Math 338 **Lab Assignment #10** Fall 2019

Lab Assignment #10

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.

In the study, 27 of the 53 dogs picked the cup with the food on the first trial.

Question #1 According to the Neyman-Pearson paradigm we have been working with in Labs 8 and 9, should we accept the null hypothesis $p = 0.5$ or the alternative hypothesis $p = 0.7$? Why?

We accept the null because the amount of dogs who went to the food does not lie in the critical region determined in Labs 8 and 9.

If dogs do not trust strangers initially, they would be expected to choose between the two cups more-or-less at random on the first trial. However, if dogs tend to trust strangers, they would be expected to choose the cup with food more often than would be suggested by chance alone.

Question #2 Using the parameter *p*, write the null and alternative hypothesis according to the "null hypothesis significance testing" paradigm. Label which one is the null hypothesis (H_0) and which is the alternative (H_a).

Null Hypothesis: when the dogs pick the food cups on their own

Alternative: when the dogs follow the stranger's indication where the food is

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
> p <- # the value of p if the null hypothesis in Question 2 is correct
```

In the experiment, 27 of the 53 dogs picked the cup with the food on the first trial. Let's define that now:

```
> X <- 27  # the number of dogs who got the food on the first trial
```

Question #3 To compute the p-value according to the "null hypothesis significance testing" paradigm, which of the events below should we find the probability of? Justify your answer.

a) Exactly 27 dogs getting the cup with food
b) 27 or fewer dogs getting the cup with food
c) 27 or more dogs getting the cup with food

The more dogs that go, there is even more evidence that the statement is true.
To find the p-value, type one of the following lines:

If you chose answer (a) to **Question #5**:

```
> dbinom(X, n, p)  # probability of getting exactly X successes out of n
trials with probability p
```

If you chose answer (b) to **Question #5**:

```
> pbinom(X, n, p, lower.tail = TRUE)  # probability of getting X or fewer
successes
```

If you chose answer (c) to **Question #5**:

```
> pbinom(X, n, p, lower.tail = FALSE) + dbinom(X, n, p)  # probability of
getting more than X successes, plus probability of getting exactly X
successes = probability of X or more successes
```

Question #4 According to R, what is the p-value?

The value from R is 0.5

Question #5 Using a significance level of 0.05, should you reject the null hypothesis or fail to reject the null hypothesis? Justify your answer.

We should fail to reject the null hypothesis because there is not enough evidence to change our minds.

Question #6 Can you conclude that dogs do not trust strangers? Can you conclude that dogs do trust strangers? Or can you not make a conclusion either way? Justify your answer.

We did not find any evidence to reject the null hypothesis.

Question #7 Would you make the same conclusion using the Neyman-Pearson testing paradigm? Why or why not?

You cannot make the same conclusion because you did not explicitly reject the null hypothesis because the alternative cannot be proven true.

Now we will use the `binom.test` command to “automatically” do a binomial hypothesis test. Any time you do a binomial test in R, you should first separately define the variables representing the number of successes, the number of trials, and the probability of success on a trial. In this lab, we’ve already defined those variables as `X`, `n`, and `p`, respectively.

```
> binom.test(X, n, p, alternative = "one letter goes here") # inside the
quotation marks, type l if your alternative hypothesis has a < sign or g if
it has a > sign
```

Question #8 Paste the console output below.

```
data:  X and n
number of successes = 27, number of trials = 53, p-value = 0.6081
alternative hypothesis: true probability of success is less than 0.5
95 percent confidence interval:
 0.0000000 0.6290759
sample estimates:
probability of success
            0.509434
```

Question #9 Identify the value of the test statistic and the p-value from the output. Are these values the same as you got using the probability calculations?

The value of the test statistic is 27 and the value of the p-value is 0.5 . These are the same values found above.