HDFS 628
Structural Equation Modeling
Fall 2015
Lecture location: LILY 3410
ITap Lab location: SC 289
Tuesday & Thursday: 12:00 – 1:15 p.m.

Professor: Sharon L. Christ
Office: 225 Hanley Hall
Phone: 765-496-1638
Email: slchrist@purdue.edu
Office hours: by appointment

Course Website: http://itap.purdue.edu/tlt/blackboard/
Class Listserv: fall-2015-hdfs-62800-001@lists.purdue.edu


Readings:
In addition to the text, there will be a few required journal article or book chapter readings as well as several suggested optional resources. Most of these will be available through the blackboard course website. Required readings are denoted with an asterisk, *.

Course Description and Objectives:
This course is an introduction to classic structural equation models with latent variables (SEM). It provides an overview of the method including the origins of the method and two major model components: simultaneous equations and confirmatory factor analysis. We will learn model notation and review the matrix algebra and covariance structures that are used to define SEMs. The primary steps of implementing SEMs will be covered to include: model specification, model identification, parameter estimation, and model evaluation (model fit). Time permitting; we will also discuss various extended topics. Potential additional topics include reliability and validity estimation in SEM, moderation analysis using multiple groups, estimation for non-normal and
categorical outcomes, generalized linear SEM, longitudinal modeling, estimation of complex sample data, and estimation with missing data.

Learning objectives include:

- Develop a basic understanding of structural equation models including proper application, interpretation, and evaluation of the models
- Develop an understanding of the underlying statistics including parameter identification and estimation as well as model fit measures.
- Learn the benefits of SEMs including when it is advantageous to use this modeling approach
- Learn the limitations of SEM, including the most common mistakes in using SEMs
- Be able to apply the method to a topic relevant to your own research
- Be able to analyze SEM models using a SEM software package
- Be able to interpret results from a SEM model

Course Components

Readings: Reading assignments from the text and other books & journals are listed in the course outline. While reading about statistics may be unappealing, it should greatly help with your understanding of the material presented in class. Therefore, I strongly encourage you to keep up with the reading as best you can.

Homework: There will be several homework assignments over the course of the semester. These generally involve application of class topics to real data using statistical software and interpretation of the estimates. The focus will be on proper application and interpretation of SEM analyses. You may work together with others on assignments, but you must turn in an independent homework. Your written work should be your own. Homework will account for 30% of your final grade.

Background Quiz: We will have a take-home quiz early in the semester that covers model notation, assumptions, and equations. It will also include some matrix and covariance algebra. Understanding the basics of the model framework is essential for the rest of the course. The quiz will count for 5% of your course grade.

Statistical Software: Our primary SEM statistical package will be STATA. I will provide in-class demonstrations using STATA. STATA will be available in ITap labs and via software remote for students in the class. Students are also welcome to use other SEM software, such as AMOS, LISREL, and Mplus.
Midterm Exam: We will have a midterm exam that focuses on interpreting results from SEM models. It will be comprised of short answer and essay style questions.

Labs: Every third class will be held in an ITaP computer lab. During these classes, demonstrations on how to estimate models in STATA will be given. Students will also have time to work on in-class exercises and homework using STATA. AMOS or other SEM software may be used if you bring your own laptop with the software.

Final Paper Proposal: A research proposal for your final paper will be due in the second half of the semester. The purpose of the proposal is to describe the data and analysis that you would like to pursue in the final paper and to get feedback on your proposed analysis. The proposal will count for 5% of your final grade.

Final Paper: There is a final research paper for this course. The paper should focus on methods and therefore does not necessarily require a complete literature review. The paper will include a short introduction, a description of the questions and hypotheses to be tested, a detailed description of the methods used, a detailed description of the results, and conclusions. You may use a data set of your choosing and I encourage you to work on a project relevant to you, for example, a conference paper or manuscript. The final paper will represent 35% of your final grade.

Final Course Grade: Your grade will be weighted based on the following course component percentages:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercises/Homework</td>
<td>30%</td>
</tr>
<tr>
<td>Background Quiz</td>
<td>5%</td>
</tr>
<tr>
<td>Midterm</td>
<td>25%</td>
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<tr>
<td>Final Paper Proposal</td>
<td>5%</td>
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<tr>
<td>Final Paper</td>
<td>35%</td>
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</table>

Final grades will be assigned according to the following scale:

- A: > 90%
- B: 80% - 89%
- C: 70% - 79%
- D: 60% - 69%
- F: < 60%
Academic Integrity:
Students are advised to familiarize themselves with the University’s regulations regarding student conduct in academic endeavors. This information is located at the following website: http://www.purdue.edu/odos/osrr/academicintegritybrochure.php. Students who are suspected to be in violation of the University’s regulations regarding academic dishonesty, including but not limited to plagiarism and cheating, will be dealt with in accordance with University policy. This may result in a referral to the Office of the Dean of Students and penalties for the assignment(s) in question.

COURSE TOPICS AND ASSOCIATED READINGS:

(*=required reading): Most required readings (*) other than the text are available via the course website. The recommended readings may NOT be on the website, but most are accessible through Purdue libraries. Additional readings and resources are available in the bibliographies to the software manuals. The listserv SEMNET (http://www.gsu.edu/~mkteer/semnet.html) is an 1800+ subscriber listserv devoted to SEM topics. You may want to join this listserv at some point. The journal *Structural Equation Modeling* is a good source of current work and the SEMNET listserv archive is another source of references and discussion of SEMs.

I. INTRODUCTION: Overview of Structural Equation Models

*Bollen 1989, SELV (Ch.1).


II. BACKGROUND MATERIAL

A. Model Notation, Path Analysis, Covariance Algebra, & Matrix Algebra

*Bollen 1989. SELV (Ch. 2, Appendix A Matrix Review).

B. Multiple Regression Review and Consequences of Measurement Error

*Bollen 1989. SELV (Ch.5).


III. SIMULTANEOUS EQUATIONS (Classical Econometric Methods)

*Bollen 1989. SELV (Ch.4).

Duncan, O.D. 1975. *Introduction to Structural Equation Models* (Chs.3-7).

IV. CONFIRMATORY FACTOR ANALYSIS (MEASUREMENT MODELS)

*Bollen 1989. SELV (Ch.7).


V. STRUCTURAL EQUATIONS WITH LATENT VARIABLES

*Bollen 1989. SELV. (Ch.8: 319-338; 349-355; 365-369; 376-394).

VI. MISCELANEOUS TOPICS (covered as time permits)

A. Overall Fit Measures

*Bollen 1989. *SELV* (256-281)

"Introduction."

B. Multiple Group Analysis

*Bollen 1989. *SELV* (Ch.8: 355-369).

Jöreskog, K. and D. Sörbom. 1989. *LISREL 8* (or 7) [ch.9].

C. Missing Data

*Bollen 1989 *SELV* (Ch 8:369-76)


D. Nonnormality of Observed Variables


E. Categorical Variables Approximation Method

F. Generalized Linear Structural Equation Models

*TBD


G. Longitudinal Data Analysis


H. Estimation of Complex Sample Data


I. Reliability and Validity Estimates

*Bollen 1989. *SELV* (Ch.6).

### Meeting Schedule:

<table>
<thead>
<tr>
<th>Date</th>
<th>Event(s)</th>
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<tbody>
<tr>
<td>August 25 &amp; 27</td>
<td>Lecture</td>
</tr>
<tr>
<td>Sept. 1</td>
<td>Computer Lab SC 289</td>
</tr>
<tr>
<td>Sept. 3 &amp; 8</td>
<td>Lecture</td>
</tr>
<tr>
<td>Sept. 10</td>
<td>Computer Lab SC 289</td>
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<tr>
<td>Sept. 15 &amp; 17</td>
<td>Lecture</td>
</tr>
<tr>
<td>Sept. 22</td>
<td>Computer Lab SC 289</td>
</tr>
<tr>
<td>Sept. 24 &amp; 29</td>
<td>Lecture</td>
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<tr>
<td>Oct. 1</td>
<td>Computer Lab SC 289</td>
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<tr>
<td>Oct. 6 &amp; 8</td>
<td>Lecture</td>
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<tr>
<td>Oct. 13</td>
<td>FALL BREAK – NO CLASS</td>
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<tr>
<td>Oct. 15</td>
<td>Computer Lab SC 289</td>
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<tr>
<td>Oct. 20 &amp; 22</td>
<td>Lecture &amp; Exam Review</td>
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<tr>
<td><strong>Oct. 27</strong></td>
<td><strong>MIDTERM EXAM</strong></td>
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<tr>
<td>Oct. 29</td>
<td>Computer Lab SC 289</td>
</tr>
<tr>
<td>Nov. 3 &amp; 5</td>
<td>Lecture</td>
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<tr>
<td>Nov. 10</td>
<td>Computer Lab SC 289</td>
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Meeting Schedule Continued:

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 12 &amp; 17</td>
<td>Lecture</td>
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<tr>
<td>Nov. 19</td>
<td>Computer Lab SC 289</td>
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<tr>
<td>Nov. 24</td>
<td>Lecture</td>
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<tr>
<td>Nov. 26</td>
<td>THANKSGIVING BREAK – NO CLASS</td>
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<tr>
<td>Dec. 1 &amp; 3</td>
<td>Lecture</td>
</tr>
<tr>
<td>Dec. 8 &amp; 10</td>
<td>Computer Lab, work on papers SC 289</td>
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<tr>
<td>Dec. 17</td>
<td>FINAL PAPER DUE</td>
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Emergencies

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor’s control. Students should sign up for emergency text messages here: [http://www.purdue.edu/securepurdue/](http://www.purdue.edu/securepurdue/) Emergency information and updates will be posted on Purdue's homepage at [http://www.purdue.edu](http://www.purdue.edu)

**EMERGENCY PREPAREDNESS SYLLABUS ATTACHMENT**

**EMERGENCY NOTIFICATION PROCEDURES** are based on a simple concept – if you hear a fire alarm inside, proceed outside. If you hear a siren outside, proceed inside.

- **Indoor Fire Alarms** mean to stop class or research and immediately evacuate the building.
  - Proceed to your Emergency Assembly Area away from building doors. **Remain outside** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.
- **All Hazards Outdoor Emergency Warning Sirens** mean to immediately seek shelter (**Shelter in Place**) in a safe location within the closest building.
“Shelter in place” means seeking immediate shelter inside a building or University residence. This course of action may need to be taken during a tornado, a civil disturbance including a shooting or release of hazardous materials in the outside air. Once safely inside, find out more details about the emergency*. **Remain in place** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

*In both cases, you should seek additional clarifying information by all means possible...Purdue Emergency Status page, text message, email alert, TV, radio, etc...review the Purdue Emergency Warning Notification System multi-communication layers at [http://www.purdue.edu/ehps/emergency_preparedness/warning-system.html](http://www.purdue.edu/ehps/emergency_preparedness/warning-system.html)

**EMERGENCY RESPONSE PROCEDURES:**

- Review the [Emergency Procedures Guidelines](https://www.purdue.edu/emergency_preparedness/flipchart/index.html)
- Review the **Building Emergency Plan** (available on the Emergency Preparedness website or from the building deputy) for:
  - evacuation routes, exit points, and emergency assembly area
  - when and how to evacuate the building.
  - shelter in place procedures and locations
  - additional building specific procedures and requirements.

**EMERGENCY PREPAREDNESS AWARENESS VIDEOS**

- "Shots Fired on Campus: When Lightning Strikes," is a 20-minute active shooter awareness video that illustrates what to look for and how to prepare and react to this type of incident. See: [http://www.purdue.edu/securePurdue/news/2010/emergency-preparedness-shots-fired-on-campus-video.cfm](http://www.purdue.edu/securePurdue/news/2010/emergency-preparedness-shots-fired-on-campus-video.cfm) (Link is also located on the EP website)
- All Hazards Online Awareness training video (on Webcert & Blackboard.) A 30 minute computer based training video that provides safety and emergency preparedness information. See the [EP website](http://www.purdue.edu/ehps/emergency_preparedness/index.html) for sign up instructions.