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:
- Scientific or graphical calculator

Friday 18 June 2010
Afternoon

Duration: 1 hour 30 minutes

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 Two celebrities judge a talent contest. Each celebrity gives a score out of 20 to each of a random sample of 8 contestants. The scores, x and y, given by the celebrities to each contestant are shown below.

Contestant	A	B	C	D	E	F	G	H
x	6	17	9	20	13	15	11	14
y	6	13	10	11	9	7	12	15

(i) Calculate the value of Spearman's rank correlation coefficient. **[5]**

(ii) Carry out a hypothesis test at the 5% significance level to determine whether there is positive association between the scores allocated by the two celebrities. **[6]**

(iii) State the distributional assumption required for a test based on the product moment correlation coefficient. Sketch a scatter diagram of the scores above, and discuss whether it appears that the assumption is likely to be valid. **[5]**

2 A radioactive source is decaying at a mean rate of 3.4 counts per 5 seconds.

(i) State conditions for a Poisson distribution to be a suitable model for the rate of decay of the source. **[2]**

You may assume that a Poisson distribution with a mean rate of 3.4 counts per 5 seconds is a suitable model.

(ii) State the variance of this Poisson distribution. **[1]**

(iii) Find the probability of

(*A*) exactly 3 counts in a 5-second period,

(*B*) at least 3 counts in a 5-second period. **[5]**

(iv) Find the probability of exactly 40 counts in a period of 60 seconds. **[3]**

(v) Use a suitable approximating distribution to find the probability of at least 40 counts in a period of 60 seconds. **[5]**

(vi) The background radiation rate also, independently, follows a Poisson distribution and produces a mean count of 1.4 per 5 seconds. Find the probability that the radiation source together with the background radiation give a total count of at least 8 in a 5-second period. **[3]**

3 In a men's cycling time trial, the times are modelled by the random variable X minutes which is Normally distributed with mean 63 and standard deviation 5.2.

(i) Find

(A) $P(X < 65)$,

(B) $P(60 < X < 65)$. **[6]**

(ii) Find the probability that 5 riders selected at random all record times between 60 and 65 minutes. **[2]**

(iii) A competitor aims to be in the fastest 5% of entrants (i.e. those with the lowest times). Find the maximum time that he can take. **[3]**

It is suggested that holding the time trial on a new course may result in lower times. To investigate this, a random sample of 15 competitors is selected. These 15 competitors do the time trial on the new course. The mean time taken by these riders is 61.7 minutes. You may assume that times are Normally distributed and the standard deviation is still 5.2 minutes. A hypothesis test is carried out to investigate whether times on the new course are lower.

(iv) Write down suitable null and alternative hypotheses for the test. Carry out the test at the 5% significance level. **[8]**

4 In a survey a random sample of 63 runners is selected. The category of runner and the type of running are classified as follows.

		Category of runner			Row totals
		Junior	Senior	Veteran	
Type of running	Track	9	8	2	19
	Road	4	8	12	24
	Both	4	10	6	20
Column totals		17	26	20	63

(i) Carry out a test at the 5% significance level to examine whether there is any association between category of runner and the type of running. 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 category of runner, comment briefly on how the type of running compares with what would be expected if there were no association. **[6]**