Activity 5
Measures of Variability

Topic Area: Data Analysis and Probability

NCTM Standard: Select and use appropriate statistical methods to analyze data.

Objective: The student will be able to utilize the Casio fx-9860G Plus calculator to determine the measures of variability and to construct a box-and whisker plot for the data in the various activities included in this unit.

Introduction: This activity is designed to demonstrate the procedure to enter data into the Casio fx-9860G Plus graphing calculator in order to determine the measures of variability and to construct a box-and whisker plot that students will need to evaluate a given set of data.

The students should be familiar with the following vocabulary.

Box-and-whisker plot
Hinges
Interquartile range
Outliers
Quartiles
Range
Whiskers

Calculator Notes for Activity 5

Objective: The student will be able to utilize the Casio fx-9860G Plus calculator to determine the measures of variability and to construct a box-and whisker plot for the data in the various activities included in this unit.

Steps for Determining Measures of Variability

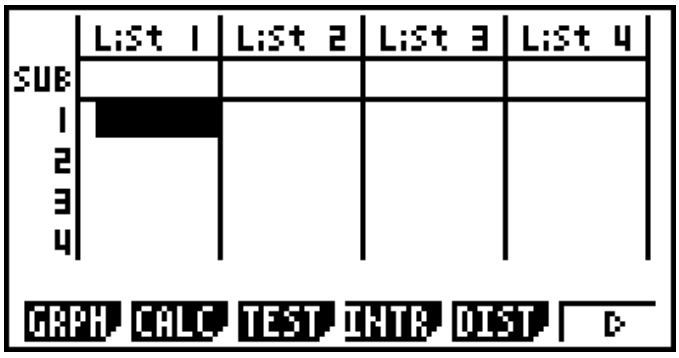
Problem: The following are scores that 75 students received on a 100 point exam. Use the fx-9860G Plus graphing calculator to determine the range, quartile 1, quartile 3, median, interquartile range and outliers. Then, construct a box-and-whisker plot of the data.

98, 85, 76, 83, 74, 85, 62, 79, 85, 89, 98, 87, 92, 84, 63, 28, 49, 88, 87, 92, 83, 79, 75, 68, 75, 96, 90, 83, 85, 68, 82, 85, 95, 100, 83, 79, 63, 85, 68, 86, 86, 85, 94, 89, 69, 98, 89, 89, 67, 84, 75, 76, 79, 87, 89, 95, 93, 86, 87, 88, 96, 57, 78, 64, 89, 75, 79, 82, 94, 96, 85, 95, 87, 88, 75.

The first step is to enter this data into the calculator. To do this, turn the calculator on and go to the Stat menu using the following key strokes.

Op$I

Your screen should look like the following screen:



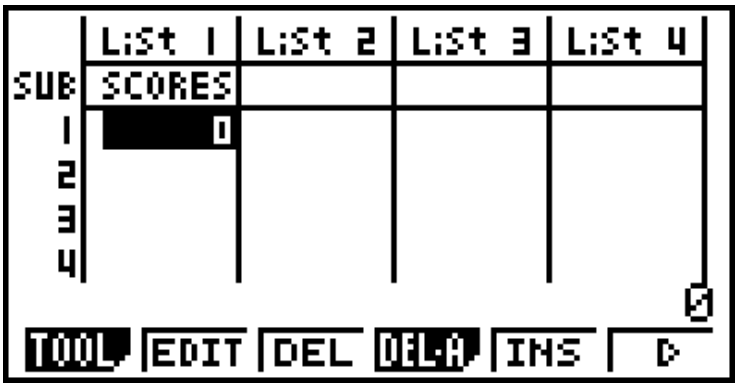
If your screen has numbers in the lists, you will need to delete them. To do this press the following keys to get the previous screen.

urq

Next, you can label the list column as SCORES. To do this, press the following keys:

BLamG96jml

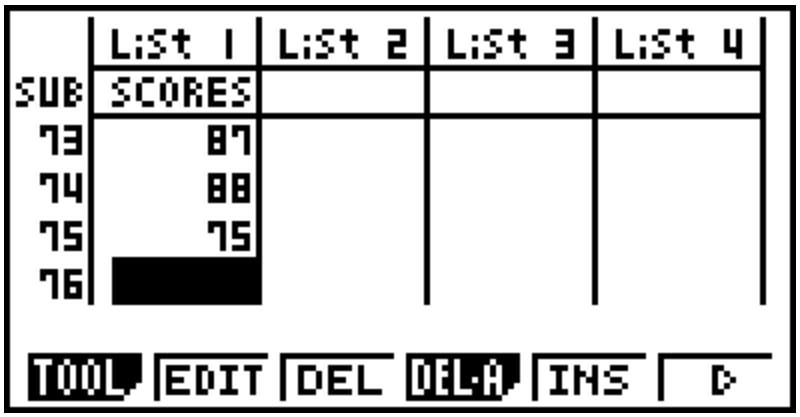
Your screen should look like this:



To enter the data into list 1, enter each of the numbers and press execute after each one. Your key strokes are as follows:

98|85|76|83|74|85|62|79|85|89|98|87|92|84|63|28|49|88|87|92|83|79|75|68|75|96|90|83|85|68|82|85|95|100|83|79|63|85|68|86|86|85|94|89|69|98|89|89|67|84|75|76|79|87|89|95|93|86|87|88|96|57|78|64|89|75|79|82|94|96|85|95|87|88|75|

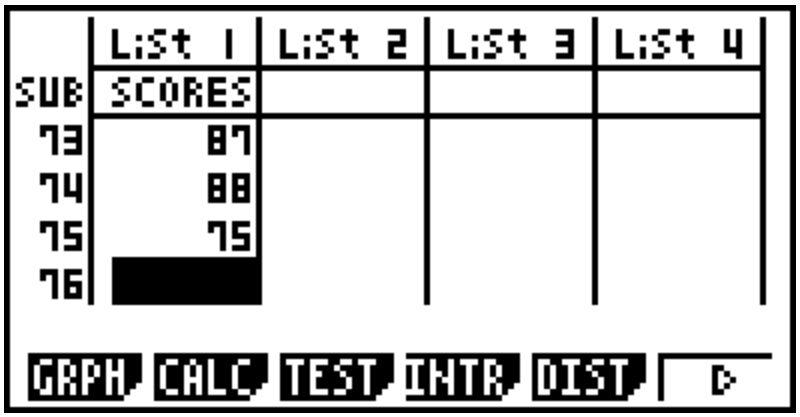
Your final screen should look like the following. Notice that the last number entered is the 75th number in the list.

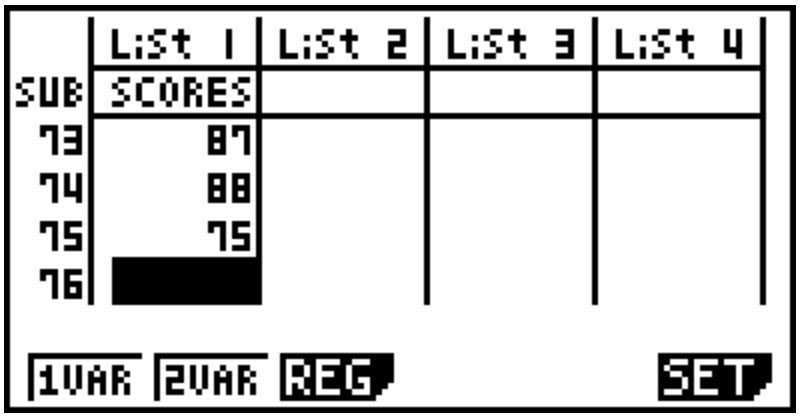


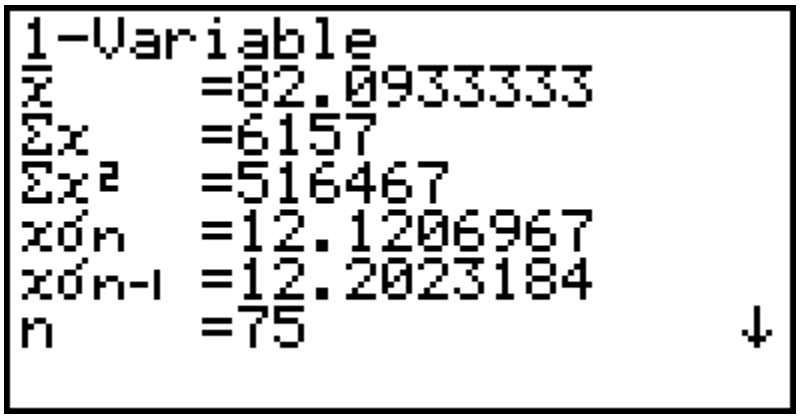
To determine the range, quartile 1, quartile 3, median, interquartile range and outliers of the data, you need to go to Calculations (CALC) and then 1VAR (since all the data is in one list). Your keystrokes are as follows:

uwq

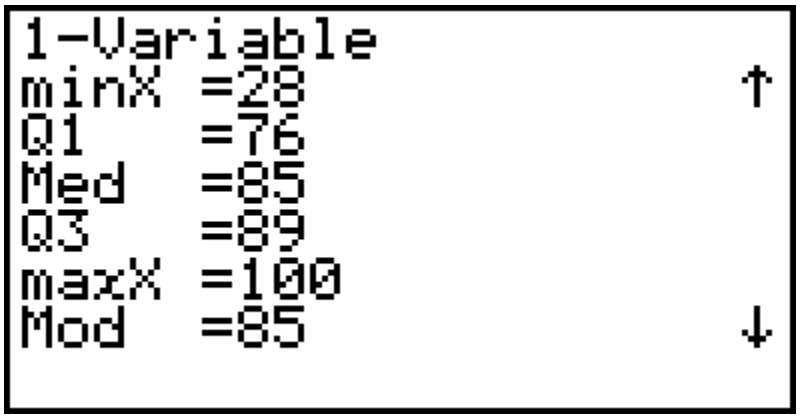
The screens you should see are as follows:







To calculate the range, scroll down the screen until you see minX and maxX. These are the lowest and highest numbers in the data. Your screen should look like this:



Subtract these two numbers to calculate range.

Range = minX – maxX = 100 – 28 = 72.

Q1 is Quartile 1 = 76

Q3 is Quartile 3 = 89

Median is the same as Q2 (Quartile 2) = Med = 85

Interquartile Range = Q3 – Q1 = 89 – 76 = 13

Outliers are any items in your data that are above or below 1.5 of the interquartile range. Therefore, to check for outliers, first multiply the interquartile range by 1.5.

$$13 \times 1.5 = 19.5$$

Next, add 19.5 to Q3 and subtract 19.5 from Q1.

$$89 + 19.5 = 108.5$$
$$76 - 19.5 = 56.5$$

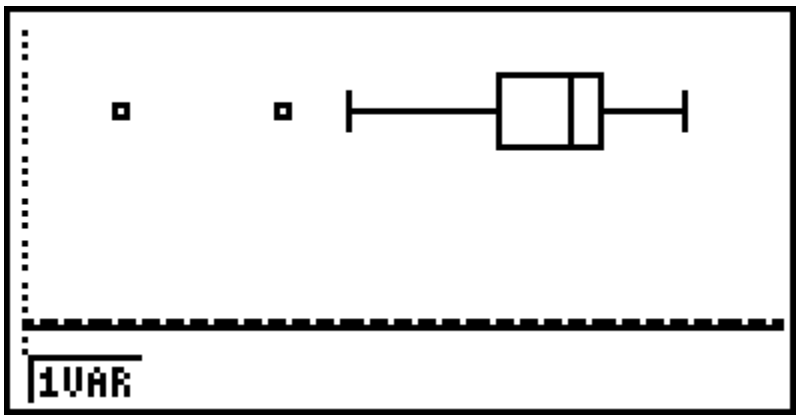
This means that there are no outliers on the right side because there are no scores beyond 108.5. But, there are outliers on the left side since there are scores below 56.5. Therefore, the following two scores are outliers:

28 and 49

The last step is to construct a box-and whisker plot on the calculator. Quartile 1 and Quartile 3 are the **hinges**. The median is the bar in the interior of the box. The **whiskers** extend to the highest and lowest points before the outliers. The outliers are points beyond the whiskers. To construct the box-and-whisker plot on the calculator, you need to go to Graph, then Set, the graph type is BOX, List 1 is the Xlist, the frequency is 1 and turn the outliers on. Go to SEL and turn Graph 1 on and Graphs 2 and 3 off, then just press draw. Use the following key strokes.

p$lquNuwNNqNqdrqNwNwu

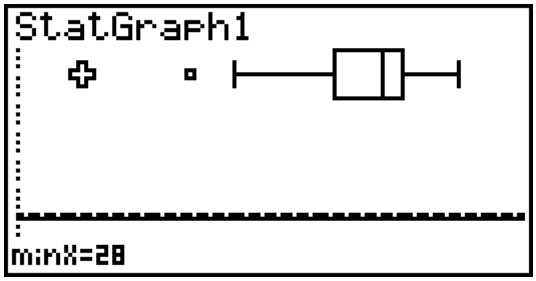
Your screen should look like this:

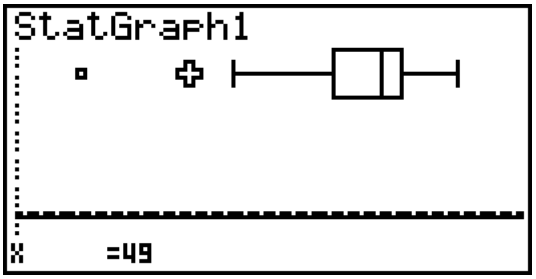


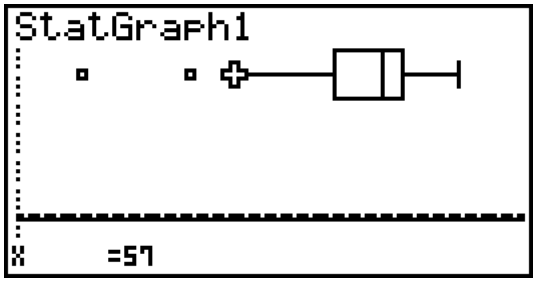
You can now use the trace capabilities to see the calculation numbers on the box-and-whisker plot screen. Use the following keystrokes:

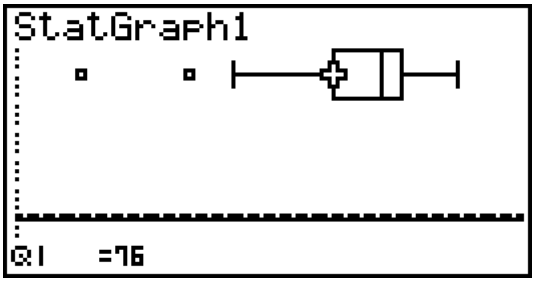
Lq

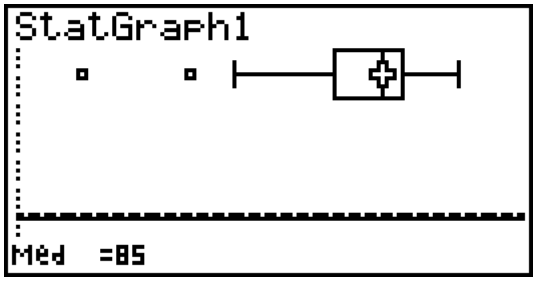
The screen shots as you scroll across the box-and-whisker plot will look like the following screens. Notice the bottom left of the screen will tell you the value of each number you are observing. Also, notice that all outliers that we determined are displayed.

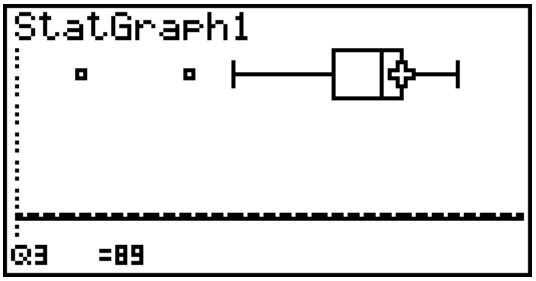


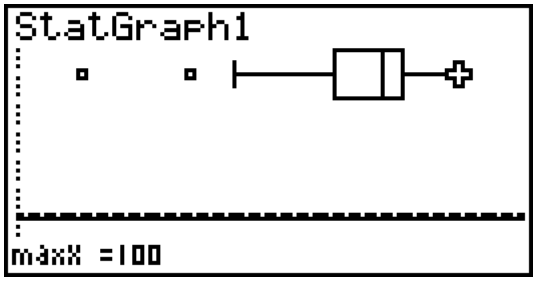












Name_____Class_____Date_____

Activity 5: Worksheet
Frequency Distributions

For each list of data, use the fx-9860G Plus graphing calculator to determine the range, quartile 1, quartile 3, median, interquartile range and outliers. Then, construct a box-and-whisker plot of the data.

1.) 11, 94, 46, 33, 25, 58, 55, 52, 31, 29, 36, 45, 51, 56, 51, 43, 32, 29, 31, 40, 42, 30, 35, 35, 39, 47, 26, 51, 57, 55, 42, 46, 53, 42, 41, 33, 35, 38, 50, 51, 52, 37, 38, 43, 47, 44, 52, 52, 38, 32, 53, 39, 31, 49, 48, 48, 45, 43, 46, 39, 52, 49, 38.

2.) 20, 62, 55, 58, 53, 43, 39, 23, 16, 21, 28, 53, 61, 62, 60, 50, 45, 55, 53, 58, 57, 58, 58, 51, 37, 36, 29, 45, 33, 32, 26, 25, 17, 26, 29, 39, 33, 37, 48, 42, 26, 47, 42, 49, 39, 40, 42, 38, 37, 30, 21, 20, 19, 29, 52, 47, 36, 31, 52, 28, 37, 41, 49.

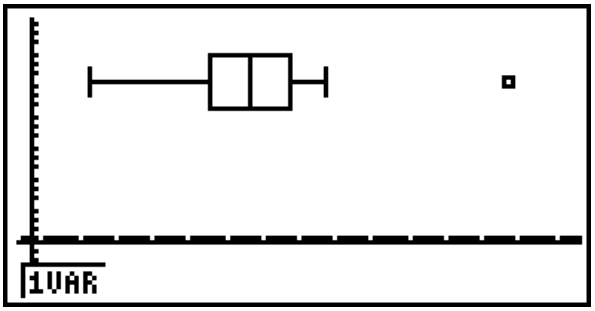
3.) 19, 26, 23, 22, 34, 43, 41, 43, 43, 42, 39, 26, 27, 31, 42, 2, 39, 37, 33, 30, 22, 19, 20, 30, 34, 34, 38, 27, 22, 29, 39, 41, 42, 45, 46, 44, 42, 47, 21, 29, 22, 28, 30, 31, 68, 41, 39, 33, 34, 34, 38, 27, 22, 26, 23, 34, 32, 31, 41, 42, 33.

4.) 12, 88, 81, 83, 34, 23, 18, 19, 34, 22, 20, 19, 55, 67, 66, 36, 84, 76, 72, 64, 81, 84, 76, 78, 68, 46, 55, 50, 24, 42, 76, 56, 43, 49, 50, 58, 56, 75, 24, 15, 41, 30, 53, 76, 81, 86, 49, 42, 55, 59, 62, 63, 74, 68, 60, 71, 37, 38, 39, 37, 49, 25, 72, 66, 77, 45, 59, 57, 62, 73, 57, 47, 24, 29, 38, 49, 82, 13, 16, 63, 56, 52, 59, 64, 78, 24.

Solutions to Activity 5 Worksheet

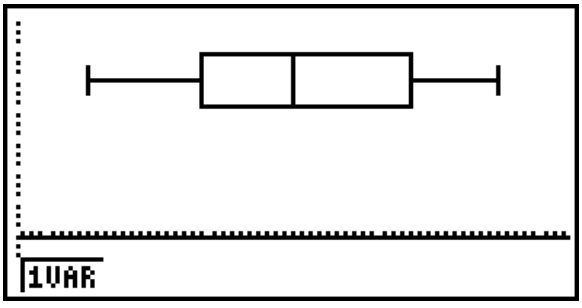
1.

Range = 83
Quartile 1 = 35
Quartile 3 = 51
Median = 43
Interquartile Range = 16
Outliers = 94



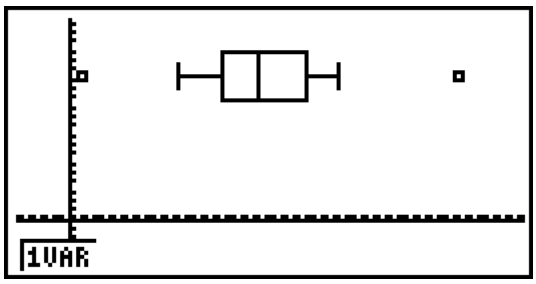
2.

Range = 46
Quartile 1 = 29
Quartile 3 = 52
Median = 39
Interquartile Range = 23
Outliers = none



3.

Range = 66
Quartile 1 = 26.5
Quartile 3 = 41
Median = 33
Interquartile Range = 14.5
Outliers = 2 and 68



4.

Range = 76
Quartile 1 = 37
Quartile 3 = 71
Median = 55.5
Interquartile Range = 34
Outliers = none