Implementing a generic method for bias correction in statistical models using random effects, with spatial and population dynamics examples - DTU Orbit (28/12/2018)

Implementing a generic method for bias correction in statistical models using random effects, with spatial and population dynamics examples

Statistical models play an important role in fisheries science when reconciling ecological theory with available data for wild populations or experimental studies. Ecological models increasingly include both fixed and random effects, and are often estimated using maximum likelihood techniques. Quantities of biological or management interest ("derived quantities") are then often calculated as nonlinear functions of fixed and random effect estimates. However, the conventional "plug-in" estimator for a derived quantity in a maximum likelihood mixed-effects model will be biased whenever the estimator is calculated as a nonlinear function of random effects. We therefore describe and evaluate a new "epsilon" estimator as a generic bias-correction estimator for derived quantities. We used simulated data to compare the epsilon-method with an existing bias-correction algorithm for estimating recruitment in four configurations of an age-structured population dynamics model. This simulation experiment shows that the epsilon-method and the existing bias-correction method perform equally well in data-rich contexts, but the epsilon-method is slightly less biased in data-poor contexts. We then apply the epsilon-method to a spatial regression model when estimating an index of population abundance, and compare results with an alternative bias-correction algorithm that involves Markov-chain Monte Carlo sampling. This example shows that the epsilon-method leads to a biologically significant difference in estimates of average abundance relative to the conventional plug-in estimator, and also gives essentially identical estimates to a sample-based bias-correction estimator. The epsilon-method has been implemented by us as a generic option in the open-source Template Model Builder software, and could be adapted within other mixed-effects modeling tools such as Automatic Differentiation Model Builder for random effects. It therefore has potential to improve estimation performance for mixed-effects models throughout fisheries science. Published by Elsevier B.V.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, National Oceanographic and Atmospheric Administration
Contributors: Thorson, J. T., Kristensen, K.
Pages: 66-74
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: Fisheries Research
Volume: 175
ISSN (Print): 0165-7836
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.94 SJR 0.941 SNIP 0.959
Web of Science (2017): Impact factor 1.874
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.21 SJR 1.183 SNIP 1.153
Web of Science (2016): Impact factor 2.185
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.01 SJR 1.092 SNIP 1.131
Web of Science (2015): Impact factor 2.23
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.17 SJR 1.122 SNIP 1.305
Web of Science (2014): Impact factor 1.903
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.85 SJR 1.049 SNIP 1.167
Web of Science (2013): Impact factor 1.843
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.78 SJR 0.948 SNIP 1.189
Web of Science (2012): Impact factor 1.695
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.7 SJR 1.162 SNIP 1.142
Web of Science (2011): Impact factor 1.586
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.063 SNIP 1.107
Web of Science (2010): Impact factor 1.656
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.994 SNIP 1.068
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.946 SNIP 1.136
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.031 SNIP 1.079
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.028 SNIP 1.274
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.924 SNIP 1.139
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.964 SNIP 1.032
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.078 SNIP 1.29
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.19 SNIP 1.246
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.933 SNIP 0.902
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.541 SNIP 0.816
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.565 SNIP 0.838
Original language: English
Keywords: FISHERIES, STOCK-REDUCTION ANALYSIS, RECRUITMENT, UNCERTAINTY, VARIABILITY, SELECTIVITY, VARIANCES, DENSITY, Random effects, Mixed-effects model, Template Model Builder (TMB), Stock assessment, Epsilon estimator, Bias correction
DOIs:
10.1016/j.fishres.2015.11.016
Source: FindIt
Source-ID: 2289495528
Research output: Research - peer-review › Journal article – Annual report year: 2016