Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

2708090108

MATHEMATICS **9709/61**

Paper 6 Probability & Statistics 2 **October/November 2021**

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 **16** pages. Any blank pages are indicated.

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1 It is known that the height H, in metres, of trees of a certain kind has the distribution N(12.5, 10.24). A scientist takes a random sample of 25 trees of this kind and finds the sample mean, $\overline{H}$, of the heights.

(a) State the distribution of $\overline{H}$, giving the values of any parameters. [2]

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(b) Find $P(12 < \overline{H} < 13)$. [3]

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2 The number of enquiries received per day at a customer service desk has a Poisson distribution with mean 45.2. If more than 60 enquiries are received in a day, the customer service desk cannot deal with them all.

Use a suitable approximating distribution to find the probability that, on a randomly chosen day, the customer service desk cannot deal with all the enquiries that are received. [4]

3 A random sample of 75 students at a large college was selected for a survey. 15 of these students said that they owned a car. From this result an approximate $\alpha\%$ confidence interval for the proportion of all students at the college who own a car was calculated. The width of this interval was found to be 0.162.

Calculate the value of α correct to 2 significant figures. [5]

4 A random variable X has probability density function given by

$$f(x) = \begin{cases} \frac{1}{18}(9 - x^2) & 0 \leqslant x \leqslant 3, \\ 0 & \text{otherwise.} \end{cases}$$

(a) Find $P(X < 1.2)$. [3]

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(b) Find $E(X)$. [3]

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The median of X is m.

(c) Show that $m^3 - 27m + 27 = 0$. [3]

5 **(a)** The proportion of people having a particular medical condition is 1 in 100 000. A random sample of 2500 people is obtained. The number of people in the sample having the condition is denoted by X.

(i) State, with a justification, a suitable approximating distribution for X, giving the values of any parameters. [2]

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(ii) Use the approximating distribution to calculate $P(X > 0)$. [2]

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(b) The percentage of people having a different medical condition is thought to be 30%. A researcher suspects that the true percentage is less than 30%. In a medical trial a random sample of 28 people was selected and 4 people were found to have this condition.

Use a binomial distribution to test the researcher's suspicion at the 2% significance level. [5]

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6 The random variable T denotes the time, in seconds, for 100 m races run by Tania. T is normally distributed with mean μ and variance σ^2. A random sample of 40 races run by Tania gave the following results.

$$n = 40 \qquad \Sigma t = 560 \qquad \Sigma t^2 = 7850$$

(a) Calculate unbiased estimates of μ and σ^2. [3]

The random variable S denotes the time, in seconds, for 100 m races run by Suki. S has the independent distribution N(14.2, 0.3).

(b) Using your answers to part **(a)**, find the probability that, in a randomly chosen 100 m race, Suki's time will be at least 0.1 s more than Tania's time. [5]

7 The masses, in grams, of apples from a certain farm have mean μ and standard deviation 5.2. The farmer says that the value of μ is 64.6. A quality control inspector claims that the value of μ is actually less than 64.6. In order to test his claim he chooses a random sample of 100 apples from the farm.

(a) The mean mass of the 100 apples is found to be 63.5 g.

Carry out the test at the 2.5% significance level. [5]

(b) Later another test of the same hypotheses at the 2.5% significance level, with another random sample of 100 apples from the same farm, is carried out.

Given that the value of μ is in fact 62.7, calculate the probability of a Type II error. [5]

Additional Page

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

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