

Box Plots & Histograms

ID: 9843

Time required

30 minutes

Activity Overview

Students create and explore a box plot and histogram for a data set. They then compare the two data displays by viewing them together and use the comparison to draw conclusions about the data.

Topic: Data Analysis and Probability

- Represent and interpret data displayed in data graphs including bar graphs, circle graphs, histograms, stem-and-leaf plots and box-and-whisker plots.

Teacher Preparation and Notes

- This activity is appropriate for an Algebra 1 classroom. Students should have experience creating and reading box plots and histograms, as well as with calculating the mean of a data set.
- Information for an optional extension is provided at the end of this activity, both on the student worksheet and in the student .tns file. Should you not wish students to complete the extension, you may delete the extension from the student .tns file and have students disregard that portion of the student worksheet.
- Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.
- To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter “9843” in the keyword search box.

Associated Materials

- BoxPlotsHistograms_Student.doc
- BoxPlotsHistograms.tns
- BoxPlotsHistograms_Soln.tns

Suggested Related Activities

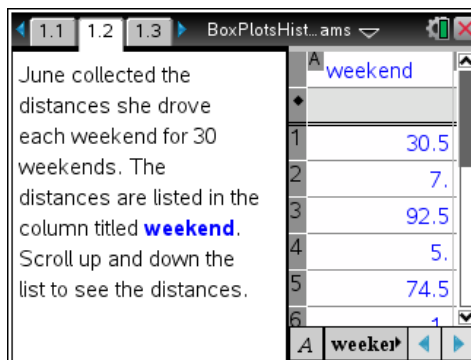
To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- Box Plot Comparison (TI-Nspire technology) — 11080
- “Nspired” by Numb3rs: Outliers Activity (TI-Nspire technology) — 11160
- Graph My Center (TI-Nspire technology) — 10896

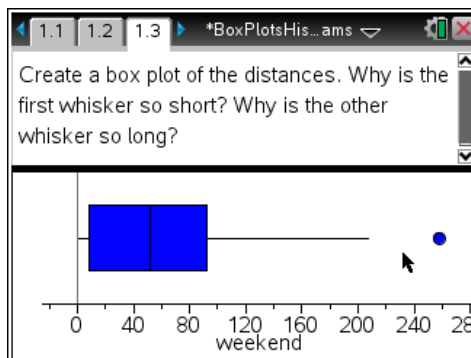
Part 1 – Create a Box Plot

The activity begins with a set of data—June’s record of how many miles she drove each weekend for 30 weekends. Discuss any visible data trends as the students scroll up and down the list, asking questions like: *Are most of the distances greater or less than 50 miles? How many distances did June record?*

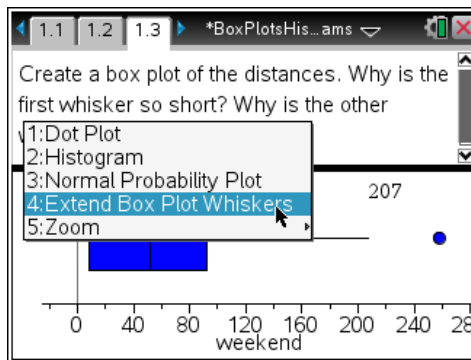
Note: Press **ctrl** **tab** to move between panes on a page.



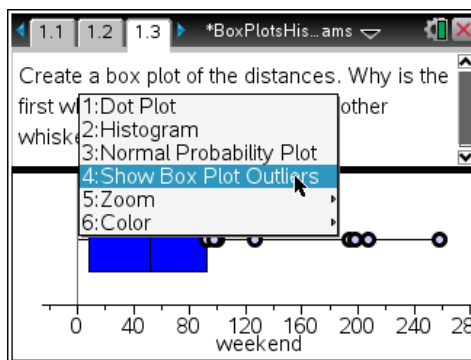
Students create a box plot of the data on page 1.3. Direct them to click on the text **Click to add variable**, at the bottom of the page, and choose **weekend**. This creates a dot plot of the data: each dot represents one distance. To change the data display type to box plot, students should go to **menu** > **Plot Type** > **Box Plot**.



Students should realize that this box plot is different from those they have seen before. Explain that by default, the handheld plots any points that are far away from most of the data, (more than 1.5 times the interquartile range from the mean), as individual points instead of including them in a the plot. Discuss why this feature might be useful. (It shows the outliers in a data set, the points that are much greater or much less than the other points and are “exceptions” to the general trend of the data.)



Demonstrate how to create a regular box plot that includes all of the data. Move the cursor over the plot and press **ctrl** **menu**. Choose **Extend Box Plot Whiskers**. Repeating this process and choosing **Show Box Plot Outliers** switches back. Allow students to practice switching back and forth between modified and standard box plots.



Note: Students can also change the attributes of the box plot by selecting the Plot Properties menu.

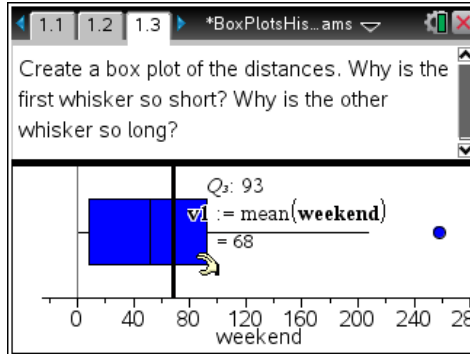
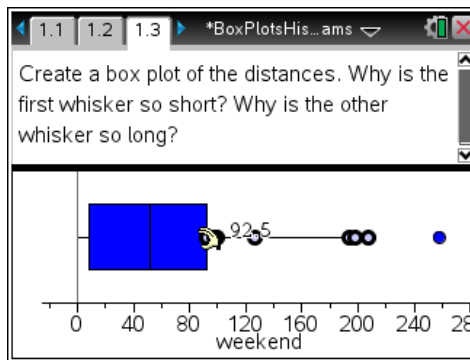
Moving the cursor over a section of the box plot displays the range of that section, while clicking on a section displays a dot for each data value. Demonstrate these features. For example, in the screen shown, the high whisker ranges from 92.5, the third quartile, to 258, the maximum, and contains 6 data values.

Let students work independently to find and record the minimum, maximum, first quartile, third quartile, and median values of the data.

Ask: *Where is the mean on this box plot?*

Some students may think that the line in the center of the box represents the mean. To clarify the difference between the mean and median, plot the mean on the data display. Go to **menu** > **Analyze** > **Plot Value**. In the text box that appears, type **mean(weekend)**. This draws a vertical line at $x = 68.4$, the mean of the distances. Compare the mean and median as a class.

*Why is the mean so much greater than the median?
What about the data might make this the case?*



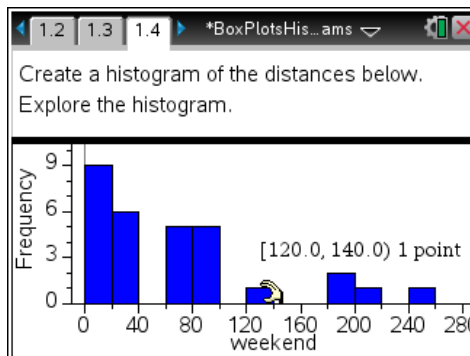
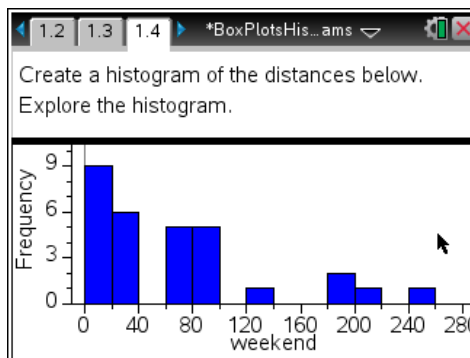
TI-Nspire™ Navigator™ Opportunity: **Quick Poll**

See Note 1 at the end of this lesson.


Part 2 – Create a Histogram

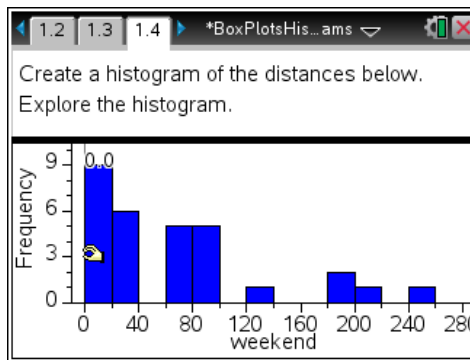
Next, students create a histogram of the same data on page 1.4. Direct them to click on the text **Click to add variable**, at the bottom of the page, and choose **weekend**. This creates a dot plot of the data. To make a histogram, students should select **menu** > **Plot Type** > **Histogram**.


Demonstrate exploring the histogram. Hovering over a bar displays the interval and value of the bar. Clicking on a point that is not part of the graph resets the selection.

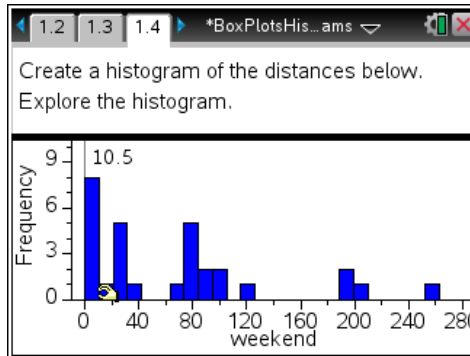


The handheld divides the data into intervals, or bins, based on its default settings. Demonstrate how to adjust the position and width of the bins.

First, adjust the bin *placement*. Move your cursor to the left edge of the first bar. It will become \leftrightarrow . Press **ctrl**  to grab the edge. A number appears telling you the value of that edge. Use the arrow keys to move the edge to $x = 0$. Press **enter** to release the edge.



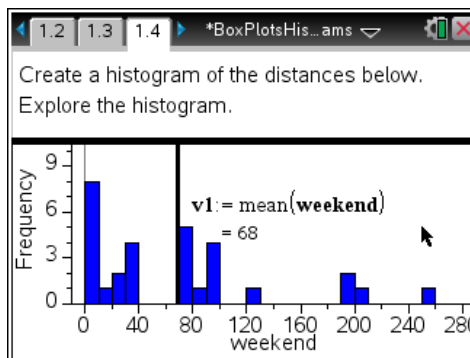
Next, adjust the bin *width*. Move your cursor to the right edge of the first bin and press **ctrl**  to grab it. Again a number appears, giving you the x-value of the edge. Using the arrow keys, you can make the bins wider or smaller. As you resize a single bin, the other bins resize automatically. Press **enter** to release the edge. Students should adjust the bin width to 10 to answer the questions on their worksheet.



Note: Students can adjust the bin settings by selecting **Histogram Properties** in the Plot Properties menu.

Ask: *Where is the mean on this histogram?*

Having calculated the mean in Part 1, some students may recall that it is at the x-value 68.4. To see the relationship of the mean and the histogram, plot the mean on the data display. Go to **menu** > **Analyze** > **Plot Value**. In the text box that appears, type **mean(weekend)**. Again, the handheld draws a vertical line at $x = 68.4$.



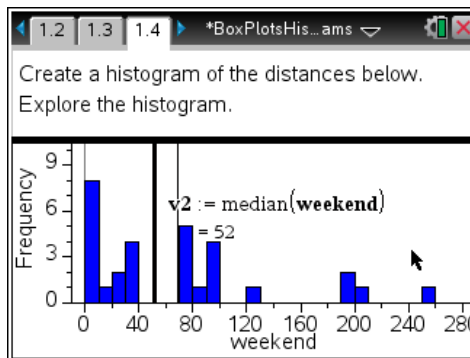
Then ask: *Where is the median on this histogram?*

To see the relationship of the median and the histogram, plot the median on the data display. In the text box that appears, type **median(weekend)**. A vertical line is drawn at $x = 52$, the median of the distances.

Discuss the question on the students' worksheets:

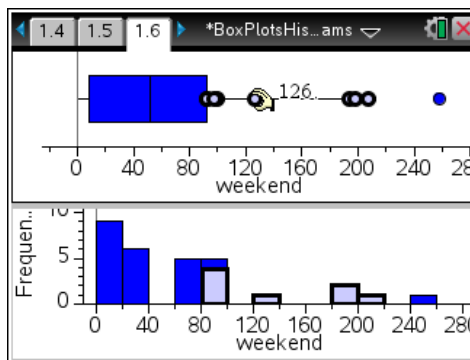
How is it possible for the median to be 52 when there are no data values between 50 and 60?

(There is an even number of values, so the median is the mean of the 15th and 16th values.)



Part 3 – Compare a Box Plot and a Histogram

Direct students to create a box plot and a histogram of the distance data in the two panes on page 1.6. They can choose either a modified or a standard box plot display. This top-and-bottom layout is very powerful because selecting a portion of the graph on one data display highlights the corresponding portion of the other display as well.

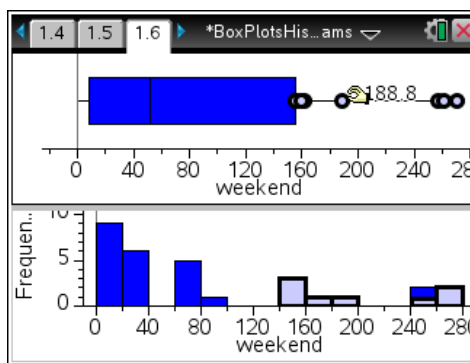


Use this feature to guide a discussion about the relationship between the box plot and the histogram. Begin with more obvious connections—a taller bar in the histogram corresponds with more points on the box plot than a shorter bar, for example. Then lead students to make deeper conclusions about the shape of the data.

(For example, it is grouped mostly in the lower values; the data contains many distances close together on the low end of the scale and relatively few larger distances; the larger distances are more spread out.)

Extension – Changing the Data

As an optional extension, students can explore changing the data directly from the box plot. Demonstrate to students how they can change data values selecting a section, then dragging one or more of the points to new locations. Observe the corresponding change in the histogram. Challenge students to “reshape” the data this way.



TI-Nspire™ Navigator™ Opportunities

Note 1

Problem 1: Quick Poll

Use Quick Poll to verify students understand the concepts of box plot and histogram. The questions provided on the student worksheet may be used for this purpose.