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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 1 4 4 2 6 7 9 7 0 8 *

MATHEMATICS **9709/63**

Paper 6 Probability & Statistics 2 **May/June 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 [ ].

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This document has **12** pages.

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[Turn over

1 The random variable X has the distribution $\mathrm{B}(4000, 0.001)$.

(a) Use a suitable approximating distribution to find $\mathrm{P}(2 \leqslant X < 5)$. [3]

(b) Justify your approximating distribution in this case. [1]

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2 The widths, w cm, of a random sample of 150 leaves of a certain kind were measured. The sample mean of w was found to be 3.12 cm.

Using this sample, an approximate 95% confidence interval for the population mean of the widths in centimetres was found to be [3.01, 3.23].

(a) Calculate an estimate of the population standard deviation. [3]

(b) Explain whether it was necessary to use the Central Limit theorem in your answer to part **(a)**. [1]

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3 The masses in kilograms of large and small bags of cement have the independent distributions N(50, 2.4) and N(26, 1.8) respectively.

Find the probability that the total mass of 5 randomly chosen large bags of cement is greater than the total mass of 10 randomly chosen small bags of cement. [5]

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4 In this question you should **not** use an approximating distribution.

At an election in Menham last year, 24% of voters supported the Today Party. A student wishes to test whether support for the Today Party has decreased since last year. He chooses a random sample of 25 voters in Menham and finds that exactly 2 of them say that they support the Today Party.

Test at the 5% significance level whether support for the Today Party has decreased. [5]

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5 A random variable X has probability density function f given by

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

where a is a constant.

(a) Show that $a = 2$. [3]

(b) Find the median of X. [4]

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(c) Find the exact value of E(X). [3]

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6 The numbers of green sweets in 200 randomly chosen packets of Frutos are summarised in the table.

Number of green sweets	0	1	2	3	> 3
Number of packets	32	50	97	21	0

(a) Calculate an unbiased estimate for the population mean of the number of green sweets in a packet of Frutos, and show that an unbiased estimate of the population variance is 0.783 correct to 3 significant figures. [3]

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The manufacturers of Frutos claim that the mean number of green sweets in a packet is 1.65 .

Anji believes that the true value of the mean, μ, is less than 1.65 . She uses the results from the 200 randomly chosen packets to test the manufacturers' claim.

(b) State suitable null and alternative hypotheses for the test. [1]

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(c) Show that the result of Anji's test is significant at the 5% level but not at the 1% level. [4]

(d) It is given that Anji made a Type I error.

Explain how this shows that the significance level that Anji used in her test was not 1%. [1]

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7 The independent random variables X and Y have the distributions Po(1.9) and Po(2.2) respectively.

(a) Find $\mathrm{P}(X+Y<4)$. [3]

(b) Find the probability that $X=2$ given that $X+Y<4$. [4]

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(c) A sample of 60 randomly chosen pairs of values of X and Y is taken, and the value of $X+Y$ is calculated for each pair. The sample mean of these 60 values is found.

Find the probability that the sample mean of $X+Y$ is less than 4.0 . [6]

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