COLLEGE OF EDUCATION
UIC

Structural Equation Modeling

EPSY 587

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Office Hour: By appointment via video-conferencing

Course Overview

Extremely rapid pace of change in statistics and methodology in education requires that graduate students (and newly minted PhDs in academic and applied settings) be well versed in current data analytic techniques and able to keep abreast of emergent techniques by being aware of contemporary methodological literature.

This course will illustrate the uses of structural equation models (SEM, also known as linear structural relations models) for cross-sectional, longitudinal, and experimental data analysis. The course is organized to take students through each of the cumulative steps in the analysis: deciding which type of model is appropriate, setting up the data file and coding variables, interpreting and displaying empirical findings, and presenting results in scholarly writing.

Topics that will be covered are:

- Refreshers of matrix algebra, covariance algebra, statistical testing, regression, etc.
- Introduction to essential elements of structural equation models.
- Model specification, identification, fit, estimation, and assumptions.
- Path diagrams and path models.
- Confirmatory factor analysis.
- Structural equation models.
- Some special SEM models as latent growth models, measurement invariance, and multiple group models.
- M*plus* as a useful tool for latent variable modeling.

Course Prerequisites

- EPSY 547 Multiple Regression in Educational Research, OR
- EPSY 583 Multivariate Analysis of Educational Data, OR equivalent

Course Objectives and Outcomes

By the end of this course, students will be able to

1. Understand basic concepts, terminology, and assumptions pertinent to SEM including path analysis, confirmatory factor analysis, and full SEM models;
2. Compare and contrast structural equation modeling with more commonly used statistical procedures such as multiple regression analysis and exploratory factor analysis;
3. Understand the role of structural equation modeling (SEM) including its directed acyclic

graphical notation as a means to estimate assumed causal relationships;
4. Understand and implement the criteria associated with decisions made at each phase of a SEM analysis;
5. Identify and be able to estimate using software the total, indirect, and direct effects within a SEM as well as assessing model fit and checking model assumptions;
6. Fully implement path models, CFA models, and SEMs using software including assessing model fit and interpreting results;
7. Read and approach the classical and emerging methodological literature on SEM;
8. Critically read research articles that use the collection of methods learned in the course;
9. Replicate and re-analyze results based on published data;
10. Write a research project using SEM in the format of a publishable research paper.

Learning Approach

We will try to accomplish the course goals following an online course approach.

1. Refer to the **Schedule** for an overview of all tasks in each module.
2. Go to the **module folder** on Blackboard (Bb), and complete all tasks in the order listed. (You do NOT need to navigate elsewhere on Bb. The listed items in each module folder should provide you with everything needed, except the textbooks.)
3. I estimate one needs **10-16 working hours** to complete all tasks each week.

My Expectations & Our Responsibilities

As your online instructor, I will assume responsibility for preparing an organized course of study, prompting online discussions, and facilitating the learning process.

As students in the course, you are expected to, each week, complete all tasks in the module folder(s) in the order listed.

DO NOT CRAM: Students who wait until the day before an assignment is due to begin work will very likely have challenge keeping pace with the course. Please realize that if you wait until the last minute to begin asking questions about an assignment, then you will likely not receive a response in time for submission by the deadline.

Course Materials

Required Text:

- Kline, R. B. Principles and practice of structural equation modeling (4th Edition preferred, 3rd Edition acceptable). New York: Guilford.

- Byrne, B. M. (2012) Structural equation modeling with Mplus: Basic concepts, applications, and programming. Mahwah, NJ: Erlbaum.

- Mplus User's Guide: https://www.statmodel.com/ugexcerpts.shtml

Additional materials will be made available on the course Blackboard site.

Required Technology:

- M*plus*. The Base Program is sufficient for the course, unless you choose to use a complex-survey data set for the final project, in which case you would need the multilevel Add-on. Different packages: https://www.statmodel.com/programs.shtml Pricing: https://www.statmodel.com/pricing.shtml

- UIC library. See *How to search lit via UIC library.docx* on Bb for literature searching.

- You will need regular access to a computer with a stable **connection to the Internet**. All course materials will be delivered on the course Blackboard site, so if you have difficulty accessing the course website, it is imperative that you take action immediately to solve the problem. It is **your** responsibility to maintain connectivity throughout the entire length of the course regardless of where you are (this includes vacations, travel, etc.)

- Internet browser is compatible with Blackboard.

- PDF reader.

- You will need to have access to The Microsoft Office suite of software. This includes Word, PowerPoint, and Excel.

- A text editor (e.g., TextEdit on Mac, and NotePad on PC).

- A smartphone with a camera, a regular camera, or a scanner would be extremely helpful.

Communication Policies

To ensure proper and efficient communication, you are required to

1) Use the *Discussion Board* for course content related questions. See the Discussion Board Guidelines in the section "Course Assignments" below.
2) Use the Blackboard email system OR use your **uic.edu** email to communicate with the instructor about personal requests.
3) Write the subject of your email starting with "EPSY594", and
4) Write your email professionally (Read this post to learn about how to write an email professionally https://www.insidehighered.com/views/2015/04/16/advice-students-so-they-dont-sound-silly-emails-essay), e.g., address me "Dr. Dai", not "hey there" or "yo."

Emails that fail to meet the criteria above-mentioned will NOT be responded to.
I will return e-mail within 36 hours unless informed otherwise or the university is closed.

Course Assignments

Students in this course will complete post-vide exercises, article homework, reviews of article homework, modeling homework, a final project, and question asking and answering on the Discussion Board:

Assignment Type	Quantity	Total Weight (%)
Post-Video Exercise (PVE)	12	10
Article HW	5	20
Reviews of Article HW	5	10
Modeling HW	4	35
Final Project	1	20
Questions & Reflection posts on DB	≥ 5	5
TOTAL:		**100**

- **Post-Video Exercises (PVE).** The goal of these assignments is to provide a hands-on experience with some content taught in the videos.
  For each PVE, you are expected to answer the questions and submit your answer to Blackboard. A solution sheet will be made available upon your submission.
  Full credit is given to a timely submission.

- **Article Homework.** The goal of these assignments is to help you, in small steps, learn how to critically read and understand the SEM approaches and results in published journal articles in your field.
  For each article HW, you are expected to
  1) search for and read an empirical journal article with SEM analysis in your area of interest,
  2) answer questions provided in the instruction sheet,
  3) post your answers on DB and attach the article PDF, and

  Full credit is given to a timely submission.

- **Reviews of Article Homework by other students.** The goal of these assignments is to increase your empirical article reading, learn by evaluating others' work, and enhance online communication within our class community.
  For each assignment, you are expected to
  1) read a classmate's Article HW on the DB due the past week,
  2) check their answers to the questions in the HW
  3) reply to their post with your feedback on whether you agree with each answer, and why or why not.

  Full credit is given to a timely submission.

- **Modeling Homework.** The goal of these assignments is to help you understand different SEM approaches by carrying them out.
  For each modeling homework, you are expected to follow the detailed instructions provided in the instruction file attached to the submission link. In order to encourage mastery of the material, IF you wish to revise a modeling homework, you may do so **within one week of receiving feedback** from me. Your grade will be based on the best score of the two—the original HW and the optional revised HW.

- **Final Project.** The goal of this project is to help you understand the full process of

conducting a research study using a SEM approach.
Each student is expected to execute a complete structural equation modeling analysis of an existing data set of your choice and fully report the analysis and results in APA style (7th Ed.) The final product is an empirical research manuscript with a brief introduction, a brief literature review, a detailed Method section, a detailed Results section, and a brief Discussion section, with the full set of M*plus* outputs as appendices. I urge you **start looking—as early as possible—for large data sets** which you are able to use for the final project. I am more than happy to take a look at your candidate data sets and let you know whether they are suitable for a final project.

- **Discussion Boards "Questions & Reflections on Module …"** The goal of these discussion boards is for you to actively engage in learning.
  You are expected to share your thoughts and ideas during the learning process, ask your questions, and respond to others' questions and ideas. Please follow the **DB Guidelines** for writing your posts:
  1. **Follow this format for the subject line** of your new thread—start with the subject topic and follow with specifics, e.g., "EFA: Item loaded on 2 factors equally" "Path Models: Fit indices are all 0 or 1" "Latent growth: Time point setting."
  2. If your post is a question, expect it to be answered **within 48 hours**. E.g., if a question must be answered in order for you to submit an assignment, you should ask it at least 48 hours in advance of the assignment due time.
  3. **Everyone should contribute to answering** the questions. The instructor will check the answer by a student to ensure whether it is correct. If you know the answer to a question asked, do not hesitate to participate in the discussion. Learning occurs in active engagement!
  4. **Check the existing posts before you create a new thread**. You may find a resource already shared, a question already asked, etc. In this case, you should reply to the thread "ditto" or state that you have the same question. Do NOT start a new thread to ask a question that has already been posted. If you are not sure whether a posted question is what you are after but you suspect it is, simply reply to it and state you version of the question.

No Extra Credit:
Your course grades are based only on the above information. There will be no extra-credit opportunities.

Late Assignments:
The course schedule contains due dates for the assignments for this course. I expect you to keep to the schedule and turn in your assignments on time so that I can provide you with timely feedback on your work. Any special arrangement (e.g., extension) for completing assignments need to be approved by the instructor at least **3 days prior** to the due date. No extension for a past-due assignment will be granted. Late assignments without a granted extension will be graded with a **10% deduction for each day late**.

If your system crashes, or your Internet provider loses connectivity just as you are getting ready to send in your work (and you cannot use an alternate system), contact the instructor and explain the circumstances as soon as possible.

Grading Scale

A	90 – 100%	Excellent	The student's work demonstrates excellent grasp of all the learning outcomes associated with the course.
B	79 – 89%	Good	The student's work demonstrates mastery of the majority of learning outcomes associated with the course.
C	68 – 78%	Average	The student's work demonstrates mastery of approximately two-thirds of the learning outcomes associated with the course.
D	57 – 67%	Poor	The student's work demonstrates mastery of fewer than half of the learning outcomes associated with the course.
F	56% and Below	Failure	The student's work does not sufficiently demonstrate that he or she has adequately grasped any of the learning outcomes associated with the course.

Incomplete Grade: I will consider giving incompletes ONLY to students who have extenuating circumstances; however, I will not consider poor performance on assignments as a legitimate reason for giving an incomplete.

Drop or Withdrawal from the Course

If a student wishes to drop or withdraw from a course, it is the student's responsibility to meet the deadline within the current semester (https://registrar.uic.edu/current_students/calendars/). Please consult the University registration policy (https://registrar.uic.edu/registration/policies_procedures.html).

Tech Support

If you are having technical problems with the course, please click on the **"Technical Support"** link in the Blackboard course site to submit a request for assistance or call **1-(312) 996-5948**. A staff member will respond to inquiries Monday - Friday, 8 a.m. - 8 p.m. Central Time and Saturday - Sunday, 11 a.m. - 3 p.m. US Central Time.

Academic Integrity

UIC is committed to upholding academic integrity among all of its students, faculty, staff, and administration. The students and instructor of this course share this responsibility by not engaging in behaviors that constitute academic dishonesty and misconduct. Examples of such misconduct include cheating, taking an examination by proxy, plagiarizing, and submitting

another person's work as your own. To detect instances of plagiarism and similar infractions, your work in the course may be scanned with plagiarism detection tools (such as SafeAssign). When evidence of plagiarism or other academic misconduct occurs, the instructor and University will take action in accordance with the Student Disciplinary Policy. Students who violate the policies governing academic dishonesty are subject to penalties such as receiving a failing grade for the course and dismissal from the University. You should review the policy and frequently asked questions from the following link:
http://www.uic.edu/depts/dos/docs/Student%20Disciplinary%20Policy.pdf

Student Code of Conduct

UIC's *Student Disciplinary Policy* outlines the University's process in handling allegations of misconduct by UIC students. It addresses both academic and behavioral misconduct. The main purpose of the conduct process is to insure that students receive due process, which means that every student should have a fair opportunity to express his or her side of the story before any decisions are made about the disciplinary case. The conduct process is designed to be educational in nature.
Student Disciplinary Policy: (http://www.uic.edu/depts/dos/studentconductprocess.shtml).

Religious Observances

As your instructor, I will make every effort to avoid scheduling examinations or requiring that assignments be turned in or completed on religious holidays. Students who wish to observe your religious holidays should notify me in writing **at least 5 days in advance** if you will need extension for assignments due to a religious holiday. I shall make every reasonable effort to honor the request.

ADA Policies

UIC strives to ensure the accessibility of programs, classes, and services to students with documented disabilities. Reasonable accommodations can be arranged for students with various types of disabilities, such as documented learning disabilities, vision or hearing impairments, and emotional or physical disabilities. If you need accommodations for this course, be sure to register with the Office of Disability Services [1190 SSB, 312-413-2183 (voice), 312-413-0123 (TTY)].

Counseling and Mental Health Services

The UIC Counseling Center provides diverse services to help students deal with stress, handle a crisis or trauma, cope with the transition to college, gain strength from gender and cultural identity, or manage serious mental illness and many other issues. Their counselors can help students increase resilience and positive well-being by developing effective coping and problem-solving skills.

The Counseling Center is supported by the Health Service Fee as assessed to all students enrolled at the university, and therefore enrolled students are eligible for Counseling Center mental health services without additional cost.

For more information, access the Counseling Center's website: (http://counseling.uic.edu/) or give them a call at (312) 996-3490.

Sexual Misconduct

UIC is committed to maintaining a campus environment free from sexual misconduct. Our community's standards for all interpersonal relationships and interactions are based upon values of mutual respect, dignity, responsibility, open communication, and clear consent. Sexual misconduct violates our shared values and is a barrier to fulfilling the university's mission and goals. It is critical that everyone feel safe and respected on our campus.

UIC developed the Student Sexual Misconduct Policy to address sexual misconduct including sexual assault, sexual harassment, stalking, dating violence, and domestic violence. The policy states that sexual misconduct "will not be tolerated at the University of Illinois at Chicago and is expressly prohibited." The policy applies to all UIC students and student participants in university-sponsored programs.

UIC has created Student Sexual Misconduct website, http://sexualmisconduct.uic.edu, in response to federal laws requiring universities to develop policies and provide education to the campus community related to sexual misconduct. If you have been a victim of sexual misconduct or would like additional information, please contact the UIC Title IX Coordinator at http://oae.uic.edu/TitleIX/ in the Office for Access and Equity or call 312-996-8670.