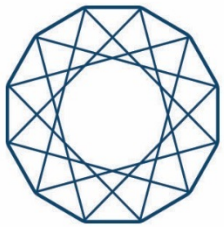


Brookhill
Institute of Mathematics

W233 N2080
Ridgeview Parkway,
Suite 100
Waukesha WI
53188
262-347-2212

Statistical Significance: What is it?

WMC Annual Conference
May 5, 2016

Sara Brown
Jeff Ziegler
Mathematics Program Specialists

Brookhill
Institute of Mathematics

Card Game

Pick a red card and win!

We will come back to this later.

Session Goals

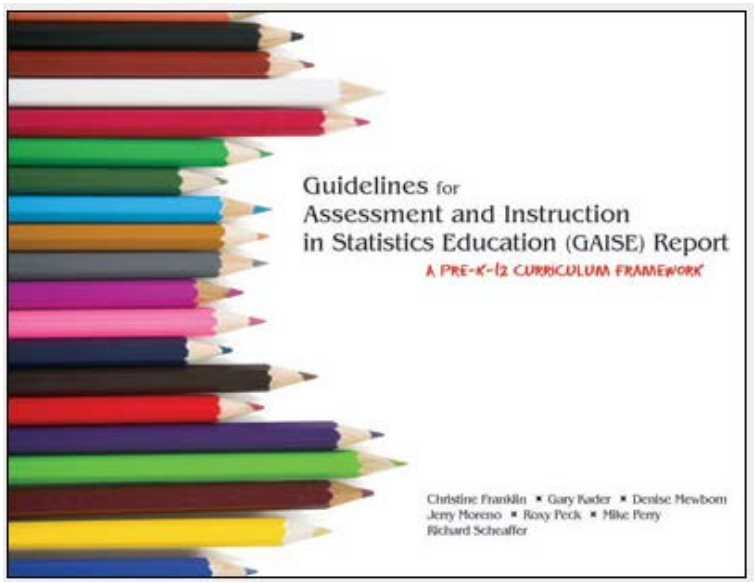
By the end of this session, you will…

- engage in the statistical problem solving process.
- develop an understanding of a progression of CCSS-M Statistics from grades 6 through 12.

The Framework

Statistical Problem Solving Process

I. Formulate Questions
II. Collect Data
III. Analyze Data
IV. Interpret Results



http://www.amstat.org/education/gaise/GaiseCollege_full.pdf

Brookhill Institute of Mathematics

Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Memorizing Words

Memorizing Words – I. Formulating Questions

The statistical question we will be investigating is, “Is it easier for participants to memorize words that have meaning over words that do not have meaning?”

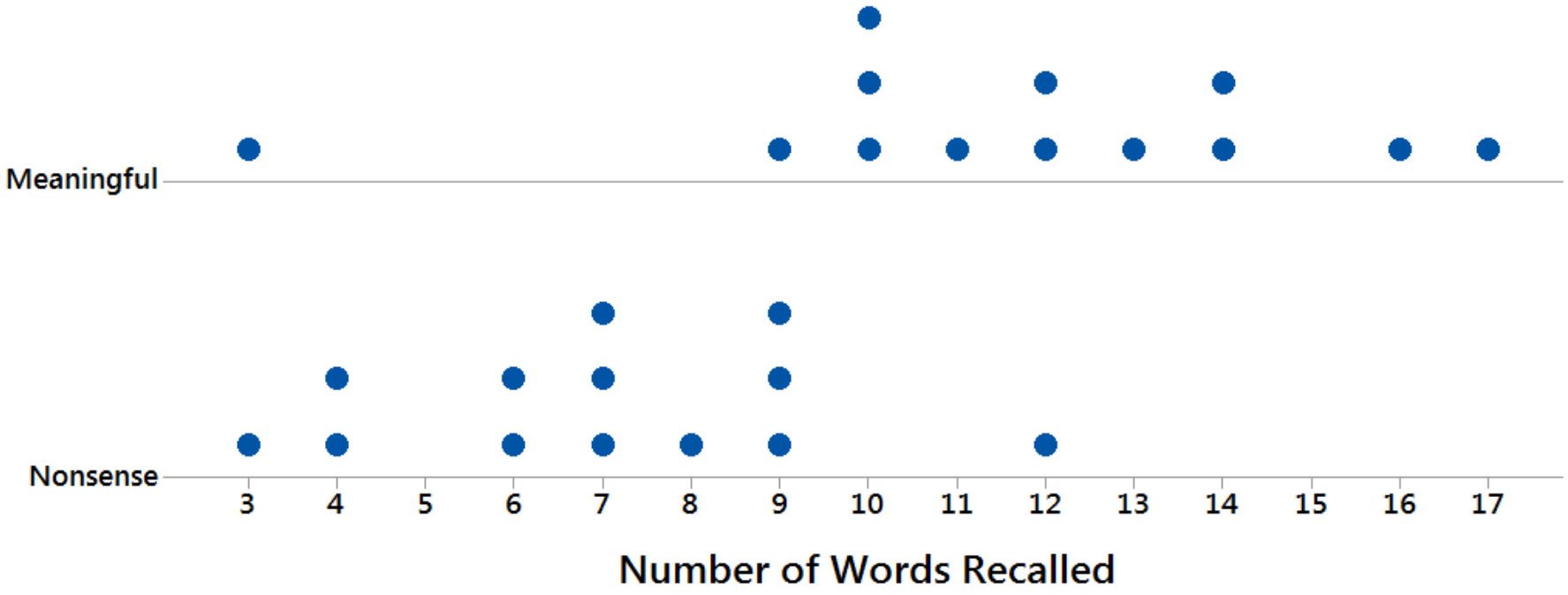
Memorizing Words – II. Collect Data

Data collection instructions:

1. You will have 1 minute to study your list of words.
2. You will then turn over your list and write down as many words as you can remember on a blank sheet of paper in 1 minute.
3. You will trade papers with someone of a **non**-matching color and check how many he/she has correct.
4. Write your number correct on a matching sticky note color (blue/orange for your word list) and post on the appropriate number line.

End

Compare 9th Grade Data
III. Analyze Data



Brookhill Institute of Mathematics

Box plot

The box plot is created from dividing an ordered data set into four groups with approximately the same number of data values in each set (about one fourth).

Five-Number Summary

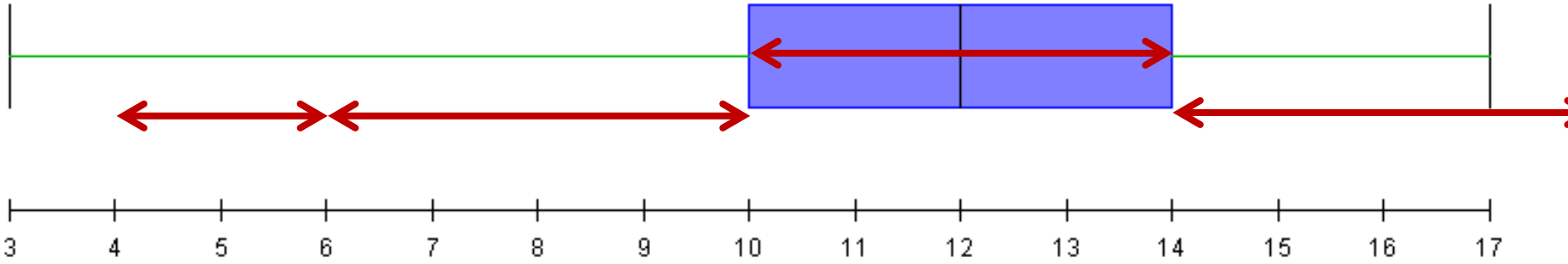
- Minimum
- First Quartile (Q_1)
- Median
- Third Quartile (Q_3)
- Maximum

- Interquartile Range (IQR)

Compare 9th Grade Data
III. Analyze Data

3 9 10 10 10 11 12 12 13 14 14 16 17

Meaningful Words

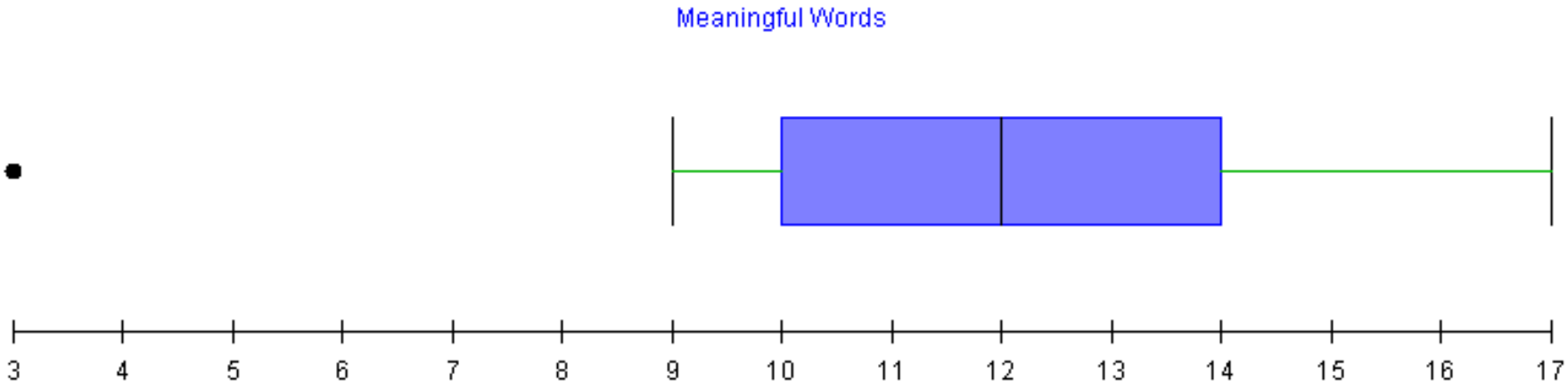


Number of Correctly Recalled Words

Describe the distribution.

Compare 9th Grade Data
III. Analyze Data

Marking the outlier



Number of Correctly Recalled Words

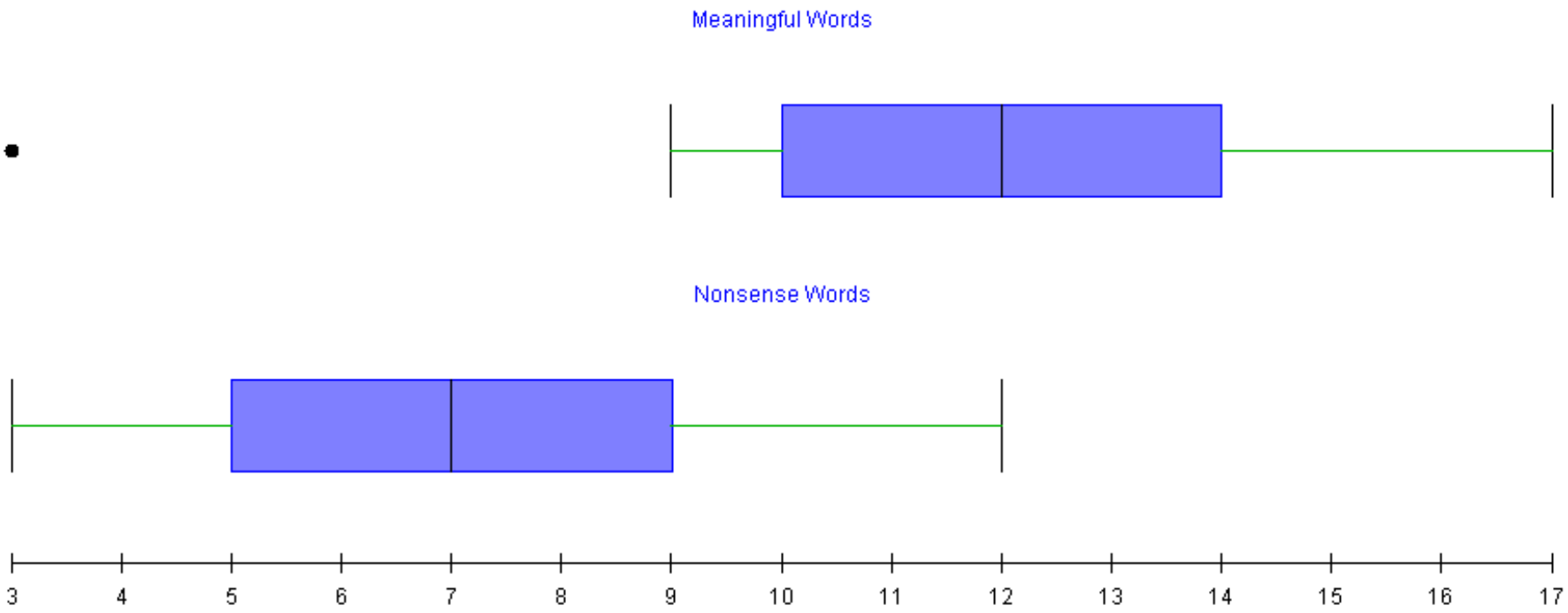
Compare 9th Grade Data
III. Analyze Data

When comparing two distributions, it is important to note similarities (overlap) and differences (areas of separation).

- What can you say about the similarities or overlap?
- What can you say about the differences or areas of separation?
- What conclusions might you draw?

Compare 9th Grade Data
III. Analyze Data

Turn and Talk

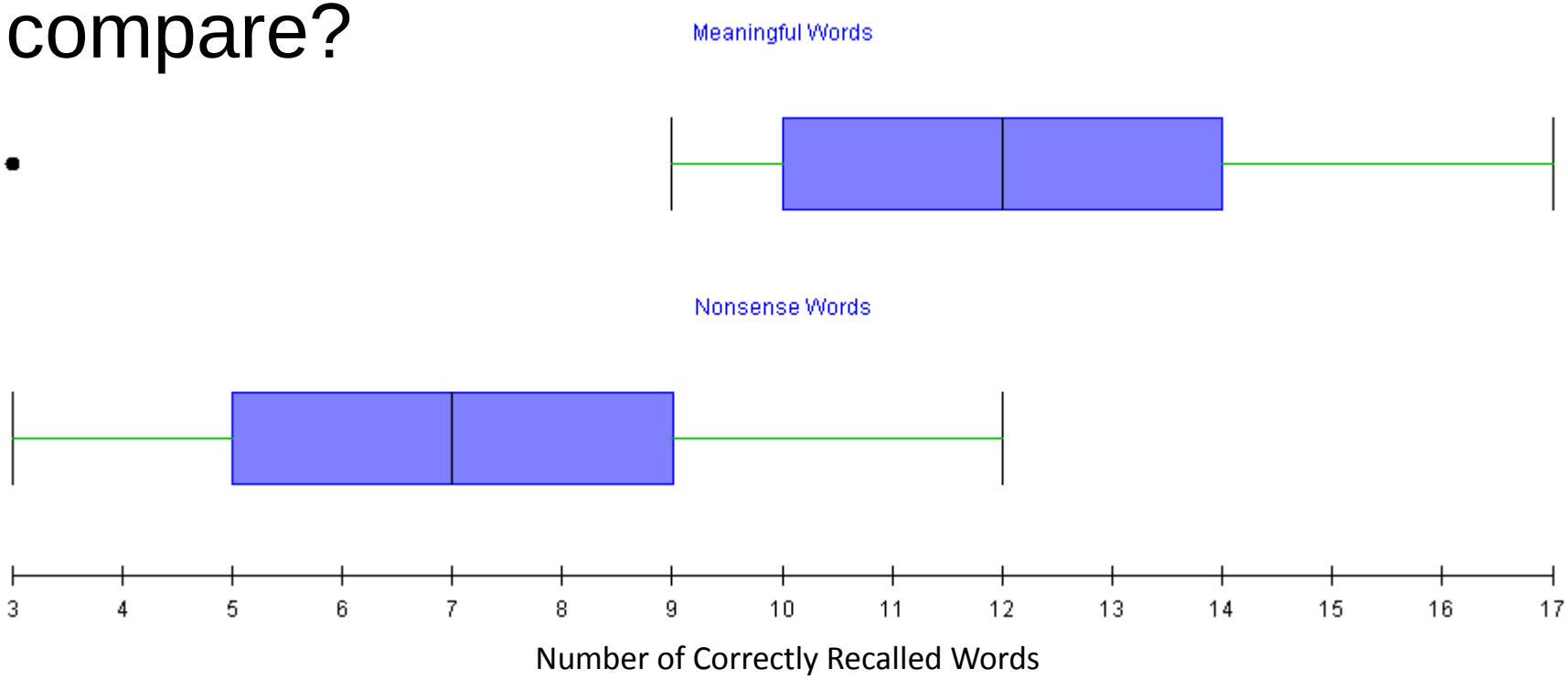


Number of Correctly Recalled Words

Brookhill Institute of Mathematics

Compare 9th Grade Data
III. Analyze Data

How do the medians for each distribution compare?



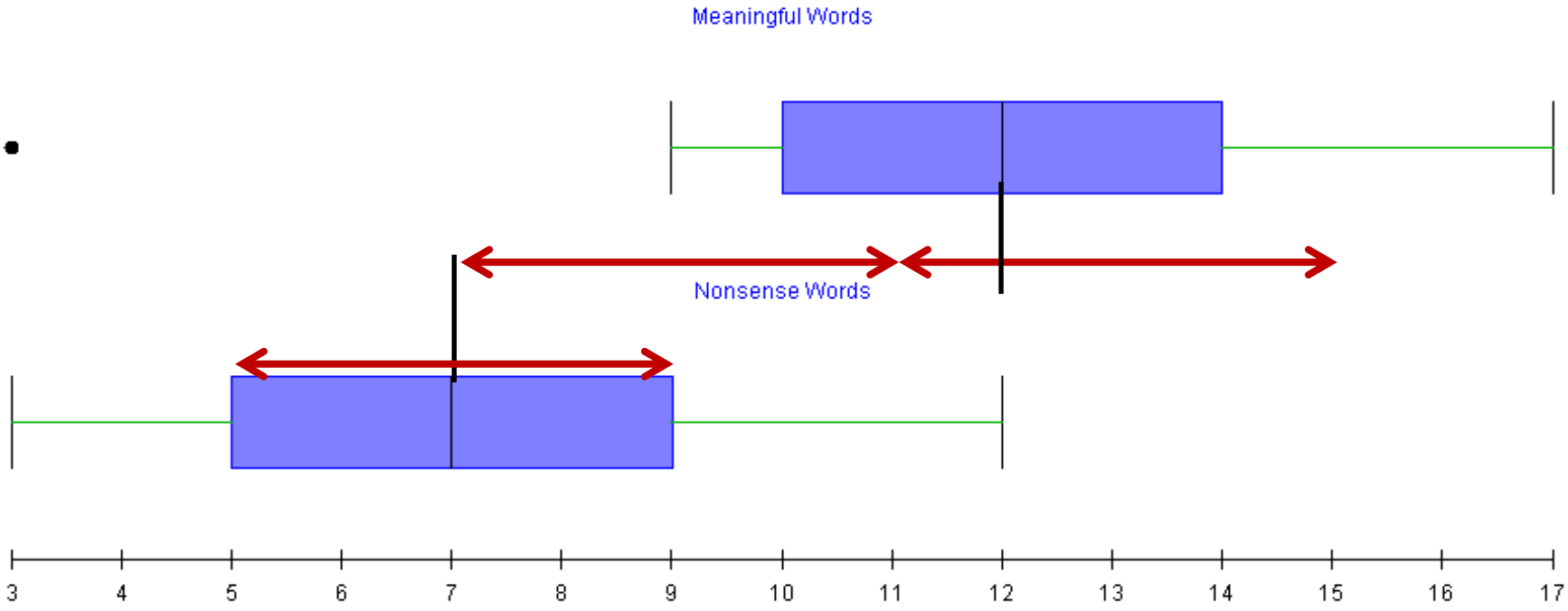
Brookhill Institute of Mathematics

Compare 9th Grade Data
IV. Interpret Results

Is a difference of 5 words large enough to matter? Is this a meaningful difference or is it just not that meaningful?

Compare 9th Grade Data
III. Analyze Data

How many IQRs separate the medians?



Number of Correctly Recalled Words

Brookhill Institute of Mathematics

Compare 9th Grade Data
III. Analyze Data

How many IQRs separate the medians?

$$\frac{Median\ of\ meaningful\ words - median\ of\ nonsense\ words}{IQR} =$$

$$\frac{12 - 7}{4} = 1.25$$

Compare 9th Grade Data
IV. Interpret Results

Is the difference between the medians of 5 words large enough to matter?

Is this a significant difference?

Simulation

Assume there is no difference between the median number of meaningful words and the median number of nonsense words.

If the list a person receives does not influence how many words he/she recalls, how likely would a difference in the medians as large or larger than 5 occur purely by chance if the true difference between the medians is 0?

Simulation Directions

With a partner, shuffle the 26 cards together and then "deal" the cards into two piles of 13 cards.

Designate one pile *A* (meaningful) and the other *B* (nonsense). Find the median of each pile.

Find the difference in the medians
(median of meaningful *A* – median of nonsense *B*)

Analyze the Results

Describe the dot plot

- Shape, center, spread
- What do the values represent?
- Where do the values center?
- Does this value make sense?

Analyze the Results

Where does the value of 5 words (actual difference between the medians) fall in this distribution?

Is this difference likely to have happened by chance if the true difference is 0?

Simulation using Technology

http://www.nctm.org/coremathtools/

Core Math Tools is a downloadable suite of interactive software tools for algebra and functions, geometry and trigonometry, and statistics and probability. The tools are appropriate for use with any high school mathematics curriculum and compatible with the Common Core State Standards for Mathematics in terms of content and mathematical practices. Java required.

General Purpose Tools CAS, Spreadsheet, Geometry, Data Analysis, and Simulation	Custom Apps Focused explorations of specific topics	Advanced Apps Focused explorations of advanced topics
Sample Lessons Problem-based lessons that employ *Core Math Tools*	Data Sets Wealth of data sets organized by data type	How-To Pages Help, hints and steps to do basic tasks

Card Game: Revisited

What did the opening card game have to do with statistical significance?

When did you begin to think the game was rigged?

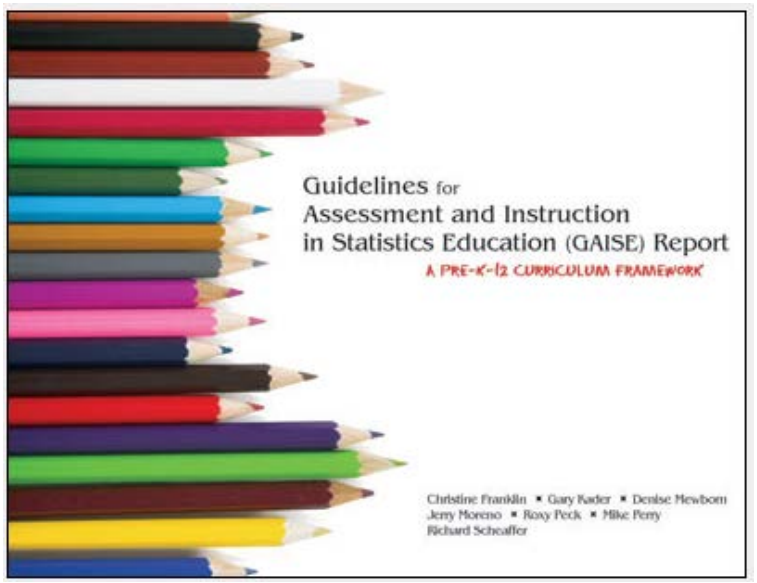
P(1 red card) = 0.5
P(2 red cards) = 0.5^2 = 0.25
P(3 red cards) = 0.5^3 = 0.125
P(4 red cards) = 0.5^4 = 0.0626
P(5 red cards) = 0.5^5 = 0.03125

Reflection

The Framework

Statistical Problem Solving Process

I. Formulate Questions
II. Collect Data
III. Analyze Data
IV. Interpret Results



Brookhill Institute of Mathematics

CCSS Standards

How did you see the progression from middle school to high school?

CCSS Standards

Cluster: Draw informal comparative inferences about two populations.

7.SP.3 Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.*

7.SP.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.*

CCSS Standards

Conceptual Category: Probability and Statistics

Domain: Interpreting Categorical and Quantitative Data

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

S-ID.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.

CCSS Standards

Conceptual Category: Probability and Statistics

Domain: Making Inferences and Justifying Conclusions

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

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

Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Closing

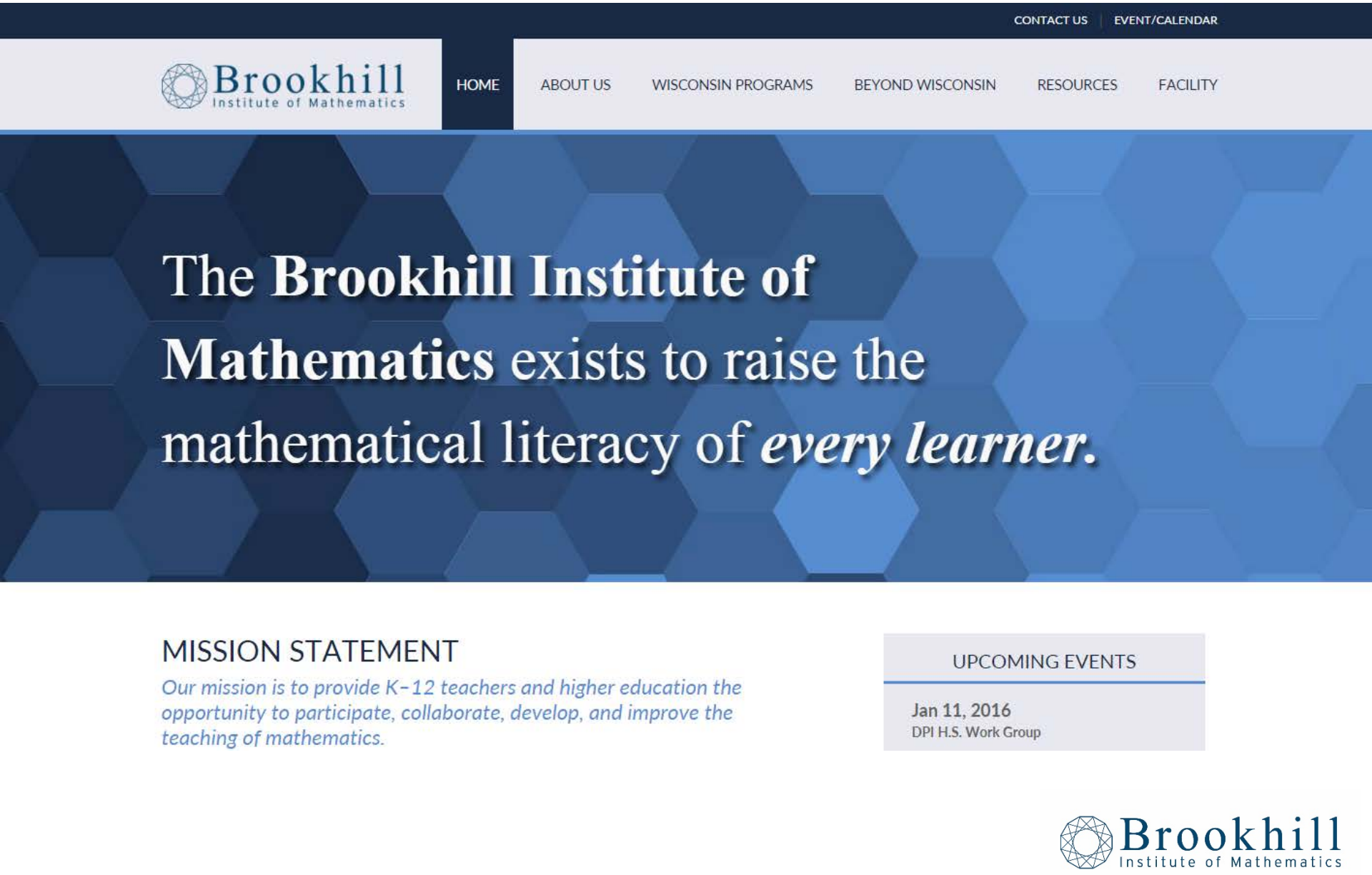
Session Goals

By the end of this session, you will…

- engage in the statistical problem solving process.
- develop an understanding of a progression of CCSS-M Statistics from grades 6 through 12.

“Statistical problem solving is an investigative process that involves four components.” GAISE

www.brookhillmath.org



Brookhill
Institute of Mathematics

www.wsmi.net

Wisconsin Statewide MATHEMATICS Initiative
A program of the Brookhill Institute of Mathematics

View Calendar

Home | About Us | Contact Us

PROFESSIONAL DEVELOPMENT | APPLICATIONS AND REGISTRATION | ELEMENTARY MATHEMATICS SPECIALIST (EMS) | RESOURCES | CAREERS

Establish a sustainable, statewide effort for high quality mathematics education and learning!

Sign Up for WSMI Updates

First name *

Last name *

Email address *

Organization/School/District *

Sign Up

Brookhill Institute of Mathematics

Module Content

- K-2: Operations and Algebraic Thinking
- K-2: Number and Operations in Base Ten
- 3-5: Operations and Algebraic Thinking
- 3-5: Number and Operations Fractions
- 6-8: Ratios and Proportional Relationships
- 6-8: Expressions and Equations
- 6-8: Statistics
- 9-12: Statistics and Probability for ALL High School Mathematics Teachers
- 8-12: Algebra and Functions with Modeling

Brookhill Institute of Mathematics

WSMI Institutes

K-2 Operations and Algebraic Thinking
and
3-5 Operations and Algebraic Thinking
are CLOSED at Greendale and Sauk Prairie!

3-5 Operations and Algebraic Thinking
And
6-8 Expressions and Equatioins
are CLOSED at New London!

Summer 2016

CESA 3	June 20-24
West Salem	July 11-15
New London	
Sauk Prairie	July 18-22
DC Everest	August 1-5
Greendale	

Brookhill Institute of Mathematics

Thank you!

Brookhill Institute of Mathematics

Mathematics Program Specialists

Sara Brown
sara.brown@brookhillmath.org

Jeff Ziegler
jeff.ziegler@brookhillmath.org

www.brookhillmath.org
www.wsmi.net

Brookhill Institute of Mathematics