General Certificate of Education
June 2005
Advanced Subsidiary Examination

STATISTICS   **SS03**
Unit Statistics 3

Monday 20 June 2005   Morning Session

In addition to this paper you will require:

*   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.
*   All necessary working should be shown; 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.
*   Mark allocations are shown in brackets.

Advice

*   Unless stated otherwise, formulae may be quoted, without proof, from the booklet.

Answer **all** questions.

1 The numbers of home runs, x, and the batting averages, y, for 13 baseball teams in the American League in 1997 are given in the following table.

Team	x	y
Boston	174	0.277
Milwaukee	163	0.276
Kansas City	167	0.272
Seattle	161	0.272
California	172	0.269
Texas	194	0.266
Cleveland	187	0.263
New York	196	0.262
Minnesota	195	0.260
Oakland	199	0.259
Chicago	173	0.258
Baltimore	213	0.257
Toronto	214	0.252

(a) Calculate the value of Spearman's rank correlation coefficient between x and y.

(6 marks)

(b) Carry out a hypothesis test, at the 1% level of significance, to determine whether the value that you calculated in part (a) indicates an association between x and y.

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

2 As part of a new government scheme, a Mathematics examination was introduced for all trainee teachers. In the first two years of the scheme, the median percentage mark gained in the examination was 42.

In the third year, the examination was changed so that it was taken on-line.

The percentage marks for a random sample of 12 trainee teachers who took the examination in the third year are given below.

31   43   48   61   52   39   48   36   47   40   57   45

Carry out a sign test, at the 10% level of significance, to investigate the claim that the median percentage mark has increased since the introduction of the new on-line examination.

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

3 A carpet warehouse decides to compare two types of carpet adhesive. The times, in minutes, for each adhesive to fix on nine different types of carpet are recorded and the results are given in the following table.

Carpet type	A	B	C	D	E	F	G	H	I
Adhesive 1	38	118	80	107	104	114	68	127	52
Adhesive 2	42	132	95	118	149	121	62	132	49

(a) (i) Carry out a Wilcoxon signed-rank test, at the 5% significance level, to investigate whether or not there is any difference in the average fixing times for the two adhesives.

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

(ii) Suggest **one** factor, other than fixing time, that the carpet warehouse should take into account before deciding which of the two adhesives to use. *(1 mark)*

(b) Explain briefly the advantage of using a matched pairs design, rather than independent samples, for the investigation in part (a). *(2 marks)*

Turn over ▶

4 A mail order company collects information from a random sample of 200 orders. The orders are categorised as being placed during a promotional campaign, during the sale or at other times.

The returns status is also recorded for each order. This is either "no items returned" or "some items returned".

The information is summarised in the following table.

When order placed / Returns status	Promotional campaign	Sale	Other times
No items returned	55	28	81
Some items returned	5	12	19

(a) (i) Investigate, at the 5% significance level, whether or not the returns status is independent of when the order was placed. *(8 marks)*

(ii) Describe any differences found in the returns status for the three different categories of when the order was placed. *(2 marks)*

(b) A further 100 orders are investigated. It is found that 28 of these are from first-time customers. Of these first-time customers, 8 returned some items and, of the other regular customers, 29 returned some items.

(i) Form a 2×2 contingency table from the above information. *(2 marks)*

(ii) Carry out a χ^2 test, at the 5% level of significance, to investigate whether returning some items from an order is independent of whether the order is made by a regular or by a first-time customer.

Interpret your conclusion in context. *(8 marks)*

5 An investigation is carried out into the effect of three fertilisers on the yield of strawberry plants. Seventeen identical plots of strawberry plants are randomly assigned to be fed with fertiliser A, fertiliser B or fertiliser C.

The total crop yield, in kilograms, from each of these plots is given in the table below.

Fertiliser A	Fertiliser B	Fertiliser C
14	30	21
17	35	23
26	38	28
27	46	29
31	47	37
	51	39

(a) Carry out a Kruskal–Wallis test, using a 5% significance level, to investigate whether there is any difference between the average yields of the plots that are fed with fertilisers A, B or C. (The formula for the Kruskal–Wallis test is on page 14 of the **blue** AQA booklet of formulae and statistical tables.) *(13 marks)*

(b) (i) Explain what the result of this test indicates about the performance of the three fertilisers. *(2 marks)*

(ii) Identify which fertiliser you would recommend to be fed to strawberry plants in order to obtain the maximum yield of strawberries. *(1 mark)*

TURN OVER FOR THE NEXT QUESTION

6 In a trial of different methods to help students overcome the problems of mild dyslexia, two techniques, "Highlighter" or "Coloured Overlay", were used. Sixteen students, all of whom suffered from mild dyslexia, were randomly assigned to one of the two techniques and, three months later, their abilities to read and answer questions on an article were tested.

Seven of the sixteen students involved in the trial were assigned to the "Highlighter" technique and the rest were assigned to the "Coloured Overlay" technique.

The test scores for their abilities to read and answer questions on the article were then ranked with rank 1 indicating the lowest score.

The total, T_H, of the ranks for the "Highlighter" technique was 66.
The total, T_C, of the ranks for the "Coloured Overlay" technique was 70.

(a) Carry out a Mann-Whitney U test, at the 5% level of significance, to determine whether there is evidence of a difference between the two techniques. *(7 marks)*

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

END OF QUESTIONS

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