

1. The volume of a sample of gas is kept constant. The gas is heated and the pressure, p , is measured at 10 different temperatures, t . The results are summarised below.

$$\sum p = 445 \quad \sum p^2 = 38\,125 \quad \sum t = 240 \quad \sum t^2 = 27\,520 \quad \sum pt = 26\,830$$

- (a) Find S_{pp} and S_{pt} . (3)

Given that $S_{tt} = 21\,760$,

- (b) calculate the product moment correlation coefficient. (2)

- (c) Give an interpretation of your answer to part (b). (1)



2. On a randomly chosen day the probability that Bill travels to school by car, by bicycle or on foot is $\frac{1}{2}$, $\frac{1}{6}$ and $\frac{1}{3}$ respectively. The probability of being late when using these methods of travel is $\frac{1}{5}$, $\frac{2}{5}$ and $\frac{1}{10}$ respectively.

- (a) Draw a tree diagram to represent this information. (3)

- (b) Find the probability that on a randomly chosen day
 - (i) Bill travels by foot and is late,
 - (ii) Bill is not late. (4)

- (c) Given that Bill is late, find the probability that he did not travel on foot. (4)



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Question 2 continued

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- 3. The variable x was measured to the nearest whole number. Forty observations are given in the table below.

x	10 – 15	16 – 18	19 –
Frequency	15	9	16

A histogram was drawn and the bar representing the 10 – 15 class has a width of 2 cm and a height of 5 cm. For the 16 – 18 class find

(a) the width, (1)

(b) the height (2)

of the bar representing this class.



4. A researcher measured the foot lengths of a random sample of 120 ten-year-old children. The lengths are summarised in the table below.

Foot length, l , (cm)	Number of children
$10 \leq l < 12$	5
$12 \leq l < 17$	53
$17 \leq l < 19$	29
$19 \leq l < 21$	15
$21 \leq l < 23$	11
$23 \leq l < 25$	7

(a) Use interpolation to estimate the median of this distribution. (2)

(b) Calculate estimates for the mean and the standard deviation of these data. (6)

One measure of skewness is given by

$$\text{Coefficient of skewness} = \frac{3(\text{mean} - \text{median})}{\text{standard deviation}}$$

(c) Evaluate this coefficient and comment on the skewness of these data. (3)

Greg suggests that a normal distribution is a suitable model for the foot lengths of ten-year-old children.

(d) Using the value found in part (c), comment on Greg's suggestion, giving a reason for your answer. (2)



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Question 4 continued

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5. The weight, w grams, and the length, l mm, of 10 randomly selected newborn turtles are given in the table below.

l	49.0	52.0	53.0	54.5	54.1	53.4	50.0	51.6	49.5	51.2
w	29	32	34	39	38	35	30	31	29	30

(You may use $S_{ll} = 33.381$ $S_{wl} = 59.99$ $S_{ww} = 120.1$)

- (a) Find the equation of the regression line of w on l in the form $w = a + bl$. (5)
- (b) Use your regression line to estimate the weight of a newborn turtle of length 60 mm. (2)
- (c) Comment on the reliability of your estimate giving a reason for your answer. (2)



6. The discrete random variable X has probability function

$$P(X = x) = \begin{cases} a(3 - x) & x = 0, 1, 2 \\ b & x = 3 \end{cases}$$

(a) Find $P(X = 2)$ and complete the table below.

x	0	1	2	3
$P(X = x)$	$3a$	$2a$		b

(1)

Given that $E(X) = 1.6$

(b) Find the value of a and the value of b .

(5)

Find

(c) $P(0.5 < X < 3)$,

(2)

(d) $E(3X - 2)$.

(2)

(e) Show that the $\text{Var}(X) = 1.64$

(3)

(f) Calculate $\text{Var}(3X - 2)$.

(2)



7. (a) Given that $P(A) = a$ and $P(B) = b$ express $P(A \cup B)$ in terms of a and b when
- (i) A and B are mutually exclusive,
 - (ii) A and B are independent.

(2)

Two events R and Q are such that

$$P(R \cap Q') = 0.15, \quad P(Q) = 0.35 \text{ and } P(R|Q) = 0.1$$

Find the value of

(b) $P(R \cup Q)$,

(1)

(c) $P(R \cap Q)$,

(2)

(d) $P(R)$.

(2)



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Question 7 continued

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(Total 7 marks)

Q7

Grading box for Question 7.



8. The lifetimes of bulbs used in a lamp are normally distributed.
A company *X* sells bulbs with a mean lifetime of 850 hours and a standard deviation of 50 hours.

(a) Find the probability of a bulb, from company *X*, having a lifetime of less than 830 hours. (3)

(b) In a box of 500 bulbs, from company *X*, find the expected number having a lifetime of less than 830 hours. (2)

A rival company *Y* sells bulbs with a mean lifetime of 860 hours and 20% of these bulbs have a lifetime of less than 818 hours.

(c) Find the standard deviation of the lifetimes of bulbs from company *Y*. (4)

Both companies sell the bulbs for the same price.

(d) State which company you would recommend. Give reasons for your answer. (2)



