Math 338 **Lab Assignment #8** Fall 2019

Tan *et al.* (2018) 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.

Question #1 Assuming that the tested dogs were independent (i.e., the dogs did not communicate anything to each other), check the other three assumptions of a binomial setting.

B: If the dog picks the cup that has food in
I: This is already assumed
N: 53
S: 0.5

Question #2 What is the sample size in this study?

Our sample size would be 53

Question #3 What is the parameter p about which we would like to make inference?

The proportion of dogs that could pick up a cup with food and without food.

According to the researchers, if dogs do not trust strangers, they would be just as likely to pick the “correct” bowl as the “incorrect” bowl. Let’s make this our “nothing unexpected is happening” condition.

Question #4 What is the value of the parameter p under the null hypothesis?

The value of parameter p is 0.5 because they could either trust the stranger or not trust the stranger.

Question #5 What type of “test statistic” can we compute from sample data in the binomial setting? What type of sampling distribution does it have, and what are the parameters of that distribution under our null hypothesis?

Using the binomial setting we can calculate the number of successes.
The test statistic is the number of dogs who pick up the food.
Under the Null Hypothesis, we have a binomial distribution

Now we will use R to set up the distribution of our test statistic under the null hypothesis. Open up a new script and assign the following variables:

```
> n <- # the sample size from question 3
> p0 <- # the value of p if the null hypothesis is correct
```

Suppose that under our “something unexpected is happening” condition, where dogs *do* trust strangers, a “practically significant” value of p is assumed to be 0.7.

Assign the appropriate variable in the R script:

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

Since the value under H_1 is higher than the value under H_0, we will look in the upper tail of the distribution for our critical region.

Question #6 According to convention, what is our desired maximum probability of committing a Type I Error?

The desired probability is 0.01 of committing a Type 1 Error because we want a small value

Again, assign the appropriate variable in the R script:

```
> alpha <- # the conventional maximum value of alpha
```

Finally, we use our binomial probability calculator:

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

Question #7 If you did everything right, you will get an output of **32**. Does this correspond to a critical region of $X \geq 32$ or a critical region of $X > 32$ (or, equivalently, $X \geq 33$)? Why? (Hint: review your `pbinom` commands from Lab 5).

The critical region of $X > 32$ because the tail does not include the value of 32.

Now we will assign the output to a variable:

```
> crit.value <- # either 32 or 33 depending on your answer to Question 7
```

Finally, to find the power, compute:

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

Question #8 According to R, what is the power of our test at our sample size and specific alternative hypothesis?

According to R, the value of power is going to be 0.950508

Question #9 What is the probability of committing a Type II Error, given our sample size, alternative hypothesis, and α value?

Our Beta value is going to be 0.049492

Save your script – it will make Lab 9 much easier!

Question #10 Based on the work you have done in this lab, do you believe that the researchers have a high enough power to detect a practically significant effect of "dog trust in strangers"?

The researchers do have high enough power because it is well above the 80% threshold.