General Certificate of Education
January 2007
Advanced Subsidiary Examination

STATISTICS **SS03**
Unit Statistics 3

Tuesday 16 January 2007 9.00 am to 10.30 am

For this paper you must have:
- an 8-page answer book
- the **blue** AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is SS03.
- Answer **all** questions.
- Show all necessary working; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information
- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.

Answer **all** questions.

1 A psychology student carries out a test on short-term memory. She reads a list of 20 commonly used words to ten 18-year-old females. Immediately after reading out these 20 words, she asks the females to write down as many of the words from the list as they can remember in 5 minutes.

The females may be regarded as a random sample of all 18-year-old females.

The numbers of words remembered by the 18-year-old females were

10 8 5 2 11 6 13 9 14 12

The median number of words remembered by 60-year-old females in this test on short-term memory is known to be 6.

Carry out a Wilcoxon signed-rank test to determine whether there is any support for the claim that the median number of words remembered by 18-year-old females is greater than that for 60-year-old females. Use the 5% level of significance. *(8 marks)*

2 (a) Randomly selected adults in a European country were asked for their views regarding a royal wedding. The responses given by the 353 men and 363 women are summarised in **Table 1**.

Table 1

Sex \ Response	Approve of wedding	Disapprove of wedding	Don't care
Male	71	35	247
Female	98	62	203

(i) Test, at the 1% level of significance, whether the response is independent of the sex of the person asked. *(8 marks)*

(ii) Interpret your conclusion in part (a)(i). *(2 marks)*

(iii) Make one further statement regarding the responses. *(1 mark)*

(b) Another random sample of adults in the same European country was asked for their views regarding the monarchy. **Table 2** shows the percentages of males and of females giving each response.

Table 2

Sex \ Response	Support Monarchy	Do not support Monarchy	No opinion
Male	25	34	41
Female	55	30	15

(i) Give a reason why the data in **Table 2** cannot be analysed to investigate whether there is an association between response and sex using the χ^2 distribution. *(1 mark)*

(ii) State what further information regarding this random sample is required, and explain how this further information would be used, in order to make the analysis suggested in part (b)(i) feasible. *(2 marks)*

3 A study was carried out into mortality ratios at hospitals. Hospital standardised mortality ratios were obtained for weekdays and weekends during 2004. The ratios are given in the table for each of 10 randomly selected major teaching hospitals.

Hospital	Weekday	Weekend
A	95	100
B	95	98
C	96	97
D	99	98
E	97	98
F	98	97
G	98	101
H	95	99
I	96	99
J	96	101

(a) Carry out a sign test, using the 10% level of significance, to investigate whether major teaching hospitals, on average, have a higher standardised mortality ratio during weekends than during weekdays.

Interpret your conclusion in context. *(7 marks)*

(b) Explain, in the context of this question, the meaning of a Type II error. *(2 marks)*

4 A company wishes to analyse the performance of its managers in three different departments. The evaluation scores, out of a maximum of 50, are given in the table for 17 managers selected at random from the three departments.

Department A	Department B	Department C
13	8	25
30	10	29
35	15	34
42	18	38
45	20	40
47		46

(a) Carry out a Kruskal–Wallis test, using the 5% significance level, to investigate whether there is any difference between the average evaluation scores for the managers in the three departments.

Interpret your conclusion in context. *(12 marks)*

(b) Managers in one of the three departments did not receive an annual bonus payment for the previous year.

Identify, with a reason, the department whose managers you think are least likely to have received an annual bonus payment for the previous year. *(2 marks)*

5 A supermarket fruit manager wishes to investigate the quality of bananas. Bananas are either delivered 'chilled' from source or 'stored at 10 °C' from source. The times to over-ripening of a random sample of 'chilled' bananas and of a random sample of 'stored at 10 °C' bananas are obtained and the rank values are given in the table.

(Rank 1 indicates the banana that was the fastest to become over-ripe.)

Chilled	2	6	5	8	1	
Stored at 10 °C	3	4	9	10	7	11

The supermarket fruit manager believes that 'chilled' bananas become over-ripe faster than bananas 'stored at 10 °C'.

Carry out a Mann–Whitney U test, at the 5% level of significance, to investigate this belief.

Interpret your conclusion in context. *(9 marks)*

6 Percentage marks were obtained for a random sample of 10 university economics students for their second year examinations in micro-economics and in macro-economics. The results are given in the table.

Student	Micro-economics	Macro-economics
1	38	28
2	41	45
3	47	53
4	51	57
5	54	52
6	56	47
7	59	54
8	61	58
9	63	63
10	70	69

(a) (i) Calculate the value of Spearman's rank correlation coefficient between the marks for micro-economics and macro-economics. *(5 marks)*

(ii) Carry out a hypothesis test, at the 2% level of significance, to determine whether the value that you calculated in part (a)(i) indicates an association between the marks for micro-economics and macro-economics.

Interpret your conclusion in context. *(5 marks)*

(b) Carry out a Wilcoxon signed-rank test, at the 5% significance level, to investigate whether the average mark for macro-economics differs from the average mark for micro-economics. *(9 marks)*

(c) Comment, in context, on your findings in parts (a) and (b). *(2 marks)*

END OF QUESTIONS

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