

Homework 3

Due: Thursday 2/20/20 by 8:30am

This homework assignment focuses on material covered in Chapter 1 of the textbook.

1. Suppose Instagram magically knew that every time the number of times user i purchases a product, denoted by Y_i , is related to the number of times the product has been advertised to user i , denoted by X_i , as follows:

$$Y_i = 1 + 2X_i + \epsilon_i$$

where ϵ_i is a *normal* random error term with mean $E\{\epsilon_i\} = 0$ and variance $\sigma^2\{\epsilon_i\} = 0.1$; ϵ_i and ϵ_j are uncorrelated so that their covariance is zero (i.e., $\sigma\{\epsilon_i, \epsilon_j\} = 0$ for all $i \neq j$) for $i = 1, \dots, n$.

- (a) Using **R**, make a plot with three panels. You can make a single plot with three panels by typing `par(mfrow = c(1, 3))` before running any lines of code that create plots. Plot the density of the errors ϵ_i for $X_i = 0$, $X_i = 1$, and $X_i = 10$, using a separate panel for each value of X_i . Ensure that the axes are the same across all three plots.
 - (b) Based on the assumed model and the information provided, can we conclude that the number of times user i purchases a product Y_i is independent of the number of times user j purchases a product Y_j ?
 - (c) Based on the assumed model and the information provided, can we state the exact probability that a single value Y_i will be greater than 4 given that $X_i = 1$?
 - (d) Simulate $n = 100$ observations from the model, with $X_i = i$. Using **R**, make a scatter plot of the data and overlay the regression function on the scatterplot.
 - (e) Repeat (d), but instead of assuming that $\sigma^2\{\epsilon_i\} = 0.1$, assume that $\sigma^2\{\epsilon_i\} = 10$. In at most one sentence, describe how increasing $\sigma^2\{\epsilon_i\}$ changes how the regression function relates to the scatter plot.
2. Problem 1.27 from the **.pdf** version of the textbook. Requires use of the **muscle** data that has been posted on the Homework page.
 3. Problem 1.34 from the **.pdf** version of the textbook.
 4. Problem 1.42 from the **.pdf** version of the textbook.
 5. Integrative Experience Step 2, as described in **ieproject.pdf** on the Project page.