

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International Advanced Level

Tuesday 13 June 2023

Morning (Time: 1 hour 30 minutes) **Paper reference** **WST03/01**

Mathematics

International Advanced Subsidiary/Advanced Level

Statistics S3

You must have:
Mathematical Formulae and Statistics Tables (Yellow), calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Values from the statistical tables should be quoted in full. If a calculator is used instead of the tables, the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ►

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1. (a) State two conditions under which it might be more appropriate to use Spearman's rank correlation coefficient rather than the product moment correlation coefficient.

(2)

A random sample of 10 melons was taken from a market stall. The length, in centimetres, and maximum diameter, in centimetres, of each melon were recorded.

The Spearman's rank correlation coefficient between the results was -0.673

- (b) Test, at the 5% level of significance, whether or not there is evidence of a correlation. State clearly your hypotheses and the critical value used.

(4)

The product moment correlation coefficient between the results was -0.525

- (c) Test, at the 5% level of significance, whether or not there is evidence of a **negative** correlation.
State clearly your hypotheses and the critical value used.

(3)

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(Total for Question 1 is 9 marks)

2. A business accepts cash, bank cards or mobile apps as payment methods.

The manager wishes to test whether or not there is an association between the payment amount and the payment method used.

The manager takes a random sample of 240 payments and records the payment amount and the payment method used.

The manager's results are shown in the table.

		Payment amount		
		Under £50	£50 to £150	Over £150
Payment method	Cash	23	19	18
	Bank card	21	32	31
	Mobile app	16	39	41

Using these results,

- (a) calculate the expected frequencies for the payment amount under £50 that

- (i) use cash
- (ii) use a bank card
- (iii) use a mobile app

(3)

Given that for the other 6 classes $\sum \frac{(O - E)^2}{E} = 2.4048$ to 4 decimal places,

- (b) test, at the 5% level of significance, whether or not there is evidence for an association between the payment amount and the payment method used.
You should state the hypotheses, the test statistic, the degrees of freedom and the critical value used for this test.

(7)



Question 2 continued

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(Total for Question 2 is 10 marks)

3. A random sample of 2 observations, X_1 and X_2 , is taken from a population with unknown mean μ and unknown variance σ^2

(a) Explain why $\frac{X_1 - X_2}{\sigma}$ is not a statistic.

(1)

$$S = \frac{3}{5}X_1 + \frac{5}{7}X_2$$

(b) Show that S is a biased estimator of μ

(2)

(c) Hence find the bias, in terms of μ , when S is used as an estimator of μ

(1)

Given that $Y = aX_1 + bX_2$ is an unbiased estimator of μ , where a and b are constants,

(d) find an equation, in terms of a and b , that must be satisfied.

(2)

(e) Using your answer to part (d), show that $\text{Var}(Y) = (2a^2 - 2a + 1)\sigma^2$

(3)

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Question 3 continued

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(Total for Question 3 is 9 marks)

Question 4 continued

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Question 4 continued

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Question 5 continued

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Question 6 continued

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Question 6 continued

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(Total for Question 6 is 13 marks)

7. The random variable X is defined as

$$X = 4A - 3B$$

where A and B are independent and

$$A \sim N(15, 5^2) \quad B \sim N(10, 4^2)$$

(a) Find $P(X < 40)$

(4)

The random variable C is such that $C \sim N(20, \sigma^2)$

The random variables C_1, C_2 and C_3 are independent and each has the same distribution as C

The random variable D is defined as

$$D = \sum_{i=1}^3 C_i$$

Given that $P(A + B + D < 76) = 0.2420$ and that A, B and D are independent,

(b) showing your working clearly, find the standard deviation of C

(6)

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Question 7 continued

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Question 7 continued

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(Total for Question 7 is 10 marks)**TOTAL FOR PAPER IS 75 MARKS**