

EDP 382K
STRUCTURAL EQUATION MODELING
Summer, 2014

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The class will meet 1:00-3:30 PM Monday, Wednesday, and Friday, in room 284 Sanchez Building.

Overview:

This course will build on your knowledge of multivariate statistical analysis by introducing you to one of the newer and most general multivariate techniques: structural equation modeling. This technique includes an entire family of methods known by many names, among them analysis of covariance structures, latent variable analysis, confirmatory factor analysis, path analysis, causal modeling, and latent growth curve modeling. An understanding of structural equation modeling will be developed by relating it to your previous knowledge of multiple regression, 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. My primary interest is that you develop a *conceptual*, rather than numerical, understanding of the method. To do so, you will need considerable practice conducting SEM analyses and interpreting the results of those analyses. Thus, I strongly urge you to work through the examples provided in the text and at the end of each chapter. I will provide several data sets for you to use in working through problems and assignments, and for your general exploration and enjoyment.

Prerequisites for this class are Experimental Design and Statistical Inference, Correlation and Regression, and Survey of Multivariate Methods (subject to instructor approval).

I will use the Amos software package for estimating structural equation models. (Mplus scripts will be available for some problems, although I will not be teaching using Mplus.) You are free to use any full-featured SEM program. You will also need access to a general statistical analysis program, such as SPSS or SAS. I will use Amos and SPSS for Windows to do class examples. There are several options available for you to get access to Amos and SPSS:

1. You may “rent” Amos 22 (12 month license) for approximately \$50 via on-line download (<http://www.onthefhub.com/spss/>) if you already have a license for the SPSS for Windows “GradPack” (\$98). There may also be copies at the Campus Computer Store. It’s a great deal: a regular version of Amos (with education discount) is \$599. Note that you should buy **SPSS for Windows** even if you use a Mac, because the Amos is a windows-only program. **This is the option I recommend.**
2. If you do not want to purchase Amos you can access the Mplus program and many other statistics programs (but not SPSS) for a nominal fee (\$5/year) through a “windows services account.” See <http://ssc.utexas.edu/consulting/stat-apps-server>. Only a limited number of people can use these “terminal services” at the same time. Mplus is a very powerful SEM program, but is not as easy to use as Amos.
3. You can download a free “student version” of Amos 5.0 from on Blackboard in the folder “Statistics Programs and Resources.” The Amos student version is similar to the current full commercial version of Amos except that the student version is limited to eight observed variables and 54 parameters. This version can be used for approximately the first half of class. The version of Amos I will be using in class (22.0) has a number of improvements and differences compared to version 5.0.
4. You can download & use a free trial version of Amos from IBM: <http://www-03.ibm.com/software/products/en/spss-amos> . I believe this version works for 14 days. Some people have had difficulty installing a paid version after installing the trial version. If you use this option and subsequently purchase the full version of Amos, you should uninstall the student version before installing the full version.

I strongly encourage you to purchase Amos for use in class. Amos only runs in Windows. You will also need SPSS for Windows. If you choose not to purchase Amos we will help you explore other possibilities (some suggested above), but we will not be responsible for ensuring that your choices work.

Textbooks and Other Readings and Materials:

Textbooks:

Arbuckle, J. L. (2011). *IBM SPSS Amos 22 user's guide*. Crawfordville, FL: Amos Development. (available as a pdf file from IBM: http://www-947.ibm.com/support/entry/portal/product/spss/spss_amos?productContext=1761702576).

Keith, T. Z. (2006). *Multiple regression and beyond*. Boston: Allyn & Bacon.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York: Guilford. (Recommended)

SPSS, Inc. The SPSS "Grad Pack" for Windows + Amos (recommended; available at On the Hub and the Campus Computer Store)

Lots of supplemental chapters for the Keith text will also be posted on Blackboard, including extra chapters that will appear in the next edition of the text. Be sure to visit the website for the Kline book for supplemental materials.

Other Readings:

Hancock, G. R. (1997). Structural equation modeling methods of hypothesis testing of latent variable means. *Measurement and Evaluation in Counseling and Development*, 30, 91-105.

Lawrence, F. R., & Hancock, G. R. (1998). Assessing the change over time using latent growth modeling. *Measurement and Evaluation in Counseling and Development*, 30, 211-224.

Steiger, J. H. (2001). Driving fast in reverse: The relationship between software development, theory, and education in structural equation modeling. *Journal of the American Statistical Association*, 96, 331-338

Numerous other readings are posted on the Blackboard site and organized topically.

Other Materials:

I will post Amos output on Blackboard. You should print these out and bring them to class. Mplus input and output will also be available.

The data sets you will need to work the examples in the Keith book are available on Blackboard. The data are saved in a variety of formats (SPSS, Excel, plain text). I may also post additional data on Blackboard.

The Amos author's website has lots of useful info, including video tutorials (<http://www.amosdevelopment.com/index.htm>). This link is listed on our Blackboard website in the "Web Links" section.

IBM's Amos support pages are also worth visiting. As noted, you can get the Amos manual there. See web links in Bb

Requirements:

Exams:

There will be three take-home exams for this class. Many of these exam questions will require you to conduct analyses on the computer. You are on your honor to do the exam completely independently; *anyone found doing otherwise will be subject to the maximum university penalties.*

Exams will be due at beginning (1:00 pm) of the next class. Late work will be accepted for full earned credit IF AND ONLY IF arrangements are made with me PRIOR TO THE DUE DATE. Otherwise, 10% of the points possible will be deducted for each weekday the exam is late.

We will make the exams available to you electronically (Bb). We prefer that you submit them electronically, as well.

The tentative schedule has me giving you the exams on a Friday, due on the following Monday. It may not be possible to stick to that schedule, however, depending on what we accomplish in class.

Assignments:

Assignments and exercises will also be given on a regular basis. Many of the assignments will not be graded, but are very important for your understanding of the material presented in class and in the text. I encourage you to work together on ungraded assignments. All work on graded assignments, however, must be your own.

Reading assignments are listed in the tentative schedule. I also encourage you to bring in articles you encounter that use SEM (or should have used SEM) so that we can discuss those articles in class.

You will fall behind if you do not keep up with the readings and assignments; it is difficult to catch up in this class if you fall behind!

Course Grades:

Your exams and projects will be averaged according to the percentages (weights) shown below.

Assessment	Weight
Exam 1	30%
Exam 2	30%
Exam 3	30%
Graded Homework	10%

Final grades will be assigned based on the scale below:

Overall course percent	Grade
93.0% - 100%	A
90.0% - 92.9%	A-
87.0% - 89.9%	B+
83.0% - 86.9%	B
80.0% - 82.9%	B-
77.0% - 79.9%	C+
70.0% - 76.9%	C
Below 70%	F

Unless I have made a computational error, grades will not be changed after the end of the semester.

Extra Credit:

You can earn 1 extra credit point (on your total final grade) by emailing me and the TA a copy of an article in your field of study that used SEM in the analysis. Ideally, articles should include a correlation matrix and standard deviations of the measured variables in the model.

Incompletes:

Unless you 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 exams and assignments. *Please be on time for class!*

Evaluation of the Course:

At the end of the semester, a formal evaluative questionnaire regarding both the curriculum and my instruction will be administered. The information gathered from this process will be used to improve future courses and instruction. **Additionally, I strongly encourage you to provide feedback to me during the semester either in person or anonymously – I am here to teach you and want to do a good job!**

Disability Services:

The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TTY.

Religious Holidays:

By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

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Tentative Schedule

Class	Date	Topic to be Covered	Assignments (to be completed prior to class)
1	June 6 F	Introduction & overview Plans for the course Review of multiple regression	
2	June 9 M	Introduction to path analysis Causality Path analysis via MR	Keith, chaps 9 & 10; Kline, 1, 5
3	June 11 W	Dangers of path analysis Introduction to Amos	Keith, 11,12; Amos, pp 13-34
4	June 13 F	Path analysis via SEM programs Equivalent models Exam 1	Keith, 12; Amos, example 4;
5	June 16 M	Exam 1 due Measurement error Intro to CFA	Keith, 13, 14; Amos, ex 8
6	June 18 W	More CFA Competing models, hierarchical models	Keith, 14; Kline, 9
7	June 20 F	Introduction to latent variable models	Keith, 15; Amos, ex 5
8	June 23 M	More on latent variable models	Keith, 16; Kline, 10
9	June 25 W	More latent variable models Multi-sample models Estimating means & intercepts	Amos, ex 10, 11, 12; Keith (BB), latent means Kline, 11
10	June 27 F	Mean structures Exam 2	Amos, ex 9, 13-16; Kline, 11
11	June 30 M	Exam 2 due More on mean structures	
12	July 2 W	CFA revisited Invariance	Keith (BB), CFA-2
13	July 3 Th	Latent growth models	Keith (BB), LGM Kline, 11
	July 4 F	Independence Day!	
14	July 7, M	Latent growth models, continued	Keith (BB), LGM Kline, 11
15	July 9 W	Loose ends, cautions, neglected issues? Exam 3	Keith, 17; Kline, 12, 13
	July 11, F	Exam 3 due	