Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8526522996

MATHEMATICS **9709/62**

Paper 6 Probability & Statistics 2 **February/March 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 **16** pages. Any blank pages are indicated.

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1 The lengths, Xcm, of a sample of 100 insects of a certain type were summarised as follows.

$$n = 100 \qquad \Sigma x = 36.8 \qquad \Sigma x^2 = 17.34$$

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

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(b) State a necessary condition for the estimates found in part **(a)** to be reliable. [1]

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2 A random sample of 250 people living in Barapet was chosen. It was found that 78 of these people owned a BETEC phone.

(a) Calculate an approximate 98% confidence interval for the proportion of people living in Barapet who own a BETEC phone. [3]

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(b) Manjit claims that more than 40% of the people living in Barapet own a BETEC phone.

Use your answer to part **(a)** to comment on this claim. [1]

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3 In a certain lottery, on average 1 in every 10 000 tickets is a prize-winning ticket. An agent sells 6000 tickets.

(a) Use a suitable approximating distribution to find the probability that at least 3 of the tickets sold by the agent are prize-winning tickets. [3]

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(b) Justify the use of your approximating distribution in this context. [1]

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4 Each year a transport firm uses X litres of gasoline and Y litres of diesel fuel, where X and Y have the independent distributions $X \sim \mathrm{N}(10\,700, 950^2)$ and $Y \sim \mathrm{N}(13\,400, 1210^2)$.

(a) Find the probability that in a randomly chosen year the firm uses more gasoline than diesel fuel. [5]

The costs per litre of gasoline and diesel fuel are \$0.80 and \$0.85 respectively.

(b) Find the probability that the total cost of gasoline and diesel fuel in a randomly chosen year is between \$20 000 and \$22 000. [5]

5 A teacher models the numbers of girls and boys who arrive late for her class on any day by the independent random variables $G \sim \text{Po}(0.10)$ and $B \sim \text{Po}(0.15)$ respectively.

(a) Find the probability that during a randomly chosen 2-day period no girls arrive late. [1]

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(b) Find the probability that during a randomly chosen 5-day period the total number of students who arrive late is less than 3. [3]

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(c) It is given that the values of $\text{P}(G = r)$ and $\text{P}(B = r)$ for $r \geqslant 3$ are very small and can be ignored.

Find the probability that on a randomly chosen day more girls arrive late than boys. [3]

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Following a timetable change the teacher claims that on average more students arrive late than before the change. During a randomly chosen 5-day period a total of 4 students are late.

(d) Test the teacher's claim at the 5% significance level. [5]

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6 The graph of the probability density function f of a random variable X is symmetrical about the line $x = 2$. It is given that $\mathrm{P}(2 < X < 5) = \frac{117}{256}$.

(a) Using only this information show that $\mathrm{P}(X > -1) = \frac{245}{256}$. [2]

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It is now given that, for x in a suitable domain,

$$\mathrm{f}(x) = k(12 + 4x - x^2), \text{ where } k \text{ is a constant.}$$

(b) Find the value of k. [3]

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(c) A different random variable X has probability density function $g(x) = \frac{2}{9}\left(2 + x - x^2\right)$. The domain of X is all values of x for which $g(x) \geqslant 0$.

Find Var(X). [5]

7 The heights, in centimetres, of adult females in Litania have mean μ and standard deviation σ. It is known that in 2004 the values of μ and σ were 163.21 and 6.95 respectively. The government claims that the value of μ this year is greater than it was in 2004. In order to test this claim a researcher plans to carry out a hypothesis test at the 1% significance level. He records the heights of a random sample of 300 adult females in Litania this year and finds the value of the sample mean.

(a) State the probability of a Type I error. [1]

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You should assume that the value of σ after 2004 remains at 6.95 .

(b) Given that the value of μ this year is actually 164.91, find the probability of a Type II error. [5]

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