

Engaging Students in Statistical Reasoning

Lessons Addressing the Common Core

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NCTM Learn-Reflect Strand

- What role does reasoning and proof play in increasing the opportunities for communication to help students develop mathematical understanding?
- How does stressing reasoning and proof influence your instructional decisions? In addition, how do your instructional decisions influence how reasoning and proof should be stressed?
- How does reasoning and proof drive the lifelong learning of significant mathematics to all students? How is equity and diversity also promoted by stressing reasoning and proof?
- How are you thinking differently about your use of reasoning and proof because of participating in the Learn-Reflect strand? What are some of the steps you plan to take to promote reasoning and proof in your classroom/school?

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Statistical Studies

Statistical reasoning is needed throughout the process:

- **Formulating** a question (or questions) that clarifies the problem and can be addressed with data
- **Designing** and **employing** a plan for collecting data.
- **Analyzing** and **summarizing** the data.
- **Interpreting** the results from the analysis, and answering the question on the basis of the data.

Guidelines for Assessment and Instruction in Statistics Education
(Franklin et al., 2007)

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Formulating Statistical Questions

What are natural questions related to stacking pennies using dominant and non-dominant hands?



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CCSSM High School Statistics Making Inferences and Justifying Conclusions, S-IC

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

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Volunteers Methods

- Describe your protocol (rules) for stacking pennies.

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Common Core State Standards for Mathematics

“Technology plays an important role in statistics and probability by making it possible to generate plots, functional models, and correlation coefficients, and simulate many possible outcomes in a short amount of time.” (p. 55)

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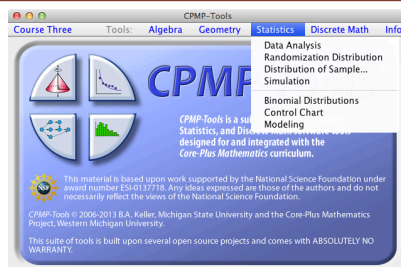
CCSSM Mathematical Practice Use Appropriate Tools Strategically

Use Mathematically proficient **students consider the available tools when solving a mathematical problem**. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a **statistical package**, or dynamic geometry software. Proficient students are **sufficiently familiar with tools** appropriate for their grade or course **to make sound decisions** about when each of these tools might be helpful. . . . They are able to use these tools **to explore and deepen their understanding of concepts**.

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CCSSM, 2010, p. 7

Public-domain Math Tools



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CCSSM High School Statistics Interpreting Categorical and Quantitative Data, S-ID

Summarize, represent, and interpret data on a single count or measurement variable

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

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Statistical Significance

How do you decide whether the difference in the mean responses for the two groups stacking pennies happened by chance or was due to the choice of dominate or non-dominate hand?

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CCSSM High School Statistics Making Inferences and Justifying Conclusions, S-IC

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

5. Use data from a randomized experiment to compare two treatments; **use simulations to decide if differences between parameters are significant**.

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Public-domain Core Math Tools

The screenshot shows the 'Core Math Tools' interface with the following categories and descriptions:

- Algebra & Functions**
 - Graphing Calculator (GAS)**: Produce tables and graphs of functions, and solve systems of equations and linear systems.
 - Spreadsheet**: Use familiar spreadsheet functions, and add and subtract formulas, sort data, and create data visualizations.
- Geometry & Trigonometry**
 - Synthetic**: Construct, measure, compare, construct, measure, and compare angles and lengths.
 - Coordinate**: Construct, measure, compare, lengths, and compare angles.
- Statistics & Probability**
 - Data Analysis**: Introduce, display, and compare distributions and statistical data.
 - Simulation**: Create and run simulations of random events.

Additional sections include **General Purpose Tools** (GAS, Spreadsheet, Synthetic Geometry, Data Analysis and Simulation), **Custom Apps**, and **Advanced Apps**.

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CCSSM High School Statistics

Making Inferences and Justifying Conclusions, S-IC

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

- Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

Clarification

- Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between sample statistics (usually sample means or sample proportions) are significant.

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CCSSM High School Statistics

Interpreting Categorical and Quantitative Data, S-ID

Summarize, represent, and interpret data on two categorical and quantitative variables

- Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
 - Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
 - Informally assess the fit of a function by plotting and analyzing residuals.
 - Fit a linear function for a scatter plot that suggests a linear association.

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CCSSM High School Statistics

Interpreting Categorical and Quantitative Data, S-ID

Interpret linear models

- Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- Compute (using technology) and interpret the correlation coefficient of a linear fit.

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Additional Resources

- CPMP-Tools** is freely available from www.wmich.edu/cpmp/CPMP-Tools/
- Core Math Tools** is freely available from www.nctm.org/coremathtools/
- A **correlation** between Core-Plus Mathematics and CCSSM: www.wmich.edu/cpmp/announcements.html
- Sample lesson materials for your classroom: <http://www.wmich.edu/cpmp/2nd/unitsamples/c3uintro.html>

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Thank you

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