

General Certificate of Education  
June 2005  
Advanced Subsidiary Examination

**MATHEMATICS**  
**Unit Statistics 1A**

MS/SS1A/W



**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.

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Answer **all** questions.

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

<b>Time (<math>x</math>)</b>	13	4	5	10	9	17	23	16	2	16
<b>Value (<math>y</math>)</b>	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:

diseased	0.75
inconclusive	0.15
non-diseased	0.10

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

diseased	0.05
inconclusive	0.15
non-diseased	0.80

(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)*

**TURN OVER FOR THE NEXT QUESTION**

- 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
<b>Residual</b>	-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
<b>Total</b>	<b>100</b>

- (a) Calculate an estimate of:
- $\mu$ , the mean number of visitors per day;
  - $\sigma$ , 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)
  - Give a reason why  $\bar{X}$ , the mean of a random sample of 100 observations on  $X$ , may be assumed to be normally distributed. (1 mark)
  - State, in terms of  $\mu$  and  $\sigma$ , the mean and variance of  $\bar{X}$ . (2 marks)
- (d) Hence construct a 99% confidence interval for  $\mu$ . (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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