A Benders Decomposition-Based Matheuristic for the Cardinality Constrained Shift Design Problem

The Shift Design Problem is an important optimization problem which arises when scheduling personnel in industries that require continuous operation. Based on the forecast, required staffing levels for a set of time periods, a set of shift types that best covers the demand must be determined. A shift type is a consecutive sequence of time periods that adheres to legal and union rules and can be assigned to an employee on any day. In this paper we introduce the Cardinality Constrained Shift Design Problem; a variant of the Shift Design Problem in which the number of permitted shift types is bounded by an upper limit. We present an integer programming model for this problem and show that its structure lends itself very naturally to Benders decomposition. Due to convergence issues with a conventional implementation, we propose a matheuristic based on Benders decomposition for solving the problem. Furthermore, we argue that an important step in this approach is finding dual alternative optimal solutions to the Benders subproblems and describe an approach to obtain a diverse set of these. Numerical tests show that the described methodology significantly outperforms a commercial mixed integer programming solver on instances with 1241 different shift types and remains competitive for larger cases with 2145 shift types. On all classes of problems the heuristic is able to quickly find good solutions. © 2016 Elsevier B.V. All rights reserved.

General information
Publication status: Published
Organisations: Department of Management Engineering, Management Science, University of Southern Denmark
Contributors: Lusby, R. M., Range, T. M., Larsen, J.
Number of pages: 13
Pages: 385-397
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: European Journal of Operational Research
Volume: 254
ISSN (Print): 0377-2217
Ratings:
  BFI (2016): BFI-level 1
  Scopus rating (2016): CiteScore 3.83 SJR 2.489 SNIP 2.417
  Web of Science (2016): Impact factor 3.297
  Web of Science (2016): Indexed yes
Original language: English
Keywords: Scheduling, Integer programming, Shift design, Benders decomposition
Electronic versions:
A_Benders_decomposition.pdf. Embargo ended: 04/05/2018
DOIs: 10.1016/j.ejor.2016.04.014
Source: PublicationPreSubmission
Source ID: 123677960
Research output: Contribution to journal › Journal article – Annual report year: 2016 › Research › peer-review