OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MEI STATISTICS

G243

Statistics 3 (Z3)

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
- Printed answer book G243
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Thursday 16 June 2011
Afternoon

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.

Section A (45 marks)

1 An advertisement claims that 'brain training' increases scores in word-matching games. A psychologist decides to investigate this claim. A random sample of 10 people is selected and all of them play the same word-matching game. After one month of doing brain training exercises, these 10 people repeat the word-matching game.

Player	A	B	C	D	E	F	G	H	I	J
Score before brain training	62	56	36	52	58	94	76	58	62	64
Score after brain training	76	54	53	47	48	87	91	62	71	83

(i) Explain why the psychologist has used a paired design. **[2]**

(ii) Use the Wilcoxon signed rank test, at the 5% level of significance, to examine the claim. **[9]**

(iii) The psychologist originally planned to carry out a paired sample t test. However, she decided that the distributional assumption required for this test might not have been satisfied. State this assumption and briefly explain why in general, if this assumption is satisfied, it is preferable to carry out a t test rather than a Wilcoxon test. **[4]**

2 The manager of a gym is investigating a claim that, on the whole, women spend more time using the gym per visit than men. The manager selects independent random samples of 50 women and 50 men using the gym. He asks each person to record the time, in minutes, spent on this visit. The times for the 50 women are summarised by $\Sigma x = 3308$, $\Sigma x^2 = 222\,020$. For the 50 men, the sample mean is 62.68 and the sample variance is 134.0.

(i) Calculate the sample mean and sample variance for the women. **[3]**

(ii) Explain briefly why, even though the population variances are unknown, it is appropriate to use a test based on the Normal distribution to investigate the claim. **[1]**

(iii) Carry out a test at the 10% significance level to investigate the claim. State your hypotheses and conclusions clearly. **[11]**

3 A random sample of 11 countries is selected. The adult literacy rate and the percentage of children under 16 who attend school in these countries are shown in the table.

Country	A	B	C	D	E	F	G	H	I	J	K
Adult literacy rate	41	56	90	97	83	95	98	29	59	76	68
Percentage attending school	67	70	78	91	84	94	92	47	75	90	83

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

(ii) Comment on whether, in view of the scatter diagram, it is appropriate to carry out a hypothesis test based on the product moment correlation coefficient. **[2]**

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

(iv) Using your answer to part **(iii)**, test at the 1% level of significance whether it is reasonable to assume that adult literacy rate and percentage of children under 16 who attend school are positively associated. State your hypotheses and conclusions clearly. **[5]**

Section B (27 marks)

4 Researchers at a crop breeding institute are investigating how the yield of a particular variety of pea is affected by the application of either organic or non-organic fertiliser. They apply three different treatments to a number of plots of peas in a field.

Treatment A:	no fertiliser.
Treatment B:	organic fertiliser.
Treatment C:	non-organic fertiliser.

(i) At least one of the three treatments is a control and at least one is experimental. Identify the control and experimental treatments. **[2]**

(ii) Explain why the researchers apply no fertiliser to one area. **[1]**

(iii) Explain why it would not be sensible to divide the field into three strips and apply one treatment to each strip. **[2]**

(iv) The field is in fact divided into 100 equal-sized plots. 10 of these plots are randomly assigned to each treatment. Explain how 30 plots can be selected at random from 100 plots. **[3]**

Two of the plots with Treatment A (no fertiliser) and three with Treatment B (organic fertiliser) were infected with a disease and the whole of the crop in each of these plots had to be destroyed. The yields, in kg per plot, from the remaining plots were as follows.

Treatment A	231	256	221	289	216	238	241	262
Treatment B	278	294	241	250	290	309	291	

For Treatment A the sample mean is 244.25 and the sample variance is 574.2.
For Treatment B the sample mean is 279 and the sample variance is 612.7.

(v) It is thought that the average yield for the crop with organic fertiliser may be greater than that for the crop with no fertiliser. State the assumptions which are required for a t test to examine whether the mean yields of the crops with organic fertiliser and with no fertiliser appear to be the same. Given that these assumptions are valid, carry out the test at the 5% significance level, stating your hypotheses and conclusions clearly. **[14]**

(vi) The researchers wish to test whether there is any difference in average yield between peas grown with organic fertiliser and those grown with non-organic fertiliser. They carry out a Wilcoxon rank sum test. State appropriate hypotheses for the test. Given that the value of the test statistic is 42 and the sample sizes for organic and non-organic are 7 and 8 respectively, complete the test at the 5% level, stating your conclusions clearly. **[5]**