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I declare this is my own work.

# INTERNATIONAL A-LEVEL FURTHER MATHEMATICS

(9665/FM04) Unit FS2 Statistics

Monday 12 January 2026

07:00 UK Time

Time allowed: 1 hour 30 minutes

## Materials

- For this paper you must have the OxfordAQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphical 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                  |      |
| <b>TOTAL</b>       |      |



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

- 1** A student is studying the maximum daily temperature recorded in a town in the month of April.

A random sample of 300 maximum daily temperatures is taken from data collected by an organisation that studies the weather.

The sample mean is  $22.6^{\circ}\text{C}$

The population variance of the maximum daily temperatures is known to be  $1.3^{\circ}\text{C}$

- 1 (a)** Construct a 93% confidence interval for the population mean maximum daily temperature.

Give your values to two decimal places.

**[3 marks]**

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Answer \_\_\_\_\_

- 1 (b)** The student claims that the population mean maximum daily temperature is  $22.8^{\circ}\text{C}$

Explain whether the confidence interval found in **part (a)** supports the student's claim.

**[2 marks]**

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**[3 marks]**

[illegible]

$n =$  \_\_\_\_\_

8

**Turn over ►**



Mork and Ellen are taking measurements in a physics experiment.

Unbiased estimates of the population variances are calculated using the samples.

### Figure 1

| Sample | Sample size | Unbiased estimate of population variance |
|--------|-------------|------------------------------------------|
| Mork   | 12          | 6.2                                      |
| Ellen  | 10          | 3.1                                      |

Test Mork's claim using the 2% level of significance.

**[6 marks]**

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**6**

**Turn over for the next question**

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Populations  $X$  and  $Y$  are independent.

A random sample of size 21 is taken from population  $Y$  and has sample mean 22

$$H_1: \mu_Y - \mu_X > k$$

The result of this hypothesis test is to reject the null hypothesis.

**[5 marks]**

[illegible]
$$k =$$


A second hypothesis test is carried out using the same random samples and hypotheses at the 1% level of significance.

**[4 marks]**

[illegible]

9

**Turn over for the next question**

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- 4** A government is studying households that own a pet in its three main cities: *A*, *B* and *C*. They take random samples of households in each of the three cities. The results are shown in **Figure 2**

**Figure 2**

|          | Observed Frequencies            |                                    |
|----------|---------------------------------|------------------------------------|
| City     | Number of households with a pet | Number of households without a pet |
| <i>A</i> | 31                              | 29                                 |
| <i>B</i> | 60                              | 30                                 |
| <i>C</i> | 9                               | 1                                  |

The government claims that there is an association between the city that a household is in and whether the household has a pet.

- 4 (a)** Calculate the expected frequencies to complete the contingency table in **Figure 3** [2 marks]

**Figure 3**

|          | Expected Frequencies            |                                    |
|----------|---------------------------------|------------------------------------|
| City     | Number of households with a pet | Number of households without a pet |
| <i>A</i> |                                 |                                    |
| <i>B</i> |                                 |                                    |
| <i>C</i> |                                 |                                    |

- 4 (b)** Explain why the data for two of the cities must be combined.

[1 mark]

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**[8 marks]**

[illegible]

A random sample of 13 employees is taken from company  $J$  and a random sample of 15 employees is taken from company  $K$  and their job happiness scores are recorded.

The results are given in **Figure 4**

| Company | Sample size | $\bar{x}$ | $s^2$ |
|---------|-------------|-----------|-------|
| $J$     | 13          | 95.2      | 9.2   |
| $K$     | 15          | 93.3      | 9.1   |

State any assumptions that you make.

**[10 marks]**

[illegible]

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**Turn over for the next question**

**6** A population has mean  $\mu$  and variance  $\sigma^2$

A random sample of size  $n$  is taken from the population and has mean  $\bar{X}$

A second population has mean  $a\mu$  and variance  $b\sigma^2$  where  $a$  and  $b$  are positive constants.

A random sample also of size  $n$  is taken from this second population and has mean  $\bar{Y}$

The two populations are independent.

The pooled estimator  $T$  is given by

$$T = 3\bar{X} - 5\bar{Y}$$

$T$  is an unbiased estimator of  $\mu$

**6 (a)** Show that  $a = \frac{2}{5}$

**[2 marks]**

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**6 (b)** Determine whether  $T$  is a consistent estimator of  $\mu$

**[2 marks]**

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**6 (c) (i)** Explain which of  $T$  or  $\bar{X}$  is the more efficient estimator of  $\mu$

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**[3 marks]**

[illegible]
$$b =$$

8



**7**

### Figure 5

| Value of coin | Frequency |
|---------------|-----------|
| 1 dollar      | 50        |
| 50 cents      | 30        |
| 20 cents      | 20        |

There are 100 cents in 1 dollar.

A coin is selected at random from the bag.

The value of the coin,  $X_1$  dollars, is recorded and the coin is replaced.

A second coin is selected at random from the bag and its value,  $X_2$  dollars, is recorded.

Find the sampling distribution of  $D$  dollars where  $D = |X_1 - X_2|$

**[7 marks]**

[illegible]

[illegible]

Answer \_\_\_\_\_

**Turn over for the next question**

7

**Turn over ►**



**8 (a)** Show that  $M_{X_i}(t)$ , the moment generating function of  $X_i$ , is given by

$$M_{X_i}(t) = 1 - p + pe^t$$

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The random variable  $X = X_1 + X_2 + \dots + X_n$

The random variable  $Y$  has moment generating function  $M_Y(t) = (pe^t + 1 - p)^n$

**[3 marks]**

[illegible]

**[8 marks]**

[illegible]

**[1 mark]**

Answer

It is given that the mean number of faulty boxes produced per hour by the machine has changed to 8

**[5 marks]**

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- 9 (b)** Explain how the power of the hypothesis test would change if the mean number of faulty boxes produced per hour was greater than 8

**[3 marks]**

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**END OF QUESTIONS**



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