A Rotatable Asymmetric Variable Compensation MIRT Model

Xinchu Zhao

The purpose of this study is to develop, estimate, and interpret a new variable compensation multidimensional item response theory (MIRT) model, named the Rotatable Asymmetric Variable Compensation Model (RAVCM), that allows for transformation between different correlation structures. Since the model is rotatable like the common compensatory models (CM), it is not necessary to specify or estimate the correlation of abilities to recover the model. Also, it can approximate the existing MIRT models well. In simulation, the RAVCM is shown to estimate the parameters with small error, especially when the non-compensatory model (NCM) is the true model and the correlation of abilities is mis-specified, and when the test has a mixture of compensatory and non-compensatory items. In a real data study, the RAVCM demonstrates better fit, and provides with a different way to interpret the latent abilities from the compensatory model.

The angle between item vectors in the RAVCM can be considered as a measure of compensation. Its effectiveness at distinguishing the CM and the NCM are evaluated and compared to some other common goodness of fit statistics in MIRT. Via a simulation study, it is shown that the RAVCM works well at both the test-level and the item-level in many cases. Two forms of the high dimensional RAVCM are proposed and discussed. Simulations show that the simple form is estimable. When the number of items and examinees are large, the estimates have smaller error, compared to the small-sample cases.