# PSYC*6380: Minor Assignment 6 (Exploratory Factor Analyses)

*Due: Monday, March 7<sup>th</sup>, 2022 @ 11:59pm*

## Part 1:

**Background:**

After hearing about our model-themed examples today, a researcher became interested in measuring a construct that seems to come up a lot in discussion with model-types: specifically, what the heck it means to be "fierce". To answer this question, the researcher developed a 10-item taxonomy of potentially "fierce" characteristics; and then, as part of a pilot test, had 120 participants rate how much they associated each of those characteristics with an individual's "fierceness". The 10 characteristics the researcher used are presented below:

*1 – Strong*

*2 – Uncompromising*

*3 – Poised*

*4 – Brave*

*5 – Unapologetic*

*6 – Stylish*

*7 – Cool*

*8 – Doesn't Give Up*

*9 – Dapper*

*10 – Snazzy*

All characteristics were rated on a five-point, Likert-type scale (1 = "*Not Particularly Fierce*", 5 = "*Quintessentially Fierce!*"). Your task for today is to load a data file containing participants' responses to the measure, and assess the factor structure of "fierceness" using a principal components analysis.

**Filename**: "*efaAssignmentData.csv*"

**Structure**: Comma-separated values

**Missing Data Code(s)**: N/A (no values are missing in this file)

**Your Task:**

Use the techniques we covered in today's class (and draw on material from our first class on using *R* to load and clean data) to run a principal components analysis on the measure, using constraints and rotations where indicated.

Once you've done this, please answer the following questions about the results. Unless otherwise indicated, you do not need to provide full-sentence answers; just the numbers the questions request are fine:

1. Please run an (un-rotated and unconstrained) principal components analysis on the "fierceness" taxonomy. How many factors do these ratings appear load onto, based on Kaiser's recommendations? **(0.5 marks).** To help answer this question, please report the Eigenvalues for each of the factors that would be considered "empirically meaningful". **(0.5 marks)**.

2. To help visualize your results, please also create a scree plot of the Eigenvalues you derived from the principal components analysis in q1. Save this plot as either and image or a .pdf document; and include it with your submission.  **(1 mark)**.

   *Hint*. The "*ggsave*" function does not appear to work with this type of plot (likely because it wasn't created using the "*ggplot2*" functions). To save it, click on the "*Export*" button (in the menu bar located just above the plot window in *R* Studio).

3. Please re-run the same principal components analysis; but this time, constrain the maximum number of factors to match the number you empirically identified as being meaningful in q1. What is the communality for 'Item 1' in this measure? **(0.5 marks).** What does this value represent, conceptually? Please be as exacting as possible in your interpretation. **(0.5 marks)**.

4. Try rotating the factor model in your principal components analysis using a "*Varimax*" rotation (continue constraining the maximum number of factors used in q3). Please list the factor that each of the 10 items load most strongly onto. **(1 mark)**.

5. After sorting the items onto their respective factors in q4, can you identify what each factor appears to represent, conceptually? Based on the results of your rotated principal components analysis, what do these factors seem to be measuring? **(1 mark)**.

**Part 2:**

**Background:**

To help the researcher better understand how principal components analyses and exploratory factor analyses work, please answer the following conceptual questions in a short answer (i.e., 1-2 sentences) format:

1.  The slides for today's class suggested that factors have some conceptual overlap with true scores (as defined by Classical Test Theory). How is this the case? What does a factor conceptually represent; and how does it compare to a true score? **(1 mark).**

2.  Imagine that you were presented with the following factor loadings:
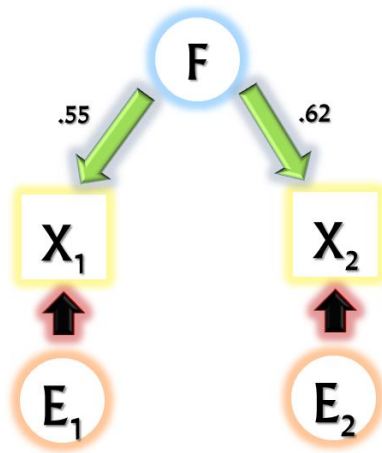


    a. What is the communality of $X_1$? **(0.25 marks).**
    b. What is the communality of $X_2$? **(0.25 marks).**
    c. What is the $r_{error}$ of $X_1$? **(0.25 marks).**
    d. What is the correlation between $X_1$ and $X_2$? **(0.25 marks).**

3.  The slides for today's class warned us that factor analyses can use circular logic if you look at them from a purely exploratory perspective. How is this the case? Why is it important to avoid being "purely exploratory" when we're analyzing factor structures? **(1 mark).**

Please provide your full *R* script with your submission and leave comments in your script (i.e., using "#") explaining what each command you wrote does. **(1 mark for including a full script; 1 mark for including appropriate commenting).**

**Good Luck!**