

**ADVANCED SUBSIDIARY GCE**  
**MATHEMATICS**  
Probability & Statistics 1

**4732**

Candidates answer on the Answer Booklet

**OCR Supplied Materials:**

- 8 page Answer Booklet
- List of Formulae (MF1)

**Other Materials Required:**

None

**Monday 15 June 2009**  
**Afternoon**

**Duration:** 1 hour 30 minutes



**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- 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.
- You are permitted to use a graphical calculator in this paper.

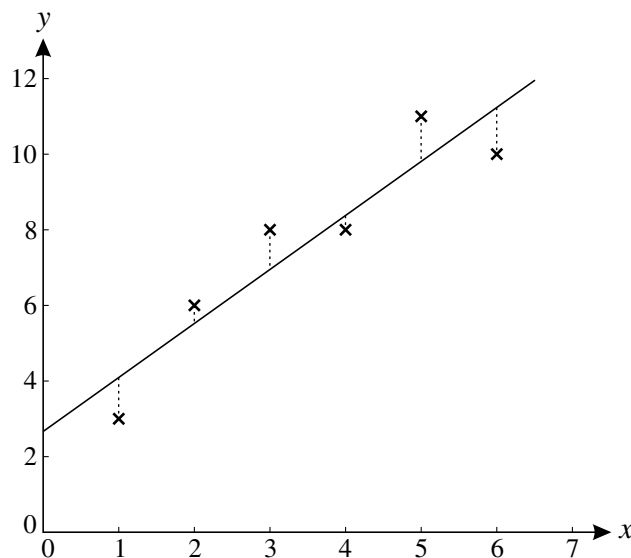
**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- This document consists of **4** pages. Any blank pages are indicated.

- 1 20% of packets of a certain kind of cereal contain a free gift. Jane buys one packet a week for 8 weeks. The number of free gifts that Jane receives is denoted by  $X$ . Assuming that Jane's 8 packets can be regarded as a random sample, find
- (i)  $P(X = 3)$ , [3]
- (ii)  $P(X \geq 3)$ , [2]
- (iii)  $E(X)$ . [2]
- 2 Two judges placed 7 dancers in rank order. Both judges placed dancers  $A$  and  $B$  in the first two places, but in opposite orders. The judges agreed about the ranks for all the other 5 dancers. Calculate the value of Spearman's rank correlation coefficient. [4]
- 3 In an agricultural experiment, the relationship between the amount of water supplied,  $x$  units, and the yield,  $y$  units, was investigated. Six values of  $x$  were chosen and for each value of  $x$  the corresponding value of  $y$  was measured. The results are shown in the table.

$x$	1	2	3	4	5	6
$y$	3	6	8	8	11	10

These results, together with the regression line of  $y$  on  $x$ , are plotted on the graph.



- (i) Give a reason why the regression line of  $x$  on  $y$  is not suitable in this context. [1]
- (ii) Explain the significance, for the regression line of  $y$  on  $x$ , of the distances shown by the vertical dotted lines in the diagram. [2]
- (iii) Calculate the value of the product moment correlation coefficient,  $r$ . [3]
- (iv) Comment on your value of  $r$  in relation to the diagram. [2]

- 4 30% of people own a Talk-2 phone. People are selected at random, one at a time, and asked whether they own a Talk-2 phone. The number of people questioned, up to and including the first person who owns a Talk-2 phone, is denoted by  $X$ . Find

(i)  $P(X = 4)$ , [3]

(ii)  $P(X > 4)$ , [2]

(iii)  $P(X < 6)$ . [3]

- 5 The diameters of 100 pebbles were measured. The measurements rounded to the nearest millimetre,  $x$ , are summarised in the table.

$x$	$10 \leq x \leq 19$	$20 \leq x \leq 24$	$25 \leq x \leq 29$	$30 \leq x \leq 49$
Number of stones	25	22	29	24

These data are to be presented on a statistical diagram.

- (i) For a histogram, find the frequency density of the  $10 \leq x \leq 19$  class. [2]

- (ii) For a cumulative frequency graph, state the coordinates of the first two points that should be plotted. [2]

- (iii) Why is it not possible to draw an exact box-and-whisker plot to illustrate the data? [1]

- 6 Last year Eleanor played 11 rounds of golf. Her scores were as follows:

79, 71, 80, 67, 67, 74, 66, 65, 71, 66, 64.

- (i) Calculate the mean of these scores and show that the standard deviation is 5.31, correct to 3 significant figures. [4]

- (ii) Find the median and interquartile range of the scores. [4]

This year, Eleanor also played 11 rounds of golf. The standard deviation of her scores was 4.23, correct to 3 significant figures, and the interquartile range was the same as last year.

- (iii) Give a possible reason why the standard deviation of her scores was lower than last year although her interquartile range was unchanged. [1]

In golf, smaller scores mean a better standard of play than larger scores. Ken suggests that since the standard deviation was smaller this year, Eleanor's overall standard has improved.

- (iv) Explain why Ken is wrong. [1]

- (v) State what the smaller standard deviation does show about Eleanor's play. [1]

[Questions 7, 8 and 9 are printed overleaf.]

7 Three letters are selected at random from the 8 letters of the word COMPUTER, without regard to order.

(i) Find the number of possible selections of 3 letters. [2]

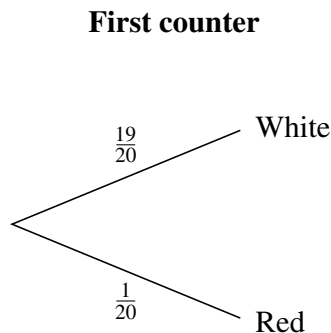
(ii) Find the probability that the letter P is included in the selection. [3]

Three letters are now selected at random, one at a time, from the 8 letters of the word COMPUTER, and are placed in order in a line.

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

8 A game at a charity event uses a bag containing 19 white counters and 1 red counter. To play the game once a player takes counters at random from the bag, one at a time, without replacement. If the red counter is taken, the player wins a prize and the game ends. If not, the game ends when 3 white counters have been taken. Niko plays the game once.

(i) (a) Copy and complete the tree diagram showing the probabilities for Niko. [4]



(b) Find the probability that Niko will win a prize. [3]

(ii) The number of counters that Niko takes is denoted by  $X$ .

(a) Find  $P(X = 3)$ . [2]

(b) Find  $E(X)$ . [4]

9 Repeated independent trials of a certain experiment are carried out. On each trial the probability of success is 0.12.

(i) Find the smallest value of  $n$  such that the probability of at least one success in  $n$  trials is more than 0.95. [3]

(ii) Find the probability that the 3rd success occurs on the 7th trial. [5]

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# 4732 Probability & Statistics 1

1			Q1: if consistent “0.8” incorrect or $1/8, 7/8$ or 0.02 allow M marks in ii, iii & 1 <sup>st</sup> M1 in i
i	Binomial stated  $0.9437 - 0.7969$ or ${}^8C_3 \times 0.2^3 \times 0.8^5$ $= 0.147$ (3 sfs)	M1  M1 A1 3	or implied by use of tables or ${}^8C_3$ or $0.2^a \times 0.8^b$ ( $a+b = 8$ )
ii	$1 - 0.7969$  $= 0.203$ (3 sf)	M1  A1 2	allow $1 - 0.9437$ or 0.056(3) or equiv using formula
iii	$8 \times 0.2$ oe 1.6	M1 A1 2	$8 \times 0.2 = 2$ M1A0 $1.6 \div 8$ or $1/1.6$ M0A0
Total		<b>7</b>	
2	first two $d$ 's = $\pm 1$ $\Sigma d^2$ attempted (= 2) $1 - \frac{6 \times "2"}{7(7^2 - 1)}$ $= 27/28$ or 0.964 (3 sfs)	B1 M1 M1dep  A1	$S_{xx}$ or $S_{yy} = 28$ B1 $S_{xy} = 27$ B1 $S_{xy} / \sqrt{(S_{xx}S_{yy})}$ M1 dep B1  1234567 & 1276543 (ans $2/7$ ): MR, lose A1
Total		<b>4</b>	
3 i	$x$ independent or controlled or changed  Value of $y$ was measured for each $x$ $x$ not dependent	B1 1	Allow Water affects yield, or yield is dependent or yield not control water supply Not just $y$ is dependent Not $x$ goes up in equal intervals Not $x$ is fixed
ii	(line given by) minimum sum of squs	B1 B1 2	B1 for “minimum” or “least squares” with inadequate or no explanation
iii	$S_{xx} = 17.5$ or 2.92 $S_{yy} = 41.3$ or 6.89 $S_{xy} = 25$ or 4.17 $r = \frac{S_{xy}}{\sqrt{(S_{xx}S_{yy})}}$ $= 0.930$ (3 sf)	B1  M1  A1 3	or $91 - 21^2/6$ or $394 - 46^2/6$ B1 for any one or $186 - 21 \times 46/6$ dep B1  0.929 or 0.93 with or without wking B1M1A0 SC incorrect $n$ : max B1M1A0
iv	Near 1 or lg, high, strong, good corr'n or relnshp oe  Close to st line or line good fit	B1ft  B1 2	$ r $ small: allow little (or no) corr'n oe  Not line accurate. Not fits trend
Total		<b>8</b>	



6i	$\Sigma x \div 11$ $70$ $\Sigma x^2$ attempted $\sqrt{\frac{\Sigma x^2}{11} - \bar{x}^2} = \sqrt{(54210/11 - 70^2)}$ or $\sqrt{28.18}$ or $5.309$ (= 5.31) <b>AG</b>	M1 A1 M1 A1 4	$\geq 5$ terms, or $\Sigma(x - \bar{x})^2$ or $\sqrt{\frac{\Sigma(x - \bar{x})^2}{11}} = \sqrt{310/11}$ or $\sqrt{28.18}$ ie correct substn or result If $\times^{11}/_{10}$ : M1A1M1A0
ii	Attempt arrange in order med = 67 74 and 66 IQR = 8	M1 A1 M1 A1 4	or $(72.5 - 76.5) - (65.5 - 66.5)$ incl must be from 74 – 66
iii	no (or fewer) extremes this year oe sd takes account of all values sd affected by extremes less spread tho' middle 50% same less spread tho' 3 <sup>rd</sup> & 9 <sup>th</sup> same or same gap	B1 1	iii, iv & v: ignore extras fewer high &/or low scores highest score(s) less than last year Not less spread or more consistent Not range less
iv	sd measures spread or variation or consistency oe	B1 1	sd less means spread is less oe or marks are closer together oe
v	more consistent, more similar, closer together, nearer to mean less spread	B1 1	allow less variance Not range less Not highest & lowest closer
<b>Total</b>		<b>11</b>	
7i	${}^8C_3$ $= 56$	M1 A1 2	
ii	${}^7C_2$ or or ${}^7P_2 / {}^8P_3$ $\div ({}^8C_3$ or "56") only $= {}^3/8$	$1/8$ not from incorrect $\times 3$ only or $1/8 + 7/8 \times 1/7 + 7/8 \times 6/7 \times 1/6$	${}^8C_1 + {}^7C_1 + {}^6C_1$ or 21 or $8 \times 7 \times 6$ or $1/8 \times 1/7 \times 1/6$ indep, dep ans < 1 $1 - \text{prod 3 probs}$
iii	${}^8P_3$ or $8 \times 7 \times 6$ or ${}^8C_1 \times {}^7C_1 \times {}^6C_1$ or 336 $1 \div {}^8P_3$ only $= 1/336$ or 0.00298 (3 sf)	M1 M1 A1 3	$1/8 \times 1/7 \times 1/6$ only M2 If $\times$ or $\div$ : M1 $(1/8)^3$ M1
<b>Total</b>		<b>8</b>	

8ia	$\frac{18}{19}$ or $\frac{1}{19}$ seen $\frac{17}{18}$ or $\frac{1}{18}$ seen structure correct ie 6 branches  all correct incl. probs and W & R	B1 B1 B1  B1 4	regardless of probs & labels (or 14 branches with correct 0s & 1s)
b	$\frac{1}{20} + \frac{19}{20} \times \frac{1}{19} + \frac{19}{20} \times \frac{18}{19} \times \frac{1}{18}$  $= \frac{3}{20}$	M2  A1 3	M1 any 2 correct terms added  $\frac{19}{20} \times \frac{18}{19} \times \frac{17}{18}$ $1 - \frac{19}{20} \times \frac{18}{19} \times \frac{17}{18}$
ia	$\frac{19}{20} \times \frac{18}{19}$ $= \frac{9}{10}$ oe	M1 A1 2	$\frac{19}{20} \times \frac{18}{19} \times \frac{1}{18} + \frac{19}{20} \times \frac{18}{19} \times \frac{17}{18}$ or $\frac{1}{20} + \frac{17}{20}$
b	$(P(X=1) = \frac{1}{20})$ $\frac{19}{20} \times \frac{1}{19}$ $= \frac{1}{20}$  $\Sigma xp$ $= \frac{57}{20}$ or 2.85	M1 A1  M1 A1 4	or $1 - (\frac{1}{20} + \frac{9}{10})$ or 2 probs of $\frac{1}{20}$ M1A1  $\geq 2$ terms, ft their $p$ 's if $\Sigma p = 1$  NB: $\frac{19}{20} \times 3 = 2.85$ no mks
ia			With replacement: Original scheme
ib			$\frac{1}{20} + \frac{19}{20} \times \frac{1}{20} + (\frac{19}{20})^2 \times \frac{1}{20}$ or $1 - (\frac{19}{20})^2$ M1
ia			$(\frac{19}{20})^2$ or $(\frac{19}{20})^2 \times \frac{1}{20} + (\frac{19}{20})^2 \times \frac{19}{20}$ M1
b			Original scheme But NB ans 2.85(25...) M1A0M1A0
Total		<b>13</b>	



9i	$(1 - 0.12)^n$ $\frac{\log 0.05}{\log 0.88}$ $n = 24$	or $0.88^{23} = 0.052\dots$ or $0.88^{24} = 0.046\dots$	M1 M1 A1 3	Can be implied by 2 <sup>nd</sup> M1 allow $n - 1$ or $\log_{0.88} 0.05$ or 23.4(...) Ignore incorrect inequ or equals signs
ii	${}^6C_2 \times 0.88^4 \times 0.12^2$  $\times 0.12$ $= 0.0155$	$(= 0.1295\dots)$	M3  M1 A1 5	or $0.88^4 \times 0.12^2$ M2 or ${}^6C_2 \times 0.88^4 \times 0.12^2$ + extra M2  or 2 successes in 6 trials implied or ${}^6C_2$ M1  dep $\geq$ M1  $0.88^4 \times 0.12^2 \times 0.12$ : M2M1 $0.88^4 \times 0.12^3$ M0M0A0 unless clear P(2 success in 6 trials) $\times 0.12$ in which case M2M1A0
Total			<b>8</b>	

**Total 72 marks**