General Certificate of Education
June 2005
Advanced Subsidiary Examination

MATHEMATICS   **MS/SS1A / W**
Unit Statistics 1A

STATISTICS
Unit Statistics 1A

Thursday 9 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 15 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 MS/SS1A / W.
• 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 60.
• Mark allocations are shown in brackets.
• Unit Statistics 1A has a **written paper and coursework**.

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

Answer **all** questions.

1 For each of a random sample of 10 customers, a store records the time, x minutes, spent shopping and the value, £y, to the nearest 10p, of items purchased. The results are tabulated below.

Time (x)	13	4	5	10	9	17	23	16	2	16
Value (y)	12.5	5.7	2.3	18.4	7.9	17.1	17.9	18.6	8.3	21.3

(a) (i) Calculate the value of the product moment correlation coefficient between x and y. *(3 marks)*

(ii) Interpret your value in context. *(2 marks)*

(b) Write down the value of the product moment correlation coefficient if the time had been recorded in seconds and the value in pence to the nearest 10p. *(1 mark)*

2 (a) The volume, X millilitres, of toothpaste in medium-sized tubes may be assumed to be normally distributed with a mean of 56 and a standard deviation of 2.5 .

Determine the probability that the volume of toothpaste in a tube is:

(i) less than 60 ml; *(3 marks)*

(ii) between 50 ml and 60 ml; *(3 marks)*

(iii) exactly 55 ml. *(1 mark)*

(b) The volume, Y millilitres, of toothpaste in large-sized tubes may be assumed to be normally distributed with a standard deviation of 3.4 .

Given that 98 per cent of these tubes contain more than 100 ml of toothpaste, determine the mean volume of toothpaste in a large-sized tube. *(4 marks)*

3 A reliable estimate for the proportion of a population of fish with a certain disease is 60 per cent.

A test for the presence of the disease in a fish is possible. The test gives one of three conclusions: diseased, inconclusive, non-diseased.

For a **diseased** fish, the probabilities of these three conclusions are:

$$\begin{array}{ll} \text{diseased} & 0.75 \\ \text{inconclusive} & 0.15 \\ \text{non-diseased} & 0.10 \end{array}$$

For a **non-diseased** fish, the probabilities of these three conclusions are:

$$\begin{array}{ll} \text{diseased} & 0.05 \\ \text{inconclusive} & 0.15 \\ \text{non-diseased} & 0.80 \end{array}$$

 (a) A fish is selected at random. Using a tree diagram, or otherwise, calculate the probability that:

  (i)   the fish has the disease and the test concludes that it is diseased;   *(2 marks)*

  (ii)   the test concludes that the fish has the disease;   *(3 marks)*

  (iii)   the test gives a correct conclusion.   *(2 marks)*

 (b) Three fish, all with the disease, are tested.

Find the probability that the test concludes that two fish are diseased and one fish is non-diseased.   *(3 marks)*

4 The time taken for a fax machine to scan an A4 sheet of paper is dependent, in part, on the number of lines of print on the sheet. The table below shows, for each of a random sample of 8 sheets of A4 paper, the number, x, of lines of print and the scanning time, y seconds, taken by the fax machine.

Sheet	1	2	3	4	5	6	7	8
x	10	16	23	27	31	35	38	44
y	2.4	3.5	3.2	4.1	4.1	5.6	4.6	5.3

(a) Calculate the equation of the least squares regression line of y on x. *(4 marks)*

(b) The following table lists some of the residuals for the regression line.

Sheet	1	2	3	4	5	6	7	8
Residual	-0.174	0.418		0.085	-0.254	0.906		-0.157

  (i) Calculate the values of the residuals for sheets 3 and 7. *(3 marks)*

  (ii) Hence explain what can be deduced about the regression line. *(2 marks)*

5 (a) At a particular checkout in a supermarket, the probability that the barcode reader fails to read the barcode first time on any item is 0.07, and is independent from item to item.

  (i) Calculate the probability that, from a shopping trolley containing 17 items, the reader fails to read the barcode first time on exactly 2 of the items. *(3 marks)*

  (ii) Determine the probability that, from a shopping trolley containing 50 items, the reader fails to read the barcode first time on at most 5 of the items. *(2 marks)*

(b) At another checkout in the supermarket, the probability that a faulty barcode reader fails to read the barcode first time on any item is 0.55, and is independent from item to item.

  Determine the probability that, from a shopping trolley containing 50 items, this reader fails to read the barcode first time on at least 30 of the items. *(3 marks)*

6 On arrival at a business centre, all visitors are required to register at the reception desk. An analysis of the register, for a random sample of 100 days, results in the following information on the number, X, of visitors per day.

Number of visitors per day	Number of days
1 – 10	13
11 – 20	33
21 – 25	17
26 – 30	12
31 – 35	8
36 – 40	5
41 – 50	5
51 – 100	7
Total	**100**

(a) Calculate an estimate of:

   (i) μ, the mean number of visitors per day;

   (ii) σ, the standard deviation of the number of visitors per day.   *(4 marks)*

(b) Give a reason, based upon the data provided, why X is **unlikely** to be normally distributed.
            (1 mark)

(c)   (i)   Give a reason why $\overline{X}$, the mean of a random sample of 100 observations on X, may be assumed to be normally distributed.   *(1 mark)*

    (ii)   State, in terms of μ and σ, the mean and variance of $\overline{X}$.   *(2 marks)*

(d) Hence construct a 99% confidence interval for μ.   *(4 marks)*

(e) The receptionist claims that she registers on average more than 30 visitors per day, and frequently registers more than 50 visitors on any one day.

    Comment on **each** of these **two** claims.   *(4 marks)*

END OF QUESTIONS

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