

## SHOE SIZES WITH BOX PLOTS

### Teacher Notes

#### References

Foundation	-
Foundation Plus	-
Higher	D2.5: Box plots, D4.7 Using box plots to compare data
Higher Plus	D2.1 Box plots, D2.4-5 Box plots comparing large data sets

#### Introduction

In the first part of this TI-Nspire activity students explore box plots by considering a very small data set – the shoe sizes of a team of 11 footballers. By comparing the box plot with a dot plot they see how quartiles, the median and the extreme values are produced. Students are challenged to predict how the box plot changes when changes are made to the data set. The second part of the activity provides four very large data sets: shoe sizes for about 1000 teenagers and 200 adults. Students draw pairs of box plots in order to make comparisons between the data sets.

#### Resources

A TI-Nspire document entitled **ShoeSizes.tns** includes all the data and step-by-step instructions.

There is also a 2-page handout that gives students more guidance.

#### TI-Nspire skills students will need

- Transferring a document to the handheld.
- Opening a document on the handheld.
- Moving from one part of the page to another.
- Entering simple expressions on a Calculator page.
- Choosing tools from menus.

#### The activity

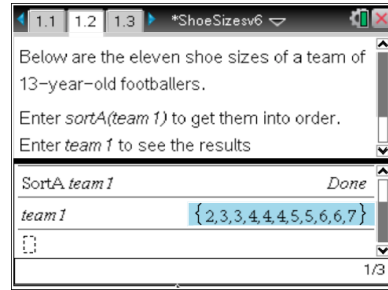
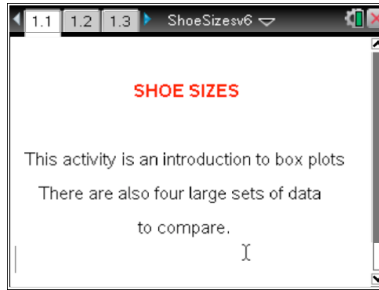
This activity is designed to be used by students working individually through the student notes and using TI-Nspire handhelds. However, the TI-Nspire document can also be used with the Teacher Software and projected onto a screen. This means that it can be used for demonstration purposes and to provoke full-class discussion.

The student notes are divided into 6 sections and there are comments on those sections below.

### 1. Football team

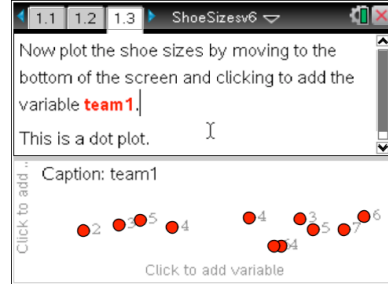
The notes ask students to open the document **ShoeSizes.tns**.

The list is sorted to make it easier for students to find the extremes, quartiles and median.



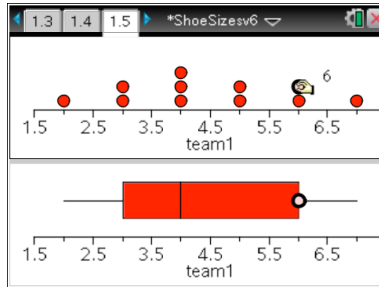
However, note that it is not necessary for the TI-Nspire to have a sorted list in order for it to produce the box plot in later sections.



The set of just 11 numbers is big enough to explore the 5 key elements of a box plot.



### 2. Box and Dot Plots

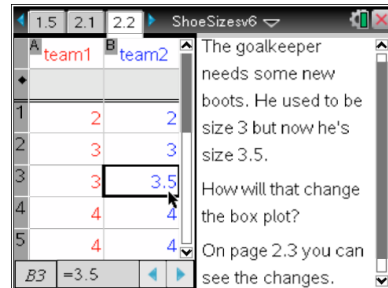
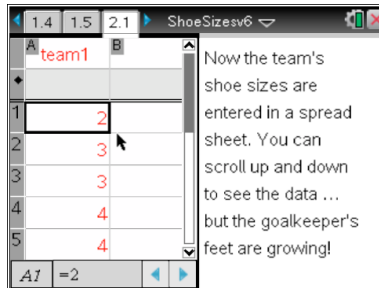
Highlighting points on the dot plot makes them also appear on the box plot—a very powerful means of increasing understanding.



It is necessary to press  to highlight a point. To remove the highlighting move the cursor to a clear part of the screen and press .

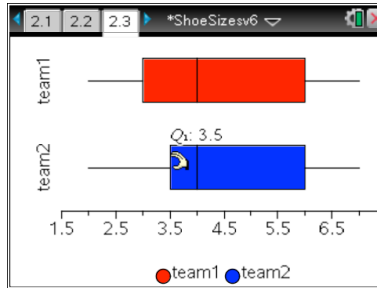
### 3. Bigger feet

In this section students see the original data in a spreadsheet. They make small changes and are asked to predict and then draw the transformed box plot.

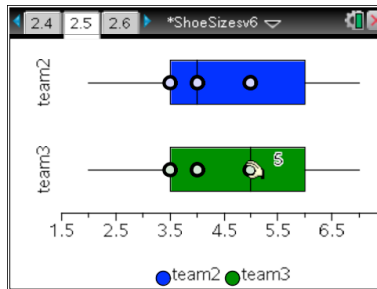


Students can compare box plots of the two data sets.

On page 2.4 they are asked to make a further change to the data sets.

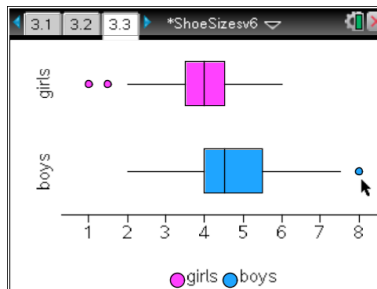
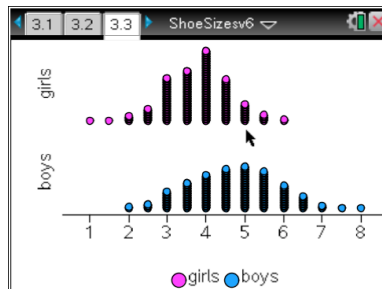


Note: it is also possible to grab and drag dots in a dot plot to change data values. This is *not* recommended here since shoe sizes are discrete data and dragging will probably result in continuous values (e.g. a shoe size of 3.957!)



#### 4. 1000 teenagers

A quick way of seeing the bottom of the data columns is to use the *Go To* option in the Actions menu. Then enter A500, for example.



Students can change between Dot Plot and Box Plot using the options in the Plot Type menu.

Notice the occurrence of outliers on the boxplots. TI-Nspire plots any points individually that are more than 1.5 x the interquartile range beyond the quartiles. In the Plot Properties menu there is an option to extend the whiskers and remove the outliers if you wish.

These two very large data sets were actually created using the random number generator built into the TI-Nspire, so if you wish you can generate a new or different set of data. The method used was to enter the following on a Calculator page.

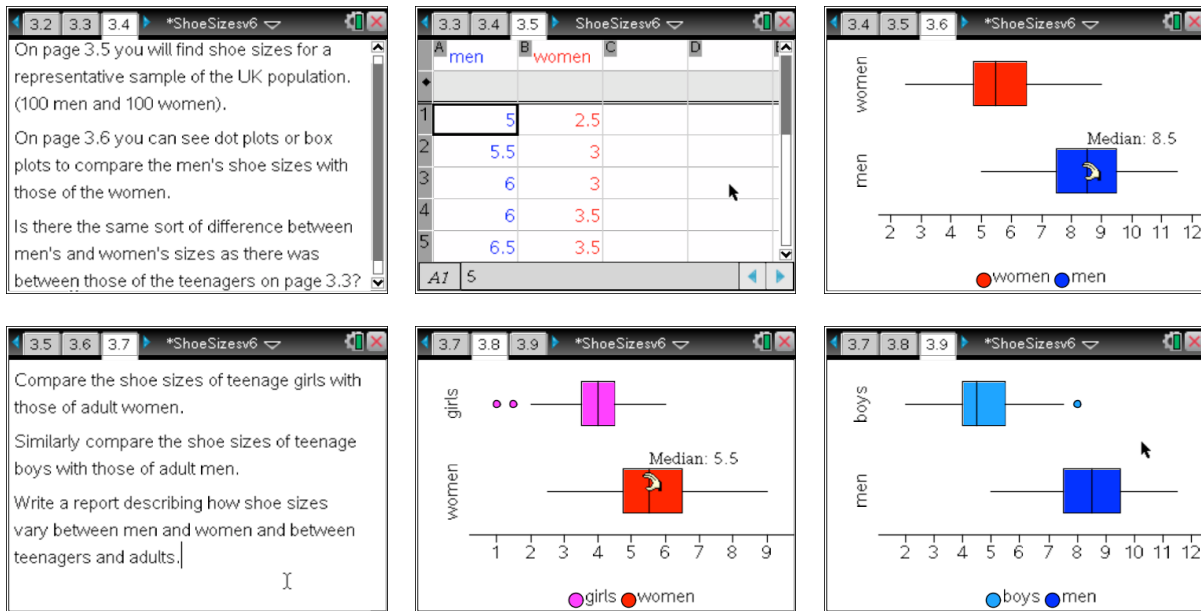
$$\text{Int}(\text{RandNorm}(10,2,487))/2 \rightarrow \text{boys}$$

$$\text{Int}(\text{RandNorm}(8,1.5,508))/2 \rightarrow \text{girls}$$

The command  $\text{RandNorm}(\mu, \sigma, n)$  produces a random normal distribution of  $n$  values with mean  $\mu$ , standard deviation  $\sigma$ . As can be seen, the two box plots reflect these choices of mean and S.D.

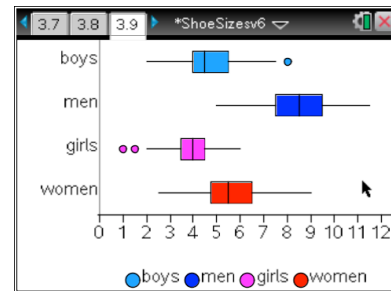
### 5. 200 adults

The website of the British Footwear Association has tables giving the percentage of the UK population with a given shoe size. These percentages were used to create these data sets, each with 100 values.



There is a wealth of interesting comparisons to investigate here. For example, notice that there is a much bigger difference between the male medians than the female ones.

It is also possible to display all four box plots on one screen, should you wish to do so. This can be done using option 4 in the Plot Properties menu.



### 6. Collecting your own data

Finally the student notes suggest that there is the opportunity to collect a small set of data from the class and to compare with the large sets used here.