Pearson Edexcel Level 3 GCE

| Paper reference | **9MA0/31** |

Mathematics

Advanced
PAPER 31: Statistics
Mock Set 4

You must have:
Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
  – *there may be more space than you need*.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Values from statistical tables should be quoted in full. If a calculator is used instead of tables the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 50. There are 6 questions.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question*.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1. Jen is using the large data set to investigate the relationship between Daily Maximum Relative Humidity and Daily Mean Visibility.
   Using the data for Camborne, Jen takes as her sample the first 8 days of October 2015

   Jen's data, without units, is given in the table below.

Daily Maximum Relative Humidity	93	92	97	98	100	99	91	96
Daily Mean Visibility	1100	1000	700	700	300	700	2300	1600

   The Daily Mean Visibility for 1st October was recorded as 1100

   (a) Give an interpretation of this value, including any units.

   (2)

   The product moment correlation coefficient for Jen's data, to 3 decimal places, is in this list

   $$0.316 \qquad -0.256 \qquad -0.484 \qquad -0.757 \qquad -1.035$$

   One of these values **cannot** be a product moment correlation coefficient.

   (b) Explain which value.

   (1)

   (c) Use your calculator to identify from the list the correct product moment correlation coefficient for Jen's data.

   (1)

   Jen believes that the Daily Maximum Relative Humidity each day can be used to predict the Daily Mean Visibility.

   (d) Carry out a suitable test, at the 5% significance level, to show why the data may support Jen's belief.
   State clearly
   • your hypotheses
   • your critical value

   (3)

   (e) Give **two** reasons why Jen's belief may still not be correct.

   (2)

Question 1 continued.

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Question 1 continued.

(Total for Question 1 is 9 marks)

2. When a piece of buttered toast is dropped, the probability that it lands butter side up is p

Two identical pieces of buttered toast are dropped independently in the same way.

The random variable T represents the number of pieces that land butter side up, so that T can take the value 0, 1 or 2

(a) Find $P(T = 0)$, giving your answer in terms of p

(1)

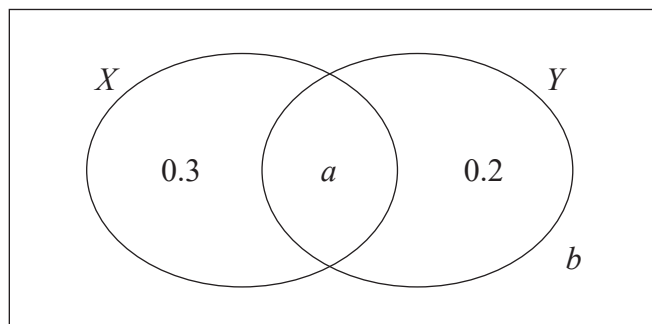(b) Show that the distribution of T is not discrete uniform.

(3)

Question 2 continued.

(Total for Question 2 is 4 marks)

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3. The Venn diagram shows probabilities related to two events, X and Y

(a) (i) State the value of $P(Y \cap X')$

(ii) Find $P(Y|X')$ giving your answer in terms of b

(3)

Given that $P(X|Y) = P(Y|X')$

(b) show that $ab = 0.04$

(3)

Given also that $a > b$

(c) find the value of a and the value of b
Show your working clearly.

(5)

(d) Hence show that X and Y are not independent.

(2)

Question 3 continued.

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Question 3 continued.

(Total for Question 3 is 13 marks)

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4. In a game of *Sixes*, each player's turn involves rolling 6 identical dice.
   If the player gets a six on fewer than 3 dice, the player does not score points.

   Assuming that the dice are fair, find the probability that in one turn a player

   (a) (i) gets a six on exactly 3 dice

       (ii) gets a six on at least 3 dice

   (3)

   Ali and four of his friends play *Sixes* together and have one turn each.
   Two of the 5 players score points.

   Ali claims that this suggests the dice are biased towards rolling a six.

   (b) Carry out a suitable test to investigate Ali's claim.
       You should
       • state your hypotheses clearly
       • use a 5% level of significance
       • state the *p*-value for the test

   **(4)**

Question 4 continued.

(Total for Question 4 is 7 marks)

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5. An engineering company buys components with a specified diameter of 5.8 mm
   Only components with a diameter between 5.75 mm and 5.85 mm are suitable for use.

   A random sample of 100 of these components is taken from each of supplier A and supplier B.
   The diameters are grouped into 0.05 mm intervals and the results are shown in the frequency polygons below.
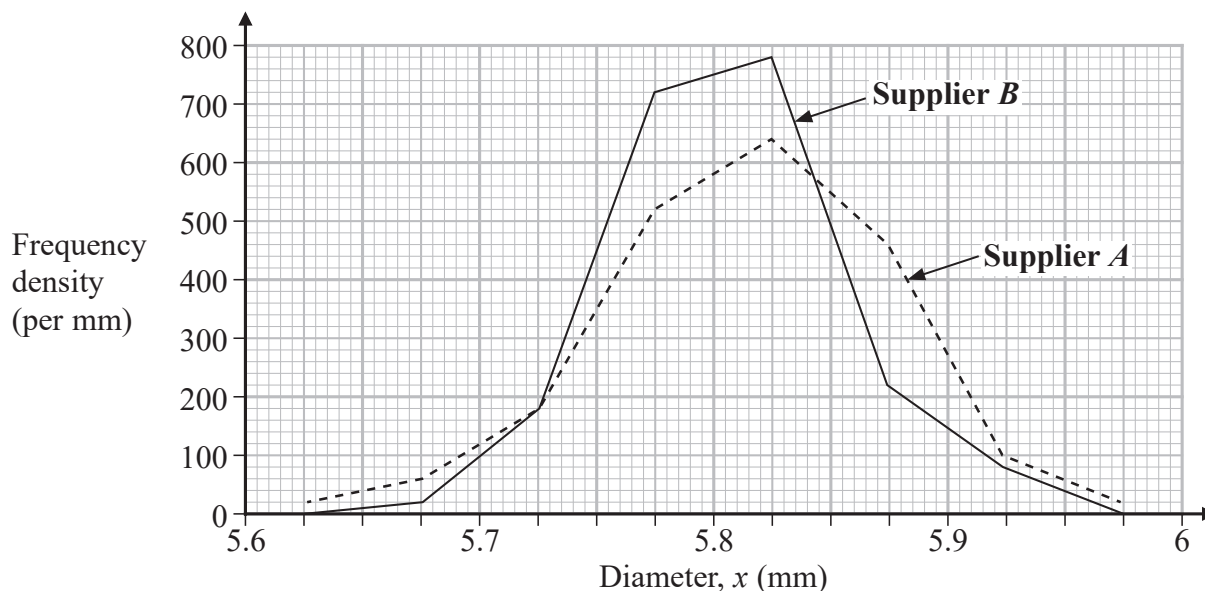
   Sam believes that supplier B will supply components with a more consistent diameter.

   (a) Explain how the frequency polygons support Sam's belief.

   (1)

   The modal class for each supplier is $5.80 \leqslant x < 5.85$

   (b) Determine how many more components are in this class for supplier B than for supplier A in these samples.

   (2)

   Sam also finds these summary statistics for the sample from supplier B

   $$\sum x^2 = 3371.1975 \qquad \sigma = 0.0483632$$

   (c) Determine the mean for this sample.

   (2)

   The diameter of components, D mm, from supplier B may be modelled by

   $$D \sim N(5.81, 0.048^2)$$

   Any component with a diameter less than 5.75 mm is not used.

   (d) Using the model, find the probability that a component randomly selected from supplier B is not used.

   (1)

   Any component with a diameter more than 5.85 mm is machined down by the company and is then suitable for use.

   (e) In a random sample of 40 components from supplier B that are suitable for use, estimate how many had been machined down by the company.

   (4)

Question 5 continued.

Question 5 continued.
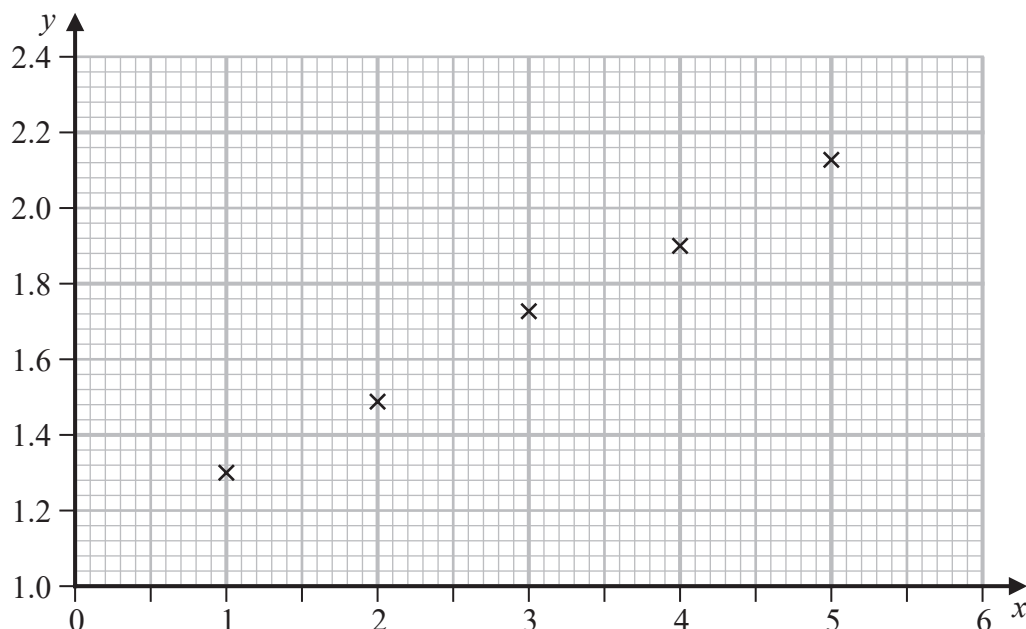
(Total for Question 5 is 10 marks)

6. Roberta started a business five years ago.

She believes that the number of customers, c, is growing exponentially.

She produced the graph below by coding her data such that

x = number of years since the business started

$y = \log_{10} c$

Roberta found the regression line for this graph to be $y = 1.10 + 0.204x$

(a) (i) Explain how the graph supports Roberta's belief of exponential growth.

  (ii) Find the relationship between the number of customers and number of years
    since the business started, in the form $c = ab^x$

(5)

Roberta claims that after 6 years she will have more than 200 customers.

(b) Show that Roberta's model supports this claim.

(1)

(c) Comment on the reliability of using Roberta's model in your answer to part (b).
  You must give a reason for your answer.

(1)

Question 6 continued.

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Question 6 continued.

(Total for Question 6 is 7 marks)

TOTAL FOR STATISTICS IS 50 MARKS

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