Math 338  **Lab Assignment #9**  Fall 2019

[Tan *et al.* (2018)](https://link.springer.com/article/10.3758/s13420-018-0353-y) were interested in how pet dogs bond with complete strangers. In one of their studies, they placed a food treat under one of two cups (the dog did not know which bowl had the food) and had a stranger point the dog toward the cup with the food. Although the researchers did many trials to see how trust evolved, one of the results they analyzed was whether dogs would pick up the cue from the stranger on the very first trial. A total of 53 dogs were tested.

Recall from Lab #8 that under the following conditions:

H0: p = 0.5

H1: p = 0.7

α = 0.05

n = 53

our binomial test had a power of 0.9138. In this lab we will explore the effect of changing the sample size, effect size, and α value on power.

Open up your saved R Script from Lab 8. Copy the lines assigning the values to n, p0, and α:

**> n <- 53 # the sample size**

**> p0 <- 0.5 # the value of p if the null hypothesis is correct**

**> alpha <- 0.05 # the conventional maximum value of alpha**

Also, copy the command to find the critical region for this hypothesis test:

**> qbinom(alpha, size = n, prob = p0, lower.tail = FALSE) # FALSE because we are looking in the upper tail of the distribution**

And the code to compute the power given the critical region:

**> crit.value <- 33 # the endpoint of the critical region**

**> p1 <- 0.7 # the value of p if the alternative hypothesis is correct**

**> power <- pbinom(crit.value, size = n, prob = p1, lower.tail = FALSE) + dbinom(crit.value, size = n, prob = p1)**

First, run the code again to make sure you still have a power of 0.9138. Next, we will explore changing the value of *p* under H1. Because this change does not affect the sampling distribution under H0, we have the same critical region, so we only need to change the value of p1 and run that line and the line after it.

**Question #1** What is the power under the *new* alternative H1: p = 0.6?

**Question #2** What is the power under the *new* alternative H1: p = 0.8?

**Question #3** How does the power change as the alternative value of *p* gets further from the null value of 0.5?

Now we will explore the effect of changing the desired maximum α-value. Although this change does not affect the sampling distribution under H0, it *does* affect the critical region. First, go into the script and reset the value of **p1** to 0.7. Then, change the value of **alpha**. Finally, re-run *just* the part of the script that finds the critical region.

**Question #4** What is the critical region for α = 0.01? Is it a larger or smaller critical region compared to α = 0.05?

**Question #5** Change **crit.value** to the endpoint of the new critical region (from **Question #4**). Then, run that line and the lines below it to compute power. What is the new power?

**Question #6** Repeat the steps using α = 0.10. What is the power of the test at this new α value?

**Question #7** How does the power change as the probability of Type I Error increases? Why do you suspect it changes in that direction?

Finally, we will explore the effect of changing the sample size *n*. This change affects the sampling distribution under both H0 and H1. First, reset **alpha** to 0.05. Then, change **n** to 30. Finally, re-run *just* the part of the script that finds the critical region.

**Question #8** What is the critical region for *n* = 30?

**Question #9** Change **crit.value** to the endpoint of the new critical region (from **Question #8**). Then, run that line and the lines below it to compute power. What is the new power?

**Question #10** Repeat the steps using *n* = 100. What is the power of the test using this new sample size?

**Question #11** How does the power change as sample size increases? Why do you suspect it changes in that direction? (Hint: think about the critical regions in terms of sample proportions!)