Guided Thought Questions

MATH 322: Mathematical Statistics II Learning Module 5: Linear Regression

All textbooks are written at two cognitive levels. The surface level is the literal information provided in the book. The deeper level is the connections between the topics. Textbooks are excellent at the surface level, rarely good at the deeper level. To help with the deeper levels, I am providing several questions for each section of the textbook.

You should take time to answer these questions after reading the section. Answer them in your notes. Make sure that you are able to confidently answer them. In fact, you should feel pressure to ask these questions in class if you cannot answer them.

Readings: Sections 8.1 to 8.7

§1: Introduction

1. Why is this method called "regression"?

§2: The Simple Linear Regression Model

- 1. What does "simple" mean in "simple linear regression"?
- 2. Can a quadratic relationship be properly fit using linear regression?
- 3. Why is the method called "least squares" regression?
- 4. What are the requirements for ordinary least squares regression?
- 5. What point is guaranteed to be on the least squares regression line?
- 6. The r² value is the ratio of what two variance estimates?
- 7. Why is "unbiased" a good property of estimators? Why is "minimum variance" also a good property of estimators?
- 8. What are the requirements for the OLS line to be BLUE?
- 9. Why does the formula for the unbiased estimator of σ^2 make total sense?
- 10. What is the difference between UMVUE and BLUE?

§3: Inferences on the Least-Squares Estimator

- 1. Why does this section remind us of the confidence interval chapter and the p-value chapter?
- 2. What is the difference between the t-test and the F-test in regression?

§4: Predicting a Particular Value of Y

- 1. What are the assumptions of OLS regression?
- 2. What is the difference between a confidence interval and a prediction interval?
- 3. Where does the 1 come from in the prediction interval formula?

§5: Correlation Analysis

- 1. What requirement of OLS regression does correlation analysis relax?
- 2. Why is the Fisher z-transform important?

§6: Matrix Notation for Linear Regression

- 1. Does using matrices make the mathematics easier or harder?
- 2. What does the column of 1s indicate in the design matrix?
- 3. Under the assumptions of OLS, what does X^TE equal?

§7: Regression Diagnostics

- 1. What are the requirements of OLS regression?
- 2. How is each requirement graphically checked?
- 3. How does knowing the appropriate graphic help with creating an appropriate test?