The regression line y = a + bx

Grade 7 | Worked solutions

GCSE Statistics topic practice

1 The owner of a seaside kiosk records the maximum temperature, x °C, and the number of ice creams sold, y, on each of 20 days. The temperatures were all between 14 °C and 28 °C.

The equation of the regression line of y on x is $y = 20 + 6x$

a. Estimate the number of ice creams sold on a day when the maximum temperature is 22 °C. (1)

b. Interpret the value 6 in the equation of the regression line. (1)

c. Give one reason why your estimate in part (a) is likely to be reliable. (1)

(3 marks)

a)

$y = 20 + 6 \times 22$

$y = 20 + 132$

$y = 152$

b) 6 is the gradient

For each extra 1 °C,

6 more ice creams are sold, on average

c)

22 °C is inside the range of the data

(14 °C to 28 °C), so it is interpolation

a) 152 b) 6 more per extra 1 °C c) interpolation

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

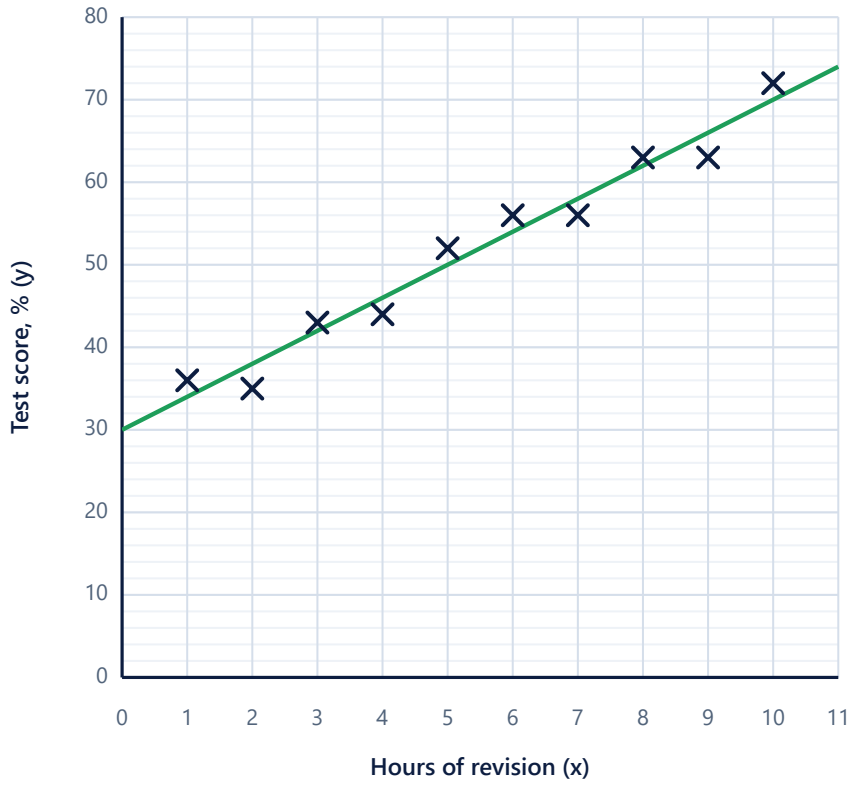
2 A teacher records the number of hours of revision, x, and the test score, y %, for each of 10 students. The scatter diagram shows this information.

The equation of the regression line of y on x is $y = 30 + 4x$

a. Draw the regression line on the scatter diagram. (2)

b. Interpret the value 4 in the equation of the regression line. (1)

c. Use the equation to estimate the test score of a student who revises for 6.5 hours. (1)



(4 marks)

a) Work out two points on the line

When $x = 0$

$y = 30 + 4 \times 0$

$y = 30$

When $x = 10$

$y = 30 + 4 \times 10$

$y = 70$

Plot (0, 30) and (10, 70)

Join them with a straight line

b) 4 is the gradient

For each extra hour of revision

the test score goes up by 4%, on average

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

c)

$y = 30 + 4 \times 6.5$

$y = 30 + 26$

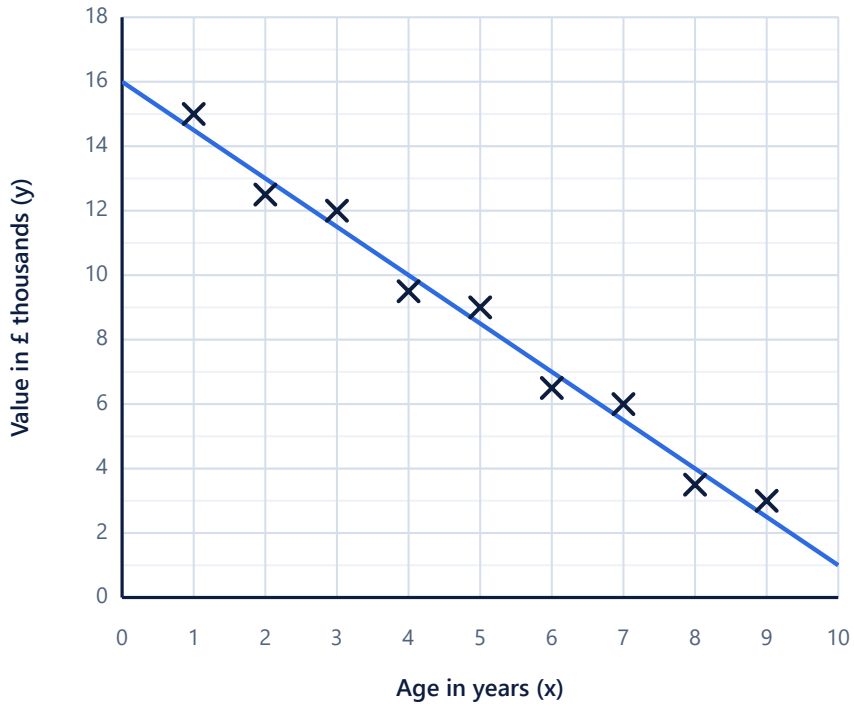
$y = 56$

a) Line drawn b) 4% more per extra hour c) 56%

3 A garage records the age, x years, and the value, y thousand pounds, of nine cars of the same model. The scatter diagram shows this information. The regression line of y on x has been drawn on the diagram.

a. Find the equation of the regression line. Give your answer in the form $y = a + bx$ (3)

b. Interpret the gradient of the regression line in context. (1)



(4 marks)

a) a is where the line crosses the y-axis

$a = 16$

b is the gradient. Use (0, 16) and (8, 4)

$b = \frac{4 - 16}{8 - 0}$

$b = \frac{-12}{8}$

$b = -1.5$

$y = 16 - 1.5x$

b)

1.5 thousand pounds is £1500

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

The value of a car falls by £1500 for each extra year of age, on average

a) $y = 16 - 1.5x$ b) falls £1500 a year

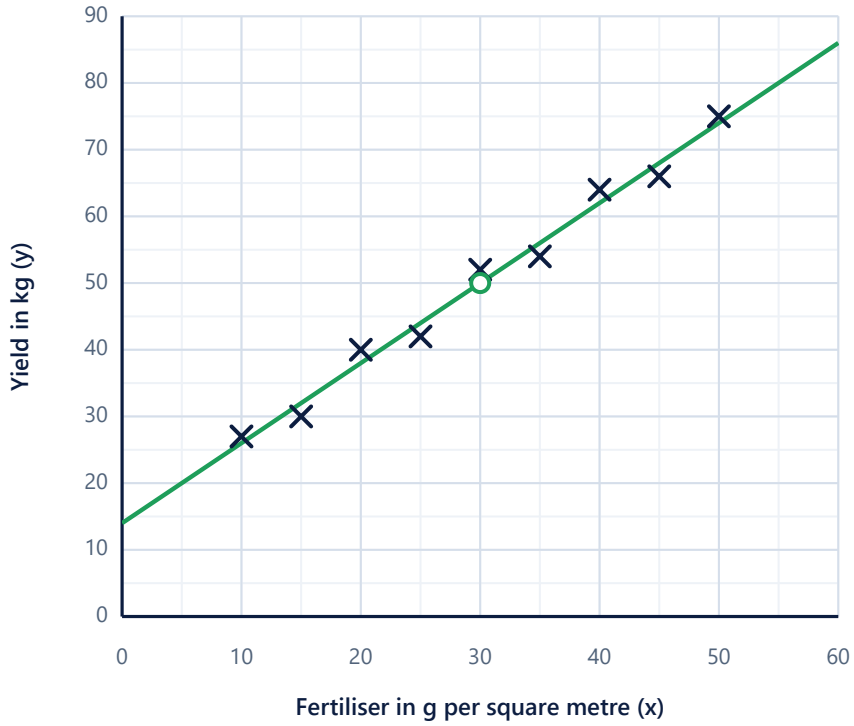
4 A farmer puts different amounts of fertiliser, x grams per square metre, on nine plots of land and records the yield of potatoes, y kg, from each plot. The scatter diagram shows this information.

The mean amount of fertiliser is 30 and the mean yield is 50. The regression line of y on x has equation $y = a + 1.2x$ and passes through the mean point (30, 50).

a. Work out the value of a. (2)

b. Draw the regression line on the scatter diagram. (2)

c. Use the equation of the regression line to estimate the yield from a plot given 38 grams of fertiliser per square metre. (1)



(5 marks)

a) The line passes through (30, 50)

$50 = a + 1.2 \times 30$

$50 = a + 36$

$a = 14$

b) Find two points on $y = 14 + 1.2x$

When $x = 0$

$y = 14$

When $x = 50$

$y = 14 + 1.2 \times 50$

$y = 74$

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

Plot (0, 14) and (50, 74)

Join them with a straight line

Check that it passes through (30, 50)

c)

$y = 14 + 1.2 \times 38$

$y = 14 + 45.6$

$y = 59.6$

a) a = 14 b) Line drawn c) 59.6 kg

5 A researcher records the age, x months, and the number of words known, y, for each of 13 young children aged from 12 months to 24 months. The scatter diagram shows this information, with the regression line of y on x.

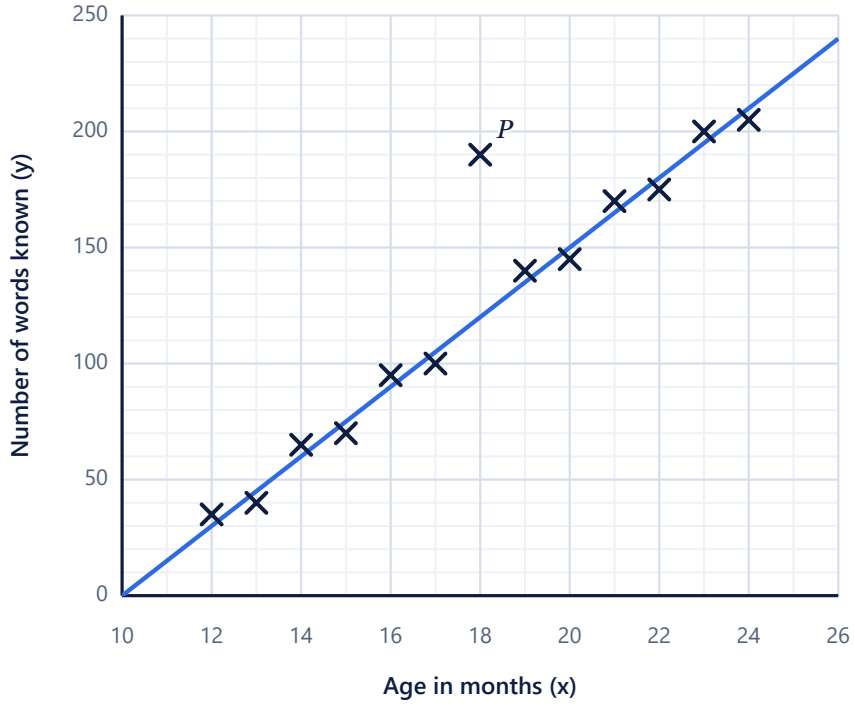
The equation of the regression line is $y = -150 + 15x$

a. Use the equation to estimate the number of words known by a child aged 20 months. (1)

b. Interpret the value 15 in the equation of the regression line. (1)

c. Explain why the value −150 has no sensible meaning in this context. (1)

d. Child P is 18 months old and knows 190 words. Compare the number of words child P knows with the number predicted by the regression line. (2)



(5 marks)

a)

$y = -150 + 15 \times 20$

$y = -150 + 300$

$y = 150$

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

b) 15 is the gradient

For each extra month of age,

a child knows 15 more words, on average

c)

When $x = 0$ the equation gives -150 words

A child cannot know a negative number of words

(and 0 months is outside the range of the data)

d) Predicted value for 18 months

$$y = -150 + 15 \times 18$$

$$y = -150 + 270$$

$$y = 120$$

$$190 - 120 = 70$$

P knows 70 more words than the line predicts

a) 150 b) 15 more words a month c) negative words d) 70 more

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.