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**Wednesday 8 June 2016 – Morning****AS GCE MATHEMATICS****4732/01** Probability & Statistics 1**QUESTION PAPER**

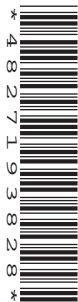
Candidates answer on the Printed Answer Book.

**OCR supplied materials:**

- Printed Answer Book 4732/01
- List of Formulae (MF1)

**Other materials required:**

- Scientific or graphical calculator

**Duration:** 1 hour 30 minutes**INSTRUCTIONS TO CANDIDATES**

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** If additional space is required, you should use the lined page(s) at the end of the Printed Answer Book. The question number(s) must be clearly shown.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

**INFORMATION FOR CANDIDATES**

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets [ ] at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **8** pages. Any blank pages are indicated.

**INSTRUCTION TO EXAMS OFFICER/INVIGILATOR**

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Answer **all** the questions.

- 1 The table shows the probability distribution of a random variable  $X$ .

$x$	1	2	3	4
$P(X=x)$	0.1	0.3	0.4	0.2

- (i) Find  $E(X)$  and  $\text{Var}(X)$ . [5]
- (ii) Three values of  $X$  are chosen at random. Find the probability that  $X$  takes the value 2 at least twice. [3]
- 2 (i) The table shows the amount,  $x$ , in hundreds of pounds, spent on heating and the number of absences,  $y$ , at a factory during each month in 2014.

Amount, $x$ , spent on heating (£ hundreds)	21	23	19	15	14	5	2	10	9	20	18	23
Number of absences, $y$	23	25	18	18	12	10	4	9	11	15	20	26

$$n = 12 \quad \Sigma x = 179 \quad \Sigma x^2 = 3215 \quad \Sigma y = 191 \quad \Sigma y^2 = 3565 \quad \Sigma xy = 3343$$

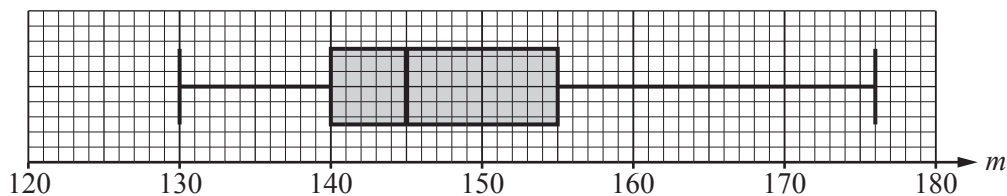
- (a) Calculate  $r$ , the product moment correlation coefficient, showing that  $r > 0.92$ . [3]
- (b) A manager says, 'The value of  $r$  shows that spending more money on heating causes more absences, so we should spend less on heating.' Comment on this claim. [1]
- (ii) The months in 2014 were numbered 1, 2, 3, ..., 12. The output,  $z$ , in suitable units was recorded along with the month number,  $n$ , for each month in 2014. The equation of the regression line of  $z$  on  $n$  was found to be  $z = 0.6n + 17$ .
- (a) Use this equation to explain whether output generally increased or decreased over these months. [1]
- (b) Find the mean of  $n$  and use the equation of the regression line to calculate the mean of  $z$ . [3]
- (c) Hence calculate the total output in 2014. [2]

- 3 The masses,  $m$  grams, of 52 apples of a certain variety were found and summarised as follows.

$$n = 52 \quad \Sigma(m - 150) = -182 \quad \Sigma(m - 150)^2 = 1768$$

- (i) Find the mean and variance of the masses of these 52 apples. [5]
- (ii) Use your answers from part (i) to find the exact value of  $\Sigma m^2$ . [3]

The masses of the apples are illustrated in the box-and-whisker plot below.



- (iii) How many apples have masses in the interval  $130 \leq m < 140$ ? [2]
- (iv) An 'outlier' is a data item that lies more than 1.5 times the interquartile range above the upper quartile, or more than 1.5 times the interquartile range below the lower quartile. Explain whether any of the masses of these apples are outliers. [3]

- 4 In this question the product moment correlation coefficient is denoted by  $r$  and Spearman's rank correlation coefficient is denoted by  $r_s$ .

(i) The scatter diagram in Fig. 1 shows the results of an experiment involving some bivariate data.

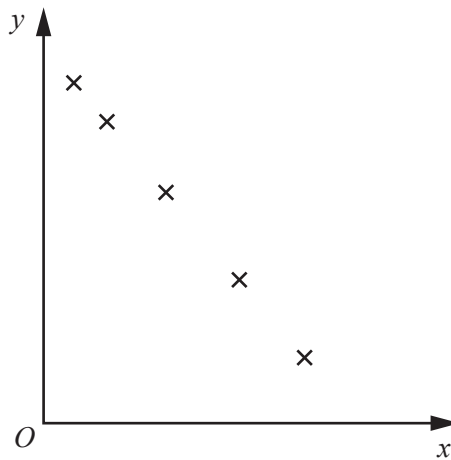


Fig. 1

Write down the value of  $r_s$  for these data. [1]

(ii) On the diagram in the Answer Booklet, draw five points such that  $r_s = 1$  and  $r \neq 1$ . [2]

(iii) The scatter diagram in Fig. 2 shows the results of another experiment involving 5 items of bivariate data.

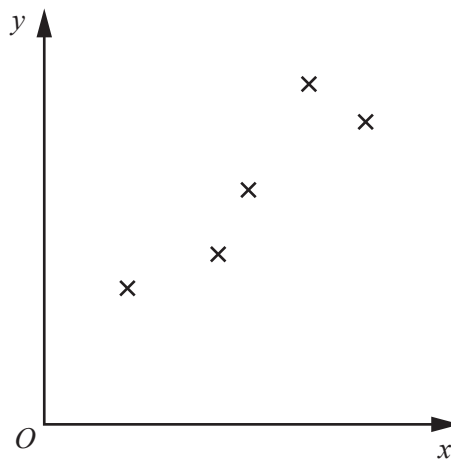


Fig. 2

Calculate the value of  $r_s$ . [5]

- 5 (i) A random variable  $X$  has the distribution  $B(25, 0.6)$ . Find
- (a)  $P(X \leq 14)$ , [1]
- (b)  $P(X = 14)$ , [2]
- (c)  $\text{Var}(X)$ . [2]
- (ii) A random variable  $Y$  has the distribution  $B(24, 0.3)$ . Write down an expression for  $P(Y = y)$  and evaluate this probability in the case where  $y = 8$ . [2]
- (iii) A random variable  $Z$  has the distribution  $B(2, 0.2)$ . Find the probability that two randomly chosen values of  $Z$  are equal. [3]
- 6 (a) Find the number of ways in which 12 people can be divided into three groups containing 5 people, 4 people and 3 people, without regard to order. [3]
- (b) The diagram shows 7 cards, each with a letter on it.



The 7 cards are arranged in a random order in a straight line.

- (i) Find the number of possible arrangements of the 7 letters. [2]
- (ii) Find the probability that the 7 letters form the name BARBARA. [1]

The 7 cards are shuffled. Now 4 of the 7 cards are chosen at random and arranged in a random order in a straight line.

- (iii) Find the probability that the letters form the word ABBA. [3]

- 7 On average Marie scores a goal on 20% of her shots. The variable random  $X$  is the number of shots Marie takes, up to and including her first goal.
- (i) State two conditions needed for  $X$  to have a geometric distribution. [2]
- (ii) Assuming these conditions are satisfied, find the probability that
- (a)  $X = 3$ , [2]
- (b)  $X < 10$ , [2]
- (c)  $9 < X < 20$ . [3]

The probability that Nadine scores a goal on any shot is 0.3. Marie and Nadine independently take shots in turn, with Marie shooting first. The winner is the first one to score two goals.

- (iii) Find the probability that
- (a) Marie wins on her second shot, [2]
- (b) Nadine wins on her second shot. [3]

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