

Psychology 9555A. Structural Equation Modeling (Fall 2018)
COURSE OUTLINE 2018-19

Instructor: Paul F. Tremblay, Ph.D.
email: ptrembla@uwo.ca
phone (office): 519 661-2111 ext 85644
office: SSC 6336
office hours: by appointment

Lectures: Tuesdays 9:00-12:00 (starting Sep 11) Rm SSC 8438/40

I. COURSE DESCRIPTION

My aim in this course is to help you develop a solid conceptual and theoretical understanding and ability to use SEM and its extensions correctly and effectively in your own independent research. Although no prior experience with SEM is required, experience in multiple linear regression, factor analysis, and psychometric principles of reliability and construct validity is required. The course topics include the foundational concepts of the measurement and structural models, confirmatory factor analysis (CFA), traditional path analysis, and basic principles of model building including specification, identification, estimation, hypothesis testing, and modification. Topics also include applications and extensions of SEM such as scale construction and validation, mediation and moderation, multi-group analyses, item response theory, measurement invariance and bias, latent growth modeling and mixture modeling. Students will have the opportunity to work on projects tailored to their research interests and needs. Mplus is the software package used for demonstration in the course, but students are free to use other programs such as R or EQS. Prerequisite: must have taken Psychology 9540 (Research Design) or obtained the permission of the instructor.

II. COURSE READINGS

Textbook:

Brown, T. A. (2015). *Confirmatory Factor Analysis for Applied Research. Second Edition*. New York: Guilford Press.

Key articles (see lecture schedule) will also be used. These will be available in the course OWL site.

III. METHOD OF EVALUATION

60%: Six lab assignments. Six assignments will be distributed throughout the course to help you gain hands-on experience with SEM analysis. These assignments will consist of running analyses, interpreting results, and writing short (one to two page) reports.

40%: Individual project. You will be required to conduct analyses for an individual project. This project will be divided into two parts: (1) an evaluation of the measurement model (similar to a confirmatory factor analysis) and an evaluation of the complete model including measurement and structural components. For the complete SEM model, you will be required to include one of the following: (1) a mediation analysis (2) a moderation (interaction) analysis, (3) a multi-group analysis, (4) a longitudinal analysis, or (5) another SEM application approved by the instructor. You will need to use a real (or simulated) data set, develop hypotheses/research questions, conduct the SEM and related analyses, interpret the results and write a report of the results and your interpretations and conclusions. You will have the choice between:

1. using a large data set that I can provide
2. providing one yourself (approved by the instructor)
3. creating a simulation data set as part of a research proposal (I will explain this option).

Note that you will need to have your topic no later than Oct 9. You will need to provide a brief report of the first part (the measurement/confirmatory analysis component) by Nov 6th (worth 20%) and the complete research report (written as an APA research article but with greater emphasis on the Results and Discussion sections) with syntax and output in an Appendix by Dec 11 (one week after the last class) (worth another 20%).

Late work. Please inform me ahead of time if you anticipate not meeting a deadline for a legitimate reason. Otherwise, there is a 5% deduction per day for a late assignment (including the project).

IV. STATEMENT OF ACADEMIC OFFENCES

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

V. LECTURE SCHEDULE

Sep 11. Introduction and overview

Brown (ch 1). Introduction

Schreiber, J. B., Stage, F. K., King, J., Nora, A., Barlow, E. A. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research*, 99(6), 323-337. doi: <http://dx.doi.org/10.3200/JOER.99.6.323-338>

Weston, R. & Gore Jr, P. A. (2006). A brief guide to structural equation modeling. *The Counseling Psychologist*, 34, 719-751. doi: 10.1177/0011000006286345

Sep 18. Building blocks: Multiple regression and factor analysis

Brown (ch 2). The common factor model and exploratory factor analysis model.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, 4, 272-299. doi: 10.1037//1082-989X.4.3.272

Supplementary resources

Wendorf, C. A. (2004). Primer on multiple regression coding: Common forms and the additional case of repeated contrasts. *Understanding Statistics*, 3, 47-57. doi:10.1207/s15328031us0301_3

Peng, C.-Y.J., & So T.-S. H. (2002). Logistic regression analysis and reporting: A primer. *Understanding Statistics*, 1, 31-70. doi: 10.1207/S15328031US0101_04

Sep 25. Introduction to CFA – part I

Brown (ch. 3). Introduction to CFA

Oct 2. Introduction to CFA – part II

Brown (ch. 4). Specification and interpretation of CFA models

Oct 9. CFA: Measurement and test construction

Brown (ch. 5). Model revision and comparison

Brown (ch 6.) CFA of multitrait-multimethod matrices (skim)

Supplementary resources

DeVellis, R. F. (2006). Classical test theory. *Medical Care*, 44, S50 S59.
<http://www.jstor.org/stable/41219505>

Clark, L. A., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment, 7*, 309-319. doi: 10.1037/1040-3590.7.3.309

Smith, G. T. (2005). On construct validity: Issues of method and measurement. *Psychological Assessment, 17*, 396-408. doi: 10.1037/1040-3590.17.4.396

Asparouhov, T., & Muthen, B. (2009). Exploratory structural equation modeling. *Structural Equation Modeling, 16*, 397-438. doi: 10.1080/10705510903008204

Marsh, H. W., Morin, A. J. S., Parker, P. D., & Kaur, G. (2014). Exploratory structural equation modeling: An integration of the best features of exploratory and confirmatory factor analysis. *Annual Review of Clinical Psychology*. Downloaded from www.annualreviews.org. doi: 10.1146/annurev-clinpsy-032813-153700

Oct 16. CFA: Extensions I: Invariance, Means

Brown (ch. 7). CFA with equality constraints, multiple groups, and mean structures

Wu, A. D., & Zumbo, B. D. (2007). Decoding the meaning of factorial invariance and updating the practice of multi-group confirmatory factor analysis: A demonstration with TIMSS data. *Practical Assessment, Research & Evaluation, 12*(3). Available online: <http://pareonline.net/getvn.asp?v=12&n=3>

Oct 23. CFA Extensions II: Higher-order models, bi-factor models, formative measurement, and categorical Data

Brown (ch. 8). Other types of CFA models

Brown (ch. 9). Data issues in CFA: Missing, non-normal, and categorical data

Supplementary resources

Flora, D. B., & Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychological Methods, 9*, 466-491. doi: 10.1037/1082-989X.9.4.466

Morin, A. J. S., Arens, A. K., & Marsh, H. W. (2016). A bifactor exploratory structural equation modeling framework for the identification of distinct sources of construct-relevant psychometric multidimensionality. *Structural Equation Modeling, 23*, 116-139. doi: 10.1080/10705511.2014.961800

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016). Evaluating bifactor models: Calculating and interpreting statistical indices. *Psychological Methods, 21*, 137-150. <http://dx.doi.org/10.1037/met0000045>

Bollen, K. A., & Bauldry, S. (2011). Three Cs in measurement models: Causal indicators, composite indicators, and covariates. *Psychological Methods, 16*, 265-284. DOI: 10.1037/a0024448

Oct 30. SEM Models: Mediation

Hayes, A. F., & Rockwood, N. J., (2016). Regression based statistical mediation and moderation analysis in clinical research: Observations, recommendations and implementation. *Behaviour Research and Therapy, 1-19*. <http://dx.doi.org/10.1016/j.brat.2016.11.001>

Lau, R. S., & Cheung, G. W. (2012). Estimating and comparing specific mediation effects in complex latent variables models. *Organizational Research Methods, 15*, 3-16. doi: 10.1177/1094428110391673

Hayes, A. F., & Preacher, K. J. (2014). Statistical mediation analysis with a multicategorical independent variable. *British Journal of Mathematical and Statistical Psychology, 67(3)*, 451-470. doi:10.1111/bmsp.12028

Nov 6. SEM Models including interactions (moderation)

Klein, A. G., & Muthén, B. O. (2007). Quasi-maximum likelihood estimation of structural equation models with multiple interaction and quadratic effects. *Multivariate Behavioral Research, 42(4)*, 647-673. doi:10.1080/00273170701710205

Maslowsky, J., Jager, J., & Hemken, D. (2015). Estimating and interpreting latent variable interactions: A tutorial for applying the latent moderated structural equations method. *International Journal of Behavioural Development, 39*, 87-96. doi: 10.1177/0165025414552301

Nov 13. Latent growth/curve modeling

Curran, P. J., & Hussong, A. M. (2003). The use of latent trajectory models in psychopathology research. *Journal of Abnormal Psychology, 112*, 526-544. doi: 10.1037/0021-843X.112.4.526

Nov 20. Multilevel CFA and SEM

Dyer, N. G., Hanges, P. J., & Hall, R. J. (2005). Applying multilevel confirmatory factor analysis techniques to the study of leadership. *The Leadership Quarterly, 16*, 149-167. doi:10.1016/j.leaqua.2004.09.009

Nov 27. Monte Carlo simulation of power

Brown (ch. 10). Statistical power and sample size (focus on Monte Carlo section)

Mplus manual ch. 12 (Monte Carlo Simulation Studies)

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. *Structural Equation Modeling, 9*, 599-620.

Dec 4. Mixture modeling: Latent Class/Profile Analysis and Growth Mixture Modeling

- Lee, C.-T., Leoutsakos, J.-M., Lyketsos, C. G., Steffens, D. C., Breitner, J. C. S., & Norton, M. C. (2012). Latent class-derived subgroups of depressive symptoms in a community sample of older adults: the Cache County Study. *International Journal of Geriatric Psychiatry, 27*, 1061-1069. doi: 10.1002/gps.2824
- Pastor, D. A., Barron, K. E., Miller, B. J., & Davis, S. L. (2007). A latent profile analysis of college students' achievement goal orientation. *Contemporary Educational Psychology, 32*, 8-47. doi:10.1016/j.cedpsych.2006.10.003

Additional Resources

- Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. *Journal of School Psychology, 48*, 5-37. doi:10.1016/j.jsp.2009.10.001
- Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60*, 549-576. doi: 10.1146/annurev.psych.58.110405.085530
- Muthén, L.K. and Muthén, B.O. (1998-2018). *Mplus User's Guide. Eighth Edition*. Los Angeles, CA: Muthén & Muthén. Available at: www.statmodel.com
- Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2). <https://www.jstatsoft.org/issue/view/v048>
- Manuals/guides are also available for other programs such as AMOS, EQS, or R. See me for further details.
- N2Mplus. This is an application that is extremely useful for converting SPSS and EXCEL data files into the data format for Mplus. The download is available at: <http://www.danielsoper.com/n2mplus/>