# Cumulative Frequency

We have already learned that when data has been grouped and we no longer have the raw data, it is only possible to estimate some measures of average and spread.

**The table below shows my scores at throwing darts over 60 sets of throws:**

| Score, s | Frequency | MID-VALUE | Total |
|---|---|---|---|
| $30 < s \le 60$ | 10 | $\times$ 45 | 450 |
| $60 < s \le 90$ | 4 | $\times$ 75 | 300 |
| $90 < s \le 120$ | 13 | 105 | 1365 |
| $120 < s \le 150$ | 23 | 135 | 3105 |
| $150 < s \le 180$ | 10 | 165 | 1650 |

$+$

**Estimate my mean score, the modal and median groups.**

$\underline{6870}$

$\text{Mean} = \text{total} \div \text{Count}$

$= 6870 \div 60$
$= 114.5$

$\text{Median} = 30^{th} \text{ throw}$
$= 120 < s \le 150$

$\text{MODAL} = 120 < s \le 150$

Another way of working with grouped data is to produce a *cumulative frequency curve (or graph)* which can be used to *estimate a median value* rather than a group and a different measure of range, the *inter-quartile range*, which focuses on how spread out the middle half of the data is. This is useful because it isn't affected by extreme data values (think of the example I used by including my age in the ages of the people in the classroom)

Before we can draw the graph, we need to produce a running total (accumulating, cumulative) for our data:

| Score, s | Frequency | s ≤ | cumulative frequency |
|---|---|---|---|
| $30 < s \le 60$ | 10 | 60 | 10 |
| $60 < s \le 90$ | 4 | 90 | 14 |
| $90 < s \le 120$ | 13 | 120 | 27 |
| $120 < s \le 150$ | 23 | 150 | 50 |
| $150 < s \le 180$ | 10 | 180 | 60 |
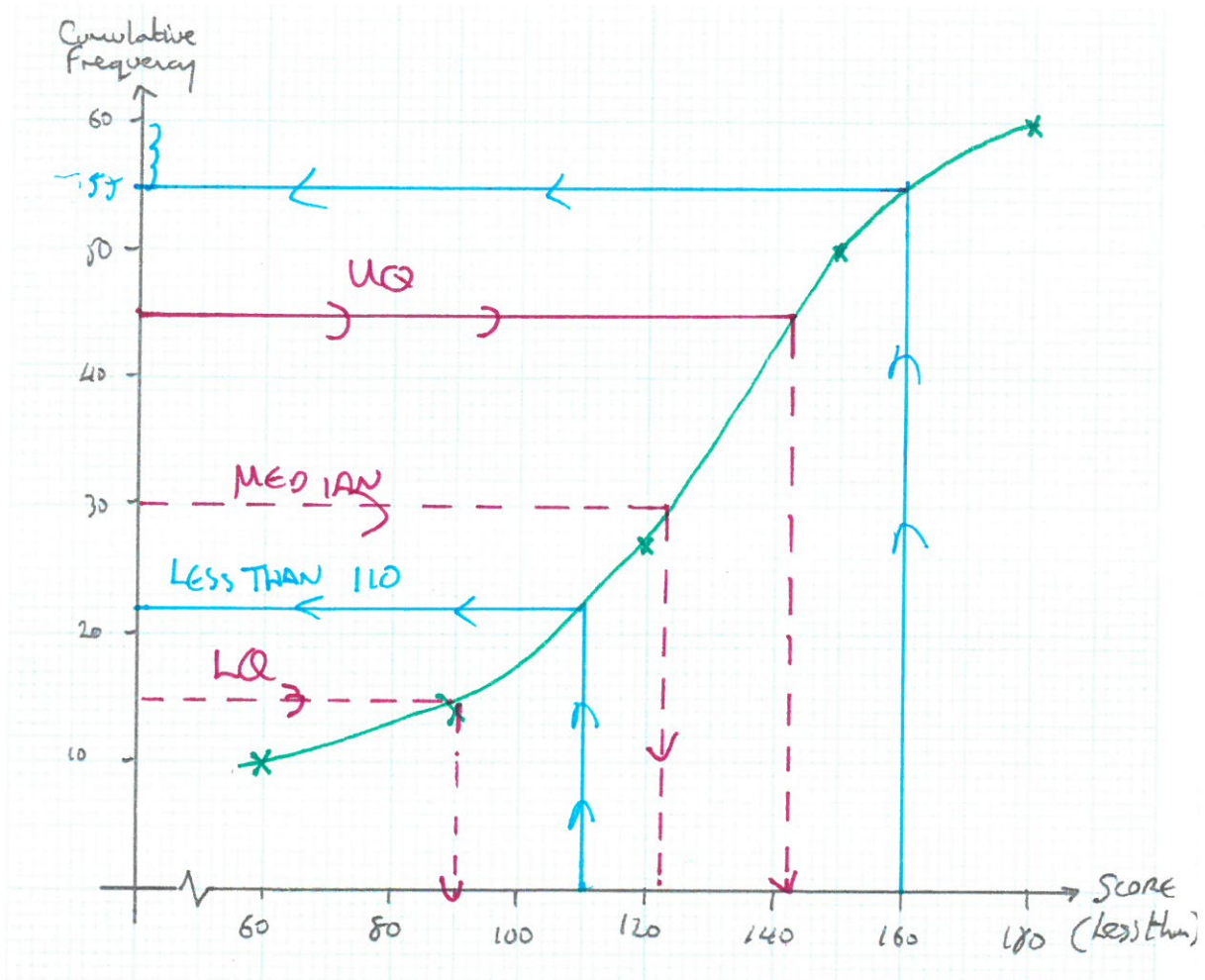
We can now use the graph to estimate the median

$30^{th}$ value = 122

To find the inter-quartile range, we find the data values located at the quarter (lower quartile) and three quarter (upper quartile) points and then find their difference: ↖ LQ          UQ
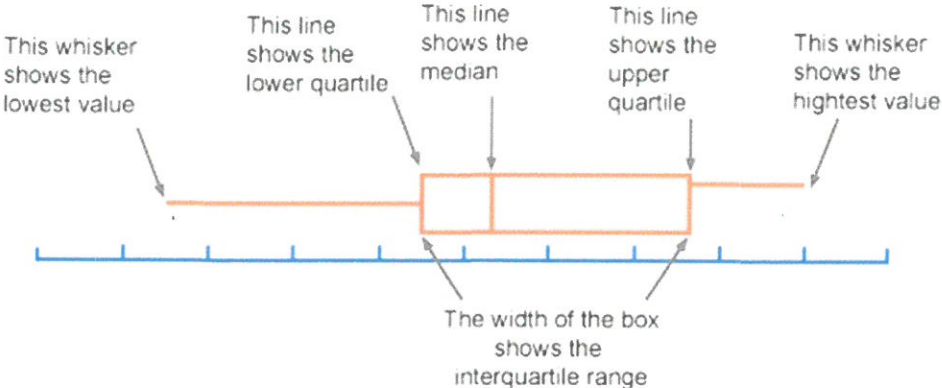
LQ = 90
UQ = 142

IQR = 142 − 90 = 52

We can also use the curve to estimate things like:

**How many of my throws scored less than 110?**   22

**How many of my throws were over 160?**   5.

We can also display this information as a Box & Whisker plot:

This whisker shows the lowest value

This line shows the lower quartile

This line shows the median

This line shows the upper quartile

This whisker shows the hightest value

The width of the box shows the interquartile range

So for my darts scores

| Median | 124 |
|---|---|
| Upper Quartile | 144 |
| Lower Quartile | 92 |
| Lowest possible score | 31 |
| Highest possible score | 180 |