APPLIED STRUCTURAL EQUATION MODELING

Psychology 368, Spring 2012
Class meeting: Wednesday 1:15-3:45, 319 Sociology-Psychology
Lab meeting: Friday 9:30-11:30, SSRI Computer Lab

Course Instructor:

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Lab Instructor:

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Course website: http://www.duke.edu/~rhoyle/teaching/psy368/

Readings

Required:

Hoyle, R. H. (in press). *Handbook of structural equation modeling*. New York: Guilford Press. (selected chapter proofs provided in hard copy)

Hoyle, R. H. (2011). *Structural equation modeling for social and personality psychology*. London: Sage Publications.

Recommended:

Byrne, B. M. (2012). *Structural equation modeling with M*plus*: Basic concepts, applications, and programming*. New York: Routledge.

Primary Goals of the Course

○ familiarize graduate students in psychology and related disciplines with the language, logic, and implementation of structural equation modeling;

○ compare and contrast structural equation modeling with more commonly used statistical procedures such as analysis of variance, multiple regression analysis, and factor analysis;

○ learn the criteria associated with decisions that must be made at each phase of a structural equation modeling analysis;

○ consider the philosophical and statistical criticisms of structural equation modeling as an approach to research design and data analysis;

○ provide firsthand experience reviewing research reports that feature structural equation modeling and writing up the results of structural equation modeling analyses.

Elements of the Course

Readings

The readings for the course come from two required textbooks. The reading requirement is heavy at times, but the readings are carefully chosen and a vital element of the learning that will take place in the course. Make every effort to complete the readings before the class meeting for which they are assigned. Bring questions inspired by the readings with you to the class meeting or, if you prefer, send them to me by email prior to the class meeting. Readings outside the textbooks will be made available to you for download from the course website, typically two weeks before the class meeting during which they will be covered.

Lab Meetings

Lab meetings are formally scheduled for a two-hour block each Friday morning beginning at 9:30. Attendance is mandatory. The purpose of lab meetings is fourfold: (1) to provide opportunities for deeper exploration of material covered in class meetings; (2) to provide training in the use of M*plus* for structural equation modeling analyses; (3) to prepare for examinations through discussion of homework assignments; (4) for administration of exams. Lab meetings will be convened by the lab instructor.

Quiz

During the third lab meeting (February 3) there will be a one-hour quiz on material covered during the first two class meetings. Primarily, the quiz will cover the relation between the general linear model and the structural equation model, basic vocabulary associated with structural equation modeling, Greek alphabet representation of parameters, and aspects of path diagrams.

Exams

You will complete two written examinations during the course; the first exam (Friday, February 17), will cover specification and estimation and the second exam (Friday, March 16) model selection, power, and basic confirmatory factor analysis. The exams will consist of short-answer items.

Presentation

You will give a brief presentation (7-10 minutes) in which you describe and evaluate a published application of structural equation modeling. You are to choose an article published since 2007 in a major journal in your field of interest. The article you choose to present must be approved by the course or lab instructor. In the presentation, you are to do the following:

1. State the primary research question.
2. Describe the data (e.g., *N*, missing data problems, measures, distributions)
3. Describe how structural equation modeling was used to address the primary research question.

4. Critique the presentation of the results (e.g., tables, figures, details about the analyses).
5. State whether, in your opinion, structural equation modeling was appropriately chosen and why. Note any alternative analyses not described in the article that might shed additional light on the primary research question.

Presentations will take place on April 11.

Application Project

The primary product of the course will be a paper in which you describe an application of structural equation modeling that is typical of research in your area. The paper can be either a proposal for an application or a write-up of an actual application of structural equation modeling.

Proposal. The goal of the proposal is to provide full information regarding a *planned* application of structural equation modeling to a set of data that is typical of research in your research area or discipline. Ideally, you would refer to an actual data set that you will, at some point, analyze. If you are unable to pinpoint such a data set, then you may propose the collection of an appropriate set of data. In either case, you must describe in detail the data and your plan to analyze the data. Proposals are to include the following.

1. a *brief* statement of the research question and hypotheses,
2. a detailed method section,
3. a detailed plan of analysis section,
4. a *brief* limitations section.

Write-up. The goal of the write-up is to provide full information regarding an *actual* application of structural equation modeling to a set of data of your choosing. (Note: Pursuing this option requires that you have a suitable set of data and that you have access to appropriate software such as M*plus*, EQS, LISREL, or AMOS.) Reports are to include the following:

1. a *brief* statement of the research question and hypotheses,
2. a detailed method section,
3. a detailed results section,
4. a *brief* conclusion section.

In either case, about one-third of the way into the course you will be asked to provide a basic description of the data set that you will either propose to analyze, propose to gather and analyze, or actually analyze.

Near the midpoint of the course you will be asked to prepare a document in which you specify the names and characteristics of the variables your project will include and the strategy you will use in applying structural equation modeling to your data.

About two-thirds of the way into the course you will be asked to meet outside of class with another member of the class to discuss your data and plan of analysis and to exchange feedback on your project.

Two weeks before the write-ups are due, *at the beginning of the class meeting* on April 18, you will provide a copy of a draft to two members of the class, and you will receive copies of

two drafts from other class members. You will provide written reviews (details will be provided in a handout) for the authors of the two drafts you receive (and copies for me); you will receive two reviews of your draft. The reviews are due one week later, on April 25, one week before the final draft of the paper is due.

The final draft of the paper is due *before noo*n on May 2.

Course Grade

Barring any unacceptable academic behavior, all class members will receive a grade of A in the course. It is my desire that the primary motive for working hard and mastering the material in the course will be students' desire to become skilled, careful scientists. A focus on grades fosters social comparison and anxiety, which undermine the mastery orientation I want to cultivate. Assignments will be scored and returned as a means of providing diagnostic feedback.

Course Outline*

January 18 background and introduction

Optional background readings:

Chapter 1 in Tucker, L. R., & MacCallum, R. C. (1997). *Exploratory factor analysis*.

Comrey, A. L. (1988). Factor-analytic methods of scale development in personality and clinical psychology. *Journal of Consulting and Clinical Psychology, 56*, 754-761.

Darlington, R. B. (1968). *Multiple regression in psychological research and practice. Psychological Bulletin, 69*, 161-182.

http://faculty.chass.ncsu.edu/garson/PA765/regress.htm—description of multiple regression analysis from the Quantitative Research in Public Administration Web site at NC State University

http://www.statsoft.com/textbook/multiple-regression/—basic description of multiple regression analysis from the Statistica Web site

http://elsa.berkeley.edu/sst/regression.html—a more technical description of multiple regression analysis from the Statistical Software Tools Web site at Berkeley

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January 25 broad overview

Hoyle (2011): Chapters 1-5

February 1 foundational material

Chapters 3, 4, 6, and 7 (Chapters 1, 2, and 16 optional)

February 8 specification

Chapters 8, 9, and 14

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*Unless otherwise noted, chapter numbers refer to the Hoyle (in press) volume

February 15 **estimation; categorical data**

Chapters 10 and 12 (Chapters 19 and 20 optional)

February 22 **model selection; statistical power**

Chapters 13, 18, and 11 (Chapter 40 optional)

February 29 **confirmatory factor analysis**

Chapters 22, 29, and 34

March 14 **mediation; moderation**

Chapters 25 and 26

March 21 **autoregressive longitudinal models; latent curve models**

Chapters 27 and 32

March 28 **structured means; measurement invariance; scale development**

Chapters 24, 23, and 28

April 4 **factor and growth mixture models; missing data methods**

Chapters 31 and 17

Lubke, G. H., & Muthén, B. (2005). Investigating population heterogeneity with factor mixture models. *Psychological Methods, 10*, 21-39.

April 11 **presentations**

April 18 **limitations and criticisms**
rough drafts due

Chapters 15, 5, and 21

April 25 **reviews due by noon**

May 2 **final drafts due by noon**

Lab Meetings*

January 20	exploratory factor analysis (EFA)
January 27	introduction to M*plus* and data preparation
February 3	**quiz**
February 10	confirmatory factor analysis (CFA) & complex measurement models
February 17	**Exam 1**
February 24	multiple group CFA and invariance testing
March 2	power and sample size calculation with Monte Carlo simulation
March 16	**Exam 2**
March 23	full structural equation models; mediation and moderation
March 30	latent growth models
April 6	latent growth models (continued)
April 13	to be determined
April 20	multiple imputation and using multiply-imputed data for SEM

*Focus of some sessions may change to accommodate students' interests and needs.