

Numerical and statistical skills

Learning objectives

- To be able to calculate mean, mode, median, range and interquartile range.
- To be able to calculate percentage increases and decreases.
- To understand what is meant by central tendency.

Key terminology

Match the key words to the definition. These are words which could be used within exam questions, so it is important to understand what they mean.

Central tendency

The difference between the upper and lower quartiles – the middle 50%.

Interquartile range

A value on a scale of 100 that indicates the percent of a distribution that is equal to or below it.

Cumulative frequency

The tendency for the values of a variable to cluster around the mean, mode or median.

Percentiles

The running total of frequencies.



Which do we already have?

- Read through your PLC and RAG the numerical and statistical skills section.
- Remember that any of these skills could be needed in your exam in any of the papers.
- In the exam you could be asked to make a number of calculations.
- It is important to have a pencil, ruler and calculator with you in the exam. These will help you to answer any numerical or statistical questions.

Geographical applications and skills personal learning checklist

Read through each statement and decide whether you feel that you are **not confident**, **sort of confident** or **confident**.

The skills which you are least confident about are the ones that you need to work on. Use the workbook to help you practise these skills.

	Geographical application or skill				Workbook
Numerical and statistical	1. I can use proportion, ratio, magnitude and frequency.				
	2. I can draw conclusions from numerical data.				
	3. I can calculate mean, mode, median and interquartile range.				
	4. I can use appropriate measures of central tendency, spread and cumulative frequency.				
	5. I can calculate percentage increases and decreases.				
	6. I can use percentiles.				
Cartographic	7. I know what latitude and longitude are.				
	8. I can identify locations using latitude and longitude.				
	9. I can describe patterns and distributions of human and physical features on a map.				
	10. I can use maps of different scales, e.g. a world map and a local OS map.				
	11. I can identify significant features on a map, e.g. settlement layouts, relief, drainage and population movement.				
	12. I can analyse the inter-relationships between physical and human features on a map, e.g. why certain locations have been selected to build settlements.				
	13. I can use and understand four- and six-figure grid references.				
	14. I can use the scale bar on a map.				
	15. I can measure distances of straight and curved lines.				
	16. I can convert the scale on a map, e.g. cm on a ruler to km on the map.				
	17. I can read contour lines and gradient on a map.				

Task

- Once we have worked our way through the numerical and statistical skills you can practise them in your workbook.
- You should frequently practise these skills so you are clear on how to use them in your exam.
- If there are any words that you do not understand you can check the dictionary in the back of your book.

Applications and skills student workbook

Mean, mode, median and range

Remember:
 Mean: the average
 Mode: the most common
 Median: the middle number
 Range: the difference between the lowest and highest values

Hint: Put the numbers in order from smallest to largest first!

Practice

1. From these lists of numbers find the mean, mode, median and range.

a. 3, 5, 7, 11, 11, 2, 4, 17, 13, 1, 9

Mean: Mode:

Median: Range:

b. 27, 24, 22, 19, 34, 7, 16, 23, 39, 4, 5, 5, 22, 17, 5

Mean: Mode:

Median: Range:

c. 9, 7, 13, 36, 43, 7, 15, 1, 15, 7, 54, 63, 6, 5

Mean: Mode:

Median: Range:

d. 11.5, 7.5, 8.5, 36.5, 17.5, 11.5, 12.5, 24.5, 11.5

Mean: Mode:

Median: Range:

Remember:

When there is an even set of values you will need to find the mean of the middle two values to find the median.

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Applications and skills student workbook

Using this skill in a geographical context

2. This table shows rainfall in mm for each month of the year.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
56	39	46	45	49	50	48	53	56	60	61	58

What is the mean amount of rainfall?

What is the median amount of rainfall?

What is the modal amount of rainfall?

What is the range for the data set?

Location	A	B	C	D	E	F	G	H
Number of pedestrians	42	17	93	42	12	51	66	20

3. Calculate the mean, median, mode and range of this pedestrian count data.

Mean:

Median:

Mode:

Range:

4. Students collected data about bedload size in the river.

	Pebble size (mm)										
Site A	40	32	45	18	55	15	28	43	16	42	38
Site B	13	12	15	13	15	12	14	13	16	14	10

Calculate the median sediment size for each site. Show your working.

5. Calculate the modal sediment size for site B. Show your working.

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Ratio and proportion

A ratio is a comparison between two different things. We see this commonly on OS maps, e.g. a 1:25 000 map. This means that every 1 cm on the map would be 25000 cm on the ground.

You could be asked to work out a ratio in your exam.

Proportions can come from ratios. You could be asked to work out a proportion in your exam.

Example questions:

1. For each of these map scales what does 1 cm on a map correspond to on the ground?
 - a. 1:50 000
 - b. 1:100 000
 - c. 1:125 000
 - d. 1:250 000
2. Students carrying out a sediment size analysis found that of 30 pebbles, 20 were rounded and 10 were sub-angular. What proportion of the pebbles were rounded? Write this as a ratio.

Magnitude and frequency

- **Magnitude** is used to describe the **size** of something, e.g. an earthquake.
- On the Richter scale each magnitude is 10 times more powerful than the last, e.g. a five on the Richter scale is 10 times more powerful than a four.
- **Frequency** is how **often** something happens. You could be asked about the frequency of earthquakes.
- Don't confuse frequency with cumulative frequency!

Central tendency

- Mean, mode and median are all measures of central tendency.
- They are used in geography to identify simple trends in data or to find the differences between data sets.
- Whenever you see the term 'central tendency' you need to think about averages – it isn't any more complicated than that!

Mean Mode Median

Mean

- The mean is the average number from a set of values.
- It is calculated by adding all of the values together and then dividing by the number of values.
- This can be used in a variety of contexts and is a common question on exam papers.
- Sometimes you could be given values which aren't whole numbers. This is why it is important to bring a calculator into the exam.

Example question:

Find the mean for each of these data sets.

a. 5, 5, 6, 5, 7, 8, 9, 5

b. 10, 13, 16, 22, 7, 11

c. 34, 37, 29, 21, 13, 19

d. 23.5, 27.2, 14.9, 7.6

e. 12.4, 16.7, 18.9, 10, 15

Mode

- Mode is the most common number.
- You will need to read the data set carefully to see which value is the most common.
- Sometimes it can help to put the values in numerical order.

Example question:

Find the mode for each of the data sets.

- a. 3, 5, 7, 4, 3, 2, 8, 9, 3, 10, 3
- b. 2.5, 7, 8, 8, 7.7, 9, 8, 34, 8
- c. 7, 4, 3, 2, 8, 7, 4, 7, 2, 3, 7, 4
- d. 1, 4, 5, 3.4, 6.4, 1

Median

- The median is the middle value.
- You should put the values into numerical order first.
- If there is an odd number of values then this is easy to find.
- If there is an even number of values then you need to find the mean of the middle two values.

Example question:

Find the median for each of the data sets.

- a. 2, 5, 6, 2, 10, 11, 4, 5, 6, 7
- b. 4, 4, 8, 9, 2, 4, 8, 3, 2, 1, 10
- c. 33, 67, 57, 34, 56, 87, 23, 45
- d. 3, 10, 19, 65, 34, 7, 7, 21, 20

Range

- The range is the difference between the highest and lowest values.
- To find it you need to subtract the lowest value from the highest value.
- This can be applied to a variety of geographical contexts, e.g. temperatures or precipitation throughout the year.
- It is important to bring a calculator to an exam as you could need it to calculate the range.

Example question:

Find the range for each of the data sets.

- 12, 18, 19, 34, 54, 23, 12, 45, 3, 4
- 100, 23, 76, 3, 28, 47, 43, 23, 9, 8
- 34, 67, 65, 43, 23, 7, 6, 5, 4, 90, 23
- 34, 56, 76, 23, 23, 21, 27, 48, 29, 4

Interquartile range

The interquartile range indicates the spread of the middle 50% of the values in a data set.

Firstly you should put the data into numerical order. You then need to find the values that represent the 25th and 75th centiles of the data set. The 25th is the lower quartile and the 75th is the upper quartile.

You then need to find the difference between the lower and upper quartiles. To do this you subtract the lower value from the highest value.

Step 1:

Put the values into numerical order:

3, 3, 4, 6, 7, 11, 13, 15, 17, 19, 23

Step 2:

Find the median value:

3, 3, 4, 6, 7, **11**, 13, 15, 17, 19, 23

Step 3:

Now find the middle value between 3 and 11 and 13 and 23 these are your LQ and UQ:

3, 3, **4**, 6, 7, **11**, 13, 15, **17**, 19, 23

Step 4:

Calculate the difference between the LQ and UQ.
 $17 - 4 = 13$. Therefore the IQR is 13:

3, 3, **4**, 6, 7, **11**, 13, 15, **17**, 19, 23

Interquartile range example questions:

Find the IQR for each of the data sets:

1. 45, 67, 32, 12, 76, 23, 34, 21, 9, 10, 43, 12, 3, 7, 9
2. 23°C, 12°C, 11°C, 7°C, 22°C, 9°C, 8°C, 9°C, 9°C
3. 12 mm, 12 mm, 8 mm, 34 mm, 9 mm, 12 mm, 4 mm, 3 mm, 2 mm
4. 567, 432, 123, 123, 156, 74, 23, 19, 245, 243, 243, 235, 56

**Remember to always include the units being used,
e.g. cm, mm, km.**

Summary

Mean is the **same as average**.

Add all of the numbers together and divide by the number of pieces of data.

Example: Find the mean of the following numbers:

3, 4, 6, 7, 7, 8, 10, 15, 17, 21 Add them together = **98** divide by **10** = **Mean 9.8**.

Mode is the **most common** number.

Example: Find the mode of the following numbers:

3, 4, 6, 7, 7, 8, 10, 15, 17, 21 The most common number is **7**. **Mode = 7**.

Median is the **middle** number.

Arrange the numbers in numerical order and take the middle number.

Example: Find the median of the following numbers:

3, 4, 6, 7, 7, 8, 10, 15, 17, 21, 23 The middle number is **8**. **Median = 8**.

Summary

The IQR is the part of the range that covers the middle 50% of the data. Start by putting the data into **numerical order** and finding the **median**. You then need to select the **middle number** between the **first value** and the **median** – this is your **lower quartile value**. Then select the **middle value** between the **median** and the **final value** – this is the **upper quartile value**. The **difference** between the **two values** is the **IQR**.

Example: Find the IQR of the following numbers:

3, 4, 6, 7, 7, 8, 10, 15, 17, 21, 23

**Lower Quartile Value = 6. Upper Quartile = 17. Difference between 17 and 6 = 11.
IQR = 11.**

Cumulative frequency

- Cumulative frequency is the running total of all frequencies.

Vehicles passing 11am–12pm	Frequency	Cumulative frequency
Cars	26	26
Buses	15	41
Vans	4	45
Lorries	4	49
Emergency vehicles	3	52
Bicycles	13	65
Motorbikes	7	72

Look closely at this table, you will see that in the third column the values are being added together to create the cumulative frequency. The final number in the third column indicates the final number of vehicles passing during the time period.

Calculating percentages

Calculating a percentage is a common question in GCSE exams.

There are a number of methods for calculating percentages. You might find this one easiest:

Example:

In a transect 15 buildings were houses, 4 were shops, 12 were offices and 2 were empty/derelict.

What percentage of the buildings were houses?

The total number of buildings is 33.

$15 \text{ divided by } 33 = 0.454$

$0.454 \times 100 = 45.4\%$ were houses.

Calculating percentages

All students in a year group were asked how they travelled to school.

The results were as follows:

- a. 150 students walked
- b. 83 students took the bus
- c. 57 students were driven in
- d. 10 students cycled in

Work out the percentage for each transport type.

Increase/decrease example

During a fieldwork study students counted pedestrians in the morning and afternoon for one hour.

In the morning there were 58 pedestrians passing them.

In the afternoon there were 73 pedestrians passing them.

What was the percentage increase?

Step 1:

Work out the difference:

$$73 - 58 = 15$$

Step 2:

Divide the increase by the first number:

$$15 / 58 = 0.2586$$

Step 3:

Multiply the number by 100:

$$0.25 \times 100 = 25.86$$

Answer = 25.86% increase

Increase/decrease questions

Vehicle type	Morning	Afternoon
a. Bus	12	16
b. Car	28	34
c. Taxi	3	2
d. Lorry	7	7
e. Motorbike	8	3

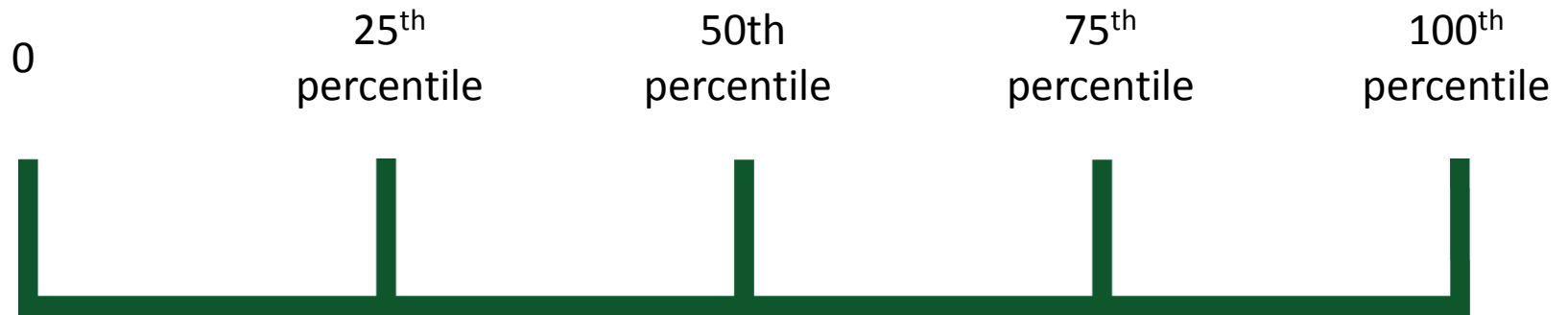
For questions like these it is important to have a calculator!

Students carrying out a traffic count recorded these results.

Calculate the percentage increase/decrease for each of the vehicle types.

Percentiles

- A percentile is a value on a scale of 100 that indicates the percent of a distribution that is equal to or below it.
- It is a way of dividing data into small parts similar to quartiles (think back to interquartile range).



Task

- Using your workbook, practise the types of numerical and statistical skills that you are either unfamiliar with or struggle with.
- You will need a calculator, a ruler and a pencil for these questions.
- For each skill, answer all questions on the page.