Course	Introduction to Structural Equation Modeling, 3 credits, Fall '16
Professor	Dr. Britain Mills
Meetings	

Dr. Mills' Contact Information

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Office Location	TBD
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Office Hours	Mondays 1:30pm to 3:30pm (or by appointment via email)

Prerequisite

HCS/ACN/PSYC 6313

General Course Information

Course Description

This course will provide students with a general introduction to structural equation models (SEM). Class activities will include critical discussions of readings (including articles from the primary literature and textbook), interactive worked examples with Mplus using simulated data, and a final written and oral project report using their own data or a publicly available data source. The course is intended for students interested in the measurement of psychological constructs, in getting the most out of their measures in their own analyses, and more generally, in how to translate verbal theoretical ideas involving three or more variables into more precise quantitative models that can be fit to data and compared to alternatives.

Learning Objectives

Students will demonstrate:
1. The ability to interpret results from exploratory and confirmatory uses of SEM.
2. An understanding of SEM's relevance to causal inference and knowledge of associated issues and concepts, including mediation, covariate selection, d-separation, colliders, and blocking.
3. The ability to conduct a path decomposition of effects in a mediation analysis.
4. Knowledge of the different degrees of measurement invariance (MI) and the ability to conduct MI analysis for continuous or categorical covariates.
5. The ability to model and test interaction effects in an SEM, including mediated moderation and moderated mediation effects.
6. Knowledge of three different longitudinal forms of SEMs and the types of research questions each is best suited for.

Required Readings & Materials

Kline, Rex (2016). *Principles and practice of structural equation modeling, 4th edition.* New York: Guilford Press.

Primary literature readings will be made available in PDF format on the course eLearning page. Articles and chapters listed for each week will be topics of discussion and should be read prior to class.

Course Schedule

Weeks 1-2. Foundational issues and distinctions.
Topics: The practical distinction between structure and measurement; Pitfalls of the distinction and parallels to the theoretical-observational distinction; Reliability versus validity; Common interpretations of latent variables and their practical implications; Classical test theory; Exploratory vs. confirmatory analysis; Component vs. common factor models; Parsimony and explanatory power; Model specification; Identification.
Readings: Kline: Chapters 1-2. (Supplemental reading: Chapter 3).
 MacCorquodale, K. and Meehl, P.E. (1948). On a distinction between hypothetical constructs and intervening variables. *Psychological Review*, 55, 95-107.
 Pearl, J. (2012). The causal foundations of structural equation modeling. In R.H. Hoyle (Ed.), *Handbook of Structural Equation Modeling.* New York: Guilford Press.

Week 3. Path analysis and mediation
Topics: Path decomposition; Modern approaches to mediation analysis and comparisons with Baron & Kenny's classical approach; Inconsistent mediation patterns; Sobel versus Bootstrapping approaches to estimating the mediation effect; MacKinnon's bias-corrected CI for the indirect effect.
Readings: Kline: Chapters 6-7.
MacKinnon, D. P., Fairchild, A. J., and Fritz, M. S. (2007). Mediation Analysis. *Annual Review of Psychology*, 58, 593-614.

Week 4. Graphical models
Topics: D-separation; Blocking; Colliders; Covariate selection and the back-door criterion; Causality and counter-factuals.
Readings: Kline: Chapter 8.
Pearl, J. (2009). Causal inference in statistics: An overview. *Statistics Surveys*, 3, 96-146.

Weeks 5-6. Diagnostics and model comparisons
Topics: Global fit indices: χ^2, RMSEA, CFI, TLI; χ^2 sensitivity to sample size; χ^2 difference testing; Evaluating local fit with observed-predicted residual covariances; Modification indices and model respecification.
Readings: Kline: Chapters 11-12.
Readings: Tomarken, A.J. and Waller, N.G. (2003). Potential problems with "well fitting" models. *Journal of Abnormal Psychology*, 112(4), 578-598.

Weeks 7-8. Psychometrics
Topics: Classical test theory; Item Response theory; Simple versus complex factor structure; Reflective versus formative models; Exploratory factor analysis; Orthogonal and oblique rotations; Bifactor rotations; Limitations and alternatives to factor scores; Alternatives to maximum likelihood estimation for indicators with non-normal distributions.
Readings: TBD

Weeks 9-10. Psychometrics: Measurement invariance (MI)
Topics: Local independence; Essential unidimensionality; Configural, metric, scalar, residual, and structural invariance; Multi-group approaches to MI for categorical covariates; Multiple-indicator multiple cause (MIMIC) approaches to MI for continuous covariates; Longitudinal MI. Satorra-Bentler scaled χ^2 difference testing for non-normal indicators; the equivalence of bias and multidimensionality; Controlling for measurement bias in structural models.
Readings: Kline: Chapter 16.
Readings: Vanderberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods,* 3,4–70.

Weeks 11-12. Modeling interactions in SEM
Topics: The multi-group approach; The product-term approach; Interactions between latent variables. Moderated-mediation and mediated moderation.
Readings: Fairchild, A.J. & MacKinnon, D.P. (2009). A general model for testing mediation and moderation effects. *Prevention Science*, 10, 87-99.
Others TBD.

Week 13. Longitudinal SEM
Topics: Cross-lagged models; latent growth curve models; latent difference score models; when to use each.
Readings: Selig, J.P. and Preacher, K.J. (2009). Mediation models for longitudinal data in developmental research. *Research in Human Development*, 6, 144–164.
Others TBD.

Week 14. Presentations

Assignments
Weekly reading assignments and class participation
Research report

> The final written research report will be a short APA-style manuscript addressing a substantive research question using a structural equation model with a measurement and structural component. A complete Methods and Results section is required, but students should limit reference to background material in the introduction and discussion. For example, the introduction should contain whatever is necessary to theoretically inform the model specification. Research reports are due by 5pm **on the final day of class** through Turn-it-in on eLearning.

Report presentation

> Each student will present his/her research report to the class during the final two weeks**.** This should be a brief, conference-style presentation of the background literature, research questions, method, analyses, results, and conclusions. Presentations should be limited to 15 minutes.

Grading
Weekly reading assignments and class participation (15% of final grade)
Research report (60% of final grade)
Report presentation (25% of final grade)

Late Work
Late work will only be accepted up to 48 hours after the deadline (includes weekends and holidays). 10% will be deducted for each day the assignment is late.

Class Attendance
In order to learn the concepts and engage in class discussion, students must attend class. Missing 3 classes or more (>20% of the course) will result in an Incomplete (if documentation is available for all absences) or an F.

University Policies

Student Conduct and Discipline	The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD printed publication, *A to Z Guide*, which is provided to all registered students each academic year. The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Series 50000, Board of Regents, The University of Texas System,* and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391) and online at http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.
Academic Integrity	The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work. Scholastic Dishonesty, any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts. Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.
Email Use	The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.
Withdrawal from Class	The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.
Student Grievance	Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures*. In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of

Procedures	academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the deal will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.
Incomplete Grades	As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.
Disability Services	The goal of Disability Services is to provide students with disabilities equal educational opportunities. Disability Services provides students with a documented letter to present to the faculty members to verify that the student has a disability and needs accommodations. This letter should be presented to the instructor in each course at the beginning of the semester and accommodations needed should be discussed at that time. It is the student's responsibility to notify his or her professors of the need for accommodation. If accommodations are granted for testing accommodations, the student should remind the instructor five days before the exam of any testing accommodations that will be needed. Disability Services is located in Room 1.610 in the Student Union. Office hours are Monday – Thursday, 8:30 a.m. to 6:30 p.m., and Friday 8:30 a.m. to 5:00 p.m. You may reach Disability Services at (972) 883-2098. Guidelines for documentation are located on the Disability Services website at http://www.utdallas.edu/disability/documentation/index.html.
Religious Holy Days	The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated. The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment. If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

These descriptions and timelines are subject to change at the discretion of the Professor.