Course Syllabus

General course information

PSY 610: Structural Equation Modeling (4 credits)

Fall 2021, 008 Straub, Mondays 9:00 - 11:50 am

Prerequisites: PSY 611, 612, and 613 or equivalent

Office hours: Wednesdays 11-12 over Zoom (https://uoregon.zoom.us/j/97425793252) or by appointment

Description

This course is an introduction to structural equation modeling (SEM). SEM is a general framework for building, comparing, and evaluating models of data. SEM can be used to fit and evaluate models of measurement, association, causation, and change over time. Specific techniques that are part of SEM include path analysis, confirmatory factor analysis, causal models with latent variables, growth curve models, and more. SEM is useful in a wide variety of research applications, including the analysis of experiments and interventions, observational designs, and designs with repeated measurements (such as within-subjects experiments and longitudinal studies).

The course will begin with a review of multiple regression and a treatment of principles of causal inference. The majority of the course will cover “classical” SEM applications like confirmatory factor analysis and structural regression models. These classical applications are the building blocks for more modern developments, such as analyzing longitudinal data, which we will cover as time permits. Class meetings will include both classroom lectures and hands-on practice in the computer lab.

Learning outcomes

By the end of this course, you will be able to:

- Recognize the relationships between structural equation modeling and other kinds of modeling and data analysis
- Articulate the assumptions for inferring causality from a dataset and critique empirical research that draws causal inferences
- Specify a structural equation model that represents a question or hypothesis of interest
- Determine if a model is identified
• Fit a model to data and interpret the parameter estimates and fit statistics
• Apply structural equation modeling in a range of designs, including experiments, psychometric studies, and longitudinal designs
• Critically analyze studies you read that use structural equation models, including understanding its limitations and misapplications

Format

We will meet once a week. Class meetings will be a mix of lecture, discussion, and practical hands-on experience. The balance will probably shift over the term - early on it will be more lecture heavy, later we will do more practical work.

Outside of class you will have reading, homework, and a final project.

Course materials

Readings

This class has a textbook, which you should purchase. It is available as an ebook or print version:


I will also assign journal articles and other readings throughout the term.

Software

Examples and exercises in class will be done using lavaan and related packages in R. Rstudio, R, and lavaan are free and I encourage you to install them on your own computer. They are installed on the computers in the lab.

**R literacy prerequisite or self-study:** If you are not already familiar with R, you will need to do some self-study to learn some basics. Specifically, by the second or third week of class please make sure you know how to:

• Install and load packages
• Read a dataset from a file into an R data frame or tibble
• Do basic data management like creating new variables, transforming variables, etc.
• Run basic statistics like means, SDs, etc., and regression models
• Plot data to examine distributions (histograms, boxplots) and associations (scatterplots)

The book *R for Data Science* is available online for free and is an excellent introduction to R ([http://r4ds.had.co.nz/index.html](http://r4ds.had.co.nz/index.html)). It is based on the tidyverse set of packages for data management, visualization, etc., which I highly recommend learning and
using.

Although it is not required, I strongly encourage students to learn and use RMarkdown to complete homework assignments. You can learn about RMarkdown here: [http://rmarkdown.rstudio.com/lesson-1.html](http://rmarkdown.rstudio.com/lesson-1.html). RMarkdown is also covered in *R for Data Science*.

**Requirements and grading**

In normal times I include **attendance and participation** in the grade, since we do interactive work and that is an important part of the learning experience. However, these are not normal times! I do not want anyone to feel pressure to come to class if you are not feeling well or if you have disruptions to your life. So the attendance and participation requirement are by **self-assessment**. By default, you will get full points in this area. If you skipped multiple classes without a good reason (like to goof off) and you are deeply wracked with guilt, contact me before grades are due and tell me how many points you think I should take off your grade.

**Assignments** will include homework and in-class assignments. If you miss class, you can make up any in-class assignments. You automatically get one week to make them up, and if you need more time I encourage you to discuss that with me. (The answer will almost always be "yes." The reason I want you to ask me is so I know what's up and can support you in staying on track.)

**Quizzes** will be in class most weeks. They will typically cover major points or concepts from the readings assigned for that day, so make sure you are up to date! As with in-class assignments, if you miss class you have 1 week to make up the quiz (and if you need more than that, please ask me).

**Final project.** For the final project, you will write up a verification report. You will find a published paper that used structural equation modeling and where you have access to the data, and you will attempt to reproduce and extend the analyses in it. More details will be given in class.

**Grading breakdown:**

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>Attendance and participation (self-assessment)</td>
</tr>
<tr>
<td>30%</td>
<td>Quizzes in class</td>
</tr>
<tr>
<td>30%</td>
<td>Assignments (in-class and homework)</td>
</tr>
<tr>
<td>30%</td>
<td>Final project</td>
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</tbody>
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**Class policies**

Please arrive a little early and be ready to go so I can start class right at 9:00 am.

My goal is to create inclusive learning environments. Please talk to me if there is anything that will be a barrier to your participation and success so that we can work together to remove it. If you have a
disability, I also encourage you to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

I plan to record my voice and take photos of whiteboards so that if you miss class you can stay up to speed. However, technical and human errors are possible, so try not to rely on this more than you have to.

Topics, readings, course requirements, or other aspects of this course may be changed at the instructor’s discretion at any time. Changes will be announced in class or on Canvas.

Schedule and readings

***Always complete readings before the class meeting where we cover a topic. You will be quizzed on them at the start of class.***

The plan is to cover 1 topic per week. BUT: our actual progress may be faster or slower depending on the pace of our class meetings, and I might change things around depending how the class goes. In other words, this schedule is subject to change!

This schedule does not show assignments (in-class or homework). They will be posted along the way during the course.

We will also have a quiz every week starting with Week 2.

Topic 1: Introduction to the course, review of regression

Kline, chapters 1-4

("Wait a minute Sanjay, you said we should complete readings before the class they are assigned for, but you didn't tell us about this in advance!" Yes, this is an exception. Chapters 1-4 should mostly be stuff you've covered in previous classes. As soon as possible after our first class meeting, skim through these chapters, and if you hit something you feel rusty on, use the Kline book or your old notes/textbooks to brush up on it.)

Topic 2: Specification and identification of models of observed variables

Kline, chapters 6-7


Topic 3: Causal inference, Part 1


**Topic 4: Causal inference, Part 2**


Learn about DAGs and DAGitty (read and work through examples): [http://dagitty.net/learn/index.html](http://dagitty.net/learn/index.html)

**Topic 5: Specification and identification of latent variable models**

Kline, chapters 9-10


**Topic 6: Estimation and fit**

Kline, chapters 11-12


**Topic 7: Analyzing measurement and structural regression models**

Kline, chapter 13-14


**Topic 8: Measurement invariance**

Kline, chapter 16

**Topic 9: Growth models**

Kline, chapter 15


**Topic 10: Slack/slop/TBD**

I am leaving this week open in case we get through the topics slower than one per week, or in case there are disruptions (COVID-related or otherwise). If this week is still open at the end of the term, we will add a topic based on what the class is interested in learning.

**Course Summary:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Details</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon Oct 11, 2021</td>
<td><a href="https://canvas.uoregon.edu/courses/188259/assignments/1172220">Jedi theory of emotions</a></td>
<td>due by 9am</td>
</tr>
<tr>
<td></td>
<td><a href="https://canvas.uoregon.edu/courses/188259/assignments/1172251">Regression - Van Zant and Moore dataset</a></td>
<td>due by 9am</td>
</tr>
</tbody>
</table>