Homework 5

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Instructions

Submit your assignment at the **beginning** of class on **Weds Mar 13**. Please make sure that the pages of your homework assignment are in the correct order and securely stapled together. You may (but are not required to) work in groups of up to four students. Each group should hand in one copy of the homework.

Grading

A small number of problems will be graded for correctness, and the remainder graded for completeness. A complete response answers the question posed and also shows your work. This means showing the steps of a mathematical calculation, or including R output that justifies your conclusions. For questions that are not just calculations (e.g., more than computing an expected value from a table) you should answer in complete, concise sentences. Detailed solutions will be available – you should always check your work against these solutions.

1. (28 points) Suppose we are modeling house price as depending on house size. Price is measured in thousands of dollars and size is measured in thousands of square feet.

   Suppose our model is:

   $$P = 20 + 50\,s + \epsilon, \;\; \epsilon \sim N(0, 15^2).$$

   (a) (4 points) Given you know that a house has size $s = 1.6$, give a 95% predictive interval for the price of the house.

   (b) (4 points) Given you know that a house has size $s = 2.2$, give a 95% predictive interval for the price.

   (c) (4 points) In our model the slope is 50. What are the units of this number?

   (d) (4 points) What are the units of the intercept 20?

   (e) (4 points) What are the units of the the error standard deviation 15?

(f) (4 points) Suppose we change the units of price to dollars and the units of size to square feet
What would be the new values and units of the intercept, slope, and error standard deviation?

(g) (4 points) If we plug $s = 1.6$ (i.e. set size = 1.6), P is a constant plus the normal random variables ϵ. Given $s = 1.6$, what is the distribution of P?

2. (54 points)

Read the case "Waite First Securities" in the course packet.

The data for this case are available from the course website, and you can read them into R using the code below.

```
library(readr)
# This is a shortcut to download data directly from the course website.
# To work offline, download the file to a folder on your computer
# and edit the path variable to point to that folder. Or you
# can use RStudio's import tool like in the tutorials in HW 0
path = "https://jaredsmurray.github.io/sta371g_f17/data/"
waite = read_csv(paste0(path, 'waite.csv'))
```

Consider the regression model

$$TI_t = \alpha + \beta SP500_t$$

where TI_t represents the return on Texas Instruments in month t and $SP500_t$ represents the return on the S&P 500 in month t.

(a) (9 points) If the returns on the SP500 are 0%, what are the predicted returns on TI? If the returns on the SP500 are 1%, what are the predicted returns on TI? If the returns on the SP500 are -1%, what are the predicted returns on TI? What is the interpretation of β in terms of a measure of risk of the stock?

(b) (8 points) Plot TI against $SP500$. What graphical evidence is there of a relationship between TI and $SP500$? Does the relationship appear to be linear? Why or why not?

(c) (10 points) Estimate β. What is the interpretation of this estimate in terms of the risk of the stock? Why is Mr. Gagnon interested in this estimate?

(d) (5 points) Is the estimate of β you obtained above the actual value of β? Why or why not?

(e) (7 points) Give a 95% confidence interval for β. From the evidence at hand, can we conlcude that TI is more risky than the market? Why or why not?

(f) (15 points) Now consider the regression models

$$Hilton_t = \alpha + \beta SP500_t + \epsilon_t \quad \epsilon_t \sim N(0, \sigma^2)$$

where $Hilton_t$ represents the return on Hilton in month t, and

$$Giant_t = \alpha + \beta SP500_t + \epsilon_t \quad \epsilon_t \sim N(0, \sigma^2)$$

where $Giant_t$ represents the return on Giant in month t.

How does the estimated beta risk of the three companies compare? (for this problem you need only to compare the point estimates of β). If Mr. Gagnon wants to lower the overall market risk of his portfolio should he buy Giant, Hilton or Texas Instruments?

Data on the returns for these companies is included in the `waite` dataset; use the `head` command to see the first few rows:

```
head(waite)
```