

## Psychology 319: Structural Equation Modeling

Professor: David A. Cole  
Class time: 11:10 – 12:25 WF

Office: Hobbs 315b  
Phone: 3-8712  
Email: david.cole@vanderbilt.edu

### Texts:

John C. Loehlin (1998) Latent variable models: An introduction to factor, path, and structural analysis (3<sup>rd</sup> ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Karl Joreskog & Dag Sorbom (1993). LISREL 8 User's Reference Guide. Chicago: Scientific Software, International.

### Overview:

This course introduces the basic principles of path analysis, confirmatory factor analysis, and latent variable structural modeling, which constitute a powerful set of statistical tools for examining correlational, observational, and even experimental data in the social sciences. Computer techniques for conducting these analyses will also be taught, LISREL in particular. Prerequisites include Introductory graduate statistic and Multiple regression. Some familiarity with multivariate statistics (especially factor analysis), a working understanding of matrix algebra, and prior experience with Windows based PCs are desirable but not necessary, as these skills will be reviewed in this class. Evaluation will be based upon tests, homework, take-home data sets, and class participation.

I. Models of causation and threats to causal inference (January 8 – January 24). The first part of the class deals with the philosophical and empirical bases underlying causal inference. We review different concepts of causation. We discuss path diagrams and the rules of path analysis (using both observed and unobserved variables) that correspond to the different models of causation. We review threats to our ability to make causal inferences and come to understand these threats in terms of path diagrams.

### Readings:

- Loehlin, chapter 1
- Kenny (1979). *Correlation and causality* (pp. 1-12 ).
- Handout on covariance algebra
- Bollen and Lennox (1991). *Psychological Bulletin*, 110, 305-314.
- Cook and Campbell (1979). *Quasi-experimental designs* (pp. 59-70).
- Start reviewing the matrix algebra chapter or Appendix A in Loehlin (you'll be scrambling later if you don't start now)

Homework: Problems 1-13 at end of Loehlin, chapter 1.

II. Introducing LISREL (Jan. 29 – Feb. 26). This portion of the course introduces the LISREL program. Some class sessions deal with the notation that LISREL uses in path analysis; other sessions focus on the mechanics of running a LISREL program. Still others involve the maximum likelihood method of parameter estimation and a review of goodness-of-fit indices. We frequently attempt to translate back and forth between the LISREL programming language and the underlying matrix algebra.

Readings:

- Become adept at using Chapter 2 in the *LISREL 8 User's Reference Guide* to assist in programming
- Loehlin, chapter 2
- Browne and Cudeck (1989). *Multivariate Behavioral Research*, 24, 445-455.
- Numerous handouts
- Hu & Bentler (1999). Structural Equation Modeling
- Marsh, Balla, & Hau (1996). Chapter 11 in *Advanced Structural Equation Modeling* (Marcoulides & Schumacker, Eds.)
- Optional: Tanaka's chapter in Bollen & Long (1993, pp. 10-39).

Homework:

- Label path diagram, write linear equations, write matrices (handout)
- Run LISREL program on the Schaeffer et al. data set.
- Problems 2, 4, 5, 6, 7, and 10 at end of chapter 2 in Loehlin

III. Confirmatory factor analysis (Feb. 28 – Mar 26). This section begins with an examination of the rationale for considering more than one factor at a time (and more than one variable at a time). After working through the mechanics of using LISREL to test more complex confirmatory factor analytic models, we explore methods to address important issues about theory and measurement. Such issues include testing the equivalence of different measures of the same construct, obtaining disattenuated estimates of the relation between two or more constructs, testing for discriminant validity, and estimating convergent validity in the context of multitrait-multimethod designs.

Reading:

- Loehlin, pp.80-99
- Chapter 3 in the *LISREL 8 User's Reference Guide*
- Cole (1987). *Journal of Consulting and Clinical Psychology*, 55, 584-594.
- Widaman (1985). *Applied Psychological Measurement*, 9, 11-26.
- Kenny & Kashy (1992). *Psychological Bulletin*, 112, 165-172.
- Maybe other readings, too.

Homework:

- Take home data set on equivalence
- Take home MTMM data set

IV. Structural equation modeling and longitudinal designs (March 28 – April 16). We will start this section with a discussion of mediational models, the dangers inherent in traditional path analysis, and the advantages of latent variable path analysis. We will spend some time reviewing procedures for testing models with reciprocal causal relations in cross-sectional designs. However, more time will be spent on the application of LISREL to longitudinal data sets designed to assess the stability of constructs and the relative strengths of putative causal relations.

Reading:

- Loehlin, pp. 99-120
- Chapter 5 in the *LISREL 8 User's Reference Guide*
- Baron & Kenny (1986). *Journal of Personality and Social Psychology*, 51, 1173-1182).
- Scarr (1985). *American Psychologist*, 40, 499-512.
- Kenny & Zautra (1995). *Journal of Consulting and Clinical Psychology*, 63, 52-59.
- Kenny & Judd (1984). *Psychological Bulletin*, 96, 201-210.
- Maybe other readings, too.

Homework:

- Take home data set on mediational models
- Take home data set on multi-wave longitudinal models