

Pearson Edexcel Level 3

GCE Further Mathematics

Advanced Subsidiary

Further Statistics 2

Specimen paper

Time: 50 minutes

Paper Reference(s)

8FM0/24

You must have:

Mathematical Formulae and Statistical Tables, calculator

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for 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).
- 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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 4 questions in this section of the paper. The total mark is 40.
- 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.

1. An antiques expert was asked to rank 10 china plates $A, B, C, D, E, F, G, H, I$ and J in order of age. Her order was

$D \ C \ B \ G \ I \ H \ A \ E \ J \ F$

with D being the plate she thinks is the oldest.

The actual ages of the plates, in years, are given in the table below.

| | | | | | | | | | | |
|--------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Plate | A | B | C | D | E | F | G | H | I | J |
| Age | 60 | 120 | 110 | 95 | 25 | 68 | 40 | 75 | 85 | 80 |

Calculate Spearman's rank correlation coefficient between the ages of the plates and the expert's ranks.

(Total 5 marks)

2. Charlie and Diane are trying to model the continuous random variable X .

Charlie suggests modelling the cumulative distribution function of X with $F_C(x)$ where

$$F_C(x) = \begin{cases} 0 & x < 2 \\ \frac{1}{6}(9x - x^2 - 14) & 2 \leq x \leq 5 \\ 1 & x > 5 \end{cases}$$

(a) Explain what is wrong with Charlie's model. (2)

Diane suggests modelling the probability density function of X with $f_D(x)$ where

$$f_D(x) = \begin{cases} k \left(x^2 - 2x + \frac{2}{3} \right) & 2 \leq x \leq 5 \\ 0 & \text{otherwise} \end{cases}$$

where k is a constant.

(b) Find the value of k for Diane's model. (3)

(c) Sketch $f_D(x)$ for Diane's model. (2)

(d) Use algebraic integration on Diane's model to find $E(X)$. (3)

Diane is going to calculate the median of X .

(e) With reference to the shape of your sketch in part (c), state, giving a reason, whether or not she should expect the median of X to be smaller, equal to or greater than $E(X)$. (2)

(Total 12 marks)

3. A piece of string AB is 7 m long. A point P on the string is chosen at random. The random variable X , representing the length AP , has a continuous uniform distribution over the interval $[0, 7]$.

A rectangle is formed with length AP and width BP .

Find the expected area of the rectangle.

(Total 6 marks)

4. Naasir is studying the hearing function of workers in his factory. He takes a random sample of 10 workers from his factory. He records their hearing function as a percentage, h , where 100% indicates perfect hearing. He also records the number of years they have worked in the factory, w .

The results are summarised below.

$$\bar{h} = 86.5 \quad \bar{w} = 10.5 \quad S_{hh} = 198.5 \quad S_{ww} = 470.5 \quad r = -0.620$$

- (a) Stating your hypotheses clearly and using a 5% level of significance, test whether or not there is evidence of a negative correlation between hearing function and the number of years worked in Naasir's factory. (3)
- (b) State why your test in part (a) is consistent with the use of a linear regression model to describe the relationship between hearing function and the number of years worked in Naasir's factory. (1)

Naasir wishes to estimate the effect that the number of years spent working in his factory has on the hearing function of his workers. He decides to create a linear regression model.

- (c) Using the above data find Naasir's linear regression model. (6)
- (d) Use this model to estimate the effect on hearing function of working in Naasir's factory for 5 years. (1)
- (e) Calculate the residual sum of squares for this model. (2)

Erica was one of the workers included in the sample. She is 58 years old, has worked in the factory for 10 years and her hearing function is 80%.

- (f) Calculate the residual for Erica's data. (2)

A friend visited Naasir's factory and suggested that all new workers should have an assessment of their hearing function when they start working in his factory.

- (g) (i) State, giving your reasons, a limitation of Naasir's current model.
- (ii) Explain how he could use this extra information to design an improved model. (2)

(Total 17 marks)

TOTAL FOR PAPER IS 40 MARKS