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.

BLANK PAGE

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(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]

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

(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]

.....

.....

.....

.....

.....

.....

.....

.....

(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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(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]

.....

.....

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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Additional page

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

BLANK PAGE

BLANK PAGE

BLANK PAGE