HDFS 628 Spring 2020

STRUCTURAL EQUATION MODELING

Lecture: University (UNIV) Hall, Room 019
Tuesday & Thursday, 10:30 a.m. – 11:45 p.m.

Professor: Sharon L. Christ
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Email: slchrist@purdue.edu
Office hours: by appointment

Course Website: https://mycourses.purdue.edu/

The course webpage is hosted by Blackboard Learn. When you login to Blackboard you should automatically have access to the webpage. The webpage will contain: required and supplemental readings, overheads from presentations given in lecture, in-class exercises, data sets, homework assignments, exam review sheets, etc.

Textbook and Other Readings:

There is one required textbook for this course. Additional required readings will be posted on the course webpage. The required textbook is available in electronic form at the Purdue library. Other readings will include book chapters and journal articles.

Required Textbook:

Bollen, Kenneth A. (1989). *Structural Equations with Latent Variables (SELV)*. N.Y.: Wiley.

Useful Supplemental Text & Resources:

Acock, Alan (2013). *Discovering Structural Equation Modeling using STATA*. Stata Press.

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. SEM software manual can also be a great resource.

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). We will also cover various extended topics, including 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.

While theoretical and mathematical basics of SEM statistical methods will be covered, **emphasis is placed on the application of SEM, including a conceptual and interpretive understanding of the methods**. The primary goal is for students to develop an ability to apply these statistical methods using a statistical software package to their substantive research questions and to understand and communicate their meaning.

Learning objectives:

- 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
- Improve analytic and critical thinking skills
- Improve written and verbal communication of analytic results

Communication:

The course webpage is the major hub of information for the course. I frequently communicate with the class through emails sent through blackboard and these messages are in the webpage announcements queue. Updates and reminders on upcoming readings and homework assignments and changes to the schedule are provided this way.

Course Components:

Readings: Reading assignments from the text and other books & journals will be posted in advance on the course webpage and announced in class and/or through email. While reading about statistics may be unappealing, it will greatly help with your understanding of the material presented in class. Therefore, I strongly encourage you to keep up with the reading. It is best to read statistics in shorter sections rather than reading through entire chapters in one sitting.

Homework: There will be several (approximately 7 or 8) 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 35% of your final grade. Homework solutions and examples will be posted so that you can check your own work.

Background Quiz: We will have one in-class 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.

In-Class Participation & Assignments: Attendance is not formally taken in the class, but we will be doing in-class exercises during class meetings and in the lab sessions. These participation assignments will account for 10% of your final grade. The lowest (missing) in-class assignment will be dropped from your participation grade.

Labs: The class will meet periodically (about every third or fourth meeting) 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.

Statistical Software: Our primary SEM statistical package will be STATA, which is available in ITaP labs and via software remote. I will provide in-class demonstrations using STATA as well as STATA programs for homework assignments. Some of our in-class, lab assignments will be work completed using STATA or your preferred SEM software package. Students are welcome to use other SEM software, such as AMOS, LISREL, and Mplus if preferred.

Exam: We will have a late midterm exam that focuses on interpreting results from SEM models. It will be comprised of short answer and essay style questions. This exam counts for 20% of your final grade.

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 will focus on methods and therefore will not include a full 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, a detailed description of the results, and conclusions. More information on this assignment will be provided later in the semester. 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 25% of your final grade.

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

Homework:	35%
Background Quiz:	5%
In-Class Exercises	10%
Exam:	20%
Final Paper Proposal:	5%
Final Paper:	25%

Final grades will be assigned according to the following scale:

A:	> 93%
A-:	90 – 92%
B+:	87 – 89%
B:	83 – 86%
B-:	80 – 82%
C+:	77 – 79%
C:	73 – 76%
C-:	70 – 72%
D:	< 70%
F:	< 60%

Schedule:
The tentative schedule of topics is provided below. **There will inevitably be changes to this schedule** due to the pace we can successfully complete each topic. I will provide updated schedules as we move through the course topics.

Tentative Schedule

Week	**Topics Covered**
January 14 & 16	Introduction: Overview of Structural Equation Models
January 21 & 23	Background: Model Notation, Path Analysis, Covariance Algebra, & Matrix Algebra
January 28 & 30	Background: Multiple Regression Review and Consequences of Measurement Error
February 4	**BACKGROUND QUIZ**
February 6	Simultaneous Equations (classical econometric models)
February 11 & 13	Simultaneous Equations (classical econometric models) Confirmatory Factor Analysis (measurement models)
February 18 & 20	Confirmatory Factor Analysis (measurement models)
February 25 & 27	Structural Equations with Latent Variables
March 3 & 5	Catch Up

Tentative Schedule

Week	**Topics Covered**
March 10 & 12	Model Fit Measures
March 17 & 19	**SPRING BREAK – NO CLASS**
March 24 & 26	Multiple Group Analysis
March 31 & April 2	Longitudinal Data Analysis (trajectory modeling)
April 7 & 9	Missing Data
April 14 & 16	Nonnormal & Categorical Variables Review for Exam
April 21	**EXAM**
April 23	Generalized Linear SEM
April 28 & 30	Help with Final Papers
May 7	**FINAL PAPER DUE**

Holiday Schedule:

Students will not be expected to do course-related work on university-recognized holidays (i.e., Labor Day, Thanksgiving Day). If other significant holidays or observances related to your background, identity, and/or religious practices overlap with assignment due dates, please contact me and we can make a plan to work around your observances.

Accommodations:

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on different abilities or disabilities, you are welcome to let me know so that we can discuss options for making accommodations for you. You are also encouraged to contact the **Disability Resource Center (DRC)** by email at drc@purdue.edu, by phone at (765)-494-1247, or in person at Young Hall, 155 S. Grant St., Room 830, West Lafayette, IN 47907.

Non-Discrimination:

Purdue University and this instructor are committed to maintaining a community which values the worth and dignity of every person and fosters sensitivity, understanding, and mutual respect among its members. We will not tolerate discrimination on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran.

Psychological Health and Wellness:

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765)-494-6995 and http://www.purdue.edu/caps/ during and after hours, on weekends and holidays, or at the Purdue University Student Health Center (PUSH) during business hours.

Academic Integrity:

- Academic integrity is among the highest values held by Purdue University. Individuals are encouraged to alert university officials to potential breaches of this value by email at integrity@purdue.edu or by phone at 765-494-8778. Information may be submitted anonymously.
- All work turned into the instructor for course credit must be original. In addition to a failing grade for the assignment, the penalties for academic dishonesty may consist of: a failing final grade (i.e., "F) for the course, academic probation or other university sanctions, or even suspension or expulsion from the university, in some cases.
- Students who are suspected of any form of cheating or plagiarism will also be reported to the Office of the Dean of Students. Please review the university policies regarding academic integrity at: http://www.purdue.edu/ODOS/osrr/integrity.htm

"As a Boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together, we are Purdue." – Purdue University Code of Honor

Campus 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. I will try to send out messages through the course webpage regarding emergencies affecting our class. Also, get information about changes in this course on the course Blackboard web page or email me at slchrist@purdue.edu.

Emergency information and updates will be posted on Purdue's homepage at http://www.purdue.edu

Students should sign up for emergency text messages here: https://www.purdue.edu/newsroom/health_safety/mail.html

Also, the following webpage details university policies and procedures during various emergency events: https://www.purdue.edu/emergency_preparedness/flipchart/index.html.

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, an active threat 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, Twitter, Desktop Alert, Albertus Beacon, digital signs, 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

EMERGENCY REPONSE PROCEDURES:

- Review the Emergency Procedures Guidelines at: https://www.purdue.edu/emergency_preparedness/flipchart/index.html
- Review the Building Emergency Plan (available on the Purdue 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

- "Run. Hide. Fight. ®" is a 6-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.youtube.com/watch?v=5mzl_5aj4Vs (Link also located on the Purdue Emergency Preparedness website)

MORE INFORMATION

- Reference the Emergency Preparedness website for additional information: https://www.purdue.edu/ehps/emergency_preparedness/