My brother and I flip a coin to decide who washes dishes. If the coin is heads, I wash. If it is tails, he washes. However, for the last five days in a row, my brother has won.

## How can I determine if he is using a fair coin?









In this lesson you will learn to test a hypothesis for a population parameter by using a simulation.



#### Let's Review

# Population

# Unknown parameter

# Make a hypothesis



#### Core Lesson





# Heads: I wash the dishes. Tails: He washes the dishes.















My hypothesis: The coin is fair.

### If the hypothesis is true, is 5 heads in a row unusual?

### I will use simulation to see how unusual it would be to get 5 heads in a row.













### Simulation: A way to model random events

## Simulations can be conducted using objects (drawing names, flipping coins, etc.), or random numbers (tables or calculators.)

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## To design a simulation, we first need to determine the component to be repeated.

In my problem, the component is flipping a coin.







# Next, we should identify how we will model the random occurrence of an outcome.

### My possible outcomes are





Heads



# There are many ways that I could model the outcomes:

- Bowl of red and green chips
- Random numbers: even digits representing heads and odd digits representing tails
- Random numbers: digits 0-4 representing heads and 5-9 representing tails



The third thing we need to determine is how we will simulate the trial, or sequence of events that we want to investigate.

For my problem, I will simulate flipping a coin 5 times and record whether or not I get 5 heads in a row.



# Now we identify the response variable, which is the result of the trials.

# In my problem, the response variable is whether the trial resulted in *all heads*.





### Next we run several trials.

### The more trials I run, the better!



## The last step in a simulation is calculating the statistic based on the results of the simulation, by analyzing the response variable.

In my problem, I would calculate the proportion of the 50 trials in which we got 5 heads.



#### Core Lesson

### Steps to Test a Hypothesis

- Determine the COMPONENT
- What are the OUTCOMES
- Design the TRIAL
- What is the RESPONSE VARIABLE
- Run the SIMULATION
- Calculate the STATISTICS
- Make a decision on the HYPOTHESIS



#### A Common Misunderstanding



The statistics that we obtain through our simulation will vary every time we do a simulation. We will use them to make an estimation of the population parameter, which is unknown.



I would then come up with a conclusion, such as, "Based on my simulation, I estimate that, on average, I should get 5 heads about "x" percent of the time."

I can use this conclusion to reject or fail to reject my hypothesis that the coin is fair.



In this lesson you have learned to test a hypothesis for a population parameter by using a simulation.

