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A Novel Approach for Estimating students' Ability of Dynamic Item Response Theory Models

Shuhrah Alghamdi[1], Nema Dean[2], Ludger Evers[3]

School of Mathematics and Statistics, University of Glasgo , *Princess Nourah Bint Abdul Rahman University,Riyadh, Saudi Arabi*

Abstract

In modern society, exams are widely used in different fields. For example, exams are used for various educational purposes, like evaluating the academic students' learning improvement and measuring individual differences. This has encouraged the development of better exams and improved statistical methods for analysing exam results. Educational measurement is an exciting field where many researchers look to construct objective measurements of students' knowledge, skills and abilities. Item response theory (IRT) is one of the most popular methods in education for estimating latent traits of students and the test (e.g. difficulty.). To date, many estimation methods have been developed for implementing IRT models. However, the challenge arises when one needs to estimate the parameters of interest in a dynamic system, where the data arrives in real-time continuously, such as in real-life scenarios when students take a test at different times or on other days. In reality, teachers and students are interested in immediate test results. The main objective of this paper is to use a proposed method, the sequential Laplace approximation (LA), to estimate students' ability in dynamic IRT models. The sequential LA estimation method's performance for the one-parameter logistic IRT model has been compared to full LA in a simulation study. Based on several comparison criteria, such as bias, RMSE, and Kendall's t measurement ranking distance, the sequential LA approximately estimated abilities results were very close to the full LA. Therefore, this method can be a helpful tool for research problems for big data or online inference.

Keywords: Approximation, Dynamic-model, Estimation, IRT, Online-inference.