Mega HW #2
ECNS 561 (Fall 2018)
Due: 10/9/2018

1.) Work the following problems from Wooldridge Appendix C (pgs. 752-754):

C1, C2, C5, C9, C10

2.) Let Y be a Bernoulli random variable with success probability P(Y = 1) = p, and let Y_1, …, Y_n be i.i.d. draws from this distribution. Let $\hat{p}$ be the fraction of successes in this sample.

a.) Show that $\hat{p} = \bar{Y}$.
b.) Show that $\hat{p}$ is an unbiased estimator of p
c.) Solve for var($\hat{p}$)

3.) In a survey of 400 likely voters, 215 responded that they would vote for the incumbent and 185 responded that they would vote for the challenger. Let p denote the fraction of all likely voters who preferred the incumbent at the time of the survey, and let $\hat{p}$ be the fraction of survey respondents who preferred the incumbent.

a.) Use the survey to estimate p.
b.) Use the estimator of the variance of $\hat{p}$ (you solved for this in part c of problem 2) to calculate the standard error of your estimator
c.) What is the p-value for the test H_0: p = 0.5 vs. H_1: p ≠ 0.5?
d.) What is the p-value for the test H_0: p = 0.5 vs. H_1: p > 0.5?
e.) Did the survey contain statistically significant evidence that the incumbent was ahead of the challenger at the time of the survey? Explain.
f.) Construct a 95% CI for p.
g.) Can we test the hypothesis H_0: p = 0.5 vs. H_1: p ≠ 0.5 at the 5% level by only referring to your answer in part f?

4.) Consider the following estimator

$$\tilde{Y} = (\frac{1}{n})(\frac{1}{2}Y_1 + \frac{3}{2}Y_2 + \frac{1}{2}Y_3 + \frac{3}{2}Y_4 + \cdots + \frac{1}{2}Y_{n-1} + \frac{3}{2}Y_n)$$

a.) Show that E[$\tilde{Y}$] = μ
b.) Show that var[$\tilde{Y}$] = $1.25\sigma^2/n$

5.) In sampling from a normal distribution, the most frequently used estimator for σ^2 is

$$S^2 = (\frac{1}{n-1}) \sum_{i=1}^{n} (X_i - \bar{X})^2$$

a.) Show that this estimator is an unbiased estimator for σ^2.
b.) Show that this estimator is a consistent estimator for σ^2.

STATA Problem

For this problem, use the Kansas Crime Data Set that is available on the course webpage. In class, we were interested in testing the following null hypothesis

$$H_0: C_i = \text{Crime\_1986}_i - \text{Crime\_1988}_i = 0$$

in order to determine if the average rate of violent crime changed after the electorate in KS voted to end prohibition on "open saloons." Recall, we were able to reject the null at the 10% level and the evidence suggested that crime was actually lower in 1988 than in 1986. In what follows, we want to dig into this problem a little bit more in order to address whether the change in crime was really related to the law change.

a.) We know that crime rates are determined by many different community-level factors, not just alcohol availability. For example, Gould et al. (2002) showed that crime rates share an inverse relationship with local labor market opportunities. Using your data set on KS and the unemployment variable, what can we say about how local labor market opportunities were changing over this time span? Does your answer support the notion that allowing by-the-drink liquor sales decreased violent crime? You are required to turn in your STATA do file for this answer. For practice, do not use the ttest command in STATA...construct any confidence intervals, t-stats, etc. "by hand" in your do file.

b.) Some have argued that personal income data are more appropriate for analyzing local economic conditions than unemployment rate data. Per capita personal income data are available on-line from the Bureau of Economic Analysis (www.bea.gov). Collect these data and merge them with the KS_Crime_Data data set (you will need to familiarize yourself with the "merge" command in STATA). Redo part a.) by examining how real income per capita changes from 1986 to 1988. Is your inference similar when using this variable as opposed to the unemployment rate? You are required to turn in your STATA do file for this answer. You may use the ttest command in STATA if you wish for this problem

c.) Perhaps the change in violent crime in the 36 counties that legalized by-the-drink alcohol sales were simply part of a general overall trend that existed throughout Kansas. To investigate this issue, calculate a simple difference-in-difference estimate and test whether this estimate is statistically different from zero. That is, compare the difference in violent crime from 1986 to 1988 in the treated counties (i.e., counties that legalized on-premises alcohol consumption) to the difference in violent crime over this same period in a set of control counties (i.e., counties that did not legalize on-premises alcohol consumption). What does this estimate imply for a potential causal relationship between allowing by-the-drink alcohol sales and violent crime? You are required to turn in your STATA do file for this answer. You may use the ttest command in STATA if you wish for this problem [Note: To this point, we have used a one-sample t-test. Here, you will have to use a two-sample t-test because we are comparing means across two different samples (i.e. treated vs. control counties). This can easily be implemented in STATA.]

References

Gould, Eric, David Mustard, and Bruce Weinberg. 2002. "Crime Rates and Local Labor Market Opportunities in the United States: 1979-1997." *Review of Economics and Statistics* 84: 45-61.