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# Department of Educational Psychology

**University of Wisconsin – Madison**

# Educational Psychology 960: Structural Equation Modeling

**Syllabus: Spring 2024**

**Instructor**:

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**Location and Hours**:

W: 9:00 – 11:30, Room 301 Education Sciences

Office Hours: W: 2:00 – 3:30 and by appointment. **I will not take questions about course content or debug R code over email. Please consider asking questions during class and come by office hours with R or content related issues.**

**Prerequisites**:

EP 763 (Regression Models in Education) or equivalent; Familiarity with R.

**Book**:

Kaplan, D. (2009)*. Structural Equation Modeling: Foundations and Extensions, 2nd Edition*: Newbury Park, Sage Publications.

**Software:**

We will be primarily using the lavaan program in R (Rosseel, 2012). Please see the file lavaanTutorial.pdf on the class Canvas website.

**Objectives**:

This course is designed to introduce students to the theory and application of structural equation modeling. Emphasis will be placed on both conceptual and practical understanding of the specification, identification, estimation, and testing of structural equation models. Topics include so-called “first generation SEM”, including path analysis, factor analysis, SEM, and multiple group SEM, and so-called “second generation SEM”, including topics in multilevel SEM, growth curve modeling, models for mixtures of continuous and categorical latent variables, and Bayesian SEM.

**Requirements**:

For this course, there will be a project proposal, five small problem sets based on data that I will supply. In addition, there will be one major paper based on your own data. All assignments and the final paper should be turned in using Canvas.

**Evaluation**:

All assignments will be scored A=4, B=3, C=2, D=1, F=0. All assignments are due by 11:59pm on the due date. Late assignments will not be accepted unless I receive a justified request for a delay at least **3 days** **ahead** of the due date. Exceptions include medical or family emergencies. Final scores will be based on weighting the assignments 10% each and the final paper 50%. Final grades will be rounded up to the nearest 10th and based on the UW grading policy: A = 3.6-4.0, AB= 3.1-3.5, B = 2.6-3.0, BC = 2.1-2.5, C = 1.6-2.0 D = 0.6-1.5, F < 0.6

**Topics, Readings, Assignments, and Due Dates (may be subject to change)**

**Week 1** (1/24) Course overview

Path analysis

Chapters 1 & 2

**Week 2** (1/31) Path analysis (Cont’d)

Chapter 2

**Week 3** (2/7) Path analysis (cont’d)

Introduction to lavaan

Project proposal due

Problem set 1 assigned: Path Analysis

**Week 4** (2/14) EFA Specification and identification

PCA and the common factor model

Readings: Chapter 3

**Week 5** (2/21) EFA with psych

CFA: Specification and identification

CFA with lavaan

Problem set 1 due

Problem set 2 assigned: EFA and CFA

**Week 6** (2/28) Assessing assumptions

Readings: Chapters 5 & 6

**Week 7** (3/6) Assessing assumptions (cont’d)

Problem set 2 due

**Week 8** (3/13) SEM: Putting it all together

SEM with lavaan

Problem set 3 assigned: SEM

Readings: Chapters 7 & 8

**Week 9** (3/20) Multiple group and MIMIC models

MIMC and multiple group models with lavaan

Readings: Chapter 4

Problem Set 4 assigned: Multiple group modeling

**Week 10** (3/27)  **Spring Break**

**Week 11** (4/3) Multilevel SEM

Growth curve modeling with lavaan

Readings: Chapters 7 & 8

Problem set 3 due

**Week 12** (4/10) Growth curve modeling with lavaan

Readings: Chapters 7 & 8

Problem set 4 due

Problem set 5 assigned: Growth curve modeling

**Week 13** (4/17) Categorical latent variables: LCA

Example using poLCA, LMest, and MultiLCIRT

Readings: Chapter 9; Kaplan (2002) on canvas

Readings Chapter 9

**Week 14** (4/24) Bayesian SEM

Readings: Kaplan & Depaoli (2013); van de Schoot et al (2013) available on course website

Problem set 5 due

**Week 14** (5/1) Bayesian SEM with blavaan

**Final paper due 5/10 at 11:59pm**

**Assignments**

For this course, there will be 5 problem sets and a final major paper. The 5 problem sets are designed to provide exposure to the main areas of structural equation modeling: path analysis, factor analysis, full SEM, multiple group modeling, and growth curve modeling. You will be required to present and interpret the results of the output. You’re welcome to use R Markdown and the Markdown code for the examples can be used as a template. Similar formats are acceptable as long as they produce readable .pdf files. Screenshots are acceptable. It is fine for students to work together, but it is expected that students will provide independent write-ups.

The major requirement for this course is a paper of publishable quality based on your own data and research interests. The paper must involve at least two of the five main topics covered in this course via the problem sets as stated in the previous paragraph. For example, a paper might include factor analysis and multiple group analysis, or path analysis and growth curve modeling. I will require a project proposal relatively early in the semester to ensure that the data and model requirements are met. The project proposal is not to exceed 10 pages (12-point font, double spaced). This project proposal should include a brief statement of the problem, a brief statement of the data source, the proposed methodologies (which might change as the semester progresses), and the contribution of the study to the field. This proposal is not graded but should be written as though you are submitting a prospectus for doctoral dissertation support.

All the components of model building are expected to be in the final paper, including the assessment of assumptions and relevant evidence of model fit. It is expected that the introduction of the paper and conclusions are warranted by the analysis. **IT IS NOT EXPECTED THAT YOU FIND A WELL-FITTING MODEL!** It is also expected that the paper will be written in the style of the major research journal in your field. All tables and figures should be placed in the back of the paper and supplementary R code **must** be in an appendix. Screenshots are acceptable as long as they are readable.

**Scoring Rubrics for Assignments and Final Paper**

Below are the criteria I am employing to assign scores of 0, 1, 2, 3, and 4 to the assignments.

0 = Student does not understand the nature of the assignment. Interpretations are incorrect given the data. Write-up is not in appropriate style and there are numerous typographical, logical, and grammatical errors. This score is also given for those who miss the assignment without an excuse.

1= Student shows inadequate understanding of the statistical procedure required to analyze the problem. Some required elements of the assignments are missing, such as tests of assumptions, etc. Those that are present in the analysis are not linked to the interpretation of the results. Write-up is not in an appropriate style and there are numerous typographical and grammatical errors.

2 = Student shows rudimentary understanding of the assignment and shows rudimentary understanding of required elements. All the required components are present in the answer but without sufficient depth of understanding with respect to interpretation. Write-up is in appropriate style but there are some grammatical and typographical errors.

3 = Student shows a good understanding of the assignment. All of the required elements are present and are linked correctly to the interpretation of the results. Minor problems in the depth of the analysis remain. Write-up is in appropriate style with minor typographical errors.

4 = Student shows an excellent understanding of the assignment. All of the required elements are present and linked correctly to the interpretation of the results. Student shows excellent depth of understanding with respect to the link between required elements and the results. Write-up is in appropriate style with minor typographical errors.

**Statement on Course Material**

For this course, we will be using a variety of material to learn about and demonstrate the methodologies covered in the syllabus. These materials might include textbooks, supplementary articles, and/or databases. It should be noted that these materials might not provide contemporary descriptors of group identities; including, but not limited to, race, gender, or disability status. Regarding textbooks, it may be that the presentation of the methodologies is excellent, but the examples in the textbooks are not up-to-date, and newer textbooks are unavailable. In the case of supplementary articles, authors might have provided an excellent template for the application of a method to a critical research question, but the subject matter of the article might not have presented participant identities using contemporary terminology. Regarding databases, these often derive from international or national contexts. In the case of international educational data sets, this may be due to cross-national negotiations on the labeling of these variables. In the case of national educational data sets, this might be due to the desire for maintaining trend to earlier data sources. However, in the United States context, current efforts are underway to provide appropriate descriptors for race, gender, and disability status. Please note that the instructor has made every effort to secure course material that is respectful of group identities. Nevertheless, in this course, lectures and discussions will use the categories as presented in the course material, with full acknowledgement of the limitations in the data as it pertains to contemporary descriptors of group identities.

**Department Principles and Policies**

**ACADEMIC HONESTY**

Students are reminded that University policies on academic honesty will be strictly enforced in this class. Appropriate acknowledgment and references are expected in all written work and oral presentations for ideas and verbatim or paraphrased passages that are derived from the words or work of other individuals. Violations of University of Wisconsin policies on academic honesty will not be tolerated and will be dealt with in accordance with University policies. For further information on these policies, students may consult this website:

https://www.students.wisc.edu/doso/academic-integrity/

**SPECIAL ARRANGEMENTS**

Students bring to the classroom a variety of interests, backgrounds, learning strategies, and learning needs. If there are ways that the instructor can facilitate learning for you, particularly in relation to evaluation procedures, please alert me to them and I will try to accommodate your special needs. You can also contact the McBurney Disability Resource Center to learn about services available to students: http://www.mcburney.wisc.edu. If you need accommodations for instruction, assignments, or assessments in this course please let me know as soon as possible so that I can make arrangements to facilitate your participation in the course.

**GRADUATE MINOR IN EDUCATIONAL PSYCHOLOGY**

For graduate students outside of Educational Psychology, this course could count toward requirements for a Graduate Minor in Educational Psychology. For details on this program, speak to the course instructor or see details at:

https://edpsych.education.wisc.edu/academics/graduate-minor/

***Please note****:* For this program, students must have a Minor Advisor (faculty member in Educational Psychology) and must have their program approved before they complete more than half the courses that are part of the minor.