MKT 791--Research II
Spring '95

SESSION 8

Let's Get Structural . . . Structural . . .

READINGS

Anderson, James C. and David W. Gerbing (1988), "Structural Equation Modeling in Practice: A Preview and Recommended Two-Step Approach," ***Psychological Bulletin***, 103 (3), 411-423.

Hair, Joseph F., Jr., Rolph E. Anderson, Ronald L. Tatham, and William C. Black (1995), ***Multivariate Data Analysis with Readings***, 4th ed., Englewood Cliffs, NJ: Prentice-Hall.

- ♦ Chapter 11: Structural Equation Modeling

Hatcher, Larry (1994), *A Step-by-Step Approach to Using the SAS System for Factor Analysis and Structural Equation Modeling*, Cary, NC: The SAS Institute.

- ♦ Review Chapter 4: Path Analysis with Manifest Variables

- ♦ Chapter 6: Path Analysis with Latent Variables

Breckler, Steven J. (1990), "Applications of Covariance Structure Modeling in Psychology: Cause for Concern?" ***Psychological Bulletin***, 107 (2), 260-273.

Optional but Highly Recommended

Bollen, Kenneth A. (1989)--Chapter 8--"The General Model, Part I: Latent Variable and Measurement Models Combined" from ***Structural Equations with Latent Variable***, New York: Wiley.

YOUR TURN

Part 1

Remember the augmented CFA you did last week? (By augmented I mean that you probably included some additional constructs.) How do you expect these constructs to relate a priori?

Draw a path diagram that illustrates your hypothesized relations. (NOTE: I suggest you keep your model simple.)

Run a full covariance structure analysis that tests these relations. Is your theory supported? Modify the model if necessary to improve fit. Theory should guide any changes.

Are your hypotheses supported? Why? Why not? Bring these analyses to class.

Part 2

Select three observed variables such that each represents a different construct in your analysis. Calculate the variances and covariances for these three variables as implied by your model's parameter estimates. Calculate the residual.

Part 3

Prepare a written summary of your analysis (**Due: Wednesday, March 27**). Write this as though it is intended for submission to a national conference. Report both your CFA and structural models. Include these sections: *Overview*, *Method*, *Results*, and *Discussion*. Make sure you state clearly your a priori model and describe any modifications made to arrive at your "final" model. (I'll assume the model can be justified by your theory.) I encourage you to examine published journal articles to see how others have reported such analyses. .

A FULL COVARIANCE STRUCTURE ANALYSIS WITH PROC CALIS:
An Annotated Example

Structural relations between constructs (latent or observed) are specified by equations added to the in the LINEQS section. Place structural equations immediately after the equations that specify the measurement models. Below I modify the control lines for the CFA to specify F1 as a predictor of F2.

```
PROC CALIS COV RESIDUAL;
        VAR VAR1-VAR6;
LINEQS
 VAR1=L1 F1+E1,
 VAR2=L2 F1+E2,
 VAR3=L3 F1+E3,

 VAR4=   F2+E4,
 VAR5=L5 F2+E5,
 VAR6=L6 F2+E6,

 F2=B1 F1+D1;
STD
 E1-E6=TE1-TE6, F1=1, D1=VARD1;
COV
 E1 E4=COVERROR;
```

<--Note a factor loading is estimated for each of F1's indicators. The variance of F1 is fixed to 1 in the STD section, below. F1 is the *exogenous* variable in this analysis.

<--The scale of F2, the *endogenous* latent construct in this analysis, is set by fixing a factor loading to one (1). The scale of all **endogenous** latent constructs **must** be set this way.

<--This equation tells the program to estimate the effect of **F1** on **F2**. **B1** tells the program to estimate the effect (regression coefficient) of **F2** on **F1**. Name these regression coefficients anything (eight characters or less) you want; there is no mandatory prefix.

The equation ends with **D1**. **D**-terms specify the disturbance (residual) component of a *structural* equation. **D** (like **F** and **E**) is a **mandatory prefix**. Put anything you want after the **D**.

<--Two changes here:
(1) The variance of **F2** (the endogenous construct) is *not* estimated. The **D**-term accomplishes this.
(2) **D1=VARD1** tells the program to estimate the error term.

<--I removed the covariance between **F1** and **F2** and inserted instead this statement that tells the program to estimate the covariance between two errors of measurement. NEVER CORRELATE ERROR TERMS UNLESS YOU CAN EXPLAIN THE SUBSTANTANTIVE MEANING OF SUCH A COVARIANCE!

Modelling convention dictates that you permit all *exogenous* constructs to covary.