IRTBEMM: An R Package for Estimating IRT Models With Guessing or Slipping Parameters

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Abstract

A recently released R package IRTBEMM is presented in this article. This package puts together several new estimation algorithms (Bayesian EMM, Bayesian E3M, and their maximum likelihood versions) for the Item Response Theory (IRT) models with guessing and slipping parameters (e.g., 3PL, 4PL, IPL-G, and IPL-AG models). IRTBEMM should be of interest to the researchers in IRT estimation and applying IRT models with the guessing and slipping effects to real datasets.

Keywords

R package, 3PLM, 4PLM, IPL-AG, IRTBEMM

The R package IRTBEMM (Guo et al., 2020) is designed to implement the family of the Bayesian Expectation-Maximization-Maximization (BEMM) algorithm to estimate unidimensional dichotomous item response models with guessing or slipping parameters. The BEMM family includes (a) the BEMM algorithm (Guo & Zheng, 2019) for three-parameter logistic (3PL) model and one-parameter logistic guessing (IPL-G) model; (b) the Bayesian Expectation-Maximization-Maximization-Maximization (BE3M) algorithm (Zhang et al., 2018) for four-parameter logistic (4PL) model and one-parameter logistic ability-based guessing (IPL-AG) model; and (c) their maximum likelihood estimation versions developed by Zheng et al. (2018). Both Bayesian modal estimates and maximum likelihood estimates are available.

In addition to offering item point estimates, the package IRTBEMM also provides (a) the corresponding standard errors via Supplemented EM algorithm; (b) the estimates of students' ability parameters via Expected A Posteriors (EAP) method; and (c) various model fit indices such as log-likelihood and G-square, Akaike information criterion (AIC), Bayesian information criterion (BIC), and root mean square error approximation (RMSEA).

IRTBEMM has default estimation setting, but it is easy to manipulate them by changing the input variables in the functions. Users can not only specify the priors and initial values for each parameter, but also control the convergence criterion, the maximum number of E-step/M-step cycles, the quadrature settings for integration, and so on.

The R package IRTBEMM is a free software written in the R language and C language and is compatible with all major platforms (Windows, Linux, and macOS). This package with all

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source codes and documentation is available from the Comprehensive R Archive Network (CRAN) via cran.r-project.org/package=IRTBEMM.

Author's note

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Declaration of Conflicting Interests

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Supplemental Material

Supplementary material is available for this article online at cran.r-project.org/package=IRTBEMM.

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