General Certificate of Education
January 2008
Advanced Subsidiary Examination

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

STATISTICS
Unit Statistics 1B

Tuesday 22 January 2008   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 4 (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.
 • 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.
 • 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, you may quote formulae, without proof, from the booklet.

Answer **all** questions.

1   In large-scale tree-felling operations, a machine cuts down trees, strips off the branches and then cuts the trunks into logs of length X metres for transporting to a sawmill.

It may be assumed that values of X are normally distributed with mean μ and standard deviation 0.16, where μ can be set to a specific value.

(a)   Given that μ is set to 3.3, determine:

(i) $P(X < 3.5)$;   *(3 marks)*

(ii) $P(X > 3.0)$;   *(3 marks)*

(iii) $P(3.0 < X < 3.5)$.   *(2 marks)*

(b)   The sawmill now requires a batch of logs such that there is a probability of 0.025 that any given log will have a length less than 3.1 metres.

Determine, to two decimal places, the new value of μ .   *(4 marks)*

2   The head and body length, x millimetres, and tail length, y millimetres, of each of a sample of 20 adult dormice were measured. The following statistics are derived from the results.

$$S_{xx} = 1280.55 \qquad S_{yy} = 281.8 \qquad S_{xy} = 416.3$$

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

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

(c)   Write down the value of the product moment correlation coefficient if the measurements had been recorded in centimetres.   *(1 mark)*

(d)   Give a reason why it is not generally advisable to calculate the value of the product moment correlation coefficient without first viewing a scatter diagram of the data. Illustrate your answer with a sketch.   *(2 marks)*

3 The height, in metres, of adult male African elephants may be assumed to be normally distributed with mean μ and standard deviation 0.20.

The heights of a sample of 12 such elephants were measured with the following results, in metres.

   3.37   3.45   2.93   3.42   3.49   3.67   2.96   3.57   3.36   2.89   3.22   2.91

(a) Stating a necessary assumption, construct a 98% confidence interval for μ. *(6 marks)*

(b) The mean height of adult male **Asian** elephants is known to be 2.90 metres.

Using your confidence interval, state, with a reason, what can be concluded about the mean heights of adult males in these two types of elephant. *(2 marks)*

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

Roseen is a self-employed decorator who wishes to estimate the times that it will take her to decorate bedrooms based upon their floor areas. She records the floor area, $x\,\mathrm{m}^2$, and the decorating time, y hours, for each of 10 bedrooms she has recently decorated.

x	11.0	22.0	7.5	21.0	13.0	16.5	14.0	16.0	18.5	20.5
y	15.0	35.0	16.0	23.5	24.0	17.5	14.5	27.5	22.5	34.5

(a) On **Figure 1**, plot a scatter diagram of these data. *(2 marks)*

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

(c) Draw your regression line on **Figure 1**. *(2 marks)*

(d)   (i) Use your regression equation to estimate the time that Roseen will take to decorate a bedroom with a floor area of $15\,\mathrm{m}^2$. *(2 marks)*

    (ii) Making reference to **Figure 1**, comment on the likely reliability of your estimate in part (d)(i). *(2 marks)*

5 A health club has a number of facilities which include a gym and a sauna. Andrew and his wife, Heidi, visit the health club together on Tuesday evenings.

On any visit, Andrew uses either the gym or the sauna or both, but no other facilities. The probability that he uses the gym, P(G), is 0.70. The probability that he uses the sauna, P(S), is 0.55. The probability that he uses both the gym and the sauna is 0.25.

(a) Calculate the probability that, on a particular visit:

   (i) he does not use the gym; *(1 mark)*

  (ii) he uses the gym but not the sauna; *(2 marks)*

 (iii) he uses either the gym or the sauna but not both. *(2 marks)*

(b) Assuming that Andrew's decision on what facility to use is independent from visit to visit, calculate the probability that, during a month in which there are exactly four Tuesdays, he does not use the gym. *(2 marks)*

(c) The probability that Heidi uses the gym when Andrew uses the gym is 0.6, but is only 0.1 when he does not use the gym.

Calculate the probability that, on a particular visit, Heidi uses the gym. *(3 marks)*

(d) On any visit, Heidi uses **exactly one** of the club's facilities.

The probability that she uses the sauna is 0.35.

Calculate the probability that, on a particular visit, she uses a facility other than the gym or the sauna. *(2 marks)*

6 For each of the Premiership football seasons 2004/05 and 2005/06, a count is made of the number of goals scored in each of the 380 matches. The results are shown in the table.

Number of goals scored in a match	Number of matches	
	2004/05	2005/06
0	30	32
1	79	82
2	99	95
3	68	78
4	60	48
5	24	30
6	11	9
7	6	6
8	2	0
9	1	0
Total	**380**	**380**

(a) For the number of goals scored in a match during the **2004/05** season:

   (i) determine the median and the interquartile range; *(4 marks)*

   (ii) calculate the mean and the standard deviation. *(4 marks)*

(b) Two statistics students, Jole and Katie, independently analyse the data on the number of goals scored in a match during the **2005/06** season.

- Jole determines correctly that the median is 2 and that the interquartile range is also 2.
- Katie calculates correctly, to two decimal places, that the mean is 2.48 and that the standard deviation is 1.59.

   (i) Use your answers from part (a), together with Jole's and Katie's results, to compare briefly the two seasons with regard to the average and the spread of the number of goals scored in a match. *(2 marks)*

   (ii) Jole claims that Katie's results must be wrong as 95% of values always lie within 2 standard deviations of the mean and $(2.48 - 2 \times 1.59) < 0$ which is nonsense.

      Explain why Jole's claim is incorrect. (You are not expected to confirm Katie's results.) *(2 marks)*

7 A travel agency in Tunisia offers customers a 3-day tour into the Sahara desert by either coach or minibus.

(a) The agency accepts bookings from 50 customers for seats on the coach. The probability that a customer, who has booked a seat on the coach, will **not** turn up to claim the seat is 0.08, and may be assumed to be independent of the behaviour of other customers.

Determine the probability that, of the customers who have booked a seat on the coach:

  (i) two or more will **not** turn up;

  (ii) three or more will **not** turn up. *(4 marks)*

(b) The agency accepts bookings from 15 customers for seats on the minibus. The probability that a customer, who has booked a seat on the minibus, will **not** turn up to claim the seat is 0.025, and may be assumed to be independent of the behaviour of other customers.

Calculate the probability that, of the customers who have booked a seat on the minibus:

  (i) all will turn up;

  (ii) one or more will **not** turn up. *(4 marks)*

(c) The coach has 48 seats and the minibus has 14 seats. If 14 or fewer customers who have booked seats on the minibus turn up, they will be allocated a seat on the minibus. If all 15 customers who have booked seats on the minibus turn up, one will be allocated a seat on the coach. This will leave only 47 seats available for the 50 customers who have booked seats on the coach.

Use your results from parts (a) and (b) to calculate the probability that there will be seats available on the coach for all those who turn up having booked such seats.

(4 marks)

END OF QUESTIONS

There are no questions printed on this page

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Insert

Insert for use in **Question 4**.

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 4)

Floor Areas and Decorating Times