



Averages, scatter graphs, tree diagrams and Venn diagrams

Year 9 About 85 minutes

No calculator 92 marks

Name _____

Class _____

Date _____

A Before you start

Recall

You will need these in every question below.

A1 Work out the mean of 4, 9, 7, 12 and 8.

[1 mark]

Answer

A2 Find the median of 15, 9, 22, 11, 18, 9 and 13.

[2 marks]

Answer

A3 A bag holds 3 red, 5 green and 4 blue counters. One counter is taken at random. Work out the probability that it is red. Give your answer as a fraction in its simplest form.

[1 mark]

Answer

A4 Work out $\frac{3}{8} \times \frac{2}{5}$. Give your answer in its simplest form.

[1 mark]

Answer

A5 The probability that it rains tomorrow is 0.36. What is the probability that it does not rain tomorrow?

[1 mark]

Answer

Your teacher works through each example with you. Then try the one beside it on your own.

EXAMPLE 1

20 students said how many books they read last month. 3 read none, 7 read 1, 6 read 2 and 4 read 3. Work out the mean number of books.

Hint Multiply each number of books by how many students gave it, and add the results. Divide by the number of students, 20, not by the number of rows.

B1 The table shows how many brothers and sisters each of 25 students has. Work out the mean. [3 marks]

Number of brothers and sisters	Frequency
0	5
1	8
2	9
3	2
4	1

Answer

EXAMPLE 2

20 students timed how long they spent on a puzzle. 4 took up to 10 minutes, 9 took more than 10 and up to 20 minutes, and 7 took more than 20 and up to 30 minutes. Work out an estimate of the mean time.

Hint You do not know each exact time, so use the middle of each class: 5, 15 and 25 minutes. That is why the answer is only an estimate.

B2 The table shows the time, t minutes, 40 students spent on homework one evening. Work out an estimate of the mean time. [3 marks]

Time, t (minutes)	Frequency
$0 < t \leq 10$	6
$10 < t \leq 20$	14
$20 < t \leq 30$	12
$30 < t \leq 40$	8

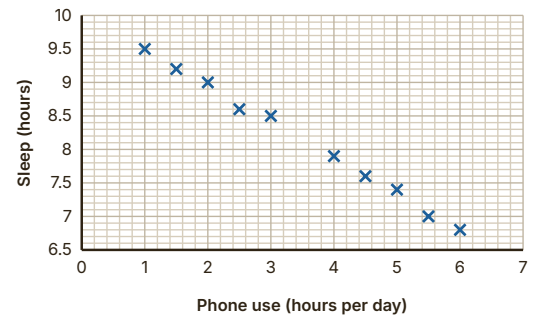
Answer

EXAMPLE 3

Six points are (2, 5), (3, 8), (5, 11), (6, 15), (8, 18) and (9, 22). Plot them on a scatter graph and describe the correlation. Draw a line of best fit and use it to estimate y when $x = 7$.

Hint A line of best fit follows the trend, with about as many points above it as below it. It does not have to go through any of the points. Read up from 7 to the line, then across.

B3 The scatter graph shows how many hours 10 teenagers use their phones each day and how many hours they sleep.



(a) Describe the correlation. [1 mark]

Answer

(b) Draw a line of best fit. Use it to estimate the hours of sleep of a teenager who uses a phone for 3.5 hours a day. [2 marks]

Answer

Total for B3: 3 marks

EXAMPLE 4

A bag holds 4 red and 3 blue counters. Ana takes two counters at random, one after the other, without putting the first back. Work out the probability that both counters are the same colour.

Hint Draw a tree diagram. On the second branches there is one counter fewer, and one fewer of the colour already taken.

B4 A box holds 5 green and 4 yellow pens. Ben takes two pens at random, one after the other, without putting the first back. Work out the probability that he takes one pen of each colour. Give your answer in its simplest form. [3 marks]

Answer

Each question asks for something different. Show your working.

C1 Ten players scored these points in a quiz.

7, 12, 9, 15, 7, 11, 8, 7, 14, 10

(a) Write down the mode.

[1 mark]

Answer

(b) Work out the median.

[2 marks]

Answer

(c) Work out the range.

[1 mark]

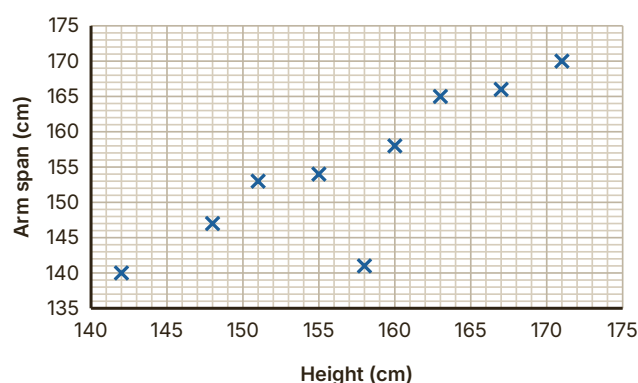
Answer

Total for C1: 4 marks

C2 Five numbers have a mean of 7. Four of the numbers are 4, 11, 6 and 9. Work out the fifth number. [2 marks]

Answer

C3 The scatter graph shows the height and the arm span of 9 students.



(a) Describe the correlation.

[1 mark]

Answer

- (b) One student does not fit the pattern. Write down this student's height and arm span. [1 mark]

Answer height cm arm span cm

Total for C3: 2 marks

- C4** A teacher finds that the line of best fit for her class is $y = 3x + 20$. Here x is the number of hours a student revised, from 0 to 10 hours, and y is the student's test mark.

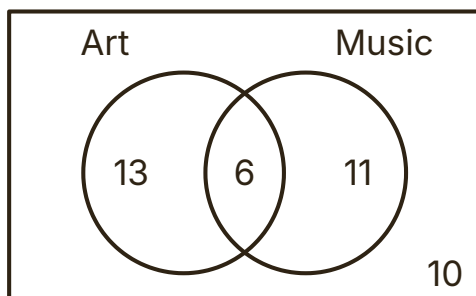
- (a) Use the line to estimate the test mark of a student who revised for 7 hours. [1 mark]

Answer

- (b) Explain why the line should not be used to estimate the mark of a student who revised for 25 hours. [1 mark]

Total for C4: 2 marks

- C5** The Venn diagram shows how many of 40 students take Art and how many take Music. One student is chosen at random. Give each answer as a fraction in its simplest form.



- (a) Work out the probability that the student takes Music. [1 mark]

Answer

- (b) Work out the probability that the student takes Art or Music or both. [1 mark]

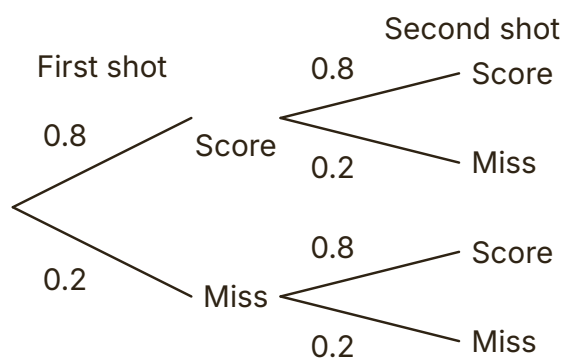
Answer

- (c) Work out the probability that the student takes exactly one of the two subjects. [1 mark]

Answer

Total for C5: 3 marks

- C6** Mia takes two shots at a basketball hoop. Each time, the probability that she scores is 0.8. The tree diagram shows this.



- (a) Work out the probability that she scores with both shots.

[1 mark]

Answer

- (b) Work out the probability that she scores with exactly one shot.

[2 marks]

Answer

Total for C6: 3 marks

- C7** Seven friends get these amounts of pocket money each week.

[2 marks]

£5, £6, £6, £7, £8, £8, £45

Which average gives the best idea of a typical amount? Give a reason, and work out that average.

Answer average value £

- C8** In a class of 32 students, 19 play football, 15 play tennis and 6 play neither.

- (a) How many students play both football and tennis?

[2 marks]

Answer

- (b) One student is chosen at random. Work out the probability that the student plays tennis but not football. [1 mark]

Answer

Total for C8: 3 marks

- C9** The table shows the heights, h cm, of 30 students. Write down the modal class and the class that contains the median. [2 marks]

Height, h (cm)	Frequency
$120 < h \leq 130$	3
$130 < h \leq 140$	11
$140 < h \leq 150$	10
$150 < h \leq 160$	6

Answer modal class median class

D Test-style questions

Stretch

Answer every question in the space given. Show your working: most of the marks are for method.

- D1** Sam says, "The mean mark for all 30 students is 70, because $(64 + 76) \div 2 = 70$." [3 marks]

Class A has 10 students and their mean test mark is 64. Class B has 20 students and their mean test mark is 76.

Explain why Sam is wrong, and work out the correct mean mark for all 30 students.

Answer

D2

The table shows the scores some students got when they spun a spinner. The mean score is 2.6.

[4 marks]

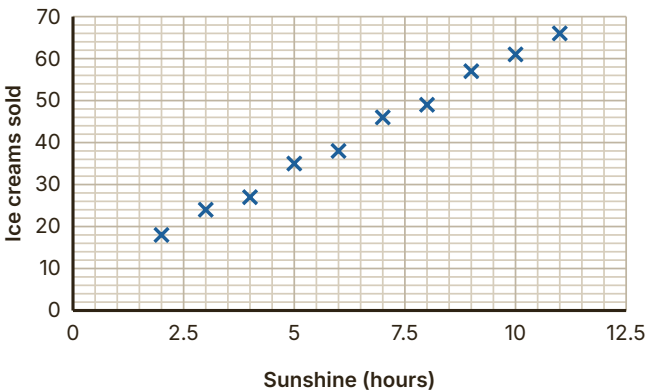
Work out the value of x . You must show your working.

Score	Frequency
1	4
2	x
3	6
4	5

Answer $x = \dots\dots$

D3

A café records the hours of sunshine and the number of ice creams it sells on 10 days.



(a)

Describe the relationship between the hours of sunshine and the number of ice creams sold.

[1 mark]

Answer

(b)

Draw a line of best fit. Use it to estimate the number of ice creams sold on a day with 6.5 hours of sunshine.

[2 marks]

Answer

- (c) On another day the café sold 30 ice creams. Use your line to estimate the hours of sunshine on that day. [2 marks]

Answer

Total for D3: 5 marks

D4 A box holds 12 chocolates. 5 are dark chocolate and 7 are milk chocolate. Tom takes two chocolates at random and eats them. Give each answer as a fraction in its simplest form.

- (a) Work out the probability that both chocolates are dark. [2 marks]

Answer

- (b) Work out the probability that he eats one dark and one milk chocolate. [2 marks]

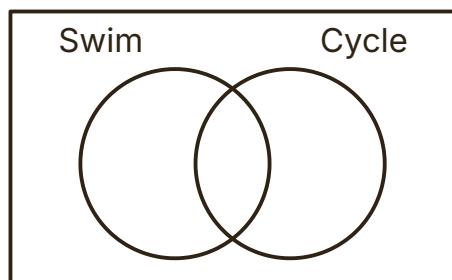
Answer

- (c) Tom then takes a third chocolate from the box. Work out the probability that all three chocolates he took are milk. [2 marks]

Answer

Total for D4: 6 marks

D5 There are 50 students in a club. 28 of them swim, 31 cycle and 6 do neither.



(a) Work out how many students both swim and cycle.

[2 marks]

Answer

(b) One student is chosen at random. Work out the probability that the student cycles but does not swim. Give your answer as a fraction in its simplest form.

[2 marks]

Answer

Total for D5: 4 marks

D6 The table shows the masses, m kg, of 50 parcels.

Mass, m (kg)	Frequency
$0 < m \leq 2$	8
$2 < m \leq 4$	15
$4 < m \leq 6$	17
$6 < m \leq 8$	10

(a) Work out an estimate of the mean mass of a parcel.

[3 marks]

Answer

(b) Explain why your answer to part (a) is only an estimate.

[1 mark]

Total for D6: 4 marks

D7 A coach records the hours, x , that 12 swimmers trained in a week and the number of lengths, y , each swam in a test. The mean of the x values is 6 and the mean of the y values is 30. The line of best fit passes through the point (6, 30) and the point (0, 12).

(a) Work out the gradient of the line of best fit.

[2 marks]

Answer

(b) Use the line to estimate the number of lengths swum by a swimmer who trained for 9 hours.

[1 mark]

Answer

Total for D7: 3 marks

D8 Five whole numbers have a mode of 4, a median of 6, a mean of 7 and a range of 9.

[3 marks]

Work out the five numbers. You must show your working.

Answer , , , ,

D9 The probability that a school bus is late on any day is 0.15. Whether it is late on one day does not affect any other day.

[3 marks]

Show that the probability that the bus is late on at least one of two days is 0.2775.

No route is given. Spend five minutes on a problem before you look at a hint. The hints are on the last page of the worksheet, and you can use one at a time.

- E1** Five numbers have a mean of 8. One number is taken away, and the mean of the four that are left is 9. Another number is taken away, and the mean of the three that are left is 11. What is the mean of the two numbers that were taken away? [4 marks]

Answer

- E2** A bag holds some red counters and 4 blue counters. There are more red counters than blue counters. Two counters are taken out at random, without putting the first back. The probability that they are different colours is $\frac{8}{15}$. How many red counters are in the bag? [4 marks]

Answer

- E3** Every student in a year group plays at least one of hockey and netball. $\frac{2}{3}$ of the students play hockey and $\frac{3}{5}$ of them play netball. 20 students play both. How many students are in the year group? [4 marks]

Answer

- E4** Eight points are plotted on a scatter graph. The mean of their x values is 5. The line of best fit, $y = 4x - 3$, passes through the point made by the two means. Seven of the y values are 14, 19, 12, 20, 22, 9 and 15. Find the eighth y value. [4 marks]

Answer

F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can find the mean, median, mode and range from a list or a frequency table, and estimate the mean of grouped data.	☐	☐	☐
I can describe correlation on a scatter graph, draw a line of best fit and use it to make an estimate.	☐	☐	☐
I can use tree diagrams and Venn diagrams to work out the probability of combined events.	☐	☐	☐

Extension hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

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- E1**
- Hint 1** Work with totals, not means. A mean of 8 for five numbers means they add to 40.
- Hint 2** The totals are $5 \times 8 = 40$, then $4 \times 9 = 36$, then $3 \times 11 = 33$.
- Hint 3** The first number taken away is $40 - 36 = 4$ and the second is $36 - 33 = 3$. Their mean is $(4 + 3) \div 2 = 3.5$.
-
- E2**
- Hint 1** Call the number of red counters r . There are $r + 4$ counters in all.
- Hint 2** The probability of different colours is $\frac{r}{r+4} \times \frac{4}{r+3} + \frac{4}{r+4} \times \frac{r}{r+3} = \frac{8r}{(r+4)(r+3)}$.
- Hint 3** $\frac{8r}{(r+4)(r+3)} = \frac{8}{15}$ gives $15r = r^2 + 7r + 12$, so $r^2 - 8r + 12 = 0$ and $r = 2$ or $r = 6$. There are more red than blue, so $r = 6$.
-
- E3**
- Hint 1** Adding the two fractions counts the students who play both twice.
- Hint 2** $\frac{2}{3} + \frac{3}{5} = \frac{19}{15}$. Everybody plays at least one, so the students who play both make up $\frac{19}{15} - 1 = \frac{4}{15}$ of the year group.
- Hint 3** $\frac{4}{15}$ of the year group is 20 students, so $\frac{1}{15}$ is 5 students and the year group has 75 students.
-
- E4**
- Hint 1** The line goes through the point (mean of x , mean of y).
- Hint 2** At $x = 5$ the line gives $y = 4 \times 5 - 3 = 17$, so the mean of the eight y values is 17.
- Hint 3** The eight y values add to $8 \times 17 = 136$. The seven you know add to 111, so the eighth is $136 - 111 = 25$.