Applied Statistics

Domain	**Exploring Data**	
Cluster	**Select appropriate graphical and numerical methods to explore data.**	
Standard(s)	M.ASHS.3	Use graphical displays and summary statistics to make conclusions. Informally develop the concept of statistical significance; a result that is unlikely to have occurred by chance alone. Instructional Note: Focus on statistics as a way of dealing with, not eliminating, inherent randomness.

Content Examples

- Interpreting a back-to-back stem plot: *https://www.youtube.com/watch?v=cmXvqGLYhbg*
- Side-by-side bar graphs: *https://www.youtube.com/watch?v=_0-6YL2U4zQ*
- Segmented bar graph: *https://www.youtube.com/watch?v=j4cAj5LTp08*
- Constructing a boxplot: *https://www.youtube.com/watch?v=635ErzR9Xzc*
- Comparing boxplots: *https://www.youtube.com/watch?v=eUkgf-2NVO8*
- Calculating and interpreting z -scores: *https://www.youtube.com/watch?v=zrbCo9BCxq4*

Relevant Content

Vocabulary

- Back-to-back stem plot: A graphic option for comparing numerical data from two populations where the two sets of data use the same set of stems
- Side-by-side bar graph: Single bar graph where corresponding bars from two or more bar graphs are split into colored segments and placed next to each other
- Segmented bar graph: Graph used to show how a category is divided into subcategories and the relationship of each to the total amount
- Boxplot: Graph used to represent the data set obtained by drawing a horizontal line from $x_{\min}$ to Q_1, drawing a horizontal line from Q_3 to $x_{\max}$, and drawing a box with vertical sides passing through Q_1 and Q_3 with a vertical line inside the box passing through the median, Q_2
- Standard score (z-score): The number of standard deviations a data value is above or below the mean for a specific distribution of values

Formulas

- z-score: $z = \dfrac{value - mean}{standard\ deviation}$
- z-score for samples: $z = \dfrac{x_i - \bar{x}}{s}$
- z-score for populations: $z = \dfrac{x_i - \mu}{\sigma}$

Analyzing Distributions from Information Obtained from a Boxplot

Position of the Median Compared to the Center of the Box	Shape of Distribution
Median is near the center	Approximately symmetric
Median falls to the left of center	Positively skewed (skewed right)
Median falls to the right of center	Negatively skewed (skewed left)

Length of Lines	Shape of Distribution
Lines are about the same length	Approximately symmetric
Right line is larger	Positively skewed (skewed right)
Left line is larger	Negatively skewed (skewed left)

Assessment Links or Tasks

- Summarizing Quantitative Data: *https://www.statsmedic.com/intro-day11*
- *Comparing Quantitative Data Project*
- Old Faithful Task: *https://www.nctm.org/rsmtasks/*
- *Shapes of Data (Penny Activity)*

Project: Comparing Quantitative Data

Use a newspaper, magazine, or Internet sources to locate two sets of quantitative data to compare. Each set of data must have a minimum of 20 values. Use these data sets to calculate appropriate statistical values and use the summary statistics to compare the sets. Graph the data sets in a way that enables you to compare the data and make informal conclusions. Provide written narrative to support your methods and conclusions.

Created by Cheryl Reger

Penny Date Distribution

» Open your roll of 50 pennies.

» Create a visual “dot plot” of your pennies on your desk. Sketch that dot plot below.

» Describe this distribution.

» Find the following.

- Minimum Penny Year
- Maximum Penny Year
- Median Penny Year
- Quartile 1 Penny Year
- Quartile 3 Penny Year
- Inner Quartile Range

» Sketch a box and whisker plot of the penny date data below.

» Describe this distribution.

Created by Adam S. Riazi

» What characteristics are evident about the penny data distribution in the dot plot that are not evident in the box and whisker plot?

» What characteristics are evident about the penny data distribution in the box and whisker plot that are not evident in the dot plot?

» What if we switched our data sheet from “Penny Year” to “Penny Age”? What would happen to your distribution? Your calculated values?

» Your friend finds an Indian Head Penny from 1859 and you trade your oldest penny for this penny.

- What would happen to your mean penny year? Why?
- What would happen to your median penny year? Why?
- What would happen to your penny year standard deviation? Why?
- What would happen to your penny year IQR? Why?
- What statistical property is this demonstrating?

Created by Adam S. Riazi

Penny Activity: Visualizing Data

Place 5 pennies on the top number line where indicated. Sketch a dot plot with your partner when you think you think you have a solution.

1. Move the pennies to make the mean as large as possible.

2. Move the pennies to make the mean as small as possible.

3. Move the pennies to make the mean 3 and the standard deviation as small as possible.

4. Move 2 pennies from the initial position and keep the mean at 3.

5. Move 3 pennies from the initial position and keep the mean at 3.

6. Move 4 pennies from the initial position and keep the mean at 3.

7. Move all 5 pennies from the initial position and keep the mean at 3.

8. Move the pennies to make the standard deviation as large as possible.

9. Move the pennies so the mean is 3 and the standard deviation is as large as possible.

10. How many arrangements can you find where the median is 3?

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Place 11 pennies on the top number line where indicated. Sketch a dot plot with your partner when you think you think you have a solution.

11. Find the 5-number summary of the data set.

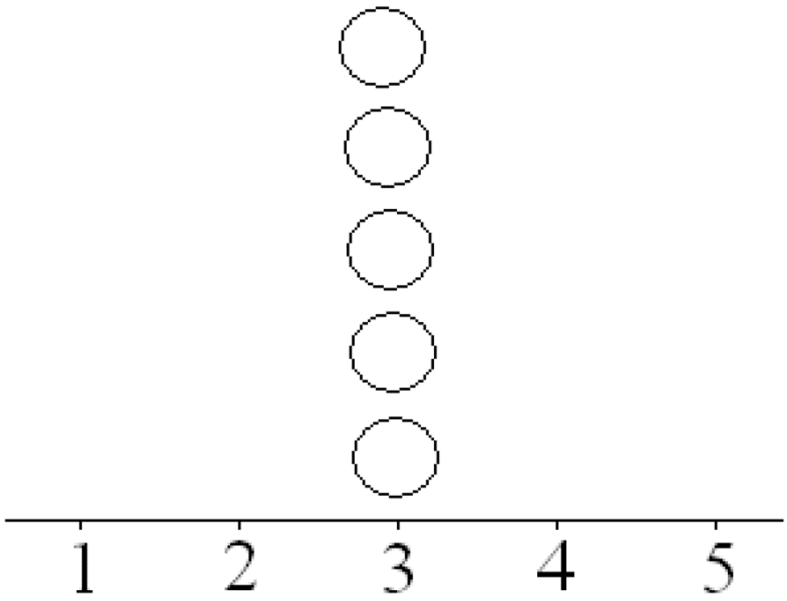
12. Draw a box and whisker plot.

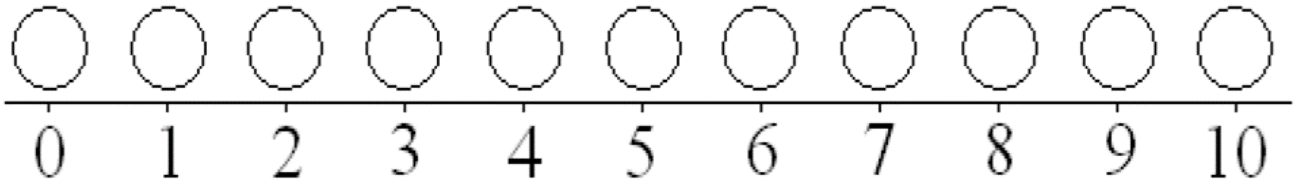
13. Move pennies to keep the box and whisker plot unchanged but make the mean as large as possible.

14. Move pennies to keep the box and whisker plot unchanged but make the mean as small as possible.

15. Move pennies to keep the box and whisker plot unchanged but make the standard deviation as large as possible.

16. Move pennies to keep the box and whisker plot unchanged but make the standard deviation as small as possible.





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