

MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

October/November 2015

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

An answer booklet and a graph paper booklet are provided inside this question paper. You should follow the instructions on the front cover of both booklets. If you need additional answer paper or graph paper ask the invigilator for a continuation booklet or graph paper booklet.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

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DO NOT WRITE IN ANY BARCODES.

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.

The use of an electronic calculator is expected, where appropriate.

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The total number of marks for this paper is 50.

This document consists of **3** printed pages, **1** blank page and **2** inserts.

- 1 In a certain town, 76% of cars are fitted with satellite navigation equipment. A random sample of 11 cars from this town is chosen. Find the probability that fewer than 10 of these cars are fitted with this equipment. [4]
- 2 The random variable X has the distribution $N(\mu, \sigma^2)$. It is given that $P(X < 54.1) = 0.5$ and $P(X > 50.9) = 0.8665$. Find the values of μ and σ . [4]
- 3 Robert has a part-time job delivering newspapers. On a number of days he noted the time, correct to the nearest minute, that it took him to do his job. Robert used his results to draw up the following table; two of the values in the table are denoted by a and b .

Time (t minutes)	60 – 62	63 – 64	65 – 67	68 – 71
Frequency (number of days)	3	9	6	b
Frequency density	1	a	2	1.5

- (i) Find the values of a and b . [3]
- (ii) On graph paper, draw a histogram to represent Robert's times. [3]
- 4 (a) Amy measured her pulse rate while resting, x beats per minute, at the same time each day on 30 days. The results are summarised below.
- $$\Sigma(x - 80) = -147 \qquad \Sigma(x - 80)^2 = 952$$
- Find the mean and standard deviation of Amy's pulse rate. [4]
- (b) Amy's friend Marok measured her pulse rate every day after running for half an hour. Marok's pulse rate, in beats per minute, was found to have a mean of 148.6 and a standard deviation of 18.5. Assuming that pulse rates have a normal distribution, find what proportion of Marok's pulse rates, after running for half an hour, were above 160 beats per minute. [3]
- 5 (a) Find the number of ways in which all nine letters of the word TENNESSEE can be arranged
- (i) if all the letters E are together, [3]
- (ii) if the T is at one end and there is an S at the other end. [3]
- (b) Four letters are selected from the nine letters of the word VENEZUELA. Find the number of possible selections which contain exactly one E. [3]

- 6 Nadia is very forgetful. Every time she logs in to her online bank she only has a 40% chance of remembering her password correctly. She is allowed 3 unsuccessful attempts on any one day and then the bank will not let her try again until the next day.

(i) Draw a fully labelled tree diagram to illustrate this situation. [3]

- (ii) Let X be the number of unsuccessful attempts Nadia makes on any day that she tries to log in to her bank. Copy and complete the following table to show the probability distribution of X . [4]

x	0	1	2	3
$P(X = x)$		0.24		

- (iii) Calculate the expected number of unsuccessful attempts made by Nadia on any day that she tries to log in. [2]

- 7 The faces of a biased die are numbered 1, 2, 3, 4, 5 and 6. The probabilities of throwing odd numbers are all the same. The probabilities of throwing even numbers are all the same. The probability of throwing an odd number is twice the probability of throwing an even number.

(i) Find the probability of throwing a 3. [3]

(ii) The die is thrown three times. Find the probability of throwing two 5s and one 4. [3]

- (iii) The die is thrown 100 times. Use an approximation to find the probability that an even number is thrown at most 37 times. [5]

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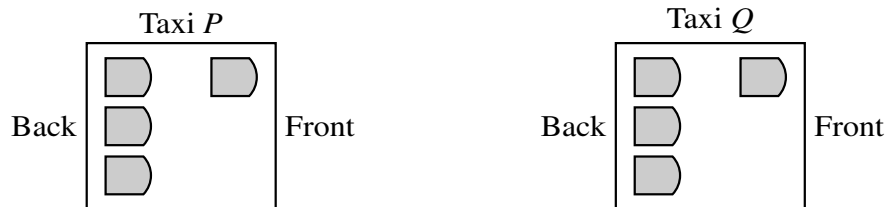
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- 1 For n values of the variable x , it is given that $\Sigma(x - 100) = 216$ and $\Sigma x = 2416$. Find the value of n . [3]
- 2 A committee of 6 people is to be chosen at random from 7 men and 9 women. Find the probability that there are no men on the committee. [3]
- 3 One plastic robot is given away free inside each packet of a certain brand of biscuits. There are four colours of plastic robot (red, yellow, blue and green) and each colour is equally likely to occur. Nick buys some packets of these biscuits. Find the probability that
- (i) he gets a green robot on opening his first packet, [1]
 - (ii) he gets his first green robot on opening his fifth packet. [2]
- Nick's friend Amos is also collecting robots.
- (iii) Find the probability that the first four packets Amos opens all contain different coloured robots. [3]
- 4 A group of 8 friends travels to the airport in two taxis, P and Q . Each taxi can take 4 passengers.
- (i) The 8 friends divide themselves into two groups of 4, one group for taxi P and one group for taxi Q , with Jon and Sarah travelling in the same taxi. Find the number of different ways in which this can be done. [3]



Each taxi can take 1 passenger in the front and 3 passengers in the back (see diagram). Mark sits in the front of taxi P and Jon and Sarah sit in the back of taxi P next to each other.

- (ii) Find the number of different seating arrangements that are now possible for the 8 friends. [4]
- 5 The weights, in kilograms, of the 15 rugby players in each of two teams, A and B , are shown below.

Team A	97	98	104	84	100	109	115	99	122	82	116	96	84	107	91
Team B	75	79	94	101	96	77	111	108	83	84	86	115	82	113	95

- (i) Represent the data by drawing a back-to-back stem-and-leaf diagram with team A on the left-hand side of the diagram and team B on the right-hand side. [4]
- (ii) Find the interquartile range of the weights of the players in team A . [2]
- (iii) A new player joins team B as a substitute. The mean weight of the 16 players in team B is now 93.9 kg. Find the weight of the new player. [3]

- 6 A fair spinner A has edges numbered 1, 2, 3, 3. A fair spinner B has edges numbered -3 , -2 , -1 , 1. Each spinner is spun. The number on the edge that the spinner comes to rest on is noted. Let X be the sum of the numbers for the two spinners.

(i) Copy and complete the table showing the possible values of X . [1]

		Spinner A			
		1	2	3	3
Spinner B	-3	-2			
	-2			1	
	-1				
	1				

(ii) Draw up a table showing the probability distribution of X . [3]

(iii) Find $\text{Var}(X)$. [3]

(iv) Find the probability that X is even, given that X is positive. [2]

- 7 (a) A petrol station finds that its daily sales, in litres, are normally distributed with mean 4520 and standard deviation 560.

(i) Find on how many days of the year (365 days) the daily sales can be expected to exceed 3900 litres. [4]

The daily sales at another petrol station are X litres, where X is normally distributed with mean m and standard deviation 560. It is given that $P(X > 8000) = 0.122$.

(ii) Find the value of m . [3]

(iii) Find the probability that daily sales at this petrol station exceed 8000 litres on fewer than 2 of 6 randomly chosen days. [3]

(b) The random variable Y is normally distributed with mean μ and standard deviation σ . Given that $\sigma = \frac{2}{3}\mu$, find the probability that a random value of Y is less than 2μ . [3]

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- 1 The time taken, t hours, to deliver letters on a particular route each day is measured on 250 working days. The mean time taken is 2.8 hours. Given that $\Sigma(t - 2.5)^2 = 96.1$, find the standard deviation of the times taken. [3]
- 2 In country X , 25% of people have fair hair. In country Y , 60% of people have fair hair. There are 20 million people in country X and 8 million people in country Y . A person is chosen at random from these 28 million people.
- (i) Find the probability that the person chosen is from country X . [1]
- (ii) Find the probability that the person chosen has fair hair. [2]
- (iii) Find the probability that the person chosen is from country X , given that the person has fair hair. [2]
- 3 Ellie throws two fair tetrahedral dice, each with faces numbered 1, 2, 3 and 4. She notes the numbers on the faces that the dice land on. Event S is ‘the sum of the two numbers is 4’. Event T is ‘the product of the two numbers is an odd number’.
- (i) Determine whether events S and T are independent, showing your working. [5]
- (ii) Are events S and T exclusive? Justify your answer. [1]
- 4 The time taken for cucumber seeds to germinate under certain conditions has a normal distribution with mean 125 hours and standard deviation σ hours.
- (i) It is found that 13% of seeds take longer than 136 hours to germinate. Find the value of σ . [3]
- (ii) 170 seeds are sown. Find the expected number of seeds which take between 131 and 141 hours to germinate. [4]
- 5 (a) Find the number of different ways that the 13 letters of the word ACCOMMODATION can be arranged in a line if all the vowels (A, I, O) are next to each other. [3]
- (b) There are 7 Chinese, 6 European and 4 American students at an international conference. Four of the students are to be chosen to take part in a television broadcast. Find the number of different ways the students can be chosen if at least one Chinese and at least one European student are included. [5]
- 6 The heights to the nearest metre of 134 office buildings in a certain city are summarised in the table below.

Height (m)	21 – 40	41 – 45	46 – 50	51 – 60	61 – 80
Frequency	18	15	21	52	28

- (i) Draw a histogram on graph paper to illustrate the data. [4]
- (ii) Calculate estimates of the mean and standard deviation of these heights. [5]

- 7 A factory makes water pistols, 8% of which do not work properly.
- (i) A random sample of 19 water pistols is taken. Find the probability that at most 2 do not work properly. [3]
 - (ii) In a random sample of n water pistols, the probability that at least one does not work properly is greater than 0.9. Find the smallest possible value of n . [3]
 - (iii) A random sample of 1800 water pistols is taken. Use an approximation to find the probability that there are at least 152 that do not work properly. [5]
 - (iv) Justify the use of your approximation in part (iii). [1]

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