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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2222837686

MATHEMATICS **9709/62**

Paper 6 Probability & Statistics 2 **October/November 2024**

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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[Turn over

1 A random variable X has the distribution $\mathrm{B}\left(4\,500\,000, \frac{1}{1\,000\,000}\right)$.

Use a Poisson distribution to calculate an estimate of $\mathrm{P}(X \geqslant 4)$. [3]

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2 The lengths of a random sample of 50 roads in a certain region were measured. Using the results, a 95% confidence interval for the mean length, in metres, of all roads in this region was found to be [245, 263].

(a) Find the mean length of the 50 roads in the sample. [1]

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(b) Calculate an estimate of the standard deviation of the lengths of roads in this region. [2]

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(c) It is now given that the lengths of roads in this region are normally distributed.

State, with a reason, whether this fact would make any difference to your calculation in part **(b)**. [1]

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3 A factory owner models the number of employees who use the factory canteen on any day by the distribution B(25, p). In the past the value of p was 0.8 . A new menu is introduced in the canteen and the owner wants to test whether the value of p has increased.

On a randomly chosen day he notes that the number of employees who use the canteen is 23.

(a) Use the binomial distribution to carry out the test at the 10% significance level. [5]

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(b) Given that there are 30 employees at the factory comment on the suitability of the owner's model. [1]

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4 A population is normally distributed with mean 35 and standard deviation 8.1 . A random sample of size 140 is chosen from this population and the sample mean is denoted by $\overline{X}$.

(a) Find $\mathrm{P}(\overline{X} > 36)$. [3]

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(b) It is given that $\mathrm{P}(\overline{X} < a) = 0.986$. Find the value of a. [3]

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5 A machine puts sweets into bags at random. The numbers of lemon and orange sweets in a bag have the independent distributions Po(3.7) and Po(2.6) respectively.

A bag of sweets is chosen at random.

(a) Find the probability that the number of lemon sweets in the bag is more than 2 but not more than 5. [2]

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(b) Find the probability that the total number of lemon and orange sweets in the bag is less than 4. [3]

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10 bags of sweets are chosen at random.

(c) Use approximating distributions to find the probability that the total number of lemon sweets in the 10 bags is less than the total number of orange sweets in the 10 bags. [6]

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6 The time, X hours, taken by a large number of people to complete a challenge is modelled by the probability density function given by

$$f(x) = \begin{cases} \dfrac{1}{x^2} & a \leqslant x \leqslant b, \\ 0 & \text{otherwise,} \end{cases}$$

where a and b are constants.

(a) State what the constants a and b represent in this context. [1]

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(b) Show that $a = \dfrac{b}{b+1}$. [3]

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It is given that $E(X) = \ln 3$.

(c) Show that $b = 2$ and find the value of a. [4]

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(d) Find the median of X. [3]

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7 The heights of one-year-old trees of a certain variety are known to have mean 2.3 m. A scientist believes that, on average, trees of this age and variety in her region are slightly taller than in other places. She plans to carry out a hypothesis test, at the 2% significance level, in order to test her belief.

(a) State the probability that she will make a Type I error. [1]

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She takes a random sample of 100 such trees in her region and measures their heights, h m. Her results are summarised below.

$$n = 100 \qquad \Sigma h = 238 \qquad \Sigma h^2 = 580$$

(b) Carry out the test at the 2% significance level. [7]

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(c) The scientist carries out the test correctly, but another scientist claims that she has made a Type II error.

Comment on this claim. [1]

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Additional page

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