Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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8199737846

MATHEMATICS **9709/63**

Paper 6 Probability & Statistics 2 **May/June 2020**

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. Blank pages are indicated.

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1 A random sample of 100 values of a variable X is taken. These values are summarised below.

$$n = 100 \qquad \Sigma x = 1556 \qquad \Sigma x^2 = 29\,004$$

Calculate unbiased estimates of the population mean and variance of X. [3]

2 Each day at the gym, Sarah completes three runs. The distances, in metres, that she completes in the three runs have the independent distributions $W \sim \text{N}(1520, 450)$, $X \sim \text{N}(2250, 720)$ and $Y \sim \text{N}(3860, 1050)$.

Find the probability that, on a particular day, Y is less than the total of W and X. [5]

3 The number of customers who visit a particular shop between 9.00 am and 10.00 am has the distribution Po(λ). In the past the value of λ was 5.2. Following some new advertising, the manager wishes to test whether the value of λ has increased. He chooses a random sample of 20 days and finds that the total number of customers who visited the shop between 9.00 am and 10.00 am on those days is 125.

Use an approximating distribution to test at the 2.5% significance level whether the value of λ has increased. [6]

4 The random variable A has the distribution Po(1.5). A_1 and A_2 are independent values of A.

(a) Find $P(A_1 + A_2 < 2)$. [3]

(b) Given that $A_1 + A_2 < 2$, find $P(A_1 = 1)$. [4]

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(c) Give a reason why $A_1 - A_2$ cannot have a Poisson distribution. [1]

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5 Sunita has a six-sided die with faces marked 1, 2, 3, 4, 5, 6. The probability that the die shows a six on any throw is p. Sunita throws the die 500 times and finds that it shows a six 70 times.

(a) Calculate an approximate 99% confidence interval for p. [4]

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(b) Sunita believes that the die is fair. Use your answer to part **(a)** to comment on her belief. [1]

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(c) Sunita uses the result of her 500 throws to calculate an $\alpha\%$ confidence interval for p. This interval has width 0.04.

Find the value of α. [5]

6 The length, X centimetres, of worms of a certain type is modelled by the probability density function

$$f(x) = \begin{cases} \frac{6}{125}(10 - x)(x - 5) & 5 \leqslant x \leqslant 10, \\ 0 & \text{otherwise.} \end{cases}$$

(a) State the value of $E(X)$. [1]

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

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(c) Two worms of this type are chosen at random.

Find the probability that exactly one of them has length less than 6 cm. [5]

7 A market researcher is investigating the length of time that customers spend at an information desk. He plans to choose a sample of 50 customers on a particular day.

(a) He considers choosing the first 50 customers who visit the information desk.

Explain why this method is unsuitable. [1]

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The actual lengths of time, in minutes, that customers spend at the information desk may be assumed to have mean μ and variance 4.8. The researcher knows that in the past the value of μ was 6.0. He wishes to test, at the 2% significance level, whether this is still true. He chooses a random sample of 50 customers and notes how long they each spend at the information desk.

(b) State the probability of making a Type I error and explain what is meant by a Type I error in this context. [2]

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(c) Given that the mean time spent at the information desk by the 50 customers is 6.8 minutes, carry out the test. [5]

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(d) Give a reason why it was necessary to use the Central Limit theorem in your answer to part **(c)**. [1]

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Additional Page

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