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- (a) Calculate Spearman's rank correlation coefficient for these data. (4)
- (b) Stating your hypotheses clearly, test at the 1% level of significance, whether or not the two judges are generally in agreement. (4)
- (c) Give a reason to support the use of Spearman's rank correlation coefficient in this case. (1)

Spearman's rank correlation coefficient for their ranks on the beam was found to be 0.952

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- This image shows a single 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.

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**Question 5 continued**

**(Total for Question 5 is 10 marks)**

6. The continuous random variable  $X$  has probability density function

$$f(x) = \begin{cases} \frac{1}{18}(11 - 2x) & 1 \leq x \leq 4 \\ 0 & \text{otherwise} \end{cases}$$

- (a) Find  $P(X < 3)$  (2)
- (b) State, giving a reason, whether the upper quartile of  $X$  is greater than 3, less than 3 or equal to 3 (1)

Given that  $E(X) = \frac{9}{4}$

- (c) use algebraic integration to find  $\text{Var}(X)$  (3)

The cumulative distribution function of  $X$  is given by

$$F(x) = \begin{cases} 0 & x < 1 \\ \frac{1}{18}(11x - x^2 + c) & 1 \leq x \leq 4 \\ 1 & x > 4 \end{cases}$$

- (d) Show that  $c = -10$  (2)
- (e) Find the median of  $X$ , giving your answer to 3 significant figures. (3)

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## Question 6 continued

**Question 6 continued**

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**Question 6 continued**

**(Total for Question 6 is 11 marks)**

7. A scientist wants to develop a model to describe the relationship between the average daily temperature,  $x^{\circ}\text{C}$ , and a household's daily energy consumption,  $y\text{kWh}$ , in winter.

A random sample of the average temperature and energy consumption are taken from 10 winter days and are summarised below.

$$\sum x = 12 \quad \sum x^2 = 24.76 \quad \sum y = 251 \quad \sum y^2 = 6341 \quad \sum xy = 284.8$$

$$S_{xx} = 10.36 \quad S_{yy} = 40.9$$

- (a) Find the product moment correlation coefficient between  $y$  and  $x$ . (2)
- (b) Find the equation of the regression line of  $y$  on  $x$  in the form  $y = a + bx$  (3)
- (c) Use your equation to estimate the daily energy consumption when the average daily temperature is  $2^{\circ}\text{C}$  (1)
- (d) Calculate the residual sum of squares (RSS). (2)

The table shows the residual for each value of  $x$ .

|                 |       |       |       |       |      |      |      |      |     |       |
|-----------------|-------|-------|-------|-------|------|------|------|------|-----|-------|
| $x$             | -0.4  | -0.2  | 0.3   | 0.8   | 1.1  | 1.4  | 1.8  | 2.1  | 2.5 | 2.6   |
| <b>Residual</b> | -0.63 | -0.32 | -0.52 | -0.73 | 0.74 | 2.22 | 1.84 | 0.32 | $f$ | -1.88 |

- (e) Find the value of  $f$ . (2)
- (f) By considering the signs of the residuals, explain whether or not the linear regression model is a suitable model for these data. (1)

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**Question 7 continued**

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**Question 7 continued**

**(Total for Question 7 is 11 marks)**

8. The continuous random variable  $X$  is uniformly distributed over the interval  $[-3, 5]$ .

(a) Sketch the probability density function  $f(x)$  of  $X$ .

(2)

(b) Find the value of  $k$  such that  $P(X < 2[k - X]) = 0.25$

(3)

(c) Use algebraic integration to show that  $E(X^3) = 17$

(3)

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### Question 8 continued

**Question 8 continued**

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**(Total for Question 8 is 8 marks)**

**TOTAL FOR SECTION B IS 40 MARKS**  
**TOTAL FOR PAPER IS 80 MARKS**