Bayesian longitudinal item response modeling with restricted covariance pattern structures

Caio Lucidius N. Azevedo*

*UNICAMP

Resumo

Educational studies are often focused on growth in student performance and background variables that can explain developmental differences across examinees. To study educational progress, a flexible latent variable model is required to model individual differences in growth given longitudinal item response data, while accounting for time-heterogenous dependencies between measurements of student performance. Therefore, an item response theory model, to measure time-specific latent traits, is extended to model growth using the latent variable technology. Restricted covariance pattern models are proposed to model the variance-covariance structure of the student achievements. The main advantage of the extension is its ability to describe and explain the type of time-heterogenous dependency between student achievements. An efficient MCMC algorithm is given that can handle identification rules and restricted parametric covariance structures. A reparameterization technique is used, where unrestricted model parameters are sampled and transformed to obtain MCMC samples under the implied restrictions. The study is motivated by a large-scale longitudinal research program of the Brazilian Federal government to improve the teaching quality and general structure of schools for primary education. It is shown that the growth in math achievement can be accurately measured when accounting for complex dependencies over grades using time-heterogenous covariances structures.