

Please write clearly in block capitals.

Centre number

Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

I declare this is my own work.

# INTERNATIONAL A-LEVEL FURTHER MATHEMATICS

(9665/FM04) Unit FS2 Statistics

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 graphic 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	
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8	
<b>TOTAL</b>	

















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Answer \_\_\_\_\_

- 4 (a) (ii) Find the power of Jane's hypothesis test, giving your answer to three decimal places.

**[2 marks]**

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Answer \_\_\_\_\_

- 4 (b) State the critical region of Jane's hypothesis test.

**[1 mark]**

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Answer \_\_\_\_\_

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Turn over ►



5

Huang is investigating the weekly household income in a country.

In this country, the weekly household income has a normal distribution.

Huang takes a random sample of 5 households.

Their weekly household income, in dollars, was recorded in a particular week in 2008 and then recorded again in 2018 in the corresponding week.

The results are shown in the following table.

Household	2008 (\$)	2018 (\$)
A	600	610
B	597	600
C	602	602
D	605	603
E	598	598

Huang claims that the mean weekly household income in 2018 has not changed compared with the mean weekly household income in 2008

Test Huang's claim, using the 10% level of significance.

**[11 marks]**

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7 The random variables  $B_i$   $\{i = 1, 2, \dots, k\}$  are independent and each have a binomial distribution with parameters  $n$  and  $p$

7 (a) Show that the random variable  $R = \frac{B_1}{n}$  is an unbiased estimator of  $p$

[2 marks]

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7 (b) Show that the random variable  $T = \frac{1}{kn} \sum_{i=1}^k B_i$  is a consistent estimator.

[4 marks]

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**8** Each of the random variables  $X_i$   $\{i = 1, 2, \dots, n\}$  has an exponential distribution with parameter  $\lambda$

**8 (a)** Show that the moment generating function of  $X_i$  is given by

$$M_{X_i}(t) = \left(1 - \frac{t}{\lambda}\right)^{-1} \quad \text{where } t < \lambda$$

**[4 marks]**

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**8 (b)** The random variable  $X$  satisfies

$$X = \sum_{i=1}^n X_i \quad \text{where } X_i \text{ and } X_j \text{ are independent for } i \neq j$$

Using moment generating functions, find  $\text{Var}(X)$

**[7 marks]**

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8 (c) The random variable  $Y$  is such that  $Y = 2\lambda X$  where  $\lambda$  is a constant

8 (c) (i) Find  $E(Y)$

[2 marks]

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Answer \_\_\_\_\_

8 (c) (ii) Find  $\text{Var}(Y)$

[2 marks]

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Answer \_\_\_\_\_

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END OF QUESTIONS



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