SEM 2: Structural Equation Modeling

Grading

- Individual assignments: 50%
    - First two assignments: 20%, third assignment: 10%
- Final project: 50% (distribution between presentation and report depends on the project)

All three must have an average grade of at least 5.5 to pass the course.

Learning Goals

Like in SEM 1, an encompassing goal of the course is to prepare the student for academic discourse (PhD). The focus in SEM2, however, is more on methodological academic work than the empirical focus of SEM 1. To this end, the goal of the course is to prepare the student to…

- Use covariance modeling to test complicated causal hypotheses (week 1).
- Understand philosophical arguments underlying the causal interpretation of structural equation models (week 2).
- Estimate multiple novel statistical models from longitudinal data (week 3)

For the final project, the learning goal depends on the choice of the student:

- Teach advanced statistical methods to your peers.
- Explain methods through writing a tutorial.
- Perform advanced empirical analyses and communicate your findings though presenting and writing.

Specific learning goals to each week follow on the next pages.

Outline

"Week 1" – Introduction to Structural Equation Modeling

Thursday May 3 – Lecture + practical (G -1.05)

- Causal modeling
- Expectation algebra and covariance algebra
- Start final project

Tuesday May 8 - Lecture + practical (JK 1.18)

- Path analysis
- Structural Equation Modeling (SEM)
- Start assignment 1

Learning Goals:

- Understand the principles of covariance modeling
- Able to calculate the expected (co)variance between variables given a causal model
- Able to derive expected (co)variances from a path diagram
- Understand the principles of SEM
- Able to derive expected (co)variances using the SEM expression
- Fit a SEM model in Lavaan

Week 2 – Causality and equivalent models

Tuesday May 15 – Lecture (G -1.05)

- Causality
- D-seperation
- Equivalent models
- Hand in assignment 1
- Start assignment 2

Thursday May 17 - Practical (JK 1.18)

- Discuss assignment 1

Learning Goals:

- Understand philosophical principles to the causal interpretation of SEMs.
- Able to derive conditional independence relationships from a path diagram.
- Able to identify equivalent models.

Week 3 – Latent variable models and network models

Tuesday May 22 – Lecture (G -1.05)

- The network perspective and psychological complexity
- Network models
- Latent change-score models
- Dynamical factor models
- Latent growth models
- Hand in assignment 2
- Start assignment 3

Thursday May 24 - Practical (JK 1.18)

- Free time to work on final project (I won't be there)

Learning Goals:

- Understand how the network perspective contrasts with latent variable modeling
- Familiar with generalized network psychometrics
- Able to estimate latent change-score models, dynamical factor models, and latent growth models from longitudinal data.

Week 4 - Wrap-up and presentations

Tuesday May 29 – Practical (G -1.05)

- Hand in assignment 3
- Discuss assignments 2 and 3
- Recap
- In case there are many groups: presentations

Tuesday May 31 - Presentations (JK 1.18)

- Final project presentations

Friday June 1 (23:59:99): DEADLINE FINAL PROJECT REPORTS

Final Project

You have three options for this assignment. The first option is done alone; the second can be done alone or in a pair and the third option should be done in pairs. Every topic can only be done by one group! Post on blackboard to claim your topic!

1) If you have your own data, do an SEM analysis. Only choose this option if your data are really best analyzed via SEM, you plan to publish this analysis or some version of it on future data, and your analysis is otherwise "real" and not contrived. Consider all issues discussed in SEM1 and SEM2: nonnormality, missing data, fit, model modification, difference tests, equivalent models, exploring different measurement models for a scale, etc. Apply as many learned concepts as possible. Report on the results via a short-written report (about 4 double spaced pages in APA style, concisely written). This is your chance to apply everything you learned and get real feedback. This option may or may not include a 5-10 minute presentation to the class, depending on how many people choose it and time constraints.

2) Write a clear manual for using semPlot or for performing SEM analyses in Jasp, Onyx or Lavaan. Your manual will be shared online in this case. You can choose to also present your work, but this is not mandatory. There is no limit on how large your manual is, but should at least cover the fitting or drawing of multiple SEM models.

3) Research an area or a topic of SEM in more detail. Pick any issue that interests you. Your task is to find several articles that address this issue and to summarize them intelligently (some examples follow). Your reference list should have no fewer than 5 articles (books can be added but cannot be substituted for articles). You will report on the results of your research via 1) a presentation to the class (10 minutes including questions), and 2) a 2-page summary report of findings (not counting references). Think of your goal as to teach yourself something that we didn't have time to learn in class, and then to teach it to the class. This option must be done in pairs[1].

[1] A very important note on plagiarism: When working in pairs, it sometimes happens that one partner copies some text from an article, then the other partner puts that text into the paper thinking that the first person wrote it, and they end up with a partially plagiarized paper. DO NOT LET THIS HAPPEN TO YOU. Plagiarism is a very big deal, and any cases will be caught and sent to the examination committee. It's best not to copy whole sentences from papers to begin with (take notes in your own words!), but if you do, be smart enough to put them in quotation marks and mark them with the source so you don't confuse yourself or your partner later. Both partners will be punished when plagiarism is detected.

Possible Subjects Include (but are not limited to):

1. Learn about an advanced type of SEM model, such as
    - Continuous time SEM (ctsem)
    - Mixture models
    - MIMIC models
    - Advanced growth-curve models
    - Advanced VAR models / Dynamic SEM
    - Multilevel SEM
    - Causal indicator Models

2. Learn about an advanced tool for SEM analysis, such as
    - Interactions among latent variables
    - Nonlinear relationships
    - LASSO regularization
    - Exploratory SEM
    - Bootstrapping standard errors (e.g., for mediation)
    - 2-stage estimation for nonnormal/missing data

3. Learn about a different latent variable model
    - Item response theory (IRT)
    - Latent class analysis
    - Latent profile analysis
    - Partial least squares modeling (PLS)

4. Something more theoretical, such as
    - Interpretation of latent variables
    - Network modeling (if you did not do network analysis)
    - Parsimony in SEM

Grading for the final project will be based on your presentation and your written report. The difficulty of your project will be taken into account.