MCMC GGUM: A New Computer Program for Estimating Unfolding IRT Models

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The latest advances in psychometric research have concluded that noncognitive measurement is better carried out using unfolding item response theory (IRT) models (Chernyshenko, Stark, Chan, Drasgow, & Williams, 2001; Drasgow, Chernyshenko, & Stark, 2010). Unlike cognitive ability tests, which deal with right/wrong responses, noncognitive measurement involves responses that indicate how well an item describes the respondent's typical preference or standing on a latent continuum. The Generalized Graded Unfolding IRT Model (GGUM), originally developed by Roberts, Donoghue, and Laughlin (2000), is the most popular unfolding IRT model, and has been widely accepted in both academia and applied industry. Up to now, the GGUM has been primarily estimated in GGUM2004 (Roberts, Fang, Cui, & Wang, 2006), which employs maximum likelihood estimation (MLE) method. This software has played a critical role in the use of unfolding IRT in research and applications. Nevertheless, in some situations, GGUM2004 has been found to produce unusually large location parameter estimates and standard errors (de la Torre, Stark, & Chernyshenko, 2006), which inevitably leads to difficulties when conducting differential item functioning (DIF) analyses with GGUM (Wang, Tay, & Drasgow, 2013). To provide an alternative method of estimating the GGUM, MCMC GGUM, a new computer program that employs Markov chain Monte Carlo (MCMC) estimation method, is developed. This computer program also offers a user-friendly graphical interface.

Program Description

The MCMC GGUM computer program employs the Metropolis-Within-Gibbs algorithm (Hastings, 1970; Metropolis, Rosenbluth, Rosenbluth, Teller, & Teller, 1953) and estimates the item and person parameters simultaneously. This program is capable of calibrating data sets with up to 10 response categories, and, theoretically, with no limit on the number of items and respondents. This program can also handle missing values in the data. In addition, the MCMC GGUM computer program allows users to adjust the distributions of priors, which is an important feature that is not supported in GGUM2004. In this program, users can specify the supports

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of the prior distributions (i.e., lower and upper limits) to increase estimation accuracy by manipulating the parameters of four-parameter beta distributions.

MCMC GGUM program also provides many useful features related to the MCMC estimation method. It allows users to specify the number of iterations for the length of the chain and the burn-in and also reports the rejection rates of the parameters being estimated. Finally, this program reports convergence statistics based on Geweke's (1992) method.

The program is developed in C++ programming language with a user-friendly graphical interface. It runs with a syntax input that carries all the parameter information and specified settings. It has been tested on operation systems Windows 7 and 8.

Availability, Documentation, and Distribution

The MCMC GGUM program is available from the website www.ComputationalBehaviors.com. It is free of charge for noncommercial use only. Users are free to distribute it without the authors' permission. Documentations such as syntax files are available separately from the same website.

Declaration of Conflicting Interests

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