

# Making Cents of the CCSS Statistics Standards



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# The 3 “Be”s of Public Speaking

- Be GOOD!
- Be BRIEF!
- Be GONE!

What's on your mind?

Inference?

CCSS?

AYP?

Statistics?



# The Inspiration



# The Inspiration





# CCSS and Statistics

- “... and we’re not ready.”
- Stats is its own discipline – it’s not mathematics!
- So why do math teachers get to teach Statistics?



# Goals for Today

- Become more comfortable with statistical inference
  - Think about how to make decisions in the face of uncertainty
  - Use randomness and chance as a tool for decision-making
  - Give you a classroom activity that can be implemented immediately
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**A LITTLE STATS  
BACKGROUND  
(GOES A LONG WAY)**





# Main Branches of Statistics

- Descriptive Statistics
  - Histograms, bar graphs, dotplots, etc
  - Measures of center
  - Measures of variability
  - Etc.
- Inferential Statistics
  - Confidence intervals
  - Tests of significance



# **TEACHING CCSS WITH PENNIES**



# CCSS Content Standard

Understand and evaluate random processes underlying statistical experiments

*2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

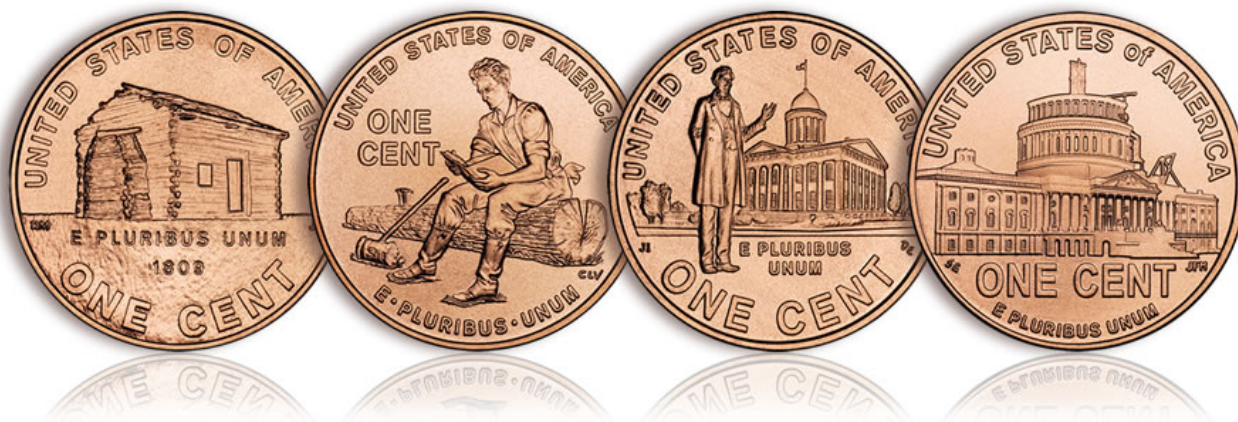


# CCSS Mathematical Processes

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.

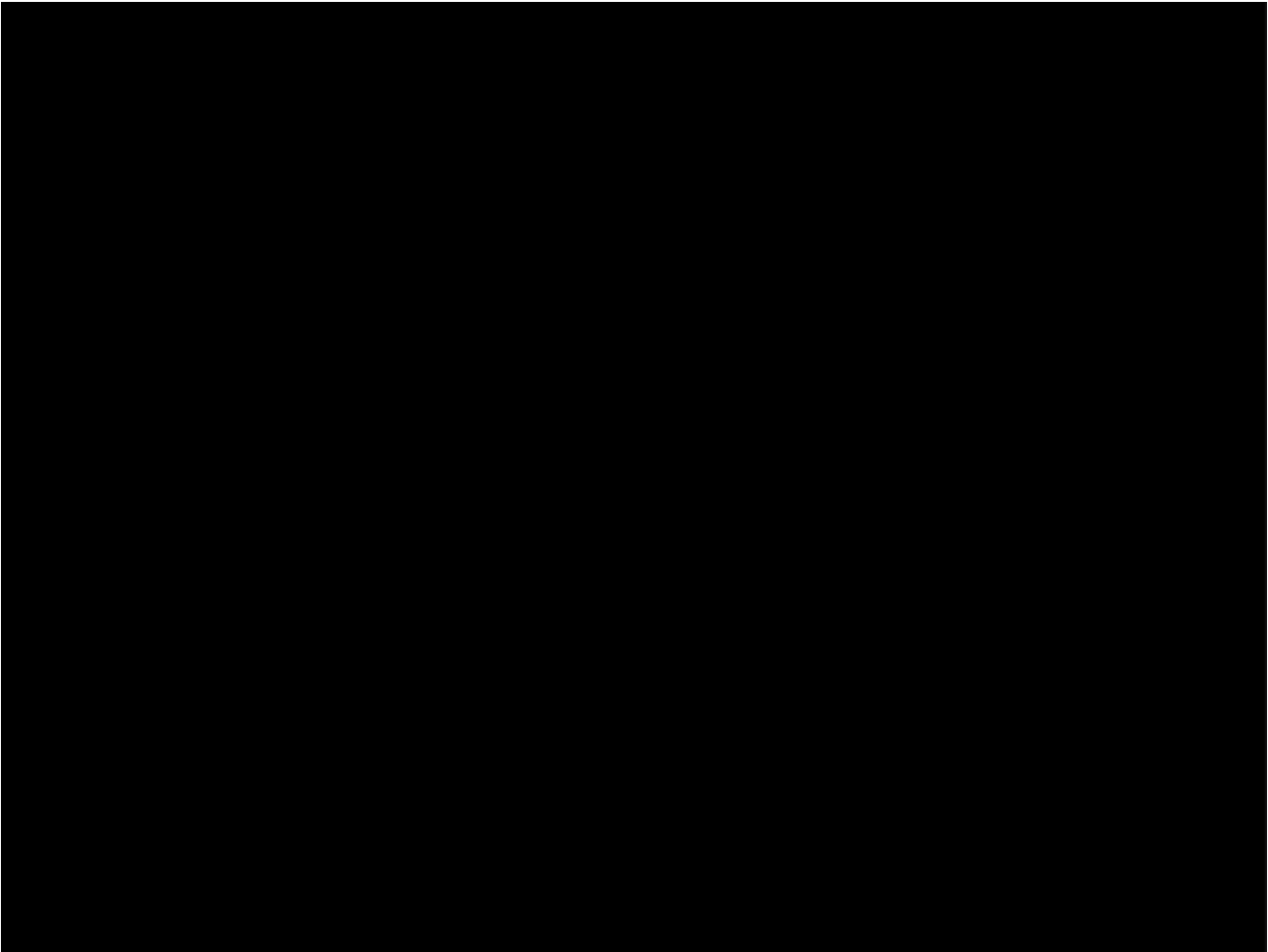
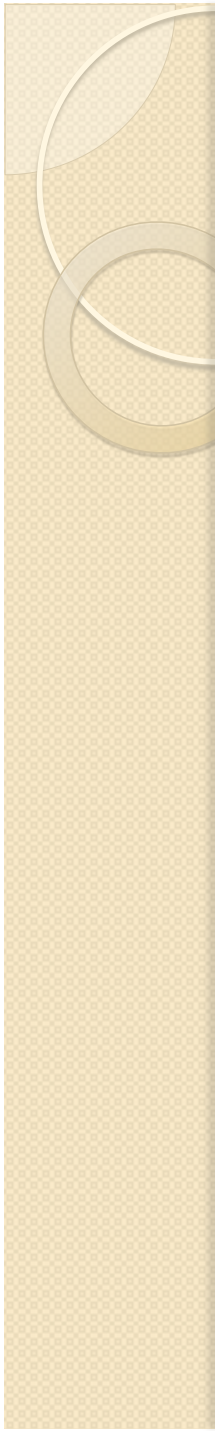
# Why Pennies?


1. Kids have a lot of experience with them.
2. They're in my price range!
3. It's hard to resist flipping and spinning pennies!
4. Don't overlook the obvious.





# **FLIPPING PENNIES**





"A weaker man might be moved to re-examine his faith, if in nothing else at least in the law of probability."

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# Is This Penny Fair?

- When we pick up a penny, we have an unspoken belief: the penny is a fair penny.
- Do you have any reason to believe the penny is unfair?
- How can we tell if the penny is fair?
- (Best student answer so far: “Weigh both sides.”)



# Is This Penny Fair?

- If you flip a fair penny 50 times, how many tails do you expect to see?
- If you don't get exactly that many tails, does that automatically mean the penny is unfair?
- How many tails would you need to see (in 50 flips) to be convinced that the penny is unfair?



# Is This Penny Fair?

- Flip 50 times.
- Keep track of the number of **tails**!
- Work with a partner if you wish.



# **SPINNING PENNIES!**



## Refer to the Handout

- Read p.1 and answer the questions, then await my instructions.
- On p.2 we begin spinning pennies!

# Rules

- Spin on a hard, flat surface.
- If the penny bumps into an object, re-spin.
- Perform only 50 spins.



**These don't count!**



# BEGIN!

(Record your results in the table on p.2 and then take a few minutes to work through the rest of the handout.)







# **A WALK THROUGH THE ACTIVITY (TEACHER EDITION)**

# Hypotheses

- Statistics lingo

$$H_0: p = 0.5$$

$$H_a: p > 0.5$$

where  $p$  is the proportion of tails

- Translation

$H_0$ : the coin is fair

$H_a$ : the coin lands tails up more than heads



# P-value

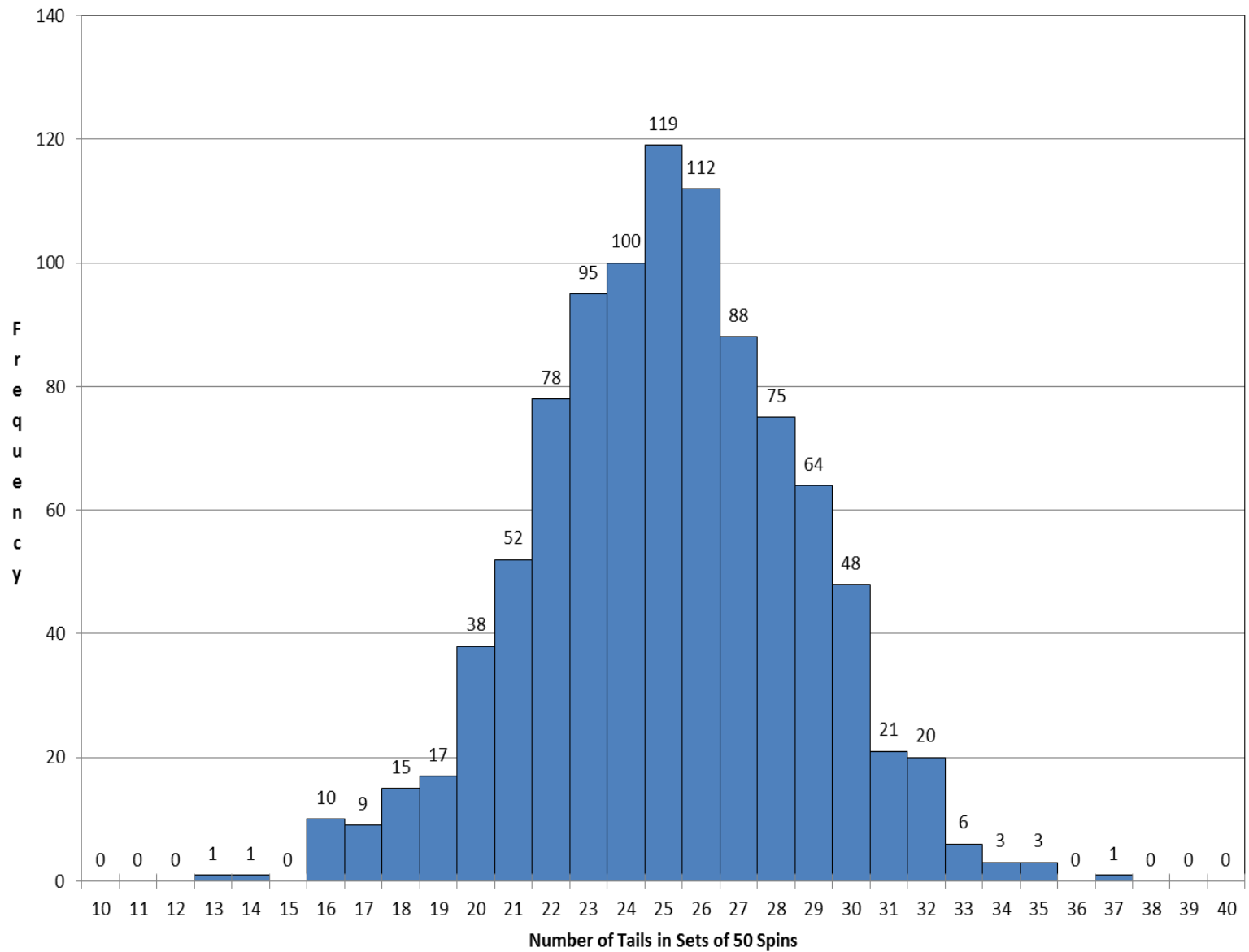
- Statistics lingo

The probability to see outcomes from sample data as extreme or more extreme as our observed data, assuming the null hypothesis is true.

- Translation

The probability to get by chance as many tails or more as the number of tails we spun, assuming the coin is fair.

## Spinning a Fair Coin





# Conclusion

- Statistics lingo

We reject (don't reject)  $H_0$ . There is (is not) enough evidence to believe the proportion of tails obtained from spinning this coin is greater than 0.5.

- Translation

We do/don't have enough evidence to believe the coin is unfair.

# A point of note

- We can never say for certain that the coin IS fair. Why?
- Because the only way to prove that is to spin the coin forever.



## A point of note

- We can never say for certain that the coin IS NOT fair. Why?
- Because the only way to prove that is to spin the coin forever.





## A point of note

- We can never *prove* the null hypothesis is true, nor can we ever prove the alternative hypothesis is true. Why?
- Because the only way to prove that is to spin the coin forever.





# Freebies!

- The teacher notes and a clean copy of the activity await you in the back.
- On my website is a .zip file with this PowerPoint, the activity, the teacher notes, and...
- Minitab, Excel, and Fathom files for simulating 50 spins of a fair penny.



# Contact Information

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