



Cambridge International AS & A Level

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 2

May/June 2025

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 **12** pages. Any blank pages are indicated.



1 At a certain shop, customers arrive independently and randomly at a constant average rate of 23.4 per hour.

(a) Find the probability that, in a randomly chosen 1-minute period, at least 2 customers arrive. [3]

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(b) The random variable X denotes the number of customers who arrive in a randomly chosen 1-hour period.

(i) State a suitable approximating distribution for X , giving the value(s) of any parameter(s). [2]

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(ii) Use your approximating distribution to find $P(20 < X < 30)$. [3]

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- 2 The lengths of pencils made at a factory are normally distributed. The standard deviation of the lengths is σ cm, and the mean is supposed to be 10 cm. An inspector thinks that the mean is actually greater than 10 cm. He takes a random sample of 50 pencils produced at the factory and finds that the mean of these 50 lengths is 10.03 cm. He then carries out a hypothesis test.

(a) He finds that the value of the test statistic z is 1.995 correct to 3 decimal places.

- (i) Calculate the value of σ . [3]

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- (ii) Carry out the hypothesis test at the 2.5% significance level. [3]

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(b) Explain whether it was necessary to use the Central Limit Theorem in carrying out the test. [1]

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- 3 A machine dispenses coffee into cups. The volume, $V\text{cm}^3$, of coffee in a cup was measured for a random sample of 150 cups. The results were summarised as follows.

$$\Sigma v = 46\,350 \qquad \Sigma v^2 = 14\,410\,800$$

- (a) (i) Calculate unbiased estimates of the population mean, μ , and population variance, σ^2 . [3]

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- (ii) Calculate a 95% confidence interval for μ . [3]

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Another random sample of n cups of coffee is taken, where $100 < n < 120$. A 95% confidence interval for μ is calculated using this sample. You may assume that, for large samples, unbiased estimates of σ^2 are very similar.

- (b) Without calculation, state whether this confidence interval would be wider or narrower than the confidence interval found in part (a)(ii). Give a reason for your answer. [2]

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- 4 Emma needs to choose one person at random from three people, P , Q and R . She plans to throw two fair coins and note the number, n , of heads. If n is 0, she will choose P . If n is 1, she will choose Q . If n is 2, she will choose R .

- (a) By considering probabilities, show that the choice made by this method is not random. [2]

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Later, Emma has to choose two people at random from three people.

- (b) Describe how Emma could use a single throw of a fair six-sided dice to make this random choice. [2]

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6 A random variable X has probability density function given by

$$f(x) = \begin{cases} ax & 0 \leq x \leq b, \\ 0 & \text{otherwise,} \end{cases}$$

where a and b are constants.

(a) Show that $a = \frac{2}{b^2}$. [3]

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(b) Show that $P(X < E(X)) = \frac{4}{9}$. [6]

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- In the month following the change, there were 35 job applicants, and r of these had first-class degrees. The firm carried out a hypothesis test at the 4% significance level to test the director's belief.

- (a) Use a binomial distribution to find the largest value of r that would provide sufficient evidence that the director's belief is correct. [6]

[illegible]



(b) Explain the meaning of a Type I error in this context, and state the probability of a Type I error. [2]

[illegible]

(c) Given that the proportion of job applicants with first class degrees this year is actually 0.05, find the probability of a Type II error. [2]

[illegible]

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