1 Objectives

To understand the fundamental concepts in latent variable modeling in order to make you a better consumer and producer of latent variable models in your research.

To understand how to evaluate the quality of models when applied to data by understanding various sources of variability of goodness of fit tests.

To learn how to apply these concepts to real data sets using a variety of standard statistical packages (e.g., R, Mx, EQS, Lisrel, Prelis, Amos)

2 Text, readings, and requirements

2.1 Text


2.2 Readings

Multiple web based readings including, but not limited to the ones listed in the references. This list will be added to throughout the quarter.

Syllabus and handouts available at http:personality-project.org/revelle/syllabi/454/454.syllabus.pdf

2.3 Requirements

Some basic knowledge of psychometric theory (to be reviewed in week 1). This course is a natural sequel to Psychology 405: Psychometric Theory. Some of the web readings will be taken from the 405 syllabus.

Familiarity with matrix algebra (to be reviewed in week 1)
Willingness to use computer packages that allow for structural equation modeling. These can either be downloaded to your computer (e.g., the open source packages R, and Mx), run on the Social Science Computer Cluster (e.g., Lisrel or Prelis), or ones that you have a license for (e.g., EQS?)

Willingness to ask questions and add to the class discussion.

### 2.4 Evaluation

Homework assignments will be given weekly. These are your benefit and will be graded on a completed, not completed basis.

Students will be expected to write a short paper demonstrating the use of structural equation techniques applied to their particular research interests. They will also be asked to present their use of latent variable models in short (15-30 minute) presentations in the last few weeks of the course.

This is a hands on course. You will be expected to try the various programs on simulated and real data sets.

### 3 Outline (to be added to frequently – keep checking)

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<th>Lecture Notes</th>
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<td>Review</td>
<td>Loehlin Chapter 1</td>
<td>Correlation and Regression, Matrix Algebra, Introduction to R, Using the SSCLC, inverse of a matrix.</td>
<td>Problem set 1, Exercises from Loehlin 1-12 (page 32-34)</td>
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<td>5</td>
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<td>EFA/CFA continued, items vs continuous measures, more on skew, change. and more on change</td>
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<td>6</td>
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<td>How to define a model, analysis and critique, R and LISREL models, types of variables, types of models</td>
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### 4 Detailed Notes

#### 4.1 Week 1

Introduction to latent variables (405 in a week).

Review of Correlation, regression, and classical reliability theory. See also Chapter 4 on Correlation and regression as well as Chapter 5 on multiple correlation and regression.

Review of matrix algebra (Appendix A)
4.2 Week 2

Application of matrix algebra to pattern and structure. Exploratory factor analysis as a basic latent variable model. Finding the inverse of a matrix.

4.3 Week 3

Structural models and goodness of fit tests. Barrett (2007), Examples with simulated data.

How to simulate structural data. This has been revised with a correction for two factor simulations and with a more extensive analysis of the effects of sample size on estimating parameters in the two factor model.

Using basic sem programs to find structure and apply goodness of fit tests. Using the *sem* (Fox et al., 2012) and *lavaan* (Rosseel, 2012) packages.

4.4 Week 4

Analysis of hierarchical factor models using hierarchical and bifactor solutions. The lecture notes for week 4 are here and prior notes are prior year notes.

4.5 Week 5

Exploratory and confirmatory factor analysis, continued. The lecture notes for week 5 are here.

Considering issues of using items rather than continuous measures. items vs continuous measures. Unfortunately, items have serious problems with skew.

One of the most powerful applications of sem is the analysis of change.

4.6 Week 6

Comparing three examples from the literature: a short example (Erdle et al., 2009) of how not to report factor analysis, a sem paper which which actually fails to identify the model correctly (Erdle et al., 2010) and another (Marsh et al., 2010) which systematically compares models. This last one includes a good discussion of how to do measurement invariance.

4.7 Weeks 7-9

*lavaan* uses many examples from the MPlus manual (http://www.statmodel.com/ugexcerpts.shtml. See in particular the example data sets at http://www.statmodel.com/usersguide/chapter5.shtml. The notes describing *lavaan* output for these examples are available here.

Comparing sem in R and LISREL (Jöreskog and Sörbom, 1999). Consideration of goodness of fit tests (Barratt et al., 2007) (Click on Issue 5 in the left had column). R and LISREL lecture notes

4.8 R advice

The R tutorial gives a short introduction to the use of R.

- (Macs and PCs) For this, or any other package to work, you must activate it by either using the Package Manager or the “library” command:
  - type library(psych)
  - If loading the psych package works, function such as ”describe” and ”pairs.panels” should work (or at least give an error message that is NOT ”could not find function”).
  - entering ?psych will give a list of the functions available in the psych package.

4.9 Using the Social Science Computer Cluster

1. Get an account and then to log in as a remote user.
2. Log on to the system using SSH (see the “how to” for doing this)
3. upload the appropriate batch command file using a sftp connection.
4. Issue a batch command (e.g., lisrel8 infile outfile)
5. sftp the outfile back to your desktop
6. repeat (3-5) until satisfied

References


