Math 243

Day 8

Binomial Test – Inv. 1.4

Last time: Inv. 1.3, Bob/Tim

- Assuming random guessing,

$$\pi = P(\text{Tim on left}) = 0.5$$

- In a sample of 20 students, 18 chose Tim to be on the left

$$\hat{p} = 0.9$$

Terminology Detour – Tim/Bob Survey

Parameter vs. Statistic

- A numerical summary from a random process or *population.*
- Usually notated with Greek letters, e.g. σ, μ, π,…
- Example: π is the probability a student randomly picks Tim

Population – the entire group of interest

- A numerical summary from a *sample*.
- Usually notated with accented Latin letters, e.g. $\bar{x}$, $\hat{p}$, s
- Example: $\hat{p}$ is the proportion of the class who pick Tim

Sample - a subset of the population whose data was recorded

Inv. 1.3, Bob/Tim

- Assuming random guessing,

$$\pi = P(\text{Tim on left}) = 0.5$$

Parameter if null model is true

- In a sample of 20 students, 18 chose Tim to be on the left

$$\hat{p} = 0.9$$

statistic

Interpretation of **p-value**

What does our study result,

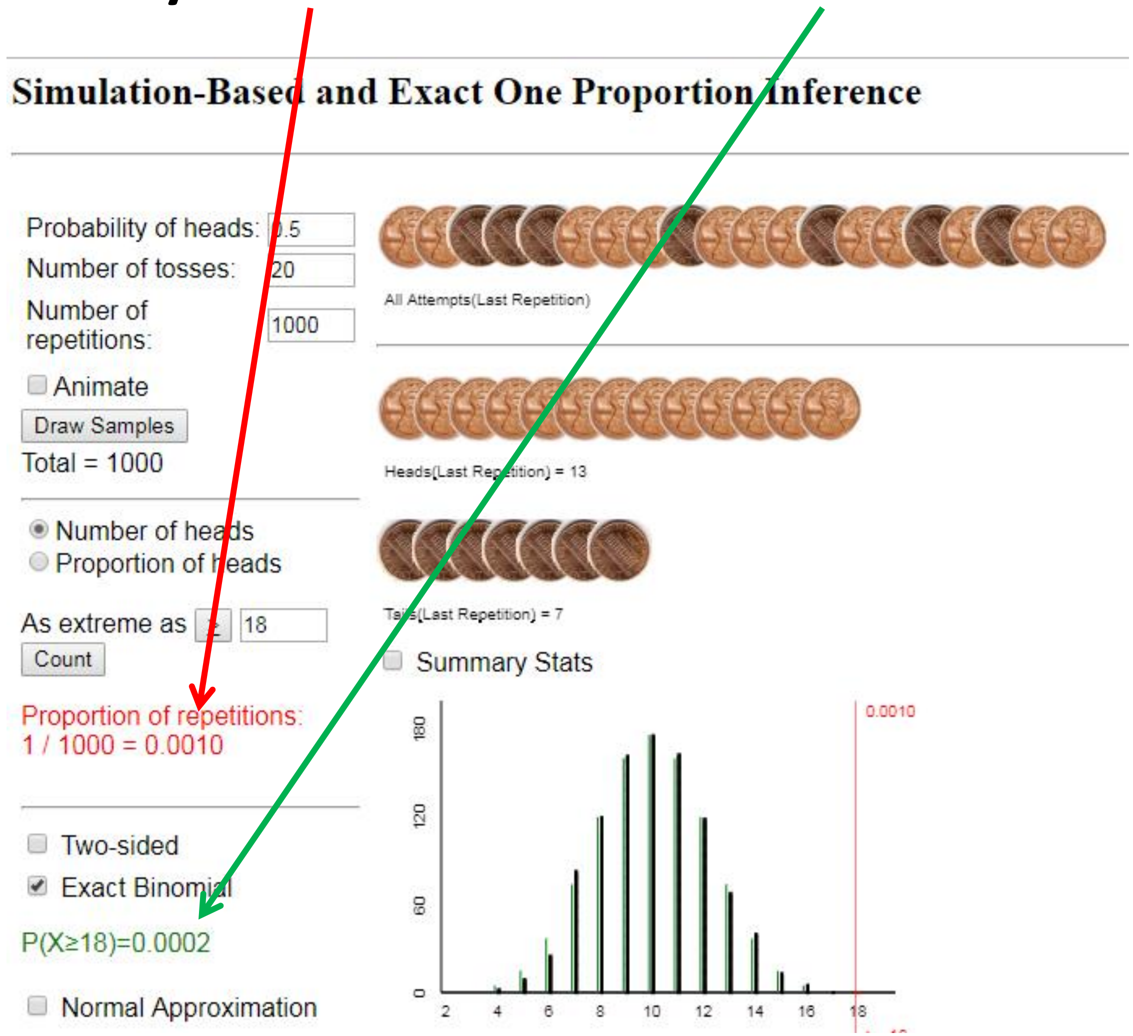
the statistic, $\hat{p} = 0.9$,

tells us about the

parameter under the null model, π=0.5 ?

- **P-value** = *probability of seeing 18 out of 20 students ($\hat{p} = 0.9$) chose Tim as the guy on the left if they were randomly guessing (**π=0.5**)*

Using technology to compute the **p-value** either by simulation or math



Drawing a conclusion from a p-value

What does our study result,

the statistic, $\hat{p} = 0.9$,

tells us about the

parameter under the null model, π=0.5 ?

There is strong evidence against the null model: students weren't just guessing.

Let X = # of students who put Tim on left out of 20.

Assuming X is a **binomial random variable**,

p-value = $P(X \geq 18) = 0.0002$

so it would be **very unlikely** to see 18 of 20 students ($\hat{p} = 0.9$) chose Tim on left **if** they were randomly guessing (**π=0.5**).

Let’s generalize the steps in Inv. 1.3

A Test of Significance

Research question

Null Hypothesis: Nope: there's nothing going on

Alternative Hypothesis : Yes, something is going on

Collect data from a sample

Choose a random process that models the data collection well

Compute a p-value, *the probability of seeing results as extreme as the statistic if chance alone is at work*

If p-value is large,
there's no evidence against the **null hypothesis**.
If p-value is small,
there's evidence against
the null hypothesis.

Binomial Test

Research question involves parameter π from a Binomial Process

H_0: π = some number

H_a: π ≠ some number

Collect a binary variable from a sample of size n

Verify that the data collection is modelled well by a binomial process

Compute a binomial p-value, either through simulating a coin toss or the exact formula for a Binomial probability, assuming
π = some number

If p-value is large,
there's no evidence against **H_0**.
If p-value is small,
there's evidence against **H_0**.

Inv. 1.4

Try parts (a), (b), (c), (d), (e) and (f) in class.

Try parts (g)-(q) at home.