GEORGE MASON UNIVERSITY
COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT
RESEARCH METHODS

EDRS 831
Structural Equation Modeling
3 credits

Summer A, 2015

PROFESSOR:
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COURSE DESCRIPTION:
    A. Prerequisites/Corequisites
       EDRS 811: Quantitative Methods in Education
    B. University Catalog Course Description:
       Focusing on the acquisition of knowledge and skills related to development of assessment scales and validation of assessment scale data in the context of education, psychology, and related fields.
    C. Expanded Course Description:
       N/A

DELIVERY METHOD:
This course will be delivered using as "synchronous" on Monday, Wednesday, and Friday (4:30pm – 7:10pm) in Thompson Hall, L01, at Fairfax campus. Course materials will be posted on the Blackboard learning management system (LMS) housed in the MyMason portal. You will log in to Blackboard course site using your Mason email name (everything before "@masonlive.gmu.edu) and email password.

TECHNICAL REQUIREMENTS:
To participate in this course, students will need the following resources:
- High-speed Internet access with a standard up-to-date browser, either Internet Explorer or Mozilla Firefox. Opera and Safari are not compatible with Blackboard;
- Consistent and reliable access to their GMU email and Blackboard, as these are the official methods of communication for this course

- Students may be asked to create logins and passwords on supplemental websites and/or to download trial software to their computer or tablet as part of the course requirements.
- The following software plug-ins for Pcs and Macs respectively, available for free downloading by clicking on the link next to each plug-in:
  - Adobe Acrobat Reader: http://get.adobe.com/reader/
  - Windows Media Player: http://windows.microsoft.com/en-US/windows/downloads/windows-media-player

EXPECTATIONS:
- **Course Week:** Refer to the asynchronous bullet below if your course is asynchronous or the synchronous bullet if your course is synchronous.
  - o Asynchronous: Because asynchronous courses do not have a "fixed" meeting day, our week will **start** on May 18 and **finish** on June 19.
  - o **Synchronous:** Our course week will begin on the day that our synchronous meetings take place as indicated on the Schedule of Classes.
- **Log-in Frequency**: Refer to the asynchronous bullet below if your course is asynchronous or the synchronous bullet if your course is synchronous.
  - o Asynchronous: Students must actively check the course Blackboard site and their GMU email for communications from the instructor, at a minimum this should be three times per week.
  - o Synchronous: Students must log-in for all scheduled online synchronous meetings. In addition, students must actively check the course Blackboard site and their GMU email for communications from the instructor, at a minimum this should be ___ times per week.
- **Participation**: Students are expected to actively engage in all course activities throughout the semester, which include viewing of all course materials, completing course activities and assignments, and participating in course discussions and group interactions.
- **Technical Competence**: Students are expected to demonstrate competence in the use of all course technology. Students are expected to seek assistance if they are struggling with technical components of the course.
- **Technical Issues**: Students should expect that they could experience some technical difficulties at some point in the semester and should, therefore, budget their time accordingly. Late work will not be accepted based on individual technical issues.
- **Workload**: Expect to log in to this course **at least three times a week** to read announcements, participate in the discussions, and work on course materials. Remember, this course is **not** self-paced. There are **specific deadlines** and **due dates** listed in the **CLASS SCHEDULE** section of this syllabus to which you are expected to

adhere. It is the student's responsibility to keep track of the weekly course schedule of topics, readings, activities and assignments due.

- **Advising:** If you would like to schedule a one-on-one meeting to discuss course requirements, content or other course-related issues, and you are unable to come to the Mason campus, we can meet via telephone or web conference. Send me an email to schedule your one-on-one session and include your preferred meeting method and suggested dates/times.

- **Netiquette:** Our goal is to be **collaborative**, not combative. Experience shows that even an innocent remark in the online environment can be misconstrued. I suggest that you always re-read your responses carefully before you post them to encourage others from taking them as personal attacks. **Be positive in your approach to others and diplomatic with your words.** I will do the same. Remember, you are not competing with each other but

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- sharing information and learning from one another as well as from the instructor.

LEARNER OUTCOMES:

This course is designed to enable students to:

- Identify techniques of path analysis and structural equation modeling that are appropriate for specified research questions and data.
- Understand concepts of path analysis and structural equation modeling.
- Test structural equation models for adequacy of identification and data fit using the computer program for statistical analysis with latent variable, Mplus (Muthén & Muthén, 2008) [1].
- Conduct confirmatory factor analysis via structural equation modeling using Mplus.
- Conduct structural equation analysis incorporating measurement models using Mplus.
- Analyze longitudinal data with linear structural equation models using Mplus
- Read and evaluate scientific articles as regards testing of causal relationships in education, psychology, and related fields.

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[1] Muthén, L. & Muthén, B. (2010). *Mplus user's guide*. Los Angeles, CA: Muthén & Muthén (available at: http://www.statmodel.com).

PROFESSIONAL STANDARDS:

The student outcomes are informed by the Standards for Reporting non Empirical Social Science Research in Publications of the American Educational Research Association (AERA; *Educational Researcher*, Vol. 35, No. 6, pp. 33–40). Those standards deemed most relevant to addressing the learning targets for the course are those that state that *educators will have the knowledge, skill and disposition to:*

1.   Apply basic principles of research practices for specific educational needs

2. Design and operationalize steps for the development of assessment instruments in education research and related fields
3. Evaluate the reliability of assessment scale data in the context of education and related fields
4. Evaluate validity of assessment scale data in the context of education and related fields
5. Conduct classical and modern analysis of assessment scales using contemporary statistical software and interpret the results
6. Use validation research results to disseminate and advance understanding and knowledge related to assessment in education and related fields
7. Recognize the implications of adequate validation of assessment scales for social justice in schools and other professional organizations.

REQUIRED TEXTS:

Raykov, T., & Marcoulides, G. A. (2006). *A First Course in Structural Equation Modeling* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.

COURSE REQUIREMENTS, PERFORMANCE-BASED ASSESSMENT, AND EVALUATION CRITERIA:
A. Requirements

1. **In class/Homework Assignments (10%):** Students will be asked to work individually on homework assignments throughout the semester.

2. **Class Attendance and Participation (5%):** Students are required to attend all classes, to be on time, prepared, follow outlined procedures in case of absence, actively participate and support the members of the learning group and the members of the class. The scoring rubric for class attendance and participation in provided in Appendix 1.

3. **Midterm Examination (15%):** Students will take a midterm examination (closed books and notes) to demonstrate understanding and knowledge of course content covered to date of examination.

4. **Pilot Research Study (50%):** This course requires students to develop and conduct a pilot-research study related to using structural equation modeling and interpretation of results in the context of education research. This study is intended to reflect what you have learned from this course. It should be written in a way that one would submit for a national professional conference paper presentation. Other requirements for this course are designed to build up bases for the final pilot research proposal. Research papers must be handed in on time and must adhere to the APA Publication Manual Guidelines.

5. **Final Examination (20%):** Students will take a final examination (closed books and notes) to demonstrate understanding and knowledge of course content covered throughout the coursework.

This pilot research study will be divided into 4 sequential parts.

1. Identify broad topic of interest; conduct a literature review; discuss significance of the proposed study; state purpose and hypotheses.
2. Methods- describe sample; identify measures to test hypotheses; discuss procedures and design of the study.
3. Data collection.
4. Data analysis.
5. Write the results section.
6. Discussion and Conclusion.

The presentation of the final paper will take place the last day of class in a research paper format (APA style, see also guidelines posted on the AERA website, www.aera.net.org.) After completing the research study, reflect on that experience. What did you learn from it? How do you think course material helped you carry out the study? [**Scoring rubric** for the research paper is provided in Appendix 2].

5. Final Examination (20%): Semi-comprehensive (closed books and notes) examination.

B. Performance-based assessments

All of the student products specified under course requirements will require performance-based assessments guided by grading rubrics. The scoring rubrics associated with the assessment of (a) class attendance and participation and (b) pilot research project ate proposal development assignment is provided in Appendices 1 and 2, respectively.

C. Criteria for evaluation

There are 100 total points for the course, distributed among the homework assignments (10%), class attendance and participation (5%), midterm examination (15%), pilot research project (50%), and final examination (20%).

D. Grading scale

Letter grades will be assigned as follows:

A+	97.5 - 100%,	**A**	92.5 - 97.49%,	**A-**	89.5 - 92.49%,
B+	87.5 - 89.49%,	**B**	82.5 - 87.49%,	**B-**	79.5 - 82.49%,
C	70-79.49%, and				
F	below 70%				

TASKSTREAM REQUIREMENTS

Every student registered for any Ph.D. in Education course with a required performance-based assessment is required to submit this assessment,[Not Applicable] to TaskStream (regardless of whether a course is an elective, a onetime course or part of an undergraduate minor). Evaluation of

the performance-based assessment by the course instructor will also be completed in TaskStream. Failure to submit the assessment to TaskStream will result in the course instructor reporting the course grade as Incomplete (IN). Unless the IN grade is changed upon completion of the required TaskStream submission, the IN will convert to an F nine weeks into the following semester.

GMU POLICIES AND RESOURCES FOR STUDENTS

a. Students must adhere to the guidelines of the George Mason University Honor Code (See **http://oai.gmu.edu/the-mason-honor-code/**).

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

c. Students are responsible for the content of university communications sent to their George Mason University 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.

d. The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance (See **http://caps.gmu.edu/**).

e. Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester (See **http://ods.gmu.edu/**).

f. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.

g. The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing (See **http://writingcenter.gmu.edu/**).

PROFESSIONAL DISPOSITIONS

Students are expected to exhibit professional behaviors and dispositions at all times.

CORE VALUES COMMITMENT

The College of Education & 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, Graduate School of Education, please visit our website http://gse.gmu.edu/.

PROPOSED CLASS SCHEDULE

Session	Topic/Learning Experiences	Readings and Assignments
May 18	Introduction to structural equation modeling (SEM) Review of statistical concepts related to SEM	**Text (Ch. 1), H, DD (Ch. 11, 13)**
May 20	Introduction to path analysis	**Text (Ch. 3), DD (Ch. 24), H**
May 22	Path analysis using Mplus.	**Text (Ch. 2, 3), H**
May 25	Confirmatory factor analysis	**Text (Ch. 4), DD(Ch. 24), H**
May27	Factorial invariance across groups and time	**Text (Ch. 5), DD(Ch. 24), H**
May 29	**Midterm Examination**	
June 1	Structural regression models	**Text (Ch. 5), H**
June 3	Structured means and MIMIC modeling	**Text (Ch. 5), DD(Ch. 24), H**
June 5	Latent change analysis	**Text (Ch. 6), H**
June 8	Multilevel (hierarchical) linear modeling	**H**
June 10	Latent class analysis	**H**
June 12	Review and examples of SEM	**Text (Ch. 2, 3, 4), H**
June 17	Additional review and examples of SEM	**Text (Ch. 5, 6), H**
June 19	**Final Examination**	

Note: **Text** = Required text (Raykov & Maqrcoulides, 2006);
     DD = Complimentary text: Dimiter Dimitrov (2008). *Quantitative research in education:*
        Intermediate and advanced methods. Oceanside, NY: Whittier Publications;
     H = Handout from relevant sources.

The research project paper is due by June 18, 2015.

APPENDIX 1

RUBRIC FOR PARTICIPATION AND ATTENDANCE

ELEMENT	**LEVEL OF PERFORMANCE**			
	Distinguished (4-5 pts.)	Proficient (3 pts.)	Basic (2 pts.)	Unsatisfactory (1 or 0 pts.)
Attendance & Participation	The student attends all classes, is on time, is prepared and follows outlined procedures in case of absence. The student actively participates and supports the members of the learning group and the members of the class.	The student attends all classes, is on time, is prepared and follows outlined procedures in case of absence; the student makes active contributions to the learning group and class.	The student is on time, prepared for class, participates in group and class discussions. The student attends all classes and if an absence occurs, the procedure outlined in this section of the syllabus is followed.	The student is late for class. Absences are not documented by following the procedures outlined in this section of the syllabus. The student is not prepared for class and does not actively participate in discussions.

APPENDIX 2

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RUBRIC FOR RESEARCH PAPER

GENERAL EVALUATION CRITERIA:

- Clarity and organization
- Comprehensiveness of content
- APA style   TOTAL SCORE: **MAX = 50 pts.**

Performance Elements	Quality Points
Introduction Section	**max = 9 points**
Statement of the nature and importance of the problem and literature review related to the issues.	**4-5 points:** The study problem is (a) relevant to the area of educational research, (b) described in a parsimonious and complete manner, (c) channeled towards the purpose of the study, and (d) embedded in a literature review on related theory and research.
	2-3 points: The study problem is relevant to the area of educational research and overall well described, but not channeled towards the purpose of the study or the literature review is not quite on target.
	0-1 points: The study problem is not relevant to the area of educational research and/or not clearly described, poorly channeled towards the purpose of the study, and not supported well by literature review.
Justification of the need for this study	**2 points:** The justification of the study is well described and stems from a necessity to fill up an existing gap in previous research on the topic or to conduct a replication study.
	0-1 points: The justification of the study is not well described and/or does not stem from a necessity to fill up an existing gap in previous research on the topic or to conduct a replication study.
Statement of the purpose of the study and related research questions.	**2 points:** The purpose of the study is connected to the statement of the problem and the research questions are properly described.
	0-1 points: The purpose of the study is not well connected to the statement of the problem and/or the research questions are not properly described.

Method Section	**max = 13 points**
Description of the study sample	**4 points:** Provided is clear, accurate, and complete description of the study sample — sampling method (random selection, volunteers, etc.), relevant demographic characteristics, sample size (total and by subgroups), and judgment about sample representativeness for the targeted population.
	2-3 points: Provided is relatively complete description of the study sample, with drawbacks related to the description of sampling method, relevant demographic characteristics, sample size, or sample representativeness.
	0-1 points: Provided is poor description of the study sample, with missing elements related to method of sampling, relevant demographic characteristics, and representativeness.
Description of the data (instruments, scales, and score reliability)	**2-3 points:** Provided is clear, accurate, and complete description of the data sources (e.g., assessment instruments, existing records, etc.), scoring rubrics, scales, and reliability of scores obtained for the study sample.
	0-1 points: Provided is incomplete (or lacking) description of data sources and there is no report on reliability estimates.
Description of the data collection method	**2 points:** Provided is clear, accurate, and complete description of the data collection method — e.g., existing students records or online data base.
	0-1 points: Provided is incomplete (or lacking) description of the data collection method.
Description of data analysis methods and procedures used to address the research questions in the project	**4 points:** Provided is clear, accurate, and complete description of *appropriate* data analysis methods and procedures used to address the research questions.
	2-3 points: Selected are *appropriate* methods and procedures of data analysis, with lack of sufficient clarity, accuracy, and/or completeness in description.
	0-1 points: Some (or all) of the selected data methods and procedures are *not appropriate* for addressing the project research questions.
Results Section	**max = 14 points**
	8 points: Provided is clear, accurate, and complete presentation of relevant results in APA style by

	project research questions.
Within-text presentation of results obtained with the statistical data analysis for each research question	**6-7 points:** Provided is clear, accurate, and complete presentation of relevant results by project research questions, with some deviations from the APA style.
	5-6 points: Presented are relevant results by project research questions, with some deviations from clarity, completeness, and the APA style.
	4-5 points: Presented are relevant results by project research questions, with some deviations from clarity, accuracy, completeness, and the APA style.
	2-3 points: Some results are irrelevant and/or there are problems with clarity, accuracy, completeness, and APA style.
	0-1 points: Some (or all) results are irrelevant and there are serious problems with clarity, accuracy, completeness, and APA style.
Presentation of tables	**2-3 points:** The tables include all necessary information presented in APA style**.**
	0-1 points: The tables do not include all necessary information and /or there APA style problems.
Presentation of figures	**2-3 points:** The figures are clear and provide relevant information in APA style.
	0-1 points: There are some (or serious) problems with clarity of the figures, their relevance, and/or APA style.
Discussion Section	**max = 14 points**
Conclusions drawn from the results, findings and implications for theory and/or practice	**8 points:** Provided is clear, accurate, and complete presentation of conclusions drawn from the study results, comparisons with findings in previous studies on the topic of interest, plausible explanations of the study findings, and implications for theory and/or practice.
	6-7 points: Provided is clear, accurate, and complete presentation of conclusions drawn from the study results, with minor problems in accuracy and/or sufficiency related to comparisons with findings in previous studies, plausible explanations of the study findings, implications for theory and/or practice, and APA style.
	5-6 points: The conclusions are drawn from the study results, but there are relatively serious problems in accuracy and/or sufficiency related to comparisons

	with findings in previous studies, plausible explanations of the study findings, implications for theory and/or practice, and APA style.
	4-5 points: Some conclusions are not well connected to the study results and there are relatively serious problems in accuracy and/or sufficiency related to comparisons with findings in previous studies, plausible explanations of the study findings, implications for theory and/or practice, and APA style.
	2-3 points: Some conclusions do not stem from the study results and there are serious problems in accuracy and/or sufficiency related to comparisons with findings in previous studies, plausible explanations of the study findings, implications for theory and/or practice, and APA style.
	0-1 points: The conclusions do not stem from the study results and there are serious problems in accuracy and/or sufficiency related to comparisons with findings in previous studies, plausible explanations of the study findings, implications for theory and/or practice, and APA style.
Limitations of the study	**2-3 points:** Provides is clear, accurate, and complete presentation of the limitations of the study, with implications for the study findings and their generalization.
	0-1 points: There are serious problems in clarity, accuracy, and completeness of the study limitations and their implications for the findings and their generalization.
Recommendations for future research	**2-3 points:** The recommendations for future research are clearly presented and stem from logical necessity for meaningful replications (e.g., to validate and/or generalize the findings) and/or further extensions of the study design and analyses.
	0-1 points: The recommendations for future research are *not* clearly presented and do not address the necessity for replications and/or further extensions.