Had a look ☐ Nearly there ☐ Nailed it! ☐

Mean, median and mode

You can analyse data by calculating statistics like the **mean**, **median** and **mode**.

Mean

Add up all the values

↓

Divide by the total number of values

↓

Do not round your answer

Median

Write the values in order of size, smallest first

↓

Count the number of values

- Odd number of values → The median is the middle value
- Even number of values → The median is half-way between the two middle values

Mode

Look for the most common value

- One value with highest frequency → This value is the mode
- More than one value with highest frequency → These values are all modes
- All values have same frequency → There is no mode

Worked example

Target grade 4

Kayla has 8 numbered cards.

1 2 3 4 5 6 7 8

She removes two cards. The mean value of the remaining cards is 4.
Which two cards could Kayla have removed? Give **one** possible answer.

(4 marks)

$6 \times 4 = 24$

$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 = 36$

$36 - 24 = 12$

The removed cards add up to 12 so Kayla could have removed 7 and 5

Check:

$\frac{1 + 2 + 3 + 4 + 6 + 8}{6} = 4$ ✓

You can work out the sum of the 6 remaining cards using this formula:

Sum of values = Mean × Number of values

Subtract this sum from the sum of all 8 cards. This tells you the sum of the 2 cards Kayla removed. The removed cards were either 5 and 7 or 8 and 4.

Check it!

Work out the mean of the remaining 6 cards.

Which average works best?

	👍	👎
Mean	Uses all the data	Affected by extreme values
Median	Not affected by extreme values	Value may not exist
Mode	Suitable for data that can be described in words	Not always near the middle of the data

Now try this

Target grade 4

Joe scored these marks out of 20 in **six** maths tests:

11 9 5 13 15 12

How many marks must he score in the next test so that his new mean mark and his new median mark are the same as each other?

(3 marks)

Make sure you check your answer by calculating the new mean and median. Remember that the median is not affected by extreme values.

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Hot Topic

Frequency table averages

This page shows you how to find averages from data given in frequency tables. Have a look at pages 118 and 121 to revise finding averages from graphs.

This frequency table shows the numbers of pets owned by the students in a class.

Number of pets (x)	Frequency (f)	Frequency × Number of pets ($f \times x$)
0	12	$12 \times 0 = 0$
1	18	$18 \times 1 = 18$
2	5	$5 \times 2 = 10$
3	2	$2 \times 3 = 6$
Total	37	34

The mode is 1. This value has the highest frequency.

To calculate the mean you need to add a column for '$f \times x$'.

There are 37 values so the median is the $\frac{37+1}{2} = 19$th value.
The first 12 values are all 0. The next 18 values are 1. So the median is 1.

The total in the '$f \times x$' column represents the total number of pets owned by the class.

$$\text{Mean} = \frac{\text{Total number of pets}}{\text{Total frequency}} = \frac{34}{37} = 0.92 \text{ (to 2 d.p.)}$$

Worked example

Target grade 4

Maisie recorded the times, in minutes, taken by 150 students to travel to school.
The table shows her results.

Time (t minutes)	Frequency (f)	Mid-point (x)	$f \times x$
$0 \leqslant t < 20$	65	10	$65 \times 10 = 650$
$20 \leqslant t < 30$	40	25	$40 \times 25 = 1000$
$30 \leqslant t < 40$	39	35	$39 \times 35 = 1365$
$40 \leqslant t < 60$	6	50	$6 \times 50 = 300$

Total frequency = 150 Total of $f \times x$ = 3315

Everything in blue is part of the answer.

(a) Work out an estimate for the mean number of minutes that the students took to travel to school. **(4 marks)**

$$\frac{3315}{150} = 22.1$$

Add extra columns to the table for 'Mid-point (x)' and 'Mid-point × frequency ($f \times x$)'.

$$\text{Estimate of mean} = \frac{\text{Total of } fx \text{ column}}{\text{Total frequency}}$$

Your answer does not have to be a whole number. Write down all the digits from your calculator display and then round **if necessary**.

(b) Explain why your answer to part (a) is an estimate. **(1 mark)**

Because you don't know the exact data values.

Now try this

Target grade 4

Emma recorded the reaction times of the members of her class using a computer program. The table shows her results.

Work out an estimate for the mean reaction time. **(4 marks)**

Reaction time (t seconds)	Frequency
$0 \leqslant t < 0.1$	2
$0.1 \leqslant t < 0.2$	9
$0.2 \leqslant t < 0.3$	16
$0.3 \leqslant t < 0.4$	5

Worked solution video

Had a look ☐ Nearly there ☐ Nailed it! ☐

Comparing data

You can use averages like the **mean** or **median** and measures of spread like the **range** and **interquartile range** to compare two sets of data. Follow these steps:

1. Calculate an average and a measure of spread for both data sets.
2. Write a sentence for each statistic, **comparing** the values for each data set.
3. Only make a statement if you can back it up with **statistical evidence**.

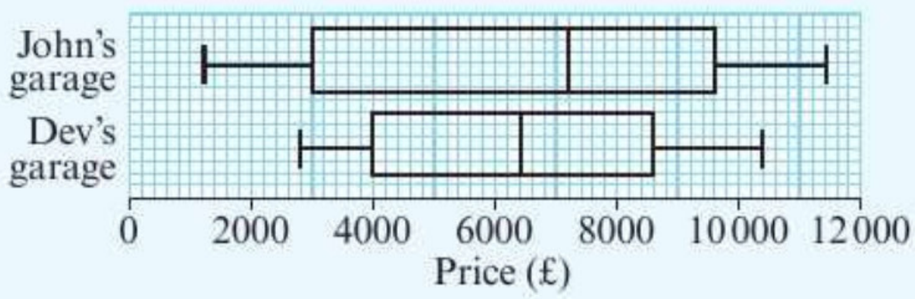
Calculate then compare

You will often have to compare two sets of data presented in different ways. Make sure you calculate the **same** statistics for both data sets. You will get marks for calculating the statistics correctly **and** for comparing the data sets.

Worked example

Target grade 6

These box plots show information about the prices of used cars at two different garages.



Compare the prices of used cars at the two garages. **(2 marks)**

	Median (£)	IQR (£)
John's	7200	9600 − 3000 = 6600
Dev's	6400	8600 − 4000 = 4600

The cars at Dev's garage were cheaper on average (smaller median).

The prices of the cars at John's garage were more spread out (larger IQR).

Remember you need to mention one average **and** one measure of spread. You should use the **interquartile range** as your measure of spread if the data is presented on a box plot or cumulative frequency diagram.

Start by writing the median and IQR for each set of data. Then write a sentence comparing each statistic.

Golden rules

1. When you are comparing two sets of data you should use **one average,** like the median, and **one measure of spread,** like the interquartile range.
2. **Interpret** your results in the **context** of the question.

Now try this

Target grade 6

(a) The cumulative frequency graph shows some information about the times taken for 40 girls to complete a challenge. The shortest time taken was 8 minutes.
Draw a box plot for this data. **(3 marks)**

(b) The box plot shows some information about the times taken by 40 boys to complete the same challenge.

Make **two** comments to compare the times taken by the girls and the times taken by the boys to complete the challenge. **(2 marks)**