Median, Quartiles, Inter-Quartile Range and Box Plots.

Measures of Spread

Remember: The range is the measure of spread that goes with the mean.

Example 1. Two dice were thrown 10 times and their scores were added together and recorded. Find the **mean** and **range** for this data.

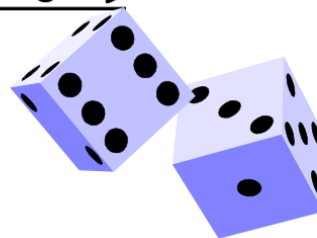$$\overset{\text{min}}{}\qquad\overset{\text{max}}{}$$

7, 5, 2, 7, 6, 12, 10, 4, 8, 9

Mean = $\dfrac{7 + 5 + 2 + 7 + 6 + 12 + 10 + 4 + 8 + 9}{10}$

= $\dfrac{70}{10}$ = 7

Range = 12 − 2 = 10

Max − Min

Median, Quartiles, Inter-Quartile Range and Box Plots.

Measures of Spread

The range is **not** a good measure of spread because one extreme, (very high or very low value can have a big effect) The measure of spread that goes with the median is called the inter-quartile range and is generally a better measure of spread because it is not affected by extreme values.

A reminder about the median

$$IQR = Q_3 - Q_1$$

Averages (The Median)

The **median** is the middle value of a set of data once the data has been **ordered**.

odd

Example 1. Robert hit 11 balls at Grimsby driving range. The recorded distances of his drives, measured in yards, are given below. Find the median distance for his drives.

①   85, 125, 130, 65, 100, 70, 75, 50, 140, 95, 70

6th

in ②   50, 65, 70, 70, 75, (85,) 95, 100, 125, 130, 140
order

Single middle value   **Ordered data**

Median drive = 85 yards

Averages (The Median)

The **median** is the middle value of a set of data once the data has been **ordered**.

even

by

Trials

①

Example 1. Robert hit **12** balls at Grimsby driving range. The recorded distances of his drives, measured in yards, are given below. Find the median distance for his drives.

85, 125, 130, 65, 100, 70, 75, 50, 140, 135, 95, 70

②

in order

50, 65, 70, 70, 75, 85, 95, 100, 125, 130, 135, 140

Two middle values so take the mean.

Ordered data

Median drive = 90 yards

$$\frac{85 + 95}{2}$$

Finding the median, quartiles and inter-quartile range.

Example 1: Find the median and quartiles for the data below.

12, 6, 4, 9, 8, 4, 9, 8, 5, 9, 8, 10   *Even*

Order the data

$6 \rightarrow$ *Even*   *Even* $\leftarrow 6$

Q_1 6th Q_2 7th Q_3

4, 4, 5, 6, 8, 8, 8, 9, 9, 9, 10, 12

$\dfrac{5+6}{2}$

$\dfrac{9+9}{2}$

| Lower Quartile = $5\frac{1}{2}$ | Median = 8 | Upper Quartile = 9 |

$\dfrac{8+8}{2} = 8$

Inter- Quartile Range = 9 – $5\frac{1}{2}$ = $3\frac{1}{2}$
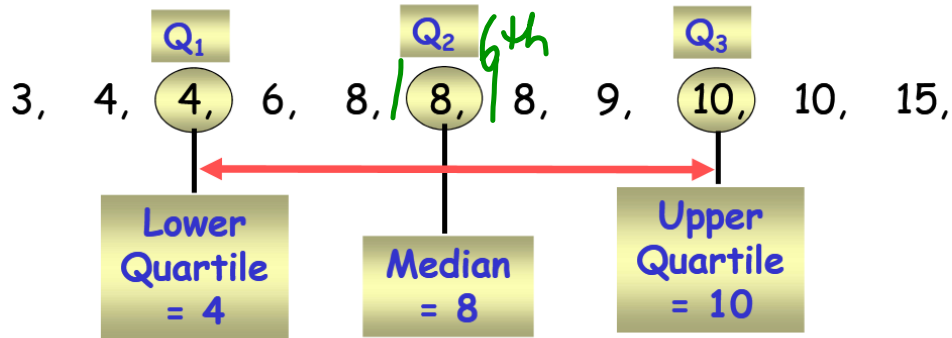
$Q_3 - Q_1 = IQR$

Finding the median, quartiles and inter-quartile range.

Example 2: Find the median and quartiles for the data below.

$\boxed{2}$ 6,   3,   9,   8,   4,   10,   8,   4,   15,   8,   10   *Odd*
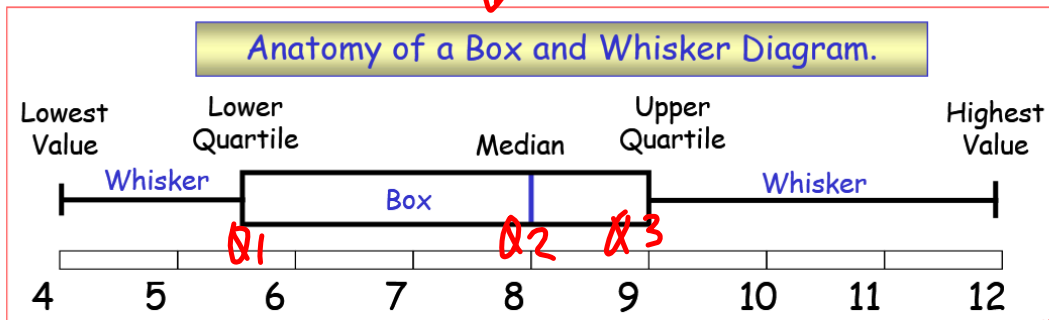
$\boxed{16}$

Order the data

| | | Q_1 | | | Q_2 6th | | | Q_3 | | |

3,   4,   (4,)   6,   8,   (8,)   8,   9,   (10,)   10,   15,

Lower Quartile = 4   **Median = 8**   **Upper Quartile = 10**

Inter- Quartile Range = 10 – 4 = 6

$2, 3, 4 | 4, 6, 8, \text{⑧}, 8, 9, 10 | 10, 15, 16$

Q_1 $Q_2 = 7^{th}$ Q_3

For Example 1

Box and Whisker Diagrams.

Box → IQR (Q_1, Q_2 & Q_3)

Anatomy of a Box and Whisker Diagram.

| Lowest Value | Lower Quartile | | Median | Upper Quartile | | Highest Value |

Whisker   Box   Whisker

Q_1 Q_2 Q_3

4   5   6   7   8   9   10   11   12

min

$Q_1 = 5\frac{1}{2}$ $Q_2 = median$ max

$Q_3 = 9$

Data Collected Value

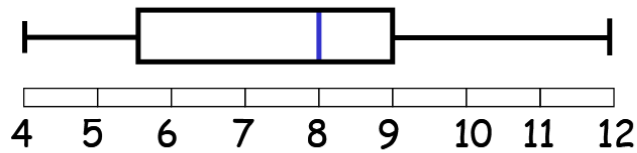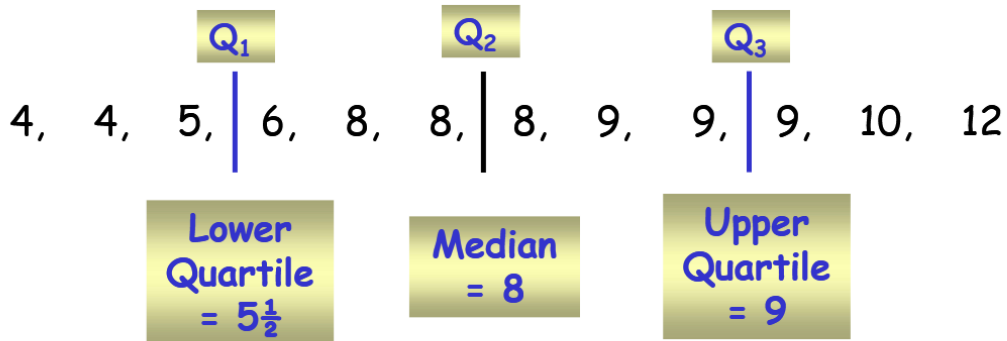## Box and Whisker Diagrams.

Box plots are useful for comparing two or more sets of data like that shown below for heights of boys and girls in a class.

Boys

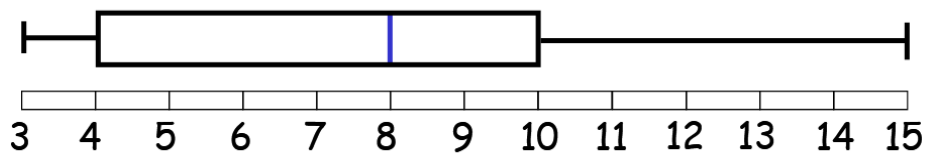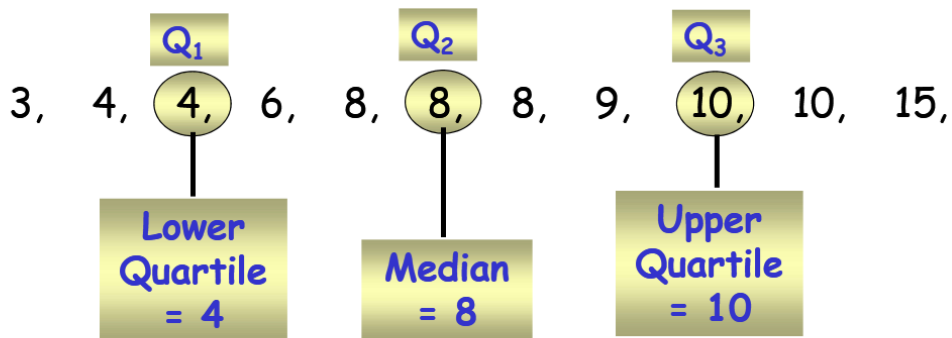130   140   150   160   170   180   cm   190

Girls
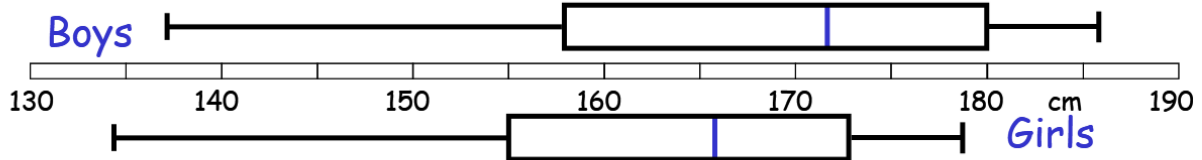
Drawing a Box Plot.

Example 1: Draw a Box plot for the data below

Q_1 Q_2 Q_3

4,   4,   5,   6,   8,   8,   8,   9,   9,   9,   10,   12

Lower Quartile = $5\frac{1}{2}$

Median = 8

Upper Quartile = 9

4   5   6   7   8   9   10   11   12

Drawing a Box Plot.

Example 2: Draw a Box plot for the data below

Q₁   Q₂   Q₃

3,   4,   (4,)   6,   8,   (8,)   8,   9,   (10,)   10,   15,

Lower Quartile = 4

Median = 8

Upper Quartile = 10

3 4 5 6 7 8 9 10 11 12 13 14 15

Drawing a Box Plot.

Question: Stuart recorded the heights in cm of boys in his class as shown below. Draw a box plot for this data.

Q_L Q_2 Q_u

137, 148, 155, (158), 165, 166, 166, (171), 171, 173, 175, (180), 184, 186, 186

Lower Quartile = 158

Median = 171

Upper Quartile = 180

130   140   150   160   170   180 cm   190
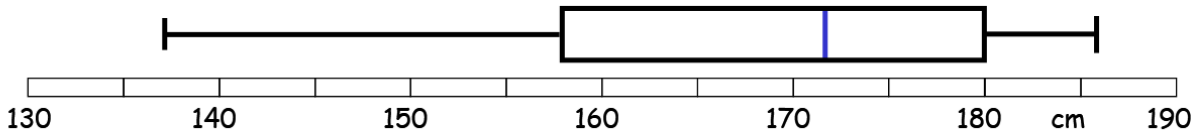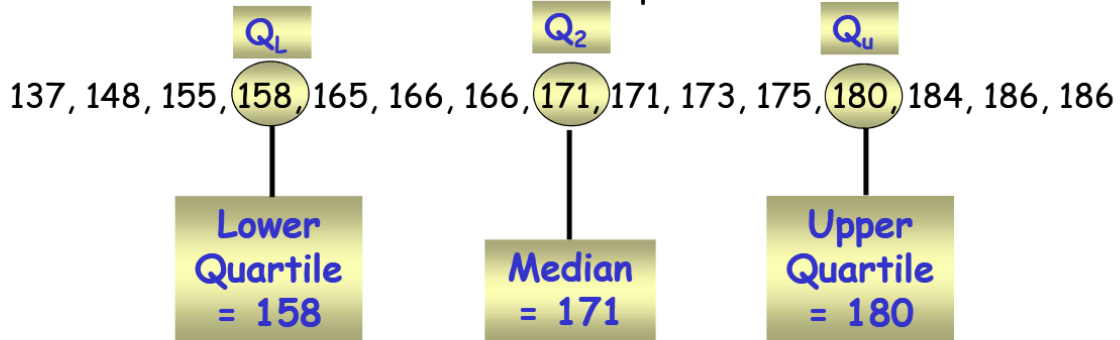
## Drawing a Box Plot.

Question: Gemma recorded the heights in cm of girls in the same class and constructed a box plot from the data. The box plots for both boys and girls are shown below. Use the box plots to choose some **correct** statements comparing heights of boys and girls in the class. Justify your answers.

Boys

I Q R

| 130 | 140 | 150 | 160 | 170 | 180 cm | 190 |

I Q R
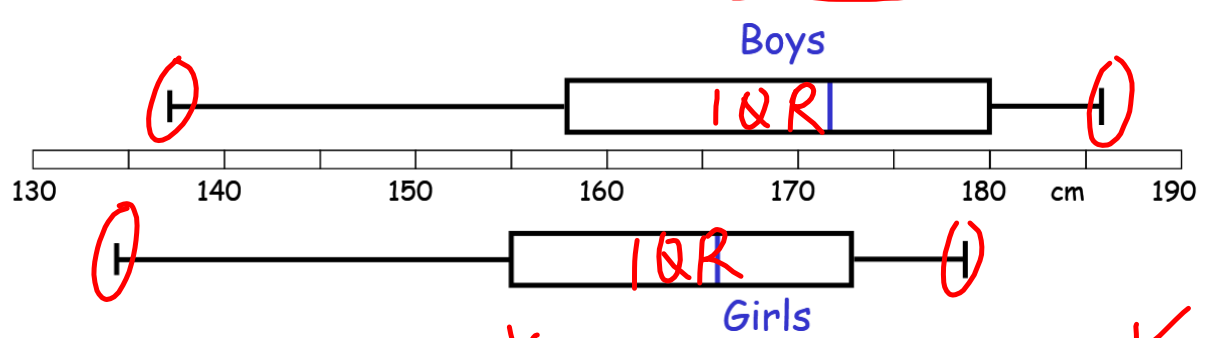
Girls

1. The girls are taller on average. ✗   2. The boys are taller on average. ✓

3. The girls show less variability in height. ✓   5. The smallest person is a girl Girl

4. The boys show less variability in height. ✗   6. The tallest person is a boy Boy

"Backing out" a data set from a box and whiskers plot

3   4   5   6   7   8   9   10 11 12 13 14 15
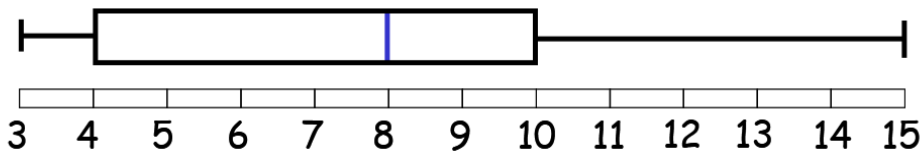
Write a possible data set that the box and whiskers plot above
Could be based on.

| min | Q₁ | Q₂ | Q₃ | max |

3, 3, 4, 4, 5, 6, 8, 8, 9, 10, 11, 12, 15

Then we fill in any numbers that fit in between so that the
quartiles remain unchanged.