OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

MATHEMATICS (MEI) **4767**

Statistics 2

Candidates answer on the Answer Booklet

OCR Supplied Materials:
*   8 page Answer Booklet
*   Graph paper
*   MEI Examination Formulae and Tables (MF2)

Other Materials Required:
None

Monday 15 June 2009
Afternoon

Duration: 1 hour 30 minutes
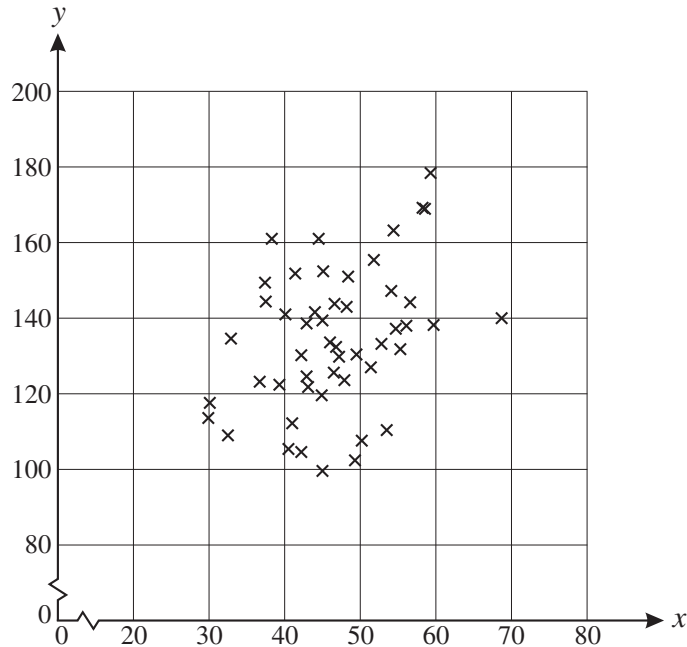
4767

INSTRUCTIONS TO CANDIDATES

*   Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
*   Use black ink. Pencil may be used for graphs and diagrams only.
*   Read each question carefully and make sure that 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 graphical calculator in this paper.
*   Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

*   The number of marks is given in brackets **[ ]** at the end of each question or part question.
*   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**.
*   This document consists of **4** pages. Any blank pages are indicated.

1 An investment analyst thinks that there may be correlation between the cost of oil, x dollars per barrel, and the price of a particular share, y pence. The analyst selects 50 days at random and records the values of x and y. Summary statistics for these data are shown below, together with a scatter diagram.

$$\Sigma x = 2331.3 \quad \Sigma y = 6724.3 \quad \Sigma x^2 = 111\,984 \quad \Sigma y^2 = 921\,361 \quad \Sigma xy = 316\,345 \quad n = 50$$

(i) Calculate the sample product moment correlation coefficient. **[5]**

(ii) Carry out a hypothesis test at the 5% significance level to investigate the analyst's belief. State your hypotheses clearly, defining any symbols which you use. **[6]**

(iii) An assumption that there is a bivariate Normal distribution is required for this test to be valid. State whether it is the sample or the population which is required to have such a distribution. State, with a reason, whether in this case the assumption appears to be justified. **[3]**

(iv) Explain why a 2-tail test is appropriate even though it is clear from the scatter diagram that the sample has a positive correlation coefficient. **[2]**

2   Jess is watching a shower of meteors (shooting stars). During the shower, she sees meteors at an average rate of 1.3 per minute.

   (i) State conditions required for a Poisson distribution to be a suitable model for the number of meteors which Jess sees during a randomly selected minute. **[2]**

   You may assume that these conditions are satisfied.

   (ii) Find the probability that, during one minute, Jess sees

      (*A*) exactly one meteor,

      (*B*) at least 4 meteors. **[4]**

   (iii) Find the probability that, in a period of 10 minutes, Jess sees exactly 10 meteors. **[3]**

   (iv) Use a suitable approximating distribution to find the probability that Jess sees a total of at least 100 meteors during a period of one hour. **[5]**

   (v) Jess watches the shower for t minutes. She wishes to be at least 99% certain that she will see one or more meteors. Find the smallest possible integer value of t. **[5]**

3   Intensity of light is measured in lumens. The random variable X represents the intensity of the light from a standard 100 watt light bulb. X is Normally distributed with mean 1720 and standard deviation 90. You may assume that the intensities for different bulbs are independent.

   (i) Show that $P(X < 1700) = 0.4121$. **[4]**

   (ii) These bulbs are sold in packs of 4. Find the probability that the intensities of exactly 2 of the 4 bulbs in a randomly chosen pack are below 1700 lumens. **[3]**

   (iii) Use a suitable approximating distribution to find the probability that the intensities of at least 20 out of 40 randomly selected bulbs are below 1700 lumens. **[5]**

   A manufacturer claims that the average intensity of its 25 watt low energy light bulbs is 1720 lumens. A consumer organisation suspects that the true figure may be lower than this. The intensities of a random sample of 20 of these bulbs are measured. A hypothesis test is then carried out to check the claim.

   (iv) Write down a suitable null hypothesis and explain briefly why the alternative hypothesis should be $H_1 : \mu < 1720$. State the meaning of μ. **[3]**

   (v) Given that the standard deviation of the intensity of such bulbs is 90 lumens and that the mean intensity of the sample of 20 bulbs is 1703 lumens, carry out the test at the 5% significance level. **[5]**

4 In a traffic survey a random sample of 400 cars passing a particular location during the rush hour is selected. The type of car and the sex of the driver are classified as follows.

		Sex		Row totals
		Male	Female	
Type of car	Hatchback	96	36	132
	Saloon	77	35	112
	People carrier	38	44	82
	4WD	19	8	27
	Sports car	22	25	47
Column totals		252	148	400

(i) Carry out a test at the 5% significance level to examine whether there is any association between type of car and sex of driver. State carefully your null and alternative hypotheses. Your working should include a table showing the contributions of each cell to the test statistic. **[12]**

(ii) For each type of car, comment briefly on how the number of drivers of each sex compares with what would be expected if there were no association. **[5]**