MATHEMATICS   **9709/61**

Paper 6 Probability & Statistics 1 **(S1)**   **October/November 2013**

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
                        Graph Paper
                        List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

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Answer **all** the questions.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

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The total number of marks for this paper is 50.

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[Turn over

1   It is given that $X \sim$ N(30, 49), $Y \sim$ N(30, 16) and $Z \sim$ N(50, 16). On a single diagram, with the horizontal axis going from 0 to 70, sketch three curves to represent the distributions of X, Y and Z.

[3]

2   The people living in two towns, Mumbok and Bagville, are classified by age. The numbers in thousands living in each town are shown in the table below.

	Mumbok	Bagville
Under 18 years	15	35
18 to 60 years	55	95
Over 60 years	20	30

One of the towns is chosen. The probability of choosing Mumbok is 0.6 and the probability of choosing Bagville is 0.4. Then a person is chosen at random from that town. Given that the person chosen is between 18 and 60 years old, find the probability that the town chosen was Mumbok.   [5]

3   Swati measured the lengths, x cm, of 18 stick insects and found that $\Sigma x^2 = 967$. Given that the mean length is $\frac{58}{9}$ cm, find the values of $\Sigma(x - 5)$ and $\Sigma(x - 5)^2$.   [5]

4   The following are the house prices in thousands of dollars, arranged in ascending order, for 51 houses from a certain area.

253 270 310 354 386 428 433 468 472 477 485 520 520 524 526 531 535
536 538 541 543 546 548 549 551 554 572 583 590 605 614 638 649 652
666 670 682 684 690 710 725 726 731 734 745 760 800 854 863 957 986

  (i) Draw a box-and-whisker plot to represent the data.   [4]

An expensive house is defined as a house which has a price that is more than 1.5 times the interquartile range above the upper quartile.

  (ii) For the above data, give the prices of the expensive houses.   [2]

  (iii) Give one disadvantage of using a box-and-whisker plot rather than a stem-and-leaf diagram to represent this set of data.   [1]

5   Lengths of a certain type of carrot have a normal distribution with mean 14.2 cm and standard deviation 3.6 cm.

  (i) 8% of carrots are shorter than c cm. Find the value of c.   [3]

  (ii) Rebekah picks 7 carrots at random. Find the probability that at least 2 of them have lengths between 15 and 16 cm.   [6]

6 A shop has 7 different mountain bicycles, 5 different racing bicycles and 8 different ordinary bicycles on display. A cycling club selects 6 of these 20 bicycles to buy.

   (i) How many different selections can be made if there must be no more than 3 mountain bicycles and no more than 2 of each of the other types of bicycle? [4]

The cycling club buys 3 mountain bicycles, 1 racing bicycle and 2 ordinary bicycles and parks them in a cycle rack, which has a row of 10 empty spaces.

  (ii) How many different arrangements are there in the cycle rack if the mountain bicycles are all together with no spaces between them, the ordinary bicycles are both together with no spaces between them and the spaces are all together? [3]

 (iii) How many different arrangements are there in the cycle rack if the ordinary bicycles are at each end of the bicycles and there are no spaces between any of the bicycles? [3]

7 James has a fair coin and a fair tetrahedral die with four faces numbered 1, 2, 3, 4. He tosses the coin once and the die twice. The random variable X is defined as follows.

- If the coin shows a **head** then X is the **sum** of the scores on the two throws of the die.
- If the coin shows a **tail** then X is the score on the **first throw** of the die only.

   (i) Explain why $X = 1$ can only be obtained by throwing a tail, and show that $P(X = 1) = \frac{1}{8}$. [2]

  (ii) Show that $P(X = 3) = \frac{3}{16}$. [4]

 (iii) Copy and complete the probability distribution table for X. [3]

x	1	2	3	4	5	6	7	8
$P(X = x)$	$\frac{1}{8}$		$\frac{3}{16}$		$\frac{1}{8}$		$\frac{1}{16}$	$\frac{1}{32}$

Event Q is 'James throws a tail'. Event R is 'the value of X is 7'.

 (iv) Determine whether events Q and R are exclusive. Justify your answer. [2]

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1   It is given that $X \sim \text{N}(1.5, 3.2^2)$. Find the probability that a randomly chosen value of X is less than -2.4. [3]

2   On Saturday afternoons Mohit goes shopping with probability 0.25, or goes to the cinema with probability 0.35 or stays at home. If he goes shopping the probability that he spends more than \$50 is 0.7. If he goes to the cinema the probability that he spends more than \$50 is 0.8. If he stays at home he spends \$10 on a pizza.

   (i) Find the probability that Mohit will go to the cinema and spend less than \$50. [1]

   (ii) Given that he spends less than \$50, find the probability that he went to the cinema. [4]

3   The amount of fibre in a packet of a certain brand of cereal is normally distributed with mean 160 grams. 19% of packets of cereal contain more than 190 grams of fibre.

   (i) Find the standard deviation of the amount of fibre in a packet. [3]

   (ii) Kate buys 12 packets of cereal. Find the probability that at least 1 of the packets contains more than 190 grams of fibre. [2]

4   The following histogram summarises the times, in minutes, taken by 190 people to complete a race.
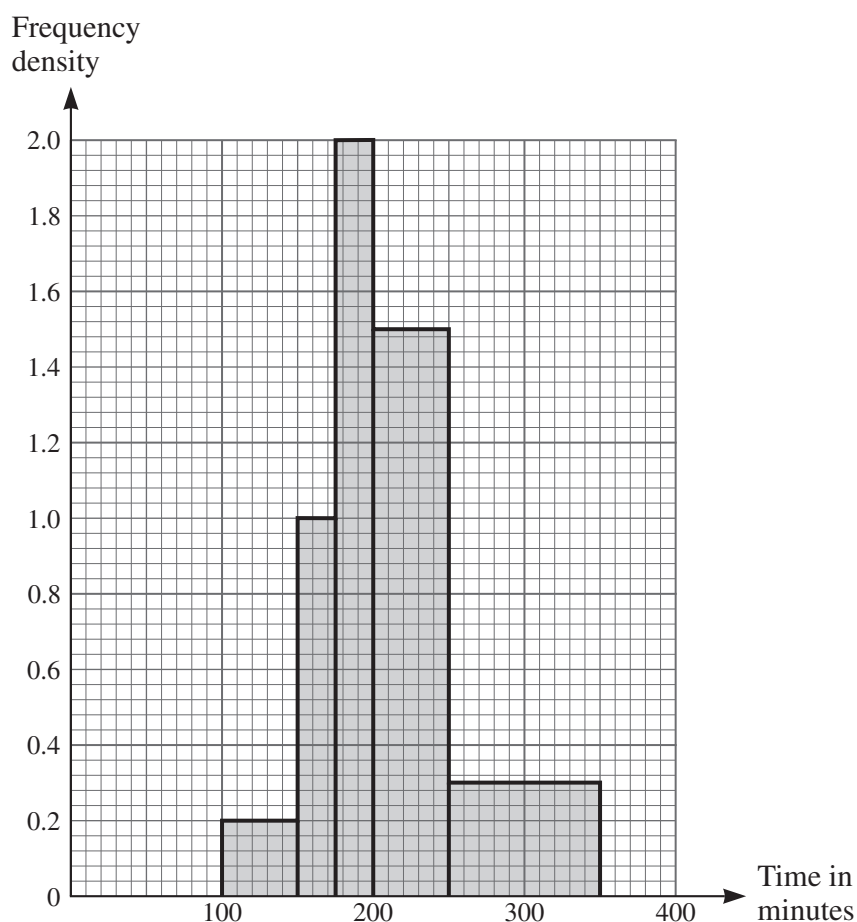
   (i) Show that 75 people took between 200 and 250 minutes to complete the race. [1]

   (ii) Calculate estimates of the mean and standard deviation of the times of the 190 people. [6]

   (iii) Explain why your answers to part **(ii)** are estimates. [1]

5 On trains in the morning rush hour, each person is either a student with probability 0.36, or an office worker with probability 0.22, or a shop assistant with probability 0.29 or none of these.

    (i) 8 people on a morning rush hour train are chosen at random. Find the probability that between 4 and 6 inclusive are office workers. [3]

    (ii) 300 people on a morning rush hour train are chosen at random. Find the probability that between 31 and 49 inclusive are neither students nor office workers nor shop assistants. [6]

6 The 11 letters of the word REMEMBRANCE are arranged in a line.

    (i) Find the number of different arrangements if there are no restrictions. [1]

    (ii) Find the number of different arrangements which start and finish with the letter M. [2]

    (iii) Find the number of different arrangements which do not have all 4 vowels (E, E, A, E) next to each other. [3]

4 letters from the letters of the word REMEMBRANCE are chosen.

    (iv) Find the number of different selections which contain no Ms and no Rs and at least 2 Es. [3]

7 Rory has 10 cards. Four of the cards have a 3 printed on them and six of the cards have a 4 printed on them. He takes three cards at random, without replacement, and adds up the numbers on the cards.

    (i) Show that P(the sum of the numbers on the three cards is 11) $= \frac{1}{2}$. [3]

    (ii) Draw up a probability distribution table for the sum of the numbers on the three cards. [4]

Event R is 'the sum of the numbers on the three cards is 11'. Event S is 'the number on the first card taken is a 3'.

    (iii) Determine whether events R and S are independent. Justify your answer. [3]

    (iv) Determine whether events R and S are exclusive. Justify your answer. [1]

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1   The distance of a student's home from college, correct to the nearest kilometre, was recorded for each of 55 students. The distances are summarised in the following table.

Distance from college (km)	1 – 3	4 – 5	6 – 8	9 – 11	12 – 16
Number of students	18	13	8	12	4

Dominic is asked to draw a histogram to illustrate the data. Dominic's diagram is shown below.
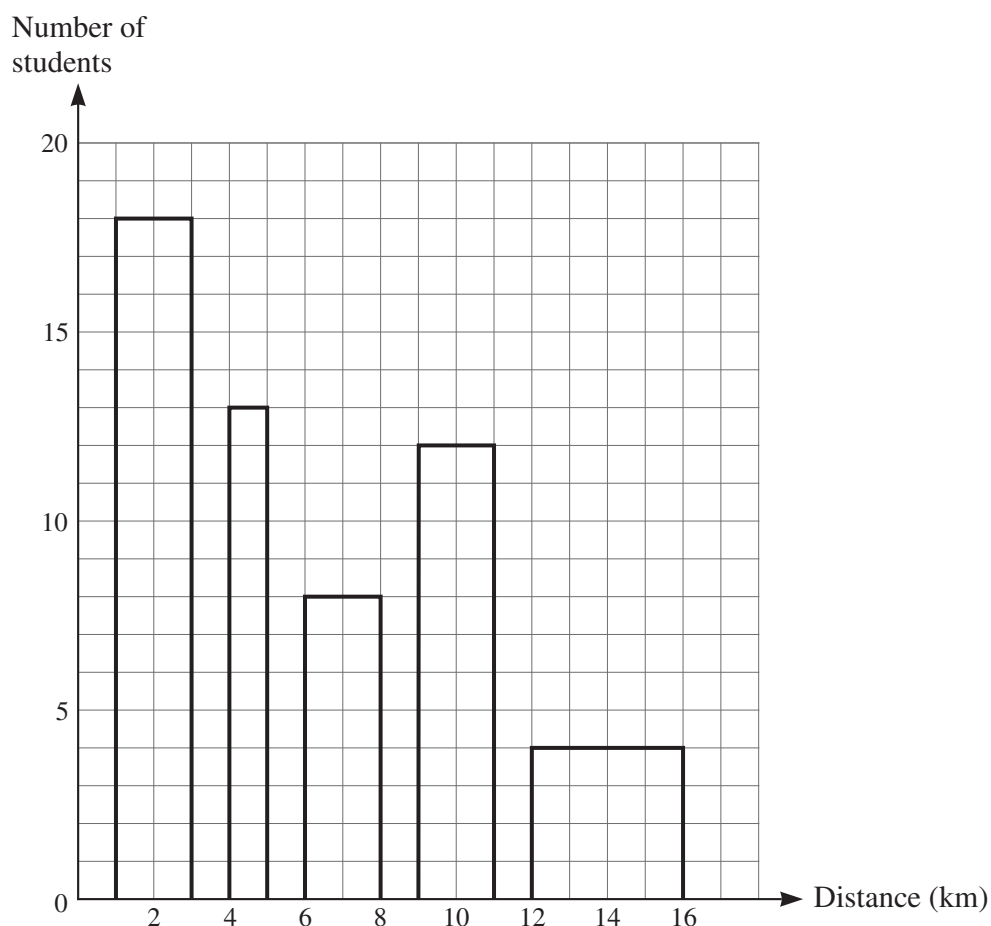
Give two reasons why this is not a correct histogram.   [2]

2   A factory produces flower pots. The base diameters have a normal distribution with mean 14 cm and standard deviation 0.52 cm. Find the probability that the base diameters of exactly 8 out of 10 randomly chosen flower pots are between 13.6 cm and 14.8 cm.   [5]

3   In a large consignment of mangoes, 15% of mangoes are classified as small, 70% as medium and 15% as large.

   (i) Yue-chen picks 14 mangoes at random. Find the probability that fewer than 12 of them are medium or large.   [3]

   (ii) Yue-chen picks n mangoes at random. The probability that none of these n mangoes is small is at least 0.1. Find the largest possible value of n.   [3]

4 Barry weighs 20 oranges and 25 lemons. For the oranges, the mean weight is 220 g and the standard deviation is 32 g. For the lemons, the mean weight is 118 g and the standard deviation is 12 g.

  (i) Find the mean weight of the 45 fruits. [2]

  (ii) The individual weights of the oranges in grams are denoted by x_o, and the individual weights of the lemons in grams are denoted by x_l. By first finding Σx_o^2 and Σx_l^2, find the variance of the weights of the 45 fruits. [5]

5 **(a)** The random variable X is normally distributed with mean 82 and standard deviation 7.4. Find the value of q such that $P(82 - q < X < 82 + q) = 0.44$. [3]

  (b) The random variable Y is normally distributed with mean μ and standard deviation σ. It is given that $5\mu = 2\sigma^2$ and that $P(Y < \frac{1}{2}\mu) = 0.281$. Find the values of μ and σ. [4]

6 **(i)** Find the number of different ways that the 9 letters of the word AGGREGATE can be arranged in a line if the first letter is R. [2]

  (ii) Find the number of different ways that the 9 letters of the word AGGREGATE can be arranged in a line if the 3 letters G are together, both letters A are together and both letters E are together. [2]

  (iii) The letters G, R and T are consonants and the letters A and E are vowels. Find the number of different ways that the 9 letters of the word AGGREGATE can be arranged in a line if consonants and vowels occur alternately. [3]

  (iv) Find the number of different selections of 4 letters of the word AGGREGATE which contain exactly 2 Gs or exactly 3 Gs. [3]

7 Dayo chooses two digits at random, without replacement, from the 9-digit number 113 333 555.

  (i) Find the probability that the two digits chosen are equal. [3]

  (ii) Find the probability that one digit is a 5 and one digit is not a 5. [3]

  (iii) Find the probability that the first digit Dayo chose was a 5, given that the second digit he chose is not a 5. [4]

  (iv) The random variable X is the number of 5s that Dayo chooses. Draw up a table to show the probability distribution of X. [3]

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