Structural Equation Modeling

Definition

A statistical technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions

SEM vs.

- Very similar procedure EXCEPT
- Structural equation modeling assesses a hypothesized model
  - All proposed paths tested simultaneously (reduces Type I error)
  - Assesses how well the model fits the data you have

Important Notes

- Your model should follow a theoretical basis; SEM is rarely exploratory
- You are usually going to leave some paths out (based on theory)
  - Discarded paths are assumed to be non-significant
  - **Fully recursive model** = all possible paths are included

of Analysis

- Similar to mediation analysis EXCEPT
  - You will have a different dependent variable in each analysis
  - You will not use "Blocks"
- Preliminary analysis in SPSS to check the significance of paths
- Follow-up analysis in AMOS or LISREL to check the fit of the model and magnitude of indirect effects (Drs. Palmer or Gore can help)

Steps in SEM Estimation:

- Draw out your model
- Specify your paths (what you expect will be related)
- Determine how many of the following you have:
  - Predictor variables (far left)
  - Outcome variables (far right)
  - Intermediate variables (in between)
  - Note: You may have several intermediate variables in the sequence (e.g., 2nd, 3rd, 4th, then the outcome)

Steps in SEM Estimation:

- Conduct a linear regression analysis with:
  - All predictors as the independent variables
  - All intermediate variables as the dependents
  - You will have as many tests as you have intermediate variables
  - Note the standardized β's and R^2's for each analysis
  - Write these numbers on the model
  - Note which additional paths may be significant

Steps in SEM Estimation:

- Conduct a linear regression analysis with:
  - All predictors and first group of intermediate variables as the independent variables
  - The second group of intermediate variables as the dependents
  - Again, you will have as many tests as you have intermediate variables
  - Note the standardized β's and R^2's for each analysis
  - Write these numbers on the model
  - Repeat this step if you have several groups of intermediate variables

Steps in SEM Estimation:

- Conduct a linear regression analysis with:
  - All predictors and all intermediate variables as the independent variables
  - The outcome variables as the dependents
  - You will have as many tests as you have outcome variables
  - Note the standardized β's and R^2's for each analysis
  - Write these numbers on the model

- Keep in mind which paths you didn't specify in the model were significant
- Remember that you need to report how well the proposed model fits the data
- Fit indices examine the covariance matrix of your data set and determines
  - How many paths you estimated
  - How much all variables are related to each other
  - A model that fits the best is one that uses the least amount of paths and all paths are significant

and Cut-Offs

- Cut-off criteria proposed by Hu and Bentler
- Chi-square (must report)
  - Cut-off: non-significant ($p > .10$)
  - Problem: large sample sizes lower p-values
- Goodness of Fit Index (GFI)
  - Cut-off: GFI > .90
- Root Mean Square Error of Approximation (RMSEA)
  - Cut-off: RMSEA < .06
- Comparative Fit Index (CFI)
  - Cut-off: CFI > .95
- LISREL gives you all of these indices

What Happens If You Get _____?

- Consider a simpler model
- Consider adding paths
- LISREL provides "Modification Indices" which flag the paths you may want to add

Additional Versions of SEM

- Longitudinal Model Estimation (we'll discuss next time)
- _____
  - Tests the fit of a model that proposes grouping of items onto factors
- _____
  - Combination of CFA and SEM
  - Only true variance used in the model
- _____
  - Testing the model between two or more groups
  - Look for moderated paths in the model
- _____
  - Examines change over time as linear, quadratic, etc.
  - More accurate version of Trend Analysis