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1. A teacher is monitoring the progress of students using a computer based revision course. The improvement in performance,  $y$  marks, is recorded for each student along with the time,  $x$  hours, that the student spent using the revision course. The results for a random sample of 10 students are recorded below.

$x$ hours	1.0	3.5	4.0	1.5	1.3	0.5	1.8	2.5	2.3	3.0
$y$ marks	5	30	27	10	-3	-5	7	15	-10	20

[You may use  $\sum x = 21.4$ ,  $\sum y = 96$ ,  $\sum x^2 = 57.22$ ,  $\sum xy = 313.7$  ]

- (a) Calculate  $S_{xx}$  and  $S_{xy}$ . (3)
- (b) Find the equation of the least squares regression line of  $y$  on  $x$  in the form  $y = a + bx$ . (4)
- (c) Give an interpretation of the gradient of your regression line. (1)

Rosemary spends 3.3 hours using the revision course.

- (d) Predict her improvement in marks. (2)

Lee spends 8 hours using the revision course claiming that this should give him an improvement in performance of over 60 marks.

- (e) Comment on Lee's claim. (1)

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4. In a study of how students use their mobile telephones, the phone usage of a random sample of 11 students was examined for a particular week.

The total length of calls,  $y$  minutes, for the 11 students were

17, 23, 35, 36, 51, 53, 54, 55, 60, 77, 110

- (a) Find the median and quartiles for these data. (3)

A value that is greater than  $Q_3 + 1.5 \times (Q_3 - Q_1)$  or smaller than  $Q_1 - 1.5 \times (Q_3 - Q_1)$  is defined as an outlier.

- (b) Show that 110 is the only outlier. (2)

- (c) Using the graph paper on page 15 draw a box plot for these data indicating clearly the position of the outlier. (3)

The value of 110 is omitted.

- (d) Show that  $S_{yy}$  for the remaining 10 students is 2966.9 (3)

These 10 students were each asked how many text messages,  $x$ , they sent in the same week.

The values of  $S_{xx}$  and  $S_{xy}$  for these 10 students are  $S_{xx} = 3463.6$  and  $S_{xy} = -18.3$ .

- (e) Calculate the product moment correlation coefficient between the number of text messages sent and the total length of calls for these 10 students. (2)

A parent believes that a student who sends a large number of text messages will spend fewer minutes on calls.

- (f) Comment on this belief in the light of your calculation in part (e). (1)

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5. In a shopping survey a random sample of 104 teenagers were asked how many hours, to the nearest hour, they spent shopping in the last month. The results are summarised in the table below.

Number of hours	Mid-point	Frequency
0 – 5	2.75	20
6 – 7	6.5	16
8 – 10	9	18
11 – 15	13	25
16 – 25	20.5	15
26 – 50	38	10

A histogram was drawn and the group (8 – 10) hours was represented by a rectangle that was 1.5 cm wide and 3 cm high.

- (a) Calculate the width and height of the rectangle representing the group (16 – 25) hours. (3)
- (b) Use linear interpolation to estimate the median and interquartile range. (5)
- (c) Estimate the mean and standard deviation of the number of hours spent shopping. (4)
- (d) State, giving a reason, the skewness of these data. (2)
- (e) State, giving a reason, which average and measure of dispersion you would recommend to use to summarise these data. (2)

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