MATHEMATICS   **4732**

Probability & Statistics 1

Thursday	**9 JUNE 2005**	Morning	1 hour 30 minutes

Additional materials:
    Answer booklet
    Graph paper
    List of Formulae (MF1)

TIME   1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

* Write your name, centre number and candidate number in the spaces provided on the answer booklet.

* Answer **all** the questions.

* 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.

* The total number of marks for this paper is 72.

* Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.

* **You are reminded of the need for clear presentation in your answers.**

This question paper consists of 5 printed pages and 3 blank pages.

1 **(i)** Calculate the value of Spearman's rank correlation coefficient between the two sets of rankings, A and B, shown in Table 1. [4]

A	1	2	3	4	5
B	4	1	3	2	5

Table 1

(ii) The value of Spearman's rank correlation coefficient between the set of rankings B and a third set of rankings, C, is known to be -1. Copy and complete Table 2 showing the set of rankings C. [2]

B	4	1	3	2	5
C					

Table 2

2 The probability that a certain sample of radioactive material emits an alpha-particle in one unit of time is 0.14. In one unit of time no more than one alpha-particle can be emitted. The number of units of time up to and including the first in which an alpha-particle is emitted is denoted by T.

(i) Find the value of

(a) $P(T = 5)$, [3]

(b) $P(T < 8)$. [3]

(ii) State the value of $E(T)$. [2]

3 In a supermarket the proportion of shoppers who buy washing powder is denoted by p. 16 shoppers are selected at random.

(i) Given that $p = 0.35$, use tables to find the probability that the number of shoppers who buy washing powder is

(a) at least 8, [3]

(b) between 4 and 9 inclusive. [2]

(ii) Given instead that $p = 0.38$, find the probability that the number of shoppers who buy washing powder is exactly 6. [3]

4   The table shows the latitude, x (in degrees correct to 3 significant figures), and the average rainfall y (in cm correct to 3 significant figures) of five European cities.

City	x	y
Berlin	52.5	58.2
Bucharest	44.4	58.7
Moscow	55.8	53.3
St Petersburg	60.0	47.8
Warsaw	52.3	56.6

$[n = 5,\ \Sigma x = 265.0,\ \Sigma y = 274.6,\ \Sigma x^2 = 14\,176.54,\ \Sigma y^2 = 15\,162.22,\ \Sigma xy = 14\,464.10.]$

(i) Calculate the product moment correlation coefficient. [3]

(ii) The values of y in the table were in fact obtained from measurements in inches and converted into centimetres by multiplying by 2.54. State what effect it would have had on the value of the product moment correlation coefficient if it had been calculated using inches instead of centimetres. [1]

(iii) It is required to estimate the annual rainfall at Bergen, where $x = 60.4$. Calculate the equation of an appropriate line of regression, giving your answer in simplified form, and use it to find the required estimate. [5]

[Turn over

5 The examination marks obtained by 1200 candidates are illustrated on the cumulative frequency graph, where the data points are joined by a smooth curve.

Cumulative frequency
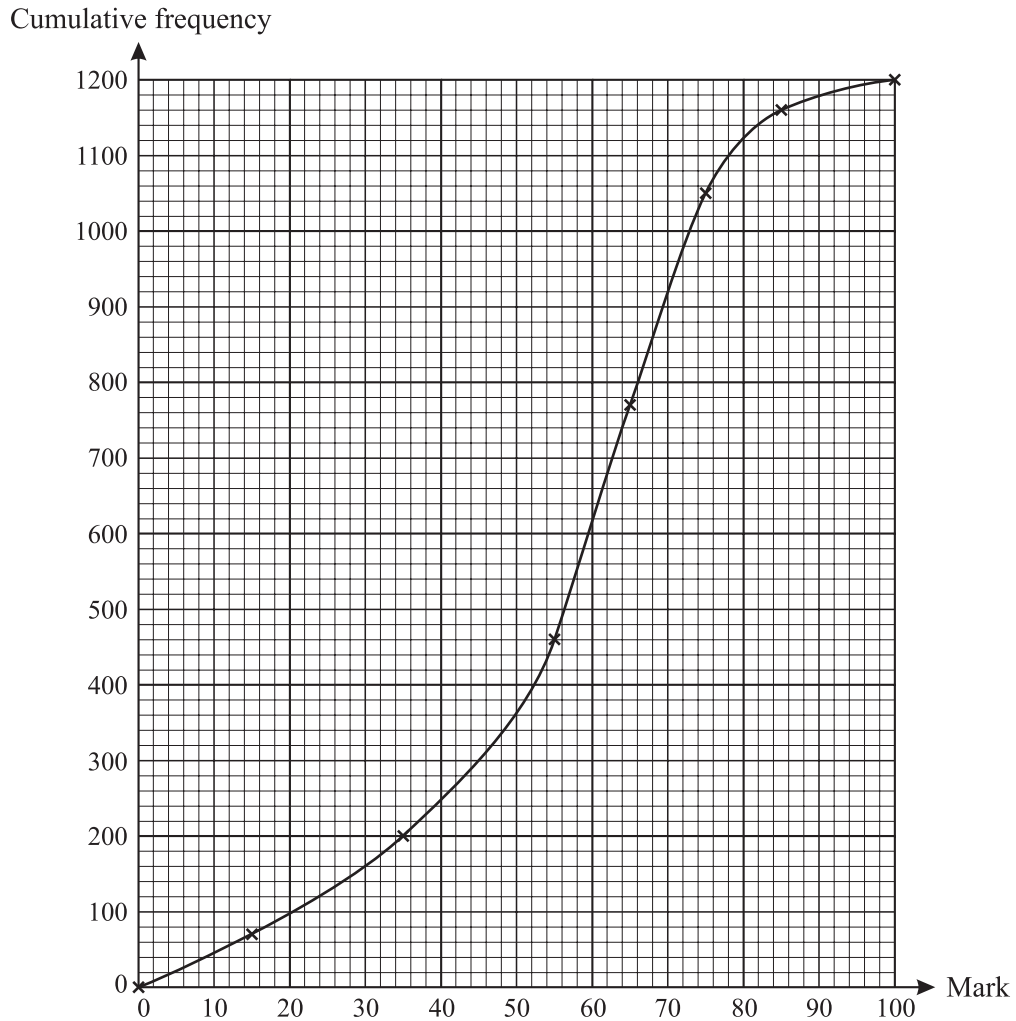
Use the curve to estimate

(i) the interquartile range of the marks, [3]

(ii) x, if 40% of the candidates scored more than x marks, [3]

(iii) the number of candidates who scored more than 68 marks. [2]

Five of the candidates are selected at random, with replacement.

(iv) Estimate the probability that all five scored more than 68 marks. [3]

It is subsequently discovered that the candidates' marks in the range 35 to 55 were evenly distributed — that is, roughly equal numbers of candidates scored 35, 36, 37, …, 55.

(v) What does this information suggest about the estimate of the interquartile range found in part (i)? [2]

6 Two bags contain coloured discs. At first, bag P contains 2 red discs and 2 green discs, and bag Q contains 3 red discs and 1 green disc. A disc is chosen at random from bag P, its colour is noted and it is placed in bag Q. A disc is then chosen at random from bag Q, its colour is noted and it is placed in bag P. A disc is then chosen at random from bag P.

The tree diagram shows the different combinations of three coloured discs chosen.
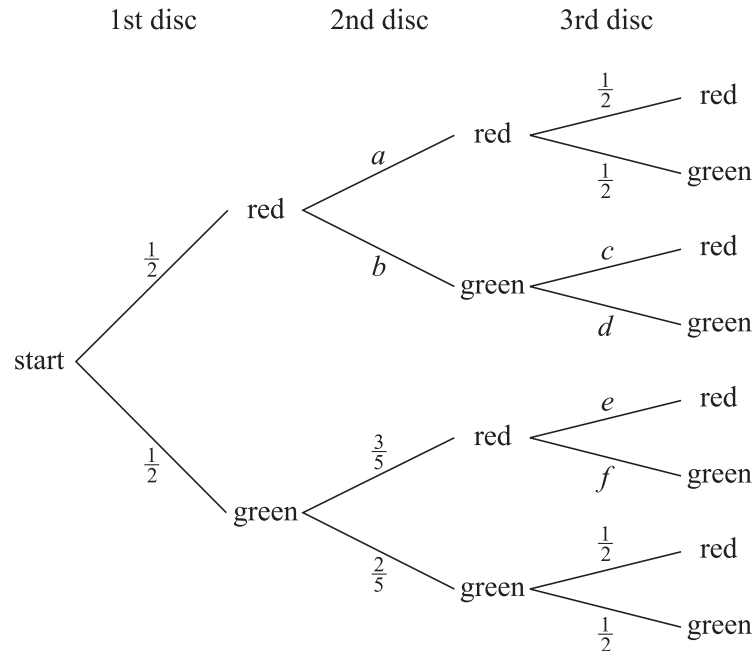
    (i) Write down the values of a, b, c, d, e and f.   [4]

The total number of red discs chosen, out of 3, is denoted by R. The table shows the probability distribution of R.

r	0	1	2	3
$P(R = r)$	$\frac{1}{10}$	k	$\frac{9}{20}$	$\frac{1}{5}$

   (ii) Show how to obtain the value $P(R = 2) = \frac{9}{20}$.   [3]

  (iii) Find the value of k.   [2]

  (iv) Calculate the mean and variance of R.   [5]

7 A committee of 7 people is to be chosen at random from 18 volunteers.

    (i) In how many different ways can the committee be chosen?   [2]

The 18 volunteers consist of 5 people from Gloucester, 6 from Hereford and 7 from Worcester. The committee is to be chosen randomly. Find the probability that the committee will

   (ii) consist of 2 people from Gloucester, 2 people from Hereford and 3 people from Worcester,   [4]

  (iii) include exactly 5 people from Worcester,   [4]

  (iv) include at least 2 people from each of the three cities.   [4]

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