nature of the calculation model, the OEE only is reflecting a static image of the process efficiency. Since the influential variables can also be of stochastic nature our approach attempts to simulate these stochastic behaviors. It is examined, in particular, whether it makes more sense reducing the OEE variability than reducing its average value. The validation of the model will be confirmed by industrial application.

2 - A Two Stage Solution Procedure of Stochastic Programming Problem for Production Planning with Advance Demand Information
Nobuyuki Ueno, Dept. of Management Information Systems, Prefectural University of Hiroshima, 1-1-71 Ujina-Higashi, Minami-Ku Hiroshima-City, 734-8558, Hiroshima, Japan, ueno@pu-hiroshima.ac.jp, Koji Okuhara, Takashi Hasuake

Under demand uncertainty, the production planning problem with in advance demand information is formulated as a nonlinear stochastic programming problem. Feasible direction and cutting plane methods have been proposed, but they need the gradient of the probability function. We propose a two stage solution procedure. First, an approximate solution is obtained by solving iteratively a linear programming problem. Then, a near-optimal solution is looked for close to the solution, using problem convexity and meta-heuristics. The proposed procedure obtains near-optimal solutions efficiently.

3 - Stochastic bi-level programming of production planning in a reconfigurable aircraft fuselage assembly
Yohannes Kristianto, production, university of vaasa, yliopistonranta 10, 65101, vaasa, vaasa, Finland, ykristiantonugroho@gmail.com

Our research is motivated by a real life aircraft manufacturing. While the assembly sequence is not flexible due to the size of the aircraft parts and space constraint of the assembly plant. We solve the problem as a two-stage stochastic program where the production routing and scheduling have to be established in advance by anticipating the future variations about manufacturing lead times and the demands. We observe that the reformulation of the problem into a shortest path problem reduces the iteration time of the solution by implementing a column generation.

4 - Strategic capacity planning in a single-site production system considering renewal, maintenance, inventory and cash-flow management under uncertainty
Ernest Benedito, Organizacijo d’Empreses, Universitat Politècnica de Catalunya, C/ Mare de Deu de Nuria, 41-43, 08017 Barcelona, Spain, ernest.benedito@upc.edu

We propose a mixed-integer linear program for strategic capacity planning of a single-site production system, under uncertainty. The model takes into account the production planning, the inventory and cash-flow management, and tax payments. A computational experience is described and the results are explained. We propose a robust strategy to reduce the resolution time, by reducing the periods in which a capacity decision can be taken.
In recent years a large number of heuristics have been proposed for the minimization of the flowtime in the permutation flowshop scheduling problem. This paper presents a comprehensive review and computational evaluation as well as a statistical assessment of 22 existing heuristics that have been carried out. Five new heuristics are presented. The comparison results identify the best existing methods and show that the five newly presented heuristics are competitive or better than the best performing ones in the literature for the permutation flowshop problem with the total completion time criterion.

2 - A soft computing based approach to integrated process planning and scheduling with setup and machine capacity considerations

Filiz Şenyüzüller, Industrial Engineering, Zirve University, Zirve Üniversitesi Mühendislik Fakültesi, Kızılıhbar Kampüsü 27260 Gaziantep, Turkey, filissen@gmail.com, Adil Baykasoğlu, Türkay Dereli

The benefits gained from integrated process planning and scheduling in manufacturing industry motivated researchers to pay great effort on this subject. The present work investigates a new approach which makes use of Baykasoglu’s grammatical representation of generic process plans and clonal selection algorithm in order to integrate process planning and scheduling. In this approach Giffiker&Thomas Algorithm and VIKOR method is employed by considering setup times and machine capacity constraints. Proposed approach is applied to some literature problems in order to analyze its performance.

3 - Blocking hybrid flow shop robotic cell scheduling problem with unrelated parallel machines, machine eligibility constraints and multiple part types

Seyda Topaloglu, Industrial Engineering, Dokuz Eylül University, 35160, Izmir, Turkey, seydaitopaloglu@deu.edu.tr, Atabak Elmi

This paper addresses the robotic scheduling problem in blocking hybrid flow shop cells with unrelated parallel machines, machine eligibility constraints, multiple part types, and a single robot to convey parts between stages. Initially, a mixed-integer programming model is proposed to minimize the makespan. Due to the complexity of the model, a simulated annealing based solution approach is developed using a new neighborhood structure based on block properties. The computational results demonstrate that the developed SA algorithm is efficient for this problem.

4 - Resource constrained project scheduling problem with alternative process plans and total changeover cost minimization

Roman Capek, Department of Control Engineering, Czech Technical University in Prague, Technicka 2, 12135, Prague, Czech Republic, capekrom@fel.cvut.cz

We study the RCPSP problem with alternative process plans where the goal is to minimize the total changeover cost given by all performed changeovers. A special attention is paid to the model that includes deadlines and covers a possibility to define more alternative ways how to complete the project. A selection of activities present in the schedule influences both decision (finding a feasible schedule) and optimization problem. We propose a heuristic based on local search that is performed in a shifting time window. The heuristic is able to handle large scale instances in an efficient manner.

1 - A decomposition approach to real-time train rescheduling

Leonardo Lamorgese, SINTEF, Forskningsveien 1, 0314, Oslo, Norway, leonardo.lamorgese@gmail.com

Train rescheduling consists in the definition of new schedules and possibly new routes for trains when a deviation from the official timetable occurs. This must be done quickly and the new solution should minimize (a measure of) the total deviation. In contrast with the classic “holistic” approach, we show how to decompose the problem into a station problem and a line problem. This decomposition allows the use of different models which can take advantage of the features of specific railway infrastructure. We solve to optimality a number of real-life instances from single-track lines in Italy.

2 - Opportunities and challenges with new railway planning approach in Sweden

Malin Forsgren, SICS, Box 1263, 16429, KISTA, Sweden, malin@sics.se, Martin Aronsson, Sara Gestrelius, Hans Dahlberg

Long lead times in railway planning can give rise to a significant discrepancy between the original plan and the traffic eventually operated, resulting in inefficient utilization of capacity. Research shows that the railway sector in Sweden would benefit from a different planning approach in which capacity consuming decisions are pushed forward in time whenever possible. This approach is currently being implemented at Trafikverket, the Swedish Transport Administration. With it follows a number of mathematical opportunities and challenges, some of which will be presented in this talk.

3 - A Rapid Branching method for the Vehicle Rotation Planning Problem

Markus Reuther, Optimization, Zuse-Institut Berlin, Takustrasse 7, 14195, Berlin, Germany, reuther@zib.de, Ralf Borndörfer, Thomas Schlechte, Steffen Weider

The Vehicle Rotation Planning Problem is to schedule rail vehicles, i.e., the rolling stock, in order to cover the trips of a given timetable by a cost optimal set of vehicle rotations. The Problem integrates several facets of railway optimization, i.e., vehicle composition, fleet management, maintenance constraints, and regularity aspects. We propose an Rapid Branching algorithm that we are using to solve very large scale instances given by our industrial partner DB Fernverkehr AG, which is the largest intercity railway operator in Germany.

4 - Railway transportation planning optimization

Jean Damay, Innovation & Research, SNCF, 40, avenue des terroirs de France, 75611, Paris, France, jean.damay@sncf.fr, Francis Sourd

Our contribution consists in the optimization of the passenger railway transportation supply in a specific area. Given on this area the possible train routings and the passenger traffic forecasts on a regular day, the model provides to the carrier a transportation plan that respects structural hard constraints, minimizes the violation of specific soft constraints, and optimizes the customer conveyance and the inherent investment costs. The resolution is based on a decomposition of this large problem and embeds OR techniques such as mixed integer programming, meta-heuristic, or list algorithms.
1 - Forest biomass planning under uncertainty
Mikael Rönnqvist, Département de génie mécanique, Université Laval, G1V 0A6, Québec, Canada, mikael.ronnqvist@nhh.no, Patrik Flisberg, Mikael Frisk

The interest in forest biomass has increased dramatically. Compared to traditional forest logistics, an additional transformation, chipping, must be planned. The demand at heating plants is uncertain with seasonal variations. This makes it difficult to coordinate the best use of resources for harvesting, chipping, inventory and transportation. The inventory management to secure supply is critical. Hence there is a need for OR based decision support dealing with large scale operations under uncertainty. We report on industrial case studies from the Swedish forest industry.

2 - Safety Stock Placement in Multi-Echelon Inventory Systems - A Comparison of the Stochastic-Service and Guaranteed-Service Approaches
Thomas Wensing, INFORM GmbH, Pascalstr. 23, 52076, Aachen, NRW, Germany, wensingt@web.de

When demand is stochastic, one can think of two basic fulfillment-policies for an inventory system. First, the system may fully capture demand uncertainty and thus provide a constant (guaranteed) service time to the following levels. Second, uncertainty may only partially be captured, meaning that the system’s supply process will be stochastic, too. We analytically compare these two strategies based on a linear multi-echelon inventory system and indicate practical implications.

3 - Inventory management and pooling of spare parts in an energy company
Mario Guajardo, Finance and Management Science, NHH Norwegian School of Economics, NHH, Institut for Foretaksøkonomi, Helleveien 30, 5045, Bergen, Norway, Mario.Guajardo@nhh.no, Mikael Rönnqvist

We study the inventory of spare parts problem in an energy company, producer of oil and gas. Spare parts are stored in several plants, which control their inventory per separate based on a min-max system. We apply methods to decide control parameters for this system under the fill rate constraint. We distinguish unit-size and lot-size demand cases, based on several distribution models. After the control parameters are found, we use them to analyze the impact of two main sources of savings: risk pooling among the plants and correcting inventory inaccuracy coming from the local inventory code.

4 - An Optimisation Model for Staff Planning in a Home Care Organisation
Pablo Andréz Maya Duque, Environment, technology and technology management, University of Antwerp, Stadsdworp, S.B.513, Prinsstraat 13, 2000, Antwerp, Antwerp, Belgium, pmayaduque@gmail.com, Marco Castro, Kenneth Sörensen, Peter Goos

In this talk, we present the core optimisation component of a decision support system that Landelijke Thuiszorg, a non-profit organisation that provides home care services for several provinces in Belgium, will implement in order to assist the regional service planning. The optimisation model takes into account assignment, scheduling and routing decisions simultaneously, while considering two objectives, namely the service level and the travelled distance. A solution strategy based on a set partition formulation and a randomised local search is described and its performance is evaluated.

1 - Solving the Integrated Physician and Surgery Scheduling Problem Under Stochastic Demand
Christophe Van Huele, Faculty of Economics and Business Administration, Ghent University, Tweekerkenstraat 2, 9000, Gent, Belgium, christophe.vanhuele@ugent.be, Mario Vanhoucke

We present a stochastic program to solve both the operating theatre scheduling problem as the physician rostering problem. Both problems have received a huge amount of attention in literature, but the combination remains untouched, largely due to complexity. The stochastic integer programming formulation is created based on the most important objectives and restrictions of both problems. We analyze schedules after applying variation on the surgeries. Our experiments show some interesting insights for physician roster schedulers as well as operating theatre scheduling managers.

2 - An Optimisation Model for Staff Planning in a Home Care Organisation
Pablo Andréz Maya Duque, Environment, technology and technology management, University of Antwerp, Stadsdworp, S.B.513, Prinsstraat 13, 2000, Antwerp, Antwerp, Belgium, pmayaduque@gmail.com, Marco Castro, Kenneth Sörensen, Peter Goos

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3 - A Branch and Bound Algorithm for Pharmacy Duty Scheduling Problem
Ozgur Ozpeynirci, Department of Logistics Management, Izmir University of Economics, Sakarya Cad. No:156, Balcova, 35330, Izmir, Turkey, ozgur.ozpeynirci@ieu.edu.tr

In Turkey, the pharmacies provide service during the daytime of weekdays. At the night of weekdays and at the weekends, only on duty pharmacies provide service. The pharmacy duty scheduling (PDS) problem assigns duties to the pharmacies in the least costly way over a planning horizon. The PDS is multi-period facility location problem with special side constraints and it is NP-Hard. We propose a branch and bound algorithm and test the performance of the algorithm on randomly generated instances. The study is supported by the Scientific and Technological Council of Turkey (TUBITAK).

4 - A Mixed Integer Linear Program for Scheduling Problem
Lakhdar Djeffal, Université Hadj-lakhdar, 05000, Batna, Algeria, lakdar_djeffal@yahoo.fr

Our work deals with a personal scheduling problem where the staff wishes and degrees of quality regarding their timetable are taken into account. This optimization problem is modelled as a mixed integer linear programming program. A solution algorithm based in branch and price procedure is then presented. Computational results are presented showing the ability of our algorithm to solve realistic instances and comparison with other solution approaches.

WA-14
Wednesday, 8:30-10:00
RB-Omega
Workforce scheduling II
Stream: Timetabling and Rostering
Invited session
Chair: Lakhdar Djeffal, Université Hadj-lakhdar, 05000, Batna, Algeria, lakdar_djeffal@yahoo.fr

1 - Solving the Integrated Physician and Surgery Scheduling Problem Under Stochastic Demand
Christophe Van Huele, Faculty of Economics and Business Administration, Ghent University, Tweekerkenstraat 2, 9000, Gent, Belgium, christophe.vanhuele@ugent.be, Mario Vanhoucke

We present a stochastic program to solve both the operating theatre scheduling problem as the physician rostering problem. Both problems have received a huge amount of attention in literature, but the combination remains untouched, largely due to complexity. The stochastic integer programming formulation is created based on the most important objectives and restrictions of both problems. We analyze schedules after applying variation on the surgeries. Our experiments show some interesting insights for physician roster schedulers as well as operating theatre scheduling managers.

WA-15
Wednesday, 8:30-10:00
RB-2101
Vector and Set-Valued Optimization III
Stream: Vector and Set-Valued Optimization
Invited session
Chair: Vicente Novo, Matematica Aplicada, Universidad Nacional de Educacion a Distancia, Juan del Rosal no. 12, 28040, Madrid, Spain, vnovo@ind.uned.es
Chair: Elena Molho, Dipartimento di Scienze Economiche e Aziendali, Università di Pavia, Via San Felice 5, 27100, Pavia, Italy, molhoe@eco.unipv.it

1 - Accuracy functions and robustness tolerances in vector discrete optimization
Yury Nikulin, Department of Mathematics and Statistics, University of Turku, Matematiikan laitos,Turun yliopisto, Vesilinnantie 5, Lounmontie 5, 30045 Turku, Finland, yurrik@utu.fi, Marko M. Mäkelä, Olga Karelin

A general vector combinatorial optimization problem is considered where individual linear cost functions are subject to small independent perturbations. For the Pareto optimality principle appropriate definitions of the worst-case relative regret and robust solution are specified. It is shown that these definitions are closely related to the concept of accuracy function. We also present formulae allowing the calculation of robustness tolerances of a single cost vector.
2 - On generalized well-posedness for vector optimization
Ruben Lopez, Departamento de Matematica y Fisica Aplicadas (DMFA), Universidad Catolica de la Santisima Concepcion, Alonso Ribera 2850, 409-0541, Concepcion, VIII Region, Chile, rlopez@ucsc.cl

The aim of this work is to study notions of generalized well-posedness for vector optimization problems. To do this, we employ a recent notion of approximation solve for vector optimization problems coupled with a notion of variational convergence for vector-valued functions.

3 - A notion of well-posedness in set-valued optimization
Elena Molho, Dipartimento di Scienze Economiche e Aziendali, Università di Pavia, Via San Felice 5, 27100, Pavia, Italy, molho@eco.unipv.it, César Gutiérrez, Enrico Miglierina, Vicente Novo

We study a notion of pointwise well-posedness in the setting of set optimization. We study the properties of a scalarization of the set optimization problem in the sense of Gerstewitz that allows us to characterize the strict minimizers on a collection of cone-proper sets. We characterize the well-posedness of the set optimization problem through the well-posedness in the Tykhonov sense, of an associate family of scalar optimization problems. Finally, we use a notion of quasi-concavity for set-valued maps in order to individuate a class of well-posed problems.

WA-16

Wednesday, 8:30-10:00
RB-2103

Conic Optimization: Algorithms and Applications

Stream: Linear and Conic Programming

Invited session

Chair: Knut Haase, Institut f. Verkehrswirtschaft, Lehrstuhl BWL, insb. Verkehr, Universität Hamburg, Von-Melle-Park 5, 20146, Hamburg, Germany, knut.haase@wiso.uni-hamburg.de

1 - Speeding up the spectral bundle method by solving the quadratic semidefinite subproblems with a PSQMR approach
Christoph Helmberg, Fakultät für Mathematik, Technische Universität Chemnitz, D-09107, Chemnitz, Germany, helmberg@mathematik.tu-chemnitz.de, Kim-Chuan Toh

The spectral bundle method is tuned to solving semidefinite programs (SDP) with large semidefinite matrix variables having constant or bounded trace. For efficient bundle sizes, solving a quadratic semidefinite subproblem by interior point methods formed the bottleneck so far. We report on our experience with a preconditioned symmetric quasi minimal residual (PSQMR) approach for computing the Newton step in this interior point method like in the package QSDP. On our test instances this results in significant savings. However, results are not yet satisfactory for cutting plane approaches.

2 - New results in copositive optimization
Mirjam Duer, Mathematics, University of Trier, 54286, Trier, Germany, duer@uni-trier.de

Copositive programming (i.e., minimization of a linear function over the cone of copositive matrices) is a highly useful tool to model non-convex quadratic problems, possibly even including binary variables. In this talk, we discuss some recent developments, such as copositivity tests, cutting plane algorithms and the relationship to Parrilo’s approximation hierarchy.

3 - A Semidefinite Optimization Approach to Multi-Row Facility Layout
Philipp Hungerländer, University of Klagenfurt, Austria, philipp.hungerlaender@uni-klu.ac.at, Miguel Anjos

The multi-row facility layout problem is concerned with placing departments along one or several rows so as to optimize objectives such as material handling and space usage. Significant progress has been made in recent years on solving single-row problems to global optimality using semidefinite optimization. In our talk we present the extension of the semidefinite programming approach to multi-row layout. Our computational results show that the proposed semidefinite optimization approach provides high-quality global bounds in reasonable time for double-row instances with up to 16 departments.

4 - A Branch-and-Price Approach for Sales Force Deployment
Knut Haase, Institut f. Verkehrswirtschaft, Lehrstuhl BWL, insb. Verkehr, Universität Hamburg, Von-Melle-Park 5, 20146, Hamburg, Germany, knut.haase@wiso.uni-hamburg.de, Sven Müller

The objective of sales force deployment is to maximize the total profit. In literature valid upper bounds are not provided. We propose a semidefinite binary model. The LP-relaxation is solved by column generation. For the optimal objective function value of the LP-relaxation an upper bound is provided. Branch-and-Price is used to obtain a tight gap for the objective function value of the optimal integer solution. We propose contiguity constraints ensuring contiguous territories. The largest instance comprises 50 potential locations and 550 sales coverage units: 1273 sec., gap < 0.01.

Global Optimization 2

Stream: Global Optimization

Invited session

Chair: Herman Mawengkang, Mathematics, The University of Sumatera Utara, FMIPA USU, KAMPUS USU, 20155, Medan, Indonesia, mawengkang@usu.ac.id

Chair: Dmitri Krushinsky, Department of Operations, University of Groningen, Nettelbosje 2, 9747 AE, Groningen, Netherlands, d.krushinsky@rug.nl

Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

1 - Modeling Super-flexibility Sustainable Distribution Centre of a Supply Chain
Ronsen Purba, Mathematics Dept., STMIK Mikroskil Medan/Graduate School of Mathematics, University of Sumatera Utara, Jalan Thamrin No. 140 Medan North Sumatera, Medan, Indonesia, purbaronsen17@yahoo.com

A supply chain is a network that performs the procurement of raw material, the transportation of raw material to intermediate and end products, and the distribution of end products to retailers or customers. Super-flexibility is defined as the capacity to transform by adapting to new realities. So far, superflexibility has not been included in the model of sustainable supply chain. In this paper we address a new optimization model to decide distribution centres based on super-flexibility and environmental consideration.

2 - Fish Processed Production Planning Under Uncertainty Considering Quality
Tutiarny Naibaho, Mathematics, Quality University, FMIPA USU, 20155, Medan, North Sumatera Province, Indonesia, tutiarny.naibaho@yahoo.com

The goal in production planning is to meet customer demand. The major decisions are production and inventory levels for each product and the number of workforce in each planning period. This paper considers the management of small traditional business at North Sumatera Province which performs processing fish into several local seafood products. The inherent uncertainty of quality to be met, leads the production planning problem to a chance constraint programming model. We use scenario generation based approach for solving the model.
3 - On multi-objective black box optimization of expensive objectives
Vytautas Jancauskas, Vilnius University, LT-01513, Vilnius, Lithuania, vytautas.jancauskas@mif.vu.lt, Antanas Zilinskas, Panos Pardalos
The problems are supposed non-convex, gradients not available; possible number of computations of objectives is relatively small. Therefore metrics used to evaluate algorithms should be defined correspondingly. The selection of test functions representing real world expensive multi-objective problems is discussed. Prospective of generalization of the algorithms, supposed to the single-objective global optimization of expensive problems, to the multi-objective optimization is analyzed including Lipschitz approach, algorithms based on statistical models, radial basis functions based algorithms.

4 - Optimality and multiobjectiveness of cell formation in group technology
Dmitry Krushinsky, Department of Operations, University of Groningen, Nettelbosje 2, 9747 AE, Groningen, Netherlands, d.krushinsky@rug.nl, Boris Goldengorin, Jannes Stomp
In this talk we present an exact model for cell formation based on the minimum multicut problem. We show that minimisation of intercell movement may not be appropriate as a sole goal. Several alternative objectives are proposed together with the ways of inserting them into the considered model. An industrial example is used for illustrative purposes.

Portfolio Decision Analysis
Stream: Decision Making Modeling and Risk Assessment in the Financial Sector
Invited session
Chair: Marius Radulescu, Institute of Mathematical Statistics and Applied Mathematics, Casa Academiei Române, Calea 13 Septembrie nr.13, Bucharest 5, RO-76100, 050711, Bucharest, Romania, mradulescu@csn.ro

1 - Absolutely optimal portfolios
Gheorghita Zhagana, Faculty of Mathematics and Informatics, University of Bucharest, Academiei 14, Bucharest, Romania, gheorghitazhagana@yahoo.com, Marius Radulescu
Consider n risky assets. A portfolio is a n-dimensional vector whose components represent the proportions of the sum owned by the investor that are invested in assets. A portfolio x is called absolutely optimal if it realizes the maximum of the expected utility of its return for every concave utility function. The aim of the paper is to give characterizations of those financial markets for which a given portfolio is absolutely optimal. Here by a financial market we understand a random vector whose components are the random variables associated with the rate of return of assets.

2 - Structured Portfolio Management under Ambiguity
Jean-luc Prigent, ThÈMA, University of Cergy-Pontoise, 33, Bd du Port, 95011, CERGY-PONTOISE, France, jean-luc.prigent@u-cergy.fr, Hachmi Ben Ameur
In this paper, using results about martingale theory and convex analysis, we determine the general optimal portfolio payoff within ambiguity. We extend results of Leland (1980), Pfug and Wozabal (2007) and generalize the robust optimization of Ben-Tal and Nemirovski (1998,1999) by introducing the ambiguity index based on relative entropy. Our findings have important applications in financial engineering for the optimal design of financial structured portfolios.

3 - Determination of the Optimal Weights in a Currency Portfolio with Sharpe Ratio Maximizing Approach
Celal Barkan Güran, Management Engineering, Istanbul Technical University, Ulus Sok. 11/8 Sezer Apt., Sudaïye, 34740, Istanbul, Turkey, barkan_guran@hotmail.com, Oktay Taş
In this paper we design a portfolio whose components are all currencies that are officially traded in Turkey. Based on the last five years daily data, the currencies lying outside the efficient frontier is excluded from the analysis and then Sharpe Ratio function, whose independent variables are the weights of the corresponding currencies, is constituted. Finally, the optimal weights maximizing this Sharpe Ratio function is found by using numerical optimization methods. This study can be considered as one of the leading portfolio optimization works about the currencies traded in Turkey.

4 - Applications of portfolio theory to production planning for fish farms
Marius Radulescu, Mathematical Statistics, Institute of Mathematical Statistics and Applied Mathematics, Casa Academiei, Calea 13 Septembrie, nr. 13, 050711, Bucharest, Romania, mradulescu.csmono@yahoo.com, Constanta Zoie Radulescu, Sorin Radulescu
The paper presents several single period portfolio selection models for production planning in fish farms. The aim of the models is to find optimal fish production plans. A fish production plan is a couple $(x, y)$ formed by a binary matrix (denoted by $x$) that describes the allocation of fish species to pools and a vector $y$ that describes the money allocations to pools. The objective functions and the constraints of the models are the financial risk and the expected return of the fish production plans. In order to solve the models heuristic algorithms and computer simulation is used.

Financial Service Management
Stream: Long Term Financial Decisions
Invited session
Chair: Heinz Eckart Klingelhoëßer, Managerial Accounting and Finance, Tshwane University of Technology, Building 12, Room 117, Private Bag X680, 0001, Pretoria, Gauteng, South Africa, klingelhoeserHE@TUT.ac.za

1 - Long-term Simulation of Investment Strategies
Geraldine Tchegho, Faculty 7: Business Studies & Economics; Department of Finance, University of Bremen, Hochschulring 4, 28359, Bremen, Germany, tchegho@uni-bremen.de, Thorsten Poddig
Pension funds and life insurance companies face the problem of long-term return guarantees, either as a promised return rate or any kind of capital guarantee. Investors need to know how the return-risk-profiles behave in the long run. We investigate vector autoregressive and Markov switching models as well as a simple random walk model as benchmark to simulate asset returns using US macro economic data from 1871-2011. We use a rolling estimation window to assess performance and show that the different asset return simulation models lead to considerably varying results.

2 - Investments into Services
Heinz Eckart Klingelhoëßer, Managerial Accounting and Finance, Tshwane University of Technology, Building 12, Room 117, Private Bag X680, 0001, Pretoria, Gauteng, South Africa, klingelhoeserHE@TUT.ac.za
The paper investigates the characteristics of services and develops a two-step approach for their valuation. The first step delivers the individually optimal service programme. The second step allows for valuating investments into new services and for identification of the determinants of the investments price ceiling. The may be interpreted as (corrected) net present values of the payments and the interdependencies arising from changes in the optimal programs. We use sensitivity analysis and example to support these findings and to get more information on the effects of these determinants.
3 - When to cut a tree
Fritz Helmedag, Economics, Technical University of Chemnitz, Chair VWL II, Thuringer Weg 7, 09107, Chemnitz, Germany, f.helmedag@wirtschaft.tu-chemnitz.de

For about two centuries, the optimal rotation period in forestry has been debated intensively. According to the meanwhile prevalent opinion, the so-called Faustmann condition solves the problem because it maximizes the present value of woodland. The result, however, contradicts the ‘principle of maximum yield’, i.e. it is productively inefficient. The article develops Faustmann’s approach further and provides an objective function suited to reconcile available cutting rules.

4 - When to cut a tree given sustainability constraints
Thomas Burkhardt, Campus Koblenz, IAM, Universitaet Koblenz-Landau, Universitaetsstr. 1, 56070, Koblenz, Germany, tburkha@uni-koblenz.de

In a remarkable paper Helmedag analyzes the problem when to cut a tree and derives an optimality condition which is independent of the interest rate, as opposed to the well known Faustmann approach. We discuss this approach and claim that a proper inclusion of sustainability constraints resolves the contradiction.

- Application of cutting plane methods in machine learning
Vojtech Franc, Department of Cybernetics, Czech Technical University in Prague, FEE, Technicka 2, 16627, Prague, Czech Republic, xfranc@cmp.felk.cvut.cz

Cutting plane methods are optimization techniques that incrementally construct an approximation of a feasible set or an objective function by linear inequalities called cutting planes. Numerous variants of this basic idea are among standard tools used in convex nonsmooth optimization. Recently, cutting plane methods have seen growing interest in the field of machine learning. We describe basic theory behind these methods and show several of their applications to solving machine learning problems. We concentrate on learning structured output classifiers and their applications in computer vision.

- Sparse Rank-One Matrix Approximations: Convex Relaxations, Direct Approaches, and Applications to Text Data
Ronny Luss, Sierra Project Team, INRIA, France, ronnyluss@gmail.com

The sparsity constrained rank-one matrix approximation problem is a difficult mathematical optimization problem arising in a wide array of useful applications. We survey a variety of approaches including convex relaxations and direct approaches to the original nonconvex formulation. Convex relaxations are solved by applying fast first-order methods, while the direct approach builds on the conditional gradient method. Numerical experiments and applications with text data will be given.

- Optimizing support vector regression parameters by using global search algorithm
Alexey Polovinkin, Computational Mathematics and Cybernetics, Nizhny Novgorod State University, Nizhny Novgorod, Russian Federation, alexey.polovinkin@gmail.com, Konstantin Barkakov, Nikolai Zolotykh, Iosif Meyerov, Sergey Sidorov

The performance of Support Vector Regression (SVR) significantly depends on insensitive zone thickness, a penalty factor and kernel function parameters. The most popular algorithms for finding optimal parameters of SVR use optimization of cross-validation error function that is multiextremal in general case. We use global search algorithm (based on information-statistical approach for global optimization) to solve multiextremal optimization problem. The algorithm reduces multidimensional problem to equivalent one-dimensional problem by applying Peano-type space-filling curves.

WA-24
Wednesday, 8:30-10:00
CC-A11

Data Mining and Decision Making
Stream: Data Mining and Decision Making
Invited session
Chair: Benjamin Gotthardt, Department of Mathematics and Scientific Computing, Uni Graz, 8010, Graz, Styria, Austria, bennogotthardt@yahoo.de

1 - Development of Traffic Accidents Prediction Model with Neural Networks
Muhammed Yasin Çodur, Engineering/civil, Ataturk University, Ataturk University Engineering Faculty Civil Engineering department no.:224, 25240, Erzurum, Turkey, mycodur@atatu.edu.tr, Ahmet Tortum

Road traffic accidents continue to be a major problem in Turkey. It is important to clarify the relationship between traffic accidents and various influencing factors in order to reduce the number of traffic accidents. The data was collected on the Turkey/Erzurum Highways. In order to minimize the uncertainty of the data, neural network theory were applied. The neural network theory can provide fair learning performance by modeling the human neural system mathematically. In conclusion, this study focused on the practicability of the neural network theory for traffic safety analysis.

2 - Multi product Newsvendor-problem - solution with NCP and a non-trivial effect
Benjamin Gotthardt, Department of Mathematics and Scientific Computing, Uni Graz, 81010, Graz, Styria, Austria, bennogotthardt@yahoo.de, Marc Reimann

This talk investigates a multi product Newsvendor-problem with two limited capacity sources. Under uncertain demand the solution contains the production strategies (speculative, reactive, dual or no production) and the produced quantities for each product. Until now only models governed by one limited capacity are known in literature. In the solution process a non-trivial effect was found: With decreasing level of one capacity (other one kept constant), a back-and-forth switch between production strategies occurs. Due to the special structure of the Newsvendor an NCP is used to solve it.

3 - A cash flow and profitability monitoring system for retailers in the greek pharmaceutical industry
George Marinakis, Engineering Sciences, University of Patras, 26500, Patras, Greece, george.marinakis@yahoo.com, Sophia Daskalaki, Theodor Dritinas, Kostas Tsekouras
We present a cash flow and profitability monitoring solution designed for Greek pharmacies. It relates accounting entries with credit time and so reflects the times of cash flows for a business unit. The equations take into account attributes that affect liquidity. Monthly inflows and outflows are represented by equations that eventually build the liquidity curve and the cash flow balance overtime. The model has an ambitious and useful purpose, to inform and consult the owners of the business units and the other members of the pharmaceutical chain and thus reduce financial risk for the chain.
4 - Preference Modelling and Market Price Forecasting with Causal-Retro-Causal Neural Networks

Hans Georg Zimmermann, Corporate Technology CT T, Siemens AG, Otto-Hahn-Ring 6, 81730, München, Germany, Hans_Georg.Zimmermann@siemens.com, Ralph Grothmann, Christoph Tietz

Forecasting of market prices is a basis of rational decision making. Recurrent neural networks offer a framework for modelling temporal developments. Causality explains the present state of a system by features, which are prior to the current state. Looking for alternatives, we remember that markets are human made dynamical systems. In microeconomics we describe human behaviour with utility functions. If we know the human reward function, we could describe the behaviour of the market participants and thus the market by retro causal equations. This approach improves the forecasting accuracy.

WA-25

Wednesday, 8:30-10:00
CC-A23

Future role of nuclear

Stream: Long Term Planning in Energy, Environment and Climate

Invited session

Chair: Nicklas Forsell, CMA, CMA, France, nicklas.forsell@cma.ensmp.fr

1 - Future challenges for the French power generation paradigm

Édi Assoumou, Centre de Mathématiques Appliquées, Mines ParisTech, Sophia Antipolis, France, édi.assoumou@cma.ensmp.fr, Vincent Mazzauri, Nadia Maïzi

In the late 80’s France shifted from fossil fuel consumption to electricity due to its nuclear power plants electricity producing capacity. We propose to examine the consequences of this shift in terms of long term energy policy in France. We apply an updated TIMES-FR model that optimizes energy systems with explicit descriptions of the technologies used. Through scenarios that reflect different nuclear policies, we illustrate the impact of future energy choices on the evolution of French electricity generating system for the 2050 horizon and assess the question of reliability of the system.

2 - Looking Japan energy future after the 11th March 2011's earthquake

Adrien Wacziarg, EPI, EDF, 75, Paris, France, adrien.wacziarg@gmail.com, Nadia Maïzi, Prabodh Pourouchottamin

The scope of the study is to investigate the consequences of the Great East Japan Earthquake on the energy future of Japan and elsewhere, while conducting prospective studies. One important focus will be Japan's possible long term evolution, beyond the current post-crisis climate. This will lead to a better understanding of how other countries, most notably western will change and the parameters that come into play.

3 - Critical Analysis of "Energy 2050" report: An overview of the French electricity mix

Renaud Doudouit, MINES ParisTech, 06904, Sophia Antipolis Cedex, France, renaud.doudouit@mines-paristech.fr

In wake of the Fukushima accident and national targets to reduce the greenhouse gases emissions, Questions are being raised concerning how the French electricity mix will evolve. 'Energy 2050' report tries to answer these questions by studying 4 scenarios of nuclear production: extension of the operation of today's nuclear power plants, acceleration of 3rd generation (European Pressurized Reactor) deployment, reduction of nuclear power capacity, and exit of the nuclear power. This study will analyze these different scenarios and evaluate their impact on the future French electricity mix.

4 - An evaluation of the European CCS potential

Olivia Ricci, Orleans Economic Laboratory, University of Orleans, 45067, Orleans, France, olivia.ricci@univ-orleans.fr, Sandrine Selosse

Carbon negative biofuels could be obtained if a carbon capture and geological storage (CCS) chain is applied to their production. This study evaluates the potential of biofuels-CCS in the transport sector in order to limit temperature increase as far below 2°C as possible. This analysis is conducted with the multiregional TIAM-FR optimization model.

WA-26

Wednesday, 8:30-10:00
CC-A24

OR and Environmental Management

Stream: OR and Environmental Management

Invited session

Chair: Ralf Gössinger, Business Administration, Production and Logistics, University of Dortmund, Otto-Hahn-Str. 6, 44227, Dortmund, Germany, ralf.goessinger@udo.edu

Chair: Michael Kaluzny, Business Administration, Production and Logistics, University of Dortmund, Germany, michael.kaluzny@tu-dortmund.de

1 - A Modified Cross Entropy Method for the Optimization of an Environmentally Sustainable Supply Chain

Ali Eshragh Jahromi, School of Mathematical Sciences, The University of Adelaide, North Terrace Campus, 5005, Adelaide, South Australia, Australia, ali.eshraghjahromi@adelaide.edu.au, Behnam Fahimnia

We develop an optimization model that minimizes the overall supply chain costs while explicitly incorporating multiple environmental performance measures including carbon emission, energy consumption and waste generation. A modified Cross-Entropy solution approach is designed to determine the optimal production and distribution strategies for the proposed environmentally sustainable supply chain. Lastly, numerical results from the model implementation in a real world case study are analyzed and interesting practical and managerial implications are discussed.

2 - Resilience of the smart meter-enabled electricity supply chains

Behzad Samii, Operations and Technology Management Center, Vlerick Research, Reep 1, 9000, Gent, Belgium, behzad.samii@vlerick.be, Hakan Ümit

Controlling demand is one of the most effective —yet hard to reach—ways to achieve resilience in any supply chain. In electricity supply chains, unfortunately, the real-time consumption data provided by the smart meters can be instrumental in designing mechanisms to flatten demand (i.e. resilience by variability reduction) during the peak hours. In this study, we use actual consumption data (recorded by the smart meters in two Belgian towns during the summer of 2011) to propose and compare subscribers' segmentation mechanisms based on the 15-minute and 24-hour meter reading frequencies.

3 - Value co-creation system for B2B service: A case study on after-sales service of electric power industry

Nobuhiko Nishimura, Faculty of Economics, Nagasaki University, 4-2-1, Katafuchi, 850-8506, Nagasaki, Japan, nishimra@nagasaki-u.ac.jp

The service proposal process in B2B sector still has been carried out mainly by experienced service engineers. The objective of this research is to establish efficient value co-creation process of the B2B service for the after-sales service of electric power plants. A number of service proposal documents were disassembled into elemental service components using the text mining. Each service proposal was characterized as the integration of each elemental service component. Then the causal relation of the criteria to the business circumstances was modeled with Bayesian network approach.
4 - Energy price models: Regime switching with clustering techniques
Baptiste Salasc, R&D, Air Liquide, Centre de recherche Claude & Delorme, 1, chemin de la porte des Loges B.P 126, 78354, Jouy-en-Josas, France, baptiste.salasc@arilique.com, Steven Gabriel, Yohan Shim
Energy prices present different commonly known smooth features, like mean reversion, troubled by highly volatile periods in the occurrence of unexpected jumps, spikes or structural breaks. The purpose of this work is to investigate the possibility to apply clustering methods used in data mining (k-mean, k-median) to the detection and reproduction of one of the specific features of energy prices: the regime switching. The application of clustering techniques to energy price regime switching models improved significantly the robustness of the underlying mean reversion model parameters estimation.

WA-27
Wednesday, 8:30-10:00
CC-A25
Decision Support Systems
Stream: Decision Support Systems
Invited session
Chair: Pascale Zarate, Institut de Recherche en Informatique de Toulouse, Toulouse University, 118 route de NarBonne, 31062, Toulouse, France, zarate@irit.fr
1 - Decisions, processes, and decision processes for enabling risk sharing and performance creation at the buyer-supplier interface
Kristian Rotaru, Accounting and Finance, Monash University, Australia, 900 Dandenong Rd, 3145, Caulfield East, Victoria, Australia, Kristian.Rotaru@buseco.monash.edu.au, Carla Wilkin, Leonid Churilov
We investigate how, through alignment of risk-performance objective trade-offs and underlying business processes, risk sharing and performance creation can be enabled at the buyer-supplier interface in collaborative supply chain processes. This is achieved by extending the Risk-Aware Value-Focused Process Engineering modeling methodology to formally represent value creation mechanisms that are driven by both performance improvement and risk minimization objectives of buyers and suppliers and align these mechanisms with process components at the buyer-supplier interface.
2 - Modelling to generate alternatives using biologically-inspired algorithms
Julian Scott Yeomans, OMIS, Schulich School of Business, York University, 4700 Keele Street, SSR S338, M3J 1P3, Toronto, Ontario, Canada, syeomans@schulich.yorku.ca, Raha ImaniRad
In solving real-world programming applications, it is preferable to generate numerous alternatives providing disparate perspectives. They should possess near-optimal measures to all known modelled objective(s), but be different in their system structures. Biologically-inspired modelling-to-generate-alternative algorithms are particularly efficient at creating multiple solution alternatives that both satisfy required system performance criteria and yet remain maximally different in their decision spaces. Efficacy of some bio-inspired methods is demonstrated on some applications.
3 - The Role of product factors, sellers’ factors and attitude toward risk on e-store purchasing
Arik Sadeh, Management of Technology, Holon Institute of Technology, 52 Golomb Street, P.O. Box 305, 58102, Holon, Israel, sadeth@hit.ac.il
The willingness to purchase products in e-stores is examined. Three aspects of purchasing are explored: (1) the role of product factors, (2) sellers’ factors and (3) the attitude of buyers toward risk. The product factors are quality and price of a given product while accurate product description, on-line seller accountability, and privacy and security are sellers’ factors. Portfolios of these five factors are examined with respect to motivation to purchase in e-stores using an experimental design scheme. The attitude of buyers toward risk is examined using Zukerman’s sensation questionnaire.

4 - A multicriteria decision scheme for water pipe replacement prioritization
Youssef Tlili, GESTE, ENGIEES, 1 Rue Quai Koch, 67000, Strasbourg, France, youssef.tlili@engiees.unistra.fr, Amir Nati
The goal of this study is to identify a reliable replacement policy for pipes of a water distribution system. The paper deals with two topics: 1) Asset management of water networks which is based on the prioritization of pipes that require an urgent intervention for the rehabilitation or replacement. 2) Decision-making concerning the classification of pipe candidates for renewal through the comparison between two kinds of aggregation methods: a) sophisticated methods or models, b) simple understandable schemes.

WA-28
Wednesday, 8:30-10:00
CC-A27
OR Military Applications
Stream: OR in Military, Safety and Security Applications
Invited session
Chair: Ana Isabel Barros, Military Operations, TNO, POBox 96864, 2509 JG, The Hague, Netherlands, ana.barros@tno.nl
Chair: Herman Monsuur, Faculty of Military Sciences, Netherlands Defence Academy, P.O. Box 10.000, 1780 CA, Den Helder, Netherlands, h.monsuur@rnl.nl
1 - Taking uncertainty into account in Unmanned Aerial Vehicle tour planning
Lanah Evers, Defence, Security and Safety, TNO, P.O. Box 96864, 2509 JG, The Hague, Netherlands, lanah.evers@tno.nl, Kristiaan Glorie, Suzanne van der Ster, Ana Isabel Barros, Herman Monsuur
Unmanned Aerial Vehicles (UAVs) are used to gather information for both civilian and military purposes by capturing imagery of specific locations in the area of interest. We model this problem as the orienteering problem. To cope with environmental dynamics, we introduce the Two Stage Orienteering Problem (TSOP), which accounts for the effect of fuel uncertainty on the tour information gain. Using stochastic programming we formulate and solve the TSOP and show that the resulting tours have a higher expected tour information gain than tours resulting from a robust optimization approach.
2 - Multi objective decision analysis for fighter squadrons flight scheduling problem
Mehmet Durkan, Turkish Staff College, Turkey, mehmet_durkan@hotmail.com
Flight scheduling in fighter squadrons is a hard and complicated problem which comes with a dynamic environment and multiple decision makers. Using pilots as machines and missions to be flown as jobs, it can be solved like an assignment problem. In this research, the Value Focused Thinking method is applied to build a decision analysis model to help decision makers in fighter squadrons evaluate the mission-pilot matches. The model is used not only for evaluating matches but also for ordering assignments to see priorities and proved to be helpful and accelerated the assignment matching process.
3 - Determining maintenance manpower requirements for aircraft units
Nicole van Elst, TNO - Defense, Security and Safety, POBox 96864, 2509 JG, The Hague, Netherlands, nicole.vanelst@tno.nl, Wouter Noordkamp
When introducing a new weapon system the required maintenance manpower levels is an important issue. This paper describes how the Dutch manpower that is required to guarantee future F-35 operations
Data Mining

Stream: Optimization and Data Mining

Invited session

Chair: Erik Kropat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.kropat@uniwb.de

1 - Exact and heuristic algorithms based on Support Vector Machine for Feature Selection with application to Financial Problems

Renato De Leone, School of Science and Technologies, Università di Camerino, via Madonna delle Carceri 9, 62032, Camerino, MC, Italy, renato.deleone@unicam.it, Sonia De Cosmos

SVMs are tool belonging to the class of supervised learning methods that can solve Regression and Feature Selection Problems. Robustness can be incorporated to address the issue of uncertainties and bounded variability in the data. In this talk we will present new heuristic algorithms for Robust Support Vector Regression and Feature Selection. We will show that, the use of Simulated Annealing allows to efficiently select a subset of features, moreover, the use of robustness slightly decreases the quality of the solution in the training set while improving the quality for the test set.

2 - Arrhythmia Classification via Mathematical Programming

Emre Çimen, Industrial Engineering, Anadolu University, Anadolu Üniversitesi İki Eylül Kampüsü Endüstri Mühendisliği no:106, 26000, Eskişehir, Turkey, ecimen@anadolu.edu.tr, Gurkan Ozturk

Heart diseases are killing millions every year. A lot of people lose their lives due to failure of diagnose heart disease earlier. Therefore, early detection of arrhythmia which is significant portion of heart diseases can be defined as a classification problem. The aim of this study is to develop a arrhythmia classifier based on mathematical programming which consists of k-means clustering algorithm and polyhedral conic functions. Proposed classifier is tested on MIT — Bih and UCI Arrhythmia databases.

3 - Proposal for generation of the three-way Perceptual Map using non-metric Multidimensional Scaling with clusters

Moacyr Machado Cardoso Junior, Production Department, Aeronautics Institute of Technology - ITA, R Licinio Rodrigues Alves 114, Chácara Jafet, 08730661, Mogi das Cruzes, São Paulo, Brazil, moacyr@ita.br, Rodrigo Scarpel

The proposal for improvement of the Three-Way perceptual map using MDS involves the separation of the judges in homogeneous clusters, so that more than one perceptual map of the group of judges will be generated. The validation of clusters was performed with an Ex-ante indicator of quality. The Final configurations obtained for each cluster were tested for effective separation of centroids within objects. The separation ratio generated an Ex-post indicator of quality of the separation of clusters. The results showed that the use of two or three clusters were optimal in most cases.

Scheduling Applications

Stream: Emerging Aspects of Production Planning in Continuous Process Industries: Theory, Optimization, and Practice

Invited session

Chair: Krystsina Bakhrankova, Applied economics, SINTEF - Technology and society, Box 4760 Sluppen, S. P. Andersens vej 5, 7465, Trondheim, Norway, krystsina.bakhrankova@sintef.no

1 - Single machine scheduling with due dates and perishable raw materials

Jean-Charles Billaut, University of Tours, 37200, Tours, France, jean-charles.billaut@univ-tours.fr, Federico Della Croce, Patrick Esquirol, Jean-François Touamille

We consider a single-machine scheduling problem. Each job is characterized by duration, a due date and a quantity, corresponding to a raw material. All jobs require the same product, which is characterized by a volume per vial and lifetime duration after opening. We search for a schedule, minimizing the quantity of lost product and satisfying a given value of the maximum lateness. This NP-hard problem comes from a chemotherapy production, where perishable active agents are required for the realization of medical drugs. Efficient solution methods based on integer linear programming are proposed.

2 - Optimum cost blending application in flour mills

Mehmet Akif Sahman, Selcuk University, Turkey, asahman@selcuk.edu.tr, Abdullah Oktay Dundar, Adem Alpaslan Altun

The quality and trade-off optimization of the product produced at flour mills is a significant problem. In this study, the most appropriate cost blending decision in producing flour suitable to the quality sought by customers from among various varieties and qualities of wheat was realized by using linear programming (the Big M method). The application was coded from among the object-oriented programming languages, Visual C#. Based on the results obtained, it was observed that the linear program produced optimal value solutions that were rapid and decisive.

3 - Production Scheduling in Batch Process Industries Using Timed Automata Models

Subanatarajan Subbiah, Dept. of Biochemical and chemical engineering, Technische Universität Dortmund, Emil-Figge strasse 70, 44227, Dortmund, NRW, Germany, subanatarajan.subbiah@bci.tu-dortmund.de, Christian Schoppmeyer, Sebastian Engell

The approach to model complex scheduling problems in the process industries by timed automata (TA) and to solve them using reachability analysis is presented. The machines and the jobs are modeled as sets of TA in a modular fashion and are composed to form a global automaton (GA) - directed graph. The GA has an initial node where no task has been started and at least one target node where all tasks to produce the products have been finished. Each path from the initial node to a target represents a schedule and a cost optimal reachability analysis is performed to compute the optimal schedule.
**DEA and Performance Measurement: Methodology 4**

**Stream:** DEA and Performance Measurement (contributed)  
**Contributed session**

**Chair:** Cecilio Mar-molinero, Kent Business School, University of Kent, KBS, University of Kent, CT2 7PE, Canterbury, Kent, cm235@kent.ac.uk

1. **On the properties of a linear transformation of variables in Data Envelopment Analysis**  
Abolfazl Keshvari, Aalto University School of Economics, Finland, abolfazl.keshvari@aalto.fi, Pekka Korhonen  
We consider the problem of making a linear transformation of variables in DEA. When a linear transformation is nonsingular, no problems arise provided the efficient frontier is re-defined. Instead, problems ensue if a linear transformation is singular. This is the case, when we reduce the number of variables. Using the geometrical structure of DEA, we show how different sets of variables can change the dominance cones and affect the efficient frontier. We will consider various dimension reduction methods applied in DEA and point out that a user has to be very careful in choosing the method.

2. **Classifying Inputs and Outputs Based on TOPSIS Method Using Modified DEA Model**  
Sahand Daneshvar, Industrial Engineering, Eastern Mediterranean University, North Cyprus (via Mersin 10, Turkey), 5555, Gazimagusa, Famagusta, Turkey, sahand.daneshvar@emu.edu.tr, Gokhan Ibzarik  
In conventional data envelopment analysis, it is assumed that the input versus output status of any particular performance measure is known. In some situations, finding the status of some variables from the input or output point of view is very difficult; these variables are treated as both inputs and outputs and are called flexible measures. In this paper the CCR Model, modified by facet analysis, and TOPSIS Method are used for classifying inputs and outputs based on Cook and Zhu (2007), for specifying the input versus output status of flexible measures.

3. **Weights in the multi-activity DEA model**  
Cecilio Mar-molinero, Kent Business School, University of Kent, KBS, University of Kent, CT2 7PE, Canterbury, Kent, cm235@kent.ac.uk, Fabiola Portillo, Diego Prior  
The standard DEA model assumes that the units to be assessed perform a single activity by using inputs to generate outputs. The multi-activity DEA model allocates efficiency scores to each one of the activities that are jointly performed, but there is a cost: the formulation becomes non-linear. We discuss the difference between the standard and linearized model within a micro-economic theoretical framework, and use Karush-Kuhn-Tucker theory to demonstrate that the linearized and the standard model only produce the same results if the units being assessed are 100% efficient at all activities.

**Sustainable Development in Civil Engineering and Multi-attribute Decision Making**

**Stream:** OR for Sustainable Development  
**Invited session**

**Chair:** Tatjana Vilutiene, Department of Construction Technology and Management, Vilnius Gediminas Technical University, Sauletekio ave. 11, LT01001, Vilnius, Lithuania, tatjana.vilutiene@vgtu.lt

1. **Logistics significance of wood product manufacturing on competitiveness based management**  
Kristine Fedotova, Civil construction and real estate economics, Riga Technical University, Meza 1/7-212, LV-1048, Riga, Latvia, kristine.fedotova@inbox.lv, Ineta Geipele, Sandra Geipele  
Topicality is associated with the important contribution of wood product manufacturing in Latvian economy. Important role in development of wood products manufacturing has improvement of wood products manufacturing that includes acceptance of strategic management decisions and solutions for wood resource flow optimization throughout wood products added value chain, as well as an interference with related industries. Solutions of logistics issues play leading role in increasing manufacturing management by providing options of product manufacturing cost optimization.

2. **Structural Reliability Analysis and Decision Support Applying Probabilistic Methods**  
Robertas Alzbutas, Lithuanian Energy Institute, Kaunas University of Technology, LT-44403, Kaunas, Lithuania, robertas@mail.lei.lt, Gintautas Dundulis  
A probability-based modelling approach was developed to analyze reliability of critical structures and to support decisions for managing of uncertainty. If parameters of structural model are uncertain, then this randomness is taken into account. As example the parameters important for structural integrity are analysed. The finite element method is used for the deterministic analysis of strength and then applying probabilistic methods the parameters under uncertainty were taken into consideration and probabilities of structural failure were estimated.

3. **Model of structure solution selection for the sustainable building’s design**  
Klaus Holschmacher, Faculty of Civil Engineering and Architecture, HTWK Leipzig, Karl-Liebknecht-Strasse 132, 04277, Leipzig, Germany, klaus.holschmacher@fhimporte-leipzig.de, Ernests Gaudutis, Jolanta Tamosaitiene  
The aim of sustainable development is to minimize the ecological damage resulting from infrastructure creation, operation and maintenance, reduce the ecological footprint of human activities. Many concepts of sustainable design aren’t properly estimated in high rise buildings design process. The objective of this research is to demonstrate how simulation can be used to reflect fuzzy inputs, which allows more complete interpretation of model results. Authors discuss on advantages and disadvantages of presented sustainable high rise building structural system selection model.

4. **Selection of the rational modernization measures: Case of art school modernization in Birstonas city**  
Tatjana Vilutiene, Department of Construction Technology and Management, Vilnius Gediminas Technical University, Sauletekio ave. 11, LT01001, Vilnius, Lithuania, tatjana.vilutiene@vgtu.lt, Ceslavos Ignatavičius  
Significant reduction of energy costs, improvement of building indoor comfort conditions, reduction of pollution of the environment, improvement of aesthetic appearance of the building and extending the lifetime of the building are important issues of modernization. This article presents the analysis of energy saving measures for art school in Birstonas, Lithuania. Objective of the study is to select appropriate energy saving measures by comparison of packages of energy saving measures.

**Solution concepts for TU-games**

**Stream:** Cooperative Game Theory  
**Invited session**

**Chair:** Ilya Katsey, St. Petersburg Institute for Economics and Mathematics, Russian Academy of Sciences, Tchaikovsky str. 1, 191187 St. Petersburg, Russia, 195067, Saint-Petersburg, Russian Federation, katsev@yandex.ru
1 - The [0,1]-nucleolus in 3-person cooperative TU-games
Nadezhda Smirnova, International Banking Institute, Russian Federation, nadezhda.v.smirnova@gmail.com, Svetlana Tarashnina

We investigate a new solution concept of a cooperative TU-game called the [0,1]-nucleolus in a class of 3-person TU-games. We construct analytical formulas for calculation of the solution. Early it has been proved that the [0,1]-nucleolus contains the prenucleolus, the SM-nucleolus for arbitrary 3-person TU-games and the modiclus for balanced games. So, the obtained formulas are hold for them as well.

2 - The lexicographic prekernel
Elena Yanovskaya, Game Theory and Decision Making, St. Petersburg Institute for Economics and Mathematics, RAS, Tchaikovsky st. 1, 191187, Saint-Petersburg, Russian Federation, eyanov@emi.nw.ru

The lexicographic prekernel of a cooperative game with transferable utilities lexicographically minimizes the maximal surpluses of one player over another. It is a non-empty efficient solution contained in both the lexicore and the prekernel, and it may not contain the prenucleolus. In the presentation a combinatorial characterization of vectors belonging to the lexicographic prekernel is given. The characterization is a weak analog of the known Kohlberg’s (1971) characterization of the prenucleolus with the help of balanced collections of coalitions.

3 - The SD-prenucleolus for TU games
Ilya Katsev, St. Petersburg Institute for Economics and Mathematics, Russian Academy of Sciences, Tchaikovsky st. 1, 191187 St. Petersburg, Russia, 195067, Saint-Petersburg, Russian Federation, katsev@yandex.ru

We introduce and characterize a new solution concept for TU games. The new solution is called SD-prenucleolus and is a lexicographic value although is not a weighted prenucleolus. The SD-prenucleolus satisfies several desirable properties and is the only known solution that satisfies core stability, strong aggregate monotonicity and null player out property in the class of balanced games. The SD-prenucleolus is the only known solution that satisfies core stability, continuity and is monotonic in the class of veto balanced games.

4 - Cooperative games on accessible union stable systems
Rene van den Brink, Econometrics, VU University Amsterdam, De Boelelaan 1105, 1081 HV, Amsterdam, Netherlands, jrbrink@feweb.vu.nl, Encarnación Algbra, Chris Dietz

We consider restricted cooperation in cooperative games where the set of feasible coalitions (i) contains the emptyset, (ii) is union stable (i.e. the union of every two nondisjoint feasible coalitions is feasible), and (iii) satisfies accessibility (i.e. every feasible coalition has at least one player such that without this player the coalition is feasible). This generalizes several known set systems such as the sets of connected coalitions in an undirected graph and antimatroids. We provide results on these structures, their dual structures, their supports and an associated restricted game.

1 - A proposal for redesign of the FedEx Cup playoff series on the PGA TOUR
Chris Potts, School of Mathematics, University of Southampton, Highfield, SO17 1BJ, Southampton, Hampshire, United Kingdom, C.N.Potts@soton.ac.uk, Nicholas Hall

We propose a new design for The TOUR Championship, the final event of the FedEx Cup playoff series on the PGA TOUR, whereby the tournament is a strongly seeded match play event. We validate our design by estimating the probability that a player with a particular rank entering The TOUR Championship finishes in various positions in the FedEx Cup standings. A match play format is chosen because it is closer to the spirit of a playoff event than stroke play. We discuss how our proposal achieves the various objectives outlined by PGA TOUR Commissioner Tim Finchem about a possible redesign.

2 - The pooling of sports teams in parallel competitions
Dennis Van den Broeck, MOSI, VUB, PP. Rubensstraat 9, 1880, Kapelle-op-den-Bos, Belgium, devdbroe@vub.ac.be

Although the organization of sports competitions is widely discussed in literature, less attention was devoted to the phenomenon of parallel competitions at some fixed hierarchical level. This is often the case in countries covering huge geographical areas or in the organization of regional sports. The term pooling is used for the process of grouping teams together in separate (parallel) competitions. In this contribution models based on mathematical optimization are given to achieve fair results. Applications in Belgian football are discussed and recommendations are given.

3 - Forecasting in-play match outcome in One-day International Cricket
Muhammad Asif, Center of Operational Research and Applied Statistics, University of Salford, 86 Ayres Road, M16 7GP, Manchester, United Kingdom, m.asif@edu.salford.ac.uk, Ian McHale

We present a model to forecast in-play match outcome in One-day International cricket. We use the modified Duckworth-Lewis method to estimate the remaining wickets resources at each given stage of the innings. These resources can further be used as an important covariate for logistic model.

4 - Patient transportation and mountain running: looking for optimal solutions
Martin Bracke, Department of Mathematics, University of Kaiserslautern, Gottlieb-Daimler-Str. 48, 67663, Kaiserslautern, Rheinland-Pfalz, Germany, bracke@mathematik.uni-kl.de

Mathematical Modelling with students at high school and undergraduate level has long been our focus. This paper introduces two real-world problems, namely the planning of efficient patient transportation in large hospitals and the design of optimal strategies in mountain running. We are going to outline some important findings from different student groups. Moreover, we shortly discuss similarities and differences of the various approaches as well as common challenges of the modelling teams.

WA-35
Wednesday, 8:30-10:00
CC-A41
Sports and OR

Stream: OR in Sports
Invited session
Chair: Luciano Mercadante, School of aApplied Science, University of Campinas, Pedro Zaccaria St, 1300, Jd Santa Luzia, Limeira, SP, Brazil, 13484350, Limeira, Sao Paulo, Brazil, lucianomerc@yahoo.com.br

Societal Complexity, Healthcare and Sustainable Development

Stream: Methodology of Societal Complexity
Invited session
Chair: Dorien DeTombe, Methodology of Societal Complexity, Chair Euro Working Group, P.O.Box 3286, 1001 AB, Amsterdam, Netherlands, detombe@nsmo.nl
Chair: Eizo Kinoshita, Urban Science Department, Meijo University, 4-3-3 Nijigaoka, 509-0261, Kani, Gifu, Japan, kinoshita@urban.meijo-u.ac.jp
1 - How to handle societal complexity
Dorien DeTombe, Methodology of Societal Complexity, Chair
Euro Working Group, P.O.Box 3286, 1001 AB, Amsterdam, Netherlands, detombe@nomol.nl

In the world of today there are many complex societal problems such as climate change and credit crisis, traffic and pollution. Policy makers handle these problems globally or locally depending on the problem. When policy makers are not trained during their academic education they should ask for scientific support on handling complex societal problems. A scientific methodology for handling complex societal problems is developed in the field of Methodology of Societal Complexity. Applying this methodology leads to a more stable and sustainable arrangements of complex societal problems.

2 - A framework for asking questions about the state of the art: the Methodology of Societal Complexity
Stephen Taylor, Champlain Regional College, Retired, 5320 Avenue MacDonald, Apt 207, H3X 2W2, Cote Saint-Luc, Quebec, Canada, steveta@alumni.concordia.ca

Predicting the future of humankind is difficult and complex. The immediate future continues the past, but, while many scenarios provide possible futures, the dominant theme is change. Mediating change will be the predominant occupation of future societal leaders, and many changes are rooted in complex societal problems. This session provides a framework for discussion of the current state and future of the study of complex societal problems, focusing attention on aspects of the COMPRAM Methodology. The participants' contributions will guide leaders of the field find pathways to its future.

3 - Globalization or isolation?-Ricardo’s Model
Eizo Kinoshita, Urban Science Department, Meijo University, 4-3-3 Niijigaoka, 509-0261, Kani, Gifu, Japan, kinoshit@urban.meijo-u.ac.jp

Through the attempt to clarify justifiable economic circumstances where a policy of globalization and/or a policy of national isolation is proven valid, the author revealed in this thesis that there are two such economic phases: An economy where the theory of comparative advantage, proposed by David Ricardo, is applicable and an economy where the theory is not applicable. The author applied his original approach to prove the validity of Ricardo’s comparative advantage theory, and found that the theory can be justified only when a macro economy is in the primal phase.

4 - Critical systems practice in generating creative knowledge
Slavica P. Petrovic, Faculty of Economics, University of Kragujevac, D. Pucara 3, 34 000, Kragujevac, Serbia, pslavica@kg.ac.rs

Critical Systems Practice (CSP), as a metamethodology, is based on critical systems thinking. CSP consists of four phases: creativity (to identify key dimensions of the problem situation), choice (to select a systems methodology/ies, methods for tackling the problem situation), implementation (to make and implement proposals for change) and reflection (to assess the intervention and learn about the problem situation and the methodology/ies, methods). Through paradigm diversity protection, CSP seeks to provide creative knowledge for managing complex organizational and societal problems.

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**WA-37**

**Wednesday, 8:30-10:00**

**CC-Act**

**OR in Health & Life Sciences 5**

**Stream: OR in Health & Life Sciences (contributed)**

**Contributed session**

Chair: Ana Viana, INESC TEC/ISEP, Campus da FEUP, Rua Dr. Roberto Frias, 4220-465, Porto, Portugal, aviana@inescporto.pt

1 - Operations Research for pediatric care systems: an opportunity for the personal medical advisor in antibiotic treatment

Jelena Hadzi-Purić, Department for Computer Science, Faculty of Mathematics, Studentski trg 16, 11000, Beograd, Serbia, Serbia, jelenagr@matf.bg.ac.rs, Jeca Gjrmusa

Pediatric drug dosing should be based on knowledge of the physiologic- ical characteristics of drugs and pharmacokinetic parameters obtained during clinical trials. Evidence of safety and efficiency cannot be extrapolated from adults to children (especially for antibiotics therapy). The objectives of this paper are to review the quantitative features of chosen antibiotics, to introduce appropriate mathematical model and solver. We have also designed an extensible Web application that regular- ularly updates the database with dosing changes, adverse reactions of drugs and biochemical parameters.

2 - An accurate model of Critical Care Unit through queueing theory
Izabela Komenda, Mathematics, Cardiff University, Senghenydd Road, CF24 4AG, Cardiff, United Kingdom, komendii@cardiff.ac.uk, Jeff Griffiths, Vincent Knight

The random behaviour of arrivals and lengths of stay within a Critical Care Unit (CCU) make for a complex system. As such dealing with the growing constraints on the healthcare system at the acute level is difficult. In this study queueing theory is used to develop a new math- ematical model of patients' flow. Predictions from the model are com- pared to the observed performance of the Units in the real world, and the sensitivity of the model to changes in Unit size is explored.

3 - Providing healthcare for elderly in smart homes
Radu Prodan, Automation, Technical University Cluj-Napoca, Gheorghe Baritiu Street, no.26-28, room 350, 40027, Cluj-Napoca, Cluj, Romania, prodan.radu@gmail.com, Ioan Nascu

The main objective of this paper is that of proposing a smart environ- ment which monitors the elderly people continuously in their daily liv- ing at home and in case of happening of an accident or a major health problem sends an emergency call for help. The paper concentrates on implementation details and practical considerations of merging the various technologies into a functional system. (Acknowledgment: TUCN, paper supported by contract no. POSDRU/107/1.5/S/78534, project co-funded by the European Social Fund through the Sectorial Opera- tional Program Human Resources 2007-2013)

4 - A compact formulation for the Kidney Exchange Problem
Xenia Klimentonova, INESC TEC, 4000, Porto, Portugal, xenia.klimentonova@inescporto.pt, Miguel Constantino, Ana Viana, Joao Pedro Pedroso, Abdur Rais, Filipe Alvelos

In recent years several countries set programs that allow exchange of kidneys between two or more incompatible patient-donor pairs. These programs are commonly referred to as Kidney Exchange Programs (KEPs) and can be modeled as integer programs (IPs). Previously proposed IP formulations are exponential either in the number of con- straints or of variables. In this talk, a new compact IP formulation for the KEP will be presented. The new description and computational results will be compared to other known formulations.

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**WA-38**

**Wednesday, 8:30-10:00**

**HH-Colombus**

**Multiobjective Optimization in Location Problems**

Stream: Multiobjective Optimization

**Invited session**

Chair: José Rui Figueira, Instituto Superior Tecnico, Technical University of Lisbon, Av. Cavaco Silva, Tagus Park, 2780 - 990 Porto Salvo, 2780 - 990, Lisbon, Portugal, figueira@ist.utl.pt
Chair: Christine Tammer, Mathematics and Computer Science, Martin-Luther University Halle-Wittenberg, Theodor-Lieser-Str. 5, D-06120, Halle, Germany, christiane.tammer@mathematik.uni-halle.de
1 - Robust multicriteria optimization problems

Elisabeth Köbis, Faculty of Natural Sciences II, Martin-Luther-Universität Halle-Wittenberg, Institute of Mathematics, 06099, Halle (Saale), Saxony-Anhalt, Germany, elisabeth.koebis@student.uni-halle.de

In this talk, we propose a class of robust multicriteria optimization problems. We show that well-known robust optimization problems correspond to certain scalarizations of robust multicriteria optimization problems by proving that solutions of the corresponding scalar problems are weakly and, under uniqueness conditions, strictly Pareto optimal for the robust multicriteria problem. Additionally, we show that we get well-known concepts of robustness by using the Tammer-Weinert-functional. Furthermore, we propose applications for robust multicriteria optimization problems in location theory.

2 - Location Problems with Future Facilities

Andrea Wagner, Mathematics, Martin-Luther-University Halle, Theodor-Lieser-Straße 5, 06120, Halle/Saale, Germany, andrea.wagner@mathematik.uni-halle.de, Kathrin Klamroth, Christiane Tammer

The talk deals with median location problems where the goal is to establish one new facility with respect to a set of existing facilities as well as a set of future facilities. Future facilities are equivalent to the existing ones concerning their usage but they do not exist yet. In case of polyhedral distances the problem will be linearized. For the more general case of an arbitrary norm, duality statements will be given using a generalized Lagrange function. Further it will be shown that the dual of the linearized problem and the Lagrange dual problem coincide in case of polyhedral norms.

3 - An algorithm for solving multicriteria location-cost optimization problems

Shaghaf Alzorba, Mathematics, Martin-Luther-University, Richard-Paulick-Str.13, 1210, 06124, Halle, Sachsen-Anhalt, Germany, shaghaf7z@yahoo.com

We investigate a multicriteria location - cost optimization problem, where distances as well as cost functions are to be minimized. First, using a decomposition method we solve the vector-valued location part. A convex partition algorithm for the solution set of the location problem is derived in order to minimize the linear (cost vector-valued) part over this partition. Finally, we present the implementation of the algorithm in Matlab.

4 - Robustness in Multiobjective Optimization

Jonas Ide, Fakultät für Mathematik, Georg-August-Universität Göttingen, Germany, j.ide@math.uni-goettingen.de, Anita Schöbel, Matthias Ehrgott

Robust Optimization considers problems with uncertain objective function or feasible set. Due to various applications, many different interpretations of robustness exist. These various concepts so far only apply to single objective functions. Hence, the question arises how to extend these robustness concepts to multiobjective optimization. In this talk we present some robustness concepts for multiobjective problems. We will concentrate on strictly robust efficiency, discuss how to compute these robust solutions and show how this concept can be applied in portfolio optimization.

WA-39
Wednesday, 8:30-10:00
HH-Cousteau

Dynamic Programming 1

Stream: Dynamic Programming

Invited session
Chair: Lidija Zadnik Stirn, Biotechnical Faculty, University of Ljubljana, Vecna pot 83, 1000, Ljubljana, Slovenia, lidija.zadnik@bf.uni-lj.si

1 - Decision support model based on group AHP and dynamic programming for optimal regulation of protected areas

Lidija Zadnik Stirn, Biotechnical Faculty, University of Ljubljana, Vecna pot 83, 1000, Ljubljana, Slovenia, lidija.zadnik@bf.uni-lj.si

Management of protected areas which calls for an equilibrium of economic, ecological, technological and social objectives is based on long-term, sustainable and multiple use (agriculture, forestry, water, CO2, etc.) principles. Several stakeholders with conflicting interests are included through participatory planning of development possibilities. The model established on new developed group AHP methods and dynamic programming will be used to solve the treated management problem. The acceptable consistency of the aggregated group interval judgments is ascertained on individual crisp judgments.

2 - A dynamic programming approach to analyze the development of non conventional oil supply under uncertainty: application to the Canadian oil sands

Frederic Lantz, IFP-School, 228, avenue Napoleon Bonaparte, 92852, Rueil-Malmaison, France, frederic.lantz@ifpen.fr

The aim of this paper is to model the development of the non conventional Canadian crude oil under uncertainty and increasing environmental cost. First, a LP model has been set-up in a deterministic approach. Second, a dynamic programming model has been developed with several crude oil prices and CO2 taxes level. The simulation for 2030 with the LP model point out that the Canadian tar sands could represent a significant crude oil supply. However, the results of the dynamic programming model point out the negative impact of uncertainties on the development of the resource.

3 - A Parallel Procedure for Dynamic Multi-objective TSP

Wei Qi Li, School of Management, University of Michigan-Flint, 303 East Kearsley Street, 48502, Flint, Michigan, United States, weli@umflint.edu

This paper proposes a parallel procedure for dynamic multi-objective TSP. For each of the objectives, a multi-start local search algorithm runs on several processors for the dynamic TSP. A solution attractor drives the local search trajectories to converge into a small region in the solution space. This procedure identifies the solutions from the solution attractor. This procedure not only generates a set of Pareto-optimalsolutions, but also provides the structural information about each of the solutions, which can aid a decision-maker in choosing the best compromise solution in real-time.

4 - Bi-criteria optimization problem of binary objects flow servicing by stationary service processor with storage container

Anastasia Kuimova, Department of Computer Sciences, Control Systems and Telecommunications, Volga State Academy of Water Transport, 5a Nesterova St., 603950, Nizhni Novgorod, Russian Federation, anastasia.kuimova@gmail.com

The mathematical model of binary objects flow servicing in one servicing processor system with storage container is considered. The problem of synthesizing effective service policies subject to two independent criteria is formulated. This problem is proved to be NP-hard. It is solved based on Pareto optimization concept. Total set of Pareto-optimal service policies is synthesized using the bi-criteria dynamic programming based algorithm. The model gives a description of mass water-transport control processes such as diesel fuel deliveries to the Northern Territories of the Yamal Peninsula.

WA-40
Wednesday, 8:30-10:00
HH-Livingstone

Preference Learning 4

Stream: Preference Learning

Invited session
Chair: Willem Waegeman, Department of Applied Mathematics, Biometrics and Process Control, Ghent University, Coupure links 653, 9000, Gent, Belgium, willem.waegeman@ugent.be
1 - Preference elicitation for interactive learning of Optimization Modulo Theory problems
Andrea Passerini, disi, University of Trento, via sommarive 5, 38100, Povo di Trento, Italy, passerini@dsi.unitn.it, Paolo Campigotto, Roberto Battiti

We consider unknown decision maker preferences as weighted combinations of predicates in a certain theory of interest. We developed an iterative approach alternating a search and a learning stage: (i) the current approximation of the preference function is optimized (Optimization Modulo Theory), providing a set of candidate solutions; (ii) the preference function is refined according to the DM feedback on these candidates. The learning stage relies on a sparse ranking algorithm aimed at automatically selecting the relevant predicates and their combination, among a catalogue of candidate ones.

2 - On the characterization of a ranking procedure based on a natural monotonicity constraint
Michael Rademaker, Departement of Mathematical Modelling, Statistics and Bioinformatics, Ghent University, Coupure links 653, 9000, Gent, Belgium, michael.rademaker@ugent.be, Bernard De Baets

In previous work, we formulated a new ranking procedure in the traditional context where each voter has expressed a linear order relation or ranking over the candidates. The final ranking of the candidates is taken to be the one which best adheres to a natural monotonicity constraint. For a ranking \( a \succ b \succ c \), monotonicity implies that the strength with which \( a \succ c \) is supported should not be less than the strength with which either one of \( a \succ b \) or \( b \succ c \) is supported. Though some properties of the ranking procedure have been determined, a formal characterization is still ongoing.

3 - Preference learning for automated reasoning
Evgeni Tsivtsivadze, Radboud University, Heyendaalseweg 135, 6525 AJ, Nijmegen, Netherlands, evgeni@science.ru.nl, Daniel Kuelheim, Tom de Ruijter, Twan van Laarhoven, Josef Urban, Tom Heskes

Learning reasoning techniques from previous knowledge is a largely underdeveloped area of automated reasoning. As large bodies of formal mathematical libraries are becoming available, the state-of-the-art preference learning and ranking methods can help us to address a cornerstone task for automated theorem provers, namely premise selection and ranking. In this talk I will briefly describe our recent results on development and application of the preference learning and ranking algorithms to the automated reasoning domain.

4 - Learning from preferences in the context of Case-Based Reasoning (CBR)
Patrice Schlegel, Mathematics and Computer Science, Philipps-Universität Marburg, Hans-Meerwein-Straße 6, 35032, Marburg, Hesse, Germany, pschlegel@mathematik.uni-marburg.de

Recent research has shown the potential of exploiting knowledge contained in preference data. Our goal is to apply this concept in the field of Case-Based Reasoning, where it complements the underlying reasoning paradigm of solving problems by considering the stored solutions of similar problems. We aim at liberating the method from the rigidity and limitations of the problem-solution tuple by replacing the solution with preferences over a space of candidate solutions. Thereby, it becomes more flexible while accommodating for the uncertain and approximate nature of case-based problem solving.

1 - Heteroscedastic processes in finance modelling
Bogdan Pakulskiy, Students Science Association, National Technical University of Ukraine, Kovalsky provulok 5, 03057, Kyiv, Ukraine, bogdanpakulskiy@gmail.com

There exists a big amount of different models to explain financial processes. Heteroscedastic modeling has important place among them. This paper analyses different heteroscedastic models in application to modern stock price forecasting to find the most adequate models for better understanding of the market situation.

2 - Comparative analysis of methods for prediction of finance and economic processes.
Yaroslav Shevchenko, Institute of Applied System Analysis, National Technical University of Ukraine, Kovalsky lane 5, 03085, Kyiv, Ukraine, y.shevchenko@gmail.com

In prediction of nonlinear nonstationary processes a number of difficulties appears in selecting mathematical models relying on the quality of predictions. This paper makes a comparative analysis of several mathematical models for price formation on stock exchange, so we’ll find the most appropriate model from proposed according to the quality of prediction.

3 - Mathematical methods for regional sustainable development modeling based on SD measurement metrics
Alexej Orlov, Students Science Association, Institute for applied system analysis of the National Technical University of Ukraine, Peremohy ave. 37, 03056, Kyiv, Ukraine, orlov.alexej@gmail.com

Usage of a system of factors (indices and indicators, based on expert and statistical data) for measuring the sustainable development allows turning the sustainability study to the practical tool which is used in strategic planning and decision-making. Sustainable development on a regional level is one of urgent issues in governmental policies in developed countries. There are different metrics used for sustainable regional development estimation and modeling in the focus of this talk; some cases of their application are considered and analyzed as well.

WA-42
Wednesday, 8:30-10:00

BW-Amber

Robust Optimization and Randomized Methods

Stream: Stochastic Modeling and Simulation in Engineering, Management and Science

Chair: Erik Kropat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.kropat@unibw.de

Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTÜ, 06531, Ankara, Turkey, gweber@metu.edu.tr

Chair: Ayse Ozmen, Scientific Computing, Institute of Applied Mathematics, Middle East Technical University, Kazimkarabekir Mah. 2048, Sok No:5/5, Etimesgut, 06790, Ankara, Turkey, ayseo zm en19@gmail.com

1 - A robust optimization approach to production planning under non-compliance risks
Ban Kawas, IBM Research – Zurich, 8803, Rueschlikon, Zurich, Switzerland, kaw@zurich.ibm.com, Marco Laumanns, Eleni Pratsini

In various industries, production companies face compliance risks as governmental authorities enforce good manufacturing practices for the protection of consumers and the environment. As failing inspections can be costly, companies should measure and manage their exposure to non-compliance risks. We study an adversarial decision model that addresses these risks and aims to find a strategy reflecting a suitable risk-return trade-off. Within the model, data uncertainty is addressed using robust optimization techniques, and a compact formulation as a robust MIP is derived.
2 - Fast sample average approximation for minimizing Conditional-Value-at-Risk
Eduardo Moreno, Faculty of Engineering and Sciences, Universidad Adolfo Ibáñez, Avenida Diagonal Las Torres 2640 Of:532C, Peñalolén, Santiago, Chile, eduardo.moreno@uai.cl, Daniel Espinosa.

Sample Average Approximation approach allows to solve stochastic optimization problems, like minimizing CVaR, using linear programming. However, the number of samples required to get good approximated solutions tends to be very large. In this work we propose an automatic aggregation scheme to exactly solve linear programs with CVaR objective function using sample average approximations with a very large number of scenarios. Our results shows that this aggregation scheme is in average between 3-100 times faster than the standard LP-equivalent formulation.

3 - Stochastic optimization of nonlinear problems with constraints and differentiable functions: The wait and see method
Kherchi Hanya, ENSSEA, 16000, Alger, Algeria, hanya.kherchi@gmail.com

It’s a matter to do a stochastic optimization of nonlinear problems with constraints and differentiable functions by using a passive method, namely, the method of wait and see based on the work established in stochastic linear programming. This technique consists in studying the behavior of the optimum as the random effect of parameters of the objective function. We will try to establish the existence of a general probabilistic law managing the behavior of the optimum, and then we can have the necessary information such as the mean and variance.

4 - Randomized Clustering: Weakening Necessary Conditions for the Confidence Interval of the True Number of Clusters
Mikhail Morozkov, Saint-Petersburg State University, 198504, St. Petersburg, Russian Federation, mmorozkov@gmail.com, Oleg Granichin, Zeer (Vladimir) Volkovich

Finding the true number of clusters in a data set has proved to be one of the most challenging problems in cluster analysis. In this paper we describe approach where the true number of groups is picked as the slope discontinuity of the underlying index function. Randomized algorithm is proposed to find confidence interval for such point. We provide relaxed conditions for necessary conditions to find corresponding interval with a prior fixed level of confidence. The ideas of scenario approach are used to significantly reduce computational intensity. Several simulation examples are given.

WA-43
Wednesday, 8:30-10:00
BW-Marble

Stochastic programming in industry I

Stream: Stochastic Programming
Invited session
Chair: Laureano Fernando Escudero, Dept. de Estadística e Investigación Operativa, Universidad Rey Juan Carlos, c/Tulipan, S/n, 28933, Mostrales (Madrid), Spain, laureano.escudero@urjc.es

1 - Risk averse measures in Stochastic mixed 0-1 Optimization
Larraitz Aranburu, Economía Aplicada III, UPV/EHU, San Bartolomé 28, 1. A, 48300, Gernika-Lumo, Bizkaia, Spain, larraitz.aranburu@ehu.eus, Laureano Fernando Escudero, María Araceli Garín, Gloria Pérez, Gloria Pérez

We present several risk averse measures for stochastic mixed 0-1 optimization as alternatives to the objective function expected value optimization. Most of the proposed strategies are extensions of the two stage case studied in the literature to the multistage environment. Additionally, two innovative multistage strategies are proposed: a mixture of CVaR and first-order SDC strategies and a mixture of CVaR and second-order SDC strategies. As a pilot case the optimization of the immunization strategy in fixed-income security portfolios is considered under some sources of uncertainty.

2 - Scenario cluster partitioning in the Lagrangian based procedures
Aitziber Unzueta, Applied Economy III, UPV/EHU, Lehendakari Aguirre 83, 48015, Bilbao, Spain, aitziber.unzueta@ehu.eus, Laureano Fernando Escudero, María Araceli Garín, Gloria Pérez

A scenario Cluster based Lagrangian Decomposition scheme for obtaining strong lower bounds to the optimal solution of two-stage stochastic mixed 0-1 problems is introduced. The aim consists of solving the Lagrangian dual problem via solving scenario cluster submodels once the nonanticipativity constraints have been dualized. We report some computational experience to compare the performance of several Lagrange multiplier updating schemes for different number of scenario clusters. The results show that the cluster partitioning outperforms the traditional scenario partitioning.

3 - Parallel computing via break stage scenario clustering for multistage stochastic programming
Gloria Pérez, Applied Mathematics and Statistics and Operational Research, Universidad del País Vasco, Science and Technology Faculty, Barrio Sarriena s/n, 48940, Leioa, Spain, Spain, gloria.perez@ehu.eus, María Merino, Laureano Fernando Escudero, María Araceli Garín, Unai Aldasoro

Break Stage Scenario Clustering is introduced for decomposing mixed integer optimization problems, where nonanticipativity constraints are partially relaxed. We analyze the effect of using parallel programming in several strategies. Main results are based on our BFC-MS procedure. We have implemented a C++ code that uses the CPLEX optimizer within COIN-OR for solving the independent MIP submodels with MPI. The experience shows the speedup obtained in the computational cluster ARINA provided by the SGI/IZO-SGIker at the UPV/EHU.

4 - Vehicle Routing with Soft Time Windows and Stochastic Travel Times: A Column Generation and Branch-and-Price Solution Approach
Michel Gendreau, MAGI and CIRRELT, École Polytechnique, C.P. 6079, succ. Centre-ville, H3C 3A7, Montreal, Quebec, Canada, michel.gendreau@cirrelt.ca, Duygu Tas, Nico Dellacret, Tom Van Woensel, Ton de Kok

We study a vehicle routing problem with stochastic travel times. For each customer, a soft time window allows early and late servicing. We study a vehicle routing problem with stochastic travel times. For each customer, a soft time window allows early and late servicing. The objective is to minimize the sum of transportation costs (total distance traveled, number of vehicles used and total expected overtime of drivers) and service costs (penalties for time-window violations). We apply a column generation procedure. The master problem is a classical set partitioning problem. The pricing subproblem corresponds to an elementary shortest path problem with resource constraints. Integer solutions are obtained by branch-and-price.

WA-44
Wednesday, 8:30-10:00
BW-Marble

Data Analysis and Its Applications

Stream: Machine Learning and Its Applications
Invited session
Chair: Michael Khachay, Ural Branch of RAS, Institute of Mathematics and Mechanics, S.Kovalyevskoy, 16, 620990, Ekaterinburg, Russian Federation, mkhachay@imm.uran.ru

1 - Forecasting algorithm for short time series with preliminary classification
Irina Yatskiv, Computer Science, Transport and Telecommunication institute, Lomonosova 1, LV-1019, Riga, Latvia, ivi1@tsi.lv
Algorithm for short time series forecasting on the basis of ARIMA model and classification are offered. A set of time series with lengths that is enough for forecast are grouped in homogeneous classes. The “time series-centroid” (TSC) for each class is determined and the estimation of parameters of ARIMA model has been performed for it. The short time series refer to one of the classes using the Mahalanobis distance. Then, a forecast on the basis a model for the TSC of determined class is built and then corrected by application the distance between TSC and short time series.

2 - A robust algorithm for sequential ANOVA with incomplete data
Carmen Anido, Economic Analysis: Quantitative Economy, Autonoma University of Madrid, Faculty of Economics, Cantoblanco., 28049, Madrid, Spain, carmen.anido@uam.es, Teotilo Valdes

We present an algorithm for ANOVA analysis of data under the following robust conditions: (a) the data is not received in batch but sequentially, (b) the data may be imprecise, (c) the error distributions may vary within the class of the strongly unimodal distributions and (d) the variance of the errors is unknown. The algorithm updates the analysis as soon as a new data is received. This updating is simple, needs little computational requirements, yields the estimates of the effect parameters and ends up estimating the asymptotic covariance matrix of the parameter estimates.

3 - A clustering method based on Independent Component Analysis
Takashi Onoda, System Engineering Lab., CRIEPI, 2-11-1, Iwado Kita, Komae-shi, 201-8511, Tokyo, Japan, onoda@criepi.denken.or.jp

The clustering result in k-means clustering method depends heavily on the chosen initial clustering centers. We propose a clustering method based on the independent component analysis. The proposed method does not need initial clustering centers. We evaluate the performance of our proposed method and compare it with some clustering methods by using artificial datasets and benchmark datasets. The experiments show that the normalized mutual information of our proposed method is better than the normalized mutual information of k-means clustering method, KKK method and k-means++ clustering method.

4 - Dissimilarity Based on Cluster Discordancy on Attribute Subsets
Yoshifumi Kusunoki, Osaka University, Japan, kusunoki@eei.eng.osaka-u.ac.jp, Tetsuzo Tanino

Clustering is to classify given objects into clusters using their attributes. In this research, we focus on clustering for objects with nominal attributes. For such objects, logical expressions such as “attribute a equals to v” are suitable to describe features of clusters. However, clustering methods using dissimilarity for object pairs do not necessarily output clusters having simple and compact logical expressions. So, we propose dissimilarity using cluster discordancy on attribute subsets. We apply the proposed dissimilarity to clustering, and examine them by numerical experiments.

Network capacity control (NCC) tools identify the most profitable proposals where the profitability is determined by incorporating a forecast about the expected remaining demand. Inaccurate demand forecasts compromise the transfer of NCC tools from the airline industry into the road haulage sector. However, road haulage product portfolios consist to a large part of flexible products with two or more execution modes. We investigate if the large number of flexible products contributes to the compensation of inaccurate demand forecasts and enable the re-use of NCC tools in road haulage.

2 - Operational capacity management in the car rental industry
Claudius Steinhardt, Department of Analytics & Optimization, University of Augsburg, Universitätstraße 16, 86159, Augsburg, Germany, claudius.steinhardt@wiwi.uni-augsburg.de, Jochen Gönsch

Car rental companies are often able to spontaneously adjust their fleet size within a certain range in order to match market needs. We present an approach that integrates these fleet decisions with revenue management’s capacity control. To decide on the fleet size, we propose an LP formulation that is used in a hierarchical planning context with a rolling horizon, allowing for the combination with arbitrary approaches of standard capacity control. To reveal the potential of the approach, we conduct extensive simulation studies based on real-world data from a European car rental company.

3 - Dynamic pricing and efficient management of installation and maintenance resources
Rupal Rana, Business School, Loughborough University, Epinal Way, Loughborough, United Kingdom, r.rana@lboro.ac.uk

We consider a problem faced by many companies that use a fixed number of employees to provide two services an installation service and a maintenance service. We propose to join resources of employees and use dynamic prices for installations in accordance to the demand for maintenance, and we explore, e.g., how changes in various problem parameters affect the optimal policy structure. We investigate the economic benefits of a joint strategy and find that dynamic pricing and capacity flexibility works best.

4 - An EMSR approach for revenue management with planned upgrades
Jochen Gönsch, Department of Analytics & Optimization, University of Augsburg, Universitätstraße 16, D-86159, Augsburg, Germany, jochen.goensch@wiwi.uni-augsburg.de, Sebastian Koch, Claudius Steinhardt

We consider the capacity control problem with integrated upgrading. The optimal dynamic program for this problem is hard to solve even in the single-leg case, as multiple hierarchical resource types must be considered simultaneously. Therefore, we propose a new heuristic approach that generalizes the well-known EMSR-a procedure. A simulation study compares the performance to other capacity control methods incorporating upgrades. The results show that our approach significantly outperforms existing methods including the successive planning approaches widely used in commercial RM systems.
On the role of randomness in exact tree search methods
Matteo Fischetti, DEI, University of Padua, via Gradenigo 6/a, 35100, Padova, Italy, Italy, fisch@dei.unipd.it, Michele Monaci

High-sensitivity to initial conditions is generally viewed as a drawback of tree search methods, as it leads to an erratic behavior to be mitigated somehow. In this talk we address the opposite viewpoint. Our working hypothesis is that erraticism is just a consequence of the exponential nature of tree search, that acts as a chaotic amplifier, so it is largely unavoidable. We discuss possible ways to actually take advantage of randomness, and present computational experiments on a testbed of difficult MILP instances.

Incorporating costs in the RCPSP with pre-emption
Francisco Ballestin, Department of Statistics and OR, Public University of Navarra, Campus Arrosadia, S/N, 31006, Pamplona, Spain, Francisco.Ballestin@uv.es

The classical models of project scheduling problems suppose that activities are non-preemptable. However, some project environments allow this assumption to be relaxed. Almost all published papers presuppose that activities can be restarted at no additional cost, but this is not true in some practical situations. We define new models that incorporate costs in the RCPSP with pre-emption. The cost might be of different types; this paper focuses in what we think are the most plausible and interesting ones. We offer algorithms capable of offering quality solutions for each of the proposed models.

Lower bounds for a Fixed Job Scheduling Problem with an equity objective function
Damián Prot, Automatique et Productique, Ecole des Mines de Nantes, 4, rue Alfred Kastler, 44307, Nantes Cedex 3, France, damien.prot@mines-nantes.fr, Tanguy Lapegue, Odille Bellenguez-Morineau

We are interested in a problem that consists in assigning a set of tasks to a set of workers with specific skills. Given a targeted working load for each worker, we want to maximize the fairness between workers; more precisely, our objective is to minimize the difference between the highest and the lowest worker's gap value, which is defined as the difference between the targeted working load and the real working load. We present specific lower bounds for this problem and compare them with the one obtained by solving an integer linear program with an industrial software.

Increasing schedule robustness by task grouping
Michel Wilson, Software Technology, Delft University of Technology, Mekelweg 4, 2628 CD, Delft, Netherlands, M.Wilson@tudelft.nl, Cees Witteveen

An important problem in scheduling is ensuring robustness of solutions in case of execution delays. We propose a new method, task grouping, and apply it to resource-constrained project scheduling. Using this method tasks that must be executed sequentially can be grouped, but their definitive order is determined at execution time such that delays can sometimes be mitigated. As a consequence, our method generates a set of execution options for a schedule. Using the well-known PSPLIB instances, we show that our method can reduce the impact of delays on the execution of the schedule significantly.

Google/Roadef Challenge: a 100-line LocalSolver model
Frédéric Gardi, e-lab, Bouygues SA, 75008, Paris, France, frédéric.gardi@bouygues.com

We present a model and run LocalSolver, the first math programming software combining the simplicity of use of a model-and-run solver and the power of local-search techniques for combinatorial optimization (www.localsolver.com). In practice it
means that we merely translated the problem definition into a straightforward 0-1 model and then launched LocalSolver on this model. Ranked 25th among 82 teams from 33 countries, LocalSolver is the sole math programming solver qualified for the final round.

2 - Adaptive Local Search for Google Machine Reassignment problem
Enmir Demirovic, Mathematics, Faculty of Natural Sciences, Bosnia And Herzegovina, enmir.demirovic@gmail.com, Mirsad Bujilbasic, Haris Gavranovic

We present a hybrid method to efficiently solve Google Machine Reassignment problem. We study, implement, combine and empirically examine different local search neighborhoods to solve the set of available instances. We present results obtained with the solver respecting the given computational time of 5 minutes. The solutions obtained with longer runs and/or with relaxed constraints will also be reported. We also develop a decomposition method for the given problem improving overall numerical efficiency of the method. Some of the obtained results are proven to be optimal or near optimal.

3 - A Hybrid Large Neighborhood and Local Search for the Machine Reassignment Problem
Thibaut Vidal, CIRREL - Université de Montréal & ICD-LOSI - Université de Technologie de Troyes, 12, rue Marie Curie, BP 2060, cedex, 10010, TROYES, France, thibaut.vidal@cirrelt.ca, Hugues Dubedout, Renaud Masson, Julien Michallet, Puca Penna, Vinicius Petrucci, Anand Subramanian

A hybrid metaheuristic combining Local Search (LS), Large Neighborhood Search (LNS) and integer programming is proposed for the machine reassignment problem. The LS performs relocations and exchanges of processes with similar resource consumptions and dependency requirements among machines in the cluster. The LNS iteratively and adaptively selects a subset of decision variables whose optimized values are given by a compact integer programming formulation. The method produces competitive results on the first set of instances provided by the ROADEF 2012 challenge organizers.

This research provides a practical method for solving infeasible mixed-integer programming models by correcting their constraints. The initial infeasible MILP is decomposed into two subproblems finally yielding to the correction problem which is deduced to an LP in case of using the uniform correction criterion. The solution of the corrected MILP shows how the constraints (e.g. resources) of the initial infeasible model can be changed in a minimal way to make the model feasible that can mean a technological update for the modeled production process (e.g. energy consumption reduction).

4 - A hybrid solution to configure H.264/AVC video CODEC for the Brazilian Digital TV
Iris Linck, University of the Sinos Valley, Av. Unisinos, 950, 93022000, Sao Leopoldo, Rio Grande do Sul, Brazil, linck.iris@gmail.com, Arthur Gomez

This article presents a study focused on finding good solutions to improve the H.264/AVC CODEC configuration for encoding video to the Brazilian Digital Television System (DBTS). A hybrid algorithm called Simulator of Metaheuristics applied to a CODEC (SMC) was developed and it utilizes the concepts of Tabu Search and Genetic Algorithm. SMC will search for the best CODEC configuration by using six parameters: bitrate, framerate, quantization parameters of the B, P and I slices; and the number of B slice in a Group Of Pictures. The goal is to get a compressed video with a good picture quality.

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**WB-05**

**Wednesday, 10:30-12h00**

**RB-L3**

**Topics in combinatorial opimization II**

Stream: Discrete Optimization, Geometry & Graphs (contributed) **Contributed session**

Chair: Robert Manger, Department of Mathematics, University of Zagreb, Bijenicka cesta 30, 10000, Zagreb, Croatia, manger@math.hr

1 - **Fixing rules, Reduction and Optimal resolution for the Knapsack Problem with Setups**
Abdelkader Shibi, Axe Logistique-Terre-Mer-Risque, Ecole de Management de Normandie, Le Havre, France, 30, rue de Richelieu, 76087, Le Havre Cedex, France, a.shibi@em-normandie.fr

The knapsack problem with setups (KPS) is a non standard hard variant of the knapsack problem with setups costs and constraints and with many real-life applications. We present a two-phase optimal approach for KPS: (i) the first one is a reduction based phase obtaining fixing the variables to their optimal values in the solution via upper/lower bounding rules and (ii) in the second phase, we apply an exact method for the reduced problem composed by the remaining free variables. We considered both B&B and LP and we give a comparison study of the two variants of the approach.

2 - **Adding an Edge between Two Levels of a Complete K-ary Linking Pin Structure Minimizing Total Distance**
Kiyoshi Sawada, Department of Policy Studies, University of Marketing and Distribution Sciences, 3-1, Gakuen-nishi-machi, Nishi-ku, 651-2188, Kobe, Japan, Kiyoshi_Sawada@red.umds.ac.jp
3 - Minimizing the costs of evacuation paths by decomposing network flows
Jan Peter Obst, Mathematics, TU Kaiserslautern, Germany, obst@mathematik.uni-kl.de, Stefan Ruzika

Many models and algorithms for large scale routing and flow optimization are known. The solution of such problems is naturally a flow on a network. However to implement this flow a decomposition into paths is required. While it is straightforward to find an arbitrary decomposition the choice of the decomposition can have a tremendous effect on the properties of the single paths. The problem of finding optimal decompositions is NP-hard but has not been investigated in detail. An integer program for such problems as well as an approximation algorithm on series-parallel graphs are presented.

4 - Implementing the work function algorithm by network flows and flow cost reduction
Robert Manger, Department of Mathematics, University of Zagreb, Bijenicka cesta 30, 10000, Zagreb, Croatia, manger@math.hr, Tomislav Rudec

This paper deals with the work function algorithm (WFA) for solving the on-line k-server problem. The WFA is usually implemented by network flow techniques including the flow augmentation method. In the paper we develop a new implementation of the WFA, which is again based on network flows, but uses simpler networks and the cost reduction method. We also present experiments showing that our implementation is considerably faster than the conventional one.

3 - Symmetric rendezvous search on a hexagon
John Howard, Operational Research, London School of Economics, Houghton Street., London, WC2A 2AE, United Kingdom, j.v.howard@lse.ac.uk

In symmetric rendezvous search on a hexagon two players are initially placed at two different vertices two edges apart. Each period they must move to one of the adjacent vertices. They try to meet in the least possible expected time using the same (mixed) strategy. This problem is unsolved, so we modify it by giving the players extra information. We are then able to solve the modified problem, thereby giving a lower bound to the original problem. The solution requires an interesting analysis of the behaviour of two intertwined discrete dynamical systems.

4 - Lorenz and lexicographic maximal allocations for bankruptcy problems
Javier Arin, Economic Theory, University of the Basque Country, L. Agirre 83, 48015, Bilbao, Spain, franciscojavier.arin@ehu.es

A bankruptcy problem consists of a set of claimants who must divide between them an infinitely divisible good, the endowment, that is not sufficient to satisfy their claims in full. We introduce egalitarian criteria to solve bankruptcy problems. We focus on two egalitarian criteria: the Lorenz and lexicographic criteria. Talmud Rule is one of the most important sharing rules. We prove that this rule is also a lexicographic maximizer. This analysis allows a new sharing rule: Lexmax Rule. We also characterize the sets of Lorenz maximal vectors of awards/losses.

This study proposes a model of adding relation to an organization structure which is a complete K-ary linking pin structure where every pair of siblings in a complete K-ary tree of height H is adjacent such that the communication of information in the organization becomes the most efficient. When an edge between a node with a depth M and its descendant with a depth N is added, an optimal pair of depth (M,N)* is obtained by minimizing the total distance which is the sum of the number of edges in shortest paths between every pair of all nodes in the complete K-ary linking pin structure.

- WB-06
Wednesday, 10:30-12h00
RB-Gamma

Industrial Organization
Stream: Dynamical Systems and Game Theory
Invited session
Chair: Luis Ferreira, Matemática, Escola Superior de Estudos Industriais e de Gestão, IPP, ESEIG, Rua D Sancho I, número 981, 4480-876, Vila do Conde, Porto, Portugal, migferreira2@gmail.com

1 - Flexibility in a Stackelberg leadership
Luis Ferreira, Matemática, Escola Superior de Estudos Industriais e de Gestão, IPP, ESEIG, Rua D Sancho I, número 981, 4480-876, Vila do Conde, Porto, Portugal, migferreira2@gmail.com

We study the effects of product differentiation in a Stackelberg model with demand uncertainty, only for the first mover. We do an ex-ante and ex-post analysis, in terms of product differentiation and of the demand uncertainty, of the profits of the leader and of the follower firms. We show that even with small uncertainty about the demand, the follower firm can achieve greater profits than the leader, if their products are sufficiently differentiated.

2 - Parallel vs. Sequential Interaction Protocols for the Multilateral Negotiations in Distributed, Multi-agent Environment
Piotr Palka, The Faculty of Electronics and Information Technology, Warsaw University of Technology, ul. Nowowiejska 15/19, 00-665, Warsaw, mazowieckie, Poland, P.Palka@ia.pw.edu.pl

In e-commerce complex markets there are numerous limitations and other ties between market participants and objects of trade. Frequently occurring constraints arising from a structure of the problem, as well as preferences of participants, cause inability to reach a satisfactory outcome using bilateral negotiations. The solution is either the trade on centralized auctions or the multilaterally negotiated agreement. In the paper we consider two interaction protocols for the multilateral negotiation. One is based on the sequential message passing, the other assumes parallel communication.

- WB-08
Wednesday, 10:30-12h00
RB-Epsilon

Boolean Optimization in Graph Theory
Stream: Boolean and Pseudo-Boolean Optimization
Invited session
Chair: Martin Milanic, UP IAM and UP FAMNIT, University of Primorska, Muzejski trg 2, 6000, Koper, Slovenia, martin.milanic@upr.si

1 - Forbidden induced subgraph characterizations of graph classes
Guilermo Durán, University of Buenos Aires, Argentina, gduran@dm.uba.ar

In this talk we present several results about partial characterizations of different graph classes by forbidden induced subgraphs. First, we analyze three classes related to perfect graphs: clique-perfect, coordinated and balanced graphs. Furthermore, we study two important classes of intersection graphs: circular-arc and circle graphs. We will show the main results on these topics obtained for our group in the last 10 years. Joint works with F. Bonomo, M. Chudnovsky, L. Grippo, M. Groshaus, M. Lin, M. Safe, F. Soulignac, G. Sueiro, J. Szwarcfiter and A. Wagler.

2 - A generalization of the P4-free graph sandwich problem to multigraphs
Endre Boros, RUTCOR, Rutgers University, 08854, Piscataway, New Jersey, United States, Endre.Boros@rutcor.rutgers.edu, Vladimir Gurvich

An n-multigraph is an n-edge colored complete graph. D is a 3 edge colored triangle, and P is a 2 colored complete graph on 4 vertices, such that each color defines a P4. In this paper we show a polynomial time algorithm to decide if a given n-multigraph contains a P- and D-free.
3 - A Set Covering Approach to Solving Heterogeneous Vehicle Routing Problem
Milan Stanojevic, Faculty of Organizational Sciences, University of Belgrade, Jove Ilica 154, 11000, Belgrade, Serbia, milans@fon.rs, Bogdana Stanojevic

We consider a vehicle routing problem with limited heterogeneous fleet of vehicles having various capacities, fixed costs and variable costs. Our approach provides approximate solution. It consists of two phases. In first phase we generate set of “good” routes for all types of vehicles from the fleet. For this step we use randomized enhanced savings algorithm. In second phase we solve to optimality set covering problem using routes from the first phase. Varing number of generated routes we can trade between solving time and solution quality. Computation results are presented.

4 - On the dominating tree problem
André Rossi, Lab-STICC - UMR 3192, Université de Bretagne-Sud, Centre de Recherche, BP 92116, 56321, Lorient, France, andre.rossi@univ-ubs.fr

The problem under consideration is called the dominating tree problem. Let G be an edge weighted, simple, connected and undirected graph. We want to build a tree of minimum cost on G such that each vertex is either covered by the tree, or is adjacent to a vertex that is covered by the tree. The cost of edge every edge is assumed to be strictly positive. We provide a simple proof of NP-hardness, and a series of cases where the problem can be solved in polynomial time. In addition, we present a cutting plane approach to this problem.

**WB-09**
Wednesday, 10:30-12h00
RB-Zeta

**Optimization Problems on Graphs**

Stream: Graphs and Networks

**Invited session**

Chair: Mirjana Cangalovic, Laboratory for Operational Research, Faculty of Organizational Sciences, University of Belgrade, Jove Ilica 154, Belgrade, Serbia, Serbia, canga@fon.bg.ac.rs

1 - An algorithm for finding the most probable cut set
Mirko Vujosevic, Faculty of Organizational Sciences, University of Belgrade, ul. Jove Ilica 154, 11000, Belgrade, Serbia, mirkov@fon.bg.ac.rs, Dragana Makajic-Nikolic, Nebojsa Nikolic

A new approach for finding the most probable cut set is proposed. The structure of the system is firstly modeled as a fault tree with random primary events as leafs, intermediate events as logic functions of primary events, and the top event in the root. The top event is also a logic function of the primary events. A cut set is a set of primary events which cause the occurrence of the top event. Given probabilities of the primary events, the problem is to find the most probable cut set. An equivalent reverse Petri net is made and its properties are used for developing a new algorithm.

2 - Strong metric dimension of generalized Petersen graphs GP(n,1)
Mirjana Cangalovic, Laboratory for Operational Research, Faculty of Organizational Sciences, University of Belgrade, Jove Ilica 154, Belgrade, Serbia, Serbia, canga@fon.bg.ac.rs, Jozef Kratica, Vera Kovacevic Vujic

Generalized Petersen graphs GP(n,k) were introduced by Coxeter in 1950. Recently, the metric dimension and the minimal doubly resolving set of GP(n,k) have been investigated. In this paper we consider a related problem of determining the strong metric dimension for GP(n,1) and prove that it is equal to n.

3 - The Price of Connectivity for Vertex Cover
Olive Schaudt, Institut für Informatik, AFS, Universität zu Köln, Weyertal 80, 50931, Cologne, Germany, schaudto@uni-koeln.de

We study a graph parameter called the Price of Connectivity for Vertex Cover (PoC). It was recently introduced by Cardinal et al. and is defined as the ratio of the minimum size of a connected vertex cover and the minimum size of a vertex cover. We prove structural results for the PoC. These results concern PoC-critical, PoC-perfect and PoC-near-perfect graphs.

4 - Equistable graphs: conjectures, results, and connections with Boolean functions
Martin Milanic, UP IAM and UP FAMNIT, University of Primorska, Muzejski trg 2, 6000, Koper, Slovenia, martin.milanic@upr.si

Equistable graphs form a graph class generalizing the well known class of threshold graphs, and are closely related to general partition graphs and triangle graphs. No combinatorial characterization of equistable graphs is known, and the complexity status of recognizing equistable graphs is open. In this talk, we will present an overview of results and conjectures on equistable graphs and related classes. Whenever applicable, connections to corresponding notions from the theory of Boolean functions will be discussed. Joint works with V. Levit, S. Miklavic, J. Orlin, G. Rudolf and D. Tankus.
3 - A Trade Credit Model for Supply Chain Coordination
Abhishek Chakraborty, Operations Management, Indian Institute of Management Calcutta, Diamond Harbour Road, Joka, 700104, Kolkata, West Bengal, India, abhisheke8@iimcal.ac.in, Ashis Chatterjee

This paper considers a single vendor and single buyer supply chain model where the vendor allows a trade credit to the buyer to synchronize its production cycle with the ordering cycle of the buyer. The vendor is being benefited from the reduction in its set up costs while the buyer is being compensated for the extra inventory that he is carrying through the trade credit offered by the vendor. Trade credit is developed as a mechanism for achieving supply chain coordination in the weak form.

4 - An Analysis of Supply Chain Related Graduate Programs in Europe
Y. Ilker Topcu, Industrial Engineering, Istanbul Technical University, Istanbul Teknik Universitesi, Isletme Fakultesi, Macka, 34357, Istanbul, Turkey, ilker.topcu@itu.edu.tr, Emel Aktas, Sezi Cevik Onar, Des Doran

There is a continuous interest in analysing and designing SCM education. Parallel to increasing impact of globalisation, more and more companies operate in larger supply chains and there is an increasing need for skilled employees trained in SCM. Motivated by lack of studies on graduate level supply chain education, this research aims to determine the current status of supply chain related programs offered at graduate level in Europe. Our findings suggest that programs are clustered according to the weight of various knowledge and skill areas such as SCM, managerial or quantitative skills.

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**WB-11**
Wednesday, 10:30-12h00
RB-Iota

**Realistic scheduling problems**

Stream: Realistic Production Scheduling  
*Invited session*

Chair: Alper Gucumengil, Foreign Relations Department, Turkish Statistical Institute, Yucetepe mah., Necatibey cad. No:114
Cankaya, Ankara, Turkey, alpergucumengil@hotmail.com

1 - Due-date assignment problems with common flow-allowance

*Gur Mosheiov*, Business School, The Hebrew University of Jerusalem, Mount Scopus, Jerusalem, 91905, Jerusalem, Israel, mosheiov@mscc.huji.ac.il, Baruch Mor

In due-date assignment problems with a common flow-allowance, the due-date of a given job is defined as the sum of its processing time and a job-independent constant. We study first the minsum version of the problem. In this case, the scheduler has the option to perform a maintenance activity which is rate modifying, i.e., improves the processing times of the following jobs. We consider a number of versions of this setting. We also study the minmax version of the problem, with extensions to position-dependent processing times, and to the (NP-hard) setting of parallel machines.

2 - Approximate algorithms for one-machine scheduling with interfering jobs

*Paz Perez Gonzalez*, Industrial Management, University of Seville, Camino de los Descubrimientos s/n, 41092, Sevilla, Spain, pazperez@esi.us.es, Jose M. Framanan

In this paper, we analyze the problem of scheduling two sets of jobs on one machine with the objectives of total completion times for both sets. This problem is known to be NP-hard considering different approaches (Pareto, epsilon-constrained and linear convex), and several algorithms have been proposed in the literature. We analyze the approaches, compare the corresponding solution procedures, and present new heuristics for the problem.

3 - Flowshop scheduling with flexible operations: Throughput optimization

*Hakan Gultekin*, Industrial Engineering, TOBB-University of Economics and Technology, Endustri Muhendisligi Bolumu, TOBB Ekonomi ve Teknoloji Universiteleri, Sogutozu Cad. No:43, 06560, Ankara, Turkey, hgultekin@etu.edu.tr

In classical flowshop scheduling, processing times of the parts are assumed to be fixed, predefined parameters. This assumption oversimplifies the problem for the systems consisting of flexible machines capable of performing different operations. In such systems, some of the operations that a part requires can be processed by alternative machines. In order to maximize the throughput rate the assignment of these operations to the machines must be determined. In this study we develop solution procedures for problems arising in 2 and 3-machine flowshops producing identical or multiple parts.

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**WB-12**
Wednesday, 10:30-12h00
RB-Omicron

**Railway Optimization II**

Stream: Optimization in Public Transport  
*Invited session*

Chair: David Canca, School of Engineers, University of Seville., Av. de los Descubrimientos s/n, Isla de la Cartuja, 41092, Seville, Spain, dcano@us.es

1 - The management of rail system breakdowns for reducing travel demand impacts

*Luca D’Acierno*, Dipartimento di Ingegneria dei Trasporti, Università degli Studi di Napoli “Federico II”, Via Claudio, 21, 80125, Napoli, Italy, dacierno@unina.it, Mariano Gallo, Bruno Montella, Antonio Placido

In urban context, the improvement of rail systems represents a useful tool to promote the use of public transport and reduce environmental impacts of private car use. However, in the event of breakdowns, since faulty trains cannot usually be overtaken and their removal could pose extreme difficulties, re-establishing the regular service could involve inconveniently long travel times. Therefore, in this framework, we analyse effects of management strategies for different levels of degraded services in order to define the best solution to adopt to minimize travel demand discomfort.

2 - New approaches for Wagon Routing in Railroad Freight Traffic

*Robert Voll*, Institute of Transport Logistics, TU Dortmund University, Leonhard-Euler-Strasse 2, 44227, Dortmund, Germany, voll@itl.tu-dortmund.de, Uwe Clausen

We consider a consolidation problem from railroad freight traffic. The problem is modeled as a fixed charge multimmodity flow problem. We present two new solution approaches based on a column generation formulation. The first one is a Branch-and-Price algorithm. The second method is a heuristic algorithm. We present computational results for a couple of test instances we constructed in cooperation with our industrial partners. Results from our computations are compared to solutions provided by CPLEX.
3 - Analysis of the variability of travel conditions and flows along a transit line
Vincent Benezech, Ecole des Ponts ParisTech, ENPC - LVMT, 6-8 avenue Blaise Pascal, 77455, Marne-la-Vallee, France, vincent.benezech@enpc.fr, Fabien Leurent

One major issue in transit planning pertains to service reliability. The paper’s objective is to provide a stochastic model of traffic variability and passenger exposure along a transit route. Headways are treated as random variables. Their distribution is estimated using data from the Transilien operator. Analytical formulas for the mean and variance of passenger loads on any section of the line, as well as average passenger exposure to crowding in the case of log-normal headways are derived. In the general case, a zip-unzip algorithm computing generalised travel times is described, for inclusion in a complete traffic assignment model.

4 - A methodology to analyze quality of railway timetables
David Canca, School of Engineers, University of Sevilla., Av. de los Descubrimientos s/n, Isla de la Cartuja, 41092, Seville, Spain, dco@us.es, Eva Barrena, Encarnación Algarba, Alejandro Zarzo

Railway scheduling and timetabling are two of the classical stages in the hierarchical railway planning process and they perhaps represent the step with major influence on user’s quality of service perception. This paper considers the problem of timetable determination considering a dynamic behavior of passenger demand considering user and service provider points of view. Aspects like the influence of train capacity are discussed. To illustrate the methodology an application to the C5 line of Madrid rapid transit system is presented.

WB-13
Wednesday, 10:30-12h00
RB-Tau
Transportation and Logistics
Stream: OR Applications in the Automotive Industry

Invited session
Chair: Achim Koberstein, Business Administration, Goethe-University of Frankfurt, Grueneburgplatz 1, 60323, Frankfurt am Main, Germany, koberstein@wiwi.uni-frankfurt.de
Chair: Martin Grunewald, Institute of Automotive Management and Industrial Production, Technische Universität Braunschweig, Katharinestraße 3, 38106, Braunschweig, Germany, m.grunewald@tu-bs.de

1 - Choosing charge carriers to guarantee the efficient material supply of production areas
Dominik Berbig, Institut für Fertigungstechnik und Logistiksysteme, KIT, Gotthard-Franz-Straße 8, 76131, Karlsruhe, Germany, berbig@kit.edu, Kai Furmans, Michaela Köker, Maximilian Altefröhle

To guarantee efficient material supply, it is crucial to choose adequate charge carriers for every part number. The larger the carrier, the larger is the required space, the number of contained pieces and, as a result, the fixed capital costs. The smaller it is, the higher the necessary transportation frequency. This trade-off shows that choosing a charge carrier is subject to many parameters. Currently, this choice is often based on the size only. This means wrong choices and wasted capital. Thus, we present an approach to solve this problem, a new model and possible benefits.

2 - The impact of decision making strategies in different network types on stock fluctuation
Meisam Nasrollahi, Industrial Engineering, University of Tehran, 32th - Masjed Jame St., Fasa - Fars - Iran, 7461833749, Fasa, Fars, Iran, Islamic Republic Of, m_nasrollahi@ut.ac.ir, Jafar Razmi, Reza Ghodsi

The knowledge about interdependency between decision making strategies and the stock fluctuation in a supply chain is important to identify those parts of a supply network which has the highest potential for improving total uncertainty. Two scenarios are suggested: each supply partner designs its own material handling system and network configuration organizes an integrated material handling policy for all supply partners. A multi-objective model is developed to compare these scenarios and identify under which situations lasting uncertainty reduction can be achieved.

3 - An integrated inventory-transportation system with periodic pick-ups and leveled replenishment
Martin Grunewald, Institute of Automotive Management and Industrial Production, Technische Universität Braunschweig, Katharinestraße 3, 38106, Braunschweig, Germany, m.grunewald@tu-bs.de, Thomas Volling, Thomas Spengler

In this paper we develop a combined inventory-transportation system. The principle idea is to integrate a simple replenishment policy with a routing component to derive operationally consistent standard routes as a basis for milk-run design. Therefore we combine stochastic vehicle routing with a replenishment policy which makes use of safety stock to level the variability propagated into transportation operations. To evaluate the approach, we compare its performance with stochastic vehicle routing as well as sequential vehicle routing and safety stock planning.

WB-14
Wednesday, 10:30-12h00
RB-Omega
Timetabling and Transport
Stream: Timetabling and Rostering
Invited session
Chair: Hagai Ilani, Industrial Eng. and management, Shamoon College of Engineering, 84 Jabotinsky st., 77245, Ashdod, Israel, Israel, hagai@sec.ac.il

1 - Algorithm for Solving Two-Stations Railway Scheduling Problem
Elena Musatova, Institute of Control Sciences V. A. Trapeznikov Academy of Sciences, Moscow, Russian Federation, nekolyap@mail.ru, Alexander Lazarev

There are two railway stations and a set of freight cars which are characterized by departures and destinations, weight and significance. Each car arrives to the departure in some release time and should be delivered to the destination before a due date. There are some restrictions on number of cars in a train. It is necessary to form trains and schedules that minimize a cost function. A polynomial algorithm is proposed for solving the described problem.

2 - An Integrated Optimization Model for Timetabling and Machinist Assignment in Light Rail Transit Systems
Selmin DanisOncul, Management Engineering, Istanbul Technical University, ITU Isetime Fakultesi, Macka-Istanbul, 34367, Istanbul, Turkey, selmindanis@gmail.com

This study proposed a novel model to solve the timetabling problem combining with resource allocation of a light rail transit system. Firstly, a detailed literature review is carried out, then extensive interviews have been realized with authorized experts. Mathematical models are built and solved by mixed-integer programming using CPLEX algorithm. Validation is made by comparing model results with real-life application. Sensitivity analysis is also performed by changing parameter values such as train capacity and also weights of objective function. Finally all the results are analyzed.

3 - Real-time Control Procedures for Transit
Alessandro Sales, Civil engineering, Università degli Studi Roma Tre, via vito volterra, 62, 00146, Roma, Italy, alessandrosales@libero.it, Stefano Carrese
In every high frequency transport system, the problem of regularity is critical. Randomness can increase passenger’s travel time. We focus the attention on the real-time deadheading problem, because deadheading is the only way that allows to re-establish the correct headway without increase of the lat time. When a vehicle is deadheaded, it runs empty from a terminal skipping a number of stations, typically in order to reduce expected large headways at later stations. The objective is to determine the optimal number of stations to skip in order to minimize passenger’s total travel time.

4 - A General Two-directional Two-campus Transport Problem
Hagai Ilani, Industrial Eng. and management, Shamoon College of Engineering, 84 Jabotinsky st., 77245, Ashdod, Israel, Israel, hagai@sce.ac.il, Elad Shafan, Tal Grinshpoun

In the present work we extend a reduction of a simple case of a transportation problem between two destinations to the shortest path problem. Our reduction is valid for a general two directional case where a set of n requests for a ride between two destinations has to be executed by a fleet of K vehicles of given capacities, in order to minimize the total waiting time of all the passengers. Our approach can be implemented to the case where passengers have different levels of importance.

WB-15

Wednesday, 10:30-12h00
RB-2101

Theory and algorithms of bilevel programming I

Stream: Variational Inequalities and Bi-Level Problems
Invited session
Chair: Stephan Dempe, Mathematics and Computer Sciences, Technische Universität Freiberg, 09596, Freiberg, Germany, dempe@math.tu-freiberg.de

1 - Fuzzy bilevel optimization problem
Alina Ruzyieva, Fakultät für Mathematik und Informatik, TU Bergakademie Freiberg, Akademiestr. 6, 09596, Freiberg, Germany, ruzyieva@student.tu-freiberg.de, Stephan Dempe

The optimal solution of a fuzzy optimization problem is described as the set of Pareto optimal solutions of a corresponding multiobjective optimization problem. The preferable fuzzy optimal solution is supposed to have a maximal membership function value, i.e. it has the highest potential being realized by the follower. In the talk fuzzy bilevel optimization problems are considered in which the preferable fuzzy optimal solution of the fuzzy lower level problem is used. Aim of the talk is to describe a solution algorithm for this problem using the stability region of this solution.

2 - Necessary optimality conditions in pessimistic bilevel programming
Alain B. Zemkoho, Mathematics and Computer Sciences, Technical University Bergakademie Freiberg, Akademiestr. 6, 09599, Freiberg, Saxonia, Germany, zemkoho@student.tu-freiberg.de

We consider the “pessimistic version” of bilevel programming programs. Employing advanced tools of variational analysis and generalized differentiation, we provide a general frameworks ensuring the Lipschitz continuity of the value functions. Several types of lower subdifferential necessary optimality conditions are derived. We also derive upper subdifferential necessary optimality conditions of a new type. Certain links are established between the obtained necessary optimality conditions for the pessimistic and optimistic versions in bilevel programming.

3 - Vanishing Stress Constraints in Topology Optimization of Mechanical Structures
Wolfgang Achtziger, Department of Mathematics, University of Erlangen-Nuremberg, Chair of Applied Mathematics 2, Cauerstrasse 11, 91058, Erlangen, Germany, achtziger@am.uni-erlangen.de

We consider the optimization of topology of mechanical structures in a discretized finite element setting. These problems express shape optimization through a problem of optimal material distribution on a given element grid. Local stress constraints are essential for a realistic modeling. The resulting problem is a large-scaled mathematical program with vanishing constraints (MPVC). In the past several numerical recipes have been proposed for the treatment of MPVCs. The talk presents some of these approaches and reports on their success in the numerical treatment of topology problems.

WB-16

Wednesday, 10:30-12h00
RB-2103

Linear and Quadratic Programming

Stream: Linear and Conic Programming
Invited session
Chair: David Bartl, Department of Mathematics, University of Ostrava, 30.dubna 22, 701 03, Ostrava, Czech Republic, bartl@osu.cz

1 - On the complexity of steepest descent algorithms for minimizing quadratic functions
Clovis Gonzaga, Dept. of Mathematics, Federal Univ. of Santa Catarina, Cx. postal 5210, Florianópolis, SC, Brazil, Florianópolis, SC, Brazil, clovis@mtm.ufsc.br

In this talk we examine patterns in the distribution of step lengths in steepest descent algorithms for minimizing a convex quadratic function. We show how a large number of short steps are needed, and how these relate to the much smaller number of large steps. We note that the order in which the step lengths is used is irrelevant, and show a worst case example with a small number of variables. We also conceive a brute force algorithm which is in a certain way optimal.

2 - Convex quadratic programming applied to the stability number of a graph
Maria F. Pacheco, Instituto Politécnico de Bragança - ESTIG, Quinta de Santa Apolónia, Gab. 112, 5301-857, Bragança, Portugal, pacheco@ipb.pt, Domingos Cardoso, Carlos J. Luz

We deal with graphs whose stability number can be determined by a convex quadratic program and describe algorithmic techniques for the determination of maximum stable sets in such graphs (except there is an induced subgraph with least adjacency eigenvalue and optimal value of the convex quadratic program not changing if the neighborhood of any vertex is deleted). Such a graph is called adverse. Assuming that every adverse graph has convex-QP stability number, an algorithm for the recognition of graphs with convex-QP stability number is introduced and applied to determine maximum matchings.

3 - A discrete version of Farkas’ Lemma and Duality Theorem for homogeneous linear programming
David Bartl, Department of Mathematics, University of Ostrava, 30.dubna 22, 701 03, Ostrava, Czech Republic, bartl@osu.cz

We report a discrete version of Farkas’ Lemma, which is formulated in the setting of a module over a linearly ordered commutative ring (e.g.
the ring of the integer numbers). Inspired by the trick of the homogen-
ization, used to prove Gale’s Theorem of the alternative, which we also show, we introduce the concept of the primal and dual problem of homogeneous linear programming. We present the optimality condi-
tions for the primal and dual problem, respectively. In conclusion, we show that the Strong Duality Theorem holds for the problems.

4 - Optimization for switching control system
Shahlar Mererem, Mathematics, Yasar University, Izmir, Turkey, Selcuk Yasar Camp, agaci yol , No.35-37, Bornova, Izmir, Turkey, sahlar.mererem@yasar.edu.tr, Rezet Polat

A class of nonsmooth optimal switching control problems is consid-
ered (nonsmoothness posed on the minimizing functional). The cost functional is to be minimized. Necessary optimality conditions are de-

duced from normal cone and Dubovitskii-Milyutin theory: a) treat local minima via the empty intersection of certain sets in the primal space; b) approximate the above sets by convex cones with no intersections; c) arrive at dual necessary optimality conditions in the form of an ab-

stract Euler equation. The main result is a new optimality condition for the nonsmooth switching control system.

■ WB-17
Wednesday, 10:30-12h00
RB-2105

DC programming and DCA 1
Stream: Nonconvex Programming: Local and Global Approaches
Invited session
Chair: Tao Pham Dinh, INSA Rouen, 76131, Rouen, France, pham@insa-rouen.fr

1 - A Continuous Optimization Approach for the General Art Gallery Problem
Mahdi Moeini, Institute of Operating Systems and Computer Networks, Technical University of Braunschweig, IBR, Algorithms Group, Muhlenpfordstr. 23, 38106, Braunschweig, Germany, moeini@ibr.cs.tu-bs.de, Alexander Kroeller, Christiane Schmidt

Suppose that an art gallery is in the shape of a polygon. The classical Art Gallery Problem (AGP) seeks for determining the minimum number of guards that are sufficient to oversee the entire art gallery. It has been proven that this problem is NP-hard even for very special cases. We present a continuous optimization approach based on DC (Differ-
ce of Convex functions) programming techniques to solve the AGP problem. The numerical experiments have been carried out on some benchmark data sets and the results will be presented.

2 - A DC Programming technique for sparse regularization in least-squares and logistic regressions
Mamadou Thiao, LITA, LITA - University of Lorraine, 57000 Ile du Saulcy, Metz, France, mamadou.thiao@gmail.com,
Hoai An Le Thi, Tao Pham Dinh

This talk addresses a DC programming technique for solving ell_2 - ell_0 simultaneous regularization problem in least-squares and logis-
tic regressions. We first consider the original ell_2 - ell_0-regularized problems and we reformulate them as DC programs with the help of new exact penalty techniques. The resulting DC programs possess very nice DC structures and are quite adapted to convex DC relaxation tech-
niques. Experiments in the context of feature selection are performed and the results on real-world data sets illustrate the potential and show the usefulness of this method.

3 - A DC programming approach for clustering massive data sets
Hoai An Le Thi, Computer Science, University of Lorraine, Ile du Saulecy, 57 045, Metz, France, hoai-an.le-thi@univ-lorraine.fr, Ta Minh Thuy, Lydia Boudjelouf-Assala

In this paper, we present a robust nonconvex optimization method for clustering massive data using data streams. Our approach is based on DC (Difference of Convex functions) programming and DCA (DC Al-

gorithms) that have been successfully applied in various fields of ap-
plied sciences. The method consists of two phases. Phase 1: the data is divided into subsets on which an efficient DCA for clustering is in-
vestigated. Phase 2: another DCA for weighted clustering on the set of centers obtained by phase 1 is studied. The numerical results on real data sets show the efficiency of our method.

4 - Solving Generalized Orienting Problem using DCA
Akh Son Ta, LMI, INSA de Rouen, LMI, INSA de Rouen, +33, Rouen, France, taanh_son@yahoo.com, Hoai An Le Thi, Tao Pham Dinh, Djamel Khadraoui

Orienteering problem is well-known as a NP-hard problem in trans-
portation with many applications. This problem aims to find a path between a given set of control points, where the source and destina-
tion points are specified with respect to maximize the total score of collected points and satisfy the distance constraint. In this paper, we first analyze the structure of a generalized orienting problem and a new solution method, based on DC programming and DCA, is introduced. Preliminary numerical experiments are reported to show the efficiency of the proposed algorithm.

■ WB-18
Wednesday, 10:30-12h00
RB-2107

Discrete Location
Stream: Network and Discrete Location
Invited session
Chair: Antonio Manuel Rodriguez-Chía, Estadística e IO, Universidad de Cádiz, Facultad de Ciencias, Pol. Rio San Pedro, 11510, Puerto Real (Cádiz), Cádiz, Spain, antonio.rodriguezchias@uca.es

1 - The p-center problem with capacities and failure ahead
Alfredo Marín, Departamento de Estadística e Investigación Operativa, Universidad de Murcia, Facultad de Matemáticas, Campus de Espinardo, 30110, Murcia, Spain, amarin@um.es, Inmaculada Espejo, Antonio Manuel Rodriguez-Chía

This work deals with the p-center problem, where the aim is to mini-

mize the maximum distance between any user and his reference cen-
ter, considering that in case of failure of any center, the capacities of the remaining centers must suffice to satisfy the demand of all users, taking into account that the users will have as a reference the closest surviving center. The problem is of interest when locating emergency centers and, at the same time, taking precautions against emergencies which can cause failure of the center it self. We consider different formulations for the problem

2 - Assigning channels in cellular networks by neural networks
Enrique Domínguez, Dept. of Computer Science, E.T.S.I.Informática - University of Malaga, Campus Teatinos s/n, 29071, Malaga, Spain, enrique@lecc.uma.es, Jose Muñoz

Wireless communication constitutes one of the fastest growing indus-
try segments in recent years, encompassing a number of application domains such as the cellular networks. Efficient allocation of chan-

nels for wireless communication in different network scenarios has become an extremely important topic of recent research. The main challenge lies in the fact that the channel allocation problem (CAP) is NP-complete. In many practical situations, sometimes we may need to be satisfied with a near-optimal solution because of a maximum allow-
able time limit is imposed for allocation of channels.

3 - A p-median model with distance selection
Stefano Benati, Department of Sociology, University of Trento, Via Verdi 26, 38100, Trento, Italy, stefano.benati@unitn.it, Sergio García Quiles
We are introducing an extension of the p-median model in which the units distance function, defined in an m-dimensional space, is the sum of elementary distances calculated on spaces of dimension 1 (this model originate from cluster analysis). We let the researcher select only q coordinates out of the m dimensional axes, so we are allowing different and possible distance definitions between the units. We propose many ILP formulations to the model and compare their properties.

4 - Single Allocation Capacitated Ordered Median Hub Location Models

Antonio Manuel Rodríguez-Chia, Estadística e IO, Universidad de Cádiz, Facultad de Ciencias, Pol. Río San Pedro, 11510, Puerto Real (Cádiz), Cádiz, Spain, antonio.rodriguezchia@uca.es, Justo Puerto, Ana Bel Ramos-Gallego, Evrim Oral, Muslu Kazım Körez, Yunus Akdoğan, Coskun Kus

In this paper we consider new formulations, based on the ordered median objective function, for capacitated hub location problems with new distribution patterns induced by the different user’s roles within the supply chain network. This approach introduces some penalty factors associated with the position of an allocation cost with respect to the sorted sequence of demands. First we present formulations for this problem, and then develop stronger formulations by exploiting properties of the model. The performance of all these formulations is compared by means of a computational analysis.

3 - Predictive Power of Generalized Additive Models in Insurance

Aysegul Iscanoglu Cekic, Statistics, Selcuk University, KONYA, Turkey, iaysegul@selcuk.edu.tr

In insurance an event or a claim is usually related with various number of risk factors. The classification techniques are used to model the impact of such factors on occurrence of such events or claims. The generalized additive model is one of these techniques. In this study, we implement the generalized additive models with Conic quadratic programming approach (GAM-CQP) to the insurance framework. We also compare the predictive performance of GAM-CQP with the classical generalized additive models and some other techniques, e.g. generalized linear models and semi-parametric regression.

4 - An Application of Wavelet Regression in Exchange Rate Estimation

Tarik Yilmaz, Statistics, Science Institute, Selcuk Universitesi Alaaddin Keykubat Kampusu, Selcuklu, 42020, KONYA, Turkey, tyilmaz@selcuk.edu.tr, Asir Genç

In this study, our main aim is to forecast exchange rate in an effective way. For this purpose we propose a new technique which is based on wavelet regression. In order to evaluate the effectiveness of the technique, the EURO/EUR - U.S. Dollar (USD) parity data is used. Effectiveness of the new process is also shown by backtesting.

WB-19

Predictive Modelling in Finance and Insurance

Stream: Simulation Methods in Finance

Invited session

Chair: Aysegul Iscanoglu Cekic, Statistics, Selcuk University, KONYA, Turkey, iaysegul@selcuk.edu.tr

1 - Simulation Study for Modified Maximum Likelihood Estimations in Poisson Regression

Muslu Kazım Körez, Statistic Department, Faculty of Science, Selcuk University, 42225, Konya, Turkey, kkorez@selcuk.edu.tr, Evrim Oral, Yunus Akdoğan, Coskun Kus

For most of the generalized linear models (GLM), the maximum likelihood (ML) equations involve nonlinear functions of the parameters and they are intractable. Solving these equations by iterations can be problematic for reasons of convergence to wrong values. In this study, we compare the ML and MML estimators with respect to their biases and mean square errors. Moreover, we provide the coverage probabilities of the confidence intervals, (based on ML, and MML estimators) of Poisson regression parameters by using a Monte Carlo simulation study. We also investigate the revised MML estimators proposed by Oral (2005) with respect to their initial values. We show that ordinarily least squares estimators yield approximations as good as those proposed by Oral (2005).

2 - An Application of Wavelet Regression on Risk Analysis

Asır Genç, Statistic, Selcuk University, Konya, Turkey, agenc@selcuk.edu.tr, Tarik Yilmaz

In this study we make a risk analysis for a software company which plans to develop and launch a new product. In the analysis we firstly model the financial statements of the company. The model includes both stochastic and deterministic variables. Therefore, we make a simulation study and we provide 10-year cash flow tables for the company. Then a risk analysis procedure is implemented. Moreover, we apply a wavelet regression smoothing procedure to the obtained values and we find new risk values. Finally, these new risk values are compared with Net Present Value and a decision plan is given.

WB-20

Financial Optimization 1

Stream: Financial Optimization

Invited session

Chair: J. E. Beasley, Mathematical Sciences, Brunel University & JB Consultants, Department of Mathematical Sciences, Kingston Lane, UB8 3PH, Uxbridge, Middlesex, United Kingdom, john.beasley@brunel.ac.uk

1 - A Risk-Return Approach to Enhanced Indexation

Francesco Cesarone, Economics, University of Rome 3, Faculty of Economics, Via Silvio D’Amico 77, 00145, Rome, Italy, fcesarone@uniroma3.it, Renato Bruni, Andrea Scozzari, Fabio Tardella

Enhanced Indexation is the problem of selecting a portfolio that generates excess return with respect to a benchmark index. We propose a linear bi-objective optimization model for enhanced indexation that maximizes average excess return and minimizes underperformance with respect to the index over a given observation period. The efficient frontier for this problem can be easily computed with standard LP solvers. We describe interesting theoretical features of the model and we present some experimental results for well-known financial data sets showing promising out-of-sample performance.

2 - Portfolio selection model based on technical, fundamental and market value analysis

Tea Poklepovic, Faculty of Economics Split, Domovinskog rata 54, 21000, Split, Croatia, tpoklepovic@net.hr, Branka Marasovic, Zdravka Aljinovic

The aim of this paper is to develop decision-making model for selecting optimal portfolio in stock exchange based on technical and fundamental analysis. In the first step of the model the set of stocks are selected based on technical analysis. In the second step optimal portfolio will be formed from selected stocks using multi criteria method. The method is based on PROMETHEE II approach and different accounting criteria and those based on market values are used. The selected model has been applied in Zagreb Stock Exchange (ZSE) as a real case.
3 - Computing the Nondominated Surface in Tri-criterion Portfolio Selection

Ralph E. Steuer, Terry College of Business, University of Georgia, Department of Banking and Finance, Brooks Hall, 30602-0253, Athens, GA, United States, rsteuer@uga.edu

Motivated by the desire to extend Markowitz portfolio selection to an additional linear criterion (dividends, etc.), we demonstrate an exact method for computing the nondominated set of a tri-criterion program that is all linear except that one of its objectives is to minimize a convex quadratic function. With the nondominated set of the resulting program being a surface composed of curved platelets, a multi-parametric algorithm is devised for computing the platelets so that they can be graphed precisely. In this way, graphs can display all tri-criterion nondominated solutions at one time.

4 - Portfolio rebalancing with an investment horizon and transaction costs

J. E. Beasley, Mathematical Sciences, Brunel University & JB Consultants, Department of Mathematical Sciences, Kingston Lane, UB8 3PH, Uxbridge, Middlesex, United Kingdom, john.beasley@brunel.ac.uk

We consider the problem of rebalancing an existing financial portfolio, where transaction costs (fixed and/or variable) have to be paid if we change the amount held of any asset. We indicate the importance of the investment horizon when rebalancing such a portfolio and illustrate the nature of the efficient frontier that results when we have transaction costs. We model the problem as a mixed-integer quadratic program with an explicit constraint on the amount that can be paid in transaction cost. Results are presented for the solution of test problems involving up to 1317 assets.

3 - Information acquisition of new technology for maintenance and replacement investment decisions

Thomas Yeung, Department of Industrial Engineering & Automatic Control, Ecole des Mines de Nantes / IRCCyN, 4, rue Alfred Kastler B.P. 20722, La Chantrerie, 44407, Nantes, France, thomas.yeung@emn.fr, Khaib Nguyen, Bruno Castanier

An important mission of managers is to determine the maintenance and replacement investment plan for equipment under technological evolution. The arrival time and profitability of new technology are uncertain; however information on this process may be acquired. We formulate a partially observable Markov decisions process to decide whether to obtain additional information as well as the action for the asset (wait, maintain, replace) based on its state and the information available on new technology. We provide structural properties of the optimal policy as well as numerical examples.

4 - One approach to reduce some aspects of costs associated with long term care

Patricia Herranz, Economy, Quantitative Methods and Economic History, Universidad Pablo de Olavide, Ctra. Utrera km 1, 41013, Seville, Spain, pherpei@upo.es, Ana M. Martin Carballo, M. Manuela Segovia-Gonzalez, Guerrero Flor

New technological and scientific advances have allowed that in some countries increases life expectancy but, unfortunately longevity causes that many people have disabilities that limit or even make it impossible to do activities of daily living. In this paper we analyze the relationship between the different diseases and different degrees of disabilities used under Spanish law. In this way the government could implement prevention policies that reduce the costs associated with long term care and improve the quality of life of disabled people. We are using the new survey data EDAD 2008.

WB-21

Wednesday, 10:30-12:00

RB-2115

Data Analysis in the Financial Sector

Stream: Numerical Methods in Finance

Invited session

Chair: Patricia Herranz, Economy, Quantitative Methods and Economic History, Universidad Pablo de Olavide, Ctra. Utrera km 1, 41013, Seville, Spain, pherpei@upo.es

1 - Sampling Frequency and Stochastic Diffusion Processes of Term Structure of Interest Rates and Exchange Rates

A. Can Inci, College of Business - Finance, Bryant University, 1150 Douglas Pike, 02917, Smithfield, RI, United States, ainci@bryant.edu

Recent studies conjecture that higher frequency data provide a better separation of continuous and jump components of a dynamic process. Stochastic processes such as jumps may not be fully utilized since they may be smoothed out with low frequency monthly or quarterly data. This study examines a sophisticated multi-country multi-state nonlinear stochastic model along with affine versions in the context of sampling frequency. Empirical performances of the models are documented and compared across models and across sampling frequencies.

2 - Seasonal allocation decision based on a multi-objective optimization

Fellipe Santos, UFMG, 30580530, Belo Horizonte, Brazil, fellipe.santos@cemig.com.br, Adriano Lisbou, Douglas Vicencio, Rodney Saldanha, Marcus Lobato

This paper discusses and formulates a simplified model of the Brazilian energy market, from where a bi-criterion optimization problem for revenue and risk is derived in order to define optimal portfolios. The resulting problem is a sub-differentiable analytical problem with guarantees to be solved to optimality by cutting-plane methods. Some case studies are presented in order to test the formulation using the ellipsoidal algorithm.

WB-22

Wednesday, 10:30-12:00

RB-2117

Fuzzy Optimization

Stream: Fuzzy Optimization - Systems, Networks and Applications

Invited session

Chair: Erik Kropat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.kropat@unibw.de

Chair: Yoshiki Uemura, 655-1, Yuraki, Kawanashichou, Shikigun, 636-0202, Nara, Japan, 636-0202, Nara, uemurr742@yahoo.co.jp

Chair: Kateryna Pereverza, Students Science Association, National Technical University of Ukraine, Kyiv, Scherbakova str., 42/44, app. 54, Kyiv, Ukraine, pereverza.kate@gmail.com

1 - Involving fuzzy orders for multi-objective linear programming

Olga Grigorenko, Mathematics, University of Latvia, Zellu Street 8, LV-1002, Riga, Latvia, ol.grigorenko@gmail.com

In our work we propose to involve fuzzy order relations for solving MOLP problems. We use fuzzy orders to describe the objective functions. Further the global fuzzy order relation is constructed by aggregating the individual fuzzy order relations. Thus the global fuzzy relation contains the information about all objective functions. In our approach we can naturally use compensatory aggregation functions and even more we can use weights to show the preference of objective functions. This work is supported by ESF project 2009/0223/1DP/1.1.1.2.0/09/APIA/VIAA/008.

2 - Forecasting Enrollments Based on Particle Swarm Optimization and Neural Network Based Fuzzy Time Series

Ozer Ozdemir, Statistics, Anadolu University, Anadolu University Faculty of Science, Department of Statistics, Eskisehir, Turkey, ozeroxodemir@anadolu.edu.tr, Memmedaga Memmedli
Many forecasting studies used enrollments of the University of Alabama to show comparison results easily by applying the concept of fuzzy time series. So, in this paper, a forecasting study based on fuzzy time series and particle swarm optimization is presented to find the proper model for this data set. Also, a new approach for neural network based fuzzy time series is taken into account for forecasting because of neural networks’ capabilities in handling nonlinear relationships. All results are compared with other studies proposed in the literature to show the performances of all models.

3 - Selection of appropriate smoothing parameter for different sample size in nonparametric fuzzy local polynomial models
Munevvere Yildiz, Statistics, Anadolu University, Turkey, munevvere@hotmail.com, Memmedaga Memmedli

In this paper, we considered the relationship between the smoothing parameter value and sample size as a simulation study in nonparametric fuzzy local polynomial regression. For this aim, we developed fuzzy version of generalized cross-validation criteria (GCV) for selecting smoothing parameter in nonparametric fuzzy local polynomial models. The appropriate smoothing parameters are selected by GCV criteria for different sample size and then performances of the models are compared using these appropriate smoothing parameters with sample sizes.

4 - Dynamic Clustering to Improve Marketing Decisions in Retail Stores
Richard Weber, Department of Industrial Engineering, University of Chile, Republica 701, 2777, Santiago, Chile, rweber@dii.uchile.cl, Georg Peters

Clustering is a common technique for customer segmentation. In real-life situations, however, customer behavior changes over time and so do customer segments. We present a methodology for dynamic rough clustering and apply it to synthetic as well as to purchase data from a retail store. Comparing clustering techniques reveals the advantages of the dynamic approach in capturing the nuance of the consumer behavior.

We investigate a class of variable metric techniques to solve a convex constrained optimization problem. We investigate squared Hessian metrics induced Legendre type functions and we characterize the geodesics of this kind of manifold. We propose a family of gradient-like algorithms for constrained optimization based on linear search along the geodesics. We are particularly interested in finding conditions ensuring value convergence. We present two alternative characterizations for this algorithm and we introduce a sort of duality scheme based on Legendre change of coordinates.

3 - Convergence of the coupling of an inexact generalized proximal algorithm with barrier methods
Julio López, Matemática, Universidad Técnica Federico Santa María, Av. Vicuña Mackenna 3939, San Joaquín, Santiago, Metropolitana, Chile, julio.lopez@usm.cl

Here, we introduce a barrier-type penalty for the nonlinear inequality constraints, then endowing the linear equality and conic constraints with the Riemannian structure induced by the Hessian of an essentially smooth convex function, and finally considering the flow generated by the Riemannian penalty gradient vector. We investigate the well-posedness of the resulting ODE and we prove that the value of the objective function converges to the optimal value. This convergence is extended to the sequences generated by a coupling of a generalized proximal method with parametric barrier schemes.

4 - Solving Network Flow Problems with General Non-Separable Convex Costs using a Two-phase Gradient Projection Algorithm
Kwong Meng Teo, Industrial & Systems Engineering, National University of Singapore, Singapore, kwongmeng@alum.mit.edu, Trung Hieu Tran

We propose an algorithm to solve network flow problems with generalized non-separable convex costs — problems often encountered in practical applications such as multi-commodity flows, traffic assignment and telecommunications problems. The algorithm can be implemented using general solvers such as CPLEX. Finally, we evaluate and compare the performance of the algorithm with other common approaches, using several industrial size problems.

**WB-24**
Wednesday, 10:30-12h00
CC-A11
Data Mining in Early Warning Systems
Stream: Data Mining in Early Warning Systems

**Invited session**
Chair: Antonio Rodrigues, CIO-FCUL, University of Lisbon, Edificio C6, Campo Grande, 1749-016, Lisboa, Portugal, ajrodrigues@fc.ul.pt

1 - Detection of seasonal changes in climate data by comparative analysis; A case study for Turkey
Tiyat Akal, Statistics, Middle East Technical University, Turkey, tiyat.210@yahoo.com.tr, Fidan Fahmi, Elcin Kartal Koc, Vilda Purutcuoglu Gazi, Cem Iyigun, Ceylan Yozgatligil, Inci Batmaz

In this study, we consider to investigate plausible climate changes in Turkey by clustering techniques implemented in data mining field. For this purpose we choose a homogenous set of stations from the Central Anatolia region. We apply bi-plot, SAMMON mapping, fuzzy, k-means, and hierarchical clustering methods for benchmark meteorological variables monthly recorded in Turkey. We evaluate the results in two periods: i) from 1950 to 1980 and from 1980 to 2010 separately, ii) from 1950 to 2010 together. We also use paired statistical tests to detect seasonal changes in these periods.

2 - Developing precipitation models for continental central Anatolia, Turkey
Fulya Aykan, statistics, METU, atapark mah. 1335 sok., 23/16 atapark Açıkören, ankara, Turkey, e123082@metu.edu.tr, Elcin Kartal Koc, Ceylan Yozgatligil, Cem Iyigun, Vilda Purutcuoglu Gazi, Inci Batmaz
Precipitation models help for deciding future scenarios of early warning systems for droughts. In this study, we develop precipitation models of continental central Anatolia, where drought has been a recurrent phenomenon for the last several decades. In the study, the monthly precipitation is modeled by using Time Series Regression and Multivariate Adaptive Regression Splines methods using 13 regressor variables such as monthly mean pressure, monthly mean humidity, monthly mean vapor pressure and some temperature indices, measured for 30 years period (1980-2010).

3 - New statistical methods for climate change investigations
Gregory Gurevich, Industrial Engineering and Management, SCE - Shamoon College of Engineering, Balik Bazel, 84100, Beer Sheva, Israel, gregory@sece.ac.il, Yossi Hadad

The main goal of this study is to present and apply recently developed nonparametric change point detection and estimation techniques for confirming patterns of regional changes in temperature. Utilizing these methods, monthly temperatures (mean, mean maximum, mean minimum) and diurnal temperature ranges in different regions of Israel have been investigated over a period of 37-years, (1967-2003). Monte Carlo experiments were carried out to obtain the p-values of the proposed tests. The results were supported also by traditional statistical methods.

4 - Surveillance and security risk minimization in ports
Antonio Rodrigues, CIO-FCUL, University of Lisbon, Edificio C6, Campo Grande, 1749-016, Lisboa, Portugal, ajrodrigues@fc.ul.pt

The protection of physical infrastructures from terrorist/criminal attacks or from natural/technological disasters heavily relies on early warning detection capabilities from sensor networks. For ports and harbours, surveillance optimization is an especially complex problem, and different types of sensors should be used complementarily. We discuss how the cost vs. risk optimization of solutions can be supported by the estimation of response surfaces.

Our daily lives are facilitated by an increasing number of electric appliances. However using electricity as two implications: a real time balance between total supply and demand, and a high environmental impact. In the transition toward sustainable energy systems smart grids have the potential to transform balancing with responsive demands and to enable higher shares of renewables. Including these operational advantages in long term model is challenging. This communication describes a methodology to quantify the long term impact of smart grid on future prospects for the electricity sector.

3 - Towards Interactive Urban Planning with Local Search Techniques
Bruno Belin, LINA, France, bruno.belin@univ-nantes.fr, Marc Christie

The task of urban planning consists in the spatial organization of the various blocks, referred to as urban forms, that constitute a city (residential, commercial, industrial, ...). The spatial organization is guided by a collection of rules related to environmental, social, transportation, and energy questions. We propose a tool assist designers in this task by modeling the problem as a local search optimisation task. To achieve large-scale interactive editing, we introduce a dynamic list of banished candidates and demonstrate its effectiveness to reduce the exploration of neighborhoods.

4 - Sustainable development and territory planning: a prospective approach to rethink cities
Steve Lechevalier, Center for applied Mathematics, Mines ParisTech, 1 rue claude Daunesse, 06560, Sophia Antipolis, France, steve.lechevalier@mines-paristech.fr, Sandrine Selosse

The "serious game" ECOTYPE aims to help cities to communicate about issues of land use in a fun and interactive form. This is to design and implement an interactive device involving prospective and representations of local development plan in an immersive space where the public is invited to play the future of its territory. In a geodesic room, the public will make choices about land use thanks to an interface. Then, consequences will be represented in the present and the future thanks to lights and sound.

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**WB-25**

**Wednesday, 10:30-12h00**

**CC-A23**

**Smart cities and Smart grids**

*Stream: Long Term Planning in Energy, Environment and Climate*

*Invited session*

Chair: **Edi Assoumou**, Centre de Mathématiques Appliquées, Mines ParisTech, Sophia Antipolis, France, ed.assoumou@cmi.ensmp.fr

1 - Demand response in smart grid systems
Abhilasha Aswal, Information Technology, International Institute of Information Technology Bangalore, India, abhilasha.aswal@iiitb.ac.in, Sunil Kumar Vuppala, G. N. Srinivasa Prasanna

The general optimization problem in a smart grid system with demand/price uncertainty is a min-max problem. In the presence of demand response (DR) mechanisms, we show that if all the appliances on the grid are controllable, then the optimizations are polynomial time linear minimizations. We discuss algorithms to find the optimal solution in both the general case and DR case. We also discuss algorithms for cases where only a subset of appliances can be controlled - the number of uncertain variables is reduced but not eliminated completely. Our results are based on both analysis and simulation.

2 - Smart grids and prospective modeling for the electricity sector
Stephanie Bouckaert, Center for applied Mathematics, Mines ParisTech, 06560, Sophia Antipolis, France, stephanie.bouckaert@mines-paristech.fr, Edi Assoumou, Nadia Maizir

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**WB-26**

**Wednesday, 10:30-12h00**

**CC-A24**

**Multi-Criteria Decision Making and Applications 1**

*Stream: Multi-Criteria Decision Making and Environmental Management*

*Invited session*

Chair: **Marta Castilho Gomes**, CESUR, Instituto Superior Técnico, Av. Rovisco Pais, 1049-001, Lisboa, Portugal, marta.gomes@ist.utl.pt

1 - On the generation of positional voting systems with variable scores
Bonifacio Llamazares, Economía Aplicada, Universidad de Valladolid, Avda. Valle de Esgueva 6, 47011, Valladolid, Spain, boni@eco.uva.es

Scoring rules are a well-known class of positional voting systems where fixed scores are assigned to each candidate and avoid some shortcomings of the methods proposed in the literature.
2 - Rank-scaled Integral Indicators of Ecological Impact
Mikhail Kuznetsov, Moscow Institute of Physics and Technology, Russian Federation, mikhail.kuznetsov@phys-tech.ru

To compare objects or alternative decisions one must evaluate a quality of each object. An integral indicator is a real-valued scalar which is correspondent to the object. We can construct an integral indicator having a set of objects and features and a quality criterion. We use the set of features and expert-given indicators in the rank scales. That is, every object is ranked by the certain feature. We consider every rank-scaled feature as a polyhedral cone. To find final ranking we use Minkowski sum of these cones. This methodology is used for the Croatian Thermal Power Plants evaluation.

3 - Fast order recommendation separately for each explicit customer of large product system
Peter Vojta, Software Engineering, Charles University, Faculty of Mathematics and Physics, Malostranske nam. 25, 118 00, Prague, Czech Republic, vojta@kni.mff.cuni.cz, Alan Eckhardt

Our motivation is a personalized recommendation for a web based e-shop (no aggregated advices like average user, most popular ...). Our interest is in support of big number of users (considered individually) for big number of alternatives (usually simple completely described products - not easy in web scaled applications). Our input is explicit user rating of a sample of products. We propose a data mining method, which based on sample rating, predicts rating (order) of all products. We calculate user’s personal objectives and utility and output top-k recommendations. We evaluate our experiments wrt. speed (usually < 1 sec.) and order violations (e.g. Kendall tau rank).

4 - A bi-objective linear programming model for hazardous medical waste management
Marta Castilho Gomes, CESUR, Instituto Superior Técnico, Av. Rovisco Pais, 1049-001, Lisbon, Portugal, marta.gomes@ist.utl.pt, Joaquim R. Duque

Interest in medical waste management has raised in recent years across Europe. In this work a bi-objective mixed-integer linear programming model for hazardous medical waste (HMW) management is presented. It accounts for construction and operating costs of facilities (either for waste decontamination or incineration), transportation costs and the environmental assessment of solutions using the Eco-indicator 99 methodology. The problem of expanding the HMW incineration capacity in Portugal is addressed and real data used for an economic-environmental trade-off analysis (with a Pareto curve).

[WB-27]
Wednesday, 10:30-12h00
CC-A25
Web-based Spatial-temporal Collaborative Decision Support Systems
Stream: Decision Support Systems
Invited session
Chair: Fatima Dargam, SimTech Simulation Technology, Ries Strasse 120, 8010, Graz, Austria, F.Dargam@SimTechnology.com

1 - Scalarising methods in DSS WebOptim
Vassil Guliashki, Optimization and Decision Making, Inst. of Information and Communication Technologies - BAS, Acad. G. Bonchev str., block 2, 1113, Sofia, Bulgaria, vggul@yahoo.com, Leoneda Kirilov, Krassimira Genova, Boris Staykov

We present a Decision Support System for solving Multiple - objective Optimization Problems. Its basic characteristics are: user-independent, multisolver-admissibility, method-independent, heterogeneity, and web-integrability. We utilize a general-ized method including most MOP methods — reference point approach, reference direction approach, interval approach and etc. The choose of suitable scalarising function is made automatically depending on the Decision Maker’s dialog. The system provides an API interface for external use by third party developers.

2 - A Smuggling Game with the secrecy of smuggler's information
Ryusuke Hohzaki, Department of Computer Science, National Defense Academy, 1-10-20 Hashirimizu, 239-8686, Yokosuka, Kanagawa, Japan, hohzaki@cc.nda.ac.jp

This report deals with a two-person zero-sum multi-stage smuggling game. Customs and a smuggler are allowed to take an action of patrol and smuggling, respectively, within the limited number of chances. Customs obtains reward by the capture of the smuggler and the smuggler gets reward by the success of smuggling. Almost all past researches modeled their games by complete information. In this paper, we deal with a game with asymmetric information, where only Customs does not know past behavior of his opponent. We evaluate the value of information by deriving Bayesian equilibrium.

[WB-28]
Wednesday, 10:30-12h00
CC-A27
OR Military and Security Applications
Stream: OR in Military, Safety and Security Applications
Invited session
Chair: Ana Isabel Barros, Military Operations, TNO, POBox 96864, 2509 JG, The Hague, Netherlands, ana.barros@tno.nl

1 - Interdiction in queueing networks
Tom van der Mijden, Twente University, Netherlands, t.l.c.vandermijden@student.utwente.nl

In the literature on network interdiction focus is on time independent models, although one can imagine situations in which a successful interdiction can only take place in certain time windows. In our research we will consider time dependent network interdiction by considering an interdiction game played on a network of queues. An operator routes customers through the network towards a destination, while an interdictor attempts to intercept these customers during their service times at the queues. We analyze optimal strategies for both the operator and the interdictor.

2 - A Smuggling Game with the secrecy of smuggler’s information
Ryusuke Hohzaki, Department of Computer Science, National Defense Academy, 1-10-20 Hashirimizu, 239-8686, Yokosuka, Kanagawa, Japan, hohzaki@cc.nda.ac.jp

This report deals with a two-person zero-sum multi-stage smuggling game. Customs and a smuggler are allowed to take an action of patrol and smuggling, respectively, within the limited number of chances. Customs obtains reward by the capture of the smuggler and the smuggler gets reward by the success of smuggling. Almost all past researches modeled their games by complete information. In this paper, we deal with a game with asymmetric information, where only Customs does not know past behavior of his opponent. We evaluate the value of information by deriving Bayesian equilibrium.
1 - Feature Ranking for Support Vector Machines with Second-Order Cone Programming
Sebastián Maldonado, School of Engineering and Applied Sciences, Universidad de los Andes, Av. San Carlos de Apoquindo 2200, Las Condes, Santiago, Chile, smaldonado@uandes.cl

This work addresses the issue of feature ranking for linear and kernel-based SVMs considering Second Order Cone Programming formulations. These formulations provide a robust and efficient framework for classification, while an adequate feature selection process avoids errors in estimation of mean and covariances. Our approach is based on a sequential backward elimination, proposing different contribution measures to determine the feature relevance. Experimental results on real life microarray data sets demonstrate the effectiveness and efficiency of our approach.

2 - A collaborative recommendation using edge weighted SimRank
Ayaka Inoue, Graduate School of Science and Technology, Sophia University, Kiiro-cho 7-1, Chiyoda-ku, 1028554, Tokyo, Tokyo, Japan, ayaka.inoue@sophia.ac.jp, Yuichiro Miyamoto

We deal with a recommendation method based on the collaborative filtering. Our recommendation approach is an elementary one based on voting by similar customers. We adopt BipartiteSimRank as a measure of similarities between customers (items). Our main contribution is an extension of SimRank by introducing edge weights for practical use in electric commerce. We also report a computational result using a real life data that includes a purchase history, personal information and site accesses of each customer.

3 - An Adaptive Weighted Kernel Technique for Online Training with Imbalanced Data
Theodore Trafalis, Industrial Engineering, University of Oklahoma, 202 West Boyd, Rm 124, 73019, Norman, OK, United States, ttrafalis@ou.edu, Nicolas Couellan

Kernel methods are widely useful for data classification problems. In the case of imbalanced datasets kernel techniques perform poorly in predicting the minority class for imbalanced data. Imbalanced datasets exist in several application areas such as medical diagnosis problems. We develop an incremental weighted scheme of classifying imbalanced data online and provide computational results for several imbalanced data sets. Our results show that the proposed incremental scheme outperforms a batch version of weighted SVM both in terms of minority class prediction accuracy and training speed.
DEA and Performance Measurement: Applications 5

Stream: DEA and Performance Measurement (contributed)

Contributed session

Chair: Sanjeet Singh, Operations Management, Indian Institute of Management Calcutta, DH Road, Joka, 700104, Kolkata, West Bengal, India, sanjeet@iimcal.ac.in

1 - Measuring Team Performances

Kei Ogawa, Operating Research, 84-4 Aza Ebinkuchi Tsuchiya, 015-0055, Yurihonjo City, Japan, d12s005@akita-pu.ac.jp, Tsutomu Mishina, Alejandra Gomez Padilla

Teams are organized at any given time to pursue high levels of output in common business settings. Forming an effective team depends on who is involved in it and how the results can be evaluated as the final team outputs. Each employed member brings the necessary skills to the team to accomplish individual targets. Generally teams have multiple targets, and the team success rests on how to deploy suitable combinations of the members’ skills; these issues are treated as team functions. Managing a team is another factor to success. Considering jointly team functions and management is required.

2 - Group cohesion and organizational performance

Cristina-Petronela Durneac, Sociology, S.N.S.P.A., Romania, cristina_durneac@yahoo.com

This paper aims to make a contribution to understanding the level of cohesion and performance in economic and financial organizations in Romania. The analysis was performed in 12 economic and financial organizations from Bucharest. Based on quantitative data obtained from an organizational survey, the general goal of the research is to make a contribution to the in-depth exploration, better understanding and explanation of the existence and the importance of group cohesion on organizational performance.

3 - DEAHP Approach for Manpower Performance Evaluation

Sanjeet Singh, Operations Management, Indian Institute of Management Calcutta, DH Road, Joka, 700104, Kolkata, West Bengal, India, sanjeet@iimcal.ac.in, Remica Aggarwal

The manpower in a company or organization constitutes an important and essential asset to an organization. In this paper we have integrated DEA to generate local weights of alternatives from pairwise comparison of judgment matrix used in the Analytic Hierarchy Process (AHP) for a three attribute system for measuring performance of manpower at different levels of managerial hierarchy. Multiple expert judgments have been considered for weight determination of the attributes. DEA-AHP (DEAHP) has been proposed in this paper as an alternative to the traditional methods of weight derivation in AHP.

OR in Sustainable Urban Development

Stream: OR for Sustainable Development

Invited session

Chair: Vida Maliene, School of the Built Environment, Liverpool John Moores University, Byrom Street, L3 3AF, Liverpool, United Kingdom, v.maliene@ljmu.ac.uk

1 - Sustainable and healthy housing: exploring stakeholders’ views

Agne Prochorskaitė, School of the Built Environment, Liverpool John Moores University, Liverpool John Moores University, Byrom Street, L3 3AF, Liverpool, United Kingdom, A.Prochorskaitė@2009.ljmu.ac.uk, Vida Maliene

Sustainable housing policy and initiatives need greater alignment with health and well being agenda. However, implementation of this is a highly complex problem as multiple objectives and different stakeholders’ views need to be considered. The paper presents a sustainable and healthy housing criteria system based on a comprehensive review of existing codes, standards and literature on housing and health. The aim of this is to allow evaluation and ranking of dwellings according to different stakeholder priorities of sustainability, health and well-being housing features.

2 - Development of a multicriteria model for comprehensive assessment of residential units

Jana Selih, Department of Civil and Geodetic Engineering, University of Ljubljana, Jamova 2, 1000, Ljubljana, Slovenia, jana.selih@ffg.uni-lj.si

The change of the buyers’ position in the current economic recession conceived a need for a tool used to assess various features of the residential unit, and make the decision regarding the purchase on a rational basis. The proposed model is based on five main criteria: location, architectural design, technical quality, living comfort and energy efficiency. The sub-criteria enable thorough but still robust description of the property of the unit. The applicability of the proposed model is exhibited by the parametric analysis, where different units within Slovenian territory are assessed.

3 - Sustainable development problems of the apartment policy in Latvia

Sanda Geipele, Riga Technical University, Mezha Street 1/7, 212 room, LV-1048, Riga, Latvia, sanda_geipele@inbox.lv, Ineta Geipele, Iveta Stamure

The aim of the research is to state the problems of the Social economic environment within the apartment policy in Latvia. Results discovered would be the foundation for elaborating the optimisation of dwelling technologies. The mathematical, monographic and statistical forecast methods were applied. The general evaluation of economical and ecological situation of two housing funds and technologies of the dwelling houses elaborated with defining principles of rent price forming justifies chances of the sustainable development of social economic environment in Latvia.

4 - Model for municipal real estate strategic management

Egl Klumbyt, Department of Civil Engineering Technologies, Kaunas University of Technology, Krasavskio 30-25, LT-50280, Kaunas, LITHUANIA, Lithuania, egleklumbyte@gmail.com, Rasa Apanavičienė

Municipalities are usually the largest real estate owners and managers. Only about 30% of major European cities are able to provide amount and value of their real estate portfolios. The Lithuanian Free Market Institute has introduced its first Index of Municipalities in Lithuania and states, that none of the Lithuanian municipality has been developed its real estate management strategy. The article presents the new model helping to manage municipal real estate management effectively by taking into account the priorities of strategic economic and social development tendencies of the region.

Games and decision making

Stream: Cooperative Game Theory

Invited session

Chair: Sirma Zeynep Alparslan Gok, Mathematics, Faculty of Arts and Sciences, Suleyman Demirel University, Faculty of Arts and Sciences, Suleyman Demirel University, Department of Mathematics, 32260, Isparta, Turkey, zeynepalparslan@yahoo.com
1 - Coalition formation in a bargaining game with a fixed payments contract and delegation

Haruo Imai, KIER, Kyoto University, Yoshida HOmittachi, Sakyo, 606-8501, Kyoto, Japan, imai@kier.kyoto-u.ac.jp

Coalition formation for bargaining is examined when coalitional contracts are limited to delegation to a member in return of fixed payments (adopted in the uniqueness literature). Specifically, SSPE of three stage games (coalition formation, coalitional bargaining, and bargaining game) are investigated. Such equilibria exist and nontrivial coalition structures emerge. We show that for order-independent equilibria, the softest player tends to be favored, but such equilibria may not exist, by means of a CRRA example. Iterating above stages, also we show that a nested coalition structure emerges.

2 - The impact of issue salience and distance in probabilistic spatial voting indexes

Tom Blockmans, MOSI, Vrije Universiteit Brussel, Pleinlaan 2, 1050, Brussel, Belgium, tblockma@vub.ac.be, Frank Plastria, Stefano Benati, Giuseppe Viitucci Marzetti

We present a generalization of a probabilistic spatial voting index. The impact of the distance function on the results of the model is examined, comparing between (squared) Euclidean and Manhattan distance. A distinction is made between the results that are weighted and unweighted by issue salience, representing the parties’ policy priorities. Instead of using the bliss points of the parties as a proxy for the coalition, we use an alternative method for estimating the coalition consensus. Empirical applications illustrate the influence these three factors have on the voting indexes.

3 - Blocks of flats renovation game

Agne Reklaitė, Vilnius University, Lithuania, agne.reklaitė@mif.vu.lt

In this paper a renovation of blocks of flats is studied. A game is constructed, which allows government to organise full-scale renovation, effectively use the resources of residents and have relatively low government expenses on renovation. In the presented game the decisions of individual residents lead to an efficient equilibrium. Vilnius’ central heating data is analysed and optimal strategies are built for residents of several types of apartment blocks. The results indicate that residents’ decisions highly depend on the expected heating price but may be influenced by other factors.

4 - On the interval Shapley value: two new characterizations

Sirma Zeynep Alparslan Gok, Mathematics, Faculty of Arts and Sciences, Suleyman Demirel University, Faculty of Arts and Sciences, Suleyman Demirel University, Department of Mathematics, 32260, Isparta, Turkey, zeynepalparslan@yahoo.com

The Shapley value, one of the most common solution concepts in Operations Research applications of cooperative game theory, was defined and axiomatically characterized in different game-theoretic models. In this study we focus on the Shapley value for cooperative games where the set of players is finite and the coalition values are compact intervals of real numbers. We give two new characterizations of the interval Shapley value with the aid of the properties of efficiency, symmetry and strong monotonicity and by using interval dividends.

1 - Solving Constraint Programming problems with AIMMS

Guido Diepen, AIMMS, Schipholweg 1, 2034 LS, Haarlem, Netherlands, Guido.Diepen@AIMMS.com

Besides the support for the traditional Mathematical Programming like (Non-)Linear Programs and Mixed Integer Programs, AIMMS now also supports Constraint Programming (CP). Typically CP performs very well on highly combinatorial problems, which can be difficult to model/solve with mathematical programming. AIMMS supports both common global constraints from CP (e.g., count/alldifferent), as well as specific scheduling constraints, which are useful when modeling scheduling problems in AIMMS.

2 - LocalSolver: black-box local search for combinatorial optimization

Julien Darlay, e-lab, Bouygues SA, 32 avenue Hoche, 75008, Paris, France, jdarlay@bouygues.com, Thierry Benoist, Bertrand Estellon, Frédéric Gardi, Romain Megel, Karim Nouioua

We present LocalSolver 2.0, a black-box solver for combinatorial optimization based on local-search techniques. It can handle very large nonlinear problems with millions of 0-1 variables on a standard computer. LocalSolver offers simple APIs as well as an efficient modeling language for fast prototyping. It has been tested on classical benchmarks and succeeded the first phase of Google ROADFE/EURO challenge. Moreover LocalSolver is used in several industrial applications: maintenance planning, energy optimization, TV media planning.

3 - Deploying MPL Optimization Models on Servers and Mobile Platforms

Bjarni Kristjansson, Maximal Software, Ltd., Boundary House, Boston Road, W7 2QE, London, United Kingdom, bjarni@maximalsoftware.com, Sandip Pindoria

The IT industry is currently undergoing a major shift, away from traditional standalone applications, to new platforms such as tablet computer and mobile phones. In this presentation, we will demonstrating for the first time, a new server-based version of MPL OptiMax, that makes writing mobile applications relatively quick and easy process. We will demonstrate how to integrate optimization models seamlessly with online data, and then deploying them on a server for servicing both web and mobile clients, using standard programming languages, such as CSharp, VB, C/C++ or Python.

WB-37
Wednesday, 10:30-12h00
CC-Act
OR in Health & Life Sciences 6
Stream: OR in Health & Life Sciences (contributed) Contributed session
Chair: Vassilis Kostoglou, Department of Informatics, Alexander TEI of Thessaloniki, P.O. Box 141, 57400, Thessaloniki, Greece, vkostogl@it.teithe.gr

1 - Improve OR utilization and reduce number of required beds

Theresia Van Essen, University of Twente, Netherlands, j.t.vanessen@utwente.nl, Johanan Hurink, Erwin Hans

Due to increasing health care costs, hospitals are forced to reduce the number of beds on the nursing wards while still increasing their production. In this presentation, we solve this problem by creating an operating room (OR) schedule which maximizes the OR utilization and minimizes the number of required beds. The solution approach consists of two steps: (1) generate surgery blocks that maximize OR utilization and satisfy several resource constraints and (2) assign blocks to ORs and days such that the number of required beds is minimized. The solution approach is tested on real-life data.
2 - Optimal experimental design for a pure birth process with incomplete information
Ali Eshragh Jahromi, School of Mathematical Sciences, The University of Adelaide, North Terrace Campus, 5005, Adelaide, South Australia, Australia, alie.jahromi@adelaide.edu.au

Our goal is to estimate the rate of growth of a population governed by a stochastic model. We may choose n time points at which to count the number of individuals present, but due to detection difficulties, or constraints on resources, we are able only to observe each individual with fixed probability p. We discuss the optimal times at which to make our observations in order to maximize Fisher Information. For computational and analytical reasons which will be discussed, we specifically focus on the cases n=1 and n=2, presenting both the theoretical and numerical findings.

3 - Implementation of an OR model for the comparison of higher technological education specialties
Vassilis Kostoglou, Department of Informatics, Alexander TEI of Thessaloniki, P.O. Box 141, 57400, Thessaloniki, Greece, vkostogl@it.teithe.gr, Michael Vassilakopoulos, Christos Keilias

This work focuses on the comparison of the specialties provided by the higher technological education regarding graduates’ employment status and vocational prospects. A survey OR model is introduced, consisting of original data collection from 5,183 Greek graduates corresponding to 45 specialties through a structure questionnaire and telephonic interviews. Bivariate, multivariate, and cluster analysis identified the statistically significant differences, leading to findings and providing guidelines for the selection of a field of studies that leads to a more promising professional career.

WB-38
Wednesday, 10:30-12h00
HH-Colombus

Multiobjective Optimization and Transportation

Stream: Multiobjective Optimization
Invited session
Chair: Anatoly Levchenko, Riga Technical University, 1 Kalku Street, Riga, Latvia, anatoliis.levchenkov@rtu.lv
Chair: Mikhail Gorobetz, Institute of Industrial Electronics and Electrical Engineering, Riga Technical University, 1 Kalku Street, Riga, Latvia, mihails.gorobec@rtu.lv

1 - Multi-Objective Road Pricing: A Game Theoretic and Multi-Level Optimization Approach
Anthony Ohazulike, Applied Mathematics, University of Twente, Drienerloaan 5, 7522 NB, Enschede, Netherlands, a.e.ohazulike@utwente.nl, Georg Still, Walter Kern, Eric van Berkum

Using a game theoretical approach, we develop a pricing scheme that internalizes multiple traffic externalities. Further, we extend the single authority road pricing scheme to a scheme with multiple actors/stakeholders or regions. Road users’ interests are represented in the upper and the same level as the decision makers, thus, making them active players in the toll setting game. Having shown that pure Nash equilibrium (NE) toll may not exist among the stakeholders (with likely opposing objectives), we design a mechanism that induces NE which coincides with system optimum.

2 - Multi-objective optimization with an immune algorithm for a railway safety control system
Andrew Mor-Yaroslavtsev, Riga Technical University, Kronvalda bulv.1, LV-1010, Riga, Latvia, andrejs@rtu.lv, Anatoly Levchenkov

This paper describes an immune clonal selection algorithm used together with a negative selection algorithm for use in an intelligent railway electric vehicle safety system. Embedded devices collect data about the rolling stock location and status, communicate it to the server and other devices, and use it to avoid dangerous situations. The authors examine the means of communication between the embedded devices and their effectiveness. The authors review data analysis methods used to detect, predict and control undesirable rolling stock travel conditions.

3 - A Multi-Objective Minimum Cost Flow Problem to Design Safe Walking-Routes for School Children
Ken-ichi Tanaka, The University of Electro-Communications, 1-5-1, Chofugasoka, Chofu, Tokyo, Japan, 182-8555, Tokyo, Japan, ken1tnk@se.ucc.ac.jp, Ryyuei Miyashiro, Yuichiro Miyamoto

For school children to walk safely to and from school, it is important to walk in groups, not alone. However, walking together may force children to walk longer distances than those of their shortest paths. A multi-objective minimum cost flow problem is presented in which both the total walking distance and the total distance walked alone for children are minimized. Pareto optimal solutions show that the total distance walked alone can be greatly reduced by making children slightly deviate from their shortest paths. Heuristically obtained solutions for a real road network are also analyzed.

WB-39
Wednesday, 10:30-12h00
HH-Couteau

Dynamic Programming 2

Stream: Dynamic Programming
Invited session
Chair: Martina Hesse, Chair of Production and Logistics, Georg-August-Universität Göttingen, Platz der Göttinger Sieben 3, 37073, Göttingen, Germany, Martina.Hesse@wiwi.uni-goettingen.de

1 - A Dynamic Classification and Prediction Model for Road Departure Warning Systems
Andre Possani Espinosa, Department of Digital Systems, Instituto Tecnológico Autónomo de México, Rio Hondo No.1, 01080, Mexico City, D.F., Mexico, andre.possani@itam.mx, Marta Cabo Nodar, Edgar Possani

One of the main tasks identified in the SAFESPOT IP Project, co-funded by the European Union, was the development of a Road Departure Prevention Application. This application relies on the identification and prediction of vehicle trajectories in order to provide advance warnings to drivers and therefore prevent deadly road accidents. Continuing with this work, we will present an application of a dynamic adaptive model evaluated with real and simulated data. Results obtained are compared with previously implemented techniques.

2 - Some applications of Optimal Control in Sustainable Fishing in the Baltic Sea
Dmitry Stukalin, Universität Greifswald, Greifswald University, Rathenau-Str. 47, 17489, Greifswald, Germany, dimidron85@rambler.ru
Problems related to the implementation of optimal control theory for the three-dimensional dynamic model cod-herring-sprat (the fish populations management problem) are presented. They belong to a class of models called Lotka-Volterra models influenced by several natural processes and human activities. Interacting species, which inhabit in a common habitat with limited resources, will be considered. The problem of optimal harvest policy is solved for the controls of various classes and their behaviour is analyzed.

3 - Supporting Tailor-made Performance Management Systems by System Dynamics — A Multiple Criteria Based Software Evaluation

Wolfgang Ossadnik, Department Business Management / Managerial Accounting, University of Osnabrueck, Rolandstrasse 8, 49069, Osnabrueck, Germany, wolfgang.ossadnik@uni-osnabrueck.de, Ralf Kaspar

A fundamental task of Management Accounting is the development, implementation and continuous improvement of Performance Management Systems (PMS). These can be visualized by strategy maps which link key performance indicators according to relevant cause-and-effect relationships. Based on the dynamic character of PMS the use of System Dynamics (SD) is necessary to take into account temporarily delaying and retroactive influences. In our study, we show the process of dynamic modeling in performance management as well as the results of a multi-criteria evaluation of SD software products.

4 - Modeling carbon storage in cascading usage systems of wood and derived timber products

Martina Hesse, Chair of Production and Logistics, Georg-August-Universität Göttingen, Platz der Göttinger Sieben 3, 37073, Göttingen, Germany, Martina.Hesse@wiwi.uni-goettingen.de, Jutta Geldermann

The carbon storage period of forests can be extended by a material use of wood and derived timber products: the storage effect of forests is continued in wooden products. A serial connection of multiple material applications including re- and upcycling loops with a final energetic use describes the idea of cascading biomass resources. Relevant parameters and data sources for modeling carbon flows and sinks are presented and the adequacy of multi-agent and dynamic system modeling approaches is discussed.

WB-40

Wednesday, 10:30-12h00
HH-Livingstone

Preference Learning 5

Stream: Preference Learning
Invited session

Chair: Willem Waegeman, Department of Applied Mathematics, Biometrics and Process Control, Ghent University, Coupure links 653, 9000, Ghent, Belgium, willem.waegeman@ugent.be

1 - Preference-based reinforcement learning
Weiwei Cheng, Mathematics and Computer Science, University of Marburg, Germany, roywchng@gmail.com

We discuss the integration of two sub-fields of machine learning, namely preference learning and reinforcement learning (RL). While conventional RL methods are restricted to deal with numerical rewards, in many applications the feedback signals are qualitative but not quantitative. Therefore, building on novel methods for preference learning, we equip the RL agent with qualitative policy models. We build on an existing method for approximate policy iteration based on roll-outs and make use of a specific type of preference learning methods, the label ranking method.

2 - Preference-based policy learning
Riad Akrour, INRIA Saclay Île-de-France, 91405, Orsay Cedex, France,riad.akrour@inria.fr, Marc Schoenauer, Michèle Sebag

The expert-robot interaction is framed as a Learning-to-rank problem: the robot demonstrates a policy, that is ranked by the expert w.r.t. to previous policies. Active Ranking and Reinforcement Learning are combined: the robot learns an estimate of the expert’s preferences, and demonstrates the most informative policy w.r.t. this estimate. The difficulty comes from the fact that the preference estimate is learned from the behavioral space, while the active learning criteria are defined on the parametric space. The resulting approach is discussed w.r.t. Inverse RL on standard benchmarks.

3 - A simple algorithm for multi-label ranking
Krzysztof Dembczynski, Institute of Computing Science, Poznan University of Technology, Piotrowo 2, 60-965, Poznan, Poland, kdembczynski@cs.put.poznan.pl, Wojciech Kotlowski, Eyke Hüllermeier

We discuss the problem of rank loss minimization in the setting of multi-label classification. In this setting, the rank loss counts the number of label pairs, in which a relevant label does not precede an irrelevant label in the predicted ranking. We show that a simple algorithm that trains a binary classifier for each label independently is competitive to the more complex state-of-the-art approaches that rely on minimization of pairwise convex surrogates of the rank loss. During the talk, we will give theoretical arguments that justify this simple approach.

WB-41

Wednesday, 10:30-12h00
HH-Heyerdahl

System Dynamics: demographics and methodology

Stream: System Dynamics Modeling and Simulation
Invited session

Chair: David Wheat, Geography, University of Bergen, Nedre Fjellsmug 6, 5018, Bergen, Norway, david.wheat@uib.no

1 - A Simulation Model of Demography & Economy in Lithuania
David Wheat, Geography, University of Bergen, Nedre Fjellsmug 6, 5018, Bergen, Norway, david.wheat@uib.no

Lithuania’s shrinking labor force is a much-discussed result of emigration and more deaths than births. Yet, the long-run macroeconomic scenario is uncertain. If demographic dynamics prove problematic for economic growth, the reinforcing feedback effects will further discourage family formation and encourage emigration—a vicious circle. Will counteracting feedback effects be strong enough to avoid economic stagnation? This paper examines this question with a system dynamics model that integrates cross-disciplinary theories with data from Lithuania’s economy and demography.

2 - A Simulation-based Analysis of Trends in Immigration and Crime
Richard McDowall, University of Bergen, Vilhelm Bjerknesvei 57, 5081, Bergen, Norge, Norway, richard.mcdowall@gmail.com

The connection between immigration and crime is a contentious issue in debates over immigration policy in European countries, in part because there is little consensus over the extent of immigrant criminality. This paper contributes an endogenous explanation of crime trends in Oslo, using a dynamic simulation model adapted from a cohort-survival model of immigrant populations and criminal behavior. The ultimate contribution of this study is the provision of a tool to aid criminal justice capacity planning and immigration policy design.

3 - Diagramming a Feedback Model of Emigration
Rasa Cincyte, University of Bergen, Norway, rasa.cincyte@gmail.com, David Wheat

Research on the emigration issue reveals the absence of a unified theory to guide data collection and analysis, as well as policy design. Recent contributions narrow this literature gap by identifying emigration drivers that cross disciplinary boundaries and form feedback loops.
This paper extends the endogenous perspective with causal loop diagramming—a system dynamics tool. Another contribution of this paper is a conceptual framework to facilitate developing a simulation model for empirically testing a unified emigration theory and policy options in the Lithuanian context.

4 - Modelling the Mechanisms of Behaviour Change at the Population level in a Social Marketing Context

Brian Dangerfield, Centre for Operations Management, Management Science & Statistics, University of Salford, Salford Business School, Maxwell Building, The Crescent, M5 4WT, Manchester, United Kingdom, b.c.dangerfield@salford.ac.uk, Norhaslinda Zainal Abidin

We need to better understand the drivers and mechanisms of population-level human behaviour change when the objective is to achieve a societal benefit. A review is made of the recent contributions which system dynamics has offered for the design, comparison and evaluation of societal policies in a social marketing context. Specifically, in the case of childhood obesity, a description is given of how a system dynamics model might be used to aid the design of policies to promote beneficial changes in eating habits.

1 - Planning Critical Resources for Offshore Oil Field Development under Uncertainty

Leonidas Sakalauskas, Operational Research, Institute of Mathematics & Informatics, Akademijos 4, LT-08663, Vilnius, Lithuania, sakal@ktl.mii.lt, Leonardo Moraes, Luiz Carlos Sousa, Roger Rocha, Adilson Elias Xavier

This work considers the problem of planning critical resources for offshore oil field development for a horizon of one year. Field development activities comprise a complex mix of resources that are interconnected in a way that their management is a challenging task due to the uncertainties of the activities durations. In an oil field development one of the key elements are the rigs, however they can only operate effectively if they are supplied by a certain amount of resources on the right time. We model this problem using stochastic programming and effectively if they are supplied by a certain amount of resources on the right time. We model this problem using stochastic programming and this significantly effects risk measures and solution algorithms. This significantly effects risk measures and solution algorithms for this kind of problem. We emphasise our results by instructive examples.

2 - A decision rule approach to medium-term hydropower scheduling under uncertainty

Paula Rocha, Department of Computing, Imperial College London, SE7 2AZ, London, United Kingdom, paula.martins-da-silva-rocha08@imperial.ac.uk, Wolfram Wiesemann, Daniel Kuhn

We present a multistage stochastic optimisation model for the medium-term scheduling of a cascaded hydropower system. Electricity spot prices change on a much shorter time scale than the hydrological dynamics of the reservoirs in the cascade. We exploit this property to reduce computational complexity: we partition the planning horizon into hydrological macroperiods, and we account for intra-stage price variability by using price duration curves. Moreover, we restrict the space of recourse decisions to those affine in the observable data, thereby obtaining a tractable approximate problem.

3 - Refinery Operations Planning under Uncertainty

Leonardo Nascimento, Federal University Rio de Janeiro, Brazil, leo_eng99@yahoo.com, Helder Venceslau, Adilson Elias Xavier, Virgilio Jose Martins Ferreira Filho, Leonidas Sakalauskas, Roger Rocha

Oil refining is a series of processes that aim to separate the crude oil into pre-standardized fractions. The way these processes can be combined result in a variety of schemes where each one can be used as a production plan. This work presents a methodology, based upon stochastic programming (SP) that support the decision makers in the mid-term operations planning of an oil refinery. Results generated by running a multi-period two-stage SP model are used to measure the impact on the economic efficiency when not considering the randomness of the demand and the receipt of crude oil.

WB-42

Energy Systems Planning

Stream: Stochastic Modeling and Simulation in Engineering, Management and Science

Invited session

Chair: Erik Kropat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neuiberg, Germany, erik.kropat@unibw.de

1 - Planning Critical Resources for Offshore Oil Field Development under Uncertainty

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WB-43

Extended Two-Stage Linear Stochastic Programs

Stream: Stochastic Programming

Invited session

Chair: Rüdiger Schultz, Mathematics, University of Duisburg-Essen, Lotharstr. 65, D-47048, Duisburg, Germany, schultz@math.uni-duisburg.de

1 - Nonlinear Two-Stage Stochastic Programs

Rüdiger Schultz, Mathematics, University of Duisburg-Essen, Lotharstr. 65, D-47048, Duisburg, Germany, schultz@math.uni-duisburg.de, Tobias Wollenberg

The paradigms of two-stage stochastic linear programming readily extend to two-stage decision making under nonanticipativity in general. Our talk picks up this abstract observation and elaborates nonlinear two-stage models of that kind. We report on applications of nonlinear two-stage stochastic programming in areas as different as supply networks for grid-based scarce commodities and shape optimization with linearized elasticity.

2 - Some Remarks on Linear Stochastic Bilevel Programs

Charlotte Henkel, Mathematics, University of Duisburg-Essen, Forsthausweg 2, 47057, Duisburg, Germany, charlotte.henkel@uni-due.de

Compared to linear stochastic two-stage programs, linear stochastic bilevel problems (LSBP) exhibit a strongly increased complexity. Starting from a deterministic linear bilevel problem, we derive structural properties for LSBPs using state-of-the-art parametric optimization techniques. As an outcome, we obtain rather weak analytical results. This significantly effects risk measures and solution algorithms for this kind of problem. We emphasise our results by instructive examples.

3 - Decomposition Methods for Stochastic Programs with Dominance Constraints Induced by Linear Recourse

Dimitri Drapkin, Mathematics, University of Duisburg-Essen, Forsthausweg 2, D-47057, Duisburg, Germany, dimitri.drapkin@gmail.com

We develop linear programming equivalents for two-stage stochastic models with linear recourse and dominance constraints of first and second order. In the favourable case, where only continuous variables are present in the second stage, cutting-plane decomposition algorithms are proposed and discussed along with the computational results.

4 - A stochastic programming approach to optimization of information retrieval

Vitaliy Vitseiny, International Information, Ternopil National Economic University, Ternopol, Ukraine, v.vitseiny@gmail.com

The research problem of optimization of the expected relevance of retrieved documents in search sessions with feedback is considered. We propose to use Multistage Stochastic Programming for this. To convey the endogenous uncertainty with gradual resolution, non-anticipativity constraints in a “tight” linear relaxed form were developed using hybrid optimization methods. In experiments with simulated database of...
documents, the proposed approach showed significantly better retrieval effectiveness comparatively with traditional information retrieval and two-stage stochastic programming.

**WB-44**

**Wednesday, 10:30-12h00**  
**BW-Marble**

**Collective Learning Procedures**

Stream: Machine Learning and its Applications  
*Invited session*

Chair: Michael Khachay, Ural Branch of RAS, Institute of Mathematics and Mechanics, S.Kovalevskaya st., 16, 620990, Ekaterinburg, Russian Federation, mkhachay@imm.uran.ru  
Chair: Vadim Strijov, Russian Academy of Sciences, Computing Center, Vavilova 42-268, 119333, Moscow, Russia, Russian Federation, strijov@ccas.ru

1 - Geometrical properties of connected search spaces for binary classification problem  
Oleksandr Frei, MIPT, Norway, sashaufrey@gmail.com

The overfitting of machine learning algorithms is often caused by excessive complexity of the search space. In this work we study geometrical properties of connected search spaces in the special case of binary classification problem. By introducing the technique of random assignment of labels to data points, we show a couple of new properties of splitting and connectivity profiles of an arbitrary search space. These properties will be demonstrated for the set of linear classifiers in three-dimensional space and for the set of conjunctive rules.

2 - Approximation for Minimum Committee Problem  
Konstantin Kobylyn, Optimization, IMM UB RAS, Sophya Kovalevskaya st., 16, 620990, Ekaterinburg, Sverdlovskaya, Russian Federation, kobylynkinks@gmail.com

We consider a problem giving an approximation for NP-hard minimum committee problem for two sets on the plane, the special case of learning problem: given sets A and B, a sequence of linear functions is called a committee if for every point a of A (b of B) there exists a subsequence of functions each of which is positive (negative) over (over b) with length exceeding a half of the sequence length; the problem is to find the smallest length committee for A and B. Experiments show the approximation problem to be reducible to the same one for sets having less cardinality.

3 - Combinatorial theory for ensemble of algorithms  
Andrey Ivakhnenko, Moscow Institute of Physics and Technology, Moscow, Russian Federation, andrey_iv@mail.ru

The combinatorial theory (CT) of machine learning was recently developed by K. Vorontsov. CT provides sharper estimations of generalization ability (GA) comparing to statistical theory of machine learning. In particular, it establishes some new overbounding formulas for logical conjunction rules. Those bounds were used to improve learning methods for logical classification algorithms on real-world data sets. In this work we extend this approach to the ensembles of algorithms. We use CT to find few simple algorithms with high GA and then combine them to ensemble by weighted voting.

4 - Computational complexity and approximability of several geometric covering problems.  
Michael Khachay, Ural Branch of RAS, Institute of Mathematics and Mechanics, S.Kovalevskaya, 16, 620990, Ekaterinburg, Russian Federation, mkhachay@imm.uran.ru, Maria Poberiy

The known Point Covering problem of finding the minimum cardinality cover of a given finite subset of the plane by straight lines (Min-2PC) is NP-hard in the strong sense. We extend this result to the k-dimensional case (for all fixed k>2). By polynomial reduction of the (k-1)-PC to the kPC problem we show that the latter is NP-complete in the strong sense. This reduction can be transformed into an L-reduction of the Min-(k-1)PC to the Min-kPC problem. Therefore, the Min-kPC problem is Max-SNP-hard for all k>2 and consequently have no PTAS, unless P=NP.

**WB-45**

**Wednesday, 10:30-12h00**  
**BW-Water**

**Customer-Oriented Revenue Management**

Stream: Advanced Inventory Control and Pricing Strategies  
*Invited session*

Chair: Catherine Cleophas, Wirtschaftswissenschaften, Freie Universität Berlin, Garsstr. 21, 14195, Berlin, Germany, catherine.cleophas@fu-berlin.de

1 - Selling to Heterogeneous Customers of Uncertain Value considering both Opportunity Costs and Mis-classification in a Dynamic Revenue Management Approach  
Michael Mohaupt, Dresden University of Technology, Germany, michael.mohaupt@mailbox.tu-dresden.de, Andreas Hilbert

Opportunity costs are very common practice in revenue management, but loose significance as reference value if the true worthiness of a booking request cannot be observed at the time of decision for acceptance or denial. In customer-oriented revenue management this problem may arise if customers differ in their future buying behavior (frequency, product choice) but cannot be classified into the appropriate customer segment unambiguously. By considering expected (mis)classification we extend a bid-price control and show advancements both in classification accuracy and revenues via simulation.

2 - Deterministic Aggregation for Discrete Choice Models  
Jonas Rauch, JRG MathOpt, University of Heidelberg, Interdisciplinary Center for Scientific Computing, Im Neuenheimer Feld 368, 69120, Heidelberg, Germany, jonas.rauch@gmx.de, Sebastian Sager

While widely used in simulation, complex discrete choice models are presently not as common in optimization, mainly due a lack of efficient, accurate aggregation methods. Most current approaches involve Monte Carlo simulation, which scales poorly with desired accuracy. We propose the use state-of-the-art numerical methods to compute choice probabilities deterministically for models with a linear utility function. Moreover, we present a way to efficiently compute derivatives of choice probabilities w.r.t. various parameters, making the method especially suitable for optimization purposes.

3 - Customer-Oriented Extensions of Revenue Management Models and the Value of Intuition  
Catherine Cleophas, Wirtschaftswissenschaften, Freie Universität Berlin, Garsstr. 21, 14195, Berlin, Germany, catherine.cleophas@fu-berlin.de

The spread of a customer-oriented view of revenue management motivates the extension of traditional demand models. In current practice, extensions of the model — when not solved analytically — are left to the intuition of analysts. This paper categorizes customer-oriented model extensions and their requirements and suggests the systematic use of simulations to evaluate the cost and benefit of extending RM models. Finally, it proposes introducing intelligent agents to the revenue management process to complement traditional analytic approaches.

4 - Filtering techniques to improve forecasting from small numbers in revenue management  
Philipp Bartke, Wirtschaftsinformatik, Freie Universität Berlin, 14195, Berlin, Germany, PHILIPP.BARTKE@gmail.com

Modern RM methods incorporate sophisticated customer choice models that call for the estimation of a variety of parameters. Estimating these parameters based on often sparse historical data becomes a key challenge previously been referred to as the problem of small numbers. This paper proposes the application of filtering techniques well studied in signal processing and control theory but rarely mentioned in RM literature so far. In an agent-based simulation system, the performance of the proposed method in life-like scenarios is evaluated and compared to more traditional methods.

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Wednesday, 12:30-14:00

■ WC-01

Wednesday, 12:30-14:00
RB-Alfa
Keynote Lecture: Professor Jonathan Caulkins

Stream: Keynote, Tutorial and Plenary Lectures
Keynote session
Chair: Richard Hartl, Dept of Management, University of Vienna, Brunner Str. 72, A-1210, Vienna, Austria, richard.hartl@univie.ac.at

1 - Providing a Scientific Basis for Managing Illegal Drugs & Markets
Jonathan Caulkins, H. John Heinz III School of Public Policy & Management, Carnegie Mellon University, 5032 Forbes Avenue, 15289, Pittsburgh, United States, caulkins@andrew.cmu.edu

What happens when formal training in operational analysis meets a classic "wicked problem" with multiple conflicting objectives, competing agency priorities, and abundant data that nevertheless do not answer the questions that really matter? This talk gives one answer, drawing on 20+ years experience working on a particularly fascinating problem — policy regarding control of illegal markets, notably those for illegal drugs.

The tools of operations research, industrial organizations, and economics can be harnessed to provide an empirical, scientific basis for drug policy making. The models discussed in this talk focus on drug initiation (product diffusion), price responsiveness (elasticity of demand), and operation of the illegal supply chain, both during normal times and when the distribution network is disrupted. Corresponding data are drawn from epidemiological studies, forensic laboratory analysis, undercover buys, and extensive interviews with incarcerated drug smugglers and dealers in Australia, France, the UK, and the US. These models provide the foundation for estimating the cost-effectiveness of different strategies for controlling drug use and associated social harms.

However, I will not tell an entirely happy tale of Operations Research (OR) as panacea, limited only by the outside world’s ignorance of its power. Rather, I will tell a story of a glass that is half full and yet also half empty.

For example, these issues are truly "OR problems" in the sense that OR ideas and insights underpin key dynamics and in the sense that knowledge of OR empowers better understanding and solutions. However, they are also problems of and for economics, sociology, political science, demography, psychology, medicine, and other disciplines. OR can and should partner with other disciplines and perspectives when grappling with fundamental strategy choices related to drug policy.

Likewise, the adversarial nature of the policy making process challenges an optimization-based way of looking at the world.

The objective of this talk is to reflect on OR’s success and limitations in this and some allied domains to draw meta lessons for how experts can effectively use mathematical models and operational analysis to produce insights that inform decision makers in comparably messy domains.

■ WC-02

Wednesday, 12:30-14:00
RB-Beta
Multi-Project Scheduling and Stochastic Project Scheduling

Stream: Project Management and Scheduling
Invited session
Chair: Rainer Kolisch, TUM School of Management, Technische Universität Muenchen, Arcisstr. 21, 80333, Muenschen, Germany, rainer.kolisch@wi.tum.de

1 - A modified branch and cut approach for Resource Portfolio Problem under Relaxed Resource Dedication policy
Umut Besikci, Industrial Engineering, Bogazici University, Bogazici Universitesi Guney Kampus Muhendislik Fakultesi, Bebek, 34342, Istanbul, Turkey, umutbesikci@gmail.com, Umut Bilge, Gündüz Ulusoy

Multi-project scheduling and management problem constitutes an important part of the project scheduling literature. In this study we deal with Resource Portfolio Problem (RPP) under Relaxed Resource Dedication (R&D) policy. The Branch and Cut (B&C) procedure of CPLEX is modified with different feasible solution heuristics, branching strategies and valid inequalities. The proposed modifications utilize the insights gained from the previous studies we have carried out for RPP. The experimental results show that the proposed modifications have significant effect on solution quality.

2 - Dynamic stochastic resource-constrained multi-project scheduling
Rainer Kolisch, TUM School of Management, Technische Universität Muenchen, Arcisstr. 21, 80333, Muenchen, Germany, rainer.kolisch@wi.tum.de, Thomas Flehchter, Philipp Melchior, Walter Gutjahr

We consider the problem where project arrive stochastically over time. Projects have a deterministic network but stochastic activity durations. The objective is to minimize the average weighted makespan of the projects. We present solutions procedures which have been proposed for this problem and compare their performance in an experimental study.

3 - Assorted sensitivity results in stochastic project networks
Anand Paul, University of Florida, United States, paula@ufl.edu

We present some results pertaining to sensitivity issues in stochastic project networks. First, we discuss how the impact of activity correlation on mean project time depends on network topology. Second, we discuss a metric that quantifies the impact of activity variance on mean project completion time; prior analytical results in the literature are qualitative rather than quantitative. Finally, we discuss conditions under which an increase in mean activity duration results in an increase in mean project duration, keeping activity variances fixed.

■ WC-03

Wednesday, 12:30-14:00
RB-L1
EURO/ROADEF Challenge Session 4

Stream: EURO/ROADEF Challenge Invited session
Chair: Christian Artigues, LAAS, CNRS, 7 avenue du Colonel Roche, 31077, Toulouse Cedex 4, France, artigues@laas.fr
Chair: Ender Özcan, Computer Science, University of Nottingham, Jubilee Campus, Wollaton Road, NG8 1BB, Nottingham, United Kingdom, eox@cs.nott.ac.uk
Chair: Emmanuel Guere, Google, 38 Avenue de l’Opera, 75002, Paris, France, guere@google.com
Chair: Eric Bourreau, COCONUT, LIRMM, 161 Rue Ada, 34000, Montpellier, France, eric.bourreau@lirmm.fr
Chair: Kedad-Sidhoum Safia, LIP6 - UPMC, 4 Place Jussieu, 75005, Paris, France, safia.kedad-sidhoum@lip6.fr
Chair: H. Murat Afsar, Industrial Systems, University of Technology of Troyes, 12 rue Marie Curie, BP 2060, 10010, Troyes, France, murat.afsar@utt.fr
Chair: Marc Sevaux, Lab-STICC - CNRS UMR 3192, Université de Bretagne Sud - UEB, Centre de Recherche - BP 92116, 2 rue de Saint Maude, 56321, Lorient, France, marc.sevaux@univ-ubs.fr
1 - Offline, enhanced, adaptive large neighborhood search for the machine reassignment problem
Alberto Delgado, IT University of Copenhagen, Rued Langgaards Vej 7, 2300, Copenhagen, Denmark, alde@itu.dk, Yuri Malitsky, Dario Pacino, Kevin Tierney

We present an approach to solve the machine reassignment problem that combines complete and incomplete approaches into an offline, enhanced, adaptive large neighborhood framework. Random selection, services, and locations are the operators to create neighborhoods, while a constraint programming and MIP model, and a Tabu Search algorithm are used to re-optimize them. The selection of the neighborhood operator is made based on online information, while the approach to re-optimized them is selected based on online information and offline learning.

2 - A hybridization of Simulated Annealing and sample local search for solving the machine reassignment problem
Marcus Ritt, Departamento de Informática Teórica, Universidade Federal do Rio Grande do Sul, Brazil, euro-conference@ritt-online.de, Gabriel Portal, Leonardo de Miranda Borba, Alexander J. Benavides, Luciana S. Buriol

We propose two heuristics based on local search with two neighbourhoods: the first obtains a neighbour by moving a process to another machine, and the second by swapping two processes on different machines. The first heuristic is a sample local search. It randomly chooses one of the best neighbours in the first neighbourhood, and uses the second to escape local minima. The second heuristic is a Simulated Annealing and uses only the first neighbourhood. The hybrid approach runs Simulated Annealing with two sets of parameters in parallel, and the sample local search in the remaining time.

3 - A co-evolutionary hyper-heuristic for ROADEF/EURO Challenge 2012 Machine Reassignment problem
Wojciech Jaśkowski, Institute of Computing Science, Poznan University of Technology, ul. Piotrowo 2, 60-985, Poznan, Poland, wjaskowski@cs.put.poznan.pl, Piotr Gawron, Marcin Szubert, Bartosz Wieloch

We propose a co-evolutionary hyper-heuristic for solving combinatorial optimization problems. Our algorithm learns how to solve a problem by selecting and generating perturbation operators using the nature-inspired concept of arm races between potential solutions and tests. It co-evolves a population of operators (solutions) with a population of states in the problem search space (tests). We evaluate the performance of the proposed method on the ROADEF/EURO Challenge 2012: Machine Reassignment problem using various operators: local-search improvements, dedicated heuristics and MIP solver.

4 - A hybrid algorithm for machine reassignment
Arnaud Liefooghe, LIfL - CNRS - INRIA, Université Lille 1, Lille, France, arnaud.liefooghe@lifl.fr, François Legillon, Francois Clautiaux, El-ghazali Talbi

We present an algorithm for the machine reassignment problem of the ROADEF/EURO 2012 challenge. Our approach is divided into two phases, applied in a sequential way. First, an iterated local search algorithm is performed. It is based on a best-improvement hill-climber, whose neighborhood consists of all the moves that reassign a given process to another machine. Second, we aim at re-balancing the over-load cost over machines. We use an integer programming solver to improve the incumbent solution locally by fixing some processes on their current machine, and solving the initial model.

1 - Minimizing setup time in colour printing schedules
Alewyn Burger, Department of Logistics, Stellenbosch University, Private Bag X1, Matieland, 7600, Stellenbosch, Western Cape, South Africa, apburger@sun.ac.za, Neil Jacobs, Van Jan Vuuren, Stephan Visagie

In this talk a scheduling problem is considered which arises in the food industry where packaging requires overlay printing with multiple colours. Printing machines used for this purpose typically accommodate a small number of colours simultaneously, called a pallet. To minimize operation time it is desirable to schedule print jobs so that the number of pallet changes, as well as the number of cartridges that have to be washed between pallet changes is minimized. We solve the problem exactly for small problem instances and heuristically for larger instances.

2 - The cost of link failure in network protection
Anton de Villiers, Logistics, Stellenbosch University, 53 Crown Street Vierlanden, Durbanville, 7550, Cape town, Western Province, South Africa, 14812073@sun.ac.za, Alewyn Burger, Jan van Vuuren

If the vertices of a network G denote facilities to be protected, and the links between facilities denote routes along which protecting guards can move, a secure deployment is an assignment of guards, at most one per facility, to the facilities, with the property that, for every facility v, there is either a guard at v or a guard at a facility adjacent to v who, after moving to v, leaves the resulting deployment secure again. In this talk, bounds are established on the smallest number of guards required for a secure deployment on G after randomly removing a specified number of links of G.

3 - Variable selection in NIR spectroscopy data using a hybrid PSO algorithm
Martin Kidd, Dipartimento di Elettronica, Informatica e Sistemistica (DEIS), University of Bologna, Bologna, Italy, martin.kidd@unibo.it

In chemometrics, near-infrared (NIR) spectroscopy is used to obtain spectral data on samples for the purpose of predicting various properties of these samples. NIR data are typically used in conjunction with multivariate calibration methods in order to model these properties of given samples, and a common obstacle is the presence of noise in the data. The use of heuristic methods to perform variable selection in NIR data has proved to be useful in the past, and in this talk a two-phase particle swarm optimisation algorithm is presented as a possible solution approach to this problem.

4 - An optimisation-based sugarcane harvest scheduling decision support system for commercial growers in South Africa
Jonas Stray, Textilhögskolan, Högskolan i Boras, Bryggaregatan 17, SE-501 90, Boras, Vastra Gotaland, Sweden, jonas.stray@hb.se, Jan van Vuuren

Commercial sugarcane growers in South Africa revise their seasonal harvesting schedules continuously since factors such as environmental events, sucrose content, growth rate and cost of harvesting change over time. Our decision support system (DSS) incorporates regression analysis of sugar content and growth, costing and risk models for the events. An asymmetric travelling salesman problem with time-dependent costs model sequences the fields by maximising profit. The DSS is analysed through a case study, and results indicate that the DSS may be useful in large-scale operations.

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**WC-05**

Wednesday, 12:30-14:00

**RB-L3**

**Topics in integer Optimization and mixed integer programming I**

Stream: Discrete Optimization, Geometry & Graphs (contributed)

**Contributed session**

Chair: Frank Fischer, Mathematics, Chemnitz University of Technology, Reichenhainer Str. 39, 091107, Chemnitz, Germany, frank.fischer@mathematik.tu-chemnitz.de
1 - Investigation of properties and solving of combinatorial optimization problems with linear constraints.
Igor Grebennik, Systems engineering, Kharkiv National University of Radio Electronics, flat 130, Geroev Truda str, 45, 61129, Kharkiv, Ukraine. IgorGrebennik@gmail.com, Oleksii Baranov

An optimization problem on a combinatorial set such as permutations, combinations as well as a special combinatorial set with linear constraints is considered. As a result of inclusion mapping of the combinatorial set into Euclidean space and a convex extension of objective function to convex set an equivalent optimization problem is constructed. Estimates of minima for the convex functions on the combinatorial sets under linear constraints are proposed. The estimates are based on linear combinatorial problems with constraints and used in the branch-and-bound algorithm. Examples are given.

2 - On Mixed Integer Random Convex Programs
Giuseppe Calafiore, DAUIN, Politecnico di Torino, Corso Duca degli Abruzzi, 24, 10141, Torino, Italy, giuseppe.calafiore@polito.it, Daniel Lyons, Lorenzo Fagiano

We consider mixed-integer (MI) optimization problems subject to N randomly drawn convex constraints. We provide explicit bounds on the tails of the probability that the optimal solution found under the N constraints will become infeasible for the next random constraint. First, we prove that the number of support constraints (constraints whose removal strictly improves the optimal objective) in general convex MI problems is bounded by a number depending only on the dimension of the decision vector. Then, we show that the tails of the violation probability are bounded by a binomial distribution.

3 - The SCIP Optimization Suite - It’s all in the bag!
Gerald Gamrath, Zuse-Institute Berlin, Takustr. 7, 14195, Berlin, Germany, gamrath@zib.de

We present the SCIP Optimization Suite, a tool for modeling and solving optimization problems. It consists of the modeling language ZIMPL, the LP solver SoPlex, and the constraint integer programming framework SCIP. Besides being one of the fastest MIP solvers available in source code, SCIP is able to solve a much wider range of optimization problems including non-convex MINLP and provides support for branch-and-price. We report on current developments and new features in the upcoming release 3.0, including enhanced MINLP support, exact integer programming, and parallelization.

4 - Dynamic Graph Generation in Lagrangian Relaxation
Frank Fischer, Mathematics, Chemnitz University of Technology, Reichenhainer Str. 39, 09107, Chemnitz, Germany, frank.fischer@mathematik.tu-chemnitz.de, Christoph Helmberg

Models based on time expanded networks, which are used in many applications, grow very quickly when the number of time steps increases which makes it impossible to solve the models with standard methods. We propose a dynamic graph generation technique that can be applied in Lagrangian relaxation or column generation approaches. Instead of working on the full model, special developments allow to keep only small sub-networks in memory but without losing any information. Numerical tests on a large scale train timetabling problem model demonstrate the effectiveness of dynamic graph generation.

1 - On the convergence to Walrasian prices in random matching Edgeworthian economies
Luis Ferreira, Matemática, Escola Superior de Estudos Industriais e de Gestão, IPP, ESEIG, Rua D Sancho I, número 981, 4480-876, Vila do Conde, Porto, Portugal, migferreira2@gmail.com

We show that for a specific class of random matching Edgeworthian economies, the expectation of the limiting equilibrium price coincides with the equilibrium price of the related Walrasian economies. This result extends to the study of economies in the presence of uncertainty within the multi-period Arrow-Debreu model, allowing to understand the dynamics of how beliefs survive and propagate through the market.

2 - A cooperative version of one group pursuit game
Yaroslavna Pankratova, Mathematics of economic research., International Banking Institute, Nevsky pr. 60, Saint-Petersburg, Russian Federation, yasyap@gmail.com, Denis Kuzytin

We consider a nonzero-sum group pursuit game with one evader and m pursuers. At each time moment the players choose their directions of motion. Each player knows the moment t and his own and all other players’ positions. Moreover, the pursuer knows the directions chosen by the evaders at the moment t. We propose a rule to associate a corresponding cooperative game to a considered nonzero-sum pursuit game. We prove that in the constructed cooperative game the core is not empty and time-consistent. Finally, we give a number of examples that illustrate the main results.

3 - On the Experimental Investigation of the Stock-Exchange Game Model
Igor Katin, Systems Analysis Department, Vilnius University Institute of Mathematics and Informatics, Akademijos str. 4, LT-08663, Vilnius, Lithuania, igor@getweb.lt, Joana Katina, Jonas Mockus

A simple SEG on was introduced by J. Mockus in 2003 to simulate the behavior of several stockholders using fixed buying-selling margins at fixed bank yield in the context of Nash equilibrium. In this paper, an extended USEGM is investigated. USEGM includes the transaction costs to reflect the reality better. To represent users that prefer linear utility functions, USEGM adds the AR-ABS(p) model, minimizing the absolute values, to the traditional AR(p) model. The objective of USEGM is not forecasting, but simulation of financial time series that are affected by predictions of the participants.
individuals, driven by both contribution to population diversity and solution quality, enables to enhance exploration capabilities and reduce the risks of premature convergence. High-quality results are reported for a wide range of vehicle routing variants.

2 - Constraint-based Construction Heuristics for Rich Vehicle Routing Problems

Felix Brandt, Logistics Systems Engineering, FZI Forschungszentrum Informatik, 76151, Karlsruhe, Germany, brandt@fzi.de, Anne Meyer

Constraint programming (CP) is successfully applied to rich vehicle routing problems (RVRP). However, during the construction phase CP is used as a mere satisfiability checker, if at all, not using its power for finding an actual solution. In this work we want to show how CP can be applied during a construction phase. Therefore, we develop branch-and-bound techniques analogous to established construction heuristics from literature. Furthermore, we present our first results and compare the performance of different approaches.

3 - Generalized disaggregation algorithm for the vehicle routing problem with time windows and multiple routes

Rita Macedo, LAMIH, Universidade de Valenciennes, Portugal, rita.sgd.macedo@gmail.com, Saïd Hanafi, François Clautiaux, Cláudio Alves, J. M. Valério de Carvalho

We address the VRP with multiple routes and time windows. For this variant of the VRP, there is a time interval within which every customer must be visited, and every vehicle is allowed to perform more than one route within the same planning period. We propose a general disaggregation algorithm that improves the exact approach described in (Macedo et al., 2011), and describe a novel rounding rule and a new node disaggregation scheme based on different discretization units. In addition, we propose a new integer model for the problem, which can also assess if a solution is feasible or not.

4 - A Mixed Integer Linear Programming Model For Solving Large-Scale Integrated Location-Routing Problems For Urban Logistics Applications at Groupe La Poste

Matthias Winkenbach, Kuehne Foundation Endowed Chair in Logistics Management, WHU - Otto Beisheim School of Management, Burgplatz 2, 56179, Vallendar, Germany, matthias.winkenbach@whu.edu, Paul Kleindorfer, Bernard Lemaire, Christèle Leveque, Alain Roset, Stefan Spindler

We present a large-scale static, deterministic mixed inter linear programming model solving an integrated location-routing problem in the context of urban logistics services (ULS). We aim at determining an optimal infrastructure and fleet design for an urban consolidation and transportation network. The model is meant to quantitatively evaluate potential strategic moves of postal operators into the domain of ULS. Based on operating data from French La Poste, we analyse the key drivers and sensitivities of optimal infrastructure and fleet design to support the development of profitable ULS.

The Bipartite TSP appears in many industrial applications, e.g., to optimize the route of an assembly robot. In many cases the numerical solution of TSP is based on the facets of its polyhedral set. The most important constraints are the degree inequalities and the subtour elimination constraints. The simplest facet-defining inequalities after these ones are the comb inequalities in the general case. However in the bipartite case the comb inequalities are not facet-defining, as it will be proven in this presentation. The case of clique-tree inequalities is also discussed.

2 - Some Results on Threshold Separability of Boolean Functions

Giovanni Felici, Istituto di Analisi dei Sistemi ed Informatica, Consiglio Nazionale delle Ricerche, Viale Manzoni 30, 00185, Roma, Italy, giovanni.felici@iasi.cnr.it, Endre Boros

We consider the conditions for the existence of a Linear Threshold Function that separates two sets of Boolean vectors obtained by discretization of real valued data. Problems of this type are found in Supervised Learning and Data Mining. We state a combinatorial necessary and sufficient condition for the existence of such function when points belong to the plane, and show how, when formulated as a linear program, this condition is equivalent to the Farkas' Lemma. Such equivalency provides insights for our problem in larger dimension that can be used in discretization algorithms.

3 - Hardness Results for Approximate Pure Horn CNF Formulae Minimization

Endre Boros, RUTCOR, Rutgers University, 08854, Piscataway, New Jersey, United States, Endre.Boros@rutcor.rutgers.edu, Aritanan Gruber

We show that for a pure Horn Boolean function on n variables, unless P = NP, it is not possible to approximate in polynomial time (in n) the minimum numbers of clauses and literals to within factors of 2( log(1-e)n) even when the inputs are restricted to 3-CNFs with O(n(1+e)) clauses, for some small e > 0. Furthermore, we show that unless the ETH is false, it is not possible to obtain constant factor approximations for these problems even in sub-exponential time (in n).
We present a combined pickup and delivery and inventory routing problem from the tramp shipping industry. The fleet is heterogeneous with each ship having a different load capacity, speed and cost structure. The inventories are paired, and there are additional optional cargoes available. The objective is to maximize the revenue of transporting spot cargoes, while keeping the inventory levels within their limits. Two path flow formulations are presented, and the problem is solved using a branch-and-price method. Computational results will be presented.

3 - A base integer programming model and benchmark suite for liner shipping network design
Fernando Alvarez, Göteborgs gata 9, 1566, Oslo, Norway, jfa2@cornell.edu, Berit Dangaard Brouer, Christian Edinger Munk Plum, David Pisinger, Mikkel M. Sigurd

The potential for making cost effective and energy efficient liner shipping networks using OR is huge and neglected. We believe access to domain knowledge and data is an entry barrier to approach the liner shipping network design problem. The purpose of the benchmark suite project is to provide access to the liner shipping domain for independent OR researchers. We present the domain of liner shipping in relation to mathematical programming. An IP model and a suite of instances based on real life data from the largest liner shipping company, Maersk Line, and several other stakeholders is presented. Finally, computational results yielding the first solutions to the benchmark suite are presented.

- The effects of unsolicited donations in disaster relief operations
Jurgita Balaisyte, INSEAD, Boulevard de Constance, 77305, Fontainebleau, none, France, jurgita.balaisyte@insead.edu, Ruth Carrasco-Gallego, Luk Van Wassenhove

The negative environmental impacts of relief operations arise at the different stages of relief supply chain: from procurement, stock positioning, transportation to waste management. It is important to regard environmental issues in humanitarian supply chain decisions. As a result a growing number of humanitarian agencies are attempting to integrate environmental considerations in their activities. We map the value chain and identify its economic, environmental and social issues and look for ways to integrate environmental aspects in to humanitarian supply chains.

- The effects of unsolicited donations in disaster relief operations
Nha-Nghi Huynh, Kuehne Logistics University, Kuehne Logistics University, Brooktorkai 20, 20457, Hamburg, Germany, nha-nghi.huynh@the-klu.org, Sandra Transchel, Maria Besiou, Luk Van Wassenhove

Why do beneficiaries not get aid items they require or why do independent humanitarian organizations (IHO) deliver these not fast enough? A reason is the chaotic setting in which IHO operate. But what affects high-priority (HP) deliveries more are material convergences at disaster entry points caused by unsolicited donations. They consume excessive resources and create serious bottlenecks. We present a queuing model that illustrates the effects of unsolicited donations on the Haiti relief operation and shows how systematic coordination could significantly increase the throughput of HP goods.

- Funding strategies in humanitarian operations for relief and development

Alfonso Pedraza-Martinez, Operations and Decision Technologies, Indiana University, 1309 10th Street, Kelley School of Business, 47405, Bloomington, INDIANA, United States, alpedraz@indiana.edu, Arian Afkali

We model funding strategies for relief and development programs in a multi-donor market with donation uncertainty. Donors decide how much to donate to each program; a humanitarian organization decides between 4 different funding strategies: 1) total earmarking; 2) partial earmarking; 3) conditional earmarking; 4) no earmarking. By comparing these four strategies we offer insights to humanitarian organizations on how to improve their levels of funding while keeping operational efficiency high.

4 - Decentralisation and Earmarked Funding in Humanitarian Logistics for Relief and Development
Maria Besiou, Kuehne Logistics University, Brooktorkai 20, 20457, Hamburg, Germany, maria.besiou@the-klu.org, Alfonso Pedraza Martinez, Luk Van Wassenhove

We study the International Humanitarian Organizations dual mission of relief and development in decentralized, stochastic operations with different levels of earmarked funding, using system dynamics methodology. Focusing on equity and efficiency we find that a system with local procurement and short lead time may take longer to respond than a system with global procurement and high lead time. Our results have important implications for humanitarian fleet management practice. Specifically, what organizational structure to adopt in different organizational environments.

Realistic parallel machines problems

Stream: Realistic Production Scheduling
Invited session
Chair: Olga Chub, Faculty of Applied Mathematics and Management, Kharkiv national university of radioelectronics, Lenina str., 18, 43, 61166, Kharkiv, Ukraine, ChubOlya@gmail.com

1 - Minimising tardiness in parallel machine scheduling with additional mold type restrictions
Amelia White, Engineering Science, The University of Auckland, 70 Symonds Street, Auckland, Auckland, New Zealand, awhi100@aucklanduni.ac.nz, Andrea Raith

We study a parallel machine scheduling problem with sequence-dependent setup times. The jobs to be produced have due dates and require a specific mold type to be installed on a machine for production. The setup time for these molds is significant and there is only a small number of each type of mold available. We present a new time-indexed IP formulation to minimise overall job tardiness, with constraints to model both the setup times of the molds on the machines and the restriction on the number of machines which can produce jobs of the same type at the same time.

2 - MIP models and algorithms for earliness/tardiness scheduling problems on parallel machines
Rosiane de Freitas Rodrigues, Institute of Computing, UFAM / UFRJ, Brazil, rosiane@icomp.ufam.edu.br, Rainer Xavier de Amorim, Bruno Cardoso Dias

Scheduling problems with earliness and tardiness penalties are presented, each one or both together, involving parallel machines, and independent jobs with distinct processing times and priorities, all of them NP-hard problems. Classical MIP models with improvements, and exact and approximate approaches have been developed with tests on - based on - OR-Library instances. Significant results were obtained, reaching optimal solutions when known, and having competitive performance compared to the works available in the literature.
3 - Multiobjective parallel machine scheduling using memetic algorithms
Felipe Baesler, Industrial Engineering, Universidad del Desarrollo, Av Sanhueza 1750, Concepcion, Chile, fbaesler@ingenieros.udd.cl, Oscar Cornejo

This work presents a multiobjective optimization algorithm for the parallel machine scheduling problem based on the memetic algorithms paradigm (MA). This algorithm combines genetic evolution with local search in the same way as traditional MA, but with the use of independent populations for each objective, as well as a mechanism to find compromised solutions. The algorithm was tested and compared against four multiobjective techniques available in the literature, MOGA, SPEA, NSGA II and MOGLS. Two objectives were considered for this problem, Cmax minimization and total tardiness minimization.

4 - Mathematical model and method for optimal planning several resources
Olga Chub, Faculty of Applied Mathematics and Management, Kharkiv national university of radioelectronics, Lenina str., 18, 43, 61166, Kharkiv, Ukraine, ChubOlya@gmail.com

The resource planning multicriteria model provided that the demand for enterprise services is a deterministic function has been considered. Enterprise functioning process is defined as a continuous sequence of projects. Some projects can (and should) be run simultaneously. This fact causes distribution of several restricted resources (time, finances, machines, human resources etc.) as between the works of a single project, and between the works of various projects. Solution method based on the interpretation of work as a geometric object and use the optimal geometric design theory toolkit.

**WC-12**
Wednesday, 12:30-14:00
RB-Omicron

Solution Methods at Seafort Container Terminals

Stream: Container Terminal Operations
**Invited session**

Chair: Erhan Kozan, Mathematical Sciences, Queensland University of Technology, GPO Box 2434, 4001, Brisbane, Queensland, Australia, e.kozan@qut.edu.au

1 - An Integrated Approach to Optimising Container Processes at Multimodal Seafort Terminals
Erhan Kozan, Mathematical Sciences, Queensland University of Technology, GPO Box 2434, 4001, Brisbane, Queensland, Australia, e.kozan@qut.edu.au, Brad Casey

A Multimodal Seafort Container Terminal (MSCT) consists of subsystems that require optimisation of the operations within them, as well as synchronisation of the movements of machines and containers between them. We present an integrated approach. Mathematical models will be presented for the Storage Area Subsystem (SAS) and Intra-terminal Transportation Subsystem (ITTS). Initial solutions are improved through an innovative heuristic algorithm which integrates the SAS and ITTS solutions together and optimises them via meta-heuristic techniques.

2 - Yard crane scheduling by using a genetic algorithm at seafort container terminals
Mehmet Ulaş Koyuncuoğlu, Industrial Engineering, Pamukkale University, Pamukkale University Information Centre, 20070, Denizli, Turkey, ulas@pau.edu.tr, Osman Kulak, Olocay Polat, Mustafa Eganem Taner

Effective use of container terminal equipments is the most important factors. Scheduling the yard cranes has an important role in improving the efficiency of terminals. In this paper, a novel approach is presented about free/restrictive deployment rules and also other priority and deployment rules are examined in combination. For the purpose of minimising total completion time of the operations, a mixed-integer linear mathematical model is proposed to solve the problems of assigning one or more yard cranes and of routing by using a genetic algorithm and developing heuristics based approach.

3 - Empty container management and the linkage between global and local allocations in export oriented countries: case of Thailand
Montathip Chanthpum, Institute of Transport and Logistics Studies, The University of Sydney, Room 201-5 C37, Newtown Campus, 2006, Sydney, NSW, Australia, montathip.chanthpum@sydney.edu.au

The availability of empty containers is a challenge for shipping lines in deficit areas of export oriented regions. This paper considers empty container management at a global scale and its linkage to empty allocation at a local scale in deficit areas by taking Thailand as a case study. We conducted in-depth interviews with scholars and key relevant persons from private and public sectors. A framework linking empty container allocations between the global and local scales is proposed, which will help to facilitate container movement and improve the efficiency of the global supply chain.

4 - Modeling and Optimal Management of Equipments of the BMT Containers Terminal (Bejaia’s Harbor)
Fazia Aoudia-rahmanoune, Operational Research, Laboratory LAMOS University of Bejaia, Laboratory LAMOS University of Bejaia, Traga Ouzemmour, 06000, Bejaia, Algeria, foufourah@yahoo.fr, Sotiane Soualal, Aichouche Ouibrahim

The performance of a containers terminal is measured by the stopover time and the transit cost. Indeed, in a world where, in addition to rivalry, the least movement is charged and where the time taken often unexpected dimensions, reducing the time and cost of treatment becomes the main objective at the expense of large investment in equipment and management techniques. In this work, we were interested in the unloading process at BMT, and we determined the optimal combinations of equipment to be used: we develop a non-Markovian queues model and solve the problem by simulation.

**WC-13**
Wednesday, 12:30-14:00
RB-Tau

Emerging Issues in Order Fulfillment

Stream: OR Applications in the Automotive Industry
**Invited session**

Chair: Bart MacCarthy, Operations Management Division, Nottingham University Business School, NG8 1BB, Nottingham, United Kingdom, Bart.Maccarthy@nottingham.ac.uk
Chair: Philip Brabazon, Portsmouth Business School, Richmond Building, Portland Street, PO1 3DE, Portsmouth, United Kingdom, philip.brabazon@port.ac.uk

1 - Auction-based coordination of retailers and manufacturer in the sales of configurable products
Andreas Matzke, Institute of Automotive Management and Industrial Production, Technische Universität Braunschweig, Katharinenstr. 3, 38106, Braunschweig, Germany, andreas.matzke@tu-bs.de, Thomas Volling, Thomas Spengler

We propose a mechanism to improve channel coordination in the sales of configurable products, assuming given capacities for product options. The approach combines two selling mechanisms. At first, the common list price mechanism between a manufacturer and multiple retailers is adopted for initial configuration of products. Second, excess capacities are sold as product upgrades by an auction mechanism. A numerical study evaluates the benefits of the approach under various conditions. As compared to static list prices, the approach allows for higher revenues in the supply chain.
2 - A review of works on the planning of capacities and orders in build-to-order automotive production

Thomas Völling, Institute of Automotive Management and Industrial Production, Technische Universität Braunschweig, Katharinenestr. 3, 38106, Braunschweig, Germany, t.volling@tu-bs.de, Martin Grunewald, Andreas Matzke, Thomas Spengler

We provide an overview about operations research (OR) models and applications in build-to-order automotive production. We focus on two important planning objects which have not been considered in prior reviews: the planning of capacities and orders. To bridge the gap between conceptual works on the one hand and quantitative contributions on the other we provide a framework for the structuring of planning tasks. 45 works have been identified in the literature and are classified according to the proposed framework. Open issues that should be addressed by OR are discussed based on that.

3 - Optimal design of open pipeline order fulfilment processes in the volume automotive sector

Philip Brabazon, Portsmouth Business School, Richmond Building, Portland Street, PO1 3DE, Portsmouth, United Kingdom, philip.brabazon@port.ac.uk, Bart MacCarthy

Order fulfilment processes used by volume automotive producers are characterized by high variety and large scale. Simulation is used to study the effect of 11 principal control parameters on performance metrics in different customer markets. The experimental study uses an NOLI design and a CHAID factor analysis. The parameter settings minimizing the cost of fulfillment in a market do not necessarily minimize the customer-centric metrics of lead time or the degree of compromise experienced by customers. The results of the study show the complexity in this type of order fulfillment process.

WC-14

Wednesday, 12:30-14:00
RB-Omega

Timetabling and People

Stream: Timetabling and Rostering
Invited session
Chair: Sara McComb, Purdue University, United States, sara@purdue.edu

1 - Deterministic Optimization of Examination Timetables

Siti Khatijah Nor Abdul Rahim, School of Computer Science, University of Nottingham, Jalan Broga, 43500, Semenyih, Selangor, Malaysia, khyx8skn@nottingham.edu.my, Andrzej Bargiela, Rong Qu

We introduce a new optimization method for the examinations scheduling problem by performing permutations of slots and reassignments of exams upon the feasible schedules. The permutations minimize the number of students taking exams in adjacent slots and guarantee a significant reduction of the cost which is further reduced by reassigning exams to other slots. Our method delivers competitive results compared to other constructive methods in the literature and maintains the same deterministic optimization pattern on all benchmark datasets proving the generality and consistency of the method.

2 - The Classroom Allocation Problem in University Timetabling

Antony Phillips, Engineering Science, University of Auckland, 70 Symonds St, 1010, Auckland, New Zealand, aphi038@aucklanduni.ac.nz, Hannah Waterer, Matthias Ehrgott, David Ryan

University timetabling is a large resource allocation problem, in which both times and rooms are determined for each class meeting. Due to the difficulty of the problem, it is often solved in two stages: timetable generation followed by room allocation. This paper looks at exact optimization-based methods for allocating rooms to a timetable in which times are preassigned. Computational results on full size datasets are presented, and the trade-off between different approaches is discussed.

WC-15

Wednesday, 12:30-14:00
RB-2101

Discrete bilevel optimization and Variational inequalities

Stream: Variational Inequalities and Bi-Level Problems
Invited session
Chair: Diana Fanghaenel, Fachbereich Elektrotechnik/Informatik, Universität Kassel, Wilhelmshöher Allee 73, 34121, Kassel, Germany, d.fanghaenel@uni-kassel.de

1 - Global Optimization of Mixed-Integer Bilevel Programming Problem

Zhaohui Xu, Fakultät für Mathematik, Technische Universität Chemnitz, Reichenhainer Str. 41/718 D-09107, Chemnitz, Sachsen, Germany, zhaohui.xu@mathematik.tu-chemnitz.de

This paper is concerned with mixed-integer nonlinear bilevel programming problem, which has a nonlinear objective function and one parameter on the right-hand sides of the constraints in the lower level problem. We propose an algorithm via an approximation of the optimal value function of the lower level problem to solve the bilevel programming problem globally.

2 - The Branch-and-Sandwich Algorithm for Mixed-Integer Nonlinear Bilevel Programming Problems

Polyxeni-Margarita Kleniati, Chemical Engineering, Imperial College London, South Kensington Campus, SW7 2AZ, London, United Kingdom, polyxeni.kleniati03@imperial.ac.uk, Claire Adjiman

We extend our newly introduced algorithm for general bilevel programming problems, named Branch and Sandwich (B&S), to the discrete case. Auxiliary bounding problems are constructed in order to bound the inner optimal value function and provide constant bound cuts for the outer bounding problems. The originally proposed KKT-based relaxations for the inner-upper and outer-lower bounding problems are applicable with respect to the continuous inner variables and for fixed integer inner variables. A hierarchical branching scheme with additional lists of nodes, as developed in B&S, is investigated.
3 - A bilevel problem with supermodular objective function in the lower level
Diana Fanghaenel, Fachbereich Elektrotechnik/Informatik, Universität Kassel, Wilhelmshöher Allee 33, 34121, Kassel, Germany, d.fanghaenel@uni-kassel.de
We investigate a bilevel programming problem with continuous variables in the upper level and a parametric supermodular maximization problem in the lower level. We analyze the structure of this bilevel problem to transform it into an equivalent one-level combinatorial problem. Furthermore, we discuss the properties of the equivalent problem.

4 - Existence results for quasivariational inequalities
Didier Aussel, Lab.PROMES UPR 8521, University of Perpignan, Technosud, Rambila de la thermodynamique, 66100, Perpignan, France, aussel@univ-perp.fr
A quasi-variational inequality is a variational inequality in which the constraint set depends on the current point. Based on fixed point and convergence techniques we prove various existence results under weak assumptions on the set-valued operator defining the quasi-variational inequality, namely quasimonotonicity and lower or upper sign-continuity. Applications to quasi-optimization and traffic network problem are also considered.

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**WC-16**

Wednesday, 12:30-14:00

**RB-2103**

**Linear programming: Algorithms and Applications**

**Stream: Linear and Conic Programming**

**Invited session**

Chair: S.M. Atiqur Rahman Chowdhury, Department of Mathematics, University of Dhaka, 1000, Dhaka, Bangladesh, Chowdhury_sher@yahoo.com

1 - The primal-dual column generation method
Pablo Gonzalez-Brevis, School of Mathematics, University of Edinburgh, United Kingdom,
P.Gonzalez-Brevis@sms.ed.ac.uk, Jacek Gondzio, Pedro Munari

In this talk we will introduce a column generation method which uses a primal-dual interior point method to obtain well-centred non-optimal solutions of the restricted master problems. We will show that the method converges to an optimal solution of the master problem even though non-optimal solutions are used in the course of the procedure. Computational experiments will be presented using linear-relaxed reformulations of three classical integer programming problems. The results indicate that the method reduces the number of iterations and running times when compared with standard approaches.

2 - Compact Formulations of the Steiner Traveling Salesman Problem
Saedeh D. Nasiri, Mathematics & Statistics and Operational Research, STOR-I DTC, Lancaster University, B44, Fylde college, Lancaster University, LA1 4YF, Lancaster, Lancashire, United Kingdom,
s.dehghannisari1@lancaster.ac.uk, Adam Letchford, Dirk Oliver Theis

The Steiner Traveling Salesman Problem (STSP) is a variant of the Traveling Salesman Problem (TSP) that is particularly suitable when dealing with sparse networks, such as road networks. The standard integer programming formulation of the STSP has an exponential number of constraints, just like the standard formulation of the TSP. On the other hand, there exist several known compact formulations of the TSP, i.e., formulations with a polynomial number of both variables and constraints. In this study, we show that some of these compact formulations can be adapted to the STSP.

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**WC-17**

Wednesday, 12:30-14:00

**RB-2105**

**Nonconvex Programming**

**Stream: Nonconvex Programming: Local and Global Approaches**

**Invited session**

Chair: Hoai An Le Thi, Computer Science, University of Lorraine, Ile du Saulcy, 57 045, Metz, France, hoai-an.le-thi@univ-lorraine.fr

1 - Solving the Multidimensional Assignment Problem via the Cross-Entropy method
Manh Nguyen Duc, LMI, INSA de Rouen, Avenue de l’Université, 76801, Saint-Étienne-du-Rouvray Cedex, Rouen, France, nguyenducmanh1982@yahoo.com, Hoai An Le Thi, Tao Pham Dinh

The multidimensional assignment problem (MAP) is a higher dimensional version of the linear assignment problem, where we find tuples of elements from given sets, such that the total cost of the tuples is minimal. The MAP has many recognized applications such as data association, target tracking and resource planning. While the linear assignment problem is solvable in polynomial time, the MAP is NP-hard. In this work, we propose a new approach based on the Cross-Entropy (CE) method for solving the MAP. The results of our method will be shown by testing for the large-scale problems.

2 - On the Permutated Perceptron Problem - A New formulation and approach
Hoai Minh Le, Université Paul Verlaine Metz, LITA, UFR MIM, Ile du Saulcy, 57000, Metz, France, lehoai@univ-metz.fr, Hoai An Le Thi, Tiru Arthanari

The permutated perceptron problem (PPP) has received renewed interest due to its application in Cryptanalysis. The problem can be cast into the DC (Difference of Convex functions) programming framework and solved by DC Algorithm as shown in: 'Solving the Perceptron Problem by deterministic optimization approach based on DC programming and DCA’. Le Thi et al., Proc. of the IEEE Conference INDIN 2009. In this work we give a new formulation to PPP by using a parametric fow problem. An algorithm to solve the parametric fow problem and a probabilistic search of the parameter space are developed.
3 - Rare event simulations applied to hierarchical sensor planning with partially known subprocess models
Frédéric Dambreville, DGA, 16bis Av. Prieur de la Cote d’Or, 94110, Arcueil, France, frida@fredericdambreville.com
Information in the context of Intelligence process usually takes the form of a hierarchical, typically bi-level, planning problem. We are especially interested in the planning at the coordination level: a constraint oriented multisensor planning associated with a variety of mono-sensor control optimizations. In this contribution, we will model our sensor models an approximation noise. Real sensor models will provide indications for successive corrections of the planning process. This paper studies strategies for optimizing these plan corrections.

4 - Optimisation in water management with passive aeration of tanks
Nataliya Metla, AMS (MODSI), CRP Henri Tudor, 29 av. John F. Kennedy, L-1855, Luxembourg-Kirchberg, Luxembourg, natalyametla@tudor.lu
A multi-objective formulation is proposed for optimal design of a small water distribution system with a special issue on aeration of reservoirs linked to water quality. Model Predictive Control approach is used to create a sequence of corresponding optimization problems over finite time horizon. A specific feature belongs to the aeration component which is non-convex. A practical approach to cope with this problem will be discussed. Finally, based on realistic consumption scenarios numerical results for control strategy will be shown.

3 - Sparser arrival times in discrete location
Maria Barbati, Business and Management Engineering Department, University of Naples Federico II, P.le Tecchio 80, 80078, Naples, Italy, Italy, mariabarbati@unina.it, Giuseppe Bruno, Alfredo Marin
We consider a discrete two-stage location problem where the minimum difference between two consecutive time arrivals of customers to a depot has to be balanced. Customers have to be allocated before to a facility and after to the depot. In order to avoid the congestion of the depot the flow of customers will be the most balanced in the time. We propose different Integer Programming formulations and we identify different valid inequalities. Computational experiments have been performed and the results have been discussed.

4 - The reliable $p$-median problem with at-facility service
Maria Albareda Sambola, Statistics and Operations Research, Technical University of Catalonia, C. Colom, 11, 08222, Terrassa, Spain, maria.albareda@upc.edu, Yolanda Hinojosa, Justo Puerto
This work deals with a facility location model where service is provided at the facility sites. It is assumed that failures on facilities can occur and, as a consequence, customers may need to follow a path through the opened facilities until finding one that is available to provide them service. The goal of the problem is to locate $p$ facilities so that the expected total travel cost of the customers is minimized. Two alternative mathematical programming formulations for this problem are presented and an approximation based on network flows is analyzed.

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WC-19
Wednesday, 12:30-14:00
RB-2111

Simulation in Estimation
Stream: Simulation Methods in Finance
Invited session
Chair: Ahmet Çalkı, Statistics, Selçuk University, Selçuk University Science Faculty, Campus Konya, 42075, Konya, Turkey, ahmetcalik@selcuk.edu.tr, Chair: Aysegül Iscanoglu Cekic, Statistics, Selçuk University, KONYA, Turkey, iaysegul@selcuk.edu.tr

1 - Estimation of Stress-Strength Reliability for Exponential Geometric Distribution
Aydın Karakoç, Department of Statistics, Selçuk University, Faculty of Arts and Sciences, Konya, Turkey, akarakoc@selcuk.edu.tr, Ismail Kinaci, Adem Yılmaz
In this study we are interested in estimation of the stress-strength reliability $R=P(X<Y)$, where $X$ and $Y$ are independent exponential-geometric (EG) random variables. The confidence intervals of $R$ based on maximum likelihood and bootstrap methods are derived. An extensive computer simulation is used for comparing the performances of these confidence intervals.

2 - Simulation Study for the Comparison of Maximum Likelihood and Modified Maximum Likelihood Estimators in Logistic Regression
Yunus Akgogan, Statistics Department, Science Faculty, Selçuk University, Selçuk University, 42225, Konya, Turkey, yakogan@selcuk.edu.tr, Evrim Oral, Muslu Kazım Köre, Coskun Kus
The maximum likelihood (ML) equations are generally intractable and therefore the ML estimators are elusive. To rectify this situation, Tiku developed the method of modified maximum likelihood (MML) estimation in 1967. The method is now well established and gives estimators which are simple, unique and highly efficient. In fact, they are asymptotically fully efficient. Tiku and Vaughan (1997) used the method to extend the techniques of binary regression to nonlogistic density functions. In this study, we consider the ML and MML estimators in logistic regression. We compare the ML and MML estimators with respect to their mean square errors via a Monte Carlo simulation study. We also investigate the coverage probabilities of confidence intervals of logistic regression parameters based on ML and MML estimators via simulations. We investigate the revised MML estimators.
proposed by Tiku and Vaughan (1997) with respect to their initials values as well. We show that using least squares estimators as initial values provides approximations as good as those proposed by Tiku and Vaughan (1997). REFERENCES


3 - Estimation of stress-strength parameter for exponential distribution based on masked data
Demet Sezer, Statistics, Selçuk University, Selçuk University Faculty of Science, Department of Statistics, Konya, Turkey, dsezer@selcuk.edu.tr, İsmail Kinaci

In this study, we estimate the stress-strength parameter(R) for serial systems with two components based on masked data. In particular, we compute the maximum likelihood and Bayes estimates of R. The considered systems consist of two independent components having non-identical complementary exponential lifetime distributions. Also in the numerical simulation study a comparison between Bayes and maximum likelihood estimates is introduced.

4 - Fuzzy AHP/DEA Approach For Relative Efficiency Of Private Universities In Turkey
Ahmet Çalık, Statistics, Selçuk University, Selçuk University Science Faculty, Campus Konya, 42075, Konya, Turkey, ahmetcalik@selcuk.edu.tr, Nimet Yapıcı Pehlivan, Ahmet Pekgör

In the study we apply integrated multi-criteria decision making (MCDM) approach, including the fuzzy analytic hierarchy process (FAHP) and data envelopment analysis (DEA) model. FAHP method is fuzzy extension of AHP applied to solve decision making problems in fuzzy environment. DEA method is a MCDM tool which solve problems that don’t require prior information for ranking the decision making units. In application part, integrated FAHP/DEA is applied to private universities in Turkey. At first, for determining weights of criteria, FAHP is used and then DEA is applied to rank universities.

WC-20
Wednesday, 12:30-14:00
RB-2113

Financial Optimization 2

Stream: Financial Optimization
Invited session

Chair: Mariya Nikitina, International Banking Institute, Russian Federation, maryaniki@gmail.com

1 - Investment timing with fixed and proportional costs of external financing
Michi Nishihara, Graduate School of Economics, Osaka University, 1-7, Machikaneyama, Toyonaka, 560-0043, Osaka, Japan, nishihara@eco.osaka-u.ac.jp, Takashi Shibata

We develop a dynamic model in which a firm exercises an option to expand production with cash balance and costly external funds. While related papers explain their results only by numerical examples, we analytically prove the following results. In the presence of only a proportional cost of external financing, the firm with more cash balance invests earlier; however, the presence of both proportional and fixed costs leads to a non-monotonic relation between the investment time and cash balance. Our results can potentially account for a variety of empirical results.

2 - On optimal strategies for long-term business
Etim Bronshtein, Numerical Mathematics and Cybernetics, Ufa State Aviation Technical University, K.Marx str., 12, USATU, 450000, Ufa, Russian Federation, bro-efim@yandex.ru

The problem of optimal allocation of resources, that the company received at time n = 1.2,... on the consumption and the production is considered. The company’s activities we describe as the production functions for all time moments. The production functions are monotonically increasing, strictly concave, bounded and differentiable. We use the consumption in the discounted form as an indicator of the effectiveness. The solution is given for stable and depressive companies.

3 - Longevity Risk Management and Financial Uneasy Premonition
Tadashi Uratani, Industrial and System Engineerig, Hosei University, Kajinocho 3-7-2, Koganei, 184-8584, Tokyo, Japan, uratani@k.hosei.ac.jp

We consider longevity risk in aspect of national budget and social security expenditure. Longevity is breaking national budget system through pension and health-care deficits in Japan. The national debt is accumulated in commercial banks as a major asset that becomes their crisis in some conditions. We will examine the theoretical possibility of application of longevity bond and derivatives to the risk management of pension budgetary system.

4 - On Minimizing the Ruin Probability by Investment
Mariya Nikitina, International Banking Institute, Russian Federation, maryaniki@gmail.com

A generalization of collective risk model is considered. We propose a model in view of the possibility of investing part of the surplus in a risky asset. The assumption allows minimizing the probability of ruin of an insurance company by investment. This generalization of classical model was computer simulated. The exact solutions and asymptotic approximations to the probability of ruin were obtained.

WC-21
Wednesday, 12:30-14:00
RB-2115

Ratings of Banks and Companies

Stream: Numerical Methods in Finance
Invited session

Chair: Wissem Ennouri, Industrial Management, High Institute of Industrial Management of Sfax-Tunisia, 74 Mecca Street, 3001, Sfax, Sfax, Tunisia, wisseemennouri@yahoo.fr

1 - Cluster Analysis of Banks in Croatia Regarding their Characteristics
Ante Rozga, Faculty of Economics, Quantitative methods, University of Split, Matice Hrvatske 31, 21000, Split, Croatia, rozga@efst.hr, Ksenija Dumicic, Blanka Škrabić Petrić

Croatia privatized her banks to increase their financial performance. As a result 95% of the banking sector is owned by foreigners. Cluster analysis used eight indicators. The analysis is done for 2003 and 2008. There were 18 most important banks used. For 2003 two clusters were obtained, almost completely divided into domestic and foreign owned banks but one. First cluster had worse financial indicators suggesting successful privatization. Results for 2008 show one change in cluster membership, but the difference in their performance has narrowed between two clusters, which is good result.

2 - Effectiveness of Credit Ratings
Ivan Lichner, Economic modeling and analysis, Institute for Economic Research SAS, Sancova 56, 81105, Bratislava, Slovakia, ivan.lichner@savba.sk

Credit rating agencies (CRAs) play an important role in the global financial markets because many market participants use their rating assessments. As CRAs have a history of failing to foresee the real future development this paper aims to find answer whether or not should financial markets trust CRAs. To find answer to this question the ratings of sovereign debt of selected EU countries will be compared with Value-At-Risk measure based on fundamental economic factors. The analysis focuses on the ability of ratings to capture economic performance of assessed country.
3 - Small and Medium-Sized Businesses through the Credit Crunch: Evidence from the UK
Meng Ma, Business School, The University of Edinburgh, 29 Buccleuch Place, EH8 9JS, Edinburgh, United Kingdom, M.Ma-4@sms.ed.ac.uk, Galina Andreeva, Jake Ansell

Access to credit is a vital condition for SMEs survival and development, especially for young start-up enterprises. The credit crisis has put the problem of SME financing to the fore, with governments putting considerable pressure on banks to lend to SMEs. This presentation looks at the credit risk modelling of the UK SMEs via logistic regression applied to a large proprietary dataset, and explores the behaviour of small businesses during the credit crisis and beyond (2007-2010) across industrial sectors, geographical regions, financial situation and for start-ups versus mature businesses.

4 - Pricing Default and Financial Distress Risks in Foreign Currency Corporate Loans in Turkey
Aycan Yılmaz, Institute of Applied Mathematics/Financial Mathematics, Middle East Technical University, Istanbul, Turkey, aycanyilmaz@gmail.com, İşıl Erol

Latest trends show that non-financial corporations are heavily financed by foreign exchange loans (fx-loans). The paper contributes to the literature on contingent claims pricing by developing a structural model to value the exchange rate risk and the interest rate risk of fx-loans at the corporate level under volatile economic conditions in Turkey. The paper uses explicit finite difference method and evaluates both financial distress and default risks. The results suggest that currency depreciation and decline in interest rates result in financial distress and trigger defaults.

WC-22
Wednesday, 12:30-14:00
RB-2117

Fuzzy Scheduling and Fuzzy Quality Management

Stream: Fuzzy Optimization - Systems, Networks and Applications
Invited session

Chair: Erik Kropat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.kropat@unibw.de
Chair: Alexey Orlov, Students Science Association, Institute for applied system analysis of the National Technical University of Ukraine, Peremohy ave. 37, 03056, Kyiv, Ukraine, orlov.alexej@gmail.com

1 - A comparison study of Wilcoxon and fuzzy Wilcoxon tests
Gultekin Atalık, Statistics, Anadolu University, Anadolu University Faculty of Science Department of Statistics, Eskisehir, Turkey, gultekinali@anadolu.edu.tr, Sevil Senturk

Parametric tests depend on the population distributions to be normal and independently. Nonparametric tests do not require assumptions which parametric tests require. Parametric and nonparametric tests also handle crisp values in statistics. In the real world, data may not be measured so precisely. In these situations, fuzzy sets’ approaches are applied the data sets. In this study, Wilcoxon and Fuzzy Wilcoxon tests are compared with each other and all results are indicated clearly.

2 - A design for sampling plans by attributes under fuzzy environment
Ebru Turanoglu, Industrial Engineering, Selcuk University, Department of Industrial Engineering Selcuk University, Campus, Selcuklu, Konya, 42031, Turkey, 42031, Konya, Turkey, ebruturanoglu@gmail.com, Cengiz Kahraman

In the design of accurate acceptance sampling plan, it is usually needed to know the actual quality level entailed by the customer. Particularly in production environments, it may not be easy to define acceptance sampling parameters including fraction of nonconforming, acceptance number, or sample size as crisp values. The purpose of this paper is to develop a new design procedure for single and double sampling plans by attributes based on the fuzzy set theory by formulating this problem as a multi-objective mathematical programming considering producer’s and consumer’s risks.

3 - Task Flow Control in the GRID-System
Vlad Kucher, Educational-scientific complex - Institute for applied system analysis, National Technical University of the Ukraine (KPI), 04111, Kiew, Ukraine, commastergm@gmail.com

The model of the planning process for the task performance in the GRID-system with the multilevel hierarchical structure is introduced. The fuzzy-set approach and the application of the principle of square stowage into the band of a given width, as well as the choice of an aggregate system as a mathematical model of the planning process, have allowed the development of an algorithm, which minimizes the time of task performance as well as balances workload of resources suppliers.

4 - The analysis of influence of a choice of a class of membership functions on quality of work of recognition system
Nigar Aliyeva, Institute of Information Technologies, National Academy of Sciences of Azerbaijan, Baku, Azerbaijan, aliyevanig@rambler.ru, Elviz Ismayilov

Was analyzed effectiveness of the hand-printed recognition system using neuro-fuzzy sets with membership functions from different classes. For pattern features was constructed smooth membership functions, and also known triangular, trapezoidal, Gaussian and bell membership functions. Analyzed results of numerical experiments of recognition system with membership functions from different classes. Revealed comparative advantage of smooth membership functions offered by authors.

WC-23
Wednesday, 12:30-14:00
RB-Delta

Recent Advances on Proximal Methods II

Stream: Convex Optimization
Invited session

Chair: Hector Ramirez, Mathematical Engineering Department, Universidad de Chile, Avda. Blanco Encalada 2120, Piso 5, Santiago Centro, Santiago, RM, Chile, hramirez@dim.uchile.cl

1 - Lagrangian-penalization algorithm for constrained optimization
Juan Peypouquet, Mathematics, Universidad Tecnica Federico Santa Maria, Av Espana 1680, 2340000, Valparaiso, Valparaiso, Chile, juan.peypouquet@usm.cl

We present a proximal algorithm that provides solutions to constrained optimization problems - constrained variational inequalities - where observations of the state variable are required to belong to some closed convex set in a Hilbert space. The algorithm combines an exact penalization procedure involving a bounded sequence of parameters, with the predictor-corrector multiplier method. As applications, we describe how the algorithm can be used to find sparse solutions of linear inequality systems and solve partial differential equations by domain decomposition.

2 - Interior Proximal Algorithm with Variable Metric for Second-Order Cone Programming: Applications to Structural Optimization
Hector Ramirez, Mathematical Engineering Department, Universidad de Chile, Avda. Blanco Encalada 2120, Piso 5, Santiago Centro, Santiago, RM, Chile, hramirez@dim.uchile.cl, Felipe Alvarez, Julio López
We propose an inexact interior proximal type algorithm for solving convex second-order cone programs. The proposed algorithm uses a variable metric and an appropriate choice of a regularization parameter. This choice ensures the well-definedness of the proximal algorithm and forces the iterates to belong to the interior of the feasible set. Thus, under suitable assumptions, it is proven that each limit point of the sequence generated by the algorithm solves the problem. Finally, computational results applied to structural optimization are presented.

3 - A Projected Subgradient -type method for Equilibrium Problems
Susanne Scheimberg, COPPE/Engenharia de Sistemas e Computação-Instituto de Matemática, COPPE/PESC-IM, Universidade Federal do Rio de Janeiro, Caixa Postal 68511, Bloco H/319, 21941-972, Rio de Janeiro, RJ, Brazil, susana@cos.ufrj.br, Paulo Sergio Santos

We consider an explicit algorithm for solving Equilibrium Problems in a finite dimensional space. We combine reflections onto suitable hyperplanes to achieve feasibility with a projected subgradient-type iteration. The algorithm has a low computational cost per iteration and some numerical results are reported.

4 - Proximal Alternating Direction Methods Combining Quadratic Regularization with Divergence Kernels
Natalia Ruiz, Mathematical Engineering, Universidad de Chile, Blanco Encalada 2120, fifth floor, santiago, Región Metropolitana, Chile, nruiz@dim.uchile.cl, Felipe Alvarez

We will introduce a new alternating minimization algorithm for solving a convex program with separable structure involving linear coupling and non negativity constraints. Our algorithm consists of two proximal minimization steps applied to an augmented Lagrangian, which are performed alternatively, using quadratic regularization for the variable defined in the whole euclidean space and divergence type for non negativity one; then a proximal maximization step is performed on the dual variable. The global and full convergence of primal-dual variables to optimal solutions are established.

Criteria Weighting in Decision Support
Stream: Multi-Criteria Decision Making and Environmental Management
Invited session
Chair: Susanne Wiedenmann, Chair of Production and Logistics, University of Goettingen, Platz der Goettinger Sieben 3, 37073, Goettingen, Germany, susanne.wiedenmann@wiwi.uni-goettingen.de

1 - Supply Planning under Uncertainty for the Industrial Use of Renewable Resources
Susanne Wiedenmann, Chair of Production and Logistics, University of Goettingen, Platz der Goettinger Sieben 3, 37073, Goettingen, Germany, susanne.wiedenmann@wiwi.uni-goettingen.de, Jutta Geldermann

We investigate the supply planning of a processor of agricultural goods which are required as raw materials in industrial production. The use of linseed and linseed oil is one example that promises to be relevant in the future. Problems arise from uncertain quantity, quantity and price. A two stage stochastic program is used as a decision support and its results are evaluated. We use data from linseed and linseed oil for validation.

2 - Hydro-turbines Optimization: Specification and Operation
Jéssica Pillon Torralba Fernandes, Energy Department, UNICAMP, Rua Roxo Moreira 1406 apto 19, 13083592, Campinas, São Paulo, Brazil, pillon@fem.unicamp.br

This paper aims to present a methodology focused at the optimization of the Brazilian hydroelectric power plants potential, based on the specification of hydroelectric turbines to power plants in construction. This methodology choose and compare the efficiency curves of Kaplan and Propeller turbines, showing that, with an appropriate operation it is possible to obtain technical and economic improvements to the plants. The mathematical model is a non-linear mixed integer and aims to maximize the plant generation. The resolution is done by Genetic Algorithms.

This paper examines the risk management practices of an electricity retailer in the Dutch electricity market. We derive the optimal futures hedging policy for the retailer in the presence of demand and price risk using base- and peak-load futures contracts. We also develop an ARIMA-GARCH model for the electricity spot prices and test the effectives of our hedging policies. We show that, on average, by hedging with base-load contracts the firm may reduce the variance of its cash flows by 91%. Including peak-load contracts into the hedging portfolio increases the efficiency of hedging to 95%.
3 - Non-profit project portfolio evaluation and selection: A multicriteria approach  
Nassim Dehouche, LAMSADÉ-Université Paris-Dauphine, Place du Maréchal de Lattre de Tassigny, 75775, Paris, Ile de France, France, dehouche@lamsade.dauphine.fr, Daniel Vanderpoorten

We study settings in which a review committee is to select a portfolio of the best projects among a set of proposals. We propose a new two-stage multiple criteria parameterizable rule-based sorting methodology. First, an evaluation process is carried out, in which the focus is on an accurate capture of the knowledge created during the work of the committee. Then, a selection process takes place, in which the preferences of the decision maker regarding the portfolio are modeled in a linear program, the resolution of which specifies values for the parameters of the rule-base.

4 - Maximization of a Sum of Kendall’s Tau Rank-Correlation Coefficients  
Alexander Bolshoy, Evolutionary Biology, University of Haifa, Mt. Carmel, 39105, Haifa, Israel, bolshoy@research.haifa.ac.il

Given data on a set of objects, while every object is defined by a set of characters, the object ranking problem is to rate each object according to its characters. The input data is a matrix R(n,m) with an element (object, character). We study rating problem in context of molecular evolution. The objective is to find an optimal scale which most accurately recovers the across-object characters. As solving of this optimization problem is NP-hard, we propose an original heuristic method, a special simulation annealing scheme.

WC-27

Wednesday, 12:30-14:00
CC-A25

Knowledge Management & Decision Systems

Stream: Decision Support Systems
Invited session
Chair: Shaofeng Liu, School of Management, Plymouth University, PL4 8AA, Plymouth, Devon, United Kingdom, shaofeng.liu@plymouth.ac.uk

1 - Extending the analysis of the EURO Working Group on DSS Research Collaboration Network (EWG-DSS Collab-Net V2)  
Pascale Zarate, Institut de Recherche en Informatique de Toulouse, Toulouse University, 118 route de NarBonne, 31062, Toulouse, France, zarate@irit.fr, Fatima Dargam, David Dadenne, Isabelle Linden, Shaofeng Liu, Rita Ribeiro, Wei Sun

EWG-DSS-Collab-Net explores the group’s research collaboration since 1989. It considers a hybrid methodology for data collection, manual and automatic, incorporating web mining of electronic databases. It embeds an enhanced model of publication structure, extending the network statistics to collaboration trend analysis, with co-authorships and co-citations to further illustrate the dynamics of publications over time. These features reveal the growth of the community, find researchers for reviewing papers and projects, and encourage collaboration not only among existing but also new members.

2 - Applying ontology in the analysis of a DSS Research Collaboration Network  
Fatima Dargam, SimTech Simulation Technology, Ries Strasse 120, 8010, Graz, Austria, F.Dargam@SimTechnology.com, Antonio C. S. Branco, Alexandre Rademaker, Renato Rocha Souza

This work specifies ontology for the EWG-DSS-Collab-Net network. This network was designed to show the research collaboration dynamics in the EWG-DSS. It considers a publication relationship structured model with authors-publications and multiple keywords-topics. The network analysis shows co-authorships and co-citations overtime. In order to refine the identification of publications that are closely related to a given topic, an ontology model is specified. This way, a common vocabulary of classifications of the publications main areas can be defined and matched with the key-words.

3 - Ranking the seawater desalination methods by using multi criteria decision making approaches  
Amin Esmaeeli, DEpartment of Civil Engineering, Tabriz university, 51759-13573, Tabriz, Iran, Islamic Republic Of, aminesmaeeli88@gmail.com, Hooman Baghban Ashgharinejad, Mahdi Zarghami

In this paper we compared common desalination alternatives such as Reverse Osmosis (RO), Mechanical Vapor Compression (MVC), Multi Stage Flash (MSF), Multi Effect Distillation-Thermal Vapor Compression (MED-TVC) by using the multi criteria decision making methods based SAW and TOPSIS. The assessment criteria are energy requirement, water production cost, environmental impact, and maintenance and water quality. According to the outcomes of research for the capacity of 1200 m3/day, RO method is the best decision by the SAW method and MVC becomes the best alternative by the TOPSIS method.

WC-28

Wednesday, 12:30-14:00
CC-A27

OR Military Applications II

Stream: OR in Military, Safety and Security Applications
Invited session
Chair: Ana Isabel Barros, Military Operations, TNO, POBox 96864, 2509 JG, The Hague, Netherlands, ana.barros@tno.nl

1 - Convoysing against piracy  
Rien van de Ven, Netherlands Defence Academy, Postbus 10000, 1780 CA, Den Held, Netherlands, MPA.vd.Ven@NLO.NL, Jack Vermeulen

The last years have seen an increase in the incidence of piracy near Somalia. The Somali East Coast and the Gulf of Aden are high-risk areas. The Gulf of Aden is an important shipping lane due to its location. The fact that it is a relatively narrow area means that traffic flows in only two directions. So convoysing merchant vessels is one of the solutions to the problem of piracy. This paper presents a mathematical model how to optimize the number of merchant vessels that can be protected by a warship. Through simulation effectiveness of such a system can be quantified.

2 - Counter improvised explosive devices game  
Toru Komiyama, Dept. of Computer Science, Japan National Defense Academy, Hashirimizu 1-10-20, 2398686, Yokosuka, kanagawa, Japan, komiyama@nda.ac.jp, Akinori Yasue

In Iraq or Afghanistan peace keeping operation (PKO), many soldiers are victimized by Improvised Explosive Devices (IED). We have modeled the counter IED operation. A patrol car drives along the road where IED may be planted. Terrorist can explode hidden IED according to his ability. He can also decide number, planting place and power of the bomb in advance. On the other hand, the PKO vehicle passes beside the IED without knowing it, but he can decide physical and operational parameters of the vehicle beforehand. By using the gaming context, we decide the optimal strategies on both sides.

3 - A NATO Guide for Judgement-based Operational Analysis  
Ingrid Bastings, Military Operation Research, TNO Defence, Safety and Security, PO Box 96864, 2509 JG, The Hague, Netherlands, ingrid.bastings@tno.nl, Diederik J.D. Wijnmalen

The SAS Panel of NATO/RTO tasked a group to write a Code of Best Practice for Judgement-based OA in Defence Decision Making. Its aim is not only to create an understanding of what judgement-based
OA is, how it can address messy defence problems and how they can be coped with, but also how to conduct a judgement-based OA study in order to maximise the validity, credibility and acceptance of such a study and its outcomes. We will clarify some of the analyst- and client-oriented highlights of the Guide.

4 - Topology of Military C2 Systems and its relation to cyber warfare
Herman Monsuur, Faculty of Military Sciences, Netherlands Defence Academy, P.O. Box 10.000, 1780 CA, Den Helder, Netherlands, h.monsuur@nlda.nl

We relate aggregate qualities found in the military C2 literature to the axiomatic approach in network theory. We address multi-layered networks and metrics for network control and for the feedback of operational links, as well as the merging of network metrics and C2 socio-technical covariates. We also apply our findings to cyber warfare.

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**Optimization and Data Mining (I)**

**Stream: **Optimization and Data Mining

**Invited session**

Chair: Concha Bielza, Inteligencia Artificial, Universidad Politécnica de Madrid, Campus de Montegancedo, 28660, Madrid, Spain, mc.bielza@t.umin.es

Chair: Rubén Armañanzas, Artificial Intelligence Department, Technical University of Madrid, Facultad de Informática, Campus de Montegancedo, 28660, Madrid, Spain, r.armananzas@upm.es

1 - Mathematical Models of Supervised Learning and Application to Biomedical Problems
Mario Guarraíno, Istituto di Calcolo e Reti ad Alte Prestazioni, 80131, Napoli, Italy, mario.guarracino@na.icar.cnr.it, Roberta De Asmundis

Supervised learning models are applicable in many fields of science. Among them, there are Support Vector Machines (SVM), which exhibit accurate solutions and low training time. SVM are based on the statistical learning theory and provide the solution by minimizing a quadratic type cost function. SVM, in conjunction with the use of kernel methods, provide non-linear classification models, namely separations that cannot be expressed using inequalities on linear combinations of parameters. We describe here some applications to biomedical problems, with the support of numerical experiments.

2 - Incorporating Partially Labeled Information into Kernel Spectral Clustering
Carlos Alzate, IBM Research, Ireland, carlos.alzate@gmail.com, Johan Suykens

Kernel Spectral Clustering (KSC) corresponds to a primal-dual formulation to clustering allowing out-of-sample extensions and model selection in a learning setting. The primal is defined in terms of high-dimensional feature maps and the dual is an eigenvalue problem of a weighted kernel matrix. We extend the core KSC model by adding extra terms in the objective function related to the labeled information together with regularization constants. The resulting dual is no longer an eigenvalue problem but a linear system. Simulation results show the applicability of the proposed method.

3 - Restating clinical impression of severity index for Parkinson’s disease using just non-motor criteria
Rubén Armañanzas, Artificial Intelligence Department, Technical University of Madrid, Facultad de Informática, Campus de Montegancedo, 28660, Madrid, Spain, r.armananzas@upm.es, Pablo Martinez-Martín, Concha Bielza, Pedro Larrañaga

Clinical impression of severity index (CISI) for Parkinson’s disease (PD) is an index to assess PD severity based on four clinical domains. Since this is a continuous value, a categorization policy is proposed by solving an optimization problem. Using this encoding, different comparisons between CISI and other non-motor indexes or items are addressed using wrapper item subset selection and estimation of distribution algorithms. Results show some of the non-motor items are very relevant, achieving good classification performances when used to predict the CISI severity index.

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**WC-30**

**Wednesday, 12:30-14:00**

**CC-A31**

**DEA and Performance Measurement: Applications 9**

**Stream:** DEA and Performance Measurement (contributed)

**Contributed session**

Chair: Ahti Salo, Systems Analysis Laboratory, Aalto University, School of Science and Technology, P.O. Box 11100, Otakaari 1 M, 00076, Aalto, Finland, ahti.salo@aalto.fi

1 - Measuring the Operation Efficiency for Bus Transit in Taiwan with Undesirable Outputs
Chao-Chung Kang, Department of Business Administration and Graduate Institute of Management, Providence University, 200, Chung-Chi, Rd., 433, Shalu, Taichung, Taiwan, cckang@pu.edu.tw

This paper studies the operating efficiency for bus transit with undesirable outputs by slack-based data envelopment analysis (SBM-DEA) in Taiwan. Data of Taipei over 2007-2010 is drawn for the study. Vehicle-kilometer and operation revenue are taken as desirable outputs; vehicle emission as undesirable output; labor, vehicle, and fuel are the inputs. We compare the differences in efficiency evaluation produced by DEA and SBM-DEA. The effects in relative efficiency of desirable and undesirable output can suggest practical strategies for improving the operating efficiency of bus transit.

2 - Factors defining Effectiveness of automatic vehicle location systems
Daniil Opolchenov, Department of Electronics, Transport and Telecommunication Institute, Lomonosova street 1, LV-1019, Riga, Latvia, Opolchenov.D@tsi.lv

This work is devoted to solving the problem of AVL systems effectiveness estimation. In this work we consider the tasks of defining the factors which determine the effectiveness of AVL systems, and of obtaining their numerical values and distribution laws. To reduce the analysis complexity, we divide AVL systems into subsystems and define accordingly the factors defining their effectiveness. The results of this work can be used to obtain an effectiveness index.

3 - Chinese Companies Distress Prediction: An Application of Data Envelopment Analysis
Zhiyong Li, King’s College London, Flat 13, 35 Peffer Bank, EH16 4FE, Edinburgh, Scotland, United Kingdom, zhiyong.li@ed.ac.uk, Jonathan Crook, Galina Andreeva

Traditional distress prediction models employ financial ratios to predict distress. We investigate the predictive accuracy of efficiency measures along with ratios in predicting distress in Chinese companies. Unlike previous studies where DEA was used to generate a single efficiency-TE, we decompose TE into PTE and SE. These variables are introduced into LR to make prediction. Efficiency of firms for several industrial sectors is integrated in one industry-specific LR. The results show the predictive power is improved by this efficiency. Both Cross-sectional and panel models are tested.
4 - Analyzing Portfolios of DMUs with Ratio-Based Efficiency Analysis (REA)
Ahti Salo, Systems Analysis Laboratory, Aalto University School of Science and Technology, P.O. Box 11100, Otakaari 1 M, 00076, Aalto, Finland, ahti.salo@aalto.fi, Janus Liesiö, Yongjun Li

In this paper, we extend Ratio-Based Efficiency Analysis [Salo and Punkka, 2011, Mgmt Sci 57/1] for the comparison of portfolios, defined as combinations of DMUs where the share of each DMU is required to satisfy linear constraints. In particular, we establish a dominance relationship among such feasible portfolios in order to determine which portfolios are more efficient than others. We also examine the composition of efficient portfolios, which allows us to determine minimum and maximum bounds on the share of any DMU across all efficient portfolios.

1 - On Multidimensional Performance Measures — A Critical Reflection and Future Developments
João Clímaco, INESC-Coimbra, 3004-512, Coimbra, Portugal, jclimaco@inescc.pt

In this communication we start by summarizing and exemplifying the difficulties to build quality of life indicators and sustainability indicators, aggregating several dimensions. Ethical, methodological and practical issues are emphasised. Secondly, we discuss how and in which cases the notion of capability, proposed by A.Sen, could be useful, and we propose a multidimensional visual procedure to explore the information provided by adequate dashboards, helpful in those situations. A software demonstration will be done. Finally, future trends of research are outlined.

2 - Responsibility in Decision-Support
Sven Diekmann, Philosophy & Ethics of Technology, Eindhoven University of Technology, P.O. Box 513, IJsselstein, 5600 MB, Eindhoven, Netherlands, s.diekmann@tue.nl

Operations Researchers (ORs) often influence decisions on ethical issues, e.g. HIV policies. Although they do not decide themselves, their work makes them accountable for consequences of supported decisions. However, are ORs also morally blameworthy? Are they accountable for unforeseeable consequences? I distinguish responsibility, accountability and blameworthiness. In the following, I investigate criteria for holding ORs accountable or blameworthy. I conclude that ORs can always be held accountable for consequences related to their work, while blameworthiness depends on specific conditions.

3 - Multicriteria analysis ranking the most developed EU countries
Zeljko Racin, Operational research, Faculty of economics, Majke Jugovic 4, Banjaluka, Bosnia And Herzegovina, zeljko.racin@efib.org, Matea Zlatkovic

Analysis of socio-economic development shows that it is a multidimensional category. That multidimensionality of socio-economic development will be the subject of this paper; specifically, the group of the most developed EU countries. Starting with the selection of development indicators, executed based on principal components analysis using the statistical software SPSS, i.e. the latest version of PASW Statistics 20, through their determination of satisfactory or “optimal” number and order of importance, using the PROMETHEE method, it will be up to the value of a synthetic indicator of the development level derived from the set of selected indicators.

4 - A value structured approach to conflicts in environmental management
Fred Wenstøp, Strategy and Logistics, BI Norwegian School of Management, Nydalsveien 37, 0483, Oslo, Norway, fred.wenstop@bi.no

The paper aims to suggest how OR practitioners ought to approach value conflicts in environmental management. The approach is practical and founded on three pillars: ethics, neuro-economics, and decision sciences. A rational approach problems is too often hampered by strong emotions elicited by value conflicts among stakeholders. Thus, considerable resources are often squandered on ill founded projects with detrimental effects. This could be mitigated if the OR analyst has a deeper understanding of ethical reasons for choice, and knowledge of practical methods to deal with values.
3 - Sustainability prioritizing constructing projects of municipalities based on AHP and COPRAS-G: a case study about construction of footbridges in Iran

Edmundas Kazimieras Zavadskas, Department of Construction Technology and Management, Vilnius Gediminas Technical University, Saulėtekio ave. 11, LT–10223, Vilnius, Lithuania, edmundas.zavadskas@vgtu.lt,
Mohammad Hasan Aghdaie, Sarfaraz Hashemkhani Zolfani

This study gives a framework for municipalities to prioritize their projects based on this framework. The footbridge project of Sari City in Iran is selected as a case study for this research. Selecting area for constructing footbridges including quantitative and qualitative factors such as the Total cost, Environmental factors, Socio-economic factors can be viewed as a kind of Multi-Attribute Decision Making (MADM) problem. The aim of this study is to use Analytic Hierarchy Process (AHP) and COPRAS-G methods for evaluation and selection the new footbridges alternatives.

4 - Sustainability assessment model of supplier selection problem

Jolanta Tamosaitiene, Department of Construction Technology and Management, Vilnius Gediminas Technical University, Saulėtekio ave. 11, LT–10223, Vilnius, Lithuania, jolanta.tamosaitiene@vgtu.lt, Edmundas Kazimieras Zavadskas, Zenonas Turskis

This paper aims to utilize a hybrid multi-criteria decision making (MCDM) model in supplier selection. Eight evaluation criteria — cost, quality, distance, delivery reliability, reputation, technology level, compatibility and development ability are identified. The Analytic Hierarchical Process is initially used for calculating the weight of each criterion and the Complex PProportional Assessment of alternatives with Grey relations (COPRAS-G method) is adopted for ranking suppliers. In order to illustrate the model’s functional ability, Kalleh Company is chosen as a case study.

**WC-33**

Wednesday, 12:30-14:00

**CC-A37**

**Sustainable Construction Processes and supplier selection**

Stream: OR for Sustainable Development

*Invited session*

Chair: Folke Björk, Civil and Architectural Engineering, KTH – Royal Institute of Technology, Brinellv. 23, SE 10044, Stockholm, Sweden, folke.bjork@byv.kth.se

1 - Multi-criteria assessment of the sustainable renovation according on the methodology of the building certification system

Milena Medineckiene, Department of Civil and Architectural Engineering, Royal Institute of Technology, Brinellvagen 23, SE 10044, Stockholm, Sweden, milenamedineckiene@gmail.com, Folke Björk, Zenonas Turskis

This research deal with how Multi Criteria Decision Making (MCDM) can be applied when building renovation is to be connected to environmental certification. The presentation will highlight the methodology of the MCDM methods and explain about how the criteria from the certification systems can be adapted to mathematical algorithms of the MCDM. The research will result in a methodology for the building owner in public or private sector, which will help to integrate sustainable technology with competitiveness. This should help the building owners to make decisions for sustainable renovation.

2 - Classification of factors influencing environmental management of enterprise

Tatjana Tamboucheva, Faculty of Engineering Economics and Management, Riga Technical University, Mezha Street 17/213, LV-1048, Riga, Latvia, tatjana.tamboucheva@rtu.lv

In article the analysis of different factors influencing environmental management was done. Company’s external and internal environment elements were clustered. The author distinguishes between the following groups of factors: production — technical, economic, political — legal, organizational, ecological and risk factors, as well as education and culture level. The study is based on the theoretical analyses of literature and scientific publications, as well as on research based on survey results collected from Latvian companies.

**WC-34**

Wednesday, 12:30-14:00

**CC-A39**

**Economic modeling and finance**

Stream: Cooperative Game Theory

*Invited session*

Chair: Sima Zeynep Alparslan Gok, Mathematics, Faculty of Arts and Sciences, Suleyman Demirel University, Faculty of Arts and Sciences, Suleyman Demirel University, Department of Mathematics, 32260, Isparta, Turkey, zeynepalparslan@yahoo.com

1 - The Choquet Integral as a continuous certainty equivalent

Gianni Bosi, Dipartimento di Scienze Economiche, Aziendali, Matematiche e Statistiche, University of Trieste, Italy, giannibo@econ.units.it, Magali E. Zuanon

The concept of a certainty equivalent is relevant in many fields when preferences over stochastic situations are considered (for example, stochastic cooperative games or risk attitudes in a multiperiod context). We present a characterization of the existence of a continuous certainty equivalent which can be represented as the Choquet integral with respect to a concave probability distortion, therefore continuing in some sense previous work by Bosi, Zuanon et al. [Mathematical Social Sciences, 2003, 2007].

2 - An Adversarial approach to maximize gain due to finite precision errors in basic financial computations

Ganesh Perumal M, International Institute of Information Technology, Bangalore, Electronics City, Hosur Road, 560100, Bangalore, Karnataka, India, ganesh_perumal@iiitb.ac.in, Abhilasha Asswal, G. N. Srinivasa Prasanna
Basic Financial transactions including deposit, withdrawal and currency conversion may be erroneous due to the usage of IEEE 754 binary standards. This cumulative error can be significantly maximized in ones favor (especially in multicurrency transactions), using a clever adversary, utilizing information about the error generation and propagation process. We give an optimization model to maximize gain due to such errors.

3 - Handling peak loads in queuing service systems
Abraham Seidmann, University of Rochester, 14627, Rochester, NY, United States, seidmannav@simon.rochester.edu, Martya Bondareva

We study the efficient design of queuing service systems with high service level constraints and non-stationary periodic arrival rates. The research introduces the concept of ‘peaker’ capacity service for handling variable peak-load demands. Internal expert teams handle the base-load of transactions, while the external peaker team is contracted to handle only the peak demand. We developed a two-staged game to choose the optimal contracting policy with the peaker, and a robust procedure to determine both the base-load - and the peaker’s capacity levels.

4 - Pricing Strategies for Gaming-on-Demand
Sumanta Basu, Operations Management, Indian Institute of Management Calcutta, K-302, New Academic Block, IIM Calcutta, D.H. Road, Joka, 700104, Kolkata, West Bengal, India, sumanta@iimcal.ac.in, Soumyakanti Chakraborty

Social gaming has pushed the traditional video gaming industry to the brink of disruption using concepts like cloud gaming or gaming-on-demand. However, the success of the gaming-on-demand model would depend to a large extent on pricing, e.g. non-linear usage based fee, a fixed fee or a combination of both. In this paper, we develop a pricing schedule for a typical cloud game provider by modeling the alternatives available to a consumer and the propensity to engage in gaming. We also determine the conditions that determine the switching behavior of customers from usage based to fixed fee plan.

2 - Balance Optimization Subset Selection (BOSS) for Causal Inference with Observational Data
Alexander Nikolaev, Department of Industrial and Systems Engineering, University at Buffalo (SUNY), 409 Bell Hall, 14260-2050, Buffalo, NY, United States, anikolaev@buffalo.edu, Sheldon Jacobson

To make causal inferences outside the experimental realm, researchers attempt to post-process large observational data sets to mimic experimental data. The primary approach used has been to match treated and untreated units to achieve a measure of balance. We explain BOSS, a novel approach that eliminates the matching stage and directly optimizes balance. It identifies sets of statistically indistinguishable treatment and control groups, perfectly optimized with respect to one or more predefined balance measures, giving a minimally biased estimator of the treatment effect.

3 - Testing of MARS on MODIS Images for Local Atmospheric Spheric Correction
Semih Kuter, Department of Forest Engineering, Cankiri Karatekin University, Cankiri Karatekin Universitesi, Orman Fakultesi, 18200, Cankiri, Turkey, semihkuter@yahoo.com, Zuhal Akyurek, Gerhard-Wilhelm Weber, Ayse Özmen

In this study, Multivariate Adaptive Regression Splines (MARS) is used for local atmospheric correction. Being adaptive and flexible, both linear and non-linear problems with large data sets can be handled by MARS. Local atmospheric correction is carried out by applying MARS method on real data, sets of MODIS (Moderate-resolution Imaging Spectroradiometer) images over Europe and Turkey. Obtained results are compared with the results of SMAC (Simplified Method for Atmospheric Correction — a numerical radiative transfer model) algorithm both numerically and visually.

4 - Estimation of Multi-dimensional Stochastic Differential Equations with CMARS Method
Fatma Yerlikaya Ozkurt, Scientific Computing, Institute of Applied Mathematics, Industrial Engineering Department, Middle East Technical University, 06800, Ankara, Turkey, fatmayerlikaya@gmail.com, Gerhard-Wilhelm Weber

CMARS, an alternative approach to the well-known data mining tool MARS, is based on a penalized residual sum of squares for MARS as a Tikhonov regularization problem. It treats this problem by a Conic Quadratic Programming. Stochastic Differential Equations are widely used to represent noisy and real world problems. SDEs are usually hard to represent and to resolve by a computer. Before, we identified 1-dimensional SDE in a simplified manner by using CMARS. Now, we aim to estimate multi-dimensional SDEs with CMARS. The theoretical results and implementation of this study will be presented.

Recent Achievements in Regression and Classification

1 - Restructuring the forward step of CMARS by a mapping approach
Elcin Kartal Koc, Statistics, Middle East Technical University, Department of Statistics, No:234, 06800, Ankara, Turkey, kartalecin@gmail.com, Cem Iyigun, Inci Batmaz, Gerhard-Wilhelm Weber

CMARS is proposed as a new approach to MARS with its model-based alternative to the backward step. Instead of stepwise elimination step, a penalized residual sum of squares is used as a Tikhonov regularization problem which is solved with a conic quadratic programming. The drawback of CMARS is its time inefficiency. In this study, to increase the run time of CMARS, a mapping idea is proposed for knot selection in the forward step. Integration of mapping idea into CMARS-forward algorithm can decrease the computing time significantly by considering less number of data points as candidate knots.

Recent Advances of OR on Societal Complexity

1 - By revitalization of ancient abandoned cemeteries to societal and economic strengthening of small sites
Eva Králova, Institute of History and Theory of Architecture and Monument Restoration, Slovak university of technology, Faculty of architecture, Namestie slobody 19, 81245, Bratislava, Slovakia, Slovakia, kralova@fa.stuba.sk
For societal and economic development of small sites, it is important to utilize local potential. Cultural traditions, local monuments and memory places are parts of the potential source for revitalization. Abandoned cemeteries represent a special group of such socially accepted and venerated places; without an active local societal life it becomes a complex societal problem. We present the case study of an old cemetery in Banska Stiavnica, Slovakia (UNESCO World Heritage). We introduce the approach and processes of revitalization using operational research.

2 - A surprising equivalence between Consolation of Philosophy and Methodology for Societal Complexity
Nicolaus Bulz, National Defence College, Romania, nbulz@yahoo.com

There is the affirmation on equivalence: two attempts toward difficult “problem solving”. 1) Consolation of Philosophy, by Roman philosopher Boetius and 2) Methodology for Societal Complexity, by prof. Dorien J. DeTombe. To point on a single occurrence of the concept problem/solve across the text of Consolation of Philosophy: Book III. True Happiness and False. “I understand the problem, but I desire to hear how thou wouldst solve it.” An inquiry within the entire content of Boetius’ texts would possible depict significant equivalence between his and our attempts on "problem solving".

3 - Using agent-based modelling and simulation in patient adherence to medication
Christos Vasilakis, Clinical Operational Research Unit, University College London, 4 Taviton Street, WC1H 0BT, London, United Kingdom, c.vasilakis@ucl.ac.uk, Christina Pagel, Steve Gallivan, Nick Barber, Martin Utley

It is known that patient adherence to medication can determine the effectiveness of a therapy. It is less known what the impact on clinical effectiveness is of a number of interacting factors: the pharmacokinetic features of a drug and drug regimen, the different patterns of patient adherence and the interaction of patients and prescribers in improving adherence. In this study we used agent-based modelling and simulation to explore the impact of hypothetical patterns of behaviour and interaction between patients and prescribers on drug concentrations.

4 - Uncovering the hospital length of stay distribution: a finite mixture model approach
Maria Guzman Castillo, University of Southampton, United Kingdom, M.Guzman-Castillo@soton.ac.uk, Sally Brailsford, Honora Smith

Most of the research on modelling length of stay (LoS) attempts to find a suitable probabilistic distribution to describe patient LoS. However, single distributions have shown limited success for this task. Lately, it has been suggested that LoS data may in fact represent a mixture of several distributions. These models are referred as finite mixture models, where a continuous variable consists of 2 or more clusters of observations with different parameters. This research extends previous work by exploring different types of mixtures and by integrating patient attributes into the model.
ethanol and sugar production, as well as in decisions related to agricultural and logistics phases, on a weekly-basis planning horizon, including the whole harvesting season and the periods between harvests. The model was applied to a real case with excellent results.

3 - A Multi-objective Portfolio Optimization Model with Higher Order Moments
Bijaya Krishna Mangaraj, Production & Operations Management Area, XLRI School of Business & Human Resources, Jamshedpur-831001, India, C.H. Area(East), Jamshedpur, Jamshedpur, Jharkhand, India, mangaraj@xlr.ac.in, Gayatri Biswal

Markowitz’s seminal work on modern portfolio theory is based on a strong normality assumption of the distribution of portfolio returns and proposed a parametric approach using mean and variance. However, due to non-parametric nature of such distributions, study on modern portfolio efficiency measure has been extended to a mean-variance-skewness-kurtosis framework. We discuss a multi-objective approach of portfolio optimization using fuzzy goal programming for generating a non-dominated portfolio in a four-dimensional case. We test the model with a sample of stocks from Mumbai Stock Exchange.

4 - Trade-off in statistical design process
Samuel Bohman, Department of Computer and Systems Sciences, Stockholm University, Forum 100, 164 40, Kista, Kista, Sweden, samboh@dsv.su.se, Maria Kalinina, Aron Larsson

The design and planning of a statistical survey can be regarded as a complex decision process involving multiple stakeholders and a diverse set of users. The process involves finding a balance between statistical quality, burden on respondents and costs. Our research is aimed towards developing a prototype system consisting of computational core based on the combination of multi-objective optimization, multi-criteria analysis, and a user-friendly interface. The overall objective of the research is to maximize statistical quality while minimizing the burden on respondents and costs.

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**WC-39**

Wednesday, 12:30-14:00

HH-Cousteau

Cops and Robber Games

Stream: Graph Searching

**Invited session**

Chair: Nancy Clarke, Mathematics and Statistics, Acadia University, 12 University Avenue, B4P 2R6, Wolfville, Nova Scotia, Canada, nancy.clarke@acadiau.ca

1 - Slow Firefighting on Graphs
Margaret-Ellen Messinger, Mathematics Department, Mount Allison University, New Brunswick, Canada, mmessinger@mta.ca

In firefighting and graph searching problems, a contaminant typically spreads very quickly. We introduce a variant in which the contaminant spreads at a slower rate. At each time step, the searchers (or firefighters) protect one vertex and the contaminant (or fire) spreads from one vertex to all unprotected, unburned neighbours. On infinite graphs, the goal of the firefighter is to surround the burned vertices with a set of protected vertices, while the goal of the fire is to avoid such containment. We will consider results on both the two-dimensional and three-dimensional grids.

2 - Cops and a Robber on a graph embedded into a surface
Dirk Oliver Theis, Mathematics, Otto von Guericke University Magdeburg, Germany, dotimidot@gmail.com, Nancy Clarke

Given a graph embedded on a surface genus $g$, what is the minimum number of Cops needed to catch a Robber? We discuss an approach based on covering spaces. For non-orientable surfaces, this technique improves the formerly known bounds effortlessly. For orientable surfaces, with considerable effort, we reduce the question to one concerning a polytope in the homology space of the surface defined by the cycles of the graph. Joint work with Nancy Clarke (Acadia, NS) and Samuel Fiorini, Gwenaël Joret, Mathieu Carette (ULB, Brussels).

3 - Ambush Cops and Robbers
Nancy Clarke, Mathematics and Statistics, Acadia University, 12 University Avenue, B4P2R6, Wolfville, Nova Scotia, Canada, nancy.clarke@acadiau.ca

A variation of the Cops and Robber game is introduced in which the robber side consists of two robbers. The cops win by moving onto the same vertex as one of the robbers after a finite number of moves. The robbers win by avoiding capture indefinitely or by both moving onto the same vertex as the cop. (Otherwise, the robbers are on distinct vertices.) We present a variety of results including a recognition theorem for graphs on which a single cop can guarantee a win, as well as a strategy that can be used by the cop to win on such graphs.

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**WC-40**

Wednesday, 12:30-14:00

HH-Livingstone

Model quality and modelling sustainable energy and transport systems

Stream: SD Modelling in Sustainable Development

**Invited session**

Chair: Pierre Kunsch, MOSI, Vrije Universiteit Brussel, Pleinlaan 2, 1050, Brussels, Belgium, pkunsch@vub.ac.be

1 - Comparing a BRT and a PRT system
Tsutomu Mishina, Systems Science and Technology, Akita Perfectural University, 84-4 Tsuchia-Ebinokuchi, 015-0055, Akita, Japan, mishina@akita-pu.ac.jp, Alejandra Gomez Padilla

Bus Rapid Transit (BRT) is a proven effective method for mass transportation. Developing countries have introduced it big cities. Personal Rapid Transit (PRT) is a relatively new transportation system, with developing applications usually in developed countries. This work compares of both systems. The data of an actually operating BRT system is considered, and this data is used suppose that a PRT system is running instead. This is, for the same demand of passengers, smaller vehicles are used, which pass more frequently, run faster and will only stop at the final destination station.

2 - Automatic control of turbo generators setting automatic frequency
Megoulou Hocine, Automatique, Université de Boumerdes, boulevard de l’indépendance, cité 392 lots bt 17 G08, 35000, Boumerdes, Boumerdes, Algeria, meg.hocine@yahoo.fr

The production-consumption balance is ensured, in normal operation, two additional automatic actions: setting primary and secondary control. Their performance is critical to the safety of the system. The primary control, it is crucial for power system reliability during the large amplitude variations, to master quickly the transition frequency so as to not reach the top levels of shedding frequency.

3 - Phasing-out nuclear energy in Belgium: is it feasible?
Pierre Kunsch, MOSI, Vrije Universiteit Brussel, Pleinlaan 2, 1050, Brussels, Belgium, pkunsch@vub.ac.be

The Belgian government has decided to phase-out nuclear power plants from 2015 on till 2025 while they represent today more than half the electricity production. By means of system dynamics modelling this presentation investigates different scenarios to check the feasibility of such decisions. It is found that gas and coal would be the winners, rather than renewable energy sources; this is rather the opposite of the sought for environment-friendly evolution.
4 - Model Quality: How to Build Better Models
Markus Schwaninger, Institut für Betriebswirtschaft, Universität St.Gallen, Dufourstrasse 40a, 9000, St.Gallen, Switzerland, markus.schwaninger@unisg.ch

Building high-quality models is perhaps the primary challenge ahead of us in modeling and simulation. This rationale is grounded in the Conant/Ashby-theorem, which will be introduced. Thereafter, strategies and methods for the validation of dynamic-simulation models, and other measures for the enhancement of model quality, will be presented.

WC-41
Wednesday, 12:30-14:00
HH-Heyerdahl
Modern project for involvement young people in OR community and OR education
Stream: Young People for System Theory, Optimization and Education
Invited session
Chair: Bohdan Pukalskyi, Students Science Association, National Technical University of Ukraine, Kovalskyi provulok 5, 03057, Kyiv, Ukraine, bogdanpukalskyy@gmail.com
Chair: Kateryna Pereverza, Students Science Association, National Technical University of Ukraine, Kyiv, Scherbakova str., 42/44, app. 54, Kyiv, Ukraine, pereverza.kate@gmail.com

1 - Achieving interdisciplinarity in OR by additional educational activities. Example of Summer School AACIMP
Iryna Smolina, Metal Physics, NTUU "KPI", 03056, Kyiv, Ukraine, iryna.smolina@gmail.com

Interdisciplinarity is one of essential characteristics of OR as well as of all modern science. Additional educational activities like summer schools, on-line courses and internships are effective tools for spreading this principle among new generations of OR researchers. Summer school "AACIMP" is good example of such educational activities, which combines different OR approaches to solve various problems and provide students with better understanding of interdisciplinarity of contemporary science. We present the experience of organization of the Summer School "AACIMP".

2 - Odss.4SC: A summer school in Optimization and Decision Support Systems for Supply Chain Management
Giuseppe Bruno, Dipartimento di Ingegneria Economico-Gestionale, Università Federico II di Napoli, Piazzale Tecchio n.80, 80125, Napoli, Italy, italy, giuseppe.bruno@unina.it, Ana Amaro, Miguel Casquilho, Albert Corominas, Andrea Genovese, Juan Manuel García Lopez, Amaia Luna, Johan Magnusson, Henrique Matos, Joao Miranda, Sergio Rubio

Our Summer School is taking place in Portalegre, Portugal, July, 1-15, within the Erasmus Intensive Programme. The audience is formed by MSc./PhD. students on Engineering and Logistics specialties, from more than 12 countries. It aims at: (a) describing the industry-based supply chain operations with a particular concern to the green logistic aspects; (b) using optimization models to solve specific problems. The lectures follow a pull approach, from distribution to supply subjects, the lab sessions are supported by IBM/ILOG. We present the program and the future perspectives.

3 - Mathematically formalized methodology for scenario study. Approaches for scenario space exploration
Kateryna Pereverza, Students Science Association, National Technical University of Ukraine, Kyiv, Scherbakova str., 42/44, app. 54, Kyiv, Ukraine, pereverza.kate@gmail.com

Scenario analysis is well known technique for exploration of future development of different complex systems as countries, cities, companies etc. The stage of scenario space exploration is one of the most relevant in scenario study. Big amount of built scenarios can be explored using different OR methods as associated analysis, Bayes network etc. The mathematically formalized methodology for scenario study will be present in the talk. The example of scenario space analysis for country using mentioned methods will be shown.

WC-42
Wednesday, 12:30-14:00
BW-Amber
Queueing Systems II
Stream: Stochastic Modeling and Simulation in Engineering, Management and Science
Invited session
Chair: Erik Kropat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.kropat@unibw.de
Chair: Devin Sezer, Middle East Technical University, Institute of Applied Mathematics, Eskisehir Yolu, 06531, Ankara, devin@metu.edu.tr
Chair: Basak Tanyeri, Bilkent University, Turkey, basak@bilkent.edu.tr

1 - Analyzing Multi-server Queueing Model with no Waiting Line
Hanhit Okan Isguder, Statistics, Dokuz Eylul University, Dokuz Eylul University Faculty of Science, Department of Statistics Tinaztepe Buca, 35160, Izmir, Turkey, okan.isguder@deu.edu.tr, Sener Akpinar, Atabak Elmi, Alper Hamzadayi, Sinme Yelkenci Kose

In this study a queueing system with recurrent arrivals, three heterogeneous servers, and no waiting line is examined. In the system customers choose only one server among the empty servers with different probabilities. When all servers are busy, customers depart from the system without taking any service. These customers are called “lost customers”. The probability of losing a customer is computed for the queueing system.

2 - Distribution Evaluation and Decomposition for Queueing Networks Modelling
Jean-Sébastien Tancrez, Louvain School of Management, Université catholique de Louvain, UCL - LSM, 151, Chaussée de Binche, 7000, Mons, Belgium, js.tancrez@uclouvain-mons.be

A modeling methodology is presented for queuing networks with general assumptions : fork/join networks, general service time distributions and finite buffers. The general distributions are discretized by aggregation of the probability masses, and the transformed system is analytically modeled using a Markov chain. First, we show that it allows a fine estimation of the cycle time distributions. Second, we introduce a decomposition approach to analyze larger queueing networks. Using computational experiments, we show that it leads to accurate performance evaluation and that the fine distribution estimation seems to bring an improvement.

3 - Alternative stochastic approaches for condition-based production-maintenance control
Michael Kaluzny, Business Administration, Production and Logistics, University of Dortmund, Germany, michael.kaluzny@tu-dortmund.de, Ralf Gossinger

Condition-based maintenance is analysed for a decentralised production-maintenance system where deterioration depends on production parameter settings. In order to keep up a defined machine availability an information exchange protocol is developed. On this basis alternative stochastic approaches to calculate the machine condition triggering the order release are formulated and numerically analysed. These approaches take waiting time between maintenance order release and order fulfillment as well as possibly modified production parameter settings during this waiting time into account.
4. Optimal Control Formulation of Query Model for Authentication Systems
Devin Sezer, Middle East Technical University, Institute of Applied Mathematics, Eskisehir Oyu, 06531, Ankara, devin@metu.edu.tr, Ferhah Orzbudak, Yildirim Ustun
This research studies the N step adaptive attack on an authentication system using an authentication oracle described in (Safavi-Naini, Wild, 2008). We represent the maximum success probability of this type of attack as the value function of an optimal control problem and derive the dynamic programming equation that the value function satisfies. The same paper cited above proves that randomized queries in such an attack have the same probability of success as that of a deterministic attack. We rederive this fact using our control representation.

WC-44
Wednesday, 12:30-14:00
BW-Marble

Information and Intelligent Systems I

Stream: Information and Intelligent Systems
Invited session
Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTU, 06531, Ankara, Turkey, gweber@metu.edu.tr
Chair: Wuyi Yue, Intelligence and Informatics, Konan University, 8-9-1 Okamoto, Higashinada-ku, 658-8501, Kobe, Japan, yue@konan-u.ac.jp

1. Malfunction diagnosis on air-conditioning using rough sets approach
Hong Tau Lee, Industrial Engineering and Management, National Chin-Yi University of Technology, Taipin, Taichung County, 411, ROC, Taiwan, leecht@ncut.edu.tw, Sheu Hua Chen

In order to effectively diagnose faults causing, this paper proposes a simplified approach for diagnosing air conditioning system which is based on rough sets theory. This approach converts the reasons and symptoms to condition and decision attributes respectively. Finally, possible reasons can be diagnosed while the specific set of core attributes of symptom occurred. This is a simplified way of avoiding the testing of all the items that are usually used in the traditional method of determining the fault cause.

2. Approach for the prolongation of the lifetime of a wireless sensor network
Abdelmalek Boudries, University of Bejaia, university of Setif, Algeria, Boumansour Cne Oued-Chir W-Bejaia, Bejaia, Algeria, am_boudries@yahoo.fr, Makhlouf Allouat

We propose an approach for the connectivity maintenance in the wireless sensor networks. The principle of the solution is the following: a node which wants to transmit data chooses the way of the greatest weight. The idea is that if the remaining rate of energy decreases then the weight of the way containing this node decreases. The aimed objective is to maintain the connected network for longest time possible by prolonging the lifetime of the nodes sensors which have consumed much energy. The suggested approach was tested on an example of scenario and showed its effectiveness.

3. Analysis of real-time traffic with the sleep mode in IEEE 802.16m networks
Wuyi Yue, Intelligence and Informatics, Konan University, 8-9-1 Okamoto, Higashinada-ku, 658-8501, Kobe, Japan, yue@konan-u.ac.jp, Shuntiu Jin, Xiaofei Zhang

In this paper, based on the working principle of the sleep mode in IEEE 802.16m, a queuing model with multiple heterogeneous vacations is presented. Considering the packet correlation in real-time traffic, the system arrival is supposed to be a discrete-time Markovian process. The formulas for the average latency and energy saving ratio are obtained, and the numerical results are given. The time length of the sleep cycle is optimized by constructing a cost function. The authors are grateful to Prof. M. Kokai for his helpful comments in this paper.

4. Planning of Map Making Technique by Planning Method with Continuously Operating Reference Station (CORS-TR)
Omur Esen, Office of Construction and Infrastructure, Selcuk University, Division of Cartography, 42250, Konya, Selcuklu, Turkey, omuresen@hotmail.com, I Bulent Gundogdu
CORS project has started in USA and Turkey as part of the project CORS-TR approved by Istanbul Culture University, General Directorate of Land Registry and Cadastre and General Command of Mapping cooperation and by The Scientific and Technological Council of Turkey sponsorship. Aim is to determine data by 7/24 observation in Turkey according to geographical position real time and by post processing in a fast and economical way and at the same time modeling of ionosphere and troposphere, requiring geological data and determining transformation parameters between ED50 and ITRF Dates.

WC-45
Wednesday, 12:30-14:00
BW-Water

Advanced Revenue Management

Stream: Advanced Inventory Control and Pricing Strategies
Invited session
Chair: Claudius Steinhardt, Department of Analytics & Optimization, University of Augsburg, Universitätsstraße 16, 86159, Augsburg, Germany, claudius.steinhardt@wiwi.uni-augsburg.de

1. Pricing-cum-Inventory Decisions in Supply Chain Networks
Lambros Pechlivanos, Athens University of Economics and Business, Greece, lpetch@uegb.e, Panos Scefritis

An optimization-based control framework that simultaneously determines the optimal inventory and product pricing policies is developed for multi-product, multi-echelon supply chain networks. Product price manipulation can be used to alleviate congested transportation routes, by altering appropriately the demand profile at the end-point nodes of the network. A flexible node-level pricing policy can be understood as a substitute instrument to supply chain management, as it succeeds in altering the flow of orders customers place by redirecting orders to the desired end-point nodes.

2. Modeling of customer choice behavior in revenue management
Petr Fiala, Dept. of Econometrics, University of Economics Prague, W.Churchill Sq. 4, 13067, Prague 3, Czech Republic, pfiala@vse.cz

Revenue management is the process of understanding, anticipating and influencing customer behavior in order to maximize revenue. The common modeling approaches assume that customers are passive. Today’s customers actively evaluate alternatives and make choices. Revenue management pays increasing attention to modeling the behavior of individual customers. A modeling approach for strategic customer behavior is proposed. The evaluation of alternatives can be done by DEA based evaluation methods. The approach is based on instruments of artificial neural networks and Petri nets.

3. Incorporating Auction Games in Logistics Optimization Academic Course
Charis Marentakis, Industrial Management and Technology, University of Piraeus, Karoli and Dimitriou Street, 18534, Piraeus, Greece, chmarent@unipi.gr, Dimitrios Emiris, Maria Giannopoulou

Auctions and Revenue Management methods are currently evolving in the research and practice of Logistics Management. Several Operations Research techniques are engaged in this direction, aiming to support pricing decisions related to optimal capacity and resource management. The present article describes experiences from the enrichment
of a Logistics Optimization course with an auction-based freight transport business game. It explains why and how to engage auctions in conformance with the theoretic operations research part of the course and demonstrates major outcomes focusing mainly on the behavioral study of participants and the convergence between participants’ valuations.

4 - Decision tools for online pricing and sourcing for truckload trucking

Hani Mahmassani, Transportation Center, Northwestern University, 600 Foster St, 60208, Evanston, Illinois, United States, masmah@northwestern.edu, Diego Klabjan, Hamed Babai, Young Woong Park, Christopher Lindsey

This study develops tools to support online operations of a third-party non-asset carrier in matching truckload shipments between shippers and carriers. The model considers respective shipper and carrier acceptance likelihood in an optimal pricing engine that maximizes profit for the matching agent.

Wednesday, 14:30-16:00

■ WD-01
Wednesday, 14:30-16:00
RB-Alfa

Tutorial Lecture: Professor Karla Hoffman

Stream: Keynote, Tutorial and Plenary Lectures

Tutorial session

Chair: Mikael Rönqvist, Département de génie mécanique, Université Laval, G1V 0A6, Québec, Canada, mikael.ronnqvist@nhh.no

1 - Auctions: Why they proliferating and what you need to know to participate

Karla Hoffman, Department of Systems Engineering and Operations Research, George Mason University, Mail Stop 4A6, 4400 University Drive, 22030, Fairfax, Virginia, United States, khoffman@gmu.edu

The advent of the Internet has led to the creation of global marketplaces in which sales of everything from low-cost used merchandise to billion dollar government procurements are conducted by auction. While some auction designs have been extremely successful, others have failed disastrously. This talk will describe a variety of alternative auction designs, and will explore why one design is likely to be more appropriate than another for a given application. We will begin with a brief history of auctions, provide reasons for eBay’s spectacular success, and highlight the Internet’s impact on auction theory and practice. We will then move on to a discussion of the strategies that are available to bidders in the most-utilized auction formats, thereby providing each of you with hints on how to be more successful when participating in auctions. Throughout the talk, we will highlight the role that operations research analysts can play in designing, running, and assisting participants in business-to-business and high-stakes government auctions.

■ WD-02
Wednesday, 14:30-16:00
RB-Beta

Methods for Resource-Constrained Project Scheduling

Stream: Project Management and Scheduling

Invited session

Chair: Vincent Van Peteghem, People, markets and humanities, EDHEC Business School, 24, avenue Gustave Delory, 59057, Roubaix, France, vincent.vanpeteghem@edhec.edu

1 - Solving resource-constrained project scheduling problems with new mathematical programming formulations

Thomas Kyriakidis, Department of Engineering Informatics & Telecommunications, University of Western Macedonia, Karamanli and Lygeris Street, 50100, Kozani, Kozani, Greece, tkiriakidis@uowm.gr, Georgios Kopanos, Michael Georgiadis

In this work, 2 binary-integer programming discrete-time models and 2 mixed-integer continuous-time formulations are presented for the solution of resource-constrained project scheduling problems. These formulations are compared with 4 state-of-the-art literature models using a total of 2760 benchmark problem instances (j30 and j60 from PSPLIB, and 1800 problem instances generated by RanGen2). A detailed computational comparison study illustrates the efficiency of the proposed mathematical formulations, with the continuous-time mathematical formulations featuring the best overall performance.
2 - Solving the resource-constrained project scheduling problem using large neighborhood search
Wolfgang Summerauer, Department of Business Administration, University of Vienna, Brunnener Strasse 72, 1210, Vienna, Vienna, Austria, wolfgang.summerauer@univie.ac.at, Christian Almeder, Richard Hartl

We present an algorithm based on large neighborhood search (LNS) to solve the resource-constrained project scheduling problem (RCPSP), where a project consists of activities that have to be scheduled under resource and precedence constraints. The objective is to find a schedule that minimizes the makespan of the project. We developed new tailor-made destroy and repair operators and also adapted existing operators from the literature to tackle the RCPSP. Preliminary results for the benchmark instances of the literature look promising with respect to solution quality and computational time.

3 - An Invasive Weed Optimization algorithm for the resource availability cost problem
Vincent Van Peteghem, People, markets and humanities, EDHEC Business School, 24, avenue Gustave Delory, 59057, Roubaix, France, vincent.vanpeteghem@edhec.edu, Mario Vanhoucke

In this study, an Invasive Weed Optimization (IWO) algorithm for the resource availability cost problem is presented, in which the total cost of the (unlimited) renewable resources required to complete the project by a pre-specified project deadline should be minimized. The IWO algorithm is a new search strategy, which makes use of mechanisms inspired by the natural behavior of weeds in colonizing and finding a suitable place for growth and reproduction. All algorithmic components are explained in detail and computational results for the RACP are presented.

WD-03
Wednesday, 14:30-16:00
RB-L1
Demand Responsiveness and Transportation Network Design

Stream: Optimization in Public Transport
Invited session
Chair: Gabriel Gutiérrez-Jarpa, School of Industrial Engineering, Pontificia Universidad Católica de Valparaíso, 2362807, Valparaíso, Chile, Gabriel.gutierrez@ucv.cl

1 - An analytical model to estimate the optimal cycle length of demand responsive feeder transit services
Luca Quadrifoglio, Civil Engineering, Texas A&M University, CE/TTI Bldg. Room 301-L, 3136 TAMU, 77843-3136, College Station, Texas, United States, quadrifo@tamu.edu, Shailesh Chandra

An increase of "livability" depends on solutions to the issue of first/last mile access to transit. We are working to identify the feeder’s optimal cycle duration to maximize LOS. At first, a simulation case study with demand data from El Cenizo, TX has been conducted by simulation. We are now developing a handy analytical model to obtain results, without relying on extensive simulation analyses. Experiments appear to validate our model, which would allow planners, decision makers to quickly identify the best feeder transit operating design of any given residential area.

2 - Dynamic Vehicle Routing for Demand Responsive Transportation Services
Jorge Pinho de Sousa, Faculdade de Engenharia da Universidade do Porto / INESC Porto, Campus da FEUP, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal, jsousa@inescporto.pt, Rui Gomes, Teresa Galvão Dias

Providing quality public transportation may be very expensive in low and unpredictable demand scenarios. Demand Responsive Transportation (DRT) services address these issues with flexible routes and frequencies. We present an innovative approach for designing and operating these services, considering the perspectives of the different stakeholders. This multi-objective approach integrates simulation and heuristics in a DSS, aiming at minimizing operating costs and maximizing service quality. The DSS is also a tool to assess the performance of different DRT deployments and operating rules.

3 - Cut and Brach Synchronization Bus Timetabling
Yasmin Rios-solis, Graduate school of systems engineering, Universidad Autonoma de Nuevo Leon, Facultad de Ingenieria Mecanica y Electrica, Av. Universidad s/n, 65450, Monterrey, Nuevo Leon, Mexico, agueda.riossolis@uannl.edu.mx, Omar Ibarra-Rojas

We focus on bus timetabling problems of typical networks of Latin America: large network where passenger transfers must be favored, almost evenly spaced departures are sought, bus bunching of different lines must be avoided, timetable generation is needed several times a day, and travel times are irregular. We formulate this timetabling problem with the objective of maximizing the number of synchronizations. We provide valid inequalities to tighten the formulation. Experimentation shows that our methods obtains solutions less than 1% from the optimum in minutes even for large instances.

WD-04
Wednesday, 14:30-16:00
RB-L2
Advances for solving Quadratic and Other Difficult 0-1 Optimization Problems

Stream: Combinatorial Optimization
Invited session
Chair: Monique Guignard-Spielberg, OPIM, University of Pennsylvania, 5th floor, JMHH, 3730 Walnut Street, 191046340, Philadelphia, PA, United States, guignard_monique@yahoo.fr
Chair: Peter Hahn, Electrical and Systems Engineering, University of Pennsylvania, 200 South 33rd Street, 191046314, Philadelphia, PA, United States, hahn@seas.upenn.edu

1 - Eigenvalues of Voting Power Indexes
Lee Papayanoopoulos, MSIS, Rutgers University, RBS, 1 Washington Park, 07102, Newark, NJ, United States, lpl1@business.rutgers.edu

We explore the eigenvectors and eigenvalues of power indexes used in legislative representation and their use in integer/mixed integer search methods for “fair” weighted votes, namely, votes that render the voting power distribution (a combinatorial vector function) near-collinear with an associated population vector of constituencies.

2 - Extensive experiments with the improved hybrid genetic algorithm for the quadratic assignment problem
Alfonsas Misevicius, Multimedia Engineering, Kaunas University of Technology, Studentu st 50-400a/416a, LT-51368, Kaunas, Lithuania, alfonsas.misevicius@ktu.lt

We provide valid inequalities to tighten the formulation.
Hybrid genetic algorithms (HGAs) are among the most efficient optimization techniques. In contrast to the standard GAs, which are based on natural evolution in a straightforward manner, the hybrid GAs can be understood as modeling of more complex environments, where the lifecycle transformations play the important role. In this work, several modifications of the improved HGA for the quadratic assignment problem (QAP) are tested, in particular: initial burst, incorporating the iterated local search, extra improvement, cohesive crossover, different population update schemes, using restarts, etc.

3 - The hypergraph assignment problem
Olga Heissmann, Zuse Institute Berlin, Germany, heissmann@zib.de, Ralf Borndörfer

The hypergraph assignment problem (HAP) is the generalization of assignments on directed graphs to directed hypergraphs. It serves, in particular, as a universal tool to model several train composition rules in vehicle rotation planning for long distance passenger railways. Even for problems with a small hyperarc size and hypergraphs with a special partitioned structure the HAP is NP-hard. We present interesting polyhedral results derived from a complete facet classification of small HAP polytopes. These can be generalized to cut inequalities for the LP relaxation of large-scale problems.

4 - 0-1 quadratic optimization problems: convexification and solution.
Monique Guignard-Spielberg, OPIM, University of Pennsylvania, 5th floor, JMHH, 3730 Walnut Street, 191046340, Philadelphia, PA, United States, guignard_monique@yahoo.fr, Lucas Létocart, Gérard Plateau

Convexification of the objective function of a 0-1 quadratic optimization problem (QQP, QKP,...) is theoretically possible using an SDP model and its dual. We will discuss the numerical difficulties encountered in the process, and will show that for small to medium size instances, one may be able to obtain an equivalent convex model and a reasonable lower bound. One can also try to generate improved bounds and good feasible solutions using the convex hull relaxation (CHR), and/or try to solve the convex model by standard MIQCP software, such as CPLEX.

As shown by R. Gomory, the set of vertices of the master corner polyhedron over a group is the union of orbits under the stabilizer of a certain element. We prove that two combinatorial operations transforming vertices to their neighbors map the orbits onto the others. So any system of representatives for some special orbits forms a polyhedron vertex basis, often small in size. We geometrically characterize the irreducible points and establish relations between the coefficients of the facets through a given vertex. The computational potential of the results is discussed.

3 - The K-Separator Problem
Mohamed Ahmed Mohamed Sidi, Telecom SudParis, 9 Rue Charles Fourier, 91000, Evry, France, m.ahmed.m-sidi@telecom-sudparis.eu, Walid Ben-ameur, Jose Neto

Let G be a vertex-weighted undirected graph and k be a positive number. We want to compute a minimum-weight subset of vertices whose removal leads to a graph where the size of each connected component is less than or equal to k. Let us call such a set a k-separator. If k=1 we get vertex cover problem. The case k=2 is equivalent to compute the dissociation number of a graph (case of unit weights). We give some formulations of the problem. We point out some cases where the problem is easy to solve. Some simple approximation algorithms are described. Numerical results are also reported.

4 - s-Fold Feasibility of Integer Knapsacks
Iskander Aliev, School of Mathematics, Cardiff University, Senghennydd Road, CF24 4AG, Cardiff, alievii@cf.ac.uk

The integer knapsack problem is a well-known problem in integer programming. Since this problem is NP-hard in general, we are interested in well-solved special cases. In particular, when the right-hand sides satisfy certain geometric criteria, the existence of a feasible solution can be determined immediately, without the need for complex optimization techniques. We focus on the case where the knapsack polytope contains at least a prescribed number of integer points. We show that the feasibility of the problem appears to be closely related to the behaviour of the s-covering radius.

1 - Analysis of stroke patients EEG signals on the base of cooperative game theory
Hamidreza Navidi, science, Shahed University, 0098, Tehran, Iran, Islamic Republic Of, navidi@shahed.ac.ir, Majid Hassanpour-ezati, Saeid Barjesteh, Hadi Aghayari

Electroencephalogram (EEG) is useful tool for detection of stroke. Here, a model presented on the base of cooperative game theory to analyses of features extraction of stroke patient EEG signals and the contribution rate of these features on outbreak of stroke is calculated. This features obtained from EEG by use of detrended fluctuation analysis method. In this research the data set were collected from 27 stroke patients. The result showed that some channels of EEG in stroke patients have more contribution rate in stroke detection. This finding is correlated with some practical observation.

2 - A game theoretical approach to the Emergency Medical Vehicle - Emergency Department interface
Vincent Knight, School of Mathematics, Cardiff University, CF24 4AG, Cardiff, United Kingdom, Knightva@cf.ac.uk

Here, a model presented on the base of cooperative game theory to analyses of features extraction of stroke patient EEG signals and the contribution rate of these features on outbreak of stroke is calculated. This features obtained from EEG by use of detrended fluctuation analysis method. In this research the data set were collected from 27 stroke patients. The result showed that some channels of EEG in stroke patients have more contribution rate in stroke detection. This finding is correlated with some practical observation.
At the forefront of any healthcare system are two interacting services: the Emergency Medical Vehicle (EMV) service and the Emergency Department (ED). Often EMVs are subject to long delays at a particular ED whilst the ED suffers from upstream congestion due to arrivals of other patients. In this work, a game theoretical model is given. The ED’s strategies correspond to the allocation of resources throughout the hospital whilst the EMV service is modelled as a routing game. Various insights are given that inform as to optimal levels of policy regulation.

3 - Non-conflicting redistribution of optimal income for non-cycling network systems
Sergei Schreider, School of Mathematical and Geospatial Sciences, RMIT University, GPO Box 2476V Melbourne, 3001, Melbourne, Victoria, Australia, sergei.schreider@rmit.edu.au

For LP optimized systems whose network structure is represented with a graph without inner cycles (which is a particular case of Berge’s normal hypergraph) the stable optimal solution exists. The stability means that the total optimal income of the system can be distributed between players in the way that no individual player or coalition of players can be better off playing individually. Such stable income redistribution was found for two network systems, one of which water allocation and the second one represents the natural gas allocation system.

4 - Strategy for Land Acquisition: a game-theoretical model
S Deman, Economics & Statistics, Centre for Statistics, Economics & Finance, PO Box 17517, SE9 2ZP, London, United Kingdom, s_deman2000@yahoo.co.uk

The process by which houses, land, and other forms of real property are sold has been the subject of considerable economic research over the last few decades. However, the recent crash in housing prices in US and in Western European countries made the study of this subject even more important.

The cross entropy (CE) method was developed to estimate rare event probabilities through simulation, and has been applied to some optimization problems. To solve a VRP we try to estimate the probability that the total distance traveled is less than a given value, over all feasible routes. We have developed new CE heuristics based on a cluster-first route-second scheme which do not limit the search over the solution space as the existing CE algorithm did. We also tackle the SVRP where the demands follow a given distribution. We present computational results to evaluate these approaches.

3 - Orienteering Problem with Hotel Selection: A Variable Neighborhood Search Method
Ali Divsalar, Center for Industrial Management/Traffic & Infrastructure, KULeuven, Belgium, Ali.Divsalar@ciib.kuleuven.be, Pieter Vansteenweghen, Dirk Cattrysse

In the orienteering problem with hotel selection (OPHS) a set of vertices with a score and a set of hotels are given. The goal is to determine a fixed number of connected trips that visits some vertices and maximizes the sum of the collected scores. Each trip is limited in length and should start and end in one of the hotels. A variable neighborhood search algorithm is developed to solve the OPHS based on a neighborhood search operator designed for the hotel selection and some neighborhoods for the regular OP. Two appropriate sets of instances with known optimal solutions are designed.

4 - Improved Methods for the Travelling Salesperson Problem with Hotel Selection
Marco Castro, Faculteit Toegepaste Economische Wetenschappen, Universiteit Antwerpen, Prinsstraat 13, 2000, Antwerpen, Belgium, marco.castro@ua.ac.be, Kenneth Sörensen, Pieter Vansteenweghen, Peter Goos

In this talk, a new formulation and a new metaheuristic solution procedure for the travelling salesperson problem with hotel selection (TSPHS) is presented. The metaheuristic is a multi-start procedure that outperforms existing heuristics on all benchmark instances. We also provide a number of new optimal solutions found by a commercial solver extended with a dedicated cutting plane procedure, as well as new best known solutions for most benchmark instances.
2 - Basic VNS for Machine Reassignment
Nenad Madenovic, School of Mathematics, Brunel University, Kingston Lane, UB3 3PH, Uxbridge, Middlesex, United Kingdom, Nenad.Madenovic@brunel.ac.uk, Bassem Jarboui, Dragan Urosevic

We propose Basic VNS for Challenging machine reassignment. Two neighborhood structures are used for Shaking: reassignment and swap. Local search uses re-assignment moves. We divide the set of constraints into hard and soft. Hard constraints are always taken into account in any move, while soft are included into objective function with increasing penalty function. In other words, our objective function is dynamic and includes some constraints, if they are violated.

3 - ROADEF/EURO Challenge 2012 : Final Results announcement
Eric Bourreau, COCONUT, LIRMM, 161 Rue Ada, 34000, Montpellier, France, eric.bourreau@lirmm.fr, H. Murat Afsar, Christian Artigues, Emmanuel Guerre, Kedad-Sidhoum Safia, Ender Ozcan, Marc Sevaux

We present the results of the ROADEF/EURO 2102 challenge, an international optimization contest propose jointly by EURO, the French OR society (ROADEF) and an industrial partner (GOOGLE). Many prizes are offered. Google propose 5000 euros in the junior category, 5000 euros in the senior category and 10 000 euros for a specific Open Source category. Intermediate qualification results (available since February 2012 on http://challenge.roadef.org/) have already shown that the competition is very tight, but after this presentation, the suspense will be over as the winners will be revealed.

2 - Solution of facility layout problem through discrete particle swarm optimization algorithm and an application
Abdullah Oktay Dundar, Akoren Vocational School, Selcuk University, Akoren, KONYA, Turkey, aodundar@selcuk.edu.tr, Mehmet Akif Salman, Muhammet Bezirci, Ali Alagöz

It is aimed in this study to demonstrate the difference in business costs that will emerge after situating the units of the manufacturing plant in the best way and thus reducing the movement within the plant. In this context, the facility layout problem of a manufacturing business located in the city of Konya was re-designed through Discrete Particle Swarm Optimization algorithm, and the cost differences between the current and the designed plant location were demonstrated.

3 - Scheduling a flowshop of batch processors containing individual job families
Marc-André Iseben, BIBA - Bremer Institut für Produktion und Logistik GmbH at the University of Bremen, Germany, ise@biba.uni-bremen.de, Bernd Scholz-Reiter

We introduce a scheduling problem consisting of a batch processor flow shop. Each stage has one batch processor working by the batch availability model. The problem contains stage specific incompatible job families. This induces non-permutation schedules, inconsistent batches and stage across interdependencies of jobs. Additionally, it includes unequal processing times, distinct due dates, time periods and batch size proportional setup times. Batch sizes underlie minimal and maximal bounds. We present the corresponding ILP, a greedy heuristic, a genetic algorithm and experimental results.

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**WD-10**

**Integrated Planning of Operations**

**Stream: Supply Chain Management Invited session**

Chair: Thomas Makuschewitz, BIBA - Bremer Institut für Produktion und Logistik GmbH at the University of Bremen, Hochschulring 20, 28359, Bremen, Germany, hmn@biba.uni-bremen.de, Thomas Makuschewitz, Enzo Frazzon, Bernd Scholz-Reiter

Interdependencies between production scheduling and maritime transport determine costs and lead times in global supply chains. An integrated scheduling combines flexible production and land transport schemes with overseas transport running a given timetable. In our talk we present a heuristic scheduling method based on the construction of a cost-weighted graph for each shipment, containing only feasible paths regarding time and capacity. In an iterative approach an overall schedule is obtained by finding shortest paths for shipments. The results are obtained using a real world test case.

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**WD-12**

**Port and Liner Management**

**Stream: Container Terminal Operations Invited session**

Chair: Haakon Lindstad, Marintek AS, Otto Nielsensvei 10, 7450, Trondheim, Norway, Haakon.Lindstad@marintek.simf.no

1 - Integrated and robust planning of bulk port operations
Nitish Umang, Transport and Mobility Laboratory (Transp-OR), Ecole Polytechnique Federale De Lausanne, Avenue Tir Federale 92, 1024, Eculbens, Vaud, Switzerland, nitish.umang@epfl.ch, Michel Bierlaire

Bulk ports have received considerably less attention than container terminals in the field of large scale optimization. We present two exact solution approaches based on mixed integer programming and generalized set partitioning, and a heuristic approach to model the dynamic, hybrid berth allocation problem in bulk ports. We make the model robust to uncertainties and present a dynamic recovery algorithm to solve the berth allocation problem in real time. We also formulate an MIP to consider the integrated planning of berth and yard space allocation, and implement it using column generation.

2 - Port dynamics - A challenge for network optimization in liner shipping
Nguyen Khoi Tran, Logistics System, Institute of Shipping Economics and Logistics, Universiteitsallee 11-13, 28359, Bremen, Germany, khoi@isl.org, Hans-Dietrich Haasis

The presentation aims to review port development as well as optimization study in liner network. Ports have integrated into global supply chain. Their scope has surpassed traditional sea side and included also land side connection. Optimization review concentrates on route optimization, fleet operation, container planning with various problems and methodologies. Naturally, network optimization should be considered both sea and land factors. Our simulation illustrates the impact of various logistics costs on total door-to-door cost, in particular inland and inventory carrying costs.
3 - Knowledge Management of Macro and Micro Seaport Repositories using Data Mining Techniques
Ana Halabi Echeverry, Computing, Macquarie University, 17a Gilda St, North Ryde, 2113, Sydney, NSW, Australia, ana.halabiecheverry@mq.edu.au, Deborah Richards, Ayse Bilgin, Jairo Montoya-Torres

We propose that repository data can be connected into a systemic framework for decision-making of port authorities (PAs). We propose a systemic model we call the Port Decision System Approach (PDSA). Initially we test it, using cluster analysis to identify patterns with the available data. Results help to understand the similarities and differences between subsystems of PDSA. Secondly, we use neural networks as a method to validate the associations by using combinations of inputs and outputs. Thus, we provide a proof of concept of a strategic decision making tool for PAs in emerging regions

4 - Multi objective scheduling and environmental routing of maritime vessels
Haakon Lindstad, Marintek AS, Otto Nielsensvei 10, 7450, Trondheim, Norway, Haakon.Lindstad@marintek.sintef.no

Ship scheduling and routing which concerns the optimal assignment of available cargoes to maximize profit is a complex problem. Increased environmental concern due to climate change adds another dimension to the scheduling and makes it multi objective. This study has focused on developing a methodology for calculating fuel consumption and emissions as function of sea conditions and vessel characteristics. And to use it for scheduling in a multi objective environment where voyage requirement will vary between minimizing voyage emissions, minimize voyage cost or maximizing profit.

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**WD-13**

**Emerging Issues in New Product Development**

Stream: OR Applications in the Automotive Industry

Invited session

Chair: Thomas Volling, Institute of Automotive Management and Industrial Production, Technische Universität Braunschweig, Katharinenstr. 3, 38106, Braunschweig, Germany, t.volling@tu-braunschweig.de

1 - A Proposal of Diagnosis Procedure for BTO Products
Yuji Sato, Graduate School of Policy Science, Me Chukyo University, 1846 Kubo, 515-8511, Matusaka, Mie, Japan, ysato@1988.jukui.kio.ac.jp

The objective of this paper is to propose a diagnosis procedure of user’s preference for a BTO product, and to subsequently optimize the specification of the product for a manufacturing company. By combining cost-benefit analysis which evaluates potential products, and AHP which quantifies subjective judgment in evaluations, user’s preference is diagnosed. The benefit of this approach is to be able to provide both the decision support and corporate strategy necessary to ensure success in the future. A case study is carried out to demonstrate the applicability of the proposed approach.

2 - Algorithms for Extending Battery’s lifespan in Electric Vehicles
Ron Adany, Computer Science, Bar-Ilan University, 52900, Ramat-Gan, Israel, adanyr@cs.biu.ac.il, Doron Aurbach, Sarit Kraus

In this paper we propose algorithms to improve the battery’s lifespan. The battery, which is actually a pack of batteries, is designed to be discharged in a specific current whereby other currents, higher or lower, have negative effects on its lifespan. The common discharge method supplies the current demand using all the batteries in the pack. Since the discharge current demands are not constant, there is room for improvement. We propose a switching algorithm which, for each discharge demand, selects a subset of batteries to be discharged as well as the discharge current for each.

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**WD-15**

**Theory and algorithms of bilevel programming II**

Stream: Variational Inequalities and Bi-Level Problems

Invited session

Chair: Alain B. Zemkoho, Mathematics and Computer Sciences, Technical University Bergakademie Freiberg, Akademiestr. 6, 09599, Freiberg, Saxonia, Germany, zemkoho@student.tu-freiberg.de

1 - Solution algorithm for linear bilevel programming problem
Stephan Dempe, Mathematics and Computer Sciences, Technische Universität Freiberg, 09596, Freiberg, Germany, dempe@math.tu-freiberg.de, Shili Peng

Let S(x) be the solution set mapping of a parametric linear optimization problem having the parameter in the right-hand side of the linear constraints. Then, the linear bilevel programming problem consists in minimizing a linear objective function subject to the variable x being an element of a certain polyhedron and y being an element of S(x). An optimal solution can be found at a vertex of the underlying polyhedron and a simplex-like algorithm is formulated which moves along the feasible vertices. This algorithm can be globalized using a tunneling idea.

2 - Some results in semivectorial bilevel optimal control problem
Henri Bonnel, ERIM, University of New Caledonia, B.P. R4, F98851, Noumea, New Caledonia, bonnel@univ-nc.nc, Jacqueline Morgan

I will present optimality conditions for the bilevel optimal control problems where the upper level is a scalar optimal control problem to be solved by the leader, and the lower level is a multiobjective convex optimal control problem to be solved by several followers acting in a cooperative way inside the greatest coalition. I will consider the so-called optimistic case as well as the pessimistic one.

3 - On an enumerative algorithm for solving eigenvalue complementarity problems
Joaquim Judice, Instituto de Telecomunicações, Polo II, 3000, Coimbra, Portugal, Joaquim.Judice@co.it.pt, Luis Fernandez, Hanif Shekari, Maria Forjaz

In this talk, we discuss the solution of linear and quadratic eigenvalue complementarity problems (EiCPs) using an enumerative method. The algorithm solves these EiCPs by finding global minima of special nonlinear programs (NLPs). Procedures for computing the interval that contains all the eigenvalues are introduced. Necessary and sufficient conditions for stationary points of these NLPs to be solutions of the EiCPs are established. Some computational experience is reported to highlight the efficiency and efficacy of the enumerative algorithm for solving the EiCPs.
Recent Advances in Linear Programming and Related Subjects

Stream: Linear and Conic Programming

Invited session

Chair: Tibor Illés, Differential Equations, Budapest University of Technology and Economics, Egry J. u. 1., 1111, Budapest, Hungary, illes@math.bme.hu

1 - Advantages and disadvantages of successive linear programming methods for solving non-linear problems
Zsolt Csizmadia, Xpress, FICO, FICO House, Starley Way, Birmingham, United Kingdom, zsoltcsizmadia@fico.com

For solving general non-linear problems using out of the box solution methods, choosing second order algorithms is often the rule of thumb entrusting in their general robustness and their ability to solve many problems without extensive tuning. However, there are several problem classes and applications where a first order method is better suited for efficiently solving the right formulation. The talk will present examples and applications where an integrated successive linear programming method outperforms second order approaches by magnitudes.

2 - The numerical behavior of s-monotone index selection rules for the simplex algorithm
Adrienn Nagy, FICO, FICO House, Starley Way, Birmingham, United Kingdom, adriennagy@fico.com, Tibor Illés

Several variations of index selection rules for Simplex algorithms like the Last-In-First-Out or the Most-Often-Selected-Variable rules not only are theoretically finite, but also provide significant flexibility in choosing a pivot element. Based on an implementation of the primal Simplex and the Monotone Build-Up (MBU) Simplex method using the callable library of FICO Xpress, the practical advantage of these methods are evaluated using public benchmark LP test sets. Our results also provide numerical evidence that the MBU-Simplex algorithm is a viable alternative to the Simplex algorithm.

3 - Cutting Plane Methods for Solving Inexact Problems
Fariba Pidani, Department of Mathematics, Mahshahr Branch, islamic Azad University, Mahshahr, Iran, Islamic Republic Of, faribapidani@yahoo.com

In this paper we study some well-known cases of nonlinear programming problems, presenting them as instances of Inexact Linear Programming. The class of problems considered contains, semidefinite programming, second order cone programming and special cases of inexact semidefinite programming. Strong duality results for the nonlinear problems studied are obtained via Lagrangian duality. Using these results we propose some dual algorithms. The proposed algorithms can be interpreted as cutting plane (also non polyhedral) or discretization algorithms.

4 - The s-Monotone Index Selection Rules for Pivot Algorithms of Linear Programming
Tibor Illés, Differential Equations, Budapest University of Technology and Economics, Egry J. u. 1., 1111, Budapest, Hungary, illes@math.bme.hu, Zsolt Csizmadia, Adrienn Nagy

We introduce the concept of s-monotone index selection rule for linear programming problems. We show that several known anti-cycling pivot rules like the minimal index, last-in-first-out and the most-often-selected-variable pivot rules are s-monotone index selection rules. Furthermore, we show a possible way to define new s-monotone pivot rules. We prove that several known algorithms like the primal (dual) simplex, MBU-simplex algorithms and criss-cross algorithm with s-monotone pivot rules are finite methods.

DC programming and DCA 2

Stream: Nonconvex Programming: Local and Global Approaches

Invited session

Chair: Tao Pham Dinh, INSA Rouen, 76131, Rouen, France, pham@insa-rouen.fr

1 - DC Programming via BMI constraints
Yi-Shuai Niu, CORIA UMR 6614, French National Centre for Scientific Research, Site Universitaire du Madrillet BP 12, 76801, SAINT ETIENNE DU ROUVRAY, France, niuy@insa-rouen.fr, Tao Pham Dinh

We propose efficient method for DC programming via BMI (Bilinear Matrix Inequality) constraints which has important applications in robust control. This is a very difficult NP-hard problem, the difficulty lies in the nonconvexity of the objective function and BMI constraints. We reformulate the problem as a DC program with convex constraints via penalization techniques and propose DC Algorithm (DCA) for numerical solution. DCA requires solving a convex program via LMI constraints in each iteration. Numerical simulations and comparisons with PENBMI show good performance of our method.

2 - Combining multiobjective constraint satisfaction and sequential control for solving the sensors management of the intelligence process
Ali Khenchaf, Lab-Stic UMR CNRS 6285, ENSTA Bretagne, 2 Rue François Verny, 29806, Brest, France, ali.khenchaf@ensta-bretagne.fr, Manh Nguyen Duc, Damhrelvire Frédéric, Christophe Osswald, Abdelmalek Toumi, Jean-Christophe Cexus

This paper deals with problems of information collection in the intelligence process. The intelligence process takes place within hierarchical military organizations. That leads to bi-level sensor management optimization problems, consisting of both a coordination level and sensors control level. We will consider problems derived from actual operational scenarios, combining a multiobjective constraint satisfaction problem at the coordination level with sequential optimal controls at the sensors level. The modeling of the problem and solution methods will be presented and compared.

3 - A new efficient deterministic approach for mixed 0-1 multiojective programming. Application to shift scheduling problems.
Viet Nga Pham, Mathematics, National Institute for Applied Sciences, Rouen, France, Avenue de l’Université BP8, 76801, Saint-Étienne-du-Rouvray, Haute Normandie, France, viet.pham@insa-rouen.fr, Hoai An Le Thi, Tao Pham Dinh

In this paper, we propose a new deterministic approach for mixed zero-one linear multiobjective programming. It consists in solving only one mixed zero-one linear program by either CPLEX solver or DC algorithm (DCA). Computational results applying to shift scheduling problems demonstrate the efficiency of our method with respect to existing algorithms, especially in the large-scale setting.

Keywords: mixed zero-one multiobjective linear optimization, integer programming, DC algorithm (DCA), shift scheduling problems.
1 - An exact cooperative method for the simple plant location problem
Philippe Michelon, LIA, Université d’Avignon et des Pays de Vaucluse, 339 Ch. des Meinajaries, Agroparc BP 91228, 84911, Avignon Cedex 9, France, philippe.michelon@univ-avignon.fr

In this paper, we present a cooperative primal-dual method to solve the SPLP exactly. It consists of a primal process, and effective tabu search, and a dual process, which performs a LaGrange branch-and-bound search. Both processes cooperate by exchanging information which helps them find the optimal solution. Further contributions include new techniques for improving the evaluation of the branch-and-bound nodes: decision-variable bound tightening rules applied at each node, and a sub gradient caching strategy to improve the bundle method applied at each node.

2 - Critical Facility Capacitated r-Interdiction Location Problem: an example of grocery stores with limited demand
Yuan Choi, Systems and Information Engineering, University of Tsukuba, I-1-1 Tennodai, Tsukuba, Ibaraki, 305-8577, Tsukuba, Japan, r10030173@risk.tsukuba.ac.jp, Tsutomu Suzuki

Our focus is on maximal covering a problem which considers two interacting players: interdiction and prevention. This study aims to minimize the maximum increase of cost caused by disruption so the system can retain the highest coverage on the next interdiction step. We specify the facilities as grocery stores with limited demand. The interdiction is capacitated according to the size of stores and total interdiction is bounded. With this problem, it is possible to discuss the necessity of participation of governments for preventing critical stores from disruption on a supposition of stagnation.

3 - A Bilinear Programming Formulation for the p-Median Problem with Unreliable Facilities and Disruption Probability Classes
Serigne Gueye, Computer Science, University of Avignon, 88212, Avignon, France, sgueye@zlc.edu.es, Mozart Menezes

The p-Median problem with unreliable facilities is the problem of locating unreliable facilities on a network that minimize the expected cost of serving the customers. The facility availability depends on a disruption probability which is independent of its location. We assume that a finite number of different probabilities exist. The approach corresponds to aggregating different designs into risk classes. A Bilinear Programming Formulation is proposed to solve exactly the problem. Some numerical results are given using randomly generated instances.

2 - Optimal Warranty Policy for a Pareto Distributed Products based on Progressive Censored Sample
Neriman Karadayi, Statistics Department, Selcuk University, 42225, Konya, Turkey, nkaradayi@selcuk.edu.tr, Yunus Akdogan, Coskun Kus, Shuo-Jye Wu

It is important to attract consumers in highly competitive markets. One of the effective ways of doing this is through warranties granted to the products. Consumers would like to buy high-priced products so long as they are supplied a reliability for the products in question. A decision problem related with the warranty involving a combination of free replacement and pro-rata policies is examined. Bayesian approach based on progressive censored product failure time data having Pareto distribution is used to determine the optimal warranty lengths. An numerical example is also given.

3 - Optimal Progressive Group Censoring Scheme under Cost Considerations for Pareto Distribution
Coskun Kus, Statistics, Selcuk University, 42225, Faculty of Science, Campus, Konya, Turkey, coskun@selcuk.edu.tr, Yunus Akdogan, Shuo-Jye Wu

In this article, optimal design under the restriction of pre-determined budget of experiment is developed for the Pareto distribution when the life test is progressively group censored. We use the maximum likelihood method to obtain the point estimator of the Pareto parameter. We propose two approaches to solve the warranty involving a combination of free replacement and pro-rata policies. We present a hybrid of the theoretical and the empirical approach with empirical procedure through experiments. To avoid data-snooping bias parameters should be estimated by a theoretical price model or by an empirical procedure. The Fisher information matrix is derived analytically in order to obtain the asymptotic covariance matrix. Simulation studies are performed and experimental results are illustrated based on a real data set.

4 - Generalized Linear Mixed Models (GLMMs) with a Financial Application
Neslihan Iyet, Statistics Department, Selcuk University, Faculty of Science Faculty, Konya, Turkey, niyet@selcuk.edu.tr

A generalized linear model (GLM) is used to determine the relationship between a response variable and fixed effects. A generalized linear mixed model (GLMM) is a statistical model that extends the class of GLMs by incorporating random effects. GLMMs are important in the analysis of finance data. When dealing with the finance data, the distribution of the response variable can be chosen from the exponential family. In this study, GLMM with a fixed and random effect will be implemented on a financial data set.

Financial Optimization 3

Stream: Financial Optimization
Invited session
Chair: Ayse Arik, actuarial science, hacettepe university, Beytepe Campus, Cankaya, Ankara, Turkey, aysearik@hacettepe.edu.tr

1 - Performance measurement of online algorithms using geometric Brownian motion and quantile regression
Esther Mohr, Information and Technology Management, Saarland University, P.O. Box 151150, 66041, Saarbrücken, Germany, em@itm.uni-sb.de, Robert Dochow, Günter Schmidt

We investigate the problem of estimating the independent risk and return represented by standard deviation and expected return of a known online conversion algorithm. The question is whether these parameters should be estimated by a theoretical price model or by an empirical procedure through experiments. To avoid data-snooping bias we present a hybrid of the theoretical and the empirical approach with 3 steps. The problem is formulated as a linear function of parameters, and solved by linear programming. Our results generalize former works.
2 - Optimization and Tax Evasion: A Portfolio Approach
Francesco Menoncin, Economics, Brescia University, Via S. Faustino, 74/B, 25122, Brescia, Italy, menoncin@eco.unibs.it, Rosella Levaggi
An agent invests on both a risk-less and a risky asset (following a GBM) and chooses how much of the latter to declare. A fine (Poisson jump process) must be paid on evasion if caught. Main results are: (i) inter-temporal consumption is higher with evasion, (ii) evasion is affected neither by the return nor by the volatility of the risky asset, (iii) evasion increases the investment in the risk-less asset, (iv) against evasion high fine is more effective than frequent controls, (v) for a sufficiently high level of taxation on the risk-less asset evasion is zero.

3 - Optimal Cash Management Using Impulse Control
Peter L. Lakner, IOMS, New York University, 44 West 4th St., Suite 8-61, 10012, New York, NY, United States, plakner@stern.nyu.edu, Joshua Reed
We solve the optimization problem of a manager who controls the amount of cash on hand by occasionally moving funds back and forth between his/her reserves and the cash on hand. The cash on hand process without any managerial intervention is assumed to follow a Levy process. The manager is charged fixed plus proportional costs for any specific adding to or withdrawing from the reserves and there are opportunity costs for keeping too little or too much cash on hand. The manager’s objective is to minimize the expected total discounted costs over an infinite horizon.

4 - The Lee Carter Method and Poisson Log-Bilinear Model: An Application To Turkish Census Data
Ayse Arik, actuarial science, hacettepe university, Beytepe Campus, Cankaya, Ankara, Turkey, aysearik@hacettepe.edu.tr, Basak Bulut, Eren Gul Ozkok, Meral Sucu
We present Lee-Carter (LC) and Poisson log-bilinear model, suggested by Brouhns et al. (2002), for modelling Turkish mortality rates. After estimating the LC parameters then we re-estimated the parameters under the Poisson log-bilinear model using bootstrap method. Projections are also made by using the estimated parameters obtained from these two methods and are compared with the actual mortality rates. References: Brouhns et al. (2002), A Poisson log-bilinear regression approach to the construction of projected life tables. Insr Math Econ 31:373-393.

2 - Risk Sensitive Approach to Inventory Management
Muge Tekin, Industrial Engineering, Koc University, Rumelifeneri Yolu, Koc Universitesi, 34450, Istanbul, – Select –, Turkey, mtekin@ku.edu.tr, Suleyman Ozekici
Newsboy models are one of the core models in inventory management literature. The classical newsboy model aims to maximize the expected profit and the risk caused by demand uncertainty is disregarded. However, the inventory managers may prefer less gain but more stable outcomes. We follow a mean-variance approach to the newsboy problem and take care of risk. We also aim to incorporate supply randomness into our model, as well. In the second part, supposing the randomness is correlated with financial markets the newsboy invests in a portfolio of financial instruments and hedges the risk.

3 - Valuation — Liquidity (Risk) and Cost of Equity
Michael Ludwig, FIM Research Center Finance & Information Management, University of Augsburg, Germany, michael.richard.ludwig@email.de, Stefan Stöckl, Dennis Diepold
While several empirical studies could find a significant impact of liquidity (risk) on asset returns, its effect on valuation has not been investigated yet. Therefore, we examine whether the market value of a company can be estimated more exactly when cost of equity are used that do explicitly account for liquidity (risk) and all other variables (e.g. cash flows) being equal. We find that estimated company values are significantly closer to the actually observed market capitalization, when the cost of equity are calculated with the liquidity-adjusted CAPM instead of the CAPM.

4 - Multi-period valuation and the CAPM
Fabian Lutzenberger, FIM Research Center Finance & Information Management, University of Augsburg, Universitätsstr. 12, 86159, Augsburg, Germany, fabian.lutzenberger@googlemail.com, Stefan Stöckl, Vasko Isakovci
This paper compares different applications of the Sharpe-Lintner-Mossin Capital Asset Pricing Model (CAPM) to the valuation of assets with stochastic cashflows in more than one periods ahead using STOXX Europe 600 data. We show that the cross-section of market capitalizations can be explained best by taking into account time-varying CAPM-based discount rates with time-varying beta coefficients, market risk premiums and risk free rates. Since discount rates are usually assumed to be constant over time, we make an important contribution to making better multi-period investment decisions.
Recent catastrophic landslide events caused large human and material damages. In order to improve protection against such kinds of natural hazards a new approach for early warning systems for landslide events is pursued where the results of complex finite element simulations of landslides are coupled with geoinformation systems. This allows a detailed investigation of unstable slopes with sophisticated crisp and fuzzy spatial data mining methods as well as a user friendly preparation of the complex simulation results for decision support.

2 - Fuzzy civilisation-state model for system analysis of world geopolitics
Alexis Pasichny, Students’ Science Association, National Technical University of Ukraine, 37, Peremohy av., 03056, Kiev, Ukraine, alexis.pasichny@gmail.com

Proposed study is based on development of fuzzy representation for the global cultures’ distribution across world countries’. Several original methods for construction of fuzzy world civilization structure using different types of expert data are proposed. Given model allows to define formal procedures for identification of world civilizations’ core states and fault lines for testing of S. Huntington’s ‘clash of civilizations’ concept.

3 - A concurrent neuro-fuzzy inference system for automotive service industry
Fehmi Evren Ding, Industrial Engineering, Kocaeli University, 41000, Kocaeli, Turkey, fevren-41@hotmail.com, Yildiz Yulugkural, Zerrin Aladag

Automotive post purchase service network and its quality can be effective on consumers’ purchasing consideration as much as product and service themselves. In this article, an intelligent model is developed to determine the motor, transmission and power unit problems of specific vehicle model. A Concurrent Neuro-Fuzzy Inference System has been generated with Self-Organized Map (SOM) and Adaptive Neural Fuzzy Inference System (ANFIS) for the detection and estimation of the vehicles’ malfunctions. SOM which takes part in model structure, has been positioned as ANFIS’s antecedent input feeder.

Based on conjugate duality we construct gap functions for general variational inequalities formulated by a perturbation function. In convex setting and if a regularity condition is fulfilled, these become gap functions. By particularizing the perturbation function we rediscover several gap functions from literature. We characterize the solutions of the general variational inequalities by the properties of the convex subdifferential. If no regularity condition is fulfilled, we give necessary and sufficient sequential characterizations for the solutions.

3 - Database for Convex Optimization
Shirgrun Nayak, IT, IIIT-B, IIIT-B, 26/C, Electronic City, 560100, Bangalore, Karnataka, India, shirgrunmayak@gmail.com, Neha Bhattach, G. N. Srinivasa Prasanna

Convex optimization methods rely on efficient representation of high dimensional convex constraints, both linear and non-linear. Vertex only and facet only representations of the feasible region are suboptimal in terms of storage. Extending work on 3D polytope representations, we propose a hybrid of vertex and facet representation to efficiently represent convex polytopes and general convex bodies. Efficient query algorithms are presented, including membership of a point in the convex body, its volume, and generation of information equivalent convex bodies.

4 - An iterative algorithm for the reflexive optimal approximation solutions of matrix equations
Heming Sun, College of Science, Hohai University, 1 Xi Kang Road, 210098, Nan Jing, China, sunheminhl@msn.com

In this paper, we consider the following 3-steps optimization problem. First step, define matrices X and Y as reflexive (anti-reflexive) matrices. Second step, minimize the Frobenius norm of AXB+CYD-E. Third step, find the nearest matrices to two given matrices among the solutions of the second step. General optimization problem is two-steps optimization problem. We present an iterative algorithm to solve the above 3-steps optimization problem by making use of the hybrid steepest descent method (HSDM).

Recent Advances in Convex Optimization
Stream: Convex Optimization
Invited session
Chair: Aharon Ben-Tal, Industrial Engineering and Mangement, Technion-Israel Institute of Technology, Technion City, 32000, Haifa, Israel, abental@ie.technion.ac.il
Chair: Atilla Gilanyi, Faculty of Informatics, University of Debrecen, Pt. 12, 4010, Debrecen, Hungary, gilanyi@math.klte.hu

1 - Iterative solution methods for a canonical dc programming problem
Syuuyi Yamada, Graduate School of Science and Technology, Niigata University, 8050 lkarashi-2nocho, 9502181, Niigata, Japan, yamada@math.sc.niigata-u.ac.jp, Tamaki Tanaka, Tetsuzo Tanino

In this talk, we consider a canonical dc programming problem (CDC) to minimize a linear function over the difference between a compact convex set and an open bounded convex set. For (CDC), many global optimization algorithms have been proposed. However, since the volume of data necessary for executing such algorithms increases in proportion to the number of iterations, such algorithms are not effective for large scale problems. Hence, to calculate an approximate solution of a large scale problem, we propose new iterative solution methods by utilizing polar coordinates.

2 - Revisiting the construction of gap functions for variational inequalities via conjugate duality
Liana Cioban, Babes-Bolyai University, Cluj Napoca, Romania, Mikhail Kogalniciangu, nr. 1, 400084, Cluj Napoca, Romania, lianacioban@yahoo.com, Emõ Robert Csetnek

Local optimization algorithms and deterministic chaos are the main creative subjects of a new style of mathematical art — the abstract determinism painting. Compared to fractal art, abstract determinism expands the creative possibilities of chaos by obscuring a mathematical nature of its paintings; even a discerning spectator can hardly say who made it — a computer or an artist-person? Software for generating the test functions and the domains of attraction of local optima are presented. Numerous illustrations, allowing the aesthetic and semantic interpretations are provided.

2 - Optimization of inner operation of a museum to enhance the educational impact on visitors
Katrina Simoncicova, Institute of History and Theory of Architecture and Monument Restoration, Slovak university of technology, Faculty of architecture, Slovakia, katka.simoncicova@gmail.com, Eva Krallova
This paper develops the process of creation of interior operation, which is important part of securing the fluency of education. It will be showed on example of conversion of a former heat plant to a poly-functional museum of technology that will mediate the history of industry. The ethic approach is in the sensitization of the relations between visitors and architectural heritage and education of ecology and sustainability. The aim of this project is to evaluate efficient interior operation and necessity of changing perceptions throughout the visitor’s path.

3 - Composing counterpoint musical scores with variable neighborhood search

Dorien Herremans, Operations Research Group ANT/OR, University of Antwerp, Doliijnstraat 82, 2018, Antwerpen, Belgium, dorien.herremans@ua.ac.be, Kenneth Sörensen

In this research a variable neighborhood search (VNS) algorithm is developed that can generate musical fragments of arbitrary length. The objective function of the algorithm is based on a quantification of existing fifth species counterpoint rules. A thorough parametric analysis of the VNS reveals the significance of the algorithm’s parameters on the quality of the composed fragment, as well as their optimal settings. The VNS algorithm has been implemented as a user-friendly software environment for composition, called Optimine.

4 - Ball motion inside symmetric surfaces, described by using special diagrams

Lina Otradnova, Department of Mechanics and Mathematics, Lomonosov MSU, GSP-1, Leninskie Gory, 119991, Moscow, Russian Federation, otradnova.lina@gmail.com

Problems of ball motion between two parallel planes, inside a sphere or a circular cylinder, and also disk motion between two parallel lines and inside the angle, by inertia in the absence of gravity are considered. During the impact, an instant constraint is imposed, and a condition of rolling without slipping is satisfied. Two cases of impacts are given: absolutely elastic and not absolutely elastic. Diagrams illustrating this effect are presented. Such model with impacts can be found in everyday life, namely in sport: pole vault, or table tennis.

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**Euro 25 - Vilnius 2012**

**WD-26**

**Wednesday, 14:30-16:00**

**CC-A24**

**Multi-Criteria Decision Making and Applications 2**

Stream: Multi-Criteria Decision Making and Environmental Management

**Invited session**

Chair: King-Wah Pang, Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, lgtapang@polyu.edu.hk

Chair: Mikhail Kuznetsov, Moscow Institute of Physics and Technology, Russian Federation, mikhail.kuznetsov@phystech.edu

1 - Multi-criteria Internet Shopping Optimization Problem

Jedrzej Musial, Computer Science and Communications Research Unit, University of Luxembourg, Luxembourg, jedrzej.musial@ext.uni.lu, Jacek Blazewicz, Pascal Bouvry

Internet Shopping Optimization Problem answers the question of how to manage a multiple-item shopping list over several shopping locations. ISOP problem is also very interesting from the practical point of view since it concerns shopping optimization for all the users of the Internet.

Multi-criteria ISOP introduces a model within a wider class of problems including additional variables and characteristics (e.g. expiration dates, product priorities). Computational experiments with greedy algorithms were conducted to check their applicability.

2 - A hybrid decision making model for labor flexibility

Erdem Aksakal, Industrial Engineering, Gazi University, Gazi University Faculty of Engineering, Maltepe, 06570, Ankara, Turkey, eaksakal@gazi.edu.tr, Metin Dagevere, Ihsan Yüksel

Globalization forces firms to consider the flexibility in human resources. Labor flexibility plays an important role in organizations in all parts. As a result of including the labor requirements in market requirements, labor flexibility and its factors become a considered cost value to the firms. Without labor flexibility, firms cannot take efficient and competent decisions. Under labor flexibility, 4 criteria will be examined and tried to find out that which one is the most affecting on labor flexibility.

3 - A knowledge based decision support system for warehousing management to improve operating efficiency

King-Wah Pang, Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, lgtapang@polyu.edu.hk

Data mining approaches have been applied in information extraction for applications such as customers relationship management. In retailing industry, this technique is used to extract consumers buying behavior when customers frequently order similar products together, thus it is beneficial to store these correlated products nearby to reduce the order picking operating time and cost. We present a knowledge based decision support system for the storage location assignment that minimizes the total travel distances for both put-away and order picking operations.
WD-27

Wednesday, 14:30-16:00
CC-A25

Applications in Decision Making & Decision Analysis

Stream: Decision Support Systems
Invited session

Chair: Pascale Zarate, Institut de Recherche en Informatique de Toulouse, Toulouse University, 118 route de NarBonne, 31062, Toulouse, France, zarate@irit.fr.
Chair: Fatima Dargam, SimTech Simulation Technology, Ries Strasse 120, 8010, Graz, Austria, F.Dargam@SimTechnology.com

1 - A decision making framework for a Colombian business group

Julián Benavides, Finance, Universidad Icesi, Cra 89 10-80, 760032, Cali, Valle, Colombia, jbenavid@icesi.edu.co, Felipe Henao

We develop a 7-steps framework to facilitate decision-making. It emerges from an ongoing project where different sources of data were gathered in order to identify the group’s needs in decision-making. It combines approaches of strategic management, Soft OR and decision analysis. Activities such as problem formulation, definition of goals and SWOT add to define relevant criteria. Alternatives are ranked using scenario planning. 3 major corporate decisions have been successfully undertaken: Portfolio prioritization, partner selection for a new venture and disposal of a failed initiative.

2 - Development of a territorial vulnerability indicator framework for cross-border risk analysis

Tina Comes, Institute for Industrial Production (IIP), Karlsruhe Institute of Technology (KIT), Hertzstr. 16, 76187, Karlsruhe, Germany, comes@kit.edu, Marjorie Vannieuwenhuyse, Frank Schultmann

To reduce vulnerability against natural disasters, decision makers must implement adequate risk management strategies. Since risks ignore national borders, the need for a transnational risk management arises: cooperation in cross-border areas must be reinforced, resources should be cumulated. By identifying key drivers and weaknesses, vulnerability analysis is the first step to an efficient risk management. We present an indicator framework for regional vulnerability analysis at cross-border scale and show how it is used as the basis for cross-border risk management.

3 - Requirements analysis and conceptual design of data warehouse

Dragana Becjekski-Vujaklijia, Faculty of Organizational Sciences, University of Belgrade, Jove Ilica 154, 11000, Belgrade, Serbia, draganab@fon.rs, Milena Panovic

The subject of paper is requirement analysis and conceptual design of data warehouses and proposal of general method for requirement analysis and conceptual design, which should be a methodological framework in implementing these phases within the overall data warehouse design. The general method for requirement analysis and conceptual design that combines current approaches is presented. Based on the research, the general steps that should be applied to specific projects in order to ensure a higher level of longevity as well as acceptance of the users are identified and described.

Chair: Gerhard-Wilhelm Weber, Institute of Applied Mathematics, Middle East Technical University, ODTU, 06531, Ankara, Turkey, gweber@metu.edu.tr

1 - Ensemble methods for classification of volcano seismic signals

Cindy Mora-Stock, Institut für Geowissenschaften, Christian-Albrechts-Universität, Otto-Hahn-Platz 1, 24118, Kiel, Schleswig-Holstein, Germany, cindy@geophysik.uni-kiel.de, Cristian Bravo

Volcanoes present different types of seismic activity depending on the source origin, such as tremors, long-period, and volcano-tectonic events. In Chile, Villarrica and Llaima are two of the most active volcanoes, constantly presenting seismicity that can be classified into these different types. To obtain a faster and reliable classification of future activity, pattern recognition ensemble methods were constructed using neural networks and support vector machines. The usefulness of the procedure applied to a real-life data set with 18 months of data from these volcanoes is presented.

2 - An integrated model for disaster mitigation and response decisions

Alper Doyn, Industrial Engineering, Bogazici University, Department of Industrial Engineering, Bogazici University, Istanbul, Turkey, doyenalper@gmail.com, Necati Aras, Gülay Barbarosoglu

We propose a two-stage stochastic integer programming model for pre-disaster planning of mitigation and response decisions in an integrated manner. The mitigation decisions involve both building and transportation infrastructure retrofitting. The objective is to minimize the total cost of retrofitting, transportation and shortage of relief item demand. The deterministic equivalent of the model is formulated as an MILP and solved by Lagrangean heuristics. Test results show that the proposed heuristics show good performance for a wide range of problem instances.

3 - A data mining approach for modeling high-frequency spectral decay of ground motions for Northwestern Turkey

Fatma Nurten Sisman, Civil Engineering, Middle East Technical University, METU Universiteler Mah. Dumlupinar Blv. No:1,06800 Çankaya, Ankara, Turkey, fsisman@metu.edu.tr, Onut Pekcan, Aysegul Askan

In this study, we use data mining methods on 114 strong ground motion records with different magnitudes, source-to-site distances, and site classes. We use both traditional regression techniques and data mining approaches to describe the relationships between kappa values and the aforementioned independent variables. We then compare the outcomes of data mining techniques with those of traditional methods to better highlight the important characteristics of the ground motion dataset. We express a regional Kappa model for Northwestern Turkey.

4 - Waveform tomography with numerical optimization techniques

Aysegul Askan, Civil Engineering, Middle East Technical University, Inonu Bulvari, 06531, Ankara, Turkey, aaskan@metu.edu.tr, Volkan Akcelik, Jacobo Bietak, Omar Ghantas

In this study, we present a recent waveform inversion method, based on least-squares optimization for solving the nonlinear full waveform inverse problem of determining the crustal velocity and intrinsic attenuation properties of sedimentary valleys in seismically active regions. The inverse problem of retrieving the crustal velocity is formulated as a constrained optimization problem. We present the method with applications for sedimentary models of the San Fernando Valley in California, under SH-wave propagation. Finally, we discuss the sensitivity of the method to various model parameters.
1. The application of neural networks and linear programming discriminant models on the file fragment classification problem

Erich Wilgenbus, School of Computer, Statistical and Mathematical Sciences, North West University Potchefstroom Campus, Internal box 107, Private Bag X6001, North-West University Potchefstroom Campus, 2520, Potchefstroom, South Africa, erichfw@gmail.com, Hennie Kruger, Tiny Du Toit

The file fragment classification problem is of importance in network and computer forensics. This classification problem requires prediction of the correct file type to which a given file fragment belongs. Several approaches have been proposed in literature. This paper compares the use of neural networks and linear programming discriminant models to solve this binary classification problem. This multi-class problem is solved using a sequence of binary neural network and linear programming classification models. The results of empirical experimentation will be presented.

2. Clustering anthropometric data addressed to the clothing industry

Teresa Leon, Statistics and OR, Universitat de Valencia, Dr. Moliner 50, 46100, Burjassot, Spain, teresa.leon@uv.es, Guillermo Vinue, Guillermo Ayala, Sandra Alemany, Juan Domingo

A 3D anthropometric survey of the female population was conducted in Spain by the Spanish Ministry of Health. Its aim was to generate anthropometric data addressed to the clothing industry. A sample of 10,415 Spanish females from 12 to 70 years old randomly selected was measured using a 3D body scanner and 95 anthropometric measures were obtained. We explore this dataset using cluster analysis techniques. We use a dissimilarity measure based on McCulloch et al’s. We modify the original measure, which is merely based on the sum of squared discrepancies over each individual feature, by taking into account the user’s opinion, using an OWA operator.

3. Fault Classification using Data Mining Technique for Semiconductor Process Monitoring

Minyoung Cho, Korea University, Korea, Republic Of, needskyblue@korea.ac.kr, Jonghyuck Park, Jun Seok Kim, Sung-Shick Kim, Jun-Geol Baek

Process control is essential to operating in the semiconductor process efficiently. This paper considers fault classification of semiconductor cyclic signal for process control and monitoring. In general, process signal usually take the different pattern depending on different causes of fault. Fault classification by causes of faults could improve the process control through a rapid diagnosis. This paper proposes the method that can classify fault causes as each one class. Data-Mining Technique such as Neural-network, SVM, Average distance, k-NNDD, Hotelling T2 are used to perform the method.

1. Identifying the upper age limit to extend screening for breast cancer in england and wales

Rachid Rafta, HEDS, University of Sheffield, SchARR, Regent court, 30 Regent street, S14DA, Sheffield, United Kingdom, r.raia@sheffield.ac.uk, Alan Brennan, Jason Madan, Lynda Wyld, Karen Collins

A mathematical model that allows the impact of screening policies on breast cancer diagnosis and subsequent management to be assessed was constructed to evaluate the optimal upper age for a breast cancer screening policy. The model has two parts - a natural history model of the progression of breast cancer up to discovery, and a post-diagnosis model of treatment, recurrence and survival. This study suggests that an extension of the current NHSBSP upper age limit for invitations from 69 to 78 would represent a cost-effective use of NHS resources.

2. Multi-criteria decision making with criteria values estimated from survival data: a case study in heart failure

Jing Zhao, Department of Epidemiology, University Medical Center Groningen, PO Box 30.001, 9700 RB, Groningen, Netherlands, j.zhao.5@student.rug.nl, Douwe Postmus, Hans Hilleg

Clinical decision making is often based on assessing the patient’s absolute risk of experiencing a disease event. When more than one event is considered, the problem is complicated by dependencies between different events and criteria value trade-offs. The stochastic multi-criteria acceptability analysis method enables to take into account the inter-criteria dependencies and identify the value trade-offs through Monte Carlo simulation. In this presentation, we show how a multi-criteria decision model can be constructed with the measurements estimated from a survival analysis.

3. Complexity of decision making with multiple stakeholders: a case study.

Cristobal Miralles, Depto. Organización de Empresas, Universidad Politecnica de Valencia, Cami de Vera s/n, 46022, Valencia, Spain, cmiralles@omp.upv.es, Alysson Costa, Maria Antonia Caravilla

Complexity theory has been used extensively in the field of strategic management to understand how organizations or firms adapt to their environments. Complementary, the CSR paradigm brings a wider perspective of the decision making process where different stakeholders should be considered. Starting from a typical optimization problem, this case study aggregates pieces of information that consecutively increase the complexity of decision making; analyzing carefully those variables that influence the decision and the stakeholders and values in conflict. Thanks to: CORSARI MAGIC DPI2010-18243.
The Liberalization of Telecommunications Markets in combination with the globalization of economies created new operational conditions of former state owned telecommunications operators, challenges and entering occasions. The aim of this paper is to assess the efficiency and productivity change in Global Telecom Operators after their transformation. The input oriented Data Envelopment Analysis is applied to the data of former public telecommunication operators for the period of 2002-2007.

2 - Returns to Scale and Incentive Regulation in Brazil Electricity Distribution Industry
Ana Lopes, CEPEAD, Federal University of Minas Gerais - UFMG, Brazil, av. Antonio Carlos, 6627, Face Sala 4042, 31270901, Belo Horizonte, Minas Gerais, Brazil, analopes.ufmg@gmail.com, Rajiv Banker

We address the empirical question of maintaining returns to scale assumption when using DEA models in incentive regulation. Although the complete specification of a production relationship between all inputs, outputs and environmental variables may exhibit NDRS or CRS for a local monopoly, we prove that the estimated production function will necessarily exhibit VRS with a region of decreasing returns in the simpler empirical abstraction. Data from 28 Brazilian electricity distribution companies also statistically rejects the NDRS assumption proposed by the regulator.

3 - Performance measurement in the marketing productivity in services. An application to the U.S. financial sector using stochastic frontier models
Hannis de la Fuente, Facultad de Ciencias Económicas y Administrativas, Pontificia Universidad Católica de Valparaíso, Avenida Brasil 2950, 6 Piso, 2340025, Valparaíso, Valparaíso, Chile, hanns.delafuente@uvc.cl

The literature on marketing productivity shows the absence of measurements, especially in the case of quantitative measures and in the measurement of the influence of marketing assets. This paper applies the Theoretical Model of Marketing Productivity (MTPM) in the case of U.S. financial sector. The results show decreasing technical efficiency levels, and demonstrate the positive influence of total assets, administrative staff and sales growth on the productivity of marketing and a negative influence of investments in marketing and labor costs on the productivity of marketing.

4 - Efficiency evaluation and analysis of Third Party Logistics in Brazil
Marina Almeida, Production engen. Escola de Engenharia de Sao Carlos, Avenida Trabalhador Sao Carlosense, 400 - Centro, 13566-590, Sao Carlos, Sao Paulo, Brazil, almeidamariana@yahoo.com, Luis Oliveira

This paper deals with the efficiency evaluation and analysis of 44 Third Party Logistics working in Brazil, using Data Envelopment Analysis — DEA for this purpose. The DEA model used considers variable returns to scale, since the analyzed companies have diversified sizes, and oriented to maximize their outputs. The use of variable selection techniques was critical to reach a subset of variables with greater representativeness for the system. As the main practical result, it was possible to identify the best players, regarding the efficiency of production processes and the returns to scale.

1 - Alternatives for Scripting in Conjunction with an Algebraic Modeling Language for Optimization
Robert Fourer, AMPL Optimization, 2521 Asbury Avenue, 60201-2308, Evanston, IL, United States, 4er@ampl.com

Optimization modeling languages are fundamentally declarative, yet successful languages also offer ways to write scripts or programs. What can scripting in a modeling language offer in comparison to modeling in a general-purpose scripting language? Some answers will be suggested through diverse examples in which the AMPL modeling language is applied to parametric analysis, solution generation, heuristics optimization, pattern enumeration, and decomposition. Concluding comments will touch on the complexity of scripts seen in practical applications, and on prospects for further improvements.

2 - CMPL - Coliop|Coin Mathematical Programming Language
Mike Steglich, University of Applied Sciences Wildau, Germany, mike.steglich@th-wildau.de

CMPL is a mathematical programming language and a system for mathematical programming and optimization of linear optimization problems. CMPL is a COIN-OR project initiated by the Technical University of Applied Sciences Wildau and the Institute for Operations Research and Business Management at the Martin Luther University Halle-Wittenberg. This talk will begin with an overview about the language, followed by the description of some advanced modelling techniques. Finally, we will present the interaction between CMPL and selected solvers.
1 - Combining Discrete Event, Agent Based and System Dynamics Simulation to explore the Health and Social Care implications of Age Related Macular Degeneration

Joe Viana, School of Social Science, University of Southampton, University Road, Highfield, SO17 1BJ, Southampton, Hampshire, United Kingdom, j.viana@soton.ac.uk, Andrew Amos Channon, Sally Brailsford

Age Related Macular degeneration (ARMD) causes sight loss, a new treatment requiring monthly injections has increased the demand on Ophthalmology departments (OD), which is compounded by the UK’s ageing population. A Discrete Event Simulation (DES) model of OD has been produced to evaluate performance. An Agent Based model has been combined with the DES model, representing the need and receipt of social care of individuals. An agent’s sight is captured by a System Dynamics (SD) model of each eye. The purpose of the models is to explore how social and health care interact.

2 - Modelling the dental workforce in Sri Lanka

Sally Brailsford, University of Southampton, School of Management, SO17 1BJ, Southampton, United Kingdom, s.s.brailsford@soton.ac.uk, Dileep de Silva

This talk presents a system dynamics simulation model of the supply and demand for dental care in Sri Lanka. The model represents the flows of dentists through the complex recruitment and career progression phases to retirement. This is augmented by a demand model, which combines empirical data on the time required to carry out various dental procedures with secondary clinical and demographic data to project the future incidence of different dental conditions. The overall supply-demand model enables policy-makers to test various policies for staffing, training and recruitment.

3 - Managing limited bed capacity at hospitals

Burhaneddin Sandikci, Booth School of Business, University of Chicago, 5807 South Woodlawn Avenue, 60637, Chicago, IL, United States, burhan@chicagobooth.edu, Tom Best, Don Eisenstein, David Meltzer

To address adverse effects of limited inpatient bed capacity, an academic medical center received government dispensation to partition its inpatient beds into mini-hospitals or wings. Each wing has a specific designation of the types of patients it can admit, and the number of beds it is allocated. A patient requesting hospital services can be admitted only if a bed is available in the appropriate wing. We present a model to help hospital administrators make wing formation decisions and a novel approach to solve the hard problem of forming wings along with a rich set of numerical results.

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**WD-36**

**Wednesday, 14:30-16:00**

CC-A43

**Technological change and productivity: permanent features of population health**

**Invited session**

Chair: M. Harvey Brenner, School of Public Health, Department of Behavioral and Community Health, University of North Texas Health Science Center, 3500 Camp Bowie Blvd., EAD-711A, 76107, Fort Worth, TX, United States, harvey.brenner@untshsc.edu

Chair: Elena Andreeva, Berlin University of Technology, ACK-185, Ackerstr. 76, 13355, Berlin, Germany, elan@ifg.tu-berlin.de

1 - Large-scale organisational downsizing and workers' health during the global crisis of the last decade

Elena Andreeva, Berlin University of Technology, ACK-185, Ackerstr. 76, 13355, Berlin, Germany, elan@ifg.tu-berlin.de

During the recent global economic crisis, enterprises have introduced a variety of strategies for managing the 'surplus' employees. This paper addresses the issues of identifying and understanding the consequences of such strategies, first of all, with respect to health responses of workers affected by the large scale downsizing. We consider the current information needs in occupational health research and discuss factors which can potentially modify the patterns of health responses in the European context.

2 - Macroeconomic influences on life expectancy in advanced industrialized countries

M. Harvey Brenner, School of Public Health, Department of Behavioral and Community Health, University of North Texas Health Science Center, 3500 Camp Bowie Blvd., EAD-711A, 76107, Fort Worth, TX, United States, harvey.brenner@untshsc.edu

Macroeconomic policy is a crucial component in the health of industrialized countries. Key findings are: GDP per capita in purchasing power parity is the most important predictor of increased life expectancy in industrialized countries. The damaging effect of income inequality can be seen only in age groups under 45. The replacement of manufacturing employment by services employment is the second most important factor beneficially influencing life expectancy. Decreased labor force participation is a significant source of increased mortality in middle age.

3 - Health policy amidst financial austerity — the case of Hungary

Peter Mihalyi, University of Pannonia (Veszprém) and Institute of Economics, Hungarian Academy of Sciences, 8200, Budapest, Hungary, peter@mihalyi.com

In early 2009, WHO advised governments not to cut health expenditures during the global financial crisis. When the present Hungarian government took office in mid-2010, its programme didn't envisage any major change. However, in the context of the Bismarckian social insurance reform, the policies aimed at cutting pension expenditures at the end resulted in totally unexpected cuts in health expenditures as well as in drastic health policy shifts. The paper will describe in detail how the model implemented in 1992 was replaced by the NHS model within a few months without any policy discussion.

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**WD-37**

**Wednesday, 14:30-16:00**

CC-ACt

**Operations Research in Health Care II**

**Invited session**

Chair: Sally Brailsford, University of Southampton, School of Management, SO17 1BJ, Southampton, United Kingdom, s.s.brailsford@soton.ac.uk

Andrew Amos Channon, Sally Brailsford

Andrew Amos Channon, Sally Brailsford

Operations Research in Health Care II

**Invited session**

Chair: Sally Brailsford, University of Southampton, School of Management, SO17 1BJ, Southampton, United Kingdom, s.s.brailsford@soton.ac.uk

1 - Pareto Data Mining based decision for Global Water Restoration Decision Process

Angel Udias, Rey Juan Carlos University, Spain, angelluis.udias@urjc.es, Andrés Redchuk, Javier Cano, Lorenzo Lgalbiati@gencat.cat

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Sustainability of water resources has become a challenging problem worldwide. We present a hydroinformatics management tool designed to find an optimal Program of Measures (PoMs) to achieve Water Framework Directive objectives. It combines 1) a water quality model (to simulate effects of PoMs) 2) a Multi-Objective Evolutionary Algorithm to identify efficient trade-offs between PoMs’ costs and water quality 3) data-mining of the Pareto optimal set to extract knowledge from optimal decisions in a usable form. We have applied our methodology in inner Catalan watersheds with promising results.

2 - A decision support system for the multiobjective management of the Kwanza river
Kiontbo Jean Marie, Universidad Rey Juan Carlos, 28943, madrid, Spain, kJean_marie@yahoo.com.br, Javier Cano, David Rios-Insua

Water management has become a challenging problem worldwide, especially in developing countries, due to the growing scarcity of natural water resources; a demographic explosion in many urban settlements; and the inherent increase in the demand of energy and natural fresh water. We provide a model for the multiobjective management of the Kwanza River, taking into account uncertainty in various involved processes, and the need to plan over a long period of time, and the presence of several conflicting interests. We describe also a decision support system implementing our model.

3 - Role of carbon capture technologies in the Spanish industry in 2030 under a CO2 reduction scenario using the TIMES-Spain energy optimisation model
Diego García, Energy System Analysis Unit, CIEMAT, Av. Complutense 40, E28040, Madrid, Madrid, Spain, diego.garcia@ciemat.es, Helena Cabal, Machtheld Van Den Broek, Yolanda Lechón, Antonio Alonso-Ayuso

In this work, a techno-economic assessment of CO2 capture technologies for relevant industrial sectors (cement, steel, and oil refineries) is presented. Main capture techniques are described, such as pre-combustion, oxyfuel combustion, and postcombustion. Introducing these technologies in the TIMES-Spain energy optimisation model results show that, under a CO2-reduction scenario (20% by 2020 and 30% by 2030 below 1990 levels), emissions in the cement sector decrease 73% compared to the BAU scenario at the end of the period. Nevertheless, there is no CO2 capture in the other sectors.
Substituting chemical fertilizers by organic wastes is a way to improve agriculture sustainability. It requires designing new management scenarios of agricultural production systems based on the knowledge available on their biophysical and managerial components. Simulation models representing those systems as productive units spread over a territory together with data from agronomical experiments are jointly used to assess the performances of the scenarios against agronomical and environmental criteria. This approach is illustrated on two examples in periurban areas of Senegal and Madagascar.

### Applications of Control Theory in Dynamical Systems

**Stream:** Control Theory & System Dynamics (contributed)  
**Contributed session**  
**Chair:** Ioan Radu Morar, Automation Dept, Technical University of Cluj-Napoca, Ghe Baritiu Street 26-28, room 350, 400027, Cluj-Napoca, Cluj, Romania, radu.morar@gmail.com

1. **A model to particles flow composed by two metastable potentials**  
   **Elso Drigo Filho,** Department of Physics, Sao Paulo State University, Rua Crisóstomo Colombo 2265, 15054-000, Sao Jose do Rio Preto, Sao Paulo, Brazil, elso@ibilce.unesp.br, Marcelo Tozo de Araujo

   A fluid flow through a tube can promote a sedimentation of particles which reduces the diameter of the tube. This phenomenon is particularly important to oil transport which induces the deposition of paraffin in the inner wall of the tube. In order to simulate this process, we suggest a model that involves two time dependent metastable potentials. The solution of a Fokker-Planck equation for each potential is the input to describe the time dependence of the total flow. Numerical results for different values of parameters are presented.

2. **The mechatronic system optimization with use of genetic programming**  
   **Marian Klucic,** Institute of Control and Industrial Informatics, Slovak University of Technology, Ilkovičova 3, 812 19, Bratislava, Slovakia, klucic2@gmail.com, Ladislav Jurisica, Anton Vitko, Peter Paszto, Jaroslav Hanzel

   The aim of this article are the desired properties of mechatronic systems, and the desired properties of mechatronic systems design. In the design process is essential to develop the method for search the optimal system structure and parameters, which ensures sufficient synergy between system components. One means of solving this difficult problem is to use genetic programming. With this method it is possible to solve the optimization problem with consideration of the large number of criteria. In the conclusion is proposed one case of control system optimization of mechatronic system.

3. **Fault-tolerant Control Systems in Stability and Recovery control Of Damaged Aircraft**  
   **M. Navabi,** Dynamics and Control, Shahid Beheshti University, GC, 123, thr, Iran, Islamic Republic Of, sciences.edu@gmail.com, **M. Radaei**

   In the emergency cases where conventional flight controls are lost, an alternative means of control is needed to maintain a certain level of stability and performance to avoid potential crashes and accidents. In this paper two classified inter-control-disciplinary of fault-tolerant control systems are introduced: 1) passive fault-tolerant control based on robust control techniques, and 2) active fault-tolerant control using direct and indirect adaptive control, reconfigurable control, and eigenstructure assignment technique for different damage scenarios. Simulation results are discussed.

4. **Modeling an Unmanned Aerial Vehicle (Quadrotor)**  
   **Ioan Radu Morar,** Automation Dept, Technical University of Cluj-Napoca, Ghe Baritiu Street 26-28, room 350, 400027, Cluj-Napoca, Cluj, Romania, radu.morar@gmail.com, Ioan Nascu

   In this paper the authors describe the process of obtaining a model for an Unmanned Aerial Vehicle (UAV) designed by the Parrot, called AR.Drone. The aim of this process is to find a simple model that can approximate as good as possible the non-linear dynamics of the real model. A simulator was designed in computational software and tested, with a purpose of developing control techniques and strategies. Simulation results are presented at the end of the paper.

**ACKNOWLEDGMENT:** TUCN, research supported by the project POSDRU/1071/S/87534

### Stochastic Modelling in Computational Biology and Environmental Sciences

**Stream:** Stochastic Modeling and Simulation in Engineering, Management and Science  
**Invited session**  
**Chair:** Erik Kropat, Department of Computer Science, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577, Neubiberg, Germany, erik.kropat@unibw.de, **Zeev (Vladimir) Volkovich,** Ort Braude Academic College, Yehiam 6, 21823, Karmiel, Israel, zeev@actcom.co.il, **Gerhard-Wilhelm Weber,** Institute of Applied Mathematics, Middle East Technical University, ODTU, 06531, Ankara, Turkey, gweber@metu.edu.tr

1. **Earthquake Scenario Reduction by Symmetry Reasoning**  
   **Steven Prestwich,** Computer Science, Cork Constraint Computation Centre, University College, Cork, Ireland, s.prestwich@cs.ucc.ie

   A recently identified problem is that of finding an optimal investment plan for a transportation network, under the assumption that an earthquake or other disaster may destroy each link in the network with a given probability. A network based on the Istanbul highway system has a billion scenarios, but it has been found that sampling a million scenarios gives reasonable results. In this work we use symmetry reasoning to reduce the number of scenarios to a few thousand, and Under an additional but realistic assumption we further reduce this number to a few hundred.

2. **Modelling the meteorological effects on air temperature for Konya city in Turkey: the approaches of quantile regression and quantile regression neural networks**  
   **Ilkay Altindag,** Statistics, Selcuk University, Selcuk University Science Faculty Deparmant of Statistics Kampus Selcuklu/KONYA, Konya, Turkey, ialtindag@selcuk.edu.tr, **Nimet Yapici Pehlivan**

   Globalization forces firms to consider the flexibility in human resources. Labor flexibility plays an important role in organizations in all parts. As a result of including the labor requirements in market requirements, labor flexibility and its factors become a considered cost value to the firms. Without labor flexibility, firms cannot take efficient and competent decisions. Under labor flexibility, 4 criteria will be examined and tried to find out that which one is the most affecting on labor flexibility.

3. **Stochastic optimization methods in change-point detection**  
   **Tatiana Polushina,** NTNU, Norway, tpholushina@inbox.ru, **Georgy Sofronov**
The change-point problem arises in a wide variety of fields, including speech and image processing, seismology, industry and financial mathematics. Multiple change-point models are also important in many biological applications and, particularly, in analysis of DNA sequences. In this talk, we consider various stochastic optimization methods to change-point detection, using Monte Carlo simulation to find estimates of change-points as well as parameters of the process on each segment. We also demonstrate the methods for a realistic problem arising in computational biology.

4 - A randomness test based on the Minimal Spanning Tree approach
Ze'ev (Vladimir) Volkovich, Ort Braude Academic College, Yehiam 6, 21823, Karmiel, Israel, ze'ev@actcom.co.il
A stochastic model intended to evaluate the relative randomness of two given texts is offered. Pairs of samples, drawn from different texts, are compared. The relative randomness is measured via the resemblance of the samples in the pooled one when the mixture quality is represented by the total number of edges connecting points from different samples in the constructed minimal spanning tree. Under the homogeneity hypothesis, this amount is normally distributed. Numerical experiments exhibit the ability of the method to distinguish texts generated by different random sources.

The original exponential smoothing has performed well in numerous empirical studies, and it is well established as an accurate and optimal forecasting method. However, there are two main problems about choosing the smoothing constant and starting value in exponential smoothing theory. In this study, we suggest an alternative method for smoothing constant and starting value. The modified method gives more weights than the classical method to most recent observations. The forecasting error is compared to the error in forecasts obtained by the original.

4 - Quadrangle Concept in Classification and Online Trading Algorithms
Stan Uryasev, Director of Risk Management and Financial Engineering Lab, University of Florida, FL 32611-6595, Gainesville, 303 Weil Hall, Florida, United States, uryasev@ufl.edu, Peter Tsyrmasto
Quadrangle Concept in Risk Management provides a convenient tool for building new numerical approaches involving decision making in an uncertain environment. We use Quadrangle for the development of new classification algorithms with application to the intraday trading strategies. We are interested in a simple trading strategy: "buy low and sell high" on daily basis. The position is closed in the end of the day. We are planning to use for solving the classification problem the CVaR-based Support Vector Machine implemented with Portfolio Safeguard (PSG) software.
3 - Design of architecture of embedded system for optimal reliability of complex system
Igor Kabashkin, Transport and Telecommunication Institute, Lomonosova iela 1, Riga, Latvia, kiv@tsi.lv

The digital systems provide higher productivity and greater flexibility, but it is also accepted that they cannot be fault-free. The role of built in test embedded system in electronics has grown in prominence with the advances in system complexity. The architecture of an embedded system is an abstraction, that typically doesn’t show detailed information such as software source code or hardware circuit design. Our paper describes the approach for design of optimal architecture of embedded system with minimal cost of reliability identification during life cycle of complex systems.

4 - Selecting Ore for an Iron Ore Mine
Jim Everett, Centre for Exploration Targeting, University of Western Australia, 49 Goldsmith Rd, 6009, Nedlands, WA, Australia, jim.everett@uwa.edu.au

Interpolated drilling data provide assay estimates for each block in the modeled mine, identifying it as ore or waste, depending on its iron and contaminants (such as silica, alumina and phosphorus). Industry practice accepts a block as ore if its grade lies within a quadrant, above a cut-off in iron and below cut-off in each contaminant. A composite cut-off function is shown preferable to quadrant selection. The method maximizes the yield of one of required product grade and matches marginal cost to marginal value, optimizing the resource net value. It can apply to other mine types.

3 - An efficient way to find an optimal power series for charging electric vehicles
Jacint Szabo, Business Optimization, IBM Research Lab, Zurich, Säumerstrasse 4, 8803, Rüschlikon, Switzerland, jsz@zurich.ibm.com, Olivier Gallay, Olle Sundstroem

The charging of electric vehicles (EV) is usually managed by charging service providers, who buy electric power from the retailer to satisfy the demand of the EV pool in such a way that the forecasted consumption profiles of the EV’s are respected, and power grid load constraints are taken into account. In this contribution we present an efficient way to calculate an optimal power series over the considered time horizon.

4 - Multi-Period Production Planning Under Non-Compliance Risk
Marco Laumanns, IBM Research - Zurich, 8803, Rueschlikon, Switzerland, mlm@zurich.ibm.com, Alwin Haensel, Ban Kawas, Eleni Pratsini, Steven Prestwich, Catalin Stefan Tiseanu

We address a production planning setting for pharmaceutical companies under the risk of failing quality inspections undertaken by the regulatory authorities. After reviewing the single-period problem of maximizing the worst-case revenue and the worst-case expectation, different stochastic programming and dynamic programming formulations for the multi-period version are discussed. We show how decision-dependent probabilities, which are due to risk transfer between products of the same site, can be handled by solving a MINLP for each state in the multi-period dynamic program.
Wednesday, 16:30-17:30

- WE-01
  Wednesday, 16:30-17:30
  RB-Alfa

IFORS Distinguished Lecture: Professor Ralph E. Gomory

Stream: Keynote, Tutorial and Plenary Lectures

Plenary session
Chair: Dominique de Werra, EPFL, 1015, Lausanne, dewerra@gmail.com

1 - Forty Years of Corner Polyhedra
Ralph E. Gomory, Stern School, New York University, 260 Douglas Road, 10514, Chappaqua, New York, United States, gomory@sloan.org

This talk will discuss the evolution of corner polyhedra from their beginnings in the study of Stock Cutting problems. We will discuss both their practical and theoretical aspects. We will see that corner polyhedra are by themselves the simplest integer programs and therefore might be expected to be more amenable to analysis than the more complex I.P.s of which they are always a part. This expectation is fulfilled by some theoretical insights gained from corner polyhedra. The practical linkage stems from the fact that cutting planes for corner polyhedra are cutting planes for the complex practical problems of which they are a part. No knowledge of corner polyhedra is assumed in this talk and historical and personal aspects will be included throughout.
STREAMS

Actuarial Sciences and Stochastic Calculus
Invited
Ricardo Josa-Fombellida
University de Valladolid
ricar@eio.uva.es
Juan Pablo Rincon-Zapatero
Universidad Carlos III de Madrid
jrincon@eco.uc3m.es
Track(s): 19
3 sessions

Advanced Inventory Control and Pricing Strategies
Invited
Alf Kimms
University of Duisburg-Essen
alf.kimms@uni-due.de
Robert Klein
Universität Augsburg
robert.klein@wiwi.uni-augsburg.de
Track(s): 45
3 sessions

Analytic Hierarchy Process, Analytic Network Process
Invited
Josef Jablonsky
University of Economics Prague
jablon@vse.cz
Y. Ilker Topcu
Istanbul Technical University
ilker.topcu@itu.edu.tr
Track(s): 41
6 sessions

Applications of Location Analysis
Invited
Sibel A. Alumur
TOBB University of Economics and Technology
salumur@etu.edu.tr
Ioannis Giannikos
University of Patras
I.Giannikos@upatras.gr
Mercedes Landete
University Miguel Hernández de Elche
landete@umh.es
Track(s): 17
5 sessions

Arc Routing
Invited
Stefan Irnich
Johannes Gutenberg University
Mainz
irnich@uni-mainz.de
Claudia Bode
Johannes Gutenberg University
Mainz
claudia.bode@uni-mainz.de
Track(s): 11
2 sessions

Boolean and Pseudo-Boolean Optimization
Invited
Endre Boros
Rutgers University
Endre.Boros@rutcor.rutgers.edu
Track(s): 8
4 sessions

Business Excellence in Logistics
Invited
Martin Josef Geiger
Helmut-Schmidt-University
m.j.geiger@hsu-hh.de
Track(s): 3
3 sessions

Combinatorial Optimization
Invited
Silvano Martello
University of Bologna
silvano.martello@unibo.it
Paolo Toth
University of Bologna
paolo.toth@unibo.it
Track(s): 4
7 sessions

Commodities and Financial Modeling
Invited
Rita Decclesia
Sapienza University of Rome
rita.decclesia@uniroma1.it
Ronald Hochreiter
WU Vienna University of Economics and Business
ronald.hochreiter@wu.ac.at
Yeliz Yolcu Okur
Middle East Technical University
yyolcu@metu.edu.tr
Track(s): 19
2 sessions

Computational Biology, Bioinformatics and Medicine
Invited
Jacek Blazewicz
Poznan University of Technology
jblazewicz@cs.put.poznan.pl
Metin Turkay
Koc University
mturkay@ku.edu.tr
Giovanni Felici
Consiglio Nazionale delle Ricerche
giovanni.felici@iasi.cnr.it
Track(s): 37
4 sessions

Computational Statistics
Invited
Pakize Taylan
Dicle University
ptaylan@dicle.edu.tr
Gerhard-Wilhelm Weber
Middle East Technical University
gweber@metu.edu.tr
Track(s): 35
2 sessions

Container Terminal Operations
Invited
Iris F.A. Vis
University of Groningen
i.f.a.vis@rug.nl
Christian Bierwirth
Martin-Luther-University
Halle-Wittenberg
christian.bierwirth@wiwi.uni-halle.de
Ceyda Oguz
Koc University
coguz@ku.edu.tr
Track(s): 12
2 sessions

Continuous Location
Invited
Emilio Carrizosa
Universidad de Sevilla
e.carrizosa@us.es
Track(s): 18
3 sessions
<table>
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<tr>
<th>STREAMS</th>
<th>EURO 25 - Vilnius 2012</th>
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<tr>
<td><strong>Control Theory &amp; System Dynamics (contributed)</strong></td>
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<tr>
<td>Richard Hartl</td>
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<td>University of Vienna</td>
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<td><a href="mailto:richard.hartl@univie.ac.at">richard.hartl@univie.ac.at</a></td>
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<td><strong>Track(s):</strong> 41</td>
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<tr>
<td>1 session</td>
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<tr>
<td><strong>Convex Optimization</strong></td>
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<td>Invited</td>
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<tr>
<td>Aharon Ben-Tal</td>
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<tr>
<td>Technion-Israel Institute of Technology</td>
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<td><a href="mailto:abental@ie.technion.ac.il">abental@ie.technion.ac.il</a></td>
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<tr>
<td>Marc Teboulle</td>
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<tr>
<td>Tel Aviv University</td>
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<tr>
<td><a href="mailto:teboulle@math.tau.ac.il">teboulle@math.tau.ac.il</a></td>
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<tr>
<td>Atila Gilanyi</td>
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<tr>
<td>University of Debrecen</td>
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<tr>
<td><a href="mailto:gilanyi@math.klte.hu">gilanyi@math.klte.hu</a></td>
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<tr>
<td><strong>Track(s):</strong> 23</td>
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<td><strong>Cooperative Game Theory</strong></td>
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<tr>
<td>Mariana Rodica Branzei</td>
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<tr>
<td>&quot;Alexandru Ioan Cuza” University</td>
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<tr>
<td><a href="mailto:branzeir@info.uaic.ro">branzeir@info.uaic.ro</a></td>
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<tr>
<td>Sirma Zeynep Alparslan Gok</td>
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<tr>
<td>Faculty of Arts and Sciences, Suleyman Demirel University</td>
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<tr>
<td><a href="mailto:zeynepalparslan@yahoo.com">zeynepalparslan@yahoo.com</a></td>
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<td><strong>Cutting and Packing</strong></td>
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<td>José Fernando Oliveira</td>
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<td>University of Porto</td>
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<td><a href="mailto:jfo@fe.up.pt">jfo@fe.up.pt</a></td>
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<td>A. Miguel Gomes</td>
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<td>INESC TEC, Faculdade de Engenharia, Universidade do Porto</td>
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<td>Jordi Castro</td>
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<td><a href="mailto:jordi.castro@upc.edu">jordi.castro@upc.edu</a></td>
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<td>Juan José Salazar González</td>
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<td>Universidad de La Laguna (Tenerife)</td>
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<td><a href="mailto:jjsalaza@ull.es">jjsalaza@ull.es</a></td>
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<td><strong>Data Mining and Decision Making</strong></td>
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<td>Lai-Soon Lee</td>
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<td>Universiti Putra Malaysia</td>
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<td>Hsin-Vonn Seow</td>
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<td><a href="mailto:hsin-vonn.seow@nottingham.edu.my">hsin-vonn.seow@nottingham.edu.my</a></td>
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<td><strong>Data Mining in Early Warning Systems</strong></td>
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<td>Inci Batmaz</td>
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<td>Middle East Technical University</td>
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<td>Gulser Koksal</td>
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<td><a href="mailto:koksal@ie.metu.edu.tr">koksal@ie.metu.edu.tr</a></td>
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<td>Antonio Rodrigues</td>
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<td>University of Lisbon</td>
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<td><a href="mailto:ajrodrigues@fc.ul.pt">ajrodrigues@fc.ul.pt</a></td>
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<td>Vadim Strijov</td>
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<tr>
<td>Russian Academy of Sciences, Computing Center</td>
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<td><a href="mailto:strijov@ccas.ru">strijov@ccas.ru</a></td>
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<td><strong>Data Mining, Knowledge Discovery and Artificial Intelligence</strong></td>
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<td>Vincent Mousseau</td>
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<td>Ecole Centrale Paris</td>
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<td><a href="mailto:vincent.mousseau@ecp.fr">vincent.mousseau@ecp.fr</a></td>
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<td><strong>DEA and Performance Measurement</strong></td>
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<td>Dimitris Despotis</td>
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<td>University of Piraeus</td>
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<td><a href="mailto:despotis@unipi.gr">despotis@unipi.gr</a></td>
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<td>Ozren Despic</td>
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<td>Meryem Duygun Fethi</td>
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<td>University of Leicester</td>
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<td><a href="mailto:m.fethi@le.ac.uk">m.fethi@le.ac.uk</a></td>
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<td>Ana Camanho</td>
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<td>Universidade do Porto</td>
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<td><a href="mailto:acamanho@fe.up.pt">acamanho@fe.up.pt</a></td>
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<td>Vania Sena</td>
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<td>Aston University</td>
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<td><a href="mailto:v.sena@aston.ac.uk">v.sena@aston.ac.uk</a></td>
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<td><strong>DEA and Performance Measurement (contributed)</strong></td>
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<td>Elena Fernandez</td>
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<td>Technical University of Catalonia</td>
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<td><a href="mailto:e.fernandez@upc.edu">e.fernandez@upc.edu</a></td>
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<td><strong>Decision Making Modeling and Risk Assessment in the Financial Sector</strong></td>
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<td>Cristina Fulga</td>
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<td>Gheorghe Mihoc-Caius Iacob</td>
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<tr>
<td>Institute of Mathematical Statistics and Applied Mathematics of Romanian Academy</td>
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<td><a href="mailto:fulga@csie.ase.ro">fulga@csie.ase.ro</a></td>
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<td><strong>Track(s):</strong> 20</td>
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<td>5 sessions</td>
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Decision Processes
Invited
Ahti Salo
Aalto University School of Science and Technology
ahti.salo@aalto.fi
Alec Morton
London School of Economics
a.morton@lse.ac.uk
Jeffrey Keisler
University of Massachusetts Boston
jeff.keisler@umb.edu
Track(s): 27
8 sessions

Dynamic Programming
Invited
Lidija Zadnik Strn
University of Ljubljana
lidija.zadnik@bf.uni-lj.si
Track(s): 39
2 sessions

Dynamical Systems and Game Theory
Invited
Alberto A. Pinto
University of Porto
aapinto1@gmail.com
Track(s): 6
3 sessions

Dynamical Systems and Mathematical Modelling in OR
Invited
Selma Belen
CAG University
selmabelen@cag.edu.tr
Gerhard-Wilhelm Weber
Middle East Technical University
gweber@metu.edu.tr
Track(s): 41
1 session

Emerging Applications in Finance and Logistics
Invited
Norbert Trautmann
University of Bern
norbert.tautmann@pqm.unibe.ch
Track(s): 30
3 sessions

Emerging Applications of Fat Tail Models in Financial Modeling and Engineering
Invited
Audrius Kabasinskas
Kaunas University of Technology
audrius.kabasinskas@ktu.lt
Track(s): 30
1 session

Emerging Aspects of Production Planning in Continuous Process Industries: Theory, Optimization, and Practice
Invited
Krystsina Bakhrankova
SINTEF - Technology and society
krystsina.bakhrankova@sintef.no
Track(s): 30
3 sessions

Decision Support Systems
Invited
Pascale Zaraté
Toulouse University
zarate@irit.fr
Fatima Dargam
SimTech Simulation Technology
F.Dargam@SimTechnology.com
Rita Ribeiro
Uninova - CA3
rita.a.ribeiro@gmail.com
Track(s): 27
4 sessions

Dynamical Systems and Game Theory
Invited
Pascale Zaraté
Toulouse University
zarate@irit.fr
Fatima Dargam
SimTech Simulation Technology
F.Dargam@SimTechnology.com
Rita Ribeiro
Uninova - CA3
rita.a.ribeiro@gmail.com
Track(s): 27
4 sessions

Emissions Trading and Energy
Invited
Magnus Fröhling
Karlsruhe Institute of Technology (KIT)
magnus.froehling@kit.edu
Track(s): 32
2 sessions

Energy, Environment and Climate 1
Contributed
Peter Letmathe
RWTH Aachen University
Peter.Letmathe@rwth-aachen.de
Track(s): 25
3 sessions

Energy, Environment and Climate 2
Invited
Wolf Fichtner
Kit
wolf.fichtner@wiwi.uni-karlsruhe.de
Costas Pappis
University of Piraeus
pappis@unipi.gr
Track(s): 25 35
3 sessions

Engineering Optimization
Invited
Wolfgang Achtziger
University of Erlangen-Nuremberg
achtziger@am.uni-erlangen.de
Helder Rodrigues
Technical University of Lisbon, UTL
her@ist.utl.pt
Track(s): 35
1 session

Environmental Issues in Operations Management
Invited
Grit Walther
Bergische Universität Wuppertal
walther@wiwi.uni-wuppertal.de
Track(s): 25
2 sessions

EURO Doctoral Dissertation Award (EDDA 2012)
Invited
Track(s): 42
1 session
### EU Excellence in Practice Award 2012

**Invited**

Michel Bierlaire  
École Polytechnique Fédérale de Lausanne (EPFL)  
michel.bierlaire@epfl.ch

**Track(s):** 42  
2 sessions

### EU/ROADEF Challenge

**Invited**

H. Murat Afsar  
University of Technology of Troyes  
murat.afsar@utt.fr

Christian Artigues  
Cnrs  
artigues@laas.fr

Eric Bourreau  
Lirmm  
eric.bourreau@lirmm.fr

Emmanuel Guere  
Google  
guere@google.com

Ender Özcan  
University of Nottingham  
exo@cs.nott.ac.uk

Marc Sevaux  
Université de Bretagne Sud - UEB  
marc.sevaux@univ-ubs.fr

**Track(s):** 3 9  
5 sessions

### Experimental Economics and Game Theory

**Invited**

Ulrike Leopold-Wildburger  
Karl-Franzens-University  
ulrike.leopold@uni-graz.at

Stefan Pickl  
Universität der Bundeswehr München  
stefan.pickl@uni-bw.de

Gerhard-Wilhelm Weber  
Middle East Technical University  
gweber@metu.edu.tr

**Track(s):** 22  
1 session

### Financial Mathematics and OR

**Invited**

Gerhard-Wilhelm Weber  
Middle East Technical University  
gweber@metu.edu.tr

Mustafa Pinar  
Bilkent University  
mustafap@bilkent.edu.tr

**Track(s):** 21  
6 sessions

### Financial Modelling & Risk Management (contributed)

**Contributed**

Stein W. Wallace  
Lancaster University Management School  
stein.w.wallace@lancaster.ac.uk

**Track(s):** 18  
4 sessions

### Financial Optimization

**Invited**

Gautam Mitra  
Brunel University  
gautam.mitra@brunel.ac.uk

J. E. Beasley  
Brunel University & JB Consultants  
john.beasley@brunel.ac.uk

**Track(s):** 20  
3 sessions

### Forecasting

**Invited**

Aris Syntetos  
University of Salford  
a.syntetos@salford.ac.uk

Antonio Rodrigues  
University of Lisbon  
ajrodrigues@fc.ul.pt

Sven F. Crone  
Lancaster University Management School  
s.crone@lancaster.ac.uk

**Track(s):** 24  
4 sessions

### Fuzzy Optimization - Systems, Networks and Applications

**Invited**

Erik Kropat  
Universität der Bundeswehr München  
erik.kropat@uni-bw.de

**Track(s):** 22  
3 sessions

### Fuzzy Sets and Soft Computing

**Invited**

Mikael Collan  
Lappeenranta University of Technology  
mikael.collan@lut.fi

**Track(s):** 12 22  
4 sessions

### Fuzzy Systems, Neural Networks & Artificial Intelligence

**Invited**

Heinrich Rommelfanger  
J. W. Goethe University  
rommel@wiwi.uni-frankfurt.de

Ana Meca  
Universidad Miguel Hernández  
anameca@umh.es

**Track(s):** 24  
2 sessions

### Game Theory and Logistics

**Invited**

Ignacio García-Jurado  
Coruna University  
igarado@udc.es

Juan Tejada  
Complutense University of Madrid  
jtejada@mat.ucm.es

**Track(s):** 31  
2 sessions

### Game Theory and Social Networks

**Invited**

Juan Enrique Martínez-Legaz  
Universitat Autònoma de Barcelona  
juan.enrique.martinez-legaz@uab.cat

**Track(s):** 23  
5 sessions

### Generalized Differentiation and Optimization

**Invited**

Boris Mordukhovich  
Wayne State University, Detroit  
boris@math.wayne.edu

Alexander Kruger  
University of Ballarat  
a.kruger@ballarat.edu.au

Gerhard-Wilhelm Weber  
Middle East Technical University  
gweber@metu.edu.tr

Juan Enrique Martínez-Legaz  
Universitat Autònoma de Barcelona  
juan.enrique.martinez-legaz@uab.cat

**Track(s):** 23  
5 sessions
Geometric Clustering
Invited
Andreas Brieden
Universität der Bundeswehr München
andreas.brieden@unibw.de
Peter Gritzmann
TU München
gritzman@ma.tum.de
Track(s): 13
1 session

Global Optimization
Invited
Herman Mawengkang
The University of Sumatera Utara
mawengkang@usu.ac.id
Track(s): 17
2 sessions

Graph Searching
Invited
Boting Yang
University of Regina
boting@cs.uregina.ca
Anthony Bonato
Ryerson University
abonato@ryerson.ca
Nancy Clarke
Acadia University
nancy.clarke@acadiau.ca
Track(s): 39
2 sessions

Graphs and Networks
Invited
Dominique de Werra
Eplf
dominique.dewerra@epfl.ch
Track(s): 9
3 sessions

Health Care Management
Invited
Sally Brailsford
University of Southampton
s.c.brailsford@soton.ac.uk
Teresa Melo
Saarland University of Applied Sciences
teresa.melo@htw-saarland.de
Stefan Nickel
Karlsruhe Institute of Technology (KIT)
Stefan.Nickel@kit.edu
Marion Rauner
University of Vienna
marion.rauner@univie.ac.at
Track(s): 37
2 sessions

Hub Location
Invited
James Campbell
University of Missouri-St. Louis
campbell@umsl.edu
Ivan Contreras
Concordia University
icontrer@encs.concordia.ca
Track(s): 17
2 sessions

IBM Research Applications
Invited
Eleni Pratsini
IBM Zurich Research Lab
pra@zurich.ibm.com
Track(s): 45
1 session

Information and Intelligent Systems
Invited
Zuzana Oplatkova
Tomas Bata University in Zlín
oplatkova@fai.utb.cz
Gerhard-Wilhelm Weber
Middle East Technical University
gweber@metu.edu.tr
Track(s): 44
2 sessions

Innovative Software Tools for MCDA
Invited
Patrick Meyer
Telecom Bretagne
patrick.meyer@telecom-bretagne.eu
Vincent Mousseau
Ecole Centrale Paris
vincent.mousseau@ecp.fr
Track(s): 39
2 sessions

Inventory Management
Invited
Dolores Romero Morales
University of Oxford
dolores.romero-morales@sbs.ox.ac.uk
Track(s): 13
2 sessions

Iterative Methods for Economic Models
Invited
Adriana Gnudi
University of Bergamo
adriana.gnudi@unibg.it
Elisabetta Allevi
University of Brescia
allevi@eco.unibs.it
Igor Konnov
University of Kazan
Igor.Konnov@ksu.ru
Track(s): 31
1 session

Keynote, Tutorial and Plenary Lectures
Invited
Marielle Christiansen
Norwegian University of Science and Technology
marielle.christiansen@iot.ntnu.no
Leonidas Sakalauskas
Institute of Mathematics & Informatics
sakal@ktl.mii.lt
Track(s): 1
15 sessions
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**Linear and Conic Programming**
*Invited*
- Miguel Anjos
  - Ecole Polytechnique de Montreal
  - anjos@stanfordalumni.org

- Tibor Illés
  - Budapest University of Technology and Economics
  - illes@math.bme.hu

**Track(s):** 16 
**Sessions:** 4

**Logistics, Transportation, Traffic**
*Contributed*
- Elena Fernandez
  - Universitat Politecnica de Catalunya
  - e.fernandez@upc.es

**Track(s):** 3 
**Sessions:** 3

**Long Term Financial Decisions**
*Invited*
- Thomas Burkhardt
  - Universitaet Koblenz-Landau
  - tburkha@uni-koblenz.de

**Track(s):** 21 
**Sessions:** 3

**Long Term Planning in Energy, Environment and Climate**
*Invited*
- Nadia Maïzi
  - MINES ParisTech
  - nadia.maiizi@mines-paristech.fr

**Track(s):** 25 
**Sessions:** 3

**Lot-sizing and Related Topics**
*Invited*
- Christian Almeder
  - European University Viadrina
  - Almeder@europa-uni.de

- Bernardo Almada-Lobo
  - Faculty of Engineering of Porto University
  - almada.lobo@fe.up.pt

- Alistair Clark
  - University of the West of England
  - Alistair.Clark@uwe.ac.uk

**Track(s):** 13 
**Sessions:** 4

**Machine Learning and its Applications**
*Invited*
- Vadim Strijov
  - Russian Academy of Sciences, Computing Center
  - strijov@ccas.ru

- Sureyya Ozogur-Akyuz
  - Bahcesehir University
  - sureyya.akyuz@bahcesehir.edu.tr

**Track(s):** 44 
**Sessions:** 6

**Manufacturing and Warehousing**
*Invited*
- Martin Grunow
  - Technische Universität München
  - martin.grunow@tum.de

**Track(s):** 13 
**Sessions:** 2

**Maritime Transportation**
*Invited*
- Henrik Andersson
  - Norwegian University of Science and Technology
  - Henrik.Andersson@iot.ntnu.no

**Track(s):** 5 9
**Sessions:** 6

**Mathematical Models in Macroeconomics**
*Invited*
- Murat Kirdar
  - Middle East Technical University
  - kirdar@metu.edu.tr

- Ludmilla Koshlai
  - Institute of Cybernetics
  - koshlai@ukr.net

- Gerhard-Wilhelm Weber
  - Middle East Technical University
  - gweber@metu.edu.tr

**Track(s):** 22 
**Sessions:** 3

**Mathematical Programming**
*Invited*
- Florian Potra
  - University of Maryland
  - potra@umbc.edu

- Tamás Terlaky
  - Lehigh University
  - terlaky@lehigh.edu

- Gerhard-Wilhelm Weber
  - Middle East Technical University
  - gweber@metu.edu.tr

- Goran Lesaja
  - Georgia Southern University
  - goran@georgiasouthern.edu

- Sandor Zoltan Nemeth
  - The University of Birmingham
  - nemeths@for.mat.bham.ac.uk

**Track(s):** 23 
**Sessions:** 3

**Matheuristics**
*Invited*
- Vittorio Maniezzo
  - University of Bologna
  - vittorio.maniezzo@unibo.it

- Stefan Voss
  - University of Hamburg
  - stefan.voss@uni-hamburg.de

**Track(s):** 6 
**Sessions:** 1

**MCDA: New Approaches and Applications**
*Invited*
- Gerhard-Wilhelm Weber
  - Middle East Technical University
  - gweber@metu.edu.tr

**Track(s):** 39 40 
**Sessions:** 10

**Metaheuristics**
*Invited*
- Marc Sevaux
  - Université de Bretagne Sud - UEB
  - marc.sevaux@univ-ubs.fr

- Kenneth Sörensen
  - University of Antwerp
  - kenneth.sorensen@ua.ac.be

- Andreas Reinholz
  - German Aerospace Center (DLR)
  - andreas.reinholz@gmx.de

**Track(s):** 6 
**Sessions:** 7
Methodology of Societal Complexity
Invited
Dorien DeTombe
Chair Euro Working Group
detombe@nosmo.nl
Track(s): 36
2 sessions

Mixed-Integer Non-Linear Programming
Invited
Sonia Cafieri
Ecole Nationale d’Aviation Civile
sonia.cafieri@enac.fr
Claudia D’Ambrosio
CNRS - Ecole Polytechnique
dambrosio@lix.polytechnique.fr
Track(s): 29
7 sessions

Models of Embodied Cognition
Invited
Susie Vrobel
The Institute for Fractal Research
Susanne.Vrobel@t-online.de
Track(s): 28
2 sessions

Multi-Criteria Decision Making and Environmental Management
Invited
Vadim Strijov
Russian Academy of Sciences,
Computing Center
strijov@ccas.ru
Track(s): 26
3 sessions

Multiobjective Optimization
Invited
José Rui Figueira
Technical University of Lisbon
figueira@ist.utl.pt
Kaisa Miettinen
University of Jyvaskyla
kaisa.miettinen@jyu.fi
Christiane Tammer
Martin-Luther-University
Halle-Wittenberg
christiane.tammer@mathematik.uni-halle.de
Track(s): 38 41
13 sessions

Network and Discrete Location
Invited
Francisco Saldanha-da-Gama
University of Lisbon
fsgama@fc.ul.pt
Alfredo Marin
University of Murcia
amarin@um.es
Stefan Nickel
Karlsruhe Institute of Technology (KIT)
Stefan.Nickel@kit.edu
Track(s): 18
4 sessions

Network Optimization
Invited
Bernard Fortz
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Luis Gouveia
University of Lisbon
legouveia@fc.ul.pt
Walid Ben-ameur
Telecom SudParis
walid.benameur@it-sudparis.eu
Track(s): 8
4 sessions

New Trends in Vehicle Routing
Invited
Jorge E. Mendoza
Université Catholique de l’Ouest
jorge.mendoza@uco.fr
Track(s): 7
3 sessions

Nonconvex Programming: Local and Global Approaches
Invited
Tao Pham Dinh
INSA Rouen
pham@insa-rouen.fr
Hoai An Le Thi
University of Lorraine
hoai-an.le-thi@univ-lorraine.fr
Track(s): 17
3 sessions

Nonlinear Programming
Invited
Edite M.G.P. Fernandes
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M. Fernanda P. Costa
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Lino Costa
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Ana Maria A.C. Rocha
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Isabel Espírito Santo
Minho University
iapinho@dps.uminho.pt
Simone Göttlich
University of Mannheim
goettlich@uni-mannheim.de
Track(s): 15 19
4 sessions

Nonsmooth Optimization
Invited
Adil Bagirov
University of Ballarat
a.bagirov@ballarat.edu.au
Albert Ferrer
Technological University of Catalonia
alberto.ferrer@upc.edu
Antonio Fuduli
Università della Calabria
antonio.fuduli@unical.it
Peter Recht
TU Dortmund
peter.recht@tu-dortmund.de
Track(s): 16
3 sessions

Numerical Methods in Finance
Invited
Ömür Ugur
Middle East Technical University
ougur@metu.edu.tr
Track(s): 21
3 sessions

Occupational Health & Wellbeing
Invited
Elena Andreeva
Berlin University of Technology
elan@ifg.tu-berlin.de
Track(s): 36
1 session
Operational Research and Quantitative Models in Banking
Invited
Constantin Zopounidis
Technical University of Crete
kostas@dpem.tuc.gr
Track(s): 19
2 sessions

Operations/Marketing Interface
Invited
Kathryn E. Stecke
University of Texas at Dallas
KStecke@utdallas.edu
Xuying Zhao
University of Notre Dame
xzhao1@nd.edu
Track(s): 35
1 session

Optimal Control
Invited
Ekaterina Kostina
University of Marburg
kostina@mathematik.uni-marburg.de
Gernot Tragler
Vienna University of Technology
tragler@eos.tuwien.ac.at
Erik Kropat
Universität der Bundeswehr München
erik.kropat@unibw.de
Gerhard-Wilhelm Weber
Middle East Technical University
gweber@metu.edu.tr
Track(s): 4
2 sessions

Optimization and Data Mining
Invited
Emilio Carrizosa
Universidad de Sevilla
e carrizosa@us.es
Theodore Trafalis
University of Oklahoma		
trafalis@ou.edu
Renato De Leone
Università di Camerino
renato.deleone@unicam.it
Track(s): 29
4 sessions

Optimization for Sustainable Development
Invited
Herman Mawengkang
The University of Sumatera Utara
mawengkang@usu.ac.id
Gerhard-Wilhelm Weber
Middle East Technical University
gweber@metu.edu.tr
Track(s): 34
3 sessions

Optimization in Public Transport
Invited
Leo Kroon
Erasmus University Rotterdam
lkroon@rsm.nl
Anita Schöbel
Georg-August Universiy Goettingen
schoebel@math.uni-goettingen.de
Track(s): 3 4 12
9 sessions

OR and Environmental Management
Invited
Marion Steven
Ruhr-University Bochum
marion.steven@rub.de
Track(s): 25 26
2 sessions

OR and Ethics
Invited
Cristobal Miralles
Universidad Politecnica de Valencia
cmiralles@omp.upv.es
Fred Wenstøp
BI Norwegian School of Management
fred.wenstop@bi.no
Track(s): 31
2 sessions

OR and Real Implementations
Invited
Ben Lev
Drexel University
blev@drexel.edu
Belarmino Adenso-Diaz
Universidad de Oviedo
adenso@epsig.uniovi.es
Istvan Maros
Imperial College London
i.maros@imperial.ac.uk
Track(s): 35
1 session

OR and the Arts
Invited
Vitaly Podobedov
Moscow State University
vetix@or-art.org
Track(s): 24
1 session

OR Applications in Industry
Invited
Geir Hasle
Sintef Ict
gear.hasle@sintef.no
Jens Wollenweber
Dr. Staedtlter Transport Consulting
j.wollenweber@staedtlter-logistik.de
Track(s): 35
1 session

OR Applications in the Automotive Industry
Invited
Thomas Spengler
Technische Universität Braunschweig
t.spengler@tu-bs.de
Thomas Volling
Technische Universität Braunschweig
volling@tu-bs.de
Track(s): 13
3 sessions
OR for Development and Developing Countries
Invited

Elise del Rosario
elise@jgdelrosario.com

Honora Smith
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Gerhard-Wilhelm Weber
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Francoise Summers
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Youssef Masmoudi
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OR in Agriculture, Forestry and Fisheries
Invited

LluisM Pla
University of Lleida
lpla@matematica.udl.es

Víctor M. Albornoz
Universidad Tecnica Federico Santa
Maria
victor.albornoz@usm.cl

Track(s): 26
4 sessions

OR in Health & Life Sciences (contributed)
Contributed

Gerhard-Wilhelm Weber
Middle East Technical University
Gweber@metu.edu.tr

Track(s): 37
6 sessions

OR in Human Resources
Invited

Bo Hu
Universität der Bundeswehr München
bo.hu@unibw.de

Track(s): 24
1 session

OR in Industry and Software for OR (contributed)
Contributed

Mikael Rönqvist
Département de génie mécanique
mikael.ronqvist@nhh.no

Track(s): 35
1 session

OR in Military, Safety and Security Applications
Invited

Ana Isabel Barros
Tno
ana.barros@tno.nl

Track(s): 28
3 sessions

OR in Quality Management
Invited

Ipek Deveci Kocakoç
Dokuz Eylul University Faculty of Economics and Administrative Sciences
ipek.deveci@deu.edu.tr

Gülser Koksal
Middle East Technical University
koksal@ie.metu.edu.tr

Track(s): 28
2 sessions

OR in Sports
Invited

Sigrid Knust
University of Osnabrück
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Dirk Briskorn
University of Siegen
dirk.briskorn@uni-siegen.de

Alexandra Newman
Colorado School of Mines
newman@mines.edu

Track(s): 35
1 session

OR in the Oil and Gas Sectors
Invited

Irina Dolgopolova
Middle East Technical University
irina.dolgopolova@gmail.com

Track(s): 26
2 sessions

OR in Water Management
Invited

Halil Önder
Middle East Technical University
onde@metu.edu.tr

Elcin Kentel
Metu
elcin.kentel@metu.edu.tr

Track(s): 26
1 session

Pioneers in Operations Research
Invited

Graham Rand
Lancaster University
g.rand@lancaster.ac.uk

Jakob Krarup
University of Copenhagen
jakob.krarup@diku.dk

Track(s): 24
1 session

Vida Maliene
School of the Built Environment, Liverpool John Moores University
v.maliene@ljmu.ac.uk

Track(s): 33
3 sessions
### Preference Learning
**Invited**
Krzysztof Dembczynski  
Poznan University of Technology  
kdembczynski@cs.put.poznan.pl

Willem Waegeman  
Ghent University  
willem.waegeman@ugent.be

Roman Slowinski  
Poznan University of Technology  
roman.slowinski@cs.put.poznan.pl

**Track(s):** 40  
**5 sessions**

### Production and the Link with Supply Chains
**Invited**
Lionel Amodeo  
University of Technology of Troyes  
lionel.amodeo@utt.fr

Farouk Yalaoui  
University of Technology of Troyes  
farouk.yalaoui@utt.fr

**Track(s):** 10  
**3 sessions**

### Production Management & Supply Chain Management (contributed)
**Contributed**
Elena Fernandez  
Univatat Politecnica de Catalunya  
e.fernandez@upc.es

**Track(s):** 6  
**6 sessions**

### Project Management and Scheduling
**Invited**
Rainer Kolisch  
Technische Universitaet Muenchen  
rainer.kolisch@wi.tum.de

**Track(s):** 2  
**4 sessions**

### Quantitative Approaches in Managerial and Financial Accounting
**Invited**
Matthias Amen  
University of Bielefeld  
Matthias.Amen@web.de

**Track(s):** 45  
**1 session**

### Quantitative Models for Performance and Dependability
**Invited**
Markus Siegle  
Universitaet der Bundeswehr  
muenchen  
markus.siegle@unibw.de

**Track(s):** 36  
**2 sessions**

### Realistic Production Scheduling
**Invited**
Ruben Ruiz  
Universidad Politecnica de Valencia  
rruiz@eio.upv.es

**Track(s):** 11  
**3 sessions**

### Recent Advances in Earthquake Studies
**Invited**
Aysegul Askan  
Middle East Technical University  
askan@metu.edu.tr

Gerhard-Wilhelm Weber  
Middle East Technical University  
gweber@metu.edu.tr

**Track(s):** 28  
**1 session**

### Revenue Management
**Invited**
Ayse Kocabiyikoglu  
Bilkent University  
aysekoca@bilkent.edu.tr

Yuri Levin  
Queen’s University  
ylevin@business.queensu.ca

Tatsiana Levina  
Queen’s University  
tlevina@business.queensu.ca

Joern Meissner  
Kuehne Logistics University  
joe@meiss.com

**Track(s):** 40  **44 45**  
**6 sessions**

### Scheduling
**Invited**
Erwin Pesch  
University of Siegen  
erwin.pesch@uni-siegen.de

Vitaly Strusevich  
University of Greenwich  
sv02@gre.ac.uk

**Track(s):** 2  
**8 sessions**

### Scheduling under Resource Constraints
**Invited**
Joanna Jozefowska  
Poznan University of Technology  
j jozefowska@cs.put.poznan.pl

Jan Weglarz  
Poznan University of Technology  
jan.weglarz@cs.put.poznan.pl

**Track(s):** 14  
**6 sessions**

### SD Modelling in Sustainable Development
**Invited**
Pierre Kunsch  
Vrije Universiteit Brussel  
pkunsch@vub.ac.be

Erik Pruyl  
Delft University of Technology  
E.Pruyl@tudelft.nl

**Track(s):** 40  
**2 sessions**

### Semi-Infinite Optimization
**Invited**
Vladimir Shikhman  
RWTH Aachen University  
shikhman@mathc.rwth-aachen.de

Gerhard-Wilhelm Weber  
Middle East Technical University  
gweber@metu.edu.tr

Shunsuke Hayashi  
Kyoto University  
shunhaya@amp.i.kyoto-u.ac.jp

**Track(s):** 15  
**2 sessions**

### Simulation
**Invited**
Track(s): 42  
**1 session**

### Simulation Based Decision Support
**Invited**
Miroljub Kljajic  
University of Maribor  
m iroljub.kljajic@fov.uni-mb.si

Viveca Asproth  
Mid Sweden University  
viveca.asproth@miun.se

**Track(s):** 25  
**1 session**
Simulation in Management
Accounting and Management Control
Invited
Friederike Wall
Alpen-Adria-Universitaet Klagenfurt
friederike.wall@uni-klu.ac.at
Stephan Leitner
Alpen-Adria-Universität Klagenfurt
stephan.leitner@uni-klu.ac.at
Track(s): 45
2 sessions

Simulation Methods in Finance
Invited
Aysegul Iscanoglu Cekic
Selcuk University
iaysegul@selcuk.edu.tr
Gerhard-Wilhelm Weber
Middle East Technical University
gweber@metu.edu.tr
Track(s): 19
3 sessions

Soft OR and Problem Structuring Methods
Invited
Giles Hindle
Hull University Business School
giles.hindle@hull.ac.uk
Track(s): 32
6 sessions

Software for OR/MS
Invited
Robert Fourer
4er@iems.northwestern.edu
Bjarni Kristjansson
Maximal Software, Ltd.
bjarni@maximalsoftware.com
Track(s): 33 35
2 sessions

Stochastic Modeling and Simulation in Engineering, Management and Science
Invited
Erik Kropat
Universität der Bundeswehr München
erik.kropat@unibw.de
Devin Sezer
Middle East Technical University, Institute of Applied Mathematics
devin@metu.edu.tr
Basak Tanyeri
Bilkent University
basak@bilkent.edu.tr
Zeev (Vladimir) Volkovich
Ort Braude Academic College
zeev@actcom.co.il
Gerhard-Wilhelm Weber
Middle East Technical University
gweber@metu.edu.tr
Track(s): 42
8 sessions

Stochastic Modelling in Logistical Networks
Invited
El-Houssaine Aghezzaf
Ghent University
ElHoussaine.Aghezzaf@UGent.be
Track(s): 45
3 sessions

Stochastic Programming
Invited
Jitka Dupacova
Charles Univ, Faculty of Math. and Physics
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Georg Pflug
University of Vienna
gpflug@univie.ac.at
Andras Prekopa
Rutgers University
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Alexander Shapiro
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Stein W. Wallace
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stein.w.wallace@lancaster.ac.uk
Giorgio Consigli
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Abdel Lisser
Université de Paris Sud
lisser@lri.fr
Asgeir Tomasgard
Sintef Technology and society
asgeir.tomasgard@sintef.no
Track(s): 43 44
12 sessions

Structured Optimization and Applications
Invited
Vladimir Shikhman
RWTH Aachen University
shikhman@mathc.rwth-aachen.de
Track(s): 28
4 sessions

Supply Chain Management
Invited
Steef van de Velde
RSM Erasmus University
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Track(s): 10
2 sessions
### Supply Chain Planning
**Invited**

- **Moritz Fleischmann**  
  University of Mannheim  
  Moritz.Fleischmann@bwl.uni-mannheim.de
- **Herbert Meyer**  
  University of Hohenheim  
  H.Meyer@uni-hohenheim.de

**Track(s):** 7 8

**4 sessions**

### Sustainable Living: Cognitive, Social, Economical, Ecological and World View
**Invited**

- **Annette Hohenberger**  
  Middle East Technical University (METU)  
  hohenberger@i.metu.edu.tr
- **Pedamallu Chandra Sekhar**  
  Dana-Farber Cancer Institute  
  pcs.murali@gmail.com
- **Gerhard-Wilhelm Weber**  
  Middle East Technical University  
  gweber@metu.edu.tr
- **Claudia Rave**  
  National University of Colombia  
  claudia.rave@gmail.com

**Track(s):** 34

**1 session**

### Timetabling and Rostering
**Invited**

- **Dario Landa-Silva**  
  University of Nottingham  
  dario.landasilva@nottingham.ac.uk
- **Nysret Musliu**  
  Vienna University of Technology  
  musliu@dbai.tuwien.ac.at
- **Timothy Curtois**  
  University of Nottingham  
  tim.curtois@nottingham.ac.uk

**Track(s):** 14

**5 sessions**

### Transportation and Logistics
**Invited**

- **Maurizio Bielli**  
  Institute of Systems Analysis and Informatics  
  bielli@iasi.cnr.it

**Track(s):** 11

**5 sessions**

### Transportation Planning
**Invited**

- **Herbert Kopfer**  
  University of Bremen  
  kopfer@uni-bremen.de
- **Frank Schultmann**  
  Karlsruhe Institute of Technology (KIT)  
  frank.schultmann@kit.edu

**Track(s):** 11

**1 session**

### Uncertainty and Perturbations in Optimization and in Environmental and Energy Modelling
**Invited**

- **Jerzy Filar**  
  Flinders University  
  jerzy.filar@flinders.edu.au
- **Julia Piantadosi**  
  University of South Australia  
  julia.piantadosi@unisa.edu.au

**Track(s):** 16

**5 sessions**

### System Dynamics Modeling and Simulation
**Invited**

- **Markus Schwaninger**  
  Universität St.Gallen  
  markus.schwaninger@unisg.ch
- **Markus Schwenke**  
  University of St. Gallen  
  markus.schwenke@unisg.ch

**Track(s):** 41

**1 session**

### Variable Neighborhood Search
**Invited**

- **José A. Moreno-Pérez**  
  University of La Laguna  
  jmoreno@ull.es
- **Nenad Mladenovic**  
  Brunel University  
  Nenad.Mladenovic@brunel.ac.uk

**Track(s):** 6

**1 session**

### Variational Inequalities and Bi-Level Problems
**Invited**

- **Stephan Dempe**  
  Technische Universitaet Freiberg  
  dempe@math.tu-freiberg.de
- **Yury Kochetov**  
  Novosibirsk State University  
  jkochet@math.nsc.ru
- **Oleg Khramov**  
  Institute of Energy Systems  
  mis@isem.sei.irk.ru

**Track(s):** 15

**3 sessions**

### Vector and Set-Valued Optimization
**Invited**

- **Vicente Novo**  
  Universidad Nacional de Educacion a Distancia  
  vnovo@ind.uned.es
- **Bienvenido Jiménez**  
  Uned  
  bjimenez@ind.uned.es
- **César Gutiérrez**  
  Universidad de Valladolid  
  cesargv@mat.uva.es

**Track(s):** 15

**3 sessions**

### Vehicle Routing and Logistics Optimization
**Invited**

- **Daniele Vigo**  
  University of Bologna  
  daniele.vigo@unibo.it

**Track(s):** 7

**6 sessions**
Young People for System Theory, Optimization and Education

Invited

Alexis Pasichny
National Technical University of Ukraine
alexis.pasichny@gmail.com

Kateryna Pererverza
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Liza Korotchenko
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Alexej Orlov
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Bohdan Pakalskyi
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Track(s): 41
2 sessions
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