

GCSE MATHS

Sampling and scatter graphs

Long workbook

Questions on GCSE Maths topics, including challenges beyond typical exam questions.

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Topic recap

Populations and samples

The population is the whole group of interest. A sample is the group actually studied. A biased method favours some members or opinions.

Choosing a sample

Give every pupil a number and use random numbers to select pupils without repeats. If a sample should contain the same proportions as the school, multiply each group fraction by the sample size.

Correlation

Positive correlation means the variables tend to increase together. Negative correlation means one tends to decrease as the other increases. Correlation alone does not prove cause and effect.

Predictions

Draw a straight line of best fit through the trend, with points roughly balanced on either side. Predictions within the observed range are more dependable than predictions far beyond it.

A calculator may be used. Graph estimates within sensible reading tolerance are accepted.

1. Populations and samples

Example Problem 1

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A town surveys only people at its library about opening a new library. Explain a possible bias.

The idea

1. Identify who is represented and who is missing.

Worked Solution

Library users are over-represented

They may value a new library differently from non-users.

1 Populations and samples

**

Q1 A school asks 60 of its 900 pupils how they travel to school.

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(a) State the population.

(b) State the sample size.

Q2 A school surveys only the football team about which new sports facilities to buy. Give one reason this may be biased.

**

Q3 A website asks visitors to choose whether to answer a survey. Why might its results be biased?

**

Q4 A researcher doubles the size of a sample taken from whoever happened to be in one shop. Does this necessarily remove bias? Explain.

**

Q5 A survey asks, "Surely you agree our excellent school lunches are good value?" Rewrite it without suggesting an answer.

**

2. Choosing a sample

Example Problem 2

A school has 240 younger pupils and 360 older pupils. A sample of 50 should contain the same proportions of younger and older pupils as the school. How many of each should be chosen?

The idea

1. Multiply each population fraction by fifty.

Worked Solution

$$50 \left(\frac{240}{600} \right) = 20$$

Select twenty younger pupils.

$$50 \left(\frac{360}{600} \right) = 30$$

Select thirty older pupils.

2 Choosing a sample

Q6 Describe how to choose a random sample of 20 from 500 named pupils.

**

Q7 A school numbers its 600 pupils from 1 to 600. A computer chooses 30 different numbers at random. Explain why this is fairer than asking the first 30 pupils to arrive at school.

**

Q8 A random sample of 40 pupils contains 14 who cycle to school. Estimate the percentage of all pupils who cycle.

**

Q9 A population has 120 Year 10 and 180 Year 11 pupils. A sample of 50 must have the same proportions from each year group. How many should be from Year 10?

Q10 A school has year-group sizes 180, 150 and 270. Find the three group sizes for a sample of 80 that has the same proportions from each year group.

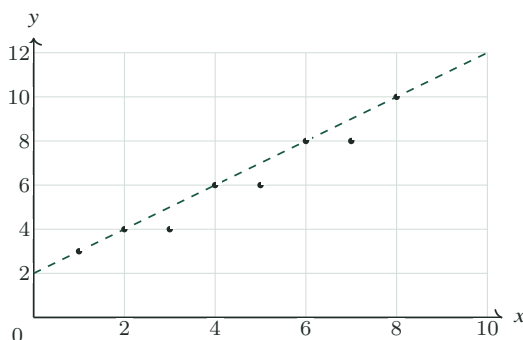
Q11 A shop estimates its weekly customer spending by surveying customers on Monday morning only. Give one reason this sample may be unrepresentative.

3. Scatter graphs and correlation

Example Problem 3

**

Describe the pattern in the scatter graph and explain why a line of best fit need not pass through every point.



The idea

1. Look for the overall direction, allowing variation around the trend.

Worked Solution

Positive correlation

Larger x -values tend to have larger y -values.

Use a central straight line

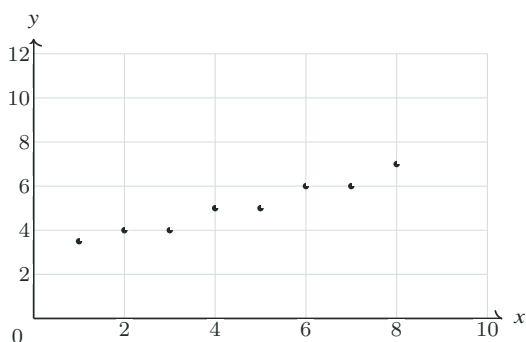
The individual observations vary around the trend.

3 Scatter graphs and correlation

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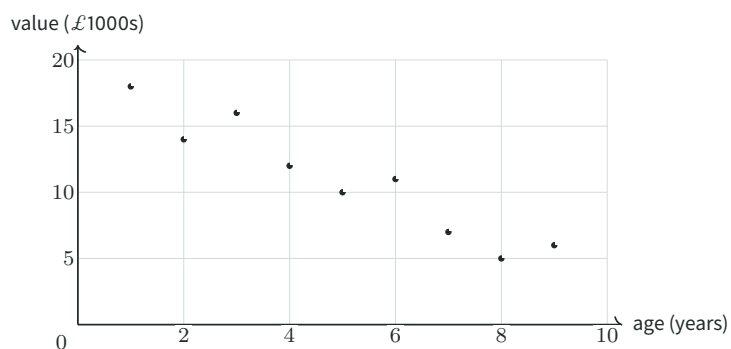
Q12 Describe the correlation in the scatter graph.

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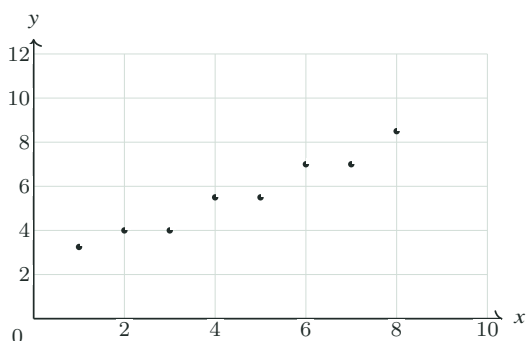
Q13 The scatter graph shows the ages and values of some cars. What type of correlation does it show?

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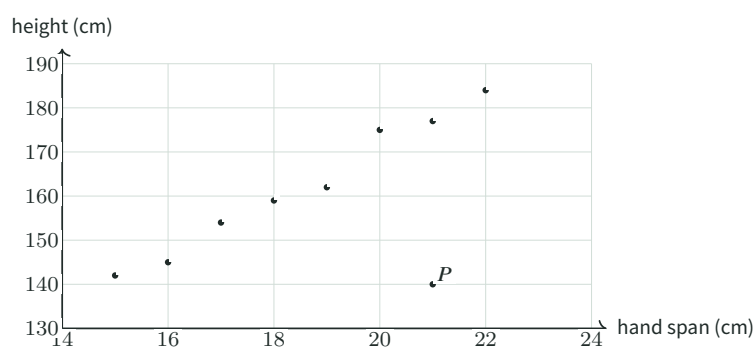


Q14 Does the scatter graph prove that increasing x causes y to increase? Explain.

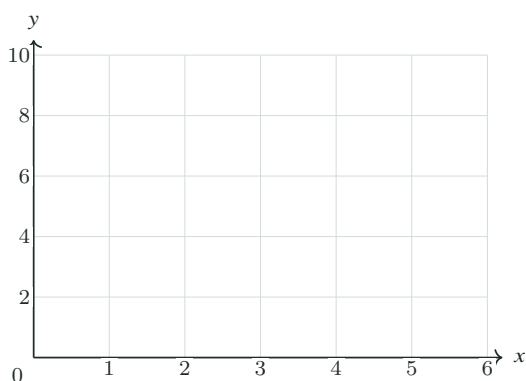
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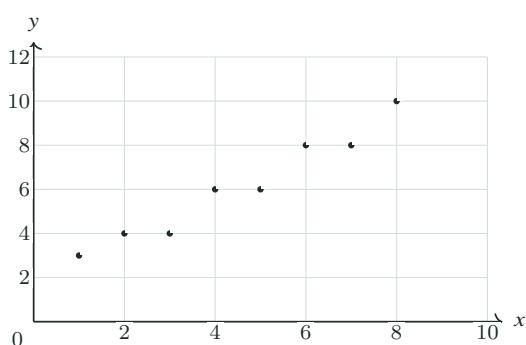
Q15 Point P lies away from the trend in the scatter graph of hand span and height. What should the researcher check before deciding whether to remove it? **



Q16 Plot the pairs $(1, 2)$, $(2, 4)$, $(3, 5)$, $(4, 8)$ and $(5, 9)$ on the grid. **



Q17 Draw a straight line of best fit on the scatter graph. **



4. Estimates and conclusions

Example Problem 4

A sample of 60 has 21 cyclists. Estimate the number of cyclists in a population of 800.

The idea

1. Apply the sample fraction to the whole population.

Worked Solution

$$800 \left(\frac{21}{60} \right) = 280$$

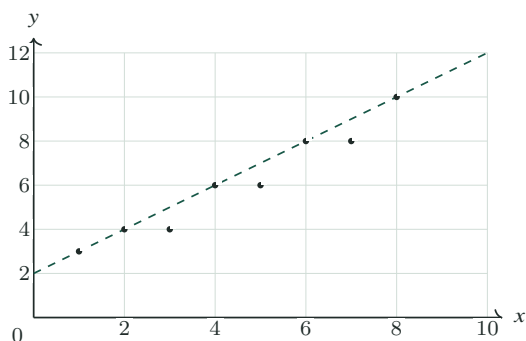
Multiply the population by the observed proportion.

4 Estimates and conclusions

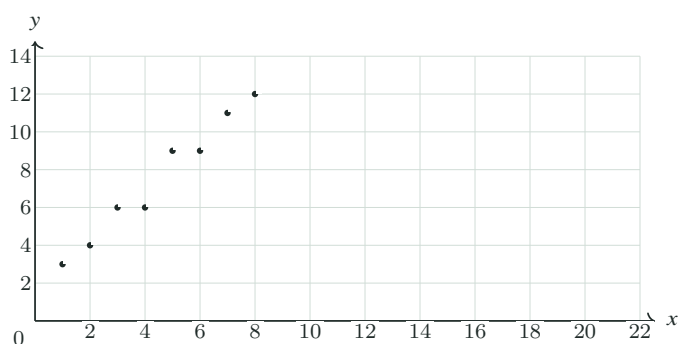
★★★★

Q18 Use the drawn line of best fit to estimate y when $x = 5$.

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**Q19** Use the scatter graph. Which prediction is more dependable: the value of y at $x = 4$ or at $x = 20$? Explain.

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**Q20** A fitted line has equation $y = 3x + 10$. Estimate x when $y = 31$.

★★★

Q21 In a random sample of 80 pupils, 28 walk to school. Estimate how many of the school's 600 pupils walk.

Q22 Sample A includes 100 randomly selected pupils. Sample B includes 400 pupils who volunteer online. Which method is more likely to give a fair sample? Explain.

Q23 A town survey samples 50 adults from each of two areas. Area A has 1000 adults and 40 of its sample support a proposal. Area B has 3000 adults and 20 support it. Estimate the total number of supporters in the town.

Solving principles

1. Check who is missing

A convenient sample may exclude parts of the population.

2. Match the proportions

Multiply each group fraction by the intended sample size.

3. Use the trend

Use a line of best fit, not a chain joining every point.

4. Limit the claim

A sample or correlation supports an estimate, not a guarantee about each individual.