



Cambridge International AS & A Level

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 2

May/June 2023

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. Any blank pages are indicated.



[3]

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- 2 (a)** The random variable W has a Poisson distribution.

State the relationship between $E(W)$ and $\text{Var}(W)$. [1]

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- (b)** The random variable X has the distribution $B(n, p)$. Jyothi wishes to use a Poisson distribution as an approximate distribution for X .

Use the formulae for $E(X)$ and $\text{Var}(X)$ to explain why it is necessary for p to be close to 0 for this to be a reasonable approximation. [1]

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- (c)** Given that Y has the distribution $B(20\,000, 0.000\,07)$, use a Poisson distribution to calculate an estimate of $P(Y > 2)$. [3]

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- 3 The masses, in kilograms, of newborn babies in country A are represented by the random variable X , with mean μ and variance σ^2 . The masses of a random sample of 500 newborn babies in this country were found and the results are summarised below.

$$n = 500 \qquad \Sigma x = 1625 \qquad \Sigma x^2 = 5663.5$$

- (a) Calculate unbiased estimates of μ and σ^2 . [3]

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A researcher wishes to test whether the mean mass of newborn babies in a neighbouring country, B , is different from that in country A . He chooses a random sample of 60 newborn babies in country B and finds that their sample mean mass is 2.95 kg.

Assume that your unbiased estimates in part (a) are the correct values for μ and σ^2 . Assume also that the variance of the masses of newborn babies in country B is the same as in country A .

(b) Carry out the test at the 1% significance level. [5]

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(b) Find the probability that exactly 10 books are received in a 3-day period. [2]

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- [illegible]

The number of DVDs received at the same shop is modelled by an independent Poisson distribution with mean 2.5 per day.

- (d) Find the probability that the total number of books and DVDs that are received at the shop in 1 day is more than 3. [3]

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[5]

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(b) Each candidate’s overall score in a science test is calculated as follows. The mark for theory is denoted by T , the mark for practical is denoted by P , and the overall score is given by $T + 1.5P$. The variables T and P are assumed to be independent with distributions $N(62, 158)$ and $N(42, 108)$ respectively. You should assume that no continuity corrections are needed when using these distributions.

(i) A pass is awarded to candidates whose overall score is at least 90.

Find the proportion of candidates who pass. [5]

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(ii) Comment on the assumption that the variables T and P are independent. [1]

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- 6** When a child completes an online exercise called a Mathlit, they might be awarded a medal. The publishers claim that the probability that a randomly chosen child who completes a Mathlit will be awarded a medal is $\frac{1}{3}$. Asha wishes to test this claim. She decides that if she is awarded no medals while completing 10 Mathlits, she will conclude that the true probability is less than $\frac{1}{3}$.

(a) Use a binomial distribution to find the probability of a Type I error. [2]

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The true probability of being awarded a medal is denoted by p .

(b) Given that the probability of a Type II error is 0.8926, find the value of p . [3]

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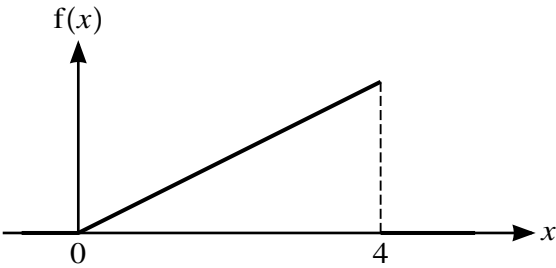
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7 (a)



The diagram shows the graph of the probability density function, f , of a random variable X which takes values between 0 and 4 only. Between these two values the graph is a straight line.

(i) Show that $f(x) = kx$ for $0 \leq x \leq 4$, where k is a constant to be determined. [2]

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(ii) Hence, or otherwise, find $E(X)$. [3]

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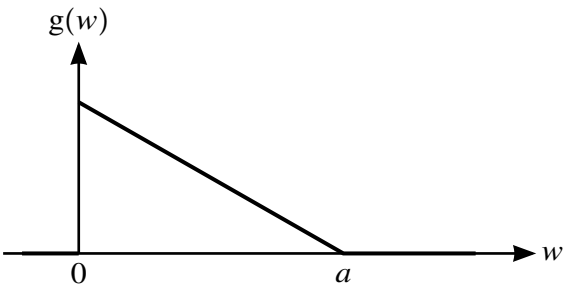
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(b)



The diagram shows the graph of the probability density function, g , of a random variable W which takes values between 0 and a only, where $a > 0$. Between these two values the graph is a straight line.

Given that the median of W is 1, find the value of a . [3]

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