OCR
RECOGNISING ACHIEVEMENT

Monday 23 January 2012 – Morning

A2 GCE MATHEMATICS (MEI)

4767   Statistics 2

QUESTION PAPER

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. HB 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 recycled. Please contact OCR Copyright should you wish to re-use this document.

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Turn over

1   Nine long-distance runners are starting an exercise programme to improve their strength. During the first session, each of them has to do a 100 metre run and to do as many push-ups as possible in one minute. The times taken for the run, together with the number of push-ups each runner achieves, are shown in the table.

Runner	A	B	C	D	E	F	G	H	I
100 metre time (seconds)	13.2	11.6	10.9	12.3	14.7	13.1	11.7	13.6	12.4
Push-ups achieved	32	42	22	36	41	27	37	38	33

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

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

   (iii) Carry out a hypothesis test at the 5% significance level to examine whether there is any association between time taken for the run and number of push-ups achieved.   **[6]**

   (iv) Under what circumstances is it appropriate to carry out a hypothesis test based on the product moment correlation coefficient? State, with a reason, which test is more appropriate for these data.   **[3]**

2   The number of printing errors per page in a book is modelled by a Poisson distribution with a mean of 0.85.

   (i) State conditions for a Poisson distribution to be a suitable model for the number of printing errors per page.   **[2]**

   (ii) A page is chosen at random. Find the probability of

   (*A*) exactly 1 error on this page,

   (*B*) at least 2 errors on this page.   **[5]**

10 pages are chosen at random.

   (iii) Find the probability of exactly 10 errors in these 10 pages.   **[3]**

   (iv) Find the least integer k such that the probability of there being k or more errors in these 10 pages is less than 1%.   **[4]**

30 pages are chosen at random.

   (v) Use a suitable approximating distribution to find the probability of no more than 30 errors in these 30 pages.   **[5]**

3 The lifetime of a particular type of light bulb is *X* hours, where *X* is Normally distributed with mean 1100 and variance 2000.

  (i) Find P$(1100 < X < 1200)$. **[3]**

 (ii) Use a suitable approximating distribution to find the probability that, in a random sample of 100 of these light bulbs, no more than 40 have a lifetime between 1100 and 1200 hours. **[5]**

(iii) A factory has a large number of these light bulbs installed. As soon as 1% of the bulbs have come to the end of their lifetimes, it is company policy to replace all of the bulbs. After how many hours should the bulbs need to be replaced? **[3]**

(iv) The bulbs are to be replaced by low-energy bulbs. The lifetime of these bulbs is Normally distributed and the mean is claimed by the manufacturer to be 7000 hours. The standard deviation is known to be 100 hours. A random sample of 25 low-energy bulbs is selected. Their mean lifetime is found to be 6972 hours. Carry out a 2-tail test at the 10% level to investigate the claim. **[8]**

[Question 4 is printed overleaf.]

4 Birds are observed at feeding stations in three different places – woodland, farm and garden. The numbers of finches, thrushes and tits observed at each site are summarised in the table. The birds observed are regarded as a random sample from the population of birds of these species that use these feeding stations.

Observed Frequency		Place			
		Farm	Garden	Woodland	Totals
Species	Thrushes	11	74	7	92
	Tits	70	26	88	184
	Finches	17	2	10	29
	Totals	98	102	105	305

The expected frequencies under the null hypothesis for the usual χ^2 test are shown in the table below.

Expected Frequency		Place		
		Farm	Garden	Woodland
Species	Thrushes	29.5607	30.7672	31.6721
	Tits	59.1213	61.5344	63.3443
	Finches	9.3180	9.6984	9.9836

  (i) Verify that the entry 9.3180 is correct. **[2]**

The corresponding contributions to the test statistic are shown in the table below.

Contribution		Place		
		Farm	Garden	Woodland
Species	Thrushes	11.6539	60.7489	19.2192
	Tits	2.0017	20.5201	9.5969
	Finches	6.3332	6.1108	0.0000

  (ii) Verify that the entry 6.3332 is correct. **[2]**

  (iii) Carry out the test at the 1% level of significance. **[7]**

  (iv) For each place, use the table of contributions to comment briefly on the differences between the observed and expected distributions of species. **[6]**