Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	CANDIDATE NUMBER

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MATHEMATICS **9709/73**

Paper 7 Probability & Statistics 2 **(S2)** **October/November 2017**

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.
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 **11** printed pages and **1** blank page.

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1 A random variable, X, has the distribution Po(31). Use the normal approximation to the Poisson distribution to find $P(X > 40)$. [3]

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2 An airline has found that, on average, 1 in 100 passengers do not arrive for each flight, and that this occurs randomly. For one particular flight the airline always sells 403 seats. The plane only has room for 400 passengers, so the flight is overbooked if the number of passengers who do not arrive is less than 3. Use a suitable approximation to find the probability that the flight is overbooked. [4]

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3 After an election 153 adults, from a random sample of 200 adults, said that they had voted. Using this information, an $\alpha\%$ confidence interval for the proportion of all adults who voted in the election was found to be 0.695 to 0.835, both correct to 3 significant figures. Find the value of α, correct to the nearest integer. [4]

4 The lengths, in millimetres, of rods produced by a machine are normally distributed with mean μ and standard deviation 0.9. A random sample of 75 rods produced by the machine has mean length 300.1 mm.

(i) Find a 99% confidence interval for μ, giving your answer correct to 2 decimal places. [3]

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The manufacturer claims that the machine produces rods with mean length 300 mm.

(ii) Use the confidence interval found in part **(i)** to comment on this claim. [1]

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5 A continuous random variable, X, has probability density function given by

$$f(x) = \begin{cases} \frac{1}{4}(x+1) & 0 \leqslant x \leqslant 2, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Find $E(X)$. [3]

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(ii) Find the median of X. [3]

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6 The numbers of barrels of oil, in millions, extracted per day in two oil fields A and B are modelled by the independent random variables X and Y respectively, where $X \sim \mathrm{N}(3.2, 0.4^2)$ and $Y \sim \mathrm{N}(4.3, 0.6^2)$. The income generated by the oil from the two fields is \$90 per barrel for A and \$95 per barrel for B.

(i) Find the mean and variance of the daily income, in millions of dollars, generated by field A. [3]

(ii) Find the probability that the total income produced by the two fields in a day is at least \$670 million. [5]

7 In the past the number of cars sold per day at a showroom has been modelled by a random variable with distribution Po(0.7). Following an advertising campaign, it is hoped that the mean number of sales per day will increase. In order to test at the 10% significance level whether this is the case, the total number of sales during the first 5 days after the campaign is noted. You should assume that a Poisson model is still appropriate.

(i) Given that the total number of cars sold during the 5 days is 5, carry out the test. [6]

The number of cars sold per day at another showroom has the independent distribution Po(0.6). Assume that the distribution for the first showroom is still Po(0.7).

(ii) Find the probability that the total number of cars sold in the two showrooms during 3 days is exactly 2. [3]

8 In order to test the effect of a drug, a researcher monitors the concentration, X, of a certain protein in the blood stream of patients. For patients who are not taking the drug the mean value of X is 0.185. A random sample of 150 patients taking the drug was selected and the values of X were found. The results are summarised below.

$$n = 150 \qquad \Sigma x = 27.0 \qquad \Sigma x^2 = 5.01$$

The researcher wishes to test at the 1% significance level whether the mean concentration of the protein in the blood stream of patients taking the drug is less than 0.185.

(i) Carry out the test. [7]

(ii) Given that, in fact, the mean concentration for patients taking the drug is 0.175, find the probability of a Type II error occurring in the test. [5]

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