Grade Level/Course: Grade 6, Grade 7

Lesson/Unit Plan Name: Comparing Data Displays

Rationale/Lesson Abstract: This lesson will focus on the progression of data displays from grades 6 through grades 7. First by comparing displays of numerical data in dot plots, histograms, and box plots. Then it will go on to compare two populations with similar variabilities represented using the same type of display.

Timeframe: This lesson covers two class periods and two grades. The grade 6 portion of this lesson is designed to be used in one class period and the grade 7 portion of this lesson is designed to be used in one class period.

Common Core Standard(s):

Summarize and describe data distributions.

6.SP.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots.

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.*

Instructional Resources/Materials: Warm Up (on last page), Something to Measure Students' Heights, Dice, Straight Edges (to create displays)

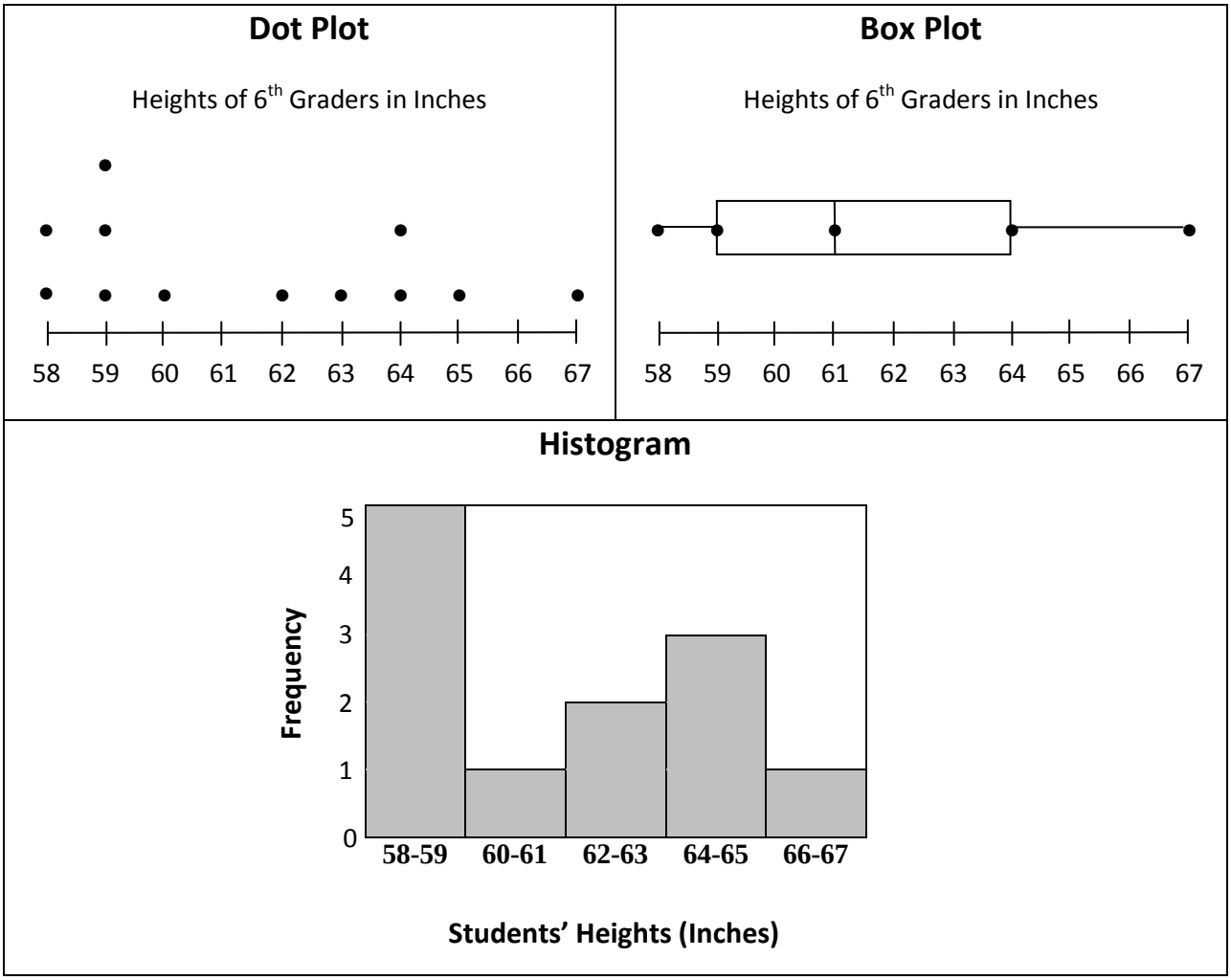
Activity/Lesson:

Initially this lesson will focus on having students compare numerical data that is displayed in dot plots (line plots), box plots (box & whisker plots), and histograms. This grade 6 portion of the lesson is designed to be a wrap-up after having taught all three displays.

Example 1: (grade 6 lesson)
Twelve students in Ms. Jackson's third period 6th grade math class were chosen at random and their heights were measured in inches. Their heights were measured as:

59, 65, 60, 64, 67, 58, 59, 63, 62, 64, 59, and 58.

Use this data to create a dot plot, box plot, and a histogram with your students below.



Given only the three displays from Example 1, have students answer the following questions using the **Sage & Scribe** activity. It is sometimes called "Brain and the Hand". Students take turns being the Sage/Brain and Scribe/Hand.

Setup: Partner A is the Sage/Brain and Partner B is the Scribe/Hand. Have students use one worksheet to help ensure they are working together.

- The Sage/Brain tells the Scribe/Hand what to write.
- The Scribe/Hand writes only what the Sage/Brain says. If the Sage/Brain doesn't know what to do or makes a mistake, the Scribe/Hand may ask questions or give hints for guidance
- Students switch roles for the next problem (or next method)

Partner A) Which displays have each of the individual data represented?

Partner B) Which displays can be used to find the median and the interquartile range? If any cannot be used, explain why not.

Partner A) Which displays can be used to find the mean and mean absolute deviation? If any cannot be used, explain why not.

Partner B) Which displays can be used to find the range? If any cannot be used, explain why not.

Partner A) Do these displays clearly skew left, skew right, or show symmetry? If any are different, explain their differences.

Partner B) What conclusions can be drawn because of the length of the whiskers on the box plot?

Partner A) What conclusions can be drawn because of the location of the median on the box plot?

Partner B) Does this seem like a large enough sample size to make reliable conclusions about the heights of 6^{th} graders as a whole?

Partner A) If you could only choose one display to use on a project, which display would you choose out of these three and why?

Sample Answers:

Partner A) Which displays have each of the individual data represented?
The dot plot is the only one that displays each of the individual data.

Partner B) Which displays can be used to find the median and the interquartile range? If any cannot be used, explain why not.
The box plot and the dot plot can be used to find the median and interquartile range. The histogram does not show individual data or the median and interquartile range because it is displaying intervals of data.

Partner A) Which displays can be used to find the mean and mean absolute deviation? If any cannot be used, explain why not.
The mean and mean absolute deviation can be found using the data displayed in the dot plot only. The box plot and histogram do not show individual data and therefore cannot be used to find these two measures.

Partner B) Which displays can be used to find the range? If any cannot be used, explain why not.
The dot plot and box plot can be used to find the range because one can identify the minimum and maximum values. One can tell that all students sampled are between 58 and 67 inches in height using the histograms but it is not clear that 58 is the minimum or 67 is the maximum and therefore one cannot find the range using the histogram.

Partner A) Do these displays clearly skew left, skew right, or show symmetry? If any are different, explain their differences.
All of the displays show that the data is not symmetric, it seems to skew left slightly in each of the displays. They all show a cluster of students between 58 and 60 inches in height.

Partner B) What conclusions can be drawn because of the length of the whiskers on the box plot?
The short whisker on left side of the box plot indicates a cluster and the long whisker on the right side of the box plot indicates the data is more spread out.

Partner A) What conclusions can be drawn because of the location of the median on the box plot?
The median is not located in the middle of the box, therefore the data is not symmetric.

Partner B) Does this seem like a large enough sample size to make reliable conclusions about the heights of 6^{th} graders as a whole?
It would be a more accurate representation of the height of 6^{th} graders if more people were sampled.

Partner A) If you could only choose one display to use on a project, which display would you choose out of these three and why?
Students' answers will vary, what is important is their reasoning, justifications and explanations as to why they choose the display they do.

Matching Activity Handout #1

Side-by-Side Comparison of Displays

	Dot Plot	Box Plot	Histogram
Characteristics			
Data Shown			
Measures of Center			
Measures of Variability			
Other Measures			

Matching Activity Handout #2 (Cut Outs)

(Note: There are 3 more cut outs than needed.)

Only measures of variability able to find are range and interquartile range (not mean absolute deviation).	Lists all of the individual data.	Also able to find minimum, 1^{st} quartile, 3^{rd} quartile, maximum, and presence of outliers.
Lists all of the individual data.	Measures of variability cannot be found.	Only measure of center able to find is median (not mean).
Able to find measures of center (mean and median).	Does not show individual data.	No measure of center can be found.
Displays each set of data as a dot or an x over a number line.	Summarizes data with a box and whiskers over a number line, showing distribution and spread.	Unable to find the minimum, 1^{st} quartile, 3^{rd} quartile, maximum, or outliers.
Does not show individual data.	Also able to find minimum, 1^{st} quartile, 3^{rd} quartile, maximum, and presence of outliers.	Able to find measures of variability (range, interquartile range and mean absolute deviation).
Type of bar graph used to display numerical data organized into equal intervals.	Does not show individual data.	Able to find measures of center (mean and median).

Matching Activity Key

Side-by-Side Comparison of Displays

	Dot Plot	**Box Plot**	**Histogram**
Characteristics	Displays each set of data as a dot or an x over a number line.	Summarizes data with a box and whiskers over a number line, showing distribution and spread.	Type of bar graph used to display numerical data organized into equal intervals.
Data Shown	Lists all of the individual data	Does not show individual data.	Does not show individual data.
Measures of Center	Able to find measures of center (mean and median).	Only measure of center able to find is median (not mean).	No measure of center can be found.
Measures of Variability	Able to find measures of variability (range, interquartile range and mean absolute deviation).	Only measures of variability able to find are range and interquartile range (not mean absolute deviation).	Measures of variability cannot be found.
Other Measures	Also able to find minimum, 1^{st} quartile, 3^{rd} quartile, maximum, and presence of outliers.	Also able to find minimum, 1^{st} quartile, 3^{rd} quartile, maximum, and presence of outliers.	Unable to find the minimum, 1^{st} quartile, 3^{rd} quartile, maximum, or outliers.

You Try #1:

Roll one die 15 times and record your results. Create a dot plot, box plot and a histogram using your data and then answer the questions below.

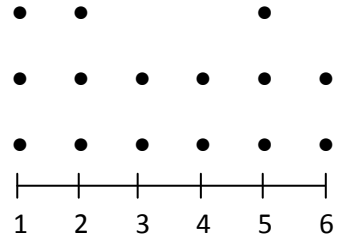
NOTE!! The following is only Sample Data.
Have your students create their own data and displays.

Sample Data: 1, 1, 1, 2, 2, 2, 3, 3, 4, 4, 5, 5, 5, 6, and 6

Displays for sample data:

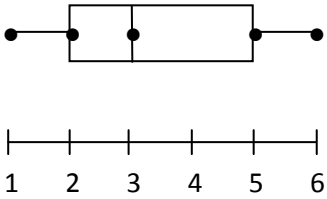
Dot Plot

Numbers Rolled on a Die

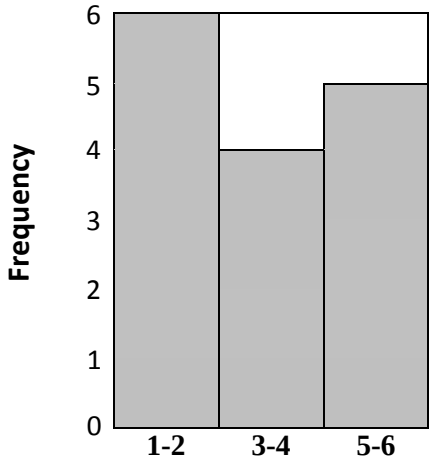


Box Plot

Numbers Rolled on a Die



Histogram



Numbers Rolled on a Die

Given only the three displays from You Try 1, answer the following using complete sentences.

1) What is the mean and mean absolute deviation of the data?

2) What is the interquartile range?

3) Do these displays clearly skew left, skew right, or show symmetry? If any are different explaining their differences.

4) What conclusions can be drawn because of the length of the whiskers on the box plot?

5) What conclusions can be drawn because of the location of the median on the box plot?

6) Does this seem like a large enough sample size to make reliable conclusions about the distribution of numbers rolled using one die?

7) If you could only choose one display to use on a project, which display would you choose out of these three?

Sample Answers to the Sample Data only! Students' answers will vary based on their data.

Given only the three displays from You Try 1, answer the following using complete sentences.

1) What is the mean and mean absolute deviation of the data?
   The mean is $3\frac{1}{3}$ ***and the mean absolute deviation is*** $1\frac{5}{9}$***.***

2) What is the interquartile range?
   The interquartile range is 3.

3) Do these displays clearly skew left, skew right, or show symmetry? If any are different explaining their differences.
   The displays seem ever so slightly skewed left. One might argue that they are mildly symmetric.

4) What conclusions can be drawn because of the length of the whiskers on the box plot?
   Both whiskers seem to be about the same size which show that the data is evenly spread on each side of the interquartile range.

5) What conclusions can be drawn because of the location of the median on the box plot?
   The median is not located in the middle of the box, it is slightly left of center. Therefore the data does not seem symmetric.

6) Does this seem like a large enough sample size to make reliable conclusions about the distribution of numbers rolled using one die?
   The data seems to be close to what one would expect. However, it would be a more accurate and reliable representation if the die was rolled more times.

7) If you could only choose one display to use on a project, which display would you choose out of these three?
   Students' answers will vary. Most important is their reasoning, justifications and explanations as to why they choose the display they do.

Activity/Lesson continued:

Example 2: (Grade 7 lesson)
Twelve students in Ms. Jackson's third period 6th grade math class were chosen at random and their heights were measured in inches. Their heights were measured as:

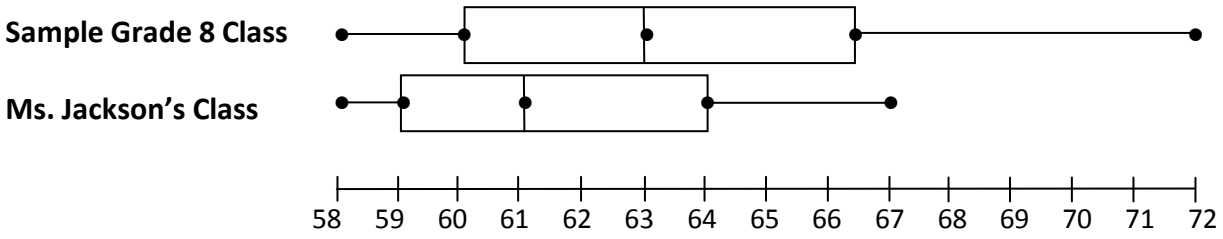
59, 65, 60, 64, 67, 58, 59, 63, 62, 64, 59, and 58

Randomly choose twelve students in your class and record their heights in inches.

Sample Results from 8th grade class: 58, 63, 68, 66, 59, 67, 62, 63, 60, 72, 60, and 63

Create a double box plot for the two sets of data below:

Sample Double Box Plot



1) What is the difference between the medians of the two data sets?

2) What is the difference between the ranges of the two sets of data?

3) What is the difference between the interquartile ranges of the two sets of data?

4) Describe how the data is skewed or symmetric for each sample.

5) What conclusions can be made about the heights of 6th graders versus 8th graders based on these box plots?

Sample Answers to the Sample Data only! Students' answers will vary based on their data.

1) What is the difference between the medians of the two data sets?

The two data sets have medians of 61 and 63. Therefore, the difference between them is 2.

2) What is the difference between the ranges of the two sets of data?

The two data sets have ranges of 14 and 9. Therefore, the difference between them is 5.

3) What is the difference between the interquartile ranges of the two sets of data?

The two data sets have interquartile ranges of 6.5 and 5. Therefore, the difference between them is 1.5.

4) Describe how the data is skewed or symmetric for each sample.

The data for the 6th grade class seems to be skewed slightly to the left for the interquartile range but clustered on the left whisker and spread on the right whisker. The data for the 8th grade sample seems to be symmetric for the interquartile range but clustered on the left whisker and spread on the right whisker.

5) What conclusions can be made about the heights of 6th graders versus 8th graders based on these box plots?

Based on these box plots, I would conclude that between 6th and 8th grade some of the students show substantial growth while some students remain about the same height.

You Try 2:
Roll one die 15 times and record your results. This will be the first set of data.
Then roll one die another 15 times and record your results. This will be your second set of data.

Sample Data

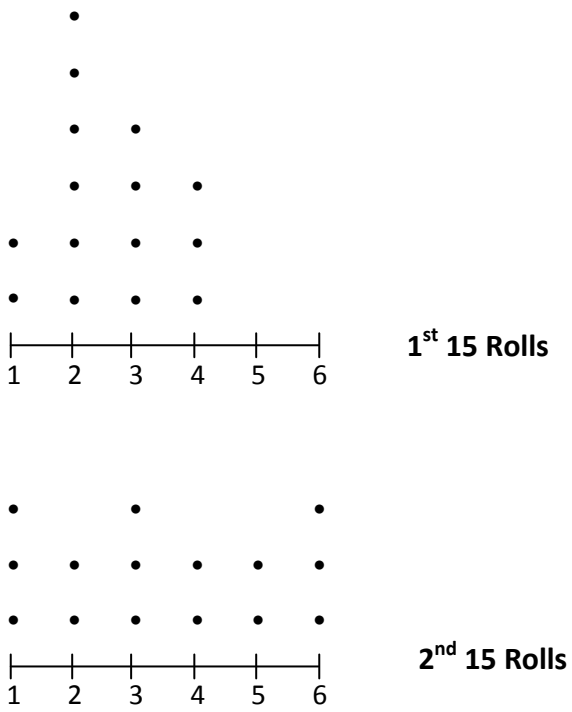
First set of data: 1 , 1, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, and 4.

Second set of data: 1, 1, 1, 2, 2, 3, 3, 3, 4, 4, 5, 5, 6, 6, and 6.

Create a double dot plot for the two sets of data below:

Sample Double Dot Plot

Numbers Rolled on a Die



1) What are the means of the two data sets?

2) What is the difference between the ranges of the two sets of data?

3) Describe how the data is skewed or symmetric for each sample.

4) What conclusions can be made about the 1st 15 rolls versus the 2nd 15 rolls based on these dot plots?

Sample Answers to the Sample Data only! Students' answers will vary based on their data.

1) What are the means of the two data sets? What is the difference between their means?

The mean of the first data set is $2\frac{8}{15}$ ***and the mean of the second data set is*** $3\frac{7}{15}$***. Therefore their difference is*** $\frac{14}{15}$***.***

2) What is the difference between the ranges of the two sets of data?

The range of the first data set is 3 and the range of the second data set is 5, so the difference between the ranges is 2.

3) Describe how the data is skewed or symmetric for each sample.

The data in the first display is skewed left and the data in the second display is mildly symmetric.

4) What conclusions can be made about the 1^{st} 15 rolls versus the 2^{nd} 15 rolls based on these dot plots?

The first 15 rolls had a surprising skew to the left whereas the second 15 rolls were more like what would be expected.

You Try 3:

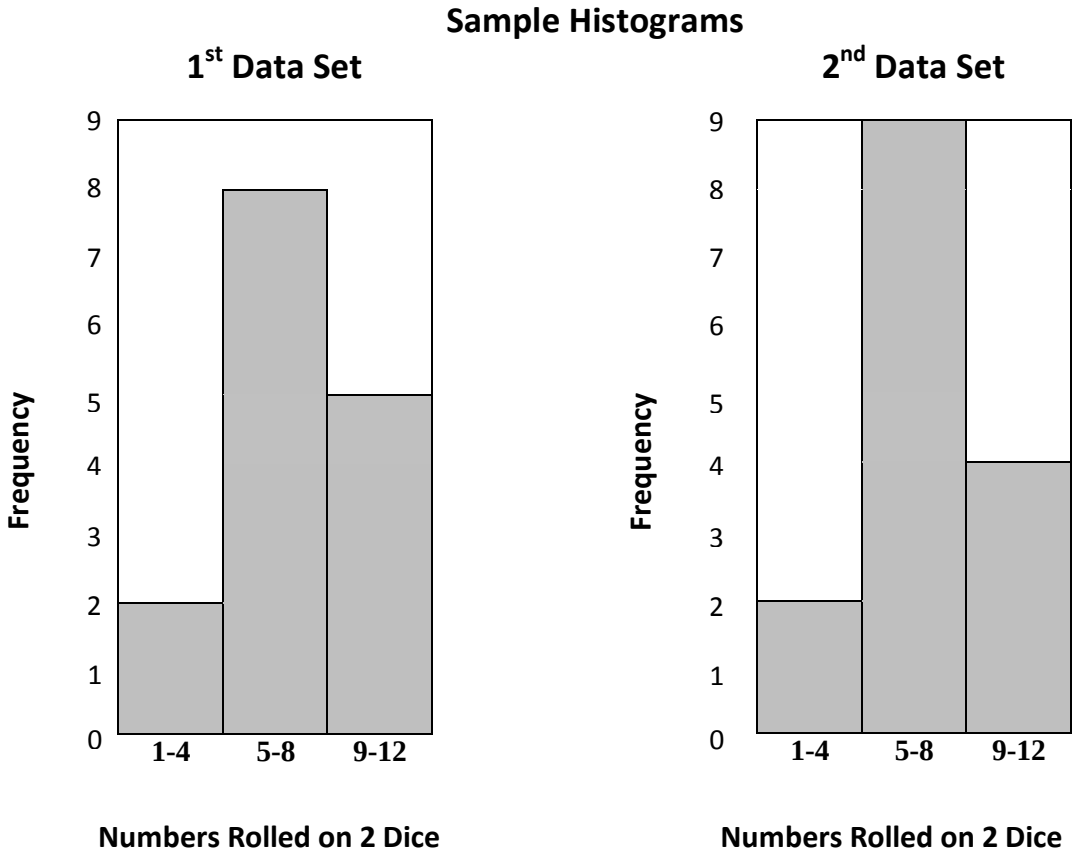
Roll two dice 15 times and record your results. This will be the first set of data.
Then roll two dice another 15 times and record your results. This will be your second set of data.

Sample Data

First set of data: 2, 4, 5, 5, 6, 6, 7, 7, 7, 8, 9, 9, 10, 10, and 12.

Second set of data: 4, 4, 5, 5, 6, 6, 7, 7, 7, 8, 8, 9, 9, 11, and 12.

Create two histograms side-by-side for the two sets of data below:



1) Compare the skew or symmetry of the two histograms.

2) What conclusions can be made about the 1st 15 rolls versus the 2nd 15 rolls based on these histograms?

Sample Answers to the Sample Data only! Students' answers will vary based on their data.

1) Compare the skew or symmetry of the two histograms.

Based on the histograms, the data seems mildly symmetric. Possibly slightly skewed right. However the intervals are misleading because it isn't possible to roll a 1 with two dice.

2) What conclusions can be made about the 1st 15 rolls versus the 2nd 15 rolls based on these histograms?

Based on the histograms, the results seem very similar. Also, it is what one would expect given that rolling 5 – 8 is more likely than rolling the other two intervals.

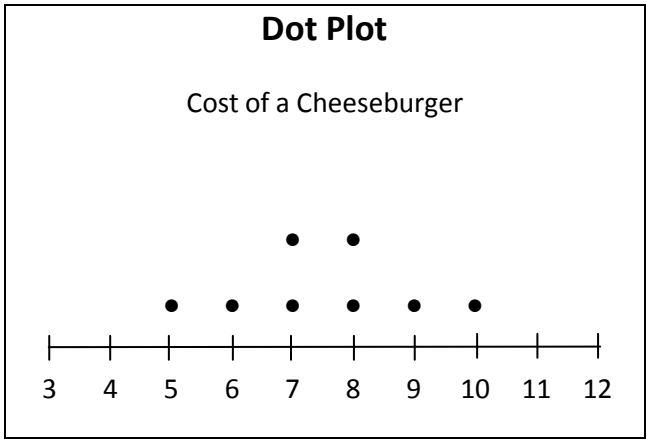
More Specific Information Presented Side-by-Side for each Display

Dot Plot	**Box Plot**	**Histogram**
Displays each set of data as a dot or an x over a number line.	Summarizes data over a number line, showing distribution and spread. Separates data into four parts. Even though they may differ in length, each part or quartile is 25% of the data. The box shows the middle 50% of the data, the interquartile range. The median does not always split the box in half because the data may be clustered toward one of the quartiles. Short whiskers indicate concentrated data in the first or fourth quartiles. Long whiskers indicate that the data is spread out in the first or fourth quartiles. Outliers represented with an asterisk and whiskers are not drawn to them.	Type of bar graph used to display numerical data organized into equal intervals. Intervals are equal which is why bar widths are equal. Intervals with a frequency of 0 have a bar height of 0. Allows us to see how many pieces of data (frequency distribution) are in each interval. Scale includes all numbers. Intervals should organize data to make it easy to compare. More visual and therefore more useful than a frequency table when trying to show a general trend.

Assessment:

Grade 6:

The cost in dollars of a cheeseburger at 8 different restaurants is displayed on a dot plot below.



Based on the dot plot above, indicate whether the following are True or False.

1) The median is 7.5. Ⓐ**True** Ⓑ**False**

2) The range is 9. Ⓐ**True** Ⓑ**False**

3) The interquartile range is 2. Ⓐ**True** Ⓑ**False**

4) The mean absolute deviation is 1.5. Ⓐ**True** Ⓑ**False**

5) The 1st quartile is 6.5. Ⓐ**True** Ⓑ**False**

Answer Key to Warm Up Above

1) The median is 7.5. ●**True** Ⓑ**False**

2) The range is 9. Ⓐ**True** ●**False**

3) The interquartile range is 2. ●**True** Ⓑ**False**

4) The mean absolute deviation is 1.5. Ⓐ**True** ●**False**

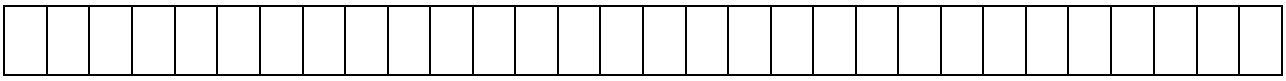
5) The 1st quartile is 6.5. ●**True** Ⓑ**False**

Assessment:

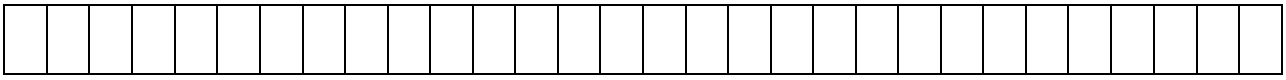
Grade 7:

Assessment Results in a Double Box Plot

Scores from One Class or One Class' First Assessment

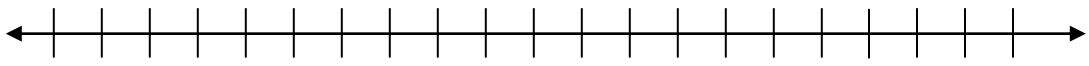


Scores from Another Class or Same Class' Second Assessment



	What is the minimum?	What is the lower quartile?	What is the median?	What is the upper quartile?	What is the maximum?
1st Class	_____	_____	_____	_____	_____
2nd Class or 2nd Assessment	_____	_____	_____	_____	_____

Make a double box plot with the five number summaries below:



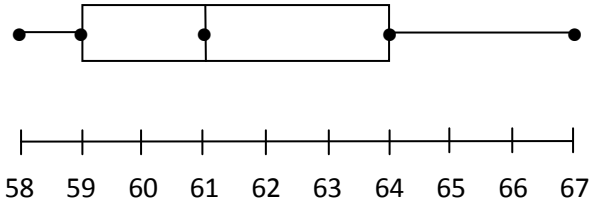
1. What conclusions can you make when comparing the two box plots that you created above? Justify and explain your reasoning.

Warm-Up

6.SP.5

Given the box plot below, indicate which of the following are True or False:

Heights of 6th Graders in Inches



1) The median is 61.5. Ⓐ**True** Ⓑ**False**

2) The range is 5. Ⓐ**True** Ⓑ**False**

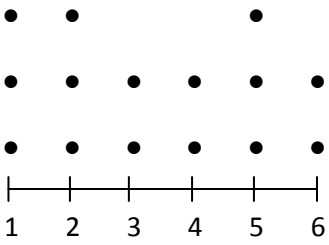
3) The interquartile range is 9. Ⓐ**True** Ⓑ**False**

4) The 3rd quartile is 61. Ⓐ**True** Ⓑ**False**

5) 50% are between 59 and 64 inches. Ⓐ**True** Ⓑ**False**

6.SP.5c

Numbers Rolled on a Die



Given the dot plot above, find the:

mean_____

median_____

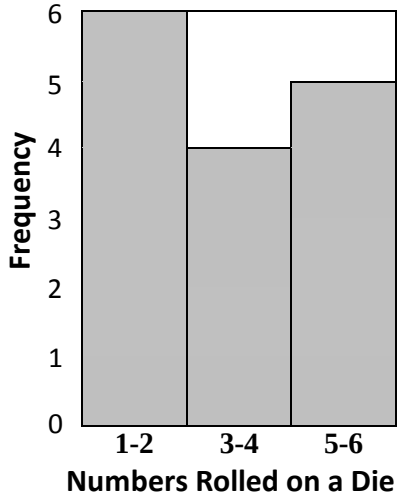
first quartile_____

third quartile_____

range_____

Interquartile range_____

8.F.4



Given the histogram on the left, how many times did this person roll a 1, 2, 3, or 4?

_____

6.SP.5c

Given the following set of data,

3, 4, 5, 6, 6, 6, 8, 10

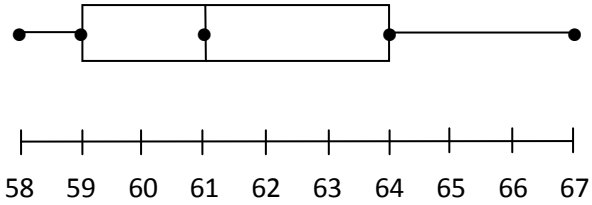
what is the mean absolute deviation?

Warm-Up Answer Key

6.SP.5

Given the box plot below, indicate which of the following are True or False:

Heights of 6th Graders in Inches



1) The median is 61.5. Ⓐ**True** ●**False**

2) The range is 5. Ⓐ**True** ●**False**

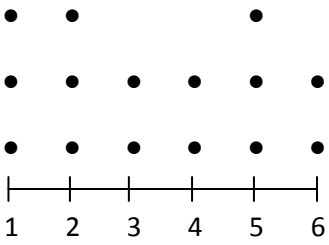
3) The interquartile range is 9. Ⓐ**True** ●**False**

4) The 3rd quartile is 61. Ⓐ**True** ●**False**

5) 50% are between 59 and 64 inches. ●**True** Ⓑ**False**

6.SP.5c

Numbers Rolled on a Die



Given the dot plot above, find the:

mean $3\frac{1}{3}$

median 3

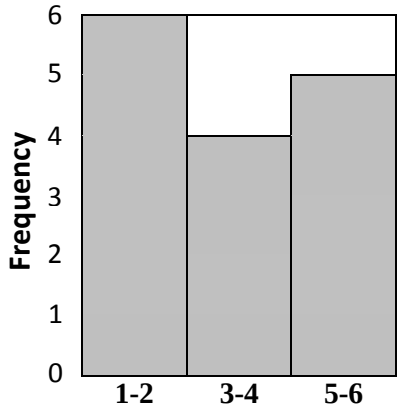
first quartile 2

third quartile 5

range 5

Interquartile range 3

8.F.4



Given the histogram on the left, how many times did this person roll a 1, 2, 3, or 4?

10

6.SP.5c

Given the following set of data,

3, 4, 5, 6, 6, 6, 8, 10

what is the mean absolute deviation?

The mean absolute deviation is 1.5.