General Certificate of Education
January 2006
Advanced Subsidiary Examination

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

STATISTICS
Unit Statistics 1B

Thursday 12 January 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
- an insert for use in Question 5 (enclosed)

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.
- Fill in the boxes at the top of the insert.

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, formulae may be quoted, without proof, from the booklet.

Answer **all** questions.

1 At a certain small restaurant, the waiting time is defined as the time between sitting down at a table and a waiter first arriving at the table. This waiting time is dependent upon the number of other customers already seated in the restaurant.

Alex is a customer who visited the restaurant on 10 separate days. The table shows, for each of these days, the number, x, of customers already seated and his waiting time, y minutes.

x	9	3	4	10	8	12	7	11	2	6
y	11	6	5	11	9	13	9	12	4	7

(a) Calculate the equation of the least squares regression line of y on x in the form $y = a + bx$. *(4 marks)*

(b) Give an interpretation, in context, for each of your values of a and b. *(2 marks)*

(c) Use your regression equation to estimate Alex's waiting time when the number of customers already seated in the restaurant is:

(i) 5;

(ii) 25. *(2 marks)*

(d) Comment on the likely reliability of **each** of your estimates in part (c), given that, for the regression line calculated in part (a), the values of the 10 residuals lie between +1.1 minutes and −1.1 minutes. *(3 marks)*

2 Xavier, Yuri and Zara attend a sports centre for their judo club's practice sessions. The probabilities of them arriving late are, independently, 0.3, 0.4 and 0.2 respectively.

(a) Calculate the probability that for a particular practice session:

(i) all three arrive late; *(1 mark)*

(ii) none of the three arrives late; *(2 marks)*

(iii) only Zara arrives late. *(2 marks)*

(b) Zara's friend, Wei, also attends the club's practice sessions. The probability that Wei arrives late is 0.9 when Zara arrives late, and is 0.25 when Zara does not arrive late.

Calculate the probability that for a particular practice session:

(i) both Zara and Wei arrive late; *(2 marks)*

(ii) either Zara or Wei, but not both, arrives late. *(3 marks)*

3 When an alarm is raised at a market town's fire station, the fire engine cannot leave until at least five fire-fighters arrive at the station. The call-out time, X minutes, is the time between an alarm being raised and the fire engine leaving the station.

The value of X was recorded on a random sample of 50 occasions. The results are summarised below, where $\bar{x}$ denotes the sample mean.

$$\sum x = 286.5 \qquad \sum (x - \bar{x})^2 = 45.16$$

(a) Find values for the mean and standard deviation of this sample of 50 call-out times. *(2 marks)*

(b) Hence construct a 99% confidence interval for the mean call-out time. *(4 marks)*

(c) The fire and rescue service claims that the station's mean call-out time is less than 5 minutes, whereas a parish councillor suggests that it is more than $6\frac{1}{2}$ minutes.

Comment on **each** of these claims. *(2 marks)*

4 The time, x seconds, spent by each of a random sample of 100 customers at an automatic teller machine (ATM) is recorded. The times are summarised in the table.

Time (seconds)	Number of customers
$20 < x \leqslant 30$	2
$30 < x \leqslant 40$	7
$40 < x \leqslant 60$	18
$60 < x \leqslant 80$	27
$80 < x \leqslant 100$	23
$100 < x \leqslant 120$	13
$120 < x \leqslant 150$	7
$150 < x \leqslant 180$	3
Total	**100**

(a) Calculate estimates for the mean and standard deviation of the time spent at the ATM by a customer. *(4 marks)*

(b) The mean time spent at the ATM by a random sample of **36** customers is denoted by $\overline{Y}$.

(i) State why the distribution of $\overline{Y}$ is approximately normal. *(1 mark)*

(ii) Write down estimated values for the mean and standard error of $\overline{Y}$. *(2 marks)*

(iii) Hence estimate the probability that $\overline{Y}$ is less than $1\frac{1}{2}$ minutes. *(3 marks)*

5 [**Figure 1**, printed on the insert, is provided for use in this question.]

The table shows the times, in seconds, taken by a random sample of 10 boys from a junior swimming club to swim 50 metres freestyle and 50 metres backstroke.

Boy	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Freestyle (x seconds)	30.2	32.8	25.1	31.8	31.2	35.6	32.4	38.0	36.1	34.1
Backstroke (y seconds)	33.5	35.4	37.4	27.2	34.7	38.2	37.7	41.4	42.3	38.4

(a) On **Figure 1**, complete the scatter diagram for these data. *(2 marks)*

(b) Hence:

(i) give **two** distinct comments on what your scatter diagram reveals; *(2 marks)*

(ii) state, **without calculation**, which of the following 3 values is most likely to be the value of the product moment correlation coefficient for the data in your scatter diagram.

0.912 0.088 0.462 *(1 mark)*

(c) In the sample of 10 boys, one boy is a junior-champion freestyle swimmer and one boy is a junior-champion backstroke swimmer.

Identify the **two** most likely boys. *(2 marks)*

(d) **Removing the data for the two boys whom you identified in part (c):**

(i) calculate the value of the product moment correlation coefficient for the remaining 8 pairs of values of x and y; *(3 marks)*

(ii) comment, in context, on the value that you obtain. *(1 mark)*

6 Plastic clothes pegs are made in various colours.

The number of red pegs may be modelled by a binomial distribution with parameter p equal to 0.2.

The contents of packets of 50 pegs of mixed colours may be considered to be random samples.

(a) Determine the probability that a packet contains:

(i) less than or equal to 15 red pegs; *(2 marks)*

(ii) exactly 10 red pegs; *(2 marks)*

(iii) more than 5 but fewer than 15 red pegs. *(3 marks)*

(b) Sly, a student, claims to have counted the number of red pegs in each of 100 packets of 50 pegs. From his results the following values are calculated.

$$\text{Mean number of red pegs per packet} = 10.5$$

$$\text{Variance of number of red pegs per packet} = 20.41$$

Comment on the validity of Sly's claim. *(4 marks)*

7 (a) The weight, X grams, of soup in a carton may be modelled by a normal random variable with mean 406 and standard deviation 4.2.

Find the probability that the weight of soup in a carton:

(i) is less than 400 grams; *(3 marks)*

(ii) is between 402.5 grams and 407.5 grams. *(4 marks)*

(b) The weight, Y grams, of chopped tomatoes in a tin is a normal random variable with mean μ and standard deviation σ.

(i) Given that $P(Y < 310) = 0.975$, explain why:

$$310 - \mu = 1.96\sigma$$ *(3 marks)*

(ii) Given that $P(Y < 307.5) = 0.86$, find, to two decimal places, values for μ and σ. *(4 marks)*

END OF QUESTIONS

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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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ASSESSMENT and QUALIFICATIONS ALLIANCE

MATHEMATICS **MS/SS1B**
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STATISTICS
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Insert

Thursday 12 January 2006 1.30 pm to 3.00 pm

Insert for use in **Question 5**.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

Turn over for Figure 1

Figure 1 (for use in Question 5)

Scatter Diagram for Freestyle and Backstroke Swimming Times