Universitat Pompeu Fabra Barcelona

Structural Equation Modeling

Duration: 12 hours/3 days

July 13-15	09:00-13:00

Course Description

Structural equation modeling (SEM) is a very general statistical technique, as it has regression analysis (and therefore t tests, ANOVA, and correlation analyses), path analysis, and factor analysis as special cases. It is also possible to combine the advantages of these techniques, which makes SEM one of the most general and most flexible techniques available to researchers. As a result, SEM presently is also one the most widely used techniques in the social and behavioral sciences.

This course will introduce you to the fundamentals of SEM by first translating univariate regression models into mean and covariance structure (MACS) analyses. The first day will also show you how path analysis is more general than the general(ized) linear model and better able to facilitate testing hypotheses about mediation. The second day will introduce measurement models for latent variables (factor analysis) and show how a "full SEM" consists of both measurement and structural components (i.e., factor and path models). Day 3 will cover tactics for evaluating data–model correspondence.

Software

All instruction and example syntax will utilize the latest version of the statistical software environment R, as well as the latest versions of add-on packages lavaan and semTools. Students are encouraged to reproduce analyses using the example data provided, as well as using their own data whenever possible. Exercises will be used to provide opportunities for practical questions that arise during applications.

Prerequisites

Besides familiarity and some experience with R, students are expected to be familiar with the fundamental statistical concepts (e.g., descriptive and inferential statistics, null hypothesis significance testing) as well as the general(ized) linear model (GLM) and its special cases: regression, t tests, ANOVA, and correlation. Familiarity with basic psychometrics (classical test theory, reliability, and validity) are helpful, especially for the portion of the course involving latent variables. Given the frequency with which SEMs are communicated using matrices (even in applied literature), some familiarity with basic matrix algebra is advantageous but not strictly necessary.

Course Content: Schedule

Day 1:

9:00–10:00 Introduction to lavaan: Mean and Covariance Structures 10:00–10:15 Break
10:15–11:00 Exercises: SEM approach to regression, t tests, AN(C)OVA
11:00–12:00 Path analysis, indirect effects (mediation)
12:00–12:15 Break
12:15–13:00 Exercises: Path analysis

Day 2:

9:00–10:00 Confirmatory factor analysis (CFA)
10:00–10:15 Break
10:15–11:00 Exercises: CFA
11:00–12:00 Structural regression with latent variables
12:00–12:15 Break
12:15–13:00 Exercises: Full SEM

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Day 3:

9:00–10:00 Testing hypotheses implied by a SEM: A trilogy of tests 10:00–10:15 Break
10:15–11:00 Exercises: Model comparison
11:00–12:00 Global and local indices of approximate data–model fit
12:00–12:15 Break
12:15–13:00 Exercises: Honest evaluation of model fit

References and Recommended Reading

Foundational texts about general(ized) linear modeling and hypothesis testing:

• Judd, C. M., McClelland, G. H., & Ryan, C. S. (2017). Data analysis: A model comparison approach to regression, ANOVA, and beyond (3rd ed.). New York, NY: Routledge. ISBN-13: 9781138819832
• Fox, J. (2016). Applied regression analysis and generalized linear models (3rd ed.) Los Angeles, CA: Sage.

Introductory and advanced SEM texts:

• Beaujean, A. A. (2014). Latent variable modeling using R: A step-by-step guide. Routledge.
• Bollen, K. A. (1989). Structural equations with latent variables. Wiley.
• Loehlin, J. C., & Beaujean, A. A. (2016). Latent variable models: An introduction to factor, path, and structural equation analysis. Taylor & Francis.
• Hoyle, R. H. (Ed.). (2012). Handbook of structural equation modeling. Guilford.

Reporting SEM results:

• Boomsma, A. (2000). Reporting analyses of covariance structures. Structural Equation Modeling, 7(3), 461–483. https://doi.org/10.1207/S15328007SEM0703_6 McDonald, R. P. & Ho, M. R. (2002). Principles and practice in reporting structural equation analyses. Psychological Methods, 7(1), 64–82. https://psycnet.apa.org/doi/10.1037/1082- 989X.7.1.64