



Math Objectives

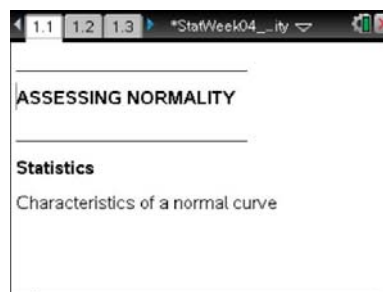
- Students will recognize that there are four tests for assessing normality in a data set:
 - The distribution is mound-shaped and approximately symmetric.
 - The mean and median are approximately equal.
 - The distribution follows the 68-95-99.7 rule.
 - A normal probability plot of the data set is approximately linear.
- Students will use the four tests to assess the normality of a given data set.
- Students will use appropriate tools strategically (CCSS Mathematical Practices).

Vocabulary

- normal distributions
- percentiles
- histograms
- normal probability plot
- measures of central tendency
- 68-95-99.7 rule

About the Lesson

- This lesson involves examining NBA two-point shooting percentages.
- As a result, students will:
 - Create a histogram of the data and determine if the shape meets the requirement for normality—mound-shaped and symmetric.
 - Use one-variable statistics to find the mean and median and determine if they are approximately equal.
 - Make a new histogram of the data using the mean as a cut-point and the standard deviation as the bin width. They will calculate the percentage of data values within one-, two- and three-standard deviations of the mean to determine if the histogram meets 68-95-99.7rule.
 - Create a normal probability plot of the data and decide if the plot is linear, indicating normality.
 - Summarize the results of all four tests to decide if the data set is approximately normal.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.
- You can hide the function entry line by pressing **ctrl** **G**.

Lesson Files:

Student Activity
 Assessing_Normality_Student.pdf
 Assessing_Normality_Student.doc
TI-Nspire document
 Assessing_Normality.tns
 Assessing_Normality_Soln.tns

Visit www.mathnspired.com for lesson updates and tech tip videos.

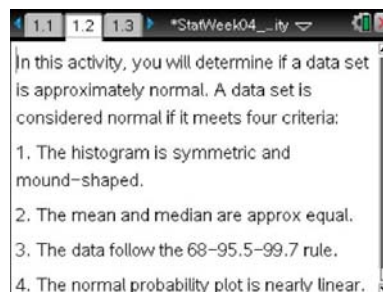
TI-Nspire™ Navigator™ System

- Transfer a File.
- Use Screen Capture to examine student work throughout the lesson. Students may select different window settings for the histogram on page 1.6 and discussing the different histograms is suggested.
- One student can be made the presenter for each section of the activity. This is especially important for the histogram on page 1.11 and the accompanying percentages.

Discussion Points and Possible Answers

Move to pages 1.2-1.4.

On Page 1.2, read the description of the criteria for a *normal distribution* of data. On Page 1.3, you learn about the data you will be assessing. Page 1.4 shows you the data in a spreadsheet.



	twopoint	threepoint	games
1	0.532	1	80
2	0.575	1	81
3	0.498	0.667	35
4	0.333	0.667	6
5	0.364	0.533	15
A7	0.532		



Move to pages 1.5-1.7.

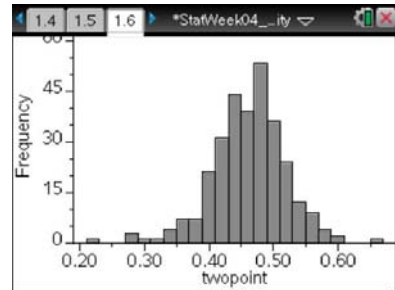
Let's investigate two-point shooting percentages to assess their 'normality'.

1. On Page 1.6, construct a histogram to test the first criteria.
 - Click the bottom on the screen, and select **twopoint**.
 - Select **MENU > Plot Type > Histogram**.
 - Answer the following questions on page 1.7.
- a. What is the overall shape of the histogram?



Sample Answer:

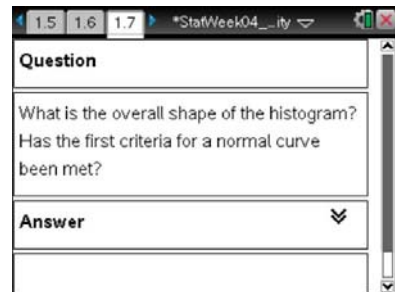
The histogram is approximately symmetric and mound-shaped and has one or two peaks in the middle.



- b. Has the first criteria for a normal distribution been satisfied?

Sample Answer:

Yes, the first criteria has been met.



Teacher Tip: From looking at the graph, students are to determine if the graph is symmetric and mound-shaped. This test is very subjective, but also determines if further tests are needed.

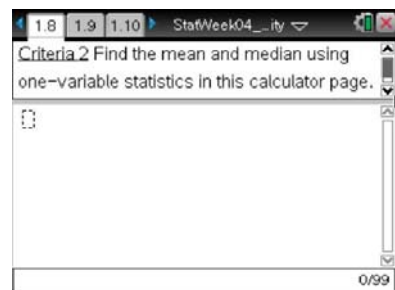
Suggested Discussion Questions:

Can this graph be changed (scaling) so that it doesn't appear symmetric and mound-shaped? How? Conversely, is it possible to have a graph that can be made to look symmetric but is not? How?

Move to pages 1.8 and 1.9.

2. Use one-variable statistics to calculate the mean and median on page 1.8. Answer the following questions on Page 1.9.
 - a. Are the mean and median approximately equal?

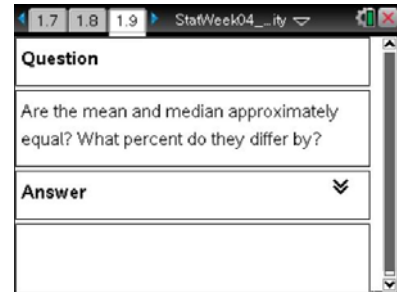
Sample Answer: The mean is 0.46208 and the median is 0.466—approximately equal.





- b. By what percent do they differ?

Sample Answer: They are approximately equal, differing by less than 1%.



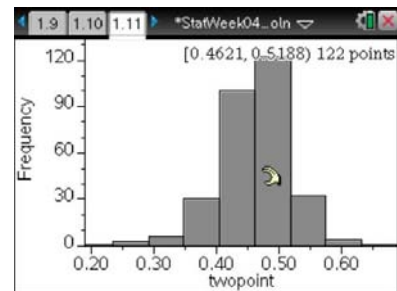
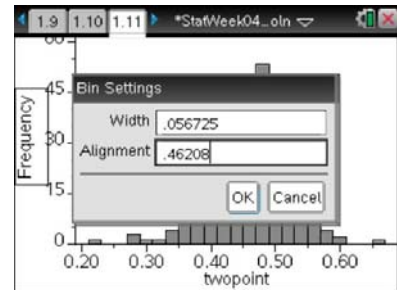
Teacher Tip: Students can see that the values of the mean and median vary by less than a hundredth, but finding the percent difference between them confirms that they are approximately the same.

Suggested Discussion Questions:

How close is close enough? Why is it important to look at the percent difference between the mean and median? For example, is a difference of 0.004 always a small enough difference?

Move to pages 1.10-1.12.

3. Read the criteria on Page 1.10, and create a new histogram on Page 1.11.
- Use histogram properties to set the mean as the center (alignment) and one standard deviation as the width of each bin (bin width).





4. Hover your cursor over each bin of the histogram to see how many values it contains, and calculate the percentage of data points that fall within one, two, and three standard deviations of the mean.

- Use the scratchpad for your calculations.
- Answer the following questions on page 1.12.
 - a. What is the number of data points in each bin of the histogram?

Answer:

Reading from the left, there are 3, 6, 30, 100, 122, 33, and 4 data values in the histogram bins.

- b. What is the percentage of values within one, two, and three standard deviations?

Answer:

74% of the data values fall within 1-standard deviation of the mean; 95% fall within 2-standard deviations of the mean; and 98.33% fall within 3-standard deviations of the mean.

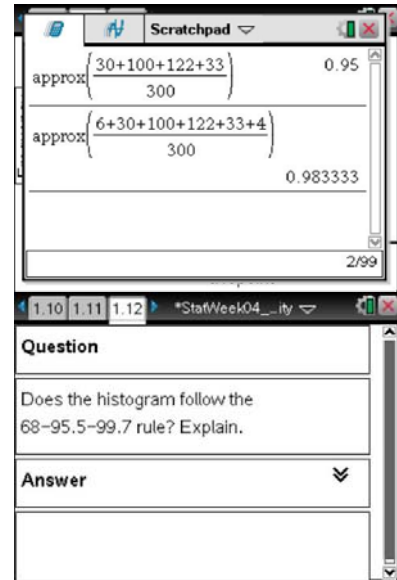
- c. Does the histogram follow the 68-95.5-99.7rule? Explain.

Answer:

Yes, fairly accurately. While there are more 1-standard deviation from the mean, the numbers of values 2- and 3-standard deviations away from the mean are close to the rule.

Tech Tip: Pressing ctrl and clicking on a bar will give the number of data points in each bar. Students can insert a *Lists & Spreadsheet* page or use paper to record these numbers if needed.

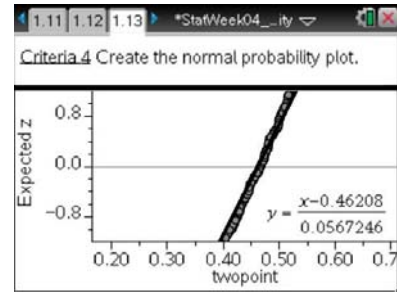
Teacher Tip: Students are to use these data to calculate the percentage of data points that fall within one, two, and three standard deviations of the mean. Remind them that each standard deviation consists of values on either side of the mean.





Move to pages 1.13-1.15.

- Read the criteria on page 1.13, and create the normal probability plot.
 - Add the variable **twopoint** at the bottom of the screen.
 - Select **MENU > Plot Type > Normal Probability Plot**.



Teacher Tip: Suggested Discussion Questions:

Why are there two points that seem to deviate greatly from the overall pattern? Return to the spreadsheet and investigate which points they might be.

A normal curve creates a straight line. The more the data deviate from a straight line, the less normally the data are distributed.

Answer the following questions on pages 1.14 and 1.15.

- What shape does the plot form? What does this tell you?

Sample Answer:

The plot is approximately linear. It tells me that the data are approximately normal.

If your data set passes all four tests, then it is approximately normal and can be modeled with a normal curve. In addition, z-scores can be calculated, and comparisons can be made.

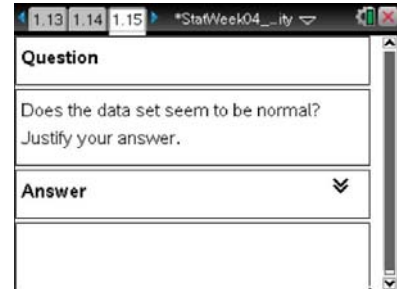
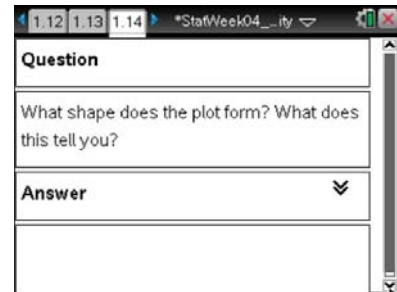
- Does the data set seem to be normal? Justify your answer.

Sample Answer:

Yes, the data set is relatively normal since the criteria have all been met with relative accuracy.

Teacher Tip: Suggested Discussion Questions:

Why does it matter if the data are normal? In context of the data, what does it mean if a data point is in the first standard deviation? In the positive side of the third standard deviation? If you are a coach in the NBA, knowing that the data for two-point percentages is normal, how could you use it to compare your team to the rest of the players?





Extension

Repeat this activity with the data sets **threepoint** and **games**.

1. Is the data set **threepoint** approximately normal?
Justify your conclusion.
2. Is the data set **games** approximately normal?
Justify your conclusion.



Wrap Up

Upon completion of the discussion, the teacher should ensure that students understand:

- That data sets must meet all four tests to be considered approximately normal.
- That real data will likely only approximately satisfy the four tests.

Assessment

State the four tests for checking normality within a set of data.

Sample Answer:

1. The distribution is mound-shaped and approximately symmetric.
2. The mean and median are approximately equal.
3. The distribution follows the 68-95-99.7rule.
4. A normal probability plot of the data set is approximately linear.



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