Cambridge International A Level

Cambridge Assessment International Education
Cambridge International Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	CANDIDATE NUMBER

4223097642

MATHEMATICS **9709/73**

Paper 7 Probability & Statistics 2 **(S2)** **May/June 2019**

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 50.

This document consists of **14** printed pages and **2** blank pages.

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1 A coin is thrown 100 times and it shows heads 60 times. Calculate an approximate 98% confidence interval for the probability, p, that the coin shows heads on any throw. [3]

2 The length of worms is denoted by X cm. The lengths of a random sample of 50 worms were measured. Some of the results were lost, but the following results are available.

- $\Sigma x^2 = 4361$
- An unbiased estimate of the population variance of X is 9.62.

Calculate the mean length of the 50 worms. [3]

3 Luis has to choose one person at random from four people, A, B, C and D. He throws a fair six-sided die. If the score is 1, he will choose A. If the score is 2 he will choose B. If the score is 3, he will choose C. If the score is 4 or more he will choose D.

(i) Explain why the choice made by this method is not random. [1]

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(ii) Describe how Luis could use a single throw of the die to make a random choice. [1]

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On another day, Luis has to choose two people at random from the same four people, A, B, C and D.

(iii) List the possible choices of two people and hence describe how Luis could use a single throw of the die to make this random choice. [2]

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4 A factory supplies boxes of children's bricks. Each box contains 10 randomly chosen large bricks and 20 randomly chosen small bricks. The masses, in grams, of large and small bricks have the distributions N(60, 1.2) and N(30, 0.7) respectively. The mass of an empty box is 8 g. Find the probability that the total weight of a box and its contents is less than 1200 g. [5]

5 The amount of money, in dollars, spent by a customer on one visit to a certain shop is modelled by the distribution N(μ, 1.94). In the past, the value of μ has been found to be 20.00, but following a rearrangement in the shop, the manager suspects that the value of μ has changed. He takes a random sample of 6 customers and notes how much they each spend, in dollars. The results are as follows.

17.60 23.50 17.30 22.00 31.00 15.50

The manager carries out a hypothesis test using a significance level of α%. The test does not support his suspicion. Find the largest possible value of α. [6]

6 A function f is defined by

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

where a is a constant.

(i) Show that f is a probability density function for all positive values of a. [3]

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The random variable X has probability density function f and the median of X is 2.

(ii) Show that $a = 2.52$, correct to 3 significant figures. [3]

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(iii) Find E(X). [3]

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7 Each day at a certain doctor's surgery there are 70 appointments available in the morning and 60 in the afternoon. All the appointments are filled every day. The probability that any patient misses a particular morning appointment is 0.04, and the probability that any patient misses a particular afternoon appointment is 0.05. All missed appointments are independent of each other.

Use suitable approximating distributions to answer the following.

(i) Find the probability that on a randomly chosen morning there are at least 3 missed appointments. [3]

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(ii) Find the probability that on a randomly chosen day there are a total of exactly 6 missed appointments. [3]

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(iii) Find the probability that in a randomly chosen 10-day period there are more than 50 missed appointments. [4]

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8 The four sides of a spinner are A, B, C, D. The spinner is supposed to be fair, but Sonam suspects that the spinner is biased so that the probability, p, that it will land on side A is greater than $\frac{1}{4}$. He spins the spinner 10 times and finds that it lands on side A 6 times.

(i) Test Sonam's suspicion using a 1% significance level. [5]

Later Sonam carries out a similar test at the 1% significance level, using another 10 spins of the spinner.

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

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(iii) Assuming that the value of p is actually $\frac{3}{5}$, calculate the probability of a Type II error. [3]

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Additional Page

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