Guidance for tutors

<table>
<tr><td>Outcome</td><td>S2</td><td>Student can consistently:</td><td>Find mean, median, mode and range of set of data (including where data is in table).</td></tr>
<tr><td>How the topic is examined</td><td colspan="3">

Examined through test paper questions.
Questions are more likely to appear on calculator papers.
Students will be asked at higher tier to find the mean, median, mode and range of data that is presented in a summarised form or table. The table may be grouped or ungrouped.

</td></tr>
<tr><td>Prior knowledge</td><td colspan="3">

Students should be confident:

Multiplying and dividing without a calculator.
Using a calculator.

</td></tr>
<tr><td>Suggested tuition approaches</td><td colspan="3">

Students need to be aware that the mean, median and mode are measures of average or central tendency.

Mode – is the most common or frequently appearing number (or object)
Median – is the middle number in an ordered set. If there are two numbers in the middle then the median is the mean of these two numbers (or halfway in between). For n values the median is the $\frac{n+1}{2}$ value.
Mean – is what is often referred to as the average. This is where you add up all the numbers and divide by how many numbers there are.

It might be worthwhile discussing the advantages and disadvantages of each of these measures http://www.bbc.co.uk/schools/gcsebitesize/maths/statistics/measuresofaveragerev6.shtml
The range is a measure of spread and is the difference between the highest and lowest values.
Questions will more likely present data in the form of a table. The table could take two forms:

Ungrouped data – usually discrete values (e.g. passengers in a car, shoe size etc…)
Grouped data – usually continuous values (e.g. height, time taken etc…)

Before tacking these questions students should try to understand what the data in the table is telling them.

<table>
<tr><th>Shoe Size</th><th>Number of people</th><th></th></tr>
<tr><td>5</td><td>15</td><td>This means that 15 people had a shoe size of 5</td></tr>
<tr><td>6</td><td>21</td><td>This means that 21 people had a shoe size of 6</td></tr>
</table>
</td></tr>
</table>

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7	8	**This means that 8 people had a shoe size of 7**

Number of passengers	Number of cars (frequency)
0	15
1	26
2	11
3	5
4	3
Total	**60**

Height, h, (cm)	Frequency
$0 < h \leq 10$	6
$10 < h \leq 20$	7
$20 < h \leq 25$	10
$25 < h \leq 30$	2
Total	**25**

Mode

Most frequent is 1 passenger as this has the greatest frequency

Modal Class

The highest frequency is 10, therefore the modal class interval is $20 < h \leq 25$

Median

This is where the $\left(\frac{60+1}{2}\right)$ =30.5th item of data appears. This item of data appears in the 1 passenger category

Median class interval

This is where the $\left(\frac{25+1}{2}\right) = 13$th item of data appears. This is in the $10 < h \leq 20$ interval so this is the median class interval.

Mean

Passenger	Frequency	Passenger x Frequency
0	15	0 x 15 = 0
1	26	1 x 26 = 26
2	11	2 x 11 = 22
3	5	3 x 5 = 15
4	3	4 x 3 = 12
Total	**60**	**75**

mean = $\frac{75}{60} = 1.25$ passengers

Estimate of the mean

Height, h, (cm)	f	Mid-point	Mid-point x frequency
$0 < h \leq 10$	6	5	6 x 5 = 30
$10 < h \leq 20$	7	15	7 x 15 = 105
$20 < h \leq 25$	10	22.5	10 x 22.5 = 225
$25 < h \leq 30$	2	27.5	2 x 27.5 = 55
Total	25		415

Estimate of the mean = $\frac{415}{25} = 16.6$

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	Range | Highest – lowest = 4 – 0 = 4 | **Range** | Highest – lowest = 25 – 0 = 25

	• Note you can only find an estimate of the mean from grouped data as you do not know the exact values. Finding an estimate of the mean is one of the most common questions at GCSE.
	• The steps involved in finding an estimate of the mean are
	  ○ Make an extra column for the midpoint and midpoint x frequency
	  ○ Complete the column of mid points.
	  ○ Multiply each mid-point by the corresponding frequency
	  ○ Find the sum of the mid-point x frequency
	  ○ Divide this total by the total frequency.
	• Some students may have learnt the following formula for the mean
	$\frac{\sum xf}{\sum f}$
	Where x is the midpoint (or actual value) and f is the frequency. The symbol Σ means the sum of or add together.

Common errors and misconceptions	• Students mix up the mean, median and mode.
	• When the data is presented in columns as opposed to rows, this sometimes can confuse students. Ensure you cover both examples.
	• When finding the median students
	  ○ Find the wrong value (particularly if they are left with two values in the middle)
	  ○ Give two values of the median when they need to give the middle of these two values.
	  ○ Students struggle to work out which class interval a median lies.
	• When working out the mean or estimate of the mean
	  ○ Students make mistakes when multiplying by 0. The answer is 0, but many students don't put this.
	  ○ Students divide by the number of lines rows in the data or the total of the midpoints instead of dividing by the total frequency. Get them to check their answer and ask themselves if it lies in the range of the data – it should do.
	  ○ The wrong value of the mid-point is found. One way of doing this is to add up the two end points and divide by 2.

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	• When finding the range of data
	  ○ Students give a range instead of a single value
	  ○ When data is in a table students subtract frequency instead of the lowest value from the highest value in the first column.
	• When asked to find the modal & median class interval students state a single value instead of the whole interval.

Suggested resources	• Questions
	  ○ http://www.cimt.org.uk/projects/mepres/allgcse/bkb9.pdf
	  ○ https://corbettmaths.files.wordpress.com/2013/02/averages-and-range-pdf.pdf
	  ○ https://corbettmaths.files.wordpress.com/2013/02/median-from-a-frequency-table-pdf.pdf
	  ○ https://corbettmaths.files.wordpress.com/2013/02/mean-from-a-frequency-table.pdf
	  ○ https://corbettmaths.files.wordpress.com/2013/02/estimated-mean-pdf.pdf
	• Past GCSE Questions
	  ○ https://keshgcsemaths.files.wordpress.com/2013/11/20_mean-median-mode-range.pdf
	  ○ https://keshgcsemaths.files.wordpress.com/2013/11/79_averages-from-frequency-tables.pdf
	• Video tutorials
	  ○ http://corbettmaths.com/2012/08/23/medians-and-quartiles-from-grouped-frequency-tables-and-histograms/
	  ○ http://corbettmaths.com/2012/08/19/means-from-frequency-tables/
	  ○ http://corbettmaths.com/2012/08/19/estimated-means-from-grouped-data/