

About the Lesson

In this activity, students will create and analyze box plots and histograms. They will find measures of central tendency and identify which best describes the data set. As a result, students will:

- Use histograms to predict the behavior of the box plot graph of a data set.
- Determine that the mean is more affected by data distribution than the median.

Vocabulary

- mean
- median
- histogram
- box plot
- skewed distribution
- symmetric distribution
- outlier

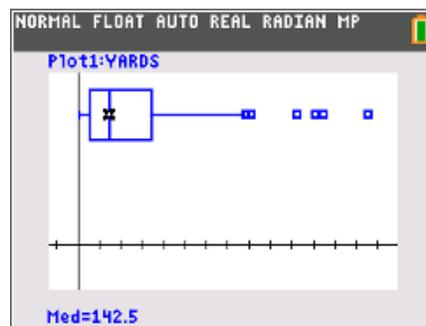
Teacher Preparation and Notes

- Teacher should know how to graph a histogram and box plot using the handheld. This is described in the teacher notes.
- Students will have different opinions about the centers. Allow discussion, asking for justifications to enable students to better determine how a mean and median can be estimated from a graph. While this activity can be done independently with a basic knowledge of graphing data with the handheld, it is intended to be a teacher-led activity with class discussion. The questions on the student worksheet can be used as discussion questions.

Activity Materials

- Compatible TI Technologies:
 - TI-84 Plus*
 - TI-84 Plus Silver Edition*
 -  TI-84 Plus C Silver Edition
 -  TI-84 Plus CE

* with the latest operating system (2.55MP) featuring MathPrint™ functionality.



Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

Lesson Files:

- Graph_My_Center_Student.doc
- Graph_My_Center_Student.pdf
- AVG.8xl
- YARDS.8xl
- LONG.8xl
- TDS.8xl



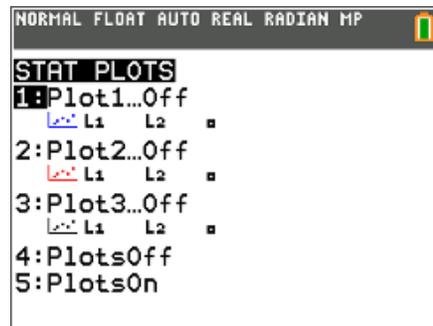
Tech Tip: Before beginning the activity, the lists AVG.8xl, YARDS.8xl, LONG.8xl, TDS.8xl need to be transferred to the students' calculators via handheld-to-handheld transfer or transferred from the computer to the calculator via TI-Connect™ CE software.

Problem 1 – Graphing Histograms

Each row of the 4 lists contains data about a single professional football player. Have students graph each of the variables using the step-by-step directions below. Students should describe the shape of the graph and estimate the center (both mean and median). The answers can be written on the student worksheet or part of a class discussion.

Students may need a review of terms to describe a distribution such as symmetric, uniform, and skewed. Outliers, while not yet defined, should be discussed.

To make a histogram for the receivers' total yards ran, found in the **YARDS** list, students need to press $\boxed{2nd} \boxed{y=}$ to open the StatPlot menu. Then choose **Plot1**.

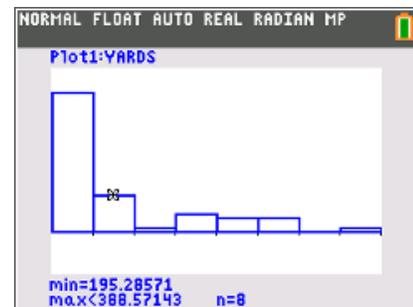


Turn Plot1 **On**. Select **Histogram** as the Plot Type, and select **YARDS** as the XList.

To select YARDS as the XList, students can type it using the ALPHA keys, or press $\boxed{2nd} \boxed{stat}$ and choose it from the **NAMES** menu.



To view the histogram, students can press \boxed{zoom} and select **9:ZoomStat**. This will automatically adjust the graphing window to fit the histogram. Students can press \boxed{trace} to see the details of the histogram.





1. Graph the histogram for the receivers' total number of yards, found in the list **YARDS**.

a. Describe the shape of the histogram.

Answer: Skewed right.

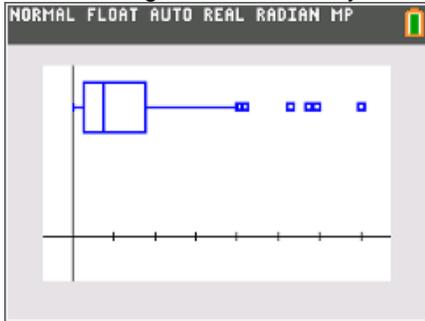
b. Estimate the mean: _____ and the median: _____.

Answers: 290; 140

c. Does the mean or the median best describe the data set? Why?

Answer: The median because the graph seems to contain some outliers to the right, and the median, unlike the mean, is immune to this.

d. Based on the histogram, draw what you think the box plot would look like.



Answer:

Students should then change the XList of Plot1 to **AVG** and select **ZoomStat** to view the histogram. Then should repeat this process for the lists **LONG** and **TDS**. As students view each histogram, they should answer the questions on the student worksheet.

2. Graph the histogram for the receivers' average number of yards, found in the **AVG** list.

a. Describe the shape of the histogram.

Answer: symmetrically distributed

b. Estimate the mean: _____ and the median: _____.

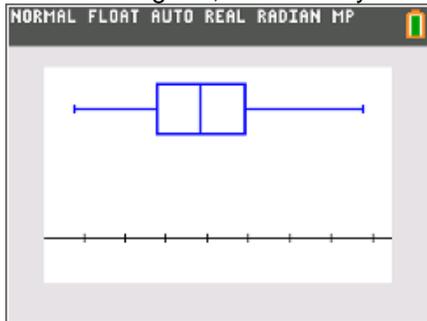
Answers: 10; 10

c. Does the mean or the median best describe the data set? Why?

Answer: The mean as the graph appears to be symmetrically distributed



- d. Based on the histogram, draw what you think the box plot would look like.



Answer:

3. Graph the histogram for the receivers' longest run of the season, found in the **LONG** list.
 a. Describe the shape of the histogram.

Answer: skewed right

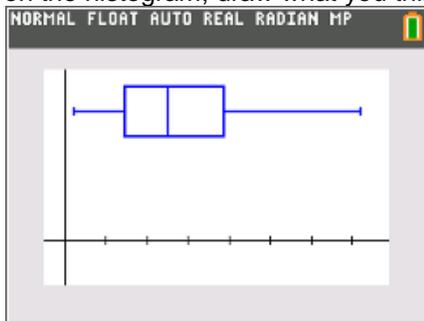
- b. Estimate the mean: _____ and the median: _____.

Answers: 29; 26

- c. Does the mean or the median best describe the data set? Why?

Answer: The median because of the possible outliers associated with the graph being skewed right.

- d. Based on the histogram, draw what you think the box plot would look like.



Answer:

4. Graph the histogram for the receivers' touchdowns, found in the list **TDS**.
 a. Describe the shape of the histogram.

Answer: The graph is skewed right.

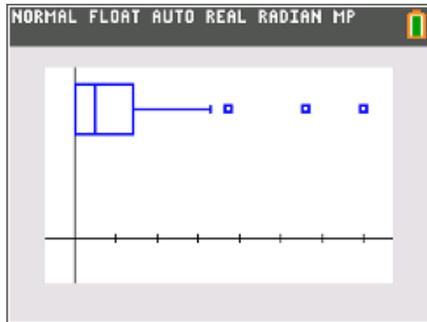
b. Estimate the mean: _____ and the median: _____.

Answers: 2; 1

c. Does the mean or the median best describe the data set? Why?

Answer: The median because the data is skewed.

d. Based on the histogram, draw what you think the box plot would look like.



Answer:

Problem 2 – Graphing Box Plots

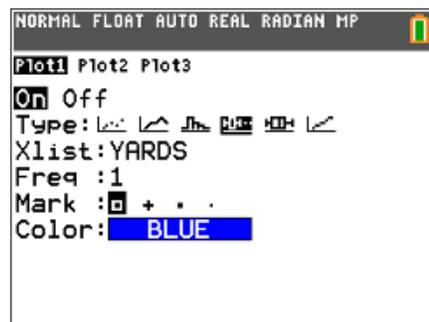
Students are to graph each list as a box plot and calculate the mean and media using the step-by-step directions below. Discuss how the shape of the histogram determines the lengths of the 4 parts of the box plot. This discussion can be recorded in Problem 3 on the worksheet.

Discuss how the shape of a symmetric or skewed histogram is seen in a box plot, how outliers are denoted, and where the mean and median are located.

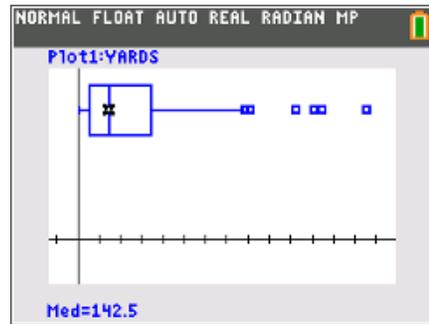
Students are to compare their estimations for the mean and median with the actual values. Discuss the reasons for the discrepancies between the estimations and the calculations. Emphasize the relationship between the graph and the position of the mean versus the median.

To graph the box plot for YARDS list, open the StatPlot menu and choose **Plot1**.

Turn **Plot1** On. Select **Box Plot with Outliers Included** as the Plot Type, and select **YARDS** as the XList.



To view the box plot, students can press `zoom` and select **ZoomStat**. This will automatically adjust the graphing window to fit the box plot. Use the `trace` key and arrows to move among the min, lower quartile, median, upper quartile, max, and outliers.



5. Graph the box plot for the total number of yards.
 a. How does your box plot compare to the calculator's?

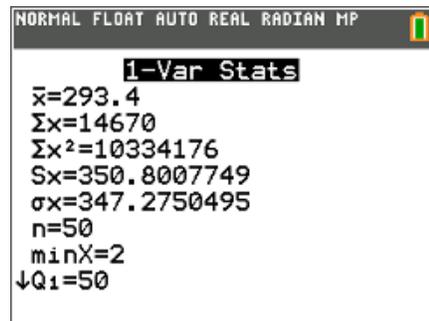
Sample Answer: My box plot was more centered than the calculators'

- b. Where is the median located on the box plot? Where do you think the mean will be?

Answer: The median is left of the center of the box. The mean will be near the right edge of the box.

To calculate the mean and median of the yards ran, students can use the calculator's **1-Var Stats** command to find the mean and median of the yards ran.

Press `stat`, right arrow to the CALC menu, and select **1:1-Var Stats**. Then either type the name of the list using the ALPHA keys or press `2nd stat` to select the list. Have the students leave **FreqList** blank and then arrow down to Calculate and press `enter`.



- c. Calculate the mean and the median. How do your estimates compare?

Answer: The mean is 293.4 and the median is 142.5.

Students should repeat this process for the lists **AVG**, **LONG**, and **TDS**.



6. Graph the box plot for the averages.

a. How does your box plot compare to the calculator's?

Possible Answer: Mine was very close. My lower quartile was larger than the one on the calculator.

b. Where is the median located on the box plot? Where do you think the mean will be?

Answer: The median is right in the middle of the box plot. The mean will be slightly to the right of the median.

c. Calculate the mean and the median. How do your estimates compare?

Sample Answer: The mean is 10.16, the median is 10. Both of my values were the same number and close to 10.

7. Graph the box plot for the longest run of the season.

a. How does your box plot compare to the calculator's?

Sample Answer: Mine was very close. I had the IQR symmetrical, while the calculator had the right side more spread out.

b. Where is the median located on the box plot? Where do you think the mean will be?

Answer: The median is slightly to the left of the box center. The mean will be slightly to the right of the median

c. Calculate the mean and the median. How do your estimates compare?

Sample Answer: The mean is 28.98 and the median is 26. I had the mean further away from the median than the calculated values indicated.

8. Graph the box plot for the number of touchdowns.

a. How does your box plot compare to the calculator's?

Sample Answer: My box plot has some parts to the left of the IQR, but the calculator's did not have anything to the left of the IQR.

b. Where is the median located on the box plot? Where do you think the mean will be?

Answer: The median is to the left of the center of the box. The mean will be near the right edge of the box.



c. Calculate the mean and the median. How do your estimates compare?

Sample Answer: The mean is 2.02 and the median is 1. My estimates were close.

Problem 3 – Conclusions

9. How does the shape of the histogram determine the shape of the box plot?

Answer: If a histogram is symmetrical, then the box plot will be symmetrical. If a histogram is skewed, then the box plot will also be skewed in the same direction.

10. What is the shape of the histogram if the value of the mean is approximately the same as the value of the median?

Answer: Symmetrical

11. What is the shape of the histogram if the value of the mean is greater than the value of the median?
Less than?

Answer: If the mean is greater than the median, then the graph will be skewed right. If the mean is less than the median, then the graph will be skewed left.

12. What effect do outliers have on the shape of the histogram and box plot?

Answer: Outliers contribute to the skewedness of both types of graphs.

13. What effect do outliers have on the value of the mean? Median?

Answer: Outliers pull the mean in their direction, while they have no effect on the median.