Means, Modes and Medians

The mean, mode and median are three different types of averages.

The mean is calculated by adding all the observations together and dividing by the total number of observations (total frequency).

Example: Below are 10 randomly selected heights (cm) of learners from *CensusAtSchool* 2012/2013:

165	157	154	149	157	142	168	152	168	180

To calculate the mean:

$$\frac{165 + 157 + 154 + 149 + 157 + 142 + 168 + 152 + 168 + 180}{10} = 159.2cm$$

The mode / modal group is the observation that occurs most often. There can be more than one mode.

Example: Firstly the data should be ordered.

142	149	152	154	**157**	**157**	165	**168**	**168**	180

Now we can see that there are two numbers that occur most frequently, so the modes are 157cm and 168cm.

The median is the middle observation of the ordered data. If there are an odd number of observations then the median is simply the middle number of the ordered data. If there are an even number of observations then the median is found halfway between the two middle numbers.

Example: Firstly remember to order the data. In this case, imagine lining up the learners in height order.

142	149	152	154	**157**	**157**	165	168	168	180

There are 10 observations (an even number), so the median will be halfway between the 5th and 6th observations.

$$\frac{157 + 157}{2} = 157cm$$

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TASK A

1. The dataset below shows the average time taken to travel to school in seconds for 8 randomly selected learners, taken from *CensusAtSchool* 2012/2013. What is the mean?

8	12	5	10	25	13	10	6

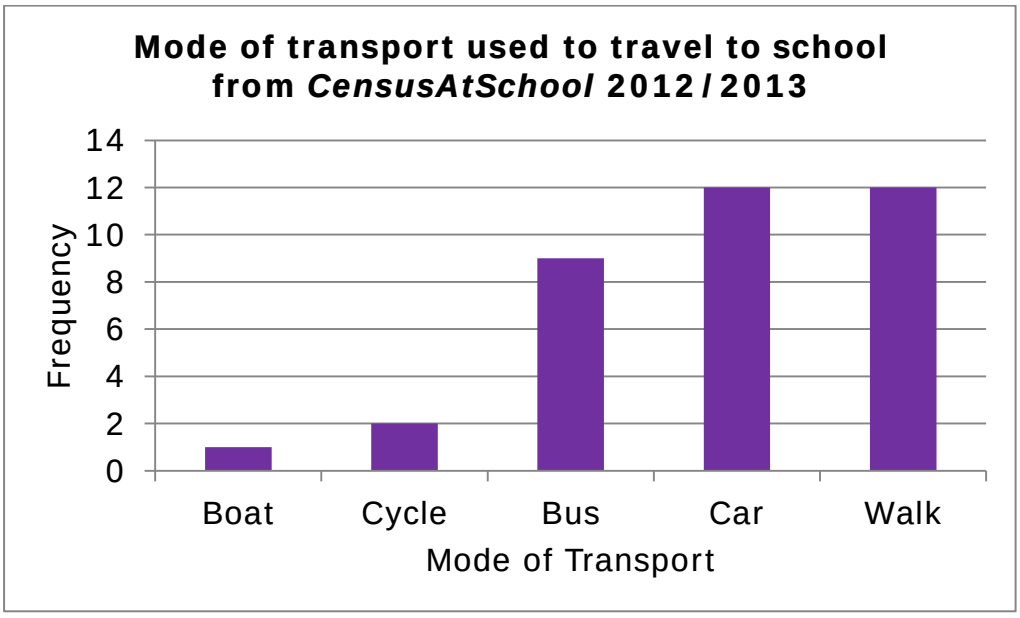
2. The dataset below shows wrist measurements (in cm) taken from a random sample of learners from *CensusAtSchool* 2012/2013. What is the mean?

18	15	15	14	15	17	16	12	14	14
17	16								

3. The dataset below shows the method of transport used to travel to school for 19 randomly selected learners from *CensusAtSchool* 2012/2013. What is the modal group?

Walk	Walk	Walk	Car	Bus
Rail	Bus	Car	Bus	Car
Walk	Car	Car	Bus	Bus
Car	Car	Cycle	Bus	

4. What is the mode of the data shown in the bar chart below?



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5. As stated previously, the median is the middle observation. Complete the table below to work out where the middle position is located. In the last column you will need to work out the following, where n is the total number of learners:

$$\frac{n+1}{2}$$

Example: For a total of 15 learners

$$\frac{15+1}{2} = \frac{16}{2} = 8$$

Number of learners (n)	Middle learner	$\frac{n+1}{2}$
3 	2	
6 	3.5 (between 3 and 4)	
11 		
15		8
1290		

6. You need to find the median of a large dataset with 36,687 observations. At which position would the median lie in the ordered data?

7. Below are scores for 10 randomly selected 14 year olds from the *WinAtSchool* Competition. What is the median?

32	40	28	27	8	20	12	8	4	12

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TASK B

The table below shows a grouped frequency table for the heights of 250 learners from *CensusAtSchool* 2012/13.

Height (cm)	Midpoint (x)	Frequency (f)	Cumulative Frequency	fx
90 - (100)	95	4	4	380
100 - (110)	105	4	8	420
110 - (120)	115	3	11	345
120 - (130)	125	16	27	2000
130 - (140)	135	17	44	2295
140 - (150)	145	39	83	5655
150 - (160)	155	83	166	12865
160 - (170)	165	51	217	8415
170 - (180)	175	23	240	4025
180 - (190)	185	8	248	1480
190 - (200)	195	0	248	0
200 - (210)	205	2	250	410
Total		250		38290

When we are given grouped data we cannot calculate the mean and the median of the data in the same way as we have previously seen. Firstly, let's explain the table.

Height Column – This shows the groupings. 90 – (100) means the heights of learners from 90cm up to, but not including, 100cm.

Midpoint (x) – The midpoint is calculated by adding the upper and lower limits of the group together and then dividing by 2.

For example for group 90 – (100): $x = \frac{90 + 100}{2} = 95$

Frequency (f) – The frequency is the number of observations that were within the range of the group. For example there were 4 people with heights that were 90cm to 100cm.

Cumulative Frequency – The cumulative frequency is the running total for the frequency.

fx – This is the frequency (f) multiplied by the midpoint (x). For example for group 90 – (100):

$$fx = 4 \times 95 = 380$$

By using the midpoint, this column works out an estimated total height for learners within each group.

Means, Modes and Medians

Mean - Grouped Data

To find the mean we divide the total of the fx column by the total frequency.

$$\frac{total\ fx}{total\ f} = \frac{38290}{250} = 153.2cm$$

Mode Group - Grouped Data

The modal group is the group with the highest frequency. For this particular data, the modal group is 150 - (160), which has the highest frequency of 83. There can be more than one modal group.

Median – Grouped Data

To find the median we need to do the same calculation as before to find out which is the middle observation:

$$\frac{250 + 1}{2} = 125.5$$

So, we need to look at the 125th and 126th observations. We do this by using the cumulative frequency. We can see that both these observations lie in the group 150 – (160), so the median height is between 150 and 160cm.

1. Complete the table below for the grouped dataset, which shows the time taken to travel to school for 250 learners from *CensusAtSchool* 2012/2013. Find the mean, median and modal group.

Time (minutes)	Midpoint (x)	Frequency (f)	Cumulative Frequency	fx
0 - (10)		83		
10 - (20)		76		
20 - (30)		42		
30 - (40)		26		
40 - (50)		15		
50 - (60)		4		
60 - (70)		0		
70 - (80)		4		
Total				

2. Which average do you think is most appropriate for this data and why?