



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

October/November 2010

1 hour 15 minutes

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



READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

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Write in dark blue or black pen.

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



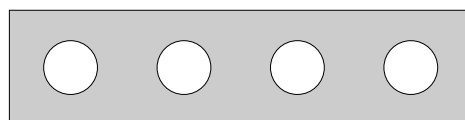
- 1 Anita made observations of the maximum temperature, $t^{\circ}\text{C}$, on 50 days. Her results are summarised by $\Sigma t = 910$ and $\Sigma(t - \bar{t})^2 = 876$, where $\bar{t}$ denotes the mean of the 50 observations. Calculate $\bar{t}$ and the standard deviation of the observations. [3]
- 2 On average, 2 apples out of 15 are classified as being underweight. Find the probability that in a random sample of 200 apples, the number of apples which are underweight is more than 21 and less than 35. [5]
- 3 The times taken by students to get up in the morning can be modelled by a normal distribution with mean 26.4 minutes and standard deviation 3.7 minutes.
- (i) For a random sample of 350 students, find the number who would be expected to take longer than 20 minutes to get up in the morning. [3]
- (ii) ‘Very slow’ students are students whose time to get up is more than 1.645 standard deviations above the mean. Find the probability that fewer than 3 students from a random sample of 8 students are ‘very slow’. [4]
- 4 The weights in grams of a number of stones, measured correct to the nearest gram, are represented in the following table.

Weight (grams)	1 – 10	11 – 20	21 – 25	26 – 30	31 – 50	51 – 70
Frequency	$2x$	$4x$	$3x$	$5x$	$4x$	x

A histogram is drawn with a scale of 1 cm to 1 unit on the vertical axis, which represents frequency density. The 1 – 10 rectangle has height 3 cm.

- (i) Calculate the value of x and the height of the 51 – 70 rectangle. [4]
- (ii) Calculate an estimate of the mean weight of the stones. [3]
- 5 Three friends, Rick, Brenda and Ali, go to a football match but forget to say which entrance to the ground they will meet at. There are four entrances, A , B , C and D . Each friend chooses an entrance independently.
- The probability that Rick chooses entrance A is $\frac{1}{3}$. The probabilities that he chooses entrances B , C or D are all equal.
 - Brenda is equally likely to choose any of the four entrances.
 - The probability that Ali chooses entrance C is $\frac{2}{7}$ and the probability that he chooses entrance D is $\frac{3}{5}$. The probabilities that he chooses the other two entrances are equal.
- (i) Find the probability that at least 2 friends will choose entrance B . [4]
- (ii) Find the probability that the three friends will all choose the same entrance. [4]

6



Pegs are to be placed in the four holes shown, one in each hole. The pegs come in different colours and pegs of the same colour are identical. Calculate how many different arrangements of coloured pegs in the four holes can be made using

(i) 6 pegs, all of different colours, [1]

(ii) 4 pegs consisting of 2 blue pegs, 1 orange peg and 1 yellow peg. [1]

Beryl has 12 pegs consisting of 2 red, 2 blue, 2 green, 2 orange, 2 yellow and 2 black pegs. Calculate how many different arrangements of coloured pegs in the 4 holes Beryl can make using

(iii) 4 different colours, [1]

(iv) 3 different colours, [3]

(v) any of her 12 pegs. [3]

7 Sanket plays a game using a biased die which is twice as likely to land on an even number as on an odd number. The probabilities for the three even numbers are all equal and the probabilities for the three odd numbers are all equal.

(i) Find the probability of throwing an odd number with this die. [2]

Sanket throws the die once and calculates his score by the following method.

- If the number thrown is 3 or less he multiplies the number thrown by 3 and adds 1.
- If the number thrown is more than 3 he multiplies the number thrown by 2 and subtracts 4.

The random variable X is Sanket's score.

(ii) Show that $P(X = 8) = \frac{2}{9}$. [2]

The table shows the probability distribution of X .

x	4	6	7	8	10
$P(X = x)$	$\frac{3}{9}$	$\frac{1}{9}$	$\frac{2}{9}$	$\frac{2}{9}$	$\frac{1}{9}$

(iii) Given that $E(X) = \frac{58}{9}$, find $\text{Var}(X)$. [2]

Sanket throws the die twice.

(iv) Find the probability that the total of the scores on the two throws is 16. [2]

(v) Given that the total of the scores on the two throws is 16, find the probability that the score on the first throw was 6. [3]

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- 1 The discrete random variable X takes the values 1, 4, 5, 7 and 9 only. The probability distribution of X is shown in the table.

x	1	4	5	7	9
$P(X = x)$	$4p$	$5p^2$	$1.5p$	$2.5p$	$1.5p$

Find p .

[3]

- 2 Esme noted the test marks, x , of 16 people in a class. She found that $\Sigma x = 824$ and that the standard deviation of x was 6.5.

(i) Calculate $\Sigma(x - 50)$ and $\Sigma(x - 50)^2$. [3]

(ii) One person did the test later and her mark was 72. Calculate the new mean and standard deviation of the marks of all 17 people. [3]

- 3 A fair five-sided spinner has sides numbered 1, 2, 3, 4, 5. Raj spins the spinner and throws two fair dice. He calculates his score as follows.

- If the spinner lands on an **even-numbered** side, Raj **multiplies** the two numbers showing on the dice to get his score.
- If the spinner lands on an **odd-numbered** side, Raj **adds** the numbers showing on the dice to get his score.

Given that Raj's score is 12, find the probability that the spinner landed on an even-numbered side.

[6]

- 4 The weights in kilograms of 11 bags of sugar and 7 bags of flour are as follows.

Sugar: 1.961 1.983 2.008 2.014 1.968 1.994 2.011 2.017 1.977 1.984 1.989

Flour: 1.945 1.962 1.949 1.977 1.964 1.941 1.953

(i) Represent this information on a back-to-back stem-and-leaf diagram with sugar on the left-hand side. [4]

(ii) Find the median and interquartile range of the weights of the bags of sugar. [3]

- 5 The distance the Zotoc car can travel on 20 litres of fuel is normally distributed with mean 320 km and standard deviation 21.6 km. The distance the Ganmor car can travel on 20 litres of fuel is normally distributed with mean 350 km and standard deviation 7.5 km. Both cars are filled with 20 litres of fuel and are driven towards a place 367 km away.

(i) For each car, find the probability that it runs out of fuel before it has travelled 367 km. [3]

(ii) The probability that a Zotoc car can travel at least $(320 + d)$ km on 20 litres of fuel is 0.409. Find the value of d . [4]

- 6** (i) State three conditions that must be satisfied for a situation to be modelled by a binomial distribution. [2]

On any day, there is a probability of 0.3 that Julie's train is late.

- (ii) Nine days are chosen at random. Find the probability that Julie's train is late on more than 7 days or fewer than 2 days. [3]
- (iii) 90 days are chosen at random. Find the probability that Julie's train is late on more than 35 days or fewer than 27 days. [5]

- 7** A committee of 6 people, which must contain at least 4 men and at least 1 woman, is to be chosen from 10 men and 9 women.

- (i) Find the number of possible committees that can be chosen. [3]
- (ii) Find the probability that one particular man, Albert, and one particular woman, Tracey, are both on the committee. [2]
- (iii) Find the number of possible committees that include either Albert or Tracey but not both. [3]
- (iv) The committee that is chosen consists of 4 men and 2 women. They queue up randomly in a line for refreshments. Find the probability that the women are not next to each other in the queue. [3]

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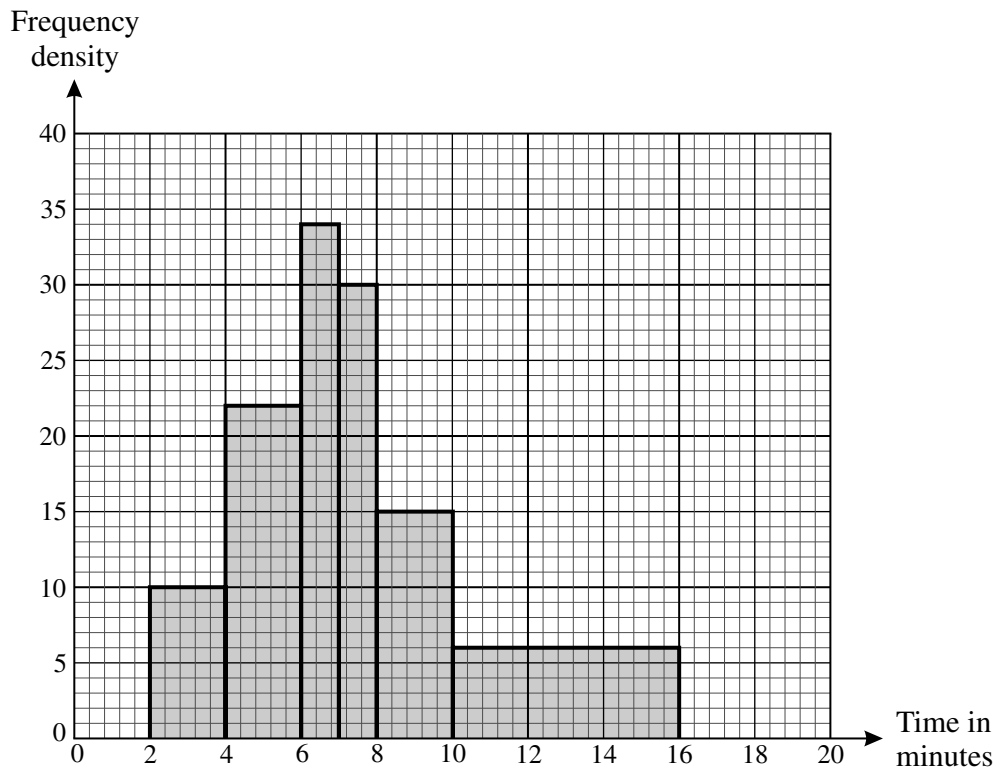
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- 1 Name the distribution and suggest suitable numerical parameters that you could use to model the weights in kilograms of female 18-year-old students. [2]
- 2 In a probability distribution the random variable X takes the value x with probability kx , where x takes values 1, 2, 3, 4, 5 only.
- (i) Draw up a probability distribution table for X , in terms of k , and find the value of k . [3]
- (ii) Find $E(X)$. [2]
- 3 It was found that 68% of the passengers on a train used a cell phone during their train journey. Of those using a cell phone, 70% were under 30 years old, 25% were between 30 and 65 years old and the rest were over 65 years old. Of those not using a cell phone, 26% were under 30 years old and 64% were over 65 years old.
- (i) Draw a tree diagram to represent this information, giving all probabilities as decimals. [2]
- (ii) Given that one of the passengers is 45 years old, find the probability of this passenger using a cell phone during the journey. [3]
- 4 Delip measured the speeds, x km per hour, of 70 cars on a road where the speed limit is 60 km per hour. His results are summarised by $\Sigma(x - 60) = 245$.
- (i) Calculate the mean speed of these 70 cars. [2]
- His friend Sachim used values of $(x - 50)$ to calculate the mean.
- (ii) Find $\Sigma(x - 50)$. [2]
- (iii) The standard deviation of the speeds is 10.6 km per hour. Calculate $\Sigma(x - 50)^2$. [2]

- 5 The following histogram illustrates the distribution of times, in minutes, that some students spent taking a shower.



- (i) Copy and complete the following frequency table for the data.

[3]

Time (t minutes)	$2 < t \leq 4$	$4 < t \leq 6$	$6 < t \leq 7$	$7 < t \leq 8$	$8 < t \leq 10$	$10 < t \leq 16$
Frequency						

- (ii) Calculate an estimate of the mean time to take a shower.

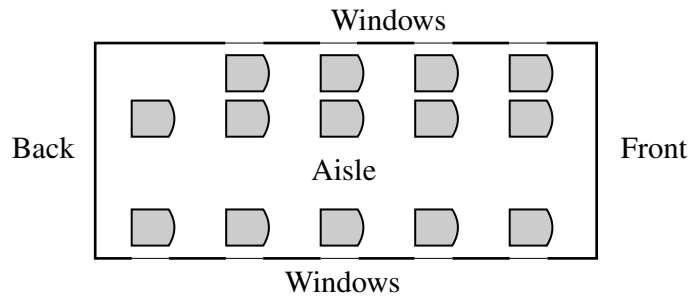
[2]

- (iii) Two of these students are chosen at random. Find the probability that exactly one takes between 7 and 10 minutes to take a shower.

[3]

[Questions 6 and 7 are printed on the next page.]

6



A small aeroplane has 14 seats for passengers. The seats are arranged in 4 rows of 3 seats and a back row of 2 seats (see diagram). 12 passengers board the aeroplane.

- (i) How many possible seating arrangements are there for the 12 passengers? Give your answer correct to 3 significant figures. [2]

These 12 passengers consist of 2 married couples (Mr and Mrs Lin and Mr and Mrs Brown), 5 students and 3 business people.

- (ii) The 3 business people sit in the front row. The 5 students each sit at a window seat. Mr and Mrs Lin sit in the same row on the same side of the aisle. Mr and Mrs Brown sit in another row on the same side of the aisle. How many possible seating arrangements are there? [4]
- (iii) If, instead, the 12 passengers are seated randomly, find the probability that Mrs Lin sits directly behind a student and Mrs Brown sits in the front row. [4]

- 7 The times spent by people visiting a certain dentist are independent and normally distributed with a mean of 8.2 minutes. 79% of people who visit this dentist have visits lasting less than 10 minutes.

- (i) Find the standard deviation of the times spent by people visiting this dentist. [3]
- (ii) Find the probability that the time spent visiting this dentist by a randomly chosen person deviates from the mean by more than 1 minute. [3]
- (iii) Find the probability that, of 6 randomly chosen people, more than 2 have visits lasting longer than 10 minutes. [3]
- (iv) Find the probability that, of 35 randomly chosen people, fewer than 16 have visits lasting less than 8.2 minutes. [5]