**Fundamental Econometric Concepts**

The following concepts are at the heart of econometrics. I strongly encourage you to write up your answers to these questions in a format that you can refer to throughout this course. I will not provide answers to these questions. You will need to turn this in and continue to resubmit revisions until all of the answers are correct.

**If you did not cover a topic in 561, do not answer the question yet.**

1. **Basic Assumptions for the OLS Estimator**
2. What is an estimator? Why is an estimator a random variable? What does it mean that it has a distribution?
3. What does it mean for an estimator to be unbiased? Consistent? Efficient? BLUE?
4. What is the formula for the OLS estimator? Give the formula for the OLS estimator using summation notation for a single independent variable and using matrix notation for multiple independent variables. Give some intuition for the formulas.
5. What is the formula for the standard error of the OLS estimator? Give this in both summation notation and matrix notation. Explain the intuition for this formula.
6. What are the Gauss-Markov assumptions that must be satisfied for the OLS estimator to be BLUE?
7. Under what violations will the OLS estimator be biased?
8. Under what violations will the OLS estimator be inefficient?
9. Which of the GM assumptions can be tested directly?
10. The distribution of the OLS estimator depends on a number of factors. Describe the distribution of the OLS estimator $\hat{β}$—that is, is the distribution of $\hat{β} $normal? t? What is it’s mean? What is it’s variance?
11. The errors are known to be distributed normally. The variance of the errors is known.
12. The errors are known to be distributed normally. The variance of the errors is unknown.
13. The distribution of the errors is not known, but there is a large sample size.
14. The distribution of the errors is not known, and the sample size is small.
15. **Violations and Complications:**

For II.1-II.7, Explain

1. Does this problem violate one of the GM assumptions? If so, which?
2. Does this problem bias the *coefficient estimates* or the *standard errors*? **Is what direction is the bias?** (If there are specific conditions that need to be satisfied to sign the bias, state these.)
3. How would you determine whether this problem was present in your data? If there are specific tests for this problem that YOU HAVE ALREADY STUDIED, list them.
4. If there is a solution for this problem that YOU HAVE ALREADY STUDIED, describe it.
5. Multicollinearity (discuss both perfect multicollinearity and imperfect multicollinearity)
6. Omitted variables
7. Included irrelevant variables
8. Measurement error in X [Do not submit this if you have not covered it.]
9. Measurement error in Y [Do not submit this if you have not covered it.]
10. Heteroskedasticity [Do not submit this if you have not covered it.]
11. Autocorrelation [Do not submit this if you have not covered it.]
12. **Hypothesis testing:**
13. What types of conclusions are made about a hypothesis (reject, fail to reject, accept, fail to accept, etc)?
14. What is a Type I error? What is a Type II error?
15. Given an example of 2 different hypotheses you could test using a t-statistic. How is the test statistic constructed in each? How is it distributed (what is the relevant distribution/degrees of freedom)? How is the test statistic used to form conclusions about the hypothesis? That is, the test statistic is calculated to be some number—say, 3.2. How do you use that number to form conclusions about your hypothesis?
16. Given an example of 2 different hypotheses you could test using an F-statistic. How is the test statistic constructed in each? How is it distributed (what is the relevant distribution/degrees of freedom)? How is the test statistic used to form conclusions about the hypothesis? That is, the test statistic is calculated to be some number—say, 3.2. How do you use that number to form conclusions about your hypothesis?