AVERAGES AND RANGE

Averages are measures that give us information about data. Along with the range they allow us to make comparisons between data.

Check first that you:
- understand the different types of data:
  discrete data is data that can only take certain values
  continuous data is data that can take any value
- can order numbers
- understand frequency tables including those for grouped data.

Averages and discrete data There are 3 types of averages that we use:

The median
- This average is the middle value when the data is arranged in order of size.
- If there are two middle values then we find the mean of the two values by adding them and dividing the total by 2.

The mode
- This average is the most common value.
- It is possible have more than one mode and it is also possible to have no mode when all values appear the same number of times.

The mean
- This average is found by dividing the total of all the values by the number of values.

The range is a measure that tells us about the spread of the data. **The range = highest – lowest value**

E.g. Find the median, mode, mean and range of the following test scores: 12, 15, 12, 13, 10, 15, 19, 8

We place the numbers in ascending order: 8, 10, 12, 12, 13, 15, 15, 19

The median 8, 10, 12, 12, 13, 15, 15, 19 $\frac{12+13}{2} = 12{\cdot}5$ **The range** $19 - 8 = 11$

The mode 8, 10, 12, 12, 13, 15, 15, 19 12 and 15 **The mean** $\frac{8+10+12+12+13+15+15+19}{8} = \frac{104}{8} = 13$

Remember **the range tells us how close together the data values are. The smaller the range the more consistent the data is.**

Frequency tables Rather than listing the individual data values, it can be easier to display it in a frequency table. E.g. The table shows the number of children in 75 households on Heol Hir. Find the median, mean, mode and range.

Number of children	Frequency
0	16
1	25
2	20
3	9
4	2
5	3

Take care! **When finding the mode or range, don't confuse the frequency values with the actual data values.**

Median
Adding the frequencies tells us how many households there are.
16 + 25 + 20 + 9 + 2 + 3 = 75
The median is the middle value and its position is given by: $\frac{75+1}{2} = 38$.

Number of children (x)	Frequency (f)	Cumulative frequency (cf)	
0	16	16	1st - 16th
1	25	16 + 25 = 41	17th - 41st
2	20	41 + 20 = 61	42nd - 61st
3	9	61 + 9 = 70	62nd - 70th
4	2	70 + 2 = 72	71st - 72nd
5	3	72 + 3 = 75	73rd - 75th

38th

The data is already ordered therefore we add the frequencies (cumulative frequency) to find where the 38th household lies. From the table we see that the **median number of children for a household in Heol Hir is 1.**

Mean
To find the mean we need the total of all the children living in Heol Hir and then we divide this number by the total number of households.
If we multiply the number of children (x) with the frequency (f) and then add these values we get the total number of children.

Number of children (x)	Frequency (f)	No of children × frequency (fx)
0	16	0 × 16 = 0
1	25	1 × 25 = 25
2	20	2 × 20 = 40
3	9	3 × 9 = 27
4	2	4 × 2 = 8
5	3	5 × 3 = 15
Total	$\sum f = 75$	$\sum fx = 115$

Mean = $\frac{\text{total number of children}}{\text{total number of households}}$ or $\frac{\sum fx}{\sum f} = \frac{115}{75} = 1{\cdot}5$ (1 d.p.)

∑ means the 'sum of'

Mode
The mode is number of children with the highest frequency. The modal number of children per household is 1 with a frequency of 25.

Range
The highest number of children is 5 and lowest number of children is 0. Therefore the range = 5 – 0 = 5

Continuous grouped data Continuous data i.e. data that can be measured such as height or weight, will also be displayed in a frequency table but the data will be grouped in equal class intervals. E.g. The table shows the time taken for pupils in Year 11 to travel to school. Find an estimate for the mean length of travel time for pupils in Year 11.

Time, t (minutes)	Frequency
$0 < t \leq 10$	24
$10 < t \leq 20$	16
$20 < t \leq 30$	35
$30 < t \leq 40$	11

When the data is grouped, the individual values are not known. Therefore, we find the midpoint of the class interval and use this as an estimate of every value recorded in that group.

Time (minutes)	Midpoint x	Frequency f	Midpoint × frequency (fx)
$0 < t \leq 10$	5	24	5 × 24 = 120
$10 < t \leq 20$	15	16	15 × 16 = 240
$20 < t \leq 30$	25	35	25 × 35 = 875
$30 < t \leq 40$	35	11	35 × 11 = 385
Total		$\sum f = 86$	$\sum fx = 1620$

Mean = $\frac{\sum fx}{\sum f} = \frac{1620}{86}$

= 19 minutes

(to the nearest minute)

Use the same method as in the example above to find the median or modal class but *remember* to write the class interval as your answer e.g for length of travel time for Year 11 pupils the modal class is $20 < t \leq 30$.

Remember **with grouped data we can only find estimates as we don't know the individual data values.**