Cambridge International A Level

Cambridge Assessment International Education
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

9931467168

MATHEMATICS **9709/73**

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

1 The random variable X has mean 2.4 and variance 3.1.

(i) The random variable Y is the sum of four independent values of X. Find the mean and variance of Y. [2]

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(ii) The random variable Z is defined by $Z = 4X - 3$. Find the mean and variance of Z. [2]

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2 Cars arrive at a filling station randomly and at a constant average rate of 2.4 cars per minute.

(i) Calculate the probability that fewer than 4 cars arrive in a 2-minute period. [2]

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(ii) Use a suitable approximating distribution to calculate the probability that at least 140 cars arrive in a 1-hour period. [4]

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3 The times, in minutes, taken by competitors to complete a puzzle have mean μ and standard deviation 3. The times taken by a random sample of 10 competitors are noted and the results are given below.

25.2 26.8 18.5 25.5 30.1 28.9 27.0 26.1 26.0 24.9

(i) Stating a necessary assumption, calculate a 97% confidence interval for μ. [5]

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(ii) Two more random samples, each of 10 competitors, are taken. Their times are used to calculate two more 97% confidence intervals for μ. Find the probability that neither of these intervals contains the true value of μ. [1]

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4 A train company claims that 92% of trains on a particular line arrive on time. Sanjeep suspects that the true percentage is less than 92%. He chooses a random sample of 20 trains on this line and finds that exactly 16 of them arrive on time. Making an assumption that should be stated, test at the 5% significance level whether Sanjeep's suspicion is justified. [6]

5 **(i)** The random variable X has the distribution B(300, 0.01). Use a Poisson approximation to find $P(2 < X < 6)$. [3]

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(ii) The random variable Y has the distribution Po(λ), and $P(Y = 0) = P(Y = 2)$. Find λ. [2]

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(iii) The random variable Z has the distribution Po(5.2) and it is given that $P(Z = n) < P(Z = n + 1)$.

(a) Write down an inequality in n. [1]

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(b) Hence or otherwise find the largest possible value of n. [2]

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6 A random variable X has probability density function given by

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

(i) Show that $k = \frac{2}{9}$. [3]

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(ii) Find $P(1 \leqslant X \leqslant 2)$. [2]

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(iii) Find $\mathrm{Var}(X)$. [5]

7 Bob is a self-employed builder. In the past his weekly income had mean \$546 and standard deviation \$120. Following a change in Bob's working pattern, his mean weekly income for 40 randomly chosen weeks was \$581. You should assume that the standard deviation remains unchanged at \$120.

(i) Test at the 2.5% significance level whether Bob's mean weekly income has increased. [5]

Bob finds his mean weekly income for another random sample of 40 weeks and carries out a similar test at the 2.5% significance level.

(ii) Given that Bob's mean weekly income is now in fact \$595, find the probability of a Type II error. [5]

Additional Page

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

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