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MATHEMATICS **9709/61**

Paper 6 Probability & Statistics 2 **October/November 2025**

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages.

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1 The random variables X and Y have independent distributions $X \sim \text{Po}(3)$ and $Y \sim \text{Po}(2)$ respectively.

(a) Find $\text{P}(2 < X < 5)$. [2]

(b) Find $\text{P}(X + Y > 2)$. [3]

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(c) The total of 100 random values of X and 150 random values of Y is denoted by T.

Use a suitable approximating distribution to find $P(T < 560)$. [4]

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2 The mean mass of packets of Trueleaf tea is supposed to be 500 grams. An inspector wishes to test whether this value is correct. He weighs 60 randomly chosen packets and notes the mass, x grams, of each packet. The results are summarised as follows.

$$n = 60 \qquad \Sigma x = 29\,970 \qquad \Sigma x^2 = 14\,970\,300$$

Test, at the 5% significance level, whether the population mean mass is 500 grams. [8]

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3 The data produced by a certain data entry firm always include a small number of incorrect characters that occur at random. The proportion of incorrect characters is denoted by p, and experience has shown that $p = 0.0001$. A particular data set from the firm contains 14 500 characters, of which X characters are incorrect.

(a) Use a suitable approximating distribution to find $P(X < 4)$. [3]

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The firm's management wishes to decrease the value of p by giving their employees some training. Their aim is that, for a data set containing 14 500 characters, the value of $P(X = 0)$ for the new value of p should be double the value of $P(X = 0)$ when $p = 0.0001$.

(b) Use a suitable approximating distribution to find the new value of p. [3]

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4 The masses of a certain species of animal are known to be normally distributed with standard deviation σ kg. A researcher obtains the masses of a random sample of n animals of this species and uses these masses to find two confidence intervals (α% and 90%) for the population mean. The width of the α% confidence interval is $1.414 \times$ the width of the 90% confidence interval.

(a) Find α. [3]

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(b) Find the probability that the 90% confidence interval contains the population mean given that the α% confidence interval contains the population mean. [1]

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5 It is known that 20% of households in a certain country contain more than 4 people. Laxmi believes that, in her town, the percentage is lower than 20%. She chooses a random sample of 40 households in her town and notes the number which contain more than 4 people. She then carries out a test at the 2.5% significance level using a binomial distribution.

(a) Find the probability of a Type I error. [4]

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(b) State the rejection region for the test. [1]

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Laxmi finds that exactly 2 households in her sample contain more than 4 people.

(c) Explain why it is impossible for Laxmi to make a Type II error. [1]

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6 The masses, in kilograms, of large and small bags of potatoes have the independent distributions N(2.5, 0.05) and N(0.8, 0.02) respectively.

(a) Find the probability that the total mass of a randomly chosen large bag of potatoes and a randomly chosen small bag of potatoes is more than 3.55 kg. [5]

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(b) Find the probability that the mass of a randomly chosen large bag of potatoes is less than 3 times the mass of a randomly chosen small bag of potatoes. [5]

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7 The time, in minutes, taken by students to complete a test is modelled by the random variable X with probability density function

$$f(x) = \begin{cases} -\frac{3}{4}(x-3)(x-5) & 3 \leqslant x \leqslant 5, \\ 0 & \text{otherwise.} \end{cases}$$

(a) Find the probability that a randomly chosen student takes longer than 4.5 minutes to complete the test. [4]

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(b) Write down the median of X. [1]

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(c) Without performing an integration, use your answer to part **(a)** to find $P(3.5 < X < 4.5)$. [2]

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Additional page

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