Causal Effect Estimation in Large-Scale Assessment Data: Using a Multi-group Structural Equation Model with Categorial Indicators in EffectLiteR

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Well-constructed achievement tests are a special strength of educational large-scale assessments (LSAs) and the students' proficiencies are frequently of main interest in subsequent analysis - like for the comparison of respondent groups. In these non-randomized comparisons, the estimation of covariate adjusted group differences is common practice. Yet, often fallible test scores, instead of the latent proficiencies itself, are used as a manifest outcome or covariate. The EffectLiteR package allows for directly including latent variables in a multi-group structural equation model for causal effect analysis and we recently provided an extension that facilitates latent variable models with categorical indicators. Using an example from the National Education Panel Study (NEPS), we show the implementation and benefit of this approach. Specifically, we investigate the effect of tutoring in mathematics on a subsequent math ability measure, while controlling for the previous math ability and additional covariates of the participants. The application is well-suited for illustrating theoretical conditions under which measurement error in test scores biases treatment effects and provides item-level data, based on which different strategies for modeling a latent outcome or latent covariates can be compared (i.e., a direct integration of latent variable models, fallible score estimates or plausible values from latent variable models). The implementation of the modeling approaches and the practical benefit of using latent variables in comparison to proficiency scores is of special interest in the application and discussion.