EDP 382K-6: Structural Equation Modeling
Spring 2011 – Unique #: 10515   TTH 11:00 - 12:30   SZB 284

Instructor
Dr. Tiffany Whittaker
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Email: tiffany.whittaker@mail.utexas.edu

Office Hours
Wednesdays 2:30pm - 4:00pm
& by appointment
Office: SZB 538H

Required Course Material

• Selected articles available on Reserve. These articles may be retrieved on ERes (Electronic Reserve): http://reserves.lib.utexas.edu/eres/. (Password: bevo)

• Class notes, available on our Blackboard website in the Course Documents section. Class notes will be posted prior to the day on which the notes are discussed in class and may be retrieved on Blackboard: http://courses.utexas.edu.

Course Overview
Prerequisites for the course include Experimental Design and Statistical Inference or equivalent, Correlation and Regression or equivalent, and Survey of Multivariate Methods or equivalent. This course will build upon students’ knowledge of multivariate statistical analysis by introducing them to one of the newer multivariate techniques – structural equation modeling. This technique encompasses an entire family of methods known by many names, among them covariance structure analysis, latent variable analysis, confirmatory factor analysis, path analysis, and causal modeling. An understanding of structural equation modeling will be developed by relating it to students’ previous knowledge of multiple linear regression and exploratory factor analysis, and expanding to allow for correlated and causally related latent constructs.

This course assumes no prior experience with this technique, and is intended as both a theoretical and practical introduction. The software package Mplus will be used for exploring and confirming support for structural models. The Mplus package is available on the PCs in the SZB 439C. Students interested in purchasing a version of this program for their personal use can order a $195, $240, or $350 (depending upon future types of analyses to be conducted) student discount copy. There is also a free Mplus demo version (with certain limitations) available for download. For more information on the Mplus program, check out http://www.statmodel.com. You can use the order form available at http://www.statmodel.com/acatalog/Student_Pricing.html. Another option to consider is the timesharing system offered by ITS which allows students and faculty access to a number of statistical and mathematical applications, including Mplus, on a server. It costs a minimum of $5 per year for storage if you have a Windows Services Account. To set this up, go to: http://www.utexas.edu/its/products/mplus/.

In general, the course will proceed through the following topics; some will take much longer than others.

• Recursive path analysis
• Confirmatory factor analysis
• Structural equation models
  Developing a theoretically based model
  Constructing a path diagram of causal relationships
  Converting the path diagram into a set of structural and measurement equations
  Estimating the proposed model using EQS
  Assessing the identification of the model equations
  Evaluating the goodness of fit
  Making theoretically justified modifications to the model
• Special types of structural models
  Models over time
  Higher-order construct models
  Multi-group models
  MIMIC models for latent means comparisons
  Structured means models
  Latent variable growth curve models

• Dangers in modeling

**Course Assessment**

1. **Quizzes:** At the start of certain class meetings (tentatively, 2/1, 2/15, 3/1, 3/22, 4/5, 4/19) a short quiz will be administered. Each quiz will cover material from the lessons since the last quiz (unless otherwise specified) and should not take more than 15 minutes. You may use one 8.5”x11”, two-sided page of notes (students will likely be much better prepared if they don’t need to rely on it). **Missed quizzes may not be made up unless arrangements have been made prior to class.** You will be able to drop your lowest quiz grade.

2. **Take-Home Exams:** There will be two comprehensive take-home exams handed out. The exams will contain both multiple-choice and free-response items. Students are on their honor to do the exams completely independently; **students found doing otherwise will be subject to the maximum university penalties.**

Exams are due as specified in class, and should be submitted on time for full earned credit. Late work will be accepted for full earned credit IF AND ONLY IF arrangements are made with me PRIOR TO DUE DATE. Otherwise, 5% of the points possible will be deducted for each weekday the exam is late.

3. **Optional Homework Assignments:** **Optional homework** will be assigned throughout the course in order to give students a chance to apply and practice the concepts learned in class. Some will involve using Mplus software. The optional homework assignments will not be graded, however, the answers will be posted for students to check their own work. While these assignments are not due for a grade, they will help students better prepare for the quizzes and take home exams and master the material.

**Course Grades**

Your quizzes and exams will be averaged according to the percentages (weights) shown below. Grades will be posted to our Blackboard website (under the My Grades section) – please periodically check for any keypunch errors. **Final grades will then be assigned based on the scale below:**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total quiz points converted to a percentage</td>
<td>50%</td>
</tr>
<tr>
<td>Total take home exam points converted to a percentage</td>
<td>50%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overall Course Percent</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>93% - 100%</td>
<td>A</td>
</tr>
<tr>
<td>90% - 92%</td>
<td>A-</td>
</tr>
<tr>
<td>87% - 89%</td>
<td>B+</td>
</tr>
<tr>
<td>83% - 86%</td>
<td>B</td>
</tr>
<tr>
<td>80% - 82%</td>
<td>B-</td>
</tr>
<tr>
<td>77% - 79%</td>
<td>C+</td>
</tr>
<tr>
<td>73% - 76%</td>
<td>C</td>
</tr>
<tr>
<td>70% - 72%</td>
<td>C-</td>
</tr>
<tr>
<td>below 70%</td>
<td>F</td>
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</table>
Unless a computational error has been made, grades will not be changed after the end of the semester.

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

Grades of “Incomplete:” Unless the student can demonstrate that near catastrophic events have led to a case of extreme hardship, grades of “Incomplete” will not be given.

Attendance: Attendance will not be part of your grade. Students who attend class, of course, tend to be better prepared for assignments.

Accommodations For Persons With Disabilities

- If you need accommodations because of a disability, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please inform me immediately. Please see me privately after class or at my office.
- To request academic accommodations (for example, a notetaker), students must also register with Disability Services, Student Services Building, Suite 4.104, (512) 471-6259, VP: (512) 232-2937. It is the campus office responsible for reviewing documentations provided by students requesting academic accommodations, and for accommodations planning in cooperation with students and instructors, as needed and consistent with course requirements.

Calendar

Following are the topics to be covered and the readings that students are expected to be doing, whether or not the material is explicitly addressed in class. Students should keep up with the readings from all sources. Topics and assignment due dates are subject to change, if we don’t move as fast as anticipated.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Lecture</th>
<th>Topic</th>
<th>Kline (conceptual)</th>
<th>Course Articles (applications)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/18; 1/20</td>
<td>Lecture 1</td>
<td>Course Introduction; Review of correlation and multiple regression; Terminology</td>
<td>Ch. 1, 2, 4</td>
<td></td>
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<tr>
<td>1/25; 1/27</td>
<td>Lecture 2</td>
<td>Introduction to path analysis; Effect decomposition</td>
<td>Ch. 5 (pp. 91-112)</td>
<td>Loehlin Howard &amp; Maxwell Bennett et al.</td>
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<tr>
<td>2/1; 2/3</td>
<td>Lecture 3</td>
<td>Quiz 1; Path analysis continued; Introduction to Mplus syntax</td>
<td>Ch. 7, 8</td>
<td>Hu &amp; Bentler Marsh et al.</td>
</tr>
<tr>
<td>2/8; 2/10</td>
<td>Lecture 4</td>
<td>Mplus syntax continued; Model estimation and fit indices</td>
<td>Ch. 5 (pp. 112-117)</td>
<td>Galassi et al.</td>
</tr>
<tr>
<td>2/15; 2/17</td>
<td>Lecture 5</td>
<td>Quiz 2; Model comparison; Introduction to confirmatory factor analysis</td>
<td>Ch. 6 (pp. 137-144)</td>
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<tr>
<td>2/22; 2/24</td>
<td>Lecture 6</td>
<td>More CFA; Construct reliability; Two-factor models; Comparing models</td>
<td>Ch. 9 (pp. 230-251)</td>
<td>Newcomb &amp; Bentler</td>
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<td>3/1; 3/3</td>
<td>Lecture 7</td>
<td>Quiz 3; Modification of models; Structural equation modeling (or “hybrid” models); Models over time</td>
<td>Ch. 5 (pp. 118-121)</td>
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<tr>
<td>3/8; 3/10</td>
<td>Lectures 8 &amp; 9</td>
<td>Full SEM models Take Home Exam 1 Due</td>
<td>Ch. 10</td>
<td>Raykov &amp; Widaman McDonald &amp; Ho Mueller</td>
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### SELECTED ARTICLES FOR THE COURSE – a variety of applied and theoretical papers

- *An excellent introduction into path diagrams and path tracing.*

- *A nice example of path analysis, including the decomposition into direct and indirect effects.*

- *Another nice example of path analysis. Although not as complete as the previous article, it includes results for multiple samples.*

- *Simulation study in which more rigorous cutoff values were recommended when assessing model fit indices.*

- *The title of this article says it all!*

- *A nice example of a confirmatory factor analysis in which the authors used an independent sample to cross-validate their model.*

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<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
<th>Topic</th>
<th>Ch.</th>
<th>References</th>
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</thead>
<tbody>
<tr>
<td>3/15;</td>
<td></td>
<td>Spring Break – No Classes</td>
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<tr>
<td>3/17</td>
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<tr>
<td>3/22;</td>
<td>Lectures 8 &amp; 9</td>
<td>Quiz 4</td>
<td>Ch. 3</td>
<td>Continue full SEM models</td>
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<tr>
<td>3/24</td>
<td>Lecture 10</td>
<td>Categorical data analysis; Higher order</td>
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<td>3/31</td>
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<tr>
<td>4/5;</td>
<td>Lecture 11</td>
<td>Quiz 5</td>
<td>Ch. 9 (pp. 251-261)</td>
<td>Byrne Chapters</td>
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<td>4/7</td>
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<tr>
<td>4/12;</td>
<td>Lectures 12 &amp; 13</td>
<td>Latent means: MIMIC and SMM</td>
<td>Ch. 11 (pp. 299-304; 316-326)</td>
<td>Hancock Gallo et al.</td>
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<td>4/14</td>
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<tr>
<td>4/19;</td>
<td>Lectures 12 &amp; 13</td>
<td>Quiz 6</td>
<td>Ch. 11 (pp. 304-316)</td>
<td>Hancock Gallo et al.</td>
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<td>4/21</td>
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<td>4/26;</td>
<td>Lecture 14</td>
<td>Growth curve models; Multilevel issues</td>
<td>Ch. 12 (pp. 343-354)</td>
<td>Lawrence &amp; Hancock Stoolmiller et al.</td>
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<td>4/28</td>
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<tr>
<td>5/3;</td>
<td>Lecture 14</td>
<td>SEM Cautions; Course evaluation</td>
<td>Ch. 13</td>
<td>Cliff Breckler</td>
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<tr>
<td>5/5</td>
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- A very complex model, but the authors have done a great job explaining the methods and presenting the results. This can be used as a template for writing up results from more complex models.

- A nice review of issues.

- A thorough discussion of current practices in SEM reporting.

- A nice little reminder about some SEM issues that we often lose sight of.

- A nice explanation and several illustrations of multiple group analysis.

- Provides a reasonable theoretical overview of means modeling.

- An application of a MIMIC approach to testing for differences on latent means.

- A didactic piece introducing latent growth models.

- A nice example of using SEM to assess change over time, as well as the factors affecting that change.

- One of the classic criticisms of structural equation modeling. A must for novices and veterans who get too caught up in the “mathemagic” of causal modeling and forget the principles of sound research.

- A good companion article to the Cliff (1983) piece.
Other selected structural equation modeling references you may wish to consult


