SEM 2: Structural Equation Modeling

Team

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Please use Canvas for all communication!

Coronavirus measures

Due to the global Coronavirus pandemic, the entire course will be online. All Tuesday lectures are cancelled and all lectures will be made available as video lectures by Tuesday 13:00 the latest. The Thursday practical sessions will start with a general Q&A Zoom meeting on Thursday's at 11:00 and will be followed with online chat Q&A for the remainder of the practical time. Attendance is not mandatory for the Zoom meetings. As we understand that this is a hard time for everyone with a lot of uncertainty, the workload for the course has been reduced. Please let us know if for any reason you cannot keep up with the course (e.g., missing assignments due to illness). While the deadline for assignments is Tuesday at 13:00, we will not post solution files online until the next day (Wednesday), giving you more time to notify us of any potential problems.

We hope you will all stay healthy, and please let us know if you have any suggestions for improving the online format of the course!

Grading

- Individual assignments: 50%
- Final project: 50%

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

Schedule

Date	Day	Class	Deadlines
April 27	Monday	**Free day**	
April 28	Tuesday	Lecture 1 online	
April 29	Wednesday		
April 30	Thursday	Zoom/chat practical	
May 1	Friday		
May 2	Saturday		
May 3	Sunday		
May 4	Monday		
May 5	Tuesday	Lecture 2 online	13:00 - Deadline assignment 1
May 6	Wednesday		
May 7	Thursday	Zoom/chat practical	
May 8	Friday		
May 9	Saturday		
May 10	Sunday		
May 11	Monday		
May 12	Tuesday	Lecture 3 online	13:00 - Deadline assignment 2
May 13	Wednesday		
May 14	Thursday	Zoom/chat practical	
May 15	Friday		
May 16	Saturday		
May 17	Sunday		
May 18	Monday		
May 19	Tuesday	Lecture 4 online	13:00 - Deadline assignment 3
May 20	Wednesday		
May 21	Thursday	**Free day**	
May 22	Friday		
May 23	Saturday		
May 24	Sunday		
May 25	Monday		
May 26	Tuesday	Zoom/chat practical	
May 27	Wednesday		
May 28	Thursday	Zoom/chat practical	23:59 - Deadline final project
May 29	Friday		

Outline

Week 1 – Expectation algebra and covariance algebra

Learning Goals:

- Able to calculate the expected (co)variance between variables given a causal model

Week 2 – Introduction to Structural Equation Modeling

Learning Goals:

- Understand the principles of covariance modeling
- 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 or psychonetrics

Week 3 – Causality and equivalent models

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 4 – Latent variable models and network models

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.
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There will be no assignment this week

Week 5 - Wrap-up

There will only be two Zoom/chat practical sessions this week!

Final Project

There are a lot of possible extensions to Structural Equation Modeling. Rather than including these in the class, you will pick up one topic yourself and teach it to your fellow students. You have to research an area or a topic of SEM in more detail (below some examples), and teach this to your fellow students in a video lecture. Pick any issue that interests you. These videos will be made available to your fellow students, such that you can all learn from each-other. If you like, your video can also be included in a publicly available online playlist next to the SEM 2 video lectures.

You can do the assignment alone, in a group of two or a group of three. The length of the video should be about 10 minutes for individuals, 15 minutes for two-person groups, and 20 minutes for three-person groups. You can use any software you like for recording the video (easy methods are to just record a Zoom meeting or to use the Camtasia free version). For groups, please keep in mind that editing a video may be tricky to collaborate on online, so recording a Zoom meeting and trimming out beginning and end may be easiest.

A detailed scoring sheet for how the presentation will be graded will be made available during the course. The presentation will at least be graded on (1) correctness of the discussed materials, (2) presentation skills, (3) clarity of the sheets, and (4) appropriate length of the presentation (shorter is ok, longer is not).

The learning goals of the final project are therefore to be able to (1) study advanced statistical methods yourself and (2) teach these to your peers.

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
    - Mediation models
    - Measurement invariance with ordered categorical data

2. Learn about an advanced tool for SEM analysis, such as
    - Meta-analytic SEM (metaSEM), with two distinct subcategories:
        - Performing regular meta-analyses with SEM
        - Meta-analysis of SEM models
    - Genomic SEM
    - Twin-data model (genetic models)
    - Exploratory SEM
    - Interactions among latent variables

- Nonlinear relationships
- LASSO regularization (regSEM)
- Bootstrapping standard errors (e.g., for mediation)
- 2-stage estimation for nonnormal/missing data
- Factor score regression models (path analysis with factor scores)
- Bayesian SEM
- Exploratory graph analysis
- Robust estimators

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

Alternative options.

You may also choose to write a tutorial or to make an interactive website explaining your topic if you prefer not to make a video lecture. Alternatively, you may also choose any other topic you want to focus your time on during the SEM 2 course. Some examples are

- If you have your own data, you can do a 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. In this case, you have to report your results in an academic poster.

- Set up a simulation study to investigate certain SEM properties (e.g., violations of normality and performance of robust estimators). In this case, report your findings in an academic poster.

- Write a tutorial on performing analyses using *psychonetrics*. This could be about SEM, but also about more advanced topics such as the included latent/residual network models. Your tutorial will then be added to the psychonetrics.org website.

- If you have another topic in mind, let us know and we can see if it would fit the course well.

We will come up with an alternative grading scheme for these topics.