Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7288751637

MATHEMATICS **9709/62**

Paper 6 Probability & Statistics 2 **February/March 2023**

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 Anita carried out a survey of 140 randomly selected students at her college. She found that 49 of these students watched a TV programme called *Bunch*.

(a) Calculate an approximate 98% confidence interval for the proportion, p, of students at Anita's college who watch *Bunch*. [3]

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Carlos says that the confidence interval found in **(a)** is not useful because it is too wide.

(b) Without calculation, explain briefly how Carlos can use the results of Anita's survey to find a narrower confidence interval for p. [1]

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2 The number of orders arriving at a shop during an 8-hour working day is modelled by the random variable X with distribution Po(25.2).

(a) State **two** assumptions that are required for the Poisson model to be valid in this context. [2]

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(b) **(i)** Find the probability that the number of orders that arrive in a randomly chosen 3-hour period is between 3 and 5 inclusive. [3]

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(ii) Find the probability that, in two randomly chosen 1-hour periods, exactly 1 order will arrive in one of the 1-hour periods, and at least 2 orders will arrive in the other 1-hour period. [4]

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(c) The shop can only deal with a maximum of 120 orders during any 36-hour period.

Use a suitable approximating distribution to find the probability that, in a randomly chosen 36-hour period, there will be too many orders for the shop to deal with. [4]

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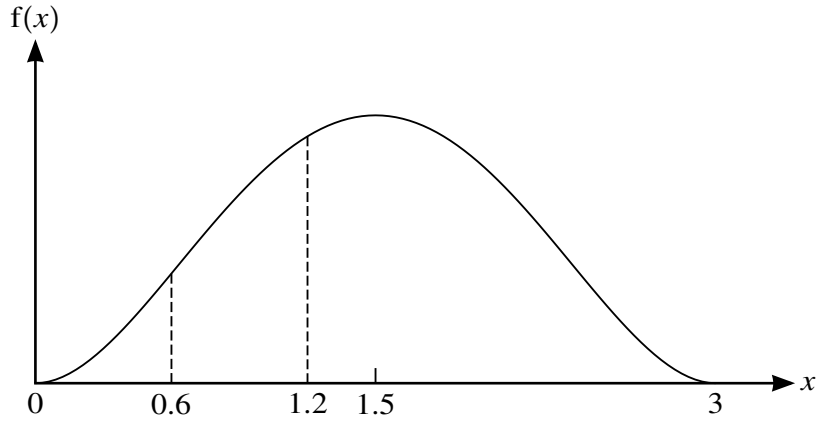
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The diagram shows the graph of the probability density function, f, of a random variable X that takes values between $x = 0$ and $x = 3$ only. The graph is symmetrical about the line $x = 1.5$.

(a) It is given that $P(X < 0.6) = a$ and $P(0.6 < X < 1.2) = b$.

Find $P(0.6 < X < 1.8)$ in terms of a and b. [2]

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(b) It is now given that the equation of the probability density function of X is

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

where k is a constant.

(i) Show that $k = \frac{10}{81}$. [3]

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(ii) Find $\text{Var}(X)$. [3]

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4 The number of accidents per 3-month period on a certain road has the distribution Po(λ). In the past the value of λ has been 5.7. Following some changes to the road, the council carries out a hypothesis test to determine whether the value of λ has decreased. If there are fewer than 3 accidents in a randomly chosen 3-month period, the council will conclude that the value of λ has decreased.

(a) Find the probability of a Type I error. [2]

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(b) Find the probability of a Type II error if the mean number of accidents per 3-month period is now actually 0.9. [3]

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5 The masses, in grams, of large and small packets of Maxwheat cereal have the independent distributions $N(410.0, 3.6^2)$ and $N(206.0, 3.7^2)$ respectively.

(a) Find the probability that a randomly chosen large packet has a mass that is more than double the mass of a randomly chosen small packet. [5]

The packets are placed in boxes. The boxes are identical in appearance. 60% of the boxes contain exactly 10 randomly chosen large packets. 40% of the boxes contain exactly 20 randomly chosen small packets.

(b) Find the probability that a randomly chosen box contains packets with a total mass of more than 4080 grams. [6]

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6 Last year, the mean time taken by students at a school to complete a certain test was 25 minutes. Akash believes that the mean time taken by this year's students was less than 25 minutes. In order to test this belief, he takes a large random sample of this year's students and he notes the time taken by each student. He carries out a test, at the 2.5% significance level, for the population mean time, μ minutes. Akash uses the null hypothesis H_0: $\mu = 25$.

(a) Give a reason why Akash should use a one-tailed test. [1]

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Akash finds that the value of the test statistic is $z = -2.02$.

(b) Explain what conclusion he should draw. [2]

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In a different one-tailed hypothesis test the z-value was found to be 2.14.

(c) Given that this value would lead to a rejection of the null hypothesis at the α% significance level, find the set of possible values of α. [3]

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The population mean time taken by students at another school to complete a test last year was m minutes. Sorin carries out a one-tailed test to determine whether the population mean this year is less than m, using a random sample of 100 students. He assumes that the population standard deviation of the times is 3.9 minutes. The sample mean is 24.8 minutes, and this result just leads to the rejection of the null hypothesis at the 5% significance level.

(d) Find the value of m. [3]

Additional Page

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