Psychology 613: Multivariate Statistics (Data Analysis III)
Problem Set 3

The following problem set is due at **5pm** on **THURSDAY, April 28th**, via Canvas.

The document that you turn in should consist of a write-up (including screenshots of relevant output) and selected bits of relevant code ***embedded in the write-up*** (i.e., as part of each problem and not in a separate section or document). Questions that ask you to interpret results of analyses should be phrased in terms that are substantively meaningful. For example, instead of saying something like "the predictor was significant," you should phrase interpretations in terms of the measured constructs, e.g., "aggression was significantly positively related to alcohol use."

Component analysis (*Choose **one** of the following three Problems to complete*)

The following problems use the dataset **03. Problem1.RData** from the webpage. It contains responses to the 19-item BIS/BAS scale from 341 subjects.

1. Run a components analysis on all 19 items. Be sure to generate the reproduced correlation matrix (i.e., the 19 × 19 matrix of correlations among the items computed based on the components). Use principal components extraction to extract any factors with an eigenvalue greater than 1, and *varimax* orthogonal rotation. How many components emerge, and how much variance do they explain all together? Are there any residual correlations (i.e., the difference between observed and reproduced) that are large (e.g., >0.2)? Do they tend to cluster on one or the other component? Based on the component loadings in the rotated solution, label each of the components.

2. Re-run the components analysis but this time allowing for a non-orthogonal (i.e., oblique) rotation of the components using *promax*. Does the amount of variance that is explained change? How about the residuals? Or the interpretability of the components? What is the correlation between the components now?

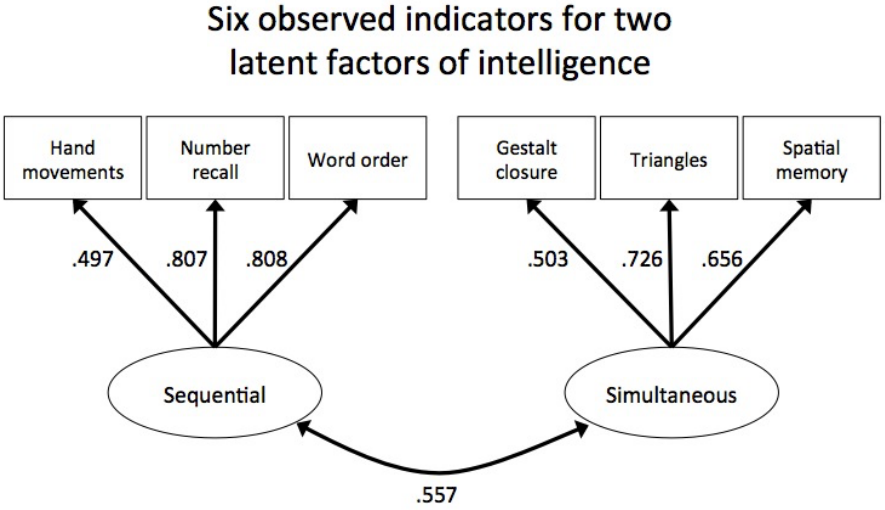
3. Suppose I only wanted to reduce this scale to 2 subscales. Force R to extract exactly 2 components and rotate them obliquely using *promax*. How much total variance is explained by these two components? What is the correlation between the two components? In your opinion, should the solution be orthogonal or oblique? What would you label the components? Include a plot of the components.

Factor analysis (*complete Problem 4; Problem 5 is **optional**)*

A researcher hypothesizes that fluid intelligence is composed of two underlying factors: Sequential processing and Simultaneous processing. She collected 3 measures of the first and 5 measures of the second, using 200 participants (see the variable "covMat" in PS3_Prob4.RData).

4. Using R, run a basic CFA model whereby "sequential" is indicated by the first three items ("handmov", "numbrec", and "wordord") and "simultaneous" is indicated by the

last five items ("gesclos", "triangle", "spatmem", "matanalg", and "photser"). Report all the path weights (with SEs), the covariance between the factors, and (any) one fit index.



5. a. The figure above shows a partial model using only 6 of the indicators. It shows the *direct paths* between factors and indicators (which make up the *pattern matrix*), use the product-of-paths tracing procedure to calculate the *indirect paths* from each indicator to the opposite factor. (For example, the expected correlation between "Hand movements" and the "Simultaneous" factor is .497*.557 = .277.) These indirect (AKA mediated) paths are part of the *structure matrix*. Write out the 6x2 structure matrix showing the total expected relationship between the (2) factors and each of the (6) indicators.

   b. Following the same path-tracing logic as in Problem 5a, write down the *reproduced correlation matrix* (which should be 6x6). Compare it to the *observed correlation matrix* below to calculate the residual correlation matrix. Are there pairs of items that stand out? If so, what steps might be taken to reduce the size of these residuals?

Observed correlation matrix	Hand movements	Number recall	Word order	Gestalt closure	Triangles	Spatial memory
Hand movements	1	.39	.35	.21	.32	.40
Number recall		1	.67	.11	.27	.29
Word order			1	.16	.29	.28
Gestalt closure				1	.38	.30
Triangles					1	.47
Spatial memory						1