PSYC 5143
Spring 2024
Problem Set #1

These are due on Monday, January 29 by 2pm via Blackboard, preferably as a single R file. Ask for help before frustration sets in. #9 is unrelated to #1 through #8.

Imagine you are interested in examining the relationship between drinking and dart-playing ability. To test this, you recruit 100 drinkers at a bar in town while they play a game of Cricket (a link to explain the game). For each drinker, their BAC is recorded (in %; in Arkansas, 0.08% is the legal limit for driving) and their Cricket scores is as well (**lower** scores indicate **better** performance). The data are in darts.csv. The variables are BAC and Darts, along with an ID variable.

1) Create a scatterplot with BAC on the x-axis and Darts on the y-axis, with a LOESS curve fit to it (ask for help if needed!). Does there appear to be a non-monotonic relationship between BAC and Cricket performance? Answer *yes* or *no* and then try to describe the relationship in the plainest language you can.
2) Center the BAC predictor and fit a linear model with Darts as the outcome. Interpret both the intercept and the slope parameter estimates. Significance is not important here.
3) What is *SSE* for the linear model? (Please do this the easy way by using something like `modelSummary()`.)
4) Now add a quadratic term to the model and fit it. (You can do this either by squaring the centered BAC variable and using it as an additional predictor or by using the `I()` function in R.) Interpret the intercept and the slopes of both the centered BAC predictor and its squared version. Again, significance is not important.
5) What is *SSE* for the quadratic model? (Again, please do this the easy way.)
6) Calculate *PRE* using the *SSE* values for the linear and quadratic models in #3 and #5 and convert it to *F*. Compare this *F* value to the *t* value (or *F*, depending on how you did things) for the quadratic term in the model in #4. Are they the same?
7) Generate a graph that illustrates both the linear and quadratic fit. (The script from class on January 24 has a template for how to do this, on lines 49-53.)
8) Briefly interpret the results of the models in #3 and #4 in the plainest language you can.

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9) Participants complete a measure of stress and complete a difficult task, with performance being measured on a scale from 1 (poor) to 7 (good). A researcher estimates the quadratic regression equation below, predicting participants' performance from mean-centered stress levels. The mean stress level was 4.

$$\widehat{performance} = 5 - 0.4 \times stress.c - 0.2 \times stress.c^2$$

   a. What does each parameter estimate tell you (precisely)?
   b. What is the predicted performance of someone whose stress level is 3?
   c. What is the simple/point slope of the stress-performance relationship for someone whose stress level is 5?