

Structural Equation Models

Psychology 7821, Fall 2016, 3 credits

Class meeting: Tues/Th 9:35 - 10:55, Jennings Hall 136

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This course is a survey of the main statistical models and methods of structural equation models. It is geared toward general PhD students in the social sciences who have taken a one year graduate level sequence in applied statistics such as Psy 6810/6811 plus a semester course in regression.

Requirements: Ten computer exercises (67%) plus final exam (33%). Computer exercises are due on the date assigned. You may turn in one exercise up to one week late. Missed homeworks lower grade by 1/3 letter. Please do not hand in unedited computer results.

Notes will be distributed in class

Tentative List of Topics

Overview, orientation, examples

Matrix algebra

Types of matrices: Constant, identity, null, diagonal, square, symmetric, lower triangle

Operations: Trace, addition, subtraction, multiplication (conformability)

Scalar-matrix multiplication

Determinant (memorize determinant of 2 x 2 matrix)

Definition of a singular matrix

Inverse matrix (memorize inverse of 2 x 2 matrix)

Basic statistics in matrices

Mean vector

Diagonal matrix of variances or standard deviations

Correlation matrix

Covariance matrix

Multiple regression

Regression equation

Least squares criterion function

Solving for the regression coefficients

Predicting an individual response

Factor analysis

- Principal Components (*not* a variety of factor analysis)
- Regression Model and Correlation Structure
- Multiple Factors: Background
- Estimation of the Multiple Factor Model
- Analytic Rotation
- How Many Factors?
- Standard Errors of Estimate
- Target Rotation
- Restricted Factor Analysis
- Test Theory Models

SEM: Major statistical components

- Path diagrams
- Mathematical representation of SEM models
- Data model and covariance structure
- LISREL model, RAM model, other versions
- Identification and estimation
- Models as approximations, model fit, model modification
- Using correlations versus variances and covariances
- Direct, indirect, total effects
- Multiple populations
- Mean structures
- Missing data
- Ordinal variables

SEM models

- Regression: Simple, multiple, multivariate, sur
- Measurement models for true scores
- Factor analysis and more general latent variable models
- Patterned correlation structures
- Path analysis, latent variable regression
- MIMC model
- Longitudinal designs and latent growth curves

Reference lists and supplementary material for leisure reading

On-line SEM workshops at Friedrich-Schiller University (Germany)

<http://www.metheval.uni-jena.de/courses.php?&lang=en> (hours and hours with the major SEM people)

Werner Wothke's nice SEM workshop notes, based on sas calis

<http://smallwaters.com/> and click on "Intro to SEM"

Syntax and data files for 5 computer programs, from T Brown "Confirmatory factor analysis"

<http://people.bu.edu/tabrown/cfabook.html>

AERA SEM-SIG links

<http://www.hawaii.edu/sem/sem.html>

Keith Smolkowski's list

<http://homes.ori.org/~keiths/bibliography/statistics-sem-cfa.html>

Jim Steiger's course, Intro to SEM

<http://www.statpower.net/SEM.html>

Edward Rigdon's page of links

<http://www2.gsu.edu/~mkteer/index.html>

SEM Net (a listserv with lots of references)

<https://listserv.ua.edu/archives/semnet.html>

Scientific Software

<http://www.ssicentral.com/lisrel/resources.html> (several program guides here)

<http://www.ssicentral.com/lisrel/examples.html>

<http://www.ssicentral.com/lisrel/advancedtopics.html>

<http://www.ssicentral.com/lisrel/references.html>

Computing

SEM is a small acronym that applies to a gigantic collection of models and methods for the analysis of several variables. After learning the concepts, the main goal of this course is to learn how to estimate and interpret SEMs. Thus computing is a big deal. The best strategy for computing is to build on the software you use most, and become familiar with it's SEM library. R, STATA, SPSS, MATLAB, SAS are comprehensive statistical packages with excellent SEM modules. AMOS, RAMONA, EQS, lavaan (in R), CALIS, MPlus, LISREL are the main specialized SEM procedures. All these programs handle the popular SEM models equally well. At the same time, they each have a few specialized features that no other program can deal with. For the major varieties of SEM, stay with the computer software that you and your research group routinely use.

I personally use SAS and LISREL. Both are available free of charge to OSU students. The student version of Lisrel is restricted to 16 variables and only plain text or SPSS SAV files can be imported. Otherwise it's the full-featured program. <http://ssccentral.com/lisrel/student.html>

Two Important Administrative Issues

(1) It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/pdfs/csc_12-31-07.pdf.

(2) The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. You are also welcome to register with Student Life Disability Services to establish reasonable accommodations. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.