

## Bivariate stats 1

1)

- (ii) A furniture manufacturer makes chairs to sell to shops.

Over a six-week period, the cost \$ $y$  of producing  $x$  chairs is given in the following table.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Number of chairs $x$	22	40	32	28	46	44
Production cost \$ $y$	3 200	4 600	3 800	3 700	5 100	5 000

- (a) Find the equation of the regression line of  $y$  on  $x$  for this data. *[2 marks]*
- (b) The chairs are sold at \$120 each. Find the least number of chairs which the factory must sell each week in order to make a profit. *[5 marks]*

2)

- (ii) Each day, a factory recorded the number ( $x$ ) of boxes it produces and the total production cost ( $y$ ) dollars. The results for nine days are shown in the following table.

$x$	28	45	60	48	51	33	67	40	56
$y$	460	580	770	600	640	490	830	570	730

- (a) Write down the equation of the least squares regression line of  $y$  on  $x$ . *[3 marks]*
- (b) In this situation, interpret the meaning of
- (i) the gradient;
- (ii) the  $y$ -intercept. *[2 marks]*

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3)

- (iii) Fifteen books are selected at random from all the books in a bookstore. For each book, the number of pages ( $x$ ) and the selling price ( $y$ ) are determined.

- (a) The correlation coefficient  $r$  is calculated.

- (i) Write down the possible minimum and maximum values of  $r$ .

It is found that  $r = 0.95$ .

- (ii) Sketch a possible scatter diagram to represent this information.

- (iii) Which **two** of the following expressions describe the correlation between  $x$  and  $y$ ?

perfect, zero, linear, strong positive, strong negative, weak positive, weak negative.

[5 marks]

- (b) For the fifteen books in the sample, the mean number of pages  $\bar{x} = 500$  and the mean price  $\bar{y} = 46$ . Using the equation of the regression line of  $y$  on  $x$ , it was estimated that a book with 660 pages would sell for \$ 49.20.

- (i) Find the equation of the regression line.

- (ii) Hence, estimate the selling price of a 550 page book.

[4 marks]

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- 4) (i) The number of hours a student spends studying for a particular examination is  $x$ . The score out of 100 the student receives is  $y$ . Pairs of  $(x, y)$  values are recorded for a class of students and the relationship between  $x$  and  $y$  is investigated. The results may be summarized in the following table.

	$x$	$y$
Mean	10	60
Standard deviation	3	15

The covariance of  $x$  and  $y$  is equal to 36.

- (a) Find the equation of the least squares regression line of  $y$  on  $x$ , expressing your answer in the form  $y = mx + c$ .

[4 marks]

- (b) (i) Use your answer to part (a) to predict how many marks a student who studies for 20 hours would achieve.

- (ii) A teacher wishes to explain to students why they cannot guarantee a score of 100 by studying for the hours calculated in part (b) (i). In order to do so, the value of the product-moment correlation coefficient,  $r$ , is to be used.

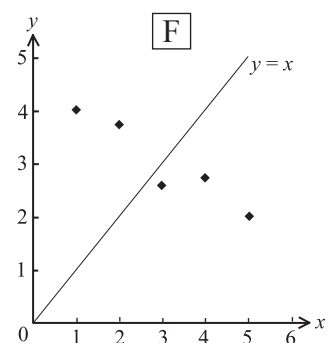
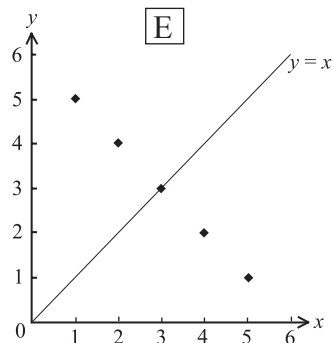
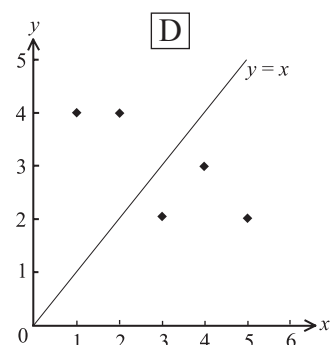
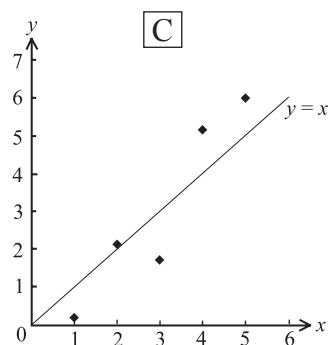
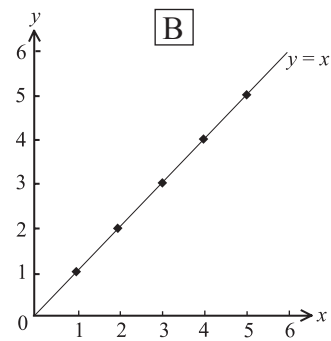
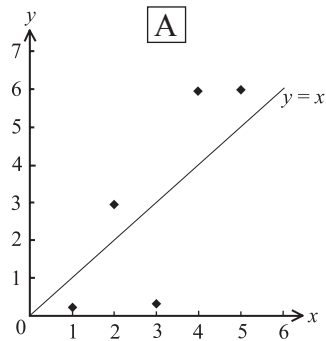
- (a) Calculate  $r$  for the given data.

- (b) Based on the value of  $r$  obtained, how reliable is the prediction of part (b) (i)?

[7 marks]

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- 5) (i) The following scatter diagrams represent six sets of data. The line  $y = x$  is shown on each diagram.



The least squares regression line  $y = ax + b$  is calculated for each set of data. The coefficient of linear correlation,  $r$ , is also calculated in each case. The values of  $a$  are  $-1$ ,  $-0.5$ ,  $1$  or  $1.5$ . The values of  $r$  are  $\pm 0.8$ ,  $\pm 0.95$  or  $\pm 1$ .

Write down the letter of the diagram corresponding to the following results.

- |                                |                 |
|--------------------------------|-----------------|
| (a) $a = -1$ , $r = -1$ ;      | <i>[1 mark]</i> |
| (b) $a = 1.5$ , $r = 0.95$ ;   | <i>[1 mark]</i> |
| (c) $a = -0.5$ , $r = -0.95$ ; | <i>[1 mark]</i> |
| (d) $a = 1.5$ , $r = 0.8$ ;    | <i>[1 mark]</i> |
| (e) $a = -0.5$ , $r = -0.8$ .  | <i>[1 mark]</i> |