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Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL A-LEVEL MATHEMATICS

(9660/MA04) Unit S2 Statistics

Tuesday 21 January 2020 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the Oxford International AQA booklet of formulae and statistical tables (enclosed).
- You may use a graphics calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.

For Examiner's Use	
Question	Mark
1	
2	
3	
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6	
7	
8	
9	
10	
TOTAL	



J A N 2 0 M A 0 4 0 1

Answer **all** questions in the spaces provided.

- 1** The continuous random variable X_1 has mean 2 and variance 3
 The continuous random variable X_2 has mean 5 and variance 1
 The continuous random variable X_3 has mean 1 and variance 0.5
 X_1 , X_2 and X_3 are independent.

1 (a) Find $E\left(\sum_{i=1}^3 X_i\right)$

[1 mark]

Answer _____

1 (b) Find $\text{Var}\left(\sum_{i=1}^3 X_i\right)$

[1 mark]

Answer _____



1 (c) Find $E(3X_1 - 4X_3)$

[2 marks]

Answer _____

1 (d) Find $\text{Var}(5X_1 - 2X_2)$

[2 marks]

Answer _____

Turn over ►



2 The random variable X has an exponential distribution with parameter λ , where $\lambda > 0$

The variance of X is 400

2 (a) Find λ .

[2 marks]

Answer _____

2 (b) Find the mean of X .

[1 mark]

Answer _____



- 2 (c) Find $P(X > 25)$, giving your answer to three significant figures.

[3 marks]

Answer _____

- 2 (d) Find x such that $P(X < x) = 0.6$, giving your answer to three significant figures.

[2 marks]

Answer _____

8

Turn over ►



3

The number of arrows hitting the target can be modelled by a binomial distribution with $n = 100$ and $p = 0.01$

3 (a)

[3 marks]

[illegible]

Answer

3 (b)

[2 marks]

- 4** Let X represent the number of people arriving at a hospital with a particular disease in a day.

A random sample of 20 days is taken. The summarised data is

$$\sum x = 50 \quad \text{and} \quad \sum x^2 = 173$$

- 4 (a)** Using the summarised data, explain why it would be reasonable to model X using a Poisson distribution.

[4 marks]

- 4 (b)** Using a Poisson model with mean 2.5, find $P(X = 4)$, giving your answer to three significant figures.

[2 marks]

Answer _____



The restaurant hires a new chef.

A random sample of 15 customers is taken and 14 customers give the restaurant an 'Excellent' rating.

[6 marks]

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5 (b) Describe, in the context of the test in part (a), a Type II error.

[1 mark]

7

Turn over for the next question

Turn over ►



- 6** The marks scored in a maths test by a class of students are modelled by a normal distribution with mean μ and standard deviation σ .

5% of the students in the class scored more than 83 marks.

- 6 (a)** Show that $83 - \mu = 1.6449\sigma$

[2 marks]

- 6 (b)** 8% of the students in the class scored less than 10 marks.

Find the value of μ and the value of σ , giving your answers to three significant figures.

[5 marks]



$$\mu = \underline{\hspace{2cm}} \quad \sigma = \underline{\hspace{2cm}}$$

- 6 (c)** The maximum possible mark for the test is 85 marks.

Explain why the normal distribution model used in parts **(a)** and **(b)** may not be a valid model.

[1 mark]



Following a power cut, a random sample of 25 pipes taken from machine A has a mean diameter of 13.892 millimetres.

Test whether the mean diameter of pipes produced by machine A has changed following the power cut, using a 2% level of significance.

Assume that the standard deviation is unchanged by the power cut.

[7 marks]

[illegible]

A random sample of 9 pipes taken from machine *B* has a mean diameter of 14.02 millimetres and a standard deviation of 0.04 millimetres.

[7 marks]

[illegible]

8

$$f(x) = \begin{cases} k(x^2 - 7x + 6) & 1 \leq x \leq 6 \\ 0 & \text{otherwise} \end{cases}$$

where k is a constant.

8 (a)

[3 marks]

[illegible]

8 (b)

[3 marks]



8 (c) Find $\text{Var}(X)$

[5 marks]

Answer _____

11

Turn over ►



A random sample of 25 plants is taken.

[1 mark]

[3 marks]

Answer



9 (b) (i) Describe the distribution of the total height of the sample of 25 plants.

[1 mark]

9 (b) (ii) Find the probability that the total height of the plants is greater than 525 centimetres, giving your answer to three significant figures.

[3 marks]

Answer _____

9 (c) Explain the link between your answers to parts **(a)(ii)** and **(b)(ii)**.

[2 marks]



10 (a) A simple random sample is taken from car owners in a town.

10 (a) (i) State the population for this sample.

[1 mark]

10 (a) (ii) State a condition which must be satisfied by a simple random sample.

[1 mark]

10 (b) State the parameter used in calculating probabilities using the Poisson distribution.

[1 mark]

10 (c) State the parameters used in calculating probabilities using the normal distribution.

[2 marks]

END OF QUESTIONS



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