HomeWork on Estimation

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Given the data on CEIBA, How do you demonstrate that this model is unidentified by its results

In the present work, we aim to analyzed the data with the model in Weston & Gore (2006) and replicate the results in the paper. In that model, self-efficacy beliefs (SEB), positive outcome expectations (POE), interests in career-related activities and occupations (ICO), and intention to engage in a particular career direction (IEC) are four latent variables and are shown by the circles. Observed variables are represented by rectangles. All latent variables are reflected by their own observed variables. Direct effects are also specified in this model. All latent variables are scaled by fixing a loading from the latent variable to an observed variable (e.g., SEB to SEB_1). The specified model is shown in Figure 1.

We use the `lavaan` package, a free open source package in `R` that provide a good platform for latent variable analyses (i.e., structural equation modeling), to analyze the data. The data is a covariance matrix with the sample size of 403 (N = 403). The specified model that try to capture the relationships between variables in the data is an over-identified model. There are 28 parameters to be estimated and a total number of 50 degree of freedom. The maximum likelihood estimator, which assumes multivariate normality is used in the present work. The optimization procedure used here is the PORT routines in the `nlminb` package in `R`. To be more specific, Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm is adopted. It belongs to quasi-Newton methods with Hessian approximation (for details).

Figure 2 shows the standardized results for the specified model. Results and fit indexes are shown as follow. Fit of the model: $\chi^2(50, N = 403) = 417.096$, $p < .05$; comparative fit index (CFI) = .913; root mean square error of approximation (RMSEA, 90% confidence interval) = .135 (.123 − .147); standardized root mean square residual (SRMR) = .052. Although no other model are presented here to perform the comparison, akaike information criterion (AIC), bayesian information criterion (BIC), and sample-size adjusted BIC (SABIC) are listed. AIC: 12614.681; BIC: 12726.651; SABIC: 12637.804. In addition to the standardized results in Figure 2, all estimates are shown in Table 1. Note that the results is really similar to the Figure 4 in Weston & Gore (2006). The only difference is that they show the disturbances but the present work shows the variance of the disturbances (e.g., disturbance of POE: $.788^2 = .621$).

We conclude that the results of `lavaan` and `EQS` are roughly the same. It is reasonable since the estimators used are the same (i.e., ML). Also, it somehow echoes the stability of the model and the sample data.

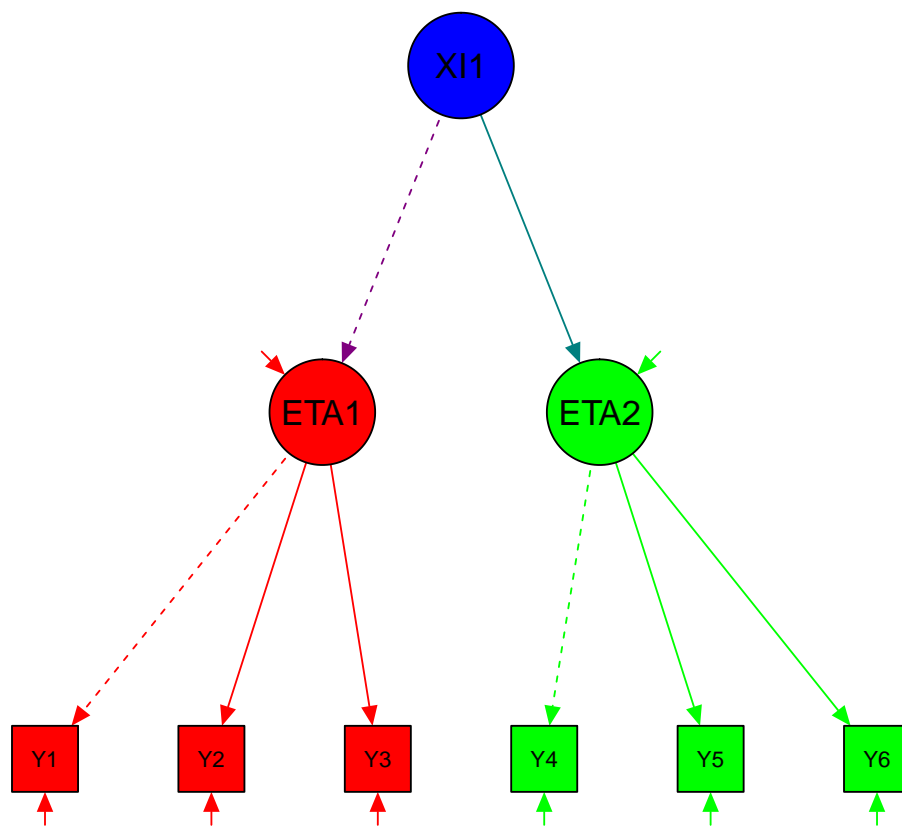Standardized parameter estimates for the specified Model

Details of the parameter estimates

Figure 1: The specified model in the present work