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Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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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	
4	
5	
6	
7	
8	
9	
10	
<b>TOTAL</b>	



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]

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Answer \_\_\_\_\_

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

[1 mark]

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Answer \_\_\_\_\_



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

[2 marks]

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Answer \_\_\_\_\_

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

[2 marks]

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Answer \_\_\_\_\_



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

The variance of  $X$  is 400

**2 (a)** Find  $\lambda$ .

**[2 marks]**

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Answer \_\_\_\_\_

**2 (b)** Find the mean of  $X$ .

**[1 mark]**

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Answer \_\_\_\_\_



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

**[3 marks]**

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Answer \_\_\_\_\_

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

**[2 marks]**

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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]**

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- 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]**

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

**[2 marks]**

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Answer \_\_\_\_\_



Over time, 80% of the customers of a restaurant have given the restaurant an 'Excellent' rating.

After one month, the new chef claims that the proportion of customers giving the restaurant an 'Excellent' rating has increased.

**5 (a)** Test the new chef's claim, using a 10% level of significance.

[illegible]



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

**[1 mark]**

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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  $\mu$  and standard deviation  $\sigma$ .

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

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

**[2 marks]**

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

Find the value of  $\mu$  and the value of  $\sigma$ , giving your answers to three significant figures.

**[5 marks]**

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

- 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]**

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**[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)** Show that  $k = -\frac{6}{125}$

**[3 marks]**

[illegible]

**8 (b)** Show that  $E(X) = 3.5$

**[3 marks]**

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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]**

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**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]**

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Answer \_\_\_\_\_

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

**[2 marks]**

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**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]**

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

**[1 mark]**

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

**[1 mark]**

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

**[2 marks]**

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**END OF QUESTIONS**



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