The University of North Carolina at Chapel Hill  
School of Social Work  
SOWO 719 Structural Equation Modeling  
Fall Semester, 2008  

Instructor  
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Class Meeting Times & Office Hours  
Class meets on Wednesdays 9:00-11:50 am  
Office hours are Tuesdays 8:30 – 10:30 am (Room 524j TTK)  

Course Description  
Structural equation modeling (SEM) is a general statistical method that can be employed to test theoretically derived models. It is “a class of methodologies that seeks to represent hypotheses about the means, variances, and covariances of observed data in terms of a smaller number of ‘structural’ parameters defined by a hypothesized underlying model” (Kaplan, 2000). In this course, students will learn fundamental concepts and skills to conduct SEM, and know how to apply these techniques to social work research.  

Course Objectives  
At the completion of the course, students will be able to:  
• Understand the fundamental hypothesis of SEM and its relationship to the specification, identification, and estimation of a structural equation model;  
• Run path analysis and test mediating hypotheses using SEM;  
• Conduct confirmatory factor analysis to evaluate measurement validity;  
• Conduct structural equations with latent variables and apply the method to test/confirm a theoretically derived model;  
• Understand statistical indices measuring goodness-of-fit of a model;  
• Conduct multiple group comparisons with SEM to test moderating effects;  
• Perform power analysis with SEM and know how to determine minimum sample size needed;  
• Understand basic concepts and skills to deal with interactions and quadratics in latent variables, and categorical variables;
• Understand the linkage between SEM and hierarchical linear models, and conduct multilevel analysis and latent growth curve analysis with SEM;
• Understand strategies dealing with missing data.

Pre-requisite

Students are assumed to be familiar with descriptive and inferential statistics. A solid understanding of multiple regression analysis is a key. They should have statistical and statistical software background at least equivalent to that provided by SOWO919 (applied regression analysis and generalized linear models), SOCI209, PSYC282, EDUC284 (linear regression), or SOCI211 (categorical data analysis).

Software Packages

Students may choose to use SAS, SPSS, or Stata as the primary statistical software package for data management and non-SEM statistical analysis, though the classroom lectures and materials will be based on SAS. The course will employ AMOS as the main software package for running SEM. It will also teach students how to run LISREL and Mplus to meet special needs.

Textbooks


Readings about Applications of SEM to Social Work Research

A reading list of 139 articles, compiled by Shenyang Guo and Chung-Kwon Lee, will be made available to students. These articles are applications of SEM to social work research. We compiled the list by reviewing all articles in eight social-work or social-work-related journals published from January 1, 1999 to December 31, 2004. These articles will be used in classroom lectures as social work examples. They will also serve as a useful literature base for students to learn various applications of SEM to social work problems.
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<tr>
<th>Assignments</th>
<th>Grade Percentage</th>
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<td>Assignment 1</td>
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<td>Midterm Exam (take home)</td>
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<td>Final Exam (take home)</td>
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**Grading System**

The standard School of Social Work interpretation of grades and numerical scores will be used.

- **H** = 94-100
- **P** = 80-93
- **L** = 70-79
- **F** = 69 and below

**Policy on Class Attendance**

Class attendance is an important element of class evaluation, and you are expected to attend all scheduled sessions. Each class session will cover a great deal of materials, and you will fall behind the course when you miss even one class session. It’s student’s responsibility to inform the instructor via email in advance for missing a class session. You are expected not to miss more than two sessions for the whole semester. Starting from the second missing, your course grade will be reduced by 10% for each session missed.

**Policy on Incomplete and Late Assignments**

Assignments are to be turned in to the professor by 5pm of the due date noted in the course outline. Extensions may be granted by the professor given advance notice of at least 24 hours. Late assignments (not turned in by 5pm on the due date) will be reduced 10 percent for each day late (including weekend days). A grade of incomplete will only be given under extenuating circumstances and in accordance with University policy.

**Policy on Academic Dishonesty**

Students are expected to follow the UNC Honor Code. Please include the honor code statement along with your signature on all assignments:

“I have neither given nor received unauthorized aid on this assignment.”

Please refer to the APA Style Guide, the SSW Manual, and the SSW Writing Guide for information on attribution of quotes, plagiarism and appropriate use of assistance in preparing assignments.
If reason exists to believe that academic dishonesty has occurred, a referral will be made to the Office of the Student Attorney General for investigation and further action as required.

**Policy on Accommodations for Students with Disabilities**

Students with disabilities which affect their participation in the course may notify the instructor if they wish to have special accommodations in instructional format, examination format, etc., considered.

**Description of the Assignments**

Assignment 1: Solving problems of basic matrix algebra and covariance algebra.

Assignment 2: Running AMOS to solve problems of path analysis and regression analysis; and solving problems related to the decomposition of direct and indirect effects.

Assignment 3: Exercises of running confirmatory factor analysis, test construct validity, and compare models with different dimensionality.

Assignment 4: Exercises of running the general structural equation models (i.e., the latent variable and measurement models combined).

Assignment 5: Critical review of studies applying SEM to social work problems; and exercises of power analysis.

Midterm exam: Use the provided or student-chosen data set to perform a confirmatory factor analysis, develop a scale that shows adequate validity and reliability, and present the findings in a clear and organized fashion.

Final exam: Use the provided or student-chosen data set to run a general structural equation model, test group differences, mediating effects, and present the findings in a clear and organized fashion.

**Outline of Course Topics and Readings**

8/20/08: Introduction to SEM and course overview  
Required readings:  
Kline Chapter 1, Byrne Chapter 1

8/27/08: Preliminaries (Part I): Basic matrix algebra  
   1. Matrix operations  
   2. Properties of matrix operations  
   3. Applications of matrix algebra to statistical analysis
4. The eight basic matrices of SEM

Required readings:
Bollen (1989), Appendix A

(Hand out Assignment 1, due 9/10/08)

9/3/08: Preliminaries (Part II): Covariance algebra, correlation, and regression
  1. Covariance (expectation) algebra
  2. Standardization, covariance, and correlation
  3. Regression, partial correlation, multiple correlation
  4. Statistical assumptions of regression and diagnostics

Required readings:
Kline Chapters 2 & 3

9/10/08: Path analysis & running AMOS
  1. Path analysis
  2. Total, direct, and indirect effects
  3. Overview of running AMOS

Required readings:
Kline Chapters 4 & 5, Byrne Chapter 2

(Hand out Assignment 2, due 9/24/08)

9/17/08: Model specification, identification, and estimation
  1. Steps in running SEM
  2. The fundamental hypothesis
  3. Theoretical model and SEM specification
  4. Identification
  5. Estimation
  6. Goodness-of-fit indices

Required readings:
Kline Chapter 6

9/24/08: Confirmatory factor analysis (Part I)
  1. Three types of measurement models: parallel, Tau-equivalent, and congeneric
  2. Construct validity
  3. Test multidimensionality in CFA

Required readings:
Kline Chapter 7, Byrne Chapters 3 & 4

(Hand out Assignment 3, due 10/8/08)

10/1/08: Confirmatory factor analysis (Part II)
  1. Implied covariance matrix of CFA
  2. Identification rules
  3. Estimation
4. Second-order CFA model

Required readings:
Byrne Chapter 5

10/8/08: General SEM (Part I): Latent variable and measurement models combined
1. Implied covariance matrix
2. Identification rules
3. Estimation
4. Evaluation and modification of models

Required readings:
Kline Chapter 8, Byrne Chapter 6

(Hand out midterm exam, due 10/22/08)

10/15/08: No Class. Happy Fall Break!

10/22/08: General SEM (Part II): Nonrecursive model and other issues
1. Nonrecursive models
2. Identification in running nonrecursive models
3. Modification indices
4. Goodness-of-fit indices

Required readings:
Kline Chapter 9


(Hand out Assignment 4, due 11/5/08)

10/29/08: Multiple-group comparison and power analysis for SEM
1. Multiple-group comparisons
2. Test moderating effects with SEM
3. Power analysis for SEM

Required readings:
Byrne Chapters 7 & 10, Kline Chapter 11


11/5/08: Statistical assumptions underlying SEM and corrective strategies
1. Non-normality and strategies
2. Create polychoric and polyserial correlations using LISREL/PRELIS
3. Heteroscedastic errors
4. Interactions and quadratics in latent variables
5. Categorical variables

Required readings:


(Hand out Assignment 5, due 11/19/08)

11/12/08: Mean structure and multilevel analysis
1. The mean structure model versus the covariance structure model
2. Treat intercept and slopes as latent variables
3. Multilevel analysis with SEM
4. Similarities and differences between SEM and HLM

Required readings:
Kline Chapter 10, Byrne Chapter 9

11/19/08: Longitudinal analysis with SEM
1. Panel model
2. Latent growth curve analysis
Required readings:


(Hand out final exam, due 12/5/08)

11/26/08: No Class. Happy Thanksgiving!

12/3/08: Extensions and Course summary
1. Bootstrapping
2. Handling missing data
3. Overview of Mplus
4. Reporting results of SEM
5. Common pitfalls in applying SEM
6. Directions for future research

Required readings:
Byrne Chapters 11 & 12


Kline Chapters 12 & 13


12/5/08: Final exam due