

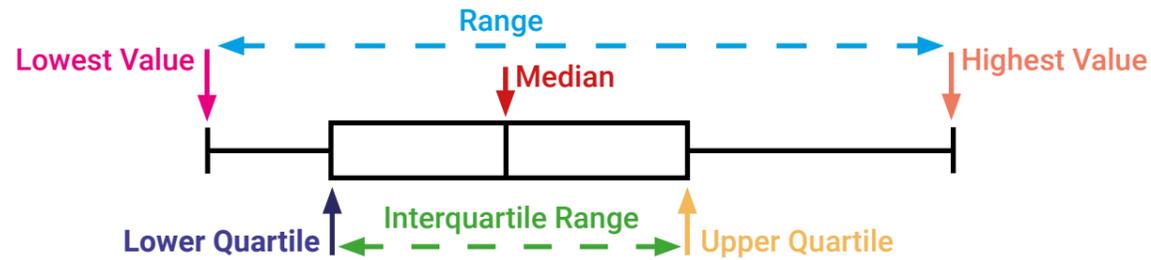
BOX AND WHISKER PLOTS

A box and whisker plot is a special diagram that is a useful way of displaying data in quartiles. It is an easy way to compare data from two distributions.

Check first that you:

- understand the difference between the averages and the range
- can find the averages and the range of a set of data
- use scales on a graph/diagram
- understand how to use a cumulative frequency diagram to find the median and interquartile range.

Understanding a Box and Whisker Plot



Median – this is the middle value. 50% of the data will be below this value and 50% above this value.

Range – measures the spread of the whole data.

$$\text{Range} = \text{Highest value} - \text{Lowest value}$$

Interquartile Range – measures the spread of the middle 50% of data. Eliminating any extreme values which can affect the data.

$$\text{Interquartile Range} = \text{Upper Quartile} - \text{Lower Quartile}$$

Remember to make note of all these values on your diagram so that it's easy to use and compare the data.

Comparing data using Box and Whisker Plots

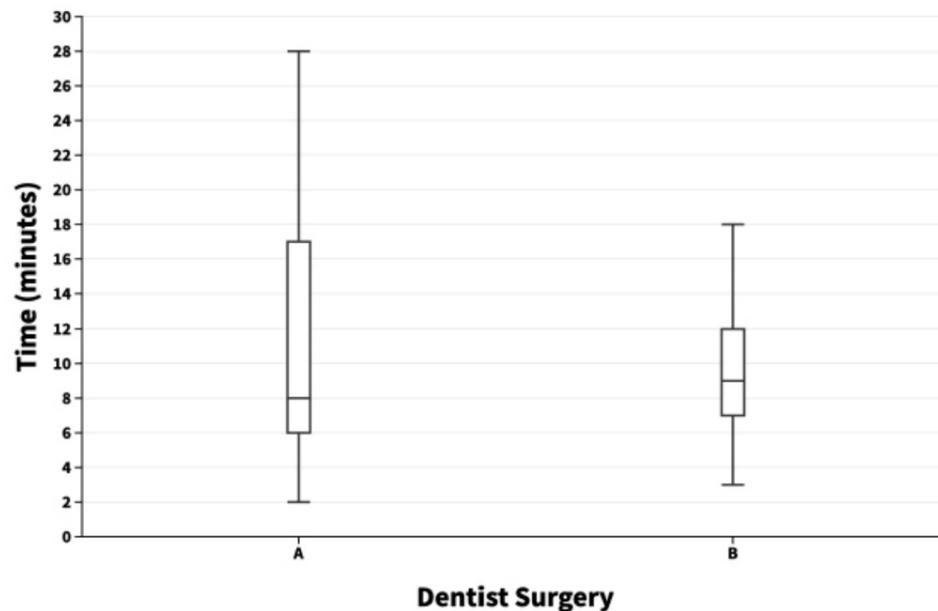
E.g. Data was collected on patient wait times, in minutes, at two dental surgeries in Pontypool over a period of one week. Use the box and whisker plot to compare the wait times at the two surgeries. Rather than listing the individual data values it can be easier to display it in a frequency table.

When comparing the median waiting time at both surgeries, surgery A on average was slightly better at 8 minutes compared to a slightly longer wait time of 9 minutes at surgery B.

However, when comparing the range of both surgeries we see that surgery A has the larger range of 26 minutes compared to only 15 minutes at surgery B suggesting that of the two, surgery A is the least consistent.

The interquartile range also shows that the middle 50% off waiting times for surgery A is the larger at 11 minutes when compared to surgery B which is just 5 minutes. Again, this suggests that surgery A is the least consistent.

| | Surgery A | Surgery B |
|---------------------|---------------|---------------|
| Lowest Value | 2 | 3 |
| Highest Value | 28 | 18 |
| Range | $28 - 2 = 26$ | $18 - 3 = 15$ |
| Median | 8 | 9 |
| Lower Quartile | 6 | 7 |
| Upper Quartile | 17 | 12 |
| Interquartile Range | $17 - 6 = 11$ | $12 - 7 = 5$ |

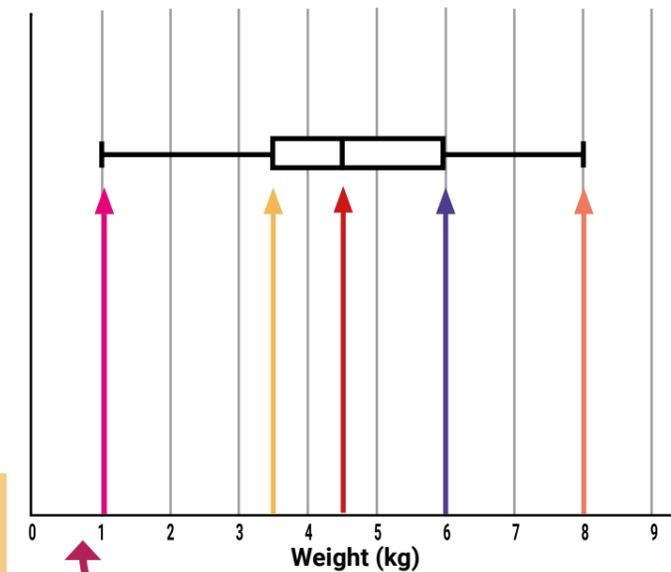


Cumulative Frequency Diagrams and Box and Whisker Plots

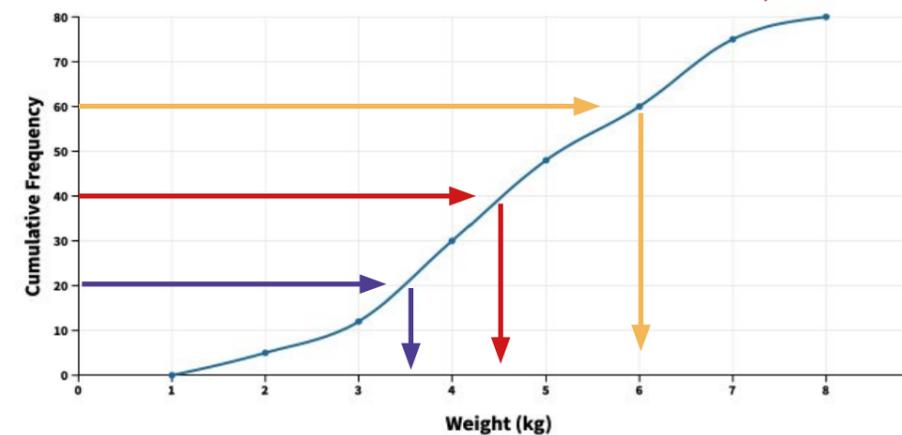
We can draw a box and whisker plot using information taken from a cumulative frequency diagram. It is also possible to compare data displayed in either as they both give information on the median, interquartile range and the range. E.g. The following cumulative frequency diagram shows the weight, in kg, of 80 passengers' hand luggage on flight X714. The lightest bag was 1 kg and the heaviest bag was 8 kg. Draw the information as a box and whisker plot.

We find the following using the cumulative frequency diagram and information in the question:

| Lowest Value | Lower Quartile | Median | Upper Quartile | Highest Value |
|--------------|----------------|--------|----------------|---------------|
| 1 | 3.5 | 4.5 | 6 | 8 |



Then use this information to draw the box and whisker plot:



$$\begin{aligned} \text{Median} &= 4.5 \\ \text{Range} &= 8 - 1 = 7 \\ \text{Interquartile Range} &= 6 - 3.5 \\ &= 2.5 \end{aligned}$$