* 0000800000001 *

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5489314759

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.

© UCLES 2024

[Turn over

BLANK PAGE

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(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]

.....

.....

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

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]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

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]

.....

.....

.....

(b) Carry out the test. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

(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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

(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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.