Math 243

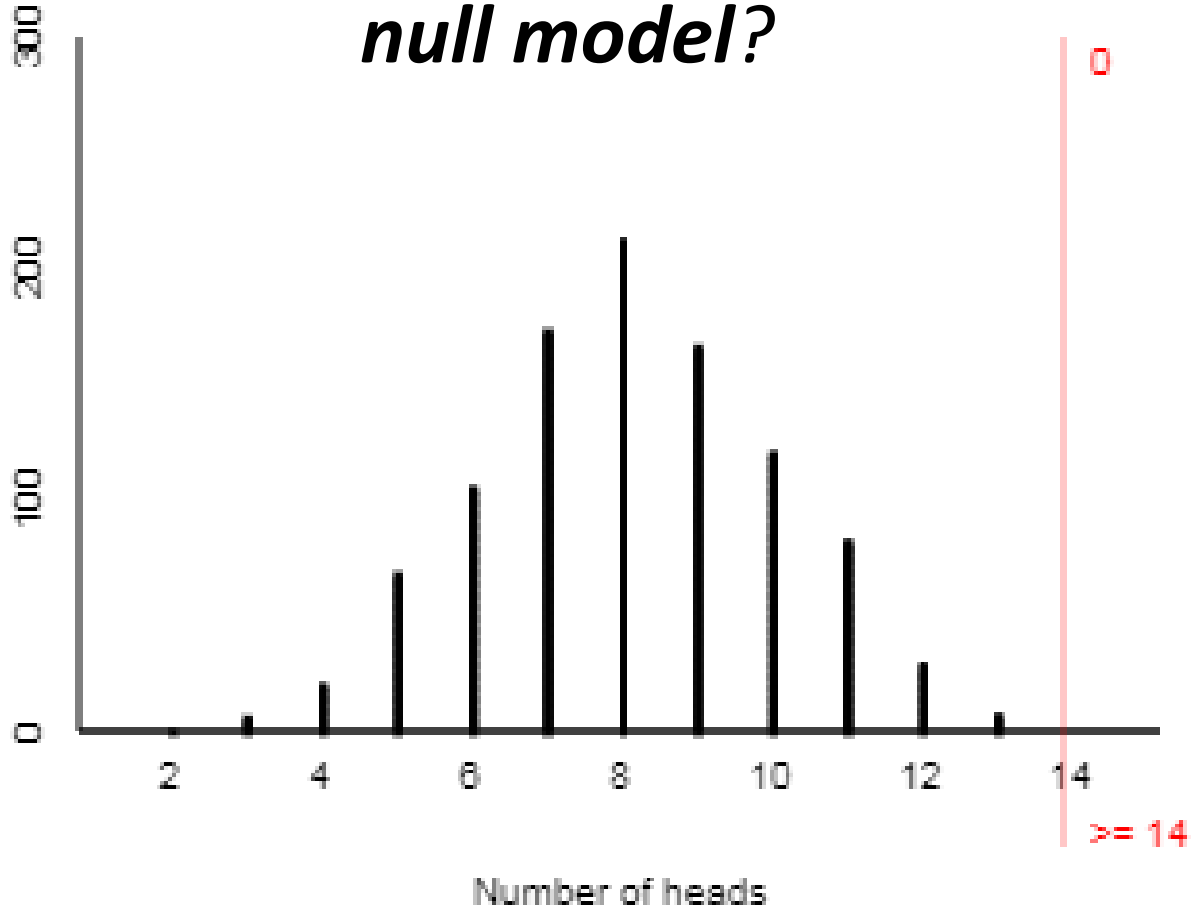
Inv. 1.2 - Do you have ESP?

Binomial Random Variables – page 28

Review

Inv. 1.1: Friend or Foe

Is a particular study result consistent with the ***null model****?*



Learning Objectives for Inv. 1.2

1. List the 4 characteristics of a **Binomial Random Process**

2. Specify the parameters for the **Binomial Random Process** associated with a **null model**.

3. Determine whether a given random process is a **Binomial Random Process**.

Inv. 1.1 Friend or Foe?

In Inv. 1.1, we were interested in the random process of **babies choosing between two toys**.

In order to determine whether the study result was consistent with the **null model** explanation we simulated another random process…

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coin tosses

Let’s generalize!

What **characteristics** do the random processes of babies choosing toys and coin tosses have in common?

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What **characteristics** do the random processes of babies choosing toys and coin tosses have in common?

Babies choosing toys

- Two outcomes possible per baby: helper or hinderer
- One baby's choice doesn't affect another baby's choice
- P(Baby choses helper) = 0.5
- There was a fixed number of babies: 16.

Coin tosses

- Two outcomes possible per coin: heads or tails
- One toss's result doesn't affect the next toss's result
- P(toss is heads) = 0.5
- There was a fixed number of tosses: 16.

Let's generalize!

and call the result a **Binomial Random Process**

Trials

- Two outcomes possible per trial: success or failure
- One trial's result does not affect another's
- P(success) = π
- There are a fixed number of trials, n

1. List the 4 characteristics of a **Binomial Random Process**

Let's generalize!

and call the result a **Binomial Process**

Trials

- Two outcomes possible per trial: success or failure
- One trial's result does not affect another's
- P(success) = π
- There are a fixed number of trials, n

This condition is called ***independence***

The probability of success may be any number between 0 and 1: the key is that it must be the ***same*** number for each trial

Some Notation

The **parameters** of a Binomial Random Process are

- n, the number of trials, and
- π, the probability of success in single trial.

2. Specify the **parameters** for the Binomial Random Process associated with a null model.

The **parameters** of a Binomial Random Process are

- n, the number of trials, and
- π, the probability of success in single trial.

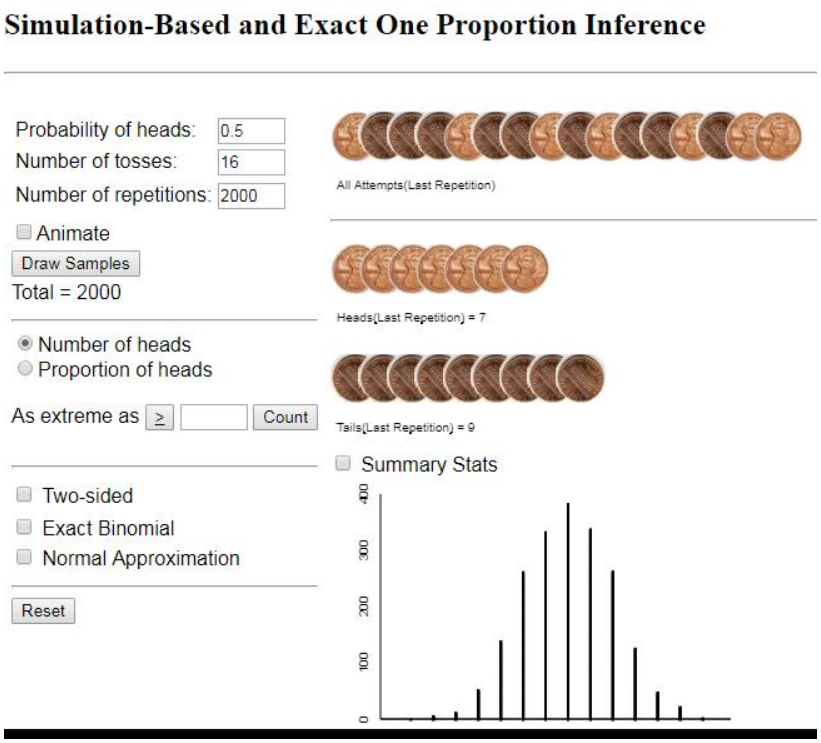
Example: specify the **parameters** of the random process of babies choosing toys.

Why bother with all this jargon?

If our data collection method matches a **Binomial Random Process**

and we identify the parameters under the null model explanation,

then we know how to estimate probabilities to decide whether our data is consistent with the null model



Inv. 1.2: Do you have ESP?

Research Question: Do I have ESP?

Collect Data:
https://psychicscience.org/esp3.aspx

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Research Question: Do I have ESP?

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Let's say I got 10 matching cards out of 25 tries.

Do you believe I have ESP or not?

3. Determine whether a given random process is a **Binomial Random Process**.

Assume I'm just guessing and let C be the number of matches in 25 cards.

Try **part (a)** on page 30.

Binomial Random Process

- Two outcomes possible per trial: success or failure
- One trial's result does not affect another's
- P(success) = π
- There are a fixed number of trials, n

Do I have ESP?

Simulation-Based and Exact One Proportion Inference

Probability of success (π): 0.2
Sample size (*n*): 25
Number of samples: 1000

☐ Animate

Draw Samples

Total = 1000

All Attempts(Last Sample)

Successes(Last Sample) = 4

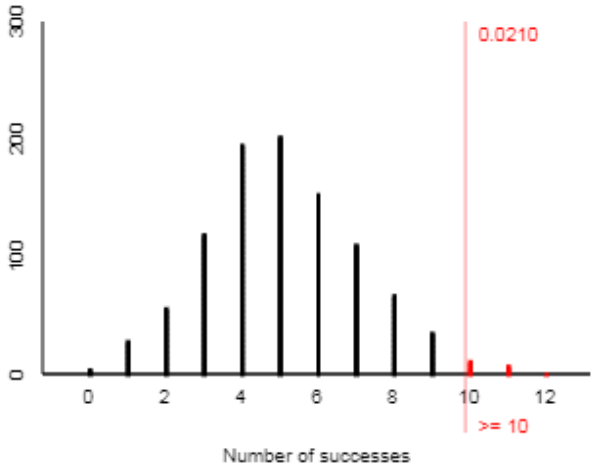
Failures(Last Sample) = 21

◉ Number of successes
○ Proportion of successes

As extreme as ≥ 10 Count

Proportion of samples:
21 / 1000 = 0.0210

☐ Summary Stats



☐ Two-sided
☐ Exact Binomial
☐ Normal Approximation

Reset

Do I have ESP?

Assuming I am just guessing, you'd expect to see me get 10 or more matches in 25 cards only 2% of the time…

Do I have ESP?

Assuming I am just guessing, you'd expect to see me get 10 or more matches in 25 cards only 2% of the time…

…so there's evidence **against** the theory that I'm just guessing!

Avoid Reinventing the Wheel

Mastering today's **Learning Objectives** will allow you to use the One-Proportion Applet for probability calculations to answer research questions.

1. List the 4 characteristics of a **Binomial Random Process**

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Group Practice

Is X a binomial random variable? If so, find the parameters n and π. If not, state which of the 4 characteristics the random process does not have.

1. Suppose a fair die is rolled three times. Let X be the number of 6's in the three rolls.

2. Suppose four babies are randomly returned to their mothers. Let X be the number of correct matches.

3. Suppose a student is guessing on a multiple choice exam. The exam has 10 questions, with 4 choices each. Let X be the number of questions the student gets right.

Group Practice

Is X a binomial random variable? If so, find the parameters n and π. If not, state which of the 4 characteristics the random process does not have.

1. Suppose a fair die is rolled three times. Let X be the number of 2's in the three rolls. **Yes, n=3, π=1/6**

2. Suppose four babies are randomly returned to their mothers. Let X be the number of correct matches.
No: a trial = one pairing and the trials are not independent. Also, the probability of success (a correct match) is not the same between trials.

3. Suppose a student is guessing on a multiple choice exam. The exam has 10 questions, with 4 choices each. Let X be the number of questions the student gets right. Yes, as long as the student's selected answer on one question does not affect his or her answer on another question (e.g. the student is really randomly choosing, on each question not just picking "c")