Psychology 405: Psychometric Theory

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1 Outline (to be added to frequently – keep checking)

This is the abbreviated form of the syllabus, The full syllabus is at https://personality-project.org/courses/405/405.syllabus.pdf

Current version of May 28, 2024

1.1 News of changes

Will appear here when I make them.

April 10: Updated the More on correlations slides.

May 15: Updated the sem vs. cfa slides. Updated psych Current date is packageDate("psych") [1] "2024-05-14"

May 28: Updated psych Current date is packageDate("psych") "2024-05-26" Note that this is version 2.4.5 and needs to be downloaded from the personality server to work.

The review session on Wednesday will be held by zoom at 847-491-7700,
1.2 Assignments as a table

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This table and the entire syllabus is being converted from HTML to \LaTeX. The original version is here

2 Detailed Notes

2.1 Week 1

Introduction to latent variables (405 in a week).

Review of Correlation and Regression and classical reliability theory (Revelle and Condon, 2018a,b). See also Chapter 4 on Correlation and regression as well as Chapter 5 on multiple correlation and regression.

Review of linear/matrix algebra (Appendix E)

What is a latent variable? Some opposing viewpoints (Bartholomew et al., 2009; Loevinger, 1957; Markon and Jonas, 2016; Jonas and Markon, 2016)

2.2 Week 2

Application of matrix algebra to pattern and structure. Chapter 6: Exploratory factor analysis as a basic latent variable model. Finding the inverse of a matrix. For a review of factor analysis, see https://personality-project.org/courses/405/405-efa.pdf.

2.3 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., 2013) and *lavaan* (Rosseel, 2012) packages.

### 2.4 Week 4

Perhaps the fundamental issue of latent variable analysis is why use latent variables. The classic development of latent variable analysis was (Spearman, 1904) with the development of what has come to be called “Exploratory Factor Analysis”. While a useful descriptive technique to describe the “common” part of variables, EFA can be made a testable technique using “Confirmatory Factor Analysis” which is the root of most SEM packages. See EFA/CFA for an overview of PCA, EFA, and then the basics of CFA. EFA/CFA – psych, sem and lavaan.

The problem of hierarchical representations of data. Many people claim a “general factor” of personality in analogy to the ‘g’ factor of ability. This has been disputed (Revelle and Wilt, 2013). See also A general factor of personality? talk given at an “Experts Meeting” on personality structure. Also see 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.

### 2.5 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.

### 2.6 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.

### 2.7 Week 7

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

### 2.8 Week 8

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 hand column). *R* and LISREL lecture notes

For a very good discussion of latent change estimation in R see Ghisletta and McArdle,( 2014 ) (Ghisletta and McArdle, 2012). Also see the lecture notes from Yves Rosseel Modeling change with lavaan

For an example of modeling change in cognitive ability and depression to examine the temporal sequencing of the effects, look at Aichele et al. (2018).

An excellent set of lecture notes on testing for invariance comes from Tutorial on measurement invariance Kate Xu.

### 2.9 Week 10

Course review
2.10 Software


2.11 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.

References


