Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. 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).
  Coloured pencils and highlighter pens must not be used.
- **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 the statistical tables should be quoted in full. When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- The total mark for this paper is 75.
- 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 ▶

PEARSON

1. The manager of a clothing shop wishes to investigate how satisfied customers are with the quality of service they receive. A database of the shop's customers is used as a sampling frame for this investigation.

(a) Identify one potential problem with this sampling frame.

(1)

Customers are asked to complete a survey about the quality of service they receive. Past information shows that 35% of customers complete the survey.

A random sample of 20 customers is taken.

(b) Write down a suitable distribution to model the number of customers in this sample that complete the survey.

(2)

(c) Find the probability that more than half of the customers in the sample complete the survey.

(2)

Question 1 continued

(Total 5 marks)

Q1

2. The continuous random variable X is uniformly distributed over the interval $[a, b]$

Given that $P(3 < X < 5) = \dfrac{1}{8}$ and $E(X) = 4$

(a) find the value of a and the value of b

(3)

(b) find the value of the constant, c, such that $E(cX - 2) = 0$

(2)

(c) find the exact value of $E(X^2)$

(3)

(d) find $P(2X - b > a)$

(2)

Question 2 continued

(Total 10 marks)

Q2

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3. Left-handed people make up 10% of a population. A random sample of 60 people is taken from this population. The discrete random variable Y represents the number of left-handed people in the sample.

(a) (i) Write down an expression for the exact value of $P(Y \leqslant 1)$

(ii) Evaluate your expression, giving your answer to 3 significant figures.

(3)

(b) Using a Poisson approximation, estimate $P(Y \leqslant 1)$

(2)

(c) Using a normal approximation, estimate $P(Y \leqslant 1)$

(5)

(d) Give a reason why the Poisson approximation is a more suitable estimate of $P(Y \leqslant 1)$

(1)

Question 3 continued

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Question 3 continued

Question 3 continued

(Total 11 marks)

Q3

4. A continuous random variable X has cumulative distribution function

$$F(x) = \begin{cases} 0 & x < 0 \\ \dfrac{1}{4}x & 0 \leqslant x \leqslant 1 \\ \dfrac{1}{20}x^4 + \dfrac{1}{5} & 1 < x \leqslant d \\ 1 & x > d \end{cases}$$

(a) Show that $d = 2$

(2)

(b) Find $P(X < 1.5)$

(2)

(c) Write down the value of the lower quartile of X

(1)

(d) Find the median of X

(3)

(e) Find, to 3 significant figures, the value of k such that $P(X > 1.9) = P(X < k)$

(4)

P 4 6 9 5 0 A 0 1 0 2 4

Question 4 continued

P 4 6 9 5 0 A 0 1 1 2 4

Question 4 continued

Question 4 continued

(Total 12 marks)

Q4

5. The number of eruptions of a volcano in a 10 year period is modelled by a Poisson distribution with mean 1

(a) Find the probability that this volcano erupts at least once in each of 2 randomly selected 10 year periods.

(2)

(b) Find the probability that this volcano does not erupt in a randomly selected 20 year period.

(2)

The probability that this volcano erupts exactly 4 times in a randomly selected w year period is 0.0443 to 3 significant figures.

(c) Use the tables to find the value of w

(3)

A scientist claims that the mean number of eruptions of this volcano in a 10 year period is more than 1

She selects a 100 year period at random in order to test her claim.

(d) State the null hypothesis for this test.

(1)

(e) Determine the critical region for the test at the 5% level of significance.

(2)

Question 5 continued

Question 5 continued

(Total 10 marks)

Q5

6. A continuous random variable X has probability density function

$$f(x) = \begin{cases} ax^2 + bx & 1 \leqslant x \leqslant 7 \\ 0 & \text{otherwise} \end{cases}$$

where a and b are constants.

(a) Show that $114a + 24b = 1$

(4)

Given that $a = \dfrac{1}{90}$

(b) use algebraic integration to find $E(X)$

(4)

(c) find the cumulative distribution function of X, specifying it for all values of x

(3)

(d) find $P(X > E(X))$

(2)

(e) use your answer to part (d) to describe the skewness of the distribution.

(2)

Leave
blank

Question 6 continued

P 4 6 9 5 0 A 0 1 9 2 4

Question 6 continued

Leave blank

Question 6 continued

(Total 15 marks)

Q6

Leave blank

7. A fisherman is known to catch fish at a mean rate of 4 per hour. The number of fish caught by the fisherman in an hour follows a Poisson distribution.

The fisherman takes 5 fishing trips each lasting 1 hour.

(a) Find the probability that this fisherman catches at least 6 fish on exactly 3 of these trips.

(6)

The fisherman buys some new equipment and wants to test whether or not there is a change in the mean number of fish caught per hour.

Given that the fisherman caught 14 fish in a 2 hour period using the new equipment,

(b) carry out the test at the 5% level of significance. State your hypotheses clearly.

(6)

Question 7 continued

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Question 7 continued

Q7

(Total 12 marks)

TOTAL FOR PAPER: 75 MARKS

END