



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 2011

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.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

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.

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

At the end of the examination, fasten all your work securely together.

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 50.

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

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



- 1 When a butternut squash seed is sown the probability that it will germinate is 0.86, independently of any other seeds. A market gardener sows 250 of these seeds. Use a suitable approximation to find the probability that more than 210 germinate. [5]

- 2 The values, x , in a particular set of data are summarised by

$$\Sigma(x - 25) = 133, \quad \Sigma(x - 25)^2 = 3762.$$

The mean, $\bar{x}$, is 28.325.

- (i) Find the standard deviation of x . [4]

- (ii) Find Σx^2 . [2]

- 3 A team of 4 is to be randomly chosen from 3 boys and 5 girls. The random variable X is the number of girls in the team.

- (i) Draw up a probability distribution table for X . [4]

- (ii) Given that $E(X) = \frac{5}{2}$, calculate $\text{Var}(X)$. [2]

- 4 The marks of the pupils in a certain class in a History examination are as follows.

28 33 55 38 42 39 27 48 51 37 57 49 33

The marks of the pupils in a Physics examination are summarised as follows.

Lower quartile: 28, Median: 39, Upper quartile: 67.

The lowest mark was 17 and the highest mark was 74.

- (i) Draw box-and-whisker plots in a single diagram on graph paper to illustrate the marks for History and Physics. [5]

- (ii) State one difference, which can be seen from the diagram, between the marks for History and Physics. [1]

- 5 The weights of letters posted by a certain business are normally distributed with mean 20 g. It is found that the weights of 94% of the letters are within 12 g of the mean.

- (i) Find the standard deviation of the weights of the letters. [3]

- (ii) Find the probability that a randomly chosen letter weighs more than 13 g. [3]

- (iii) Find the probability that at least 2 of a random sample of 7 letters have weights which are more than 12 g above the mean. [3]

- 6** (a) Find the number of different ways in which the 12 letters of the word STRAWBERRIES can be arranged
- (i) if there are no restrictions, [2]
 - (ii) if the 4 vowels A, E, E, I must all be together. [3]
- (b) (i) 4 astronauts are chosen from a certain number of candidates. If order of choosing is not taken into account, the number of ways the astronauts can be chosen is 3876. How many ways are there if order of choosing is taken into account? [2]
- (ii) 4 astronauts are chosen to go on a mission. Each of these astronauts can take 3 personal possessions with him. How many different ways can these 12 possessions be arranged in a row if each astronaut's possessions are kept together? [2]
- 7** Bag *A* contains 4 balls numbered 2, 4, 5, 8. Bag *B* contains 5 balls numbered 1, 3, 6, 8, 8. Bag *C* contains 7 balls numbered 2, 7, 8, 8, 8, 8, 9. One ball is selected at random from each bag.
- (i) Find the probability that exactly two of the selected balls have the same number. [5]
 - (ii) Given that exactly two of the selected balls have the same number, find the probability that they are both numbered 2. [2]
 - (iii) Event *X* is 'exactly two of the selected balls have the same number'. Event *Y* is 'the ball selected from bag *A* has number 2'. Showing your working, determine whether events *X* and *Y* are independent or not. [2]

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- 1 The following are the times, in minutes, taken by 11 runners to complete a 10 km run.

48.3 55.2 59.9 67.7 60.5 75.6 62.5 57.4 53.4 49.2 64.1

Find the mean and standard deviation of these times. [3]

- 2 Twelve coins are tossed and placed in a line. Each coin can show either a head or a tail.

(i) Find the number of different arrangements of heads and tails which can be obtained. [2]

(ii) Find the number of different arrangements which contain 7 heads and 5 tails. [1]

- 3 (a) Geoff wishes to plant 25 flowers in a flower-bed. He can choose from 15 different geraniums, 10 different roses and 8 different lilies. He wants to have at least 11 geraniums and also to have the same number of roses and lilies. Find the number of different selections of flowers he can make. [4]

(b) Find the number of different ways in which the 9 letters of the word GREENGAGE can be arranged if exactly two of the Gs are next to each other. [3]

- 4 The weights of 220 sausages are summarised in the following table.

Weight (grams)	<20	<30	<40	<45	<50	<60	<70
Cumulative frequency	0	20	50	100	160	210	220

(i) State which interval the median weight lies in. [1]

(ii) Find the smallest possible value and the largest possible value for the interquartile range. [2]

(iii) State how many sausages weighed between 50 g and 60 g. [1]

(iv) On graph paper, draw a histogram to represent the weights of the sausages. [4]

- 5 A triangular spinner has one red side, one blue side and one green side. The red side is weighted so that the spinner is four times more likely to land on the red side than on the blue side. The green side is weighted so that the spinner is three times more likely to land on the green side than on the blue side.

(i) Show that the probability that the spinner lands on the blue side is $\frac{1}{8}$. [1]

(ii) The spinner is spun 3 times. Find the probability that it lands on a different coloured side each time. [3]

(iii) The spinner is spun 136 times. Use a suitable approximation to find the probability that it lands on the blue side fewer than 20 times. [5]

- 6 There are a large number of students in Lutley College. 60% of the students are boys. Students can choose exactly one of Games, Drama or Music on Friday afternoons. It is found that 75% of the boys choose Games, 10% of the boys choose Drama and the remainder of the boys choose Music. Of the girls, 30% choose Games, 55% choose Drama and the remainder choose Music.
- (i) 6 boys are chosen at random. Find the probability that fewer than 3 of them choose Music. [3]
- (ii) 5 Drama students are chosen at random. Find the probability that at least 1 of them is a boy. [6]
- 7 (i) In a certain country, the daily minimum temperature, in $^{\circ}\text{C}$, in winter has the distribution $N(8, 24)$. Find the probability that a randomly chosen winter day in this country has a minimum temperature between 7°C and 12°C . [3]

The daily minimum temperature, in $^{\circ}\text{C}$, in another country in winter has a normal distribution with mean μ and standard deviation 2μ .

- (ii) Find the proportion of winter days on which the minimum temperature is below zero. [2]
- (iii) 70 winter days are chosen at random. Find how many of these would be expected to have a minimum temperature which is more than three times the mean. [3]
- (iv) The probability of the minimum temperature being above 6°C on any winter day is 0.0735. Find the value of μ . [3]

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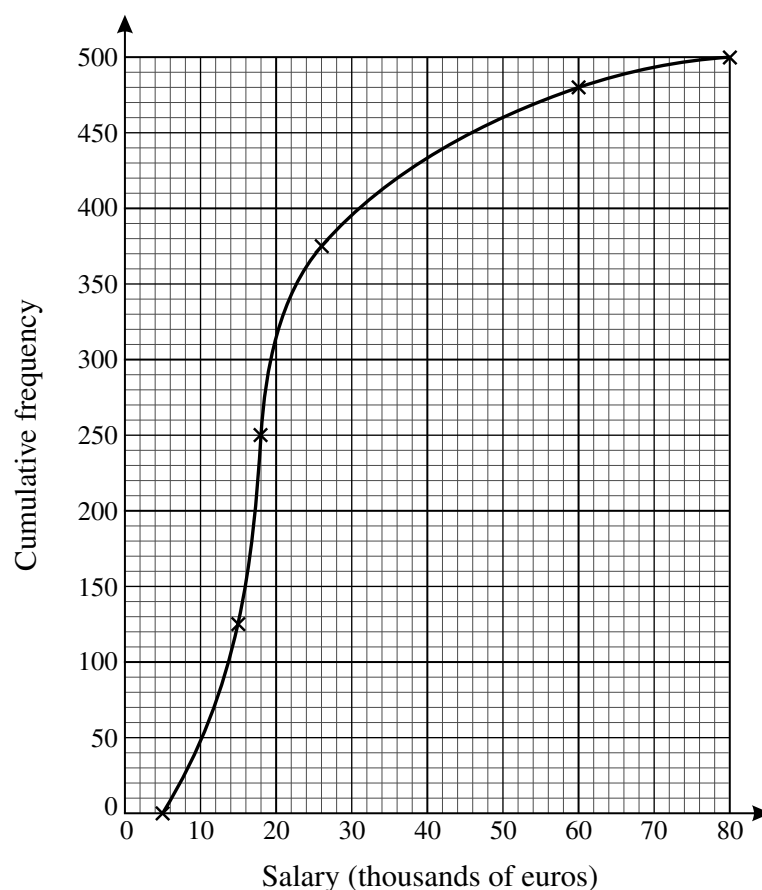
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- 1** The random variable X is normally distributed and is such that the mean μ is three times the standard deviation σ . It is given that $P(X < 25) = 0.648$.
- (i) Find the values of μ and σ . [4]
- (ii) Find the probability that, from 6 random values of X , exactly 4 are greater than 25. [2]
- 2** In a group of 30 teenagers, 13 of the 18 males watch 'Kops are Kids' on television and 3 of the 12 females watch 'Kops are Kids'.
- (i) Find the probability that a person chosen at random from the group is either female or watches 'Kops are Kids' or both. [4]
- (ii) Showing your working, determine whether the events 'the person chosen is male' and 'the person chosen watches Kops are Kids' are independent or not. [2]
- 3** A factory makes a large number of ropes with lengths either 3 m or 5 m. There are four times as many ropes of length 3 m as there are ropes of length 5 m.
- (i) One rope is chosen at random. Find the expectation and variance of its length. [4]
- (ii) Two ropes are chosen at random. Find the probability that they have different lengths. [2]
- (iii) Three ropes are chosen at random. Find the probability that their total length is 11 m. [3]
- 4** Mary saves her digital images on her computer in three separate folders named 'Family', 'Holiday' and 'Friends'. Her family folder contains 3 images, her holiday folder contains 4 images and her friends folder contains 8 images. All the images are different.
- (i) Find in how many ways she can arrange these 15 images in a row across her computer screen if she keeps the images from each folder together. [3]
- (ii) Find the number of different ways in which Mary can choose 6 of these images if there are 2 from each folder. [2]
- (iii) Find the number of different ways in which Mary can choose 6 of these images if there are at least 3 images from the friends folder and at least 1 image from each of the other two folders. [4]

5



The cumulative frequency graph shows the annual salaries, in thousands of euros, of a random sample of 500 adults with jobs, in France. It has been plotted using grouped data. You may assume that the lowest salary is 5000 euros and the highest salary is 80 000 euros.

(i) On graph paper, draw a box-and-whisker plot to illustrate these salaries. [4]

(ii) Comment on the salaries of the people in this sample. [1]

(iii) An 'outlier' is defined as any data value which is more than 1.5 times the interquartile range above the upper quartile, or more than 1.5 times the interquartile range below the lower quartile.

(a) How high must a salary be in order to be classified as an outlier? [3]

(b) Show that none of the salaries is low enough to be classified as an outlier. [1]

6 Human blood groups are identified by two parts. The first part is A, B, AB or O and the second part (the Rhesus part) is + or -. In the UK, 35% of the population are group A+, 8% are B+, 3% are AB+, 37% are O+, 7% are A-, 2% are B-, 1% are AB- and 7% are O-.

(i) A random sample of 9 people in the UK who are Rhesus + is taken. Find the probability that fewer than 3 are group O+. [6]

(ii) A random sample of 150 people in the UK is taken. Find the probability that more than 60 people are group A+. [5]

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