

## MA206, Lesson 4 - Strength of Evidence

What is Statistical Significance?

What is the 3S Strategy?

What is the difference between a **parameter** and a **statistic**?

Define:

$H_0$  :

$H_a$  :

$\pi$  :

$\hat{p}$  :

**n** :

**p-value** :

Classify the strength of evidence for each range of p-values.

0.1 <  $p$

0.05 <  $p \leq$  0.1

0.01 <  $p \leq$  0.05

<  $p \leq$  0.01

1) CPT Rocha dreams of running West Point's best cookie bakery. To test his chances of success, he bakes chocolate chip cookies and has his cadets taste them in a blind comparison to two unnamed competitors. If we assume there is no difference in taste between the three cookies, we would expect an even distribution of preferences as cadet choice would be left to randomly guessing. This method was conducted among the class.

For your class, what is the ratio of cadets that chose CPT Rocha's cookie as their favorite?

What is the ratio of cadets that chose mystery cookie K as their least favorite?

a) What is the research question?

b) What are the observational units in this study?

c) What are the variable(s)? Classify each as categorical or quantitative.

d) Describe the parameter of interest. What symbol is used to represent it?

e) For your class, list the appropriate values for the variables below and describe them in words.

$n$ :

$\hat{p}$ :

$H_0$ :

$H_a$ :

f) Is it possible for the sample to match the null hypothesis if the null hypothesis is false?

g) Is it possible to differ significantly from the null hypothesis if the null is true?

h) How might we use dice to randomly simulate and test our null hypothesis?

i) Using the applets, run a simulation using your observed statistic, your hypotheses, and at least 1,000 simulations. Describe the null distribution. Describe where the observation falls (near the center or in the tails).

j) List your p-value from the simulation and describe the strength of evidence in words. Have we proven the alternate hypothesis?

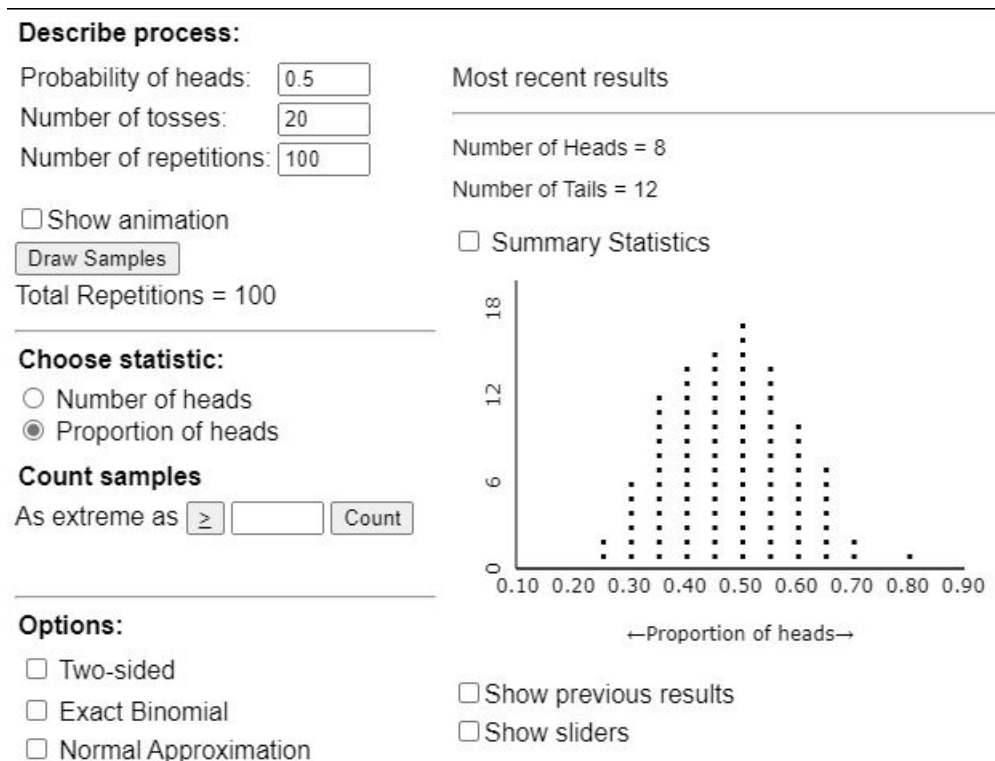
h) Be able to repeat the above work for a different research question: Is the Keebler Chips Deluxe the least favorite cookie, in general? Repeat the analysis, provide a p-value, and write your conclusion.

2) Many types of studies have been done to see whether animals have a sense of number. In one study (Beran & Beran, 2004), researchers wanted to see whether chimpanzees could remember how many items were added to a container when they see them added one at a time. To do this they had two containers set up so the chimpanzees could not see inside them. They randomly added bananas to the containers one at a time and then had the chimpanzees choose the container they wanted. In one set of experiments, they added 3 bananas to one container and 4 to the other and had a chimpanzee named Mercury pick which container he wanted. In 20 trials, he picked the container containing 4 bananas 16 times.

a) What is the observed statistic? Include the appropriate symbol.

b) In words and symbols, define the null and alternate hypotheses for this study.

c) Below is a screenshot of a simulation done 100 times. What is the p-value, given our observed statistic and defined hypotheses? Comment on the strength of evidence.



d) If we converted the null distribution to count of “successes” instead of proportion, where would we expect the above distribution to be centered on?

e) Given the above distribution, what is the fewest number of times that Mercury could pick the box with more bananas and we would still consider it strong evidence against randomly selecting boxes?

**3)** Your friend says he can shoot free throws as well as someone in the NBA and you don't think he is that good. You know that the NBA average for shooting free throws in the 2021-2022 season was 77.8%. You test your friend by asking him to make 40 shots, and he makes 24 of them. Make a conclusion about your friend's claim, including your p-value.