

# Item response theory models for higher-order latent traits and multilevel data

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## Abstract

In educational and psychological tests, categorical responses to test items are often collected from examinees for the evaluation of the quality of measurement or statistical inferences. Conventional factor analysis is inapplicable for such kind of data because the relationship between the indicators and factors is nonlinear. An item response theory (IRT; Lord, 1980) model has been proposed to fit the data with categorical item responses. However, a higher-order latent trait structure, which has widely applied in factor analysis models, is not considered in the traditional IRT models. Recently, a new class of IRT models combining the higher-order latent traits with the IRT models has been proposed (Huang, Wang, Chen, & Su, in press). In this study, the author will introduce the development of the novel higher-order IRT models and extend the new ones to multilevel data (Huang & Wang, 2012; Huang, 2013). In addition, Bayesian estimation with Markov chain Monte Carlo (MCMC) methods furnishes an efficient approach to calibrating model parameters because a high dimensionality involves in the complicated models. Finally, applications of the new models to empirical data and implications of measurement theory are also addressed.

Keywords: item response theory, higher-order models, multilevel models, MCMC