General Certificate of Education
June 2006
Advanced Subsidiary Examination

MATHEMATICS **MS/SS1B**
Unit Statistics 1B

STATISTICS
Unit Statistics 1B

Wednesday 24 May 2006 1.30 pm to 3.00 pm

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

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

Answer **all** questions.

1 The table shows, for each of a random sample of 8 paperback fiction books, the number of pages, x, and the recommended retail price, £y, to the nearest 10p.

x	223	276	374	433	564	612	704	766
y	6.50	4.00	5.50	8.00	4.50	5.00	8.00	5.50

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

(ii) Interpret your value in the context of this question. *(2 marks)*

(iii) Suggest one other variable, in addition to the number of pages, which may affect the recommended retail price of a paperback fiction book. *(1 mark)*

(b) The same 8 books were later included in a book sale. The value of the product moment correlation coefficient between the number of pages and the sale price was 0.959, correct to three decimal places.

What can be concluded from this value? *(2 marks)*

2 The heights of sunflowers may be assumed to be normally distributed with a mean of 185 cm and a standard deviation of 10 cm.

(a) Determine the probability that the height of a randomly selected sunflower:

(i) is less than 200 cm; *(3 marks)*

(ii) is more than 175 cm; *(3 marks)*

(iii) is between 175 cm and 200 cm. *(2 marks)*

(b) Determine the probability that the mean height of a random sample of 4 sunflowers is more than 190 cm. *(4 marks)*

3 A new car tyre is fitted to a wheel. The tyre is inflated to its recommended pressure of 265 kPa and the wheel left unused. At 3-month intervals thereafter, the tyre pressure is measured with the following results:

Time after fitting (x months)	0	3	6	9	12	15	18	21	24
Tyre pressure (y kPa)	265	250	240	235	225	215	210	195	180

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

(ii) Interpret in context the value for the gradient of your line. *(2 marks)*

(iii) Comment on the value for the intercept with the y-axis of your line. *(2 marks)*

(b) The tyre manufacturer states that, when one of these new tyres is fitted to the wheel of a car and then inflated to 265 kPa, a suitable regression equation is of the form

$$y = 265 + bx$$

The manufacturer also states that, as the car is used, the tyre pressure will decrease at twice the rate of that found in part (a).

(i) Suggest a suitable value for b. *(2 marks)*

(ii) One of these new tyres is fitted to the wheel of a car and inflated to 265 kPa. The car is then used for 8 months, after which the tyre pressure is checked for the first time.

Show that, accepting the manufacturer's statements, the tyre pressure can be expected to have fallen below its minimum safety value of 220 kPa. *(2 marks)*

Turn over for the next question

4 The weights of packets of sultanas may be assumed to be normally distributed with a standard deviation of 6 grams.

The weights of a random sample of 10 packets were as follows:

498 496 499 511 503 505 510 509 513 508

(a) (i) Construct a 99% confidence interval for the mean weight of packets of sultanas, giving the limits to one decimal place. *(5 marks)*

(ii) State why, in calculating your confidence interval, use of the Central Limit Theorem was **not** necessary. *(1 mark)*

(iii) On each packet it states 'Contents 500 grams'.

Comment on this statement using **both** the given sample **and** your confidence interval. *(3 marks)*

(b) Given that the mean weight of all packets of sultanas is 500 grams, state the probability that a 99% confidence interval for the mean, calculated from a random sample of packets, will **not** contain 500 grams. *(1 mark)*

5 Kirk and Les regularly play each other at darts.

(a) The probability that Kirk wins any game is 0.3, and the outcome of each game is independent of the outcome of every other game.

Find the probability that, in a match of 15 games, Kirk wins:

(i) exactly 5 games; *(3 marks)*

(ii) fewer than half of the games; *(3 marks)*

(iii) more than 2 but fewer than 7 games. *(3 marks)*

(b) Kirk attends darts coaching sessions for three months. He then claims that he has a probability of 0.4 of winning any game, and that the outcome of each game is independent of the outcome of every other game.

(i) Assuming this claim to be true, calculate the mean and standard deviation for the number of games won by Kirk in a match of 15 games. *(3 marks)*

(ii) To assess Kirk's claim, Les keeps a record of the number of games won by Kirk in a series of 10 matches, each of 15 games, with the following results:

8 5 6 3 9 12 4 2 6 5

Calculate the mean and standard deviation of these values. *(2 marks)*

(iii) Hence comment on the validity of Kirk's claim. *(3 marks)*

Turn over for the next question

6 A housing estate consists of 320 houses: 120 detached and 200 semi-detached. The numbers of children living in these houses are shown in the table.

	Number of children				
	None	**One**	**Two**	**At least three**	**Total**
Detached house	24	32	41	23	120
Semi-detached house	40	37	88	35	200
Total	64	69	129	58	320

A house on the estate is selected at random.

D denotes the event 'the house is detached'.
R denotes the event 'no children live in the house'.
S denotes the event 'one child lives in the house'.
T denotes the event 'two children live in the house'.
(D' denotes the event 'not D'.)

(a) Find:

(i) $\mathrm{P}(D)$; *(1 mark)*

(ii) $\mathrm{P}(D \cap R)$; *(1 mark)*

(iii) $\mathrm{P}(D \cup T)$; *(2 marks)*

(iv) $\mathrm{P}(D \mid R)$; *(2 marks)*

(v) $\mathrm{P}(R \mid D')$. *(3 marks)*

(b) (i) Name two of the events D, R, S and T that are mutually exclusive. *(1 mark)*

(ii) Determine whether the events D and R are independent. Justify your answer. *(2 marks)*

(c) Define, in the context of this question, the event:

(i) $D' \cup T$; *(2 marks)*

(ii) $D \cap (R \cup S)$. *(2 marks)*

END OF QUESTIONS

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