Structural Equation Modeling with R (Dr. M. Murat Ardag)

In words of Yves Rosseel, the developer of the R package lavaan (latent variable analysis), "In the social sciences, structural equation modeling (SEM) is often considered to be the mother of all statistical modeling. It includes univariate and multivariate regression models, generalized linear mixed models, factor analysis, path analysis, item response theory, latent class analysis, and much more. SEM can also handle missing data, non-normal data, categorical data, multilevel data, longitudinal data, (in)equality constraints, and on a good day, SEM makes you a fresh cup of tea." Put simply: there is almost nothing you cannot do with SEM.

This workshop is designed to be a practitioner's guide. After going over the fundamentals of the outlined topics below, we will get to focus on their application in the R environment. There is almost no math involved; however, we will get to understand the conceptual reasoning over the math going on in the background

Please note that a general familiarity with R is a prerequisite for attending the workshop. I will not teach R, but I can provide some prep/refresher material for the R environment before the workshop.

Day 1

Morning session 1: 09:15 – 10:45
1. *Recap*: Simple & multiple linear regression
2. Path analysis: going beyond the regression framework to test hypothesized mechanisms
3. *Recap*: Principal component analysis vs. exploratory factor analysis

Break

Morning Session 2: 11:00 – 12:00
4. Applications in the R environment

Lunch Break

Afternoon Session 3: 13:00 – 14:30
5. Confirmatory factor analysis:
5.1. Operationalization
5.2. Formal model comparison
5.3. Higher-order latent constructs
5.4. Reliability
5.5. (Factor) Score calculation
6. Basics of item response theory: eliminating the bad items in a measurement model and seeing the general psychometric qualities of the scale

Break

Afternoon Session 4: 14:45 – 15:45
7. Applications in the R environment

Day 2

Morning Session 5: 09:15 – 10:45
8. Full structural equation models: finding the associations between the latent constructs
9. Including survey-weights in structural equation models: when to weight the indicators

10. Multiple group models:

10.1.   Exact measurement invariance across groups: multi-group CFA

10.2.   Approximate measurement invariance across groups: (frequentist-)alignment optimization

11. Causality with SEM

11.1.   Non-recursive structural equation models for (pseudo-)causal relationships: testing causality with cross-sectional survey data

11.2.   Application of structural equation models in experiments: testing causality with multi-group models

Break

Morning Session 6: 11:00 – 12:00

12. Applications in the R environment

Lunch Break

Afternoon Session 7: 13:00 – 14:30

13. Multilevel structural equation models: dealing with nested data structures

14.   Combining SEM with machine learning:

14.1.   SEM trees & forests: model based recursive partitioning

14.2.   Factor Forest: finding the right number of factors to retain

14.3.1. Regularized SEM: variable selection

14.3.2. SEM with TensorFlow: extending SEM to deep learning

Break

Afternoon Session 8: 14:45 – 15:45

15.   Applications in the R environment