EDRS 831: Structural Equation Modeling (3 credits)
College of Education and Human Development

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Prerequisite:
EDRS 821

University Catalog Course Description: Develops knowledge and skills related to structural equation modeling and research applications in education, psychology, and related fields.

Course Overview: The purpose of this course is an introduction to structural equation modeling (SEM) appropriate for analyzing mediational and moderated structured models as well as measurement models. The content is especially pertinent to applications of quantitative methods in the practice of educational research. The course will reinforce and build upon concepts and skills acquired in EDRS 811 and EDRS 821. Students will learn through a combination of reading assignments, hands-on experience in using a computer program for data analysis, and application activities. Students will be expected to critically read advanced quantitative methods used in published research, to analyze data, and to provide written report of methodology and results in APA format.

Course Delivery Method: The class sessions will include lecture, small group discussion, applied lab instruction and discussion of software output. **Questions are encouraged**. The lab portion of the class will provide time for hands-on computer work that is directly related to the homework and course goals.

Information on course assignments, weekly quizzes, and notes for class lectures are available on the course Blackboard site. For assistance with Blackboard students may email courses@gmu.edu, call (803) 993-3141, or go to Johnson Center Rm 311 (office hours: 8:30 am-5 pm). For general technical assistance, students may call (703) 993-8870 or go to the counter in Innovation Hall.

The most important thing you can bring with you to class is a willingness to try to conceptually understand the material. *Please be active--ask questions and participate.*

Learner Objectives: This course is a one-semester introduction to covariance structure analysis. By the end of the semester, it is expected that you 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 factor analysis;
(3) Understand and implement the criteria associated with decisions made at each phase of a SEM analysis;
(3) Understand and critique research studies that feature SEM analyses;
(4) Write up the results of SEM analyses in correct APA format.

Materials:
Required Textbook:

Kline, R. B. (2010). *Principles and Practice of Structural Equation Modeling* (4th ed.). New York, NY: Guilford Press.

Recommended Textbook:
Brown, T. A. (2015). Confirmatory Factor Analysis for Applied Research (2nd ed.). New York, NY: Guilford Press.
Software:
Access to SAS software. There are computer labs on campus that provide access to SAS. You can also access this software through GMU's virtual computer library at www.vcl.gmu.edu. Information about how to use the virtual computer library is available at http://itservices.gmu.edu/services/view-service.cfm?customel_dataPageID_4609=5689.
Additionally SAS University Edition provides free access: http://www.sas.com/en_us/software/university-edition.html#

R software is also an option for SEM. R software is free download: https://www.r-project.org/ and the lavaan package for latent variable modeling: http://lavaan.ugent.be/
It is the student's responsibility to ensure access to the software outside of class time as there will not be sufficient time in class to complete required assignments.

Course Performance Evaluation:
A primary goal of learning statistical methods at this level is to become an expert learner. It is not realistic for one professor or one book to be your only source of information, nor is this a viable learning model for the scientist/researcher that you are becoming. Please remember to make use of the many resources that are easily available on the internet and to work with one another as you progress and prepare for the learning assessment in this course.

Outside of class, remember that reading statistical information takes a long time, and even when you read slowly and deliberately, you will need to go back and revisit it over and over. Many people find that this is not easy material; you should accept struggles as a normal part of the learning process.

Exam (20%): There will be 1 exam consisting of short answer and output interpretation items similar to those from homework assignments. The exam will cover the basic concepts presented in class and in the readings.

Application & Analysis (30%): These assignments involve working with data to replicate class or textbook analyses and/or run new analyses in a small group (2-3 students per group). The exercises will also include several conceptual questions about the method to help you gain conceptual understanding as you work through the assignments. You may work together or individually on running the analysis; however your responses to the questions should be a collaborative effort. Your group will upload your responses to the Bb site. There are 4 application assignments.

The goal of these application assignments is to help you learn about the basics of a very sophisticated modeling method. Advances in computing have enabled the rapid development these sophisticated modeling tools. There is no way that you will ever know and understand all of them. What you need to understand are the basic assumptions underlying different models, how to select among them, and where to go to get information to learn more if you need something new.

Research Article Presentation / Group Critique (10 %): Throughout the semester we will be reading publications which are examples of the types of models that we are studying. In a small group (Doodle sign-up on Bb), you will overview the model used in the publication and how it addresses the research questions as well as present a short critique. You will also respond to questions/comments submitted by your peers. Note: On your "off weeks" you will submit a reflection to other groups about the other example papers. Upload your reflection (questions/comments) to Bb by Sunday noon of the week of the presentation.

Research Article Critique (10%): You will evaluate a published application of structural equation modeling. You are to choose an article published since 2014 in a major journal in your field of interest. The article you choose should be approved by the course instructor in advance.
In the written critique, you are to do the following:

1. State the primary research question.
2. Describe the data (e.g., "methods section" → N, missing data problems, measures used, sample).
3. Describe how SEM was used to address the primary research question.
4. Critique the presentation of the results (e.g., tables, figures, details about the analysis, etc.).
5. State whether, in your opinion, SEM was appropriately chosen and why. Note any alternative analyses that might shed additional light on the research question.

Final Project (30%): The final paper for this class is the application of some type of path or structural modeling to a research problem in your area of interest. The goal is to provide full information of the application of an SEM model to a set of data of your choosing. You should begin looking for an appropriate data set early in the semester.
Your project may be one of the following:

- Analysis of your own or faculty mentor's data (assuming appropriate approvals are in place)

- A replication or extension of another author's study (if public data)

Your paper should include the following:

1. A brief statement of the research question and hypotheses;
2. a detailed Methods section;
3. a detailed Results section;
4. a brief Discussion section.

*You will be asked to provide a basic description of the model you are testing for the project including a brief theoretical rationale.

Other Requirements:

Class Readings: The readings for this course come from the required textbook as well as journals and other books which provide insight or examples of the topic. Readings, when possible, will be made available to you for download from the Blackboard course website.

Class Attendance & Participation: Students are expected to come to class on time, complete assignments, and participate in class discussions.

Grading Policies:

Grades will be assigned based on the following:

A+	98-100%	B+	88-89%	C	70-79%
A	93-100%	B	83-87%	F	below 70%
A-	90-92%	B-	80-82%		

Final grades are based on the assessments described above. "Extra credit" is not available.

Late Assignments: *As a general rule, late assignments will not be accepted*. If you believe you have EXCEPTIONAL circumstances and wish to negotiate to have extra time to complete course work, you must discuss this with me before the day the assignment is due. (Negotiating means that you will be sacrificing a portion, perhaps substantial, of your grade for extra time).

GMU Policies and Resources for Students

Policies

- Students must adhere to the guidelines of the Mason Honor Code (see https://catalog.gmu.edu/policies/honor-code-system/).

- Students must follow the university policy for Responsible Use of Computing (see http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/).

- Students are responsible for the content of university communications sent to their Mason email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students **solely** through their Mason email account.

- Students with disabilities who seek accommodations in a course must be registered with George Mason University Disability Services. Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor (see https://ds.gmu.edu/).

- Students must silence all sound emitting devices during class unless otherwise authorized by the instructor.

Campus Resources

- Support for submission of assignments to Tk20 should be directed to tk20help@gmu.edu or https://cehd.gmu.edu/aero/tk20. Questions or concerns regarding use of Blackboard should be directed to http://coursessupport.gmu.edu/.

- For information on student support resources on campus, see https://ctfe.gmu.edu/teaching/student-support-resources-on-campus

Professional Dispositions

See https://cehd.gmu.edu/students/polices-procedures/

Core Values Commitment

The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: http://cehd.gmu.edu/values/.

For additional information on the College of Education and Human Development, please visit our website https://cehd.gmu.edu/students/ .

Course Schedule

Date	Class	Topic	Reading	Due
1/23	1	Course Info. & Overview Review of Correlation/Regression Introduction to software: SAS & R	Chapters 1& 4	
1/30	2	Review: Mediation/Moderation Intro to Path Analysis	Chapters 2,3 & 5	
2/6	3	Path Analysis	Chapters 6-7 & 11-12	
2/13	4	Path Analysis *Article #1: Path (reflection by 2/10)*	Chapters 6-7 & 11-12	**App. #1**
2/20	5	Path Analysis: Comparing Models/ Moderation *Article #2 : Path –Comparison (reflection by 2/17)*	Chapters 6-7 & 11-12	
2/27	6	Measurement Models Latent Variables	Chapters 9 & 13	**App. #2**
3/6	7	CFA *Article #3: CFA (reflection by 3/3)*	Chapters 9 & 13	
3/13		SPRING BREAK		
3/20	8	CFA *Article #4: CFA –meas. Invariance (reflection by 3/17)*	Chapters 9 & 13	**App #3**
3/27	9	CFA: Other variations *Article #5: CFA-higher order/bifactor (reflection by 3/24)*	Chapter 16	
4/3	10	**EXAM**		
4/10	11	SEM	Chapter 10 &14	**Article Critique due**
4/17	12	SEM *Article #6: SEM (reflection by 4/14)*	Chapter 8	
4/24	13	*Individual Meetings/ no class*	Chapter 18	**App.#4**
5/1	14	Pitfalls to avoid in SEM /Final Project Work		**Present Model**
5/8	15			**Final Project Due**

Note: Faculty reserves the right to alter the schedule as necessary, with notification to students.