

**Answer ALL questions. Write your answers in the spaces provided.**

1. A company imports consumer goods from around the world. When the company receives a new shipment they need staff to work overtime.

The finance department wishes to investigate the relationship between the size of the shipment,  $x$  containers, and the wage bill,  $y$  in hundreds of pounds.

Data were collected for a random sample of 10 weeks when new shipments were received and are summarised by the following statistics.

$$\sum xy = 604430 \quad \bar{x} = 326 \quad \bar{y} = 180.8 \quad \sigma_x = 139.2 \quad \sigma_y = 11.1$$

- (a) Calculate the product moment correlation coefficient for these data. (4)
- (b) Stating your hypotheses clearly, test whether there is evidence of correlation between the size of the shipment and wage bill. Use a 5% level of significance. (4)



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Question 1 continued

Lined area for writing answers.

(Total for Question 1 is 8 marks)



2. A finance manager records the number of lorry loads of goods,  $x$ , leaving his factory each week, together with the total production costs,  $c$ , measured in £100s, for those goods.

He takes a random sample of 12 weeks and his results are summarised below.

$$\sum c = 783 \quad \sum x = 540 \quad S_{xc} = 6452 \quad \sum x^2 = 30\,786 \quad \sum c^2 = 57\,557$$

- (a) Find the equation of the regression line of  $c$  on  $x$  in the form  $c = a + bx$  as a model for these results. (4)
- (b) According to this model, give an interpretation of
- (i) the value of  $b$
  - (ii) the value of  $a$
- (2)

In the finance manager's sample, the actual total production cost for a week with 72 lorry loads was £8900 and for a week with 12 lorry loads the total production cost was £3500

- (c) Calculate the residuals for these 2 weeks. (3)
- (d) Calculate the residual sum of squares for these 12 weeks. (3)
- (e) Using your answer to part (d), suggest an approximate range of values for the total production costs in a week when 60 lorry loads leave the factory. (2)

The managing director believes that if the factory produces more goods, then the production cost per lorry load should decrease.

- (f) Comment on whether or not the managing director's belief is consistent with the finance manager's model. (1)

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Question 2 continued

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Question 2 continued

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Question 2 continued

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(Total for Question 2 is 15 marks)





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Question 3 continued

Lined area for writing the answer to Question 3.

(Total for Question 3 is 9 marks)



4. In a newspaper article a journalist claimed that in football matches, teams that have more shots at goal also score more goals.

A football fan wanted to see if the journalist's claim was correct, so collected data for a random sample of 10 teams from the previous season. She collected, for each team, the number of shots at goal and the number of goals scored that season.

Her results are given in the table below.

| Team                    | <i>A</i> | <i>B</i> | <i>C</i> | <i>D</i> | <i>E</i> | <i>F</i> | <i>G</i> | <i>H</i> | <i>I</i> | <i>J</i> |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Number of shots at goal | 902      | 1017     | 932      | 945      | 996      | 947      | 943      | 984      | 997      | 917      |
| Number of goals scored  | 118      | 112      | 119      | 120      | 121      | 83       | 106      | 89       | 122      | 94       |

- (a) Calculate the value of Spearman's rank correlation coefficient between the number of shots at goal and the number of goals scored. Show your working clearly. (5)
- (b) Stating your hypotheses clearly, test whether the value that you calculated in part (a) supports the journalist's claim. Use a 5% level of significance. (4)

The football fan discovers that the number of shots at goal for team *A* is in fact 802 not 902

- (c) Without further calculations, state how this effects the answer to part (a). (1)



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**(Total for Question 4 is 10 marks)**



5. A factory that manufactures bottles of juice receives complaints that its bottles contain less juice than is stated. The bottles are meant to contain 750 ml of juice.

An inspector visits the factory and takes a random sample of 6 bottles of juice. She measures the volumes of their contents, correct to the nearest half millilitre.

The results are as follows.

746.5    751.5    751.0    747.5    747.5    747.0

- (a) Stating your hypotheses clearly, test, at the 5% level of significance, whether or not there is evidence that the mean content of bottles is less than 750 ml.  
You must make your working clear, showing the calculation of your test statistic and stating the critical value used.

(6)

- (b) State an assumption needed for this test.

(1)



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6. A continuous random variable  $X$  has cumulative distribution function  $F(x)$  given by

$$F(x) = \begin{cases} 0 & x < a \\ k(x - a)^2 & a \leq x \leq 2a \\ 1 & x > 2a \end{cases}$$

where  $k$  and  $a$  are constants.

- (a) Find  $k$  in terms of  $a$ . (2)

Given that  $P(X > 2) = \frac{3}{4}$

- (b) explain why the value of  $a = \frac{4}{3}$  (3)

- (c) Find the median of  $X$ , giving your answer to 3 significant figures. (3)

- (d) Without using a calculator, show that  $E(X) = \frac{20}{9}$  (5)

- (e) Find the mode of  $X$ . (1)



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Question 6 continued

Lined area for writing the answer to Question 6.



Question 6 continued

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[illegible]

7. The diameter,  $X$  mm, of the circular mouth of bottles is normally distributed with mean 20 mm and standard deviation 0.1 mm. The diameter,  $Y$  mm, of the circular cross section of glass stoppers is normally distributed with mean 19.7 mm and standard deviation 0.1 mm. For a stopper to seal a bottle, the diameter of the mouth of the bottle minus the diameter of the stopper must be between 0 and 0.15 mm.

A bottle and a stopper are each selected at random.

- (a) Determine the probability that the stopper will seal the bottle.

(6)

Another bottle and a stopper are each selected at random.

- (b) Find the probability that the diameter of the mouth of the bottle is less than 19.5 mm smaller than twice the diameter of the stopper.

(6)



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Question 7 continued

Lined area for writing the answer to Question 7.



**Question 7 continued**

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**(Total for Question 7 is 12 marks)**

**TOTAL FOR PAPER IS 75 MARKS**

