OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

MATHEMATICS (MEI) **4767**

Statistics 2

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
*   Printed answer book 4767
*   MEI Examination Formulae and Tables (MF2)

Other materials required:
*   Scientific or graphical calculator

Wednesday 22 June 2011
Morning

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the printed answer book and the question paper.

*   The question paper will be found in the centre of the printed answer book.
*   Write your name, centre number and candidate number in the spaces provided on the printed answer book. Please write clearly and in capital letters.
*   **Write your answer to each question in the space provided in the printed answer book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
*   Use black ink. Pencil may be used for graphs and diagrams only.
*   Read each question carefully. Make sure you know what you have to do before starting your answer.
*   Answer **all** the questions.
*   Do **not** write in the bar codes.
*   You are permitted to use a scientific or graphical calculator in this paper.
*   Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the printed answer book and the question paper.

*   The number of marks is given in brackets **[ ]** at the end of each question or part question on the question paper.
*   You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
*   The total number of marks for this paper is **72**.
*   The printed answer book consists of **12** pages. The question paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

*   Do not send this question paper for marking; it should be retained in the centre or destroyed.

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Turn over

1   An experiment is performed to determine the response of maize to nitrogen fertilizer. Data for the amount of nitrogen fertilizer applied, x kg/hectare, and the average yield of maize, y tonnes/hectare, in 5 experimental plots are given in the table below.

x	0	30	60	90	120
y	0.5	2.5	4.7	6.2	7.4

   (i) Draw a scatter diagram to illustrate these data.   **[3]**

   (ii) Calculate the equation of the regression line of y on x.   **[5]**

   (iii) Draw your regression line on your scatter diagram and comment briefly on its fit.   **[3]**

   (iv) Calculate the value of the residual for the data point where $x = 30$ and $y = 2.5$.   **[3]**

   (v) Use the equation of the regression line to calculate estimates of average yield with nitrogen fertilizer applications of

      (*A*) 45 kg/hectare,

      (*B*) 150 kg/hectare.   **[2]**

   (vi) In a plot where 150 kg/hectare of nitrogen fertilizer is applied, the average yield of maize is 8.7 tonnes/hectare. Comment on this result.   **[2]**

2   At a drive-through fast food takeaway, cars arrive independently, randomly and at a uniform average rate. The numbers of cars arriving per minute may be modelled by a Poisson distribution with mean 0.62.

   (i) Briefly explain the meaning of each of the three terms 'independently', 'randomly' and 'at a uniform average rate', in the context of cars arriving at a fast food takeaway.   **[3]**

   (ii) Find the probability of at most 1 car arriving in a period of 1 minute.   **[3]**

   (iii) Find the probability of more than 5 cars arriving in a period of 10 minutes.   **[3]**

   (iv) State the exact distribution of the number of cars arriving in a period of 1 hour.   **[2]**

   (v) Use a suitable approximating distribution to find the probability that at least 40 cars arrive in a period of 1 hour.   **[5]**

3

3 The weights of Braeburn apples on display in a supermarket, measured in grams, are Normally distributed with mean 210.5 and standard deviation 15.2.

  (i) Find the probability that a randomly selected apple weighs at least 220 grams. **[3]**

  (ii) These apples are sold in packs of 3. You may assume that the weights of apples in each pack are independent. Find the probability that all 3 of the apples in a randomly selected pack weigh at least 220 grams. **[2]**

 (iii) 100 packs are selected at random.

    (*A*) State the exact distribution of the number of these 100 packs in which all 3 apples weigh at least 220 grams. **[2]**

    (*B*) Use a suitable approximating distribution to find the probability that in at most one of these packs all 3 apples weigh at least 220 grams. **[5]**

    (*C*) Explain why this approximating distribution is suitable. **[1]**

 (iv) The supermarket also sells Cox's Orange Pippin apples. The weights of these apples, measured in grams, are Normally distributed with mean 185 and standard deviation σ.

    (*A*) Given that 10% of randomly selected Cox's Orange Pippin apples weigh less than 170 grams, calculate the value of σ. **[3]**

    (*B*) Sketch the distributions of the weights of both types of apple on a single diagram. **[4]**

[Question 4 is printed overleaf.]

4 **(a)** In a survey on internet usage, a random sample of 200 people is selected. The people are asked how much they have spent on internet shopping during the last three months. The results, classified by amount spent and sex, are shown in the table.

		Sex		Row totals
		Male	Female	
Amount spent	Nothing	28	34	62
	Less than £50	17	21	38
	£50 up to £200	22	26	48
	£200 up to £1000	23	16	39
	£1000 or more	8	5	13
Column totals		98	102	200

  (i) Write down null and alternative hypotheses for a test to examine whether there is any association between amount spent and sex of person. **[1]**

The contributions to the test statistic for the usual χ^2 test are shown in the table below.

		Sex	
		Male	Female
Amount spent	Nothing	0.1865	0.1791
	Less than £50	0.1409	0.1354
	£50 up to £200	0.0982	0.0944
	£200 up to £1000	0.7918	0.7608
	£1000 or more	0.4171	0.4007

The sum of these contributions, correct to 3 decimal places, is 3.205.

  (ii) Calculate the expected frequency for females spending nothing. Verify the corresponding contribution, 0.1791, to the test statistic. **[3]**

  (iii) Carry out the test at the 5% level of significance, stating your conclusion clearly. **[5]**

 (b) A bakery sells loaves specified as having a mean weight of 400 grams. It is known that the weights of these loaves are Normally distributed and that the standard deviation is 5.7 grams. An inspector suspects that the true mean weight may be less than 400 grams. In order to test this, the inspector takes a random sample of 6 loaves. Carry out a suitable test at the 5% level, given that the weights, in grams, of the 6 loaves are as follows. **[9]**

    392.1   405.8   401.3   387.4   391.8   400.6