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Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

INTERNATIONAL A-LEVEL FURTHER MATHEMATICS

(9665/FM04) Unit FS2 – Further Statistics

Monday 24 June 2019

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	
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TOTAL	



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5



A business claims that the standard deviation of the mass of their tins of beans is 1.6 grams.

Assume that the mass of tins of beans is normally distributed.

Investigate the claim at the 5% level of significance.

[6 marks]

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3 (a) Show that the moment generating function of X_i is given by

[4 marks]

[illegible]

3 (b) The random variables X_1 and X_2 are independent.

Given that $\lambda_1 = 2$ and $\lambda_2 = 3$, find the moment generating function of $X_1 + X_2$

Simplify your answer.

[2 marks]

3 (c) Describe the distribution of $X_1 + X_2$

[1 mark]

7

Turn over for the next question

Turn over ►



- 4** The following table shows the contents of a bag of coins.

Coin (cents)	10	20	50
Frequency	25	55	20

- 4 (a)** Find the mean μ of the value of the coins in the bag.

[1 mark]

- 4 (b)** A random sample of two coins is selected from the bag in the following way.

Step 1: A first coin is taken randomly from the bag, its value is recorded and then the coin is put back into the bag.

Step 2: A second coin is taken randomly from the bag, its value is recorded and then the coin is put back into the bag.

For example, a 10 cent coin followed by a 20 cent coin is recorded as (10, 20).

- 4 (b) (i)** Write down all the distinct possible samples.

[2 marks]



Find the sampling distribution of the mean, $\bar{X}$, of the two coins.

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[2 marks]



Devon is modelling the number of traffic accidents per day in a town.

Devon records the results in the following table.

Accidents per day	0	1	2	3	4 or more
Frequency	22	30	33	13	2

Devon claims that the number of accidents per day in the town can be modelled by a Poisson distribution.

[10 marks]

[illegible]

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6 (a) Determine whether or not

$$\frac{\sum_{i=1}^n X_i}{n} + \frac{1}{n}$$

[4 marks]

[illegible]
$$E(X_i^2) = \sigma^2 + \mu^2$$

[2 marks]



$$\frac{\sum_{i=1}^n X_i^2}{n} - \bar{X}^2$$

[5 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

A random sample of the monthly milk production, X , of five cows on the farm was taken.

The results can be summarised as

$$\sum x = 4499 \quad \text{and} \quad \sum x^2 = 4048993$$

[4 marks]

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7 (b) Sean wants the width of the 95% confidence interval to be at most 5 kilograms.

Calculate how many more cows are needed in the sample to achieve this.

[4 marks]

Question 7 continues on the next page

Turn over ►



- [5 marks]**

[illegible]

- 7 (c) (ii)** Sean and Millie each carry out a hypothesis test on the mean monthly milk production with the following hypotheses

$$H_0: \mu = 890$$

$$H_1: \mu \neq 890$$

Sean and Millie each use their confidence interval to carry out the test.

State whether Sean and Millie reach the same conclusion.

Explain your answer.

[2 marks]

15

Turn over for the next question

Turn over ►



The chocolate produced in one hour, in tonnes, by the machines can be modelled by normal distributions.

	Number of Measurements	Mean (tonnes)	Standard Deviation (tonnes)
Machine A	5	5.6	0.20
Machine B	7	6.0	0.24

8 (a) Using a pooled estimate of variance, investigate at the 1% level of significance whether Beth's claim is valid.

[illegible]

8 (b) State the assumption required for the test in part (a) to be valid.

[1 mark]

Turn over for the next question

Turn over ►



[6 marks]

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