

SMART Goals Packet #6

Box – & – Whisker Plots

Student: _____ Date: _____ Period: _____

Standards

- A.S.5 Construct a histogram, cumulative frequency histogram, and a box-and-whisker plot, given a set of data
- A.S.6 Understand how the five statistical summary (minimum, maximum, and the three quartiles) is used to construct a box-and-whisker plot
- A.S.9 Analyze and interpret a frequency distribution table or histogram, a cumulative frequency distribution table or histogram, or a box-and-whisker plot
- A.S.11 Find the percentile rank of an item in a data set and identify the point values for first, second, and third quartiles

When describing a set of data, without listing all of the values, we have seen that we can use measures of location such as the mean and median. It is also possible to get a sense of the data's spread of data by examining a five statistical summary (or five number summary) the (1) *minimum*, (2) *maximum*, (3) *median* (or *second quartile*), (4) the *first quartile*, and (5) the *third quartile*. Such information will show the extent to which the data is located near the median or near the minimum or maximum.

Part I. *Finding the Five Statistical Summary*

Minimum	First or Lower Quartile Q₁	Median or Second Quartile Q₂	Third or Upper Quartile Q₃	Maximum
Lowest value of the ordered data	Middle of lower half of data	Middle of all the ordered data	Middle of upper half of data	Highest value of ordered data
	25 th percentile	50 th percentile	75 th percentile	

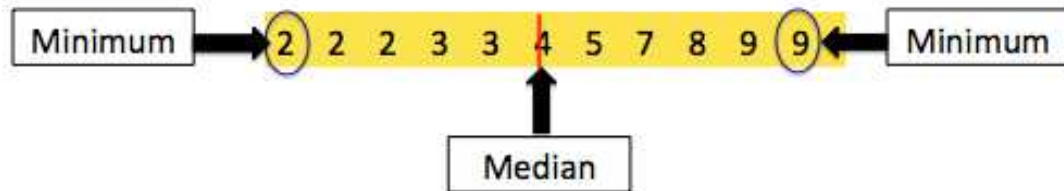
Example 1: Find the Five Statistical Summary for the following data.

4, 5, 3, 7, 2, 9, 3, 2, 8, 2, 9

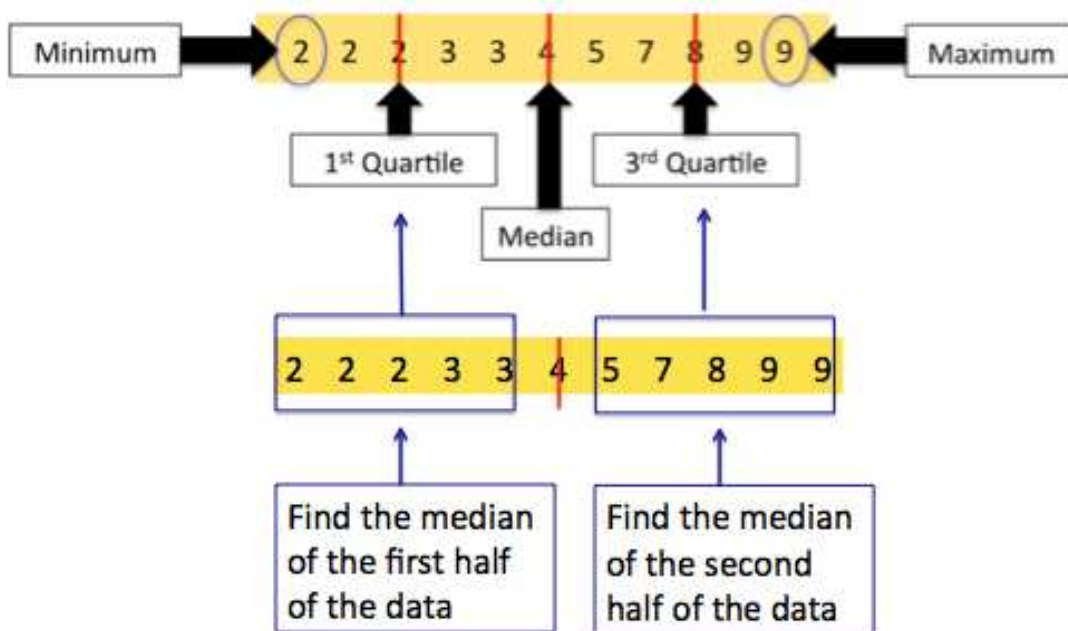
Step 1: Arrange the data in numerical order.

2 2 2 3 3 4 5 7 8 9 9 9

Step 2: Find the minimum, maximum, and median.



Step 3: Find the first and third quartiles.



Solution: The minimum value is 2. The lower quartile is 3.
The maximum value is 9. The upper quartile is 8.
The median is 4.

★ **Range** – the difference between the maximum and minimum value of the data is the

$$\text{Range} = \text{maximum} - \text{minimum}$$

For the above data set, the **range** = $9 - 2 = 7$

Example 2. Find the five statistical summary and the range of the following data.

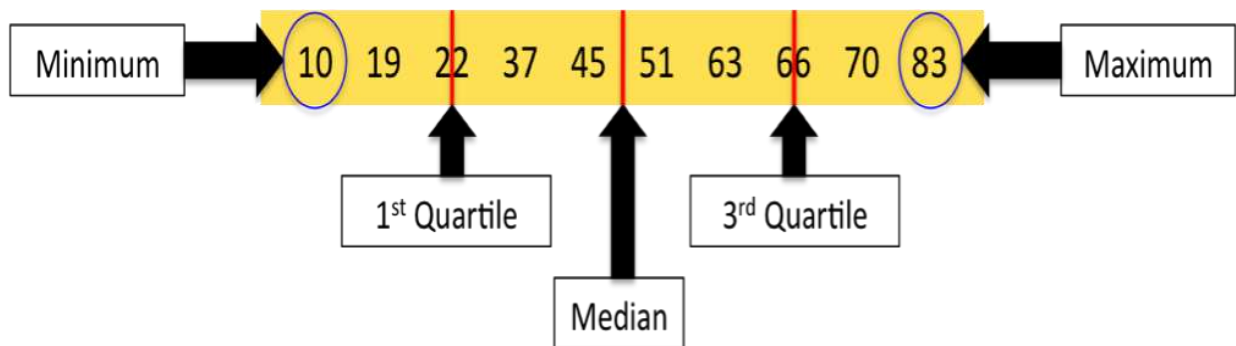
10, 19, 22, 37, 45, 51, 63, 66, 70, 83

Step 1: Arrange the data in numerical order.

We don't need to rearrange the data because it is already in numerical order.

10, 19, 22, 37, 45, 51, 63, 66, 70, 83

Step 2: Find the Five Statistical Summary.



Solution: Minimum: 10

First Quartile: 22

Median: 48

Since there are two middle values, 45 and 51, the median is the average (mean) of the two middle numbers.

$$\frac{44 + 51}{2} = 48$$

Upper Quartile: 66

Maximum: 83

Range: $83 - 10 = 73$

PRACTICE

1. Find the five statistical summary for the data set.

23, 23, 26, 27, 30, 31, 31, 34, 36, 39, 40, 42, 44, 44, 46

2. Find the five statistical summary for the data set.

85, 86, 60, 55, 73, 75, 84, 21, 56, 98, 64, 68, 66, 92, 83, 90, 81, 88, 78

3. Find the five statistical summary for the data set.

3, 5, 2, 7, 8, 2, 10, 5, 3, 7, 6, 4, 1, 9

4. Find the five statistical summary for the data set.

6, 17, 8, 9, 9, 5, 9, 19, 12, 14, 7, 17, 18, 19, 10

Part II. *Drawing Box-and-Whisker Plots*

Box-and-whisker plot – a visual display of the spread of numerical data.

It shows:

- the minimum value (Min)
- the lower quartile (Q1)
- the median
- the upper quartile (Q3)
- the maximum value (Max).



How to draw a Box-and-Whisker Plot:

1. Arrange data in numerical order.
2. Compute the *quartiles*: Q1, Q2, and Q3.
3. Find the *extreme values*, the *minimum* and the *maximum*, of the data.
4. Draw a number line and choose a scale that includes the extreme values. Above the number line, draw dots corresponding to MIN, Q1, Q2, Q3, and MAX. Draw a box to designate the data between Q1 and Q3. Draw a vertical line through Q2.
5. Draw a segment from Q1 to the MIN and from Q3 to the MAX. These segments are the *whiskers*.

Example. Construct a box-and-whisker plot for the data set:

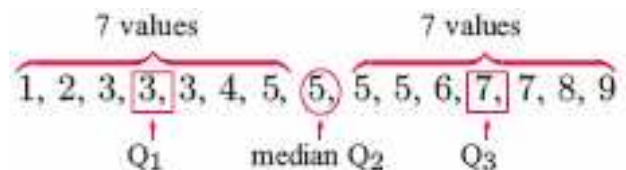
2, 3, 5, 4, 3, 6, 5, 7, 3, 8, 1, 7, 5, 5, 9

Step 1: Put the data set in numerical order

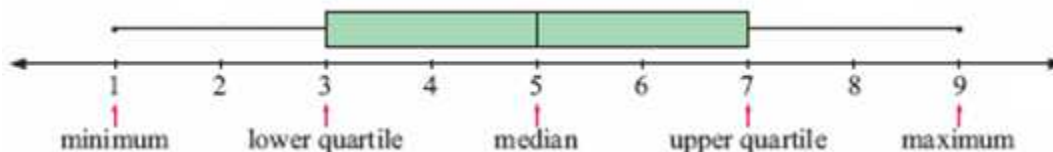
1, 2, 3, 3, 3, 4, 5, 5, 5, 5, 6, 7, 7, 8, 9

Step 2: Find the *five-number summary* is:

- The minimum is **1**.
- The maximum is **9**.
- The median is **5**.
- The lower quartile is **3**.
- The upper quartile is **7**.



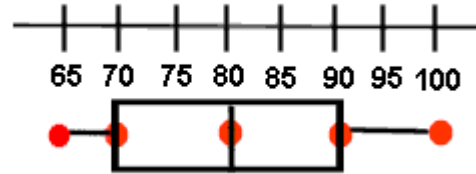
Step 3: Draw the box-and-whisker plot using the values found in step 2.



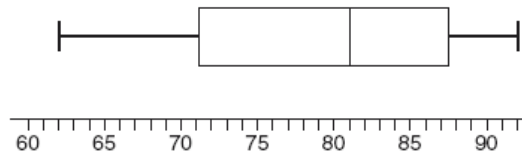
PRACTICE

1. According to the box-and-whisker plot shown below, what are the five statistical summary values?

- a. the median? _____
- b. the lower quartile? _____
- c. the upper quartile? _____
- d. the maximum value? _____
- e. the minimum value? _____



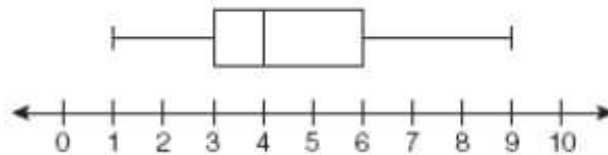
2. The accompanying diagram shows a box-and-whisker plot of student test scores on last year's Integrated Algebra midterm examination.



What is the median score?

- (1) 62 (2) 71 (3) 81 (4) 9

3. A movie theater recorded the number of tickets sold for a popular movie during a certain hour of the day. The box-and-whisker plot below represents the data for the number of tickets sold.



Which conclusion can be made using this plot?

- (1) The range of the tickets sold is from 3 to 6. (2) The maximum number of tickets sold is 10.
- (3) The median number of tickets sold is 4. (4) The mean number of tickets sold is 5.

4. Using the following set of data that was collected, answer the questions:

2, 6, 3, 5, 4, 4, 6, 2, 7.

a) Write the collected data in order.

b) Find the five-number summary for the above data.

Minimum = _____ Maximum = _____ Median (Q2) = _____

Lower Quartile (Q1) = _____ Upper Quartile (Q3) = _____

c) Draw a box-and-whisker plot for this data.

5. Use the data below to draw a box- and- whisker plot.

3, 3, 7, 8, 8, 5, 9, 10, 12, 7, 1, 8, 16, 8, 6, 9, 10, 13, 7, 14

Part III. Creating a Box and Whisker Plot on the graphing calculator

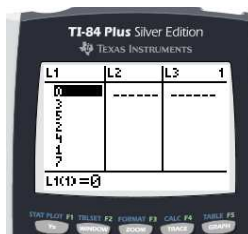
Model Problem 1:

Make a Box-and-Whisker plot for the following data, using your calculator.

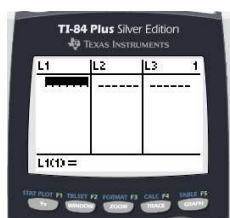
{2, 3, 3, 5, 7, 7, 7, 8, 9, 10, 10, 10, 12}

Solution:

1. Press **STAT** and then **ENTER** .

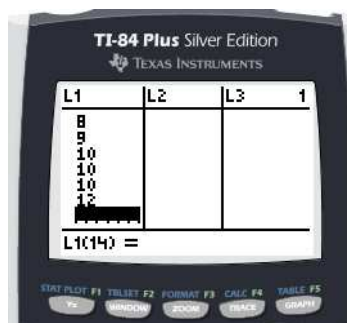


2. Press **↑** to highlight 'L1', **CLEAR** and then **ENTER** .



3. Enter the sample data by typing the number and pressing

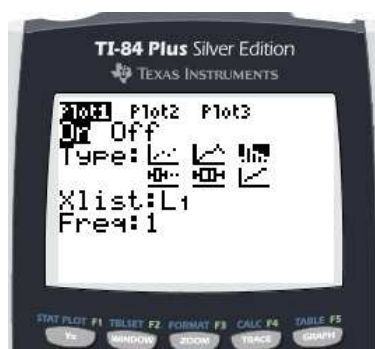
ENTER after each number.



4. Press **2nd** then **Y=** and **ENTER** .



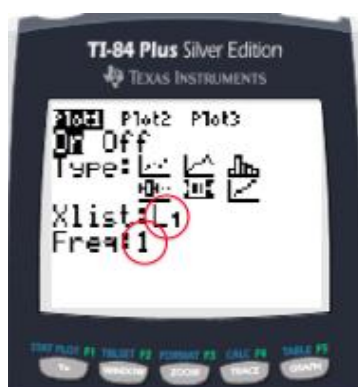
5. Make sure 'On' is highlighted and press **ENTER** .



6. Press  and  until  is highlighted and press **ENTER**



7. Make sure the 'Xlist' has L_2 entered and the 'Freq' is 1.



8. Press **WINDOW** . For 'Xmin' press **0** then **ENTER** .

For 'Xmax' press **1** and **5** then **ENTER** .

For 'Xsc1' press **1** then **ENTER**

. For 'Ymin' press **0** then **ENTER** .

For 'Ymax' press **5** then **ENTER** .

For 'Ysc1' press **1** then **ENTER**



*NOTE: The window for the x-axis for each problem will need to be changed based upon the minimum and maximum values of your data set. Always set the 'Xmin' at least one digit below the minimum and the 'Xmax' at least one digit above the maximum.

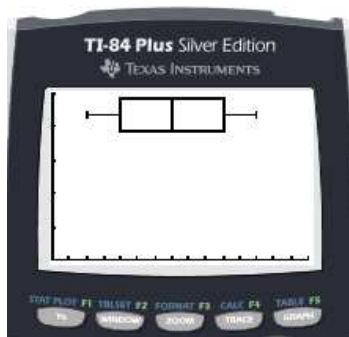
If your minimum value is 87 and your maximum value is 100 your 'Xmin' will be 86 or less, and your 'Xmax' value will be 101 or more.

*NOTE: The window for the y-axis can always be from 0 to 5.

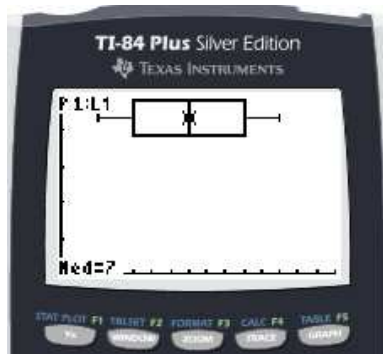
9. Press **Y=** and **CLEAR** to delete any functions that are entered.



10. Press **GRAPH**.



11. Press **TRACE** and **→** to read the minimum, first quartile, median, third quartile and maximum values.



12. Press **2nd** then **Y=** and **ENTER**. Press **→** to make sure 'OFF' is highlighted and press **ENTER**.



Practice Problems

1. Using the calculator, create a box and whisker plot for the following data. Indicate the values for the Minimum, 1st Quartile, Median, 3rd Quartile, and Maximum.

{40, 61, 43, 98, 74, 65, 72, 56, 81, 55, 67, 87, 92}

Minimum:

1st Quartile:

Median:

3rd Quartile:

Maximum: