Homework 3
Psychology 313

Instructions. Answer the following questions. Show your R code, your input, and your output. Feel free to email me for hints or post a question on Piazza if you get stumped.

1. (30 points). Given the following matrices

$$\mathbf{A} = \begin{bmatrix} 1 & 4 & 9 \\ 0 & 6 & 7 \\ 3 & 3 & 8 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 1 & 3 & 13 \\ 2 & 2 & 4 \\ 3 & 1 & 7 \end{bmatrix}, \mathbf{C} = \begin{bmatrix} 6 & 7 & 5 \\ 6 & 8 & 6 \\ 15 & 19 & 11 \end{bmatrix}$$

Using R, compute:

   (a) $\mathbf{A} + \mathbf{B}$

   (b) $\mathbf{C}\mathbf{C}'$

   (c) $\mathbf{A} - \mathbf{C}$

   (d) $\mathrm{Tr}(\mathbf{A}\mathbf{A}')$

   (e) $\mathrm{Tr}(\mathbf{A}'\mathbf{C})$

   (f) $\mathbf{A}^{-1}$

2. (15 points). Given the data matrix $\mathbf{X}$ below.

$$\mathbf{X} = \begin{bmatrix} 5 & 1 & 5 \\ 4 & 1 & 5 \\ 3 & 3 & 6 \\ 2 & 4 & 3 \\ 1 & 2 & 5 \end{bmatrix}$$

Produce a matrix $\mathbf{B}$ which, when pre-multiplied by $\mathbf{X}$ to yield $\mathbf{Y} = \mathbf{X}\mathbf{B}$, will accomplish the following 3 objectives, and also demonstrate with R that your solutions work.

   (a) Create a 3-column matrix that is identical to $\mathbf{X}$, except with the columns in reverse order.

   (b) Create a 4-column matrix with the first 3 columns being those of $\mathbf{X}$, and the 4th column being the sum of the 3 columns in $\mathbf{X}$.

(c) Create a single column that is the arithmetic average of the columns of **X**.

3. (10 points). (Review from Chapter 02.) Imagine that you were involved in a large research project as the consulting statisticician. As part of the analysis, you fit a simple linear regression model to a data set with $n = 2087$, and included a 90% confidence interval around the regression line, superimposed on as scatterplot graph together with the regression line itself. An article describing the project was submitted for publication and rejected because a referee found your analysis suspicious. Specifically, the referee noted that "it appears that the vast majority of the points plotted on the scatterplot fall outside the supposed 90% confidence interval shown in red on the plot. I fear that there is a serious error in the analysis."

In a brief paragraph, give me your rejoinder to the referee, explaining why there is no error in your graph.

4. (45 points) Do ALR4, Problem 3.3.