

What Are Box-and Whisker Plots?

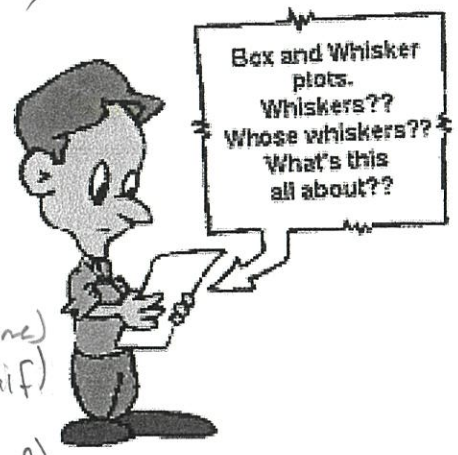
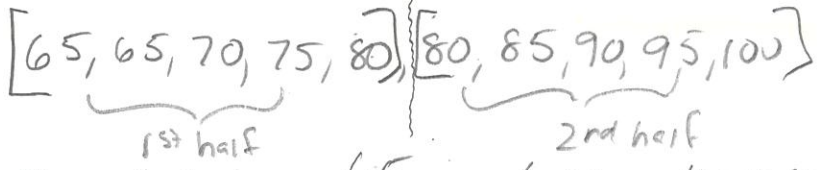
Box-and-whisker plots are a useful way to display data. They allow you to see important characteristics of the data at a glance.

Constructing a box-and -whisker plot:



The data: Math test scores: 80, 75, 90, 95, 65, 65, 80, 85, 70, 100.

Steps: 1) Write the data in numerical order.

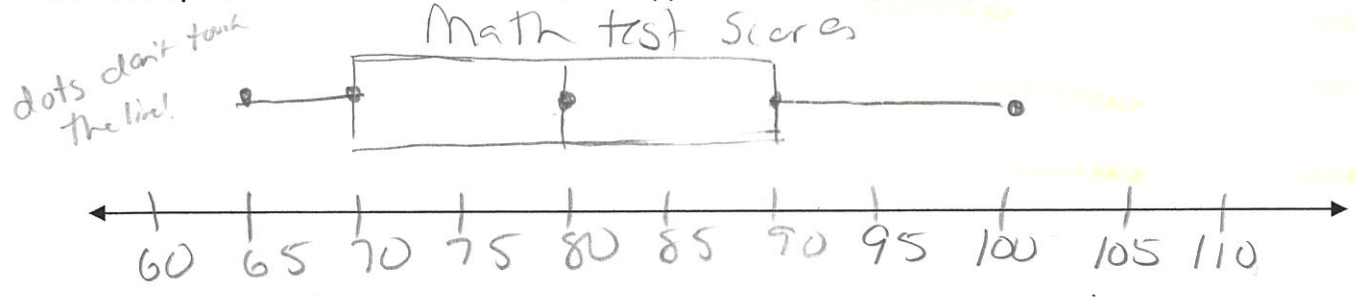


- 2) Find:
- The smallest value 65 (minimum/lower extreme)
  - The first (or lower) quartile 70 (median of 1st half)
  - The median 80 (2nd Quartile)
  - The third (or upper) quartile 90 (median of 2nd half)
  - The largest value 100 (maximum/upper extreme)

5 # Summary

→ #'s you plot

3) Draw a number line. The number line must include the extreme values (least and greatest value). Plot dots to represent the extreme values, the upper and lower quartile, and the median.



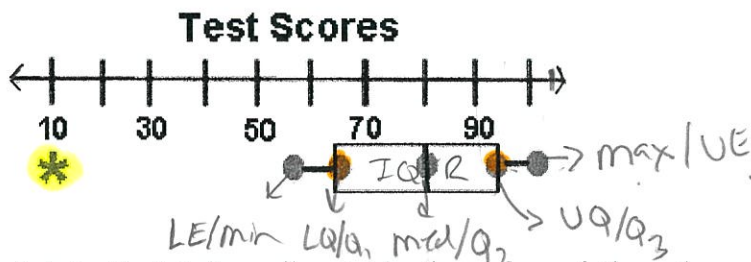
4) Draw a box with ends through the points for the first and third quartiles (this designates the data falling between the upper and lower quartiles).

5) Draw a vertical line through the point representing the median.

6) Draw a segment from the lower quartile to the least value and one from the upper quartile to the greatest value. These segments are the whiskers of the plot.

**Special Case:**

You may see a box-and-whisker plot, like the one below, which contains an asterisk.



Sometimes there is **ONE** piece of data that falls well outside the range of the other values. This single piece of data is called an **outlier**. If the outlier is included in the whisker, readers may think that there are grades dispersed throughout the whole range from the first quartile to the outlier, which is not true. To avoid this misconception, an **\*** is used to mark this "out of the ordinary" value.

Examples:

1) According to the above box and whisker plot above, find the following information:

a) Median  $(80)$     b) 1<sup>st</sup> quartile  $(65)$     c) 3<sup>rd</sup> quartile  $(95)$     d) maximum value  $(103)$

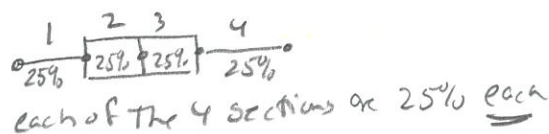
e) Minimum  $(55)$     f) outlier  $(10)$

g) The **Interquartile range** is the difference between the upper quartile and the lower quartile. What is the interquartile range of the box-and-whisker?  $Q_3 - Q_1$      $95 - 65 = 30$

h) What percent of data is between 65 and 95?  $50\%$

i) What percent of data is greater than 95?  $25\%$

j) What percent of data is less than 95?  $75\%$



Box + whisker in the calculator?

1) [STAT] [I:Edit] put #'s into L1

2) [STAT] [F->] [CALC] [1: 1-Var:Stats]

Calculate then scroll down to get 5 # summary

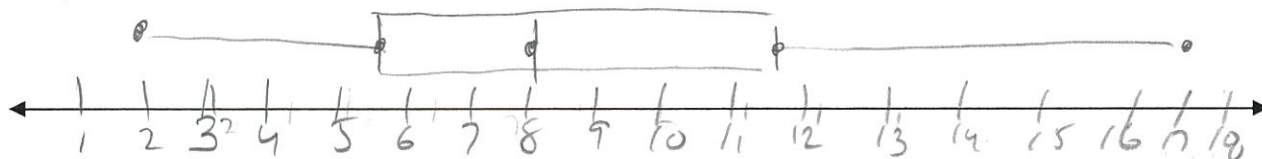
8, 5, 12, 9, 6, 2, 14, 7, 10, 17, 11, 8, 5

5 # Summary

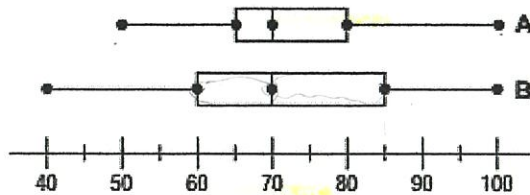
- min  $2$
- $Q_1$   $5.5$
- med  $8$
- $Q_3$   $11.5$
- max  $17$

IQR:  $Q_3 - Q_1$   
 $11.5 - 5.5 = 6$

Data



3) Compare box-and-whisker plots A and B to answer each question.



a) What is the <sup>Q<sub>2</sub></sup> median of each set of data?

A:  $\boxed{70}$     B:  $\boxed{70}$

b) Which plot has the lesser range?

max - min  
 A:  $100 - 50 = 50$      $\boxed{A}$   
 B:  $100 - 40 = 60$

c) Which plot has the greater interquartile range?

Q<sub>3</sub> - Q<sub>1</sub>  
 A:  $80 - 65 = 15$      $\boxed{B}$   
 B:  $85 - 60 = 25$

d) What is the upper quartile of each set of data?

Q<sub>3</sub>  
 A:  $\boxed{80}$     B:  $\boxed{85}$

e) What is the lower quartile of each set of data?

Q<sub>1</sub>  
 A:  $\boxed{65}$     B:  $\boxed{60}$

f) What is the least value in plot A?

min / LE  $\boxed{50}$

g) What is the greatest value in plot B?

max / UE  $\boxed{100}$

h) Which plot illustrates the larger range of data?

$\boxed{B}$

i) What percent of the data in plot B is between 60 and 85?

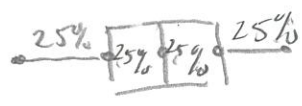
$\boxed{50\%}$  (2 sections)

j) What percent of the data in plot A is greater than 80?

$\boxed{25\%}$  (1 section)

k) What percent of the data in plot A is less than 65?

$\boxed{25\%}$  (1 section)



## Review

We know that the median of a set of data separates the data into two equal parts. The numbers that separate the set into four equal parts are called Quartiles.

\* The 1<sup>st</sup> quartile (lower) is the median of the lower part of the data

\* The 2<sup>nd</sup> quartile is another name for the median of the entire set of data.

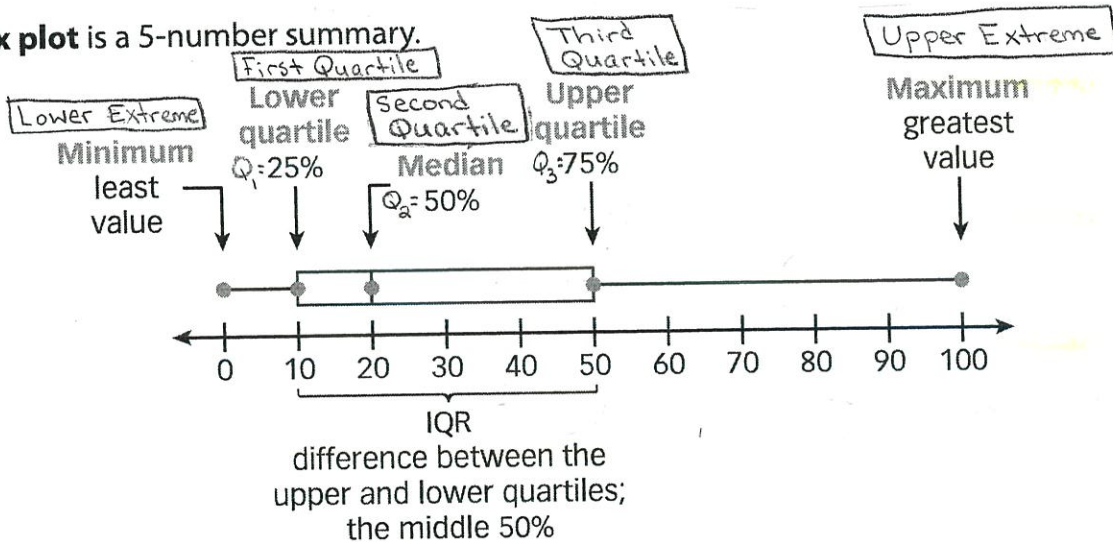
\* The 3<sup>rd</sup> quartile (upper) is the median of the upper part of the data.

\* The IQR is the difference between the upper quartile and the lower quartile.

$$Q_3 - Q_1$$

Range: diff between max + min

A **box plot** is a 5-number summary.



Another number, the **interquartile range (IQR)**, is the difference between the upper quartile and lower quartile. It represents the middle 50% of the data.