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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

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* 5 4 8 9 3 1 4 7 5 9 *

MATHEMATICS **9709/61**

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. Any blank pages are indicated.

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1 The heights of a certain species of deer are known to have standard deviation 0.35 m. A zoologist takes a random sample of 150 of these deer and finds that the mean height of the deer in the sample is 1.42 m.

(a) Calculate a 96% confidence interval for the population mean height. [3]

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(b) Bubay says that 96% of deer of this species are likely to have heights that are within this confidence interval.

Explain briefly whether Bubay is correct. [1]

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2 The masses, in kilograms, of small and large bags of wheat have the independent distributions $N(16.0, 0.4)$ and $N(51.0, 0.9)$ respectively.

Find the probability that the total mass of 3 randomly chosen small bags is greater than the mass of one randomly chosen large bag. [5]

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3 The times, T minutes, taken by a random sample of 75 students to complete a test were noted. The results were summarised by $\Sigma t = 230$ and $\Sigma t^2 = 930$.

(a) Calculate unbiased estimates of the population mean and variance of T. [3]

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You should now assume that your estimates from part **(a)** are the true values of the population mean and variance of T.

(b) The times taken by another random sample of 75 students were noted, and the sample mean, $\overline{T}$, was found.

Find the value of a such that $P(\overline{T} > a) = 0.234$. [3]

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4 A random variable X has probability density function f defined by

$$\mathrm{f}(x) = \begin{cases} \dfrac{a}{x^2} - \dfrac{18}{x^3} & 2 \leqslant x \leqslant 3, \\ 0 & \text{otherwise,} \end{cases}$$

where a is a constant.

(a) Show that $a = \frac{27}{2}$. [3]

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(b) Show that $\mathrm{E}(X) = \frac{27}{2}\ln\frac{3}{2} - 3$. [3]

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5 The lengths, in centimetres, of worms of a certain kind are normally distributed with mean μ and standard deviation 2.3 . An article in a magazine states that the value of μ is 12.7 . A scientist wishes to test whether this value is correct. He measures the lengths, x cm, of a random sample of 50 worms of this kind and finds that $\sum x = 597.1$. He plans to carry out a test, at the 1% significance level, of whether the true value of μ is different from 12.7 .

(a) State, with a reason, whether he should use a one-tailed or a two-tailed test. [1]

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(b) Carry out the test. [5]

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6 The numbers of customers arriving at service desks A and B during a 10-minute period have the independent distributions Po(1.8) and Po(2.1) respectively.

(a) Find the probability that during a randomly chosen 15-minute period more than 2 customers will arrive at desk A. [2]

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(b) Find the probability that during a randomly chosen 5-minute period the total number of customers arriving at both desks is less than 4. [3]

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(c) An inspector waits at desk B. She wants to wait long enough to be 90% certain of seeing at least one customer arrive at the desk.

Find the minimum time for which she should wait, giving your answer correct to the nearest minute. [4]

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7 The number of accidents per year on a certain road has the distribution Po(λ). In the past the value of λ was 3.3 . Recently, a new speed limit was imposed and the council wishes to test whether the value of λ has decreased. The council notes the total number, X, of accidents during **two** randomly chosen years after the speed limit was introduced and it carries out a test at the 5% significance level.

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

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(b) Given that $X = 2$, carry out the test. [3]

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(c) The council decides to carry out another similar test at the 5% significance level using the same hypotheses and two different randomly chosen years.

Given that the true value of λ is 0.6, calculate the probability of a Type II error. [3]

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(d) Using $\lambda = 0.6$ and a suitable approximating distribution, find the probability that there will be more than 10 accidents in 30 years. [4]

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