

General Certificate of Education  
June 2005  
Advanced Subsidiary Examination

**MATHEMATICS**  
**Unit Statistics 1B**

MS/SS1B



**STATISTICS**  
**Unit Statistics 1B**

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 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 MS/SS1B.
- 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.
- Unit Statistics 1B has a **written paper only**.

**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 The weight,  $X$  grams, of a particular variety of orange is normally distributed with mean 205 and standard deviation 25.
- (a) Determine the probability that the weight of an orange is:
- (i) less than 250 grams; (3 marks)
- (ii) between 200 grams and 250 grams. (3 marks)
- (b) A wholesaler decides to grade such oranges by weight. He decides that the smallest 30 per cent should be graded as small, the largest 20 per cent graded as large, and the remainder graded as medium.
- Determine, to one decimal place, the maximum weight of an orange graded as:
- (i) small;
- (ii) medium. (5 marks)
- (c) The weight,  $Y$  grams, of a second variety of orange is normally distributed with mean 175.
- Given that 90 per cent of these oranges weigh less than 200 grams, calculate the standard deviation of their weights. (4 marks)

3 Fred and his daughter, Delia, support their town's rugby team. The probability that Fred watches a game is 0.8. The probability that Delia watches a game is 0.9 when her father watches the game, and is 0.4 when her father does not watch the game.

(a) Calculate the probability that:

(i) both Fred and Delia watch a particular game; *(2 marks)*

(ii) neither Fred nor Delia watch a particular game. *(2 marks)*

(b) Molly supports the same rugby team as Fred and Delia. The probability that Molly watches a game is 0.7, and is independent of whether or not Fred or Delia watches the game.

Calculate the probability that:

(i) all 3 supporters watch a particular game; *(3 marks)*

(ii) exactly 2 of the 3 supporters watch a particular game. *(4 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)
- (c) The time,  $z$  seconds, to **transmit** an A4 page after scanning is given by:

$$z = 0.80 + 0.05x$$

Estimate the **total** time to scan and transmit an A4 page containing:

- (i) 15 lines of print;
- (ii) 75 lines of print.

In **each** case comment on the likely reliability of your estimate. (5 marks)

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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)*

(c) At a third checkout in the supermarket, a record is kept of  $X$ , the number of times per 50 items that the barcode reader fails to read a barcode first time. An analysis of the records gives a mean of 10 and a standard deviation of 6.8.

(i) Estimate  $p$ , the probability that the barcode reader fails to read a barcode first time. *(1 mark)*

(ii) Using your estimate of  $p$  and assuming that  $X$  can be modelled by a binomial distribution, estimate the standard deviation of  $X$ . *(2 marks)*

(iii) Hence comment on the assumption that  $X$  can be modelled by a binomial distribution. *(2 marks)*

**TURN OVER FOR THE NEXT QUESTION**

- 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**

**THERE ARE NO QUESTIONS PRINTED ON THIS PAGE**

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