

**Monday 28 January 2013 – Morning**

**AS GCE MATHEMATICS**

**4732/01** Probability and 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 in the centre of 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.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- 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**.
- This 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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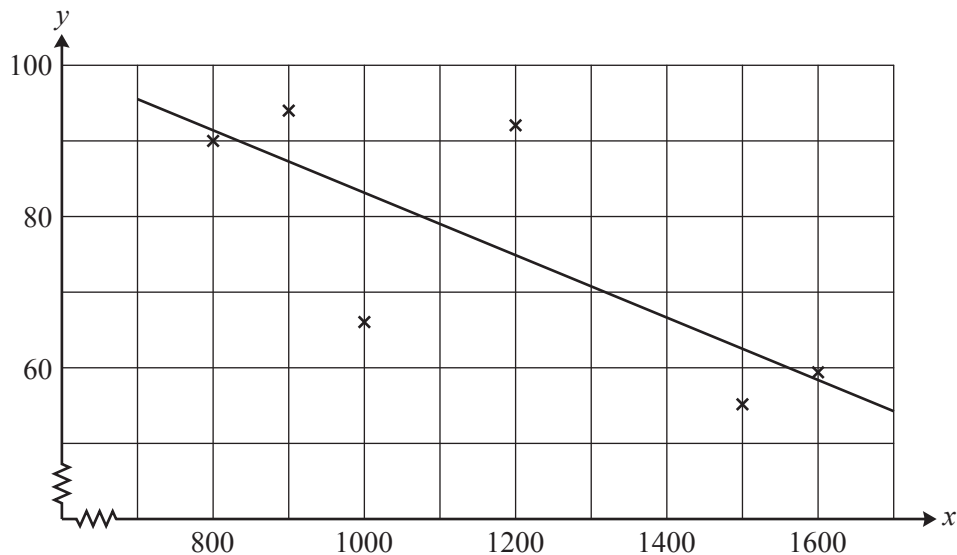
- 1 When a four-sided spinner is spun, the number on which it lands is denoted by  $X$ , where  $X$  is a random variable taking values 2, 4, 6 and 8. The spinner is biased so that  $P(X = x) = kx$ , where  $k$  is a constant.
- (i) Show that  $P(X = 6) = \frac{3}{10}$ . [2]
- (ii) Find  $E(X)$  and  $\text{Var}(X)$ . [5]
- 2 (i) Kathryn is allowed three attempts at a high jump. If she succeeds on any attempt, she does not jump again. The probability that she succeeds on her first attempt is  $\frac{3}{4}$ . If she fails on her first attempt, the probability that she succeeds on her second attempt is  $\frac{3}{8}$ . If she fails on her first two attempts, the probability that she succeeds on her third attempt is  $\frac{3}{16}$ . Find the probability that she succeeds. [3]
- (ii) Khaled is allowed two attempts to pass an examination. If he succeeds on his first attempt, he does not make a second attempt. The probability that he passes at the first attempt is 0.4 and the probability that he passes on either the first or second attempt is 0.58. Find the probability that he passes on the second attempt, given that he failed on the first attempt. [3]

- 3 The Gross Domestic Product per Capita (GDP),  $x$  dollars, and the Infant Mortality Rate per thousand (IMR),  $y$ , of 6 African countries were recorded and summarised as follows.

$$n = 6 \quad \Sigma x = 7000 \quad \Sigma x^2 = 8\,700\,000 \quad \Sigma y = 456 \quad \Sigma y^2 = 36\,262 \quad \Sigma xy = 509\,900$$

- (i) Calculate the equation of the regression line of  $y$  on  $x$  for these 6 countries. [4]

The original data were plotted on a scatter diagram and the regression line of  $y$  on  $x$  was drawn, as shown below.



- (ii) The GDP for another country, Tanzania, is 1300 dollars. Use the regression line in the diagram to estimate the IMR of Tanzania. [1]
- (iii) The GDP for Nigeria is 2400 dollars. Give two reasons why the regression line is unlikely to give a reliable estimate for the IMR for Nigeria. [2]
- (iv) The actual value of the IMR for Tanzania is 96. The data for Tanzania ( $x = 1300$ ,  $y = 96$ ) is now included with the original 6 countries. Calculate the value of the product moment correlation coefficient,  $r$ , for all 7 countries. [4]
- (v) The IMR is now redefined as the infant mortality rate per hundred instead of per thousand, and the value of  $r$  is recalculated for all 7 countries. Without calculation state what effect, if any, this would have on the value of  $r$  found in part (iv). [1]

- 4 (i) How many different 3-digit numbers can be formed using the digits 1, 2 and 3 when
- no repetitions are allowed, [1]
  - any repetitions are allowed, [2]
  - each digit may be included at most twice? [2]
- (ii) How many different 4-digit numbers can be formed using the digits 1, 2 and 3 when each digit may be included at most twice? [5]

5 A random variable  $X$  has the distribution  $B(5, \frac{1}{4})$ .

(i) Find

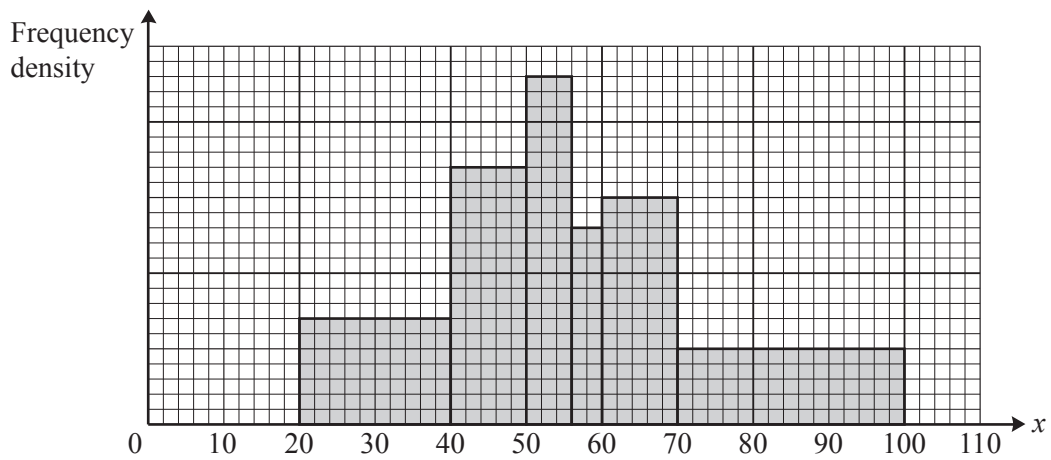
(a)  $E(X)$ , [1]

(b)  $P(X = 2)$ . [2]

(ii) Two values of  $X$  are chosen at random. Find the probability that their sum is less than 2. [4]

(iii) 10 values of  $X$  are chosen at random. Use an appropriate formula to find the probability that exactly 3 of these values are 2s. [3]

6 The masses,  $x$  grams, of 800 apples are summarised in the histogram.



(i) On the frequency density axis, 1 cm represents  $a$  units. Find the value of  $a$ . [3]

(ii) Find an estimate of the median mass of the apples. [4]

- 7 (i) Two judges rank  $n$  competitors, where  $n$  is an even number. Judge 2 reverses each consecutive pair of ranks given by Judge 1, as shown.

Competitor	$C_1$	$C_2$	$C_3$	$C_4$	$C_5$	$C_6$	.....	$C_{n-1}$	$C_n$
Judge 1 rank	1	2	3	4	5	6	.....	$n-1$	$n$
Judge 2 rank	2	1	4	3	6	5	.....	$n$	$n-1$

Given that the value of Spearman's coefficient of rank correlation is  $\frac{63}{65}$ , find  $n$ . [4]

- (ii) An experiment produced some data from a bivariate distribution. The product moment correlation coefficient is denoted by  $r$ , and Spearman's rank correlation coefficient is denoted by  $r_s$ .

- (a) Explain whether the statement

$$r = 1 \Rightarrow r_s = 1$$

is true or false.

[1]

- (b) Use a diagram to explain whether the statement

$$r \neq 1 \Rightarrow r_s \neq 1$$

is true or false.

[2]

- 8 Sandra makes repeated, independent attempts to hit a target. On each attempt, the probability that she succeeds is 0.1.

- (i) Find the probability that

- (a) the first time she succeeds is on her 5th attempt, [2]  
 (b) the first time she succeeds is after her 5th attempt, [2]  
 (c) the second time she succeeds is before her 4th attempt. [4]

Jill also makes repeated attempts to hit the target. Each attempt of either Jill or Sandra is independent. Each time that Jill attempts to hit the target, the probability that she succeeds is 0.2. Sandra and Jill take turns attempting to hit the target, with Sandra going first.

- (ii) Find the probability that the first person to hit the target is Sandra, on her

- (a) 2nd attempt, [2]  
 (b) 10th attempt. [3]

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