

MOCK EXAM

AS Unit 2: Applied Mathematics A

Time allowed 1 hour 45 minutes

Total Marks Available 78

Section A: Statistics 44 marks

Section B: Mechanics 34 marks

*Reminder: Sufficient working must be shown to demonstrate the **mathematical** method employed*

Section A: Statistics

1. A researcher records the blood glucose levels of a group of females. The results, in mmol/litre are represented in the box plot in Fig. 2 below.

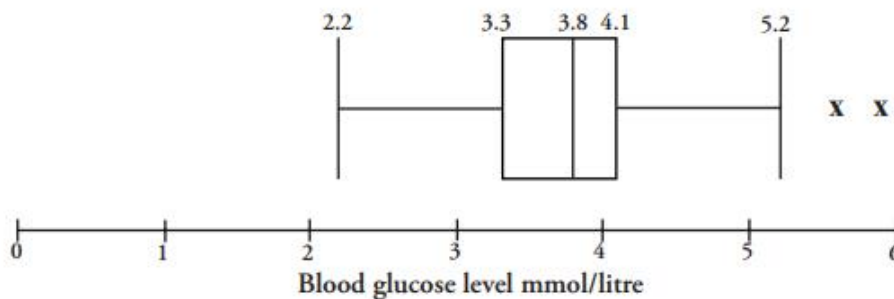


Fig.2

The researcher decides it is appropriate to clean the data by removing any outliers, which are indicated by **x** on the box plot.

If the outliers are removed from the original set of results, describe the effect this will have on

(i) the median, [1]

(ii) the standard deviation. [1]

2. (i) State **two** of the conditions necessary for a random variable to be modelled by a binomial distribution. [2]

Customers at a petrol station can pay by cash or by credit card.
The probability that a customer pays by cash is 0.3

- (ii) 10 customers are selected at random.

Calculate the probability that exactly 2 customers pay by cash. [4]

3. The independent events A and B are such that

$$P(A \cup B) = 0.9, \quad P(A \cap B) = 0.4, \quad P(A) > P(B).$$

- (a) Determine the values of $P(A)$ and $P(B)$. [7]

4. Cars arrive at a car wash in such a way that the number arriving during an interval of length t minutes has a Poisson distribution with mean $0.25t$.

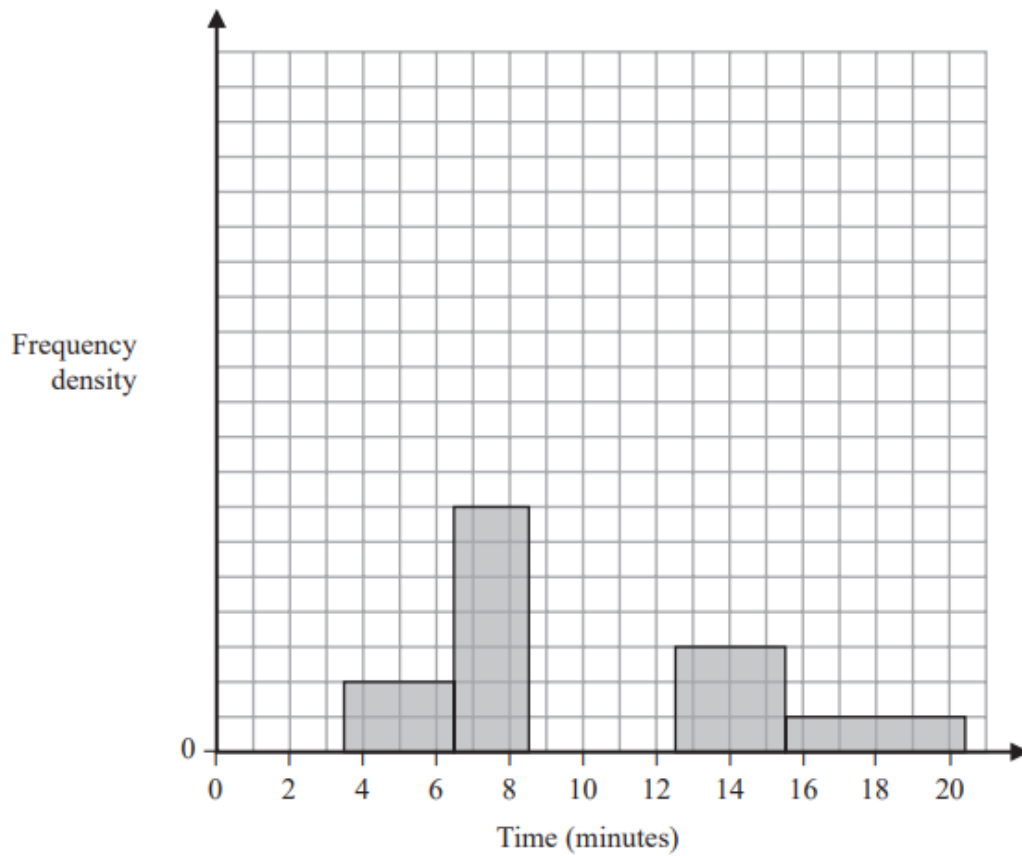
- (a) Find the probability that

- (i) exactly 4 cars arrive between 9:00 a.m. and 9:15 a.m.,
(ii) more than 6 cars arrive between 10:00 a.m. and 10:20 a.m. [6]

- (b) The probability that less than 10 cars arrive during an interval of length t minutes is equal to 0.7166. Find the value of t . [3]

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5. The partially completed histogram and the partially completed table show the time, to the nearest minute, that a random sample of motorists was delayed by roadworks on a stretch of motorway.



Delay (minutes)	Number of motorists
4 – 6	6
7 – 8	
9	17
10 – 12	45
13 – 15	9
16 – 20	

Estimate the percentage of these motorists who were delayed by the roadworks for between 8.5 and 13.5 minutes.

(5)

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6. Sara was studying the relationship between rainfall, r mm, and humidity, $h\%$, in the UK. She takes a random sample of 11 days from May 1987 for Leuchars from the large data set.

She obtained the following results.

h	93	86	95	97	86	94	97	97	87	97	86
r	1.1	0.3	3.7	20.6	0	0	2.4	1.1	0.1	0.9	0.1

Sara examined the rainfall figures and found

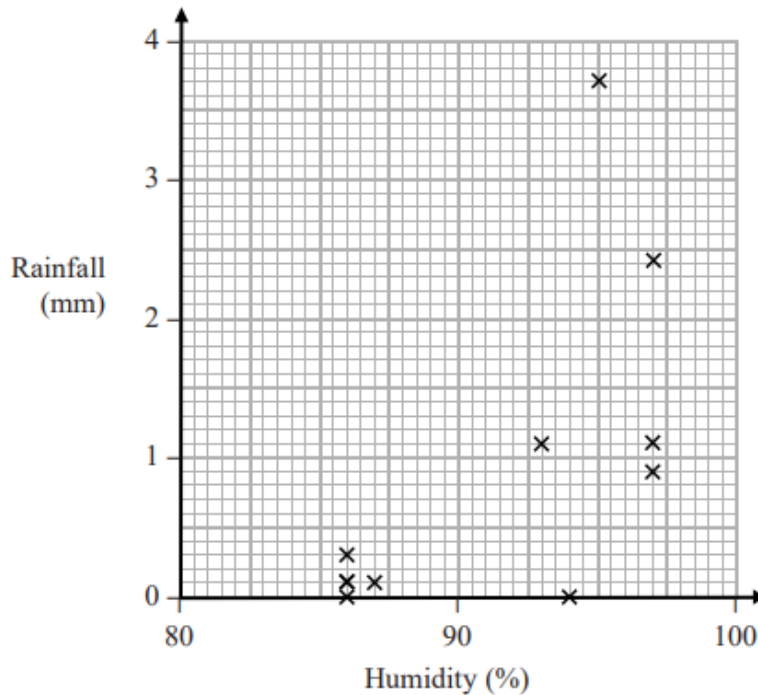
$$Q_1 = 0.1 \quad Q_2 = 0.9 \quad Q_3 = 2.4$$

A value that is more than 1.5 times the interquartile range (IQR) above Q_3 is called an outlier.

- (a) Show that $r = 20.6$ is an outlier. (1)

- (b) Give a reason why Sara might:
- (i) include
 - (ii) exclude
- this day's reading. (2)

Sara decided to exclude this day's reading and drew the following scatter diagram for the remaining 10 days' values of r and h .



- (c) Give an interpretation of the correlation between rainfall and humidity. (1)

The equation of the regression line of r on h for these 10 days is $r = -12.8 + 0.15h$

- (d) Give an interpretation of the gradient of this regression line.
- (e) (i) Comment on the suitability of Sara's sampling method for this study. (1)
- (ii) Suggest an improvement that Sara could make to her sampling method. (1)

7. (a) The discrete random variable $X \sim B(40, 0.27)$

Find $P(X \geq 16)$ (2)

Past records suggest that 30% of customers who buy baked beans from a large supermarket buy them in single tins. A new manager suspects that there has been a change in the proportion of customers who buy baked beans in single tins. A random sample of 20 customers who had bought baked beans was taken.

(b) Write down the hypotheses that should be used to test the manager's suspicion. (1)

(c) Using a 10% level of significance, find the critical region for a two-tailed test to answer the manager's suspicion. You should state the probability of rejection in each tail, which should be less than 0.05 (3)

(d) Find the actual significance level of a test based on your critical region from part (c). (1)

One afternoon the manager observes that 12 of the 20 customers who bought baked beans, bought their beans in single tins.

(e) Comment on the manager's suspicion in the light of this observation. (1)

Later it was discovered that the local scout group visited the supermarket that afternoon to buy food for their camping trip.

(f) Comment on the validity of the model used to obtain the answer to part (e), giving a reason for your answer. (1)

Section B: Mechanics

8. (a) A lift, of mass 1200 kg, is moving upwards. Find the tension in the lift cable when the lift is moving with
- (i) an acceleration of 2 ms^{-2} ,
 - (ii) constant speed. [4]
- (b) A person of mass M kg stands in a lift which is moving downwards with an acceleration of 3 ms^{-2} . The reaction of the floor of the lift on the person is 442 N. Determine the value of M . [3]
9. Two particles P and Q , of masses 3 kg and 5 kg respectively, are attached one to each end of a light inextensible string which passes over a smooth peg. Initially, the particles are held at rest with the string just taut and with both hanging parts of the string vertical. The particles are then released from rest.
- (a) Find the magnitude of the acceleration of P and the tension in the string. [7]
 - (b) What assumption does the word 'light', in the description of the string, enable you to make in your solution? [1]
10. A raindrop A falls freely from rest from the top of a cliff. After it has fallen a distance 0.1 m, a second raindrop B begins to fall from rest from the top of the same cliff. The height of the cliff is 40 m.
- (a) Find the velocity of A at the instant B begins to fall. [3]
 - (b) Find the velocity of A at the instant it reaches the ground. [2]
 - (c) Calculate the distance between the raindrops when the first raindrop A hits the ground. [7]
11. Two forces $(2\mathbf{i} - 11\mathbf{j})$ N and $(6\mathbf{i} + 7\mathbf{j})$ N act on a body of mass 4 kg.
- (i) Find the acceleration of the body. [3]

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12. A particle P moves in a straight line, starting from a point O . The velocity of P , measured in m s^{-1} , at time t s after leaving O is given by

$$v = 0.6t - 0.03t^2.$$

- (i) Verify that, when $t = 5$, the particle is 6.25 m from O . Find the acceleration of the particle at this time. [4]

END OF PAPER