AQA

General Certificate of Education
Advanced Subsidiary Examination
January 2010

Mathematics   MS/SS1B

Unit Statistics 1B

Statistics

Unit Statistics 1B

Wednesday 13 January 2010   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 7 (enclosed).

You may use a graphics calculator.

Time allowed
- 1 hour 30 minutes

Instructions
- Use black ink or black 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 marks for questions are shown in brackets.
- The maximum mark for this paper is 75.
- Unit Statistics 1B has a **written paper only**.

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

MS/SS1B

Answer **all** questions.

1 Draught excluder for doors and windows is sold in rolls of nominal length 10 metres.

The actual length, X metres, of draught excluder on a roll may be modelled by a normal distribution with mean 10.2 and standard deviation 0.15 .

  (a) Determine:

      (i) $P(X < 10.5)$;   *(3 marks)*

      (ii) $P(10.0 < X < 10.5)$.   *(3 marks)*

  (b) A customer randomly selects six 10-metre rolls of the draught excluder.

      Calculate the probability that all six rolls selected contain more than 10 metres of draught excluder.   *(3 marks)*

2 Lizzie, the receptionist at a dental practice, was asked to keep a weekly record of the number of patients who failed to turn up for an appointment. Her records for the first 15 weeks were as follows.

        20   26   32   *a*   37   14   27   34   15   18   *b*   25   37   29   25

Unfortunately, Lizzie forgot to record the actual values for two of the 15 weeks, so she recorded them as *a* and *b*. However, she did remember that $a < 10$ and that $b > 40$.

  (a) Calculate the median and the interquartile range of these 15 values.   *(4 marks)*

  (b) Give a reason why, for these data:

      (i) the mode is **not** an appropriate measure of average;

      (ii) the standard deviation **cannot** be used as a measure of spread.   *(2 marks)*

  (c) Subsequent investigations revealed that the missing values were 8 and 43.

      Calculate the mean and the standard deviation of the 15 values.   *(2 marks)*

3 The table shows, for each of a random sample of 7 weeks, the number of customers, x, who purchased fuel from a filling station, together with the total volume, y litres, of fuel purchased by these customers.

x	230	184	165	147	241	174	210
y	4551	3410	3252	3756	3787	4024	4254

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

(b) Estimate the volume of fuel sold during a week in which 200 customers purchase fuel.
(2 marks)

(c) Comment on the likely reliability of your estimate in part (b), given that, for the regression line calculated in part (a), the values of the 7 residuals lie between approximately -415 litres and $+430$ litres. *(2 marks)*

4 Each school-day morning, three students, Rita, Said and Ting, travel independently from their homes to the same school by one of three methods: walk, cycle or bus. The table shows the probabilities of their independent daily choices.

	Walk	**Cycle**	**Bus**
Rita	0.65	0.10	0.25
Said	0.40	0.45	0.15
Ting	0.25	0.55	0.20

(a) Calculate the probability that, on any given school-day morning:

  (i) all 3 students walk to school; *(2 marks)*

  (ii) only Rita travels by bus to school; *(2 marks)*

  (iii) at least 2 of the 3 students cycle to school. *(4 marks)*

(b) Ursula, a friend of Rita, never travels to school by bus. The probability that:

      Ursula walks to school when Rita walks to school is 0.9 ;
      Ursula cycles to school when Rita cycles to school is 0.7 .

Calculate the probability that, on any given school-day morning, Rita and Ursula travel to school by:

  (i) the same method; *(3 marks)*

  (ii) different methods. *(1 mark)*

Turn over ▶

5 In a random sample of 12 bags of flour, the weight, in grams, of flour in each bag was recorded as follows.

1011   995   1018   1022   1014   1005   1017   1015   993   1018   992   1020

(a) It may be assumed that the weight of flour in a bag is normally distributed with a standard deviation of 10.5 grams.

  (i) Construct a 98% confidence interval for the mean weight, μ grams, of flour in a bag, giving the limits to four significant figures. *(5 marks)*

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

  (iii) If the distribution of the weight of flour in a bag was unknown, indicate a minimum number of weights that you would consider necessary for a confidence interval for μ to be valid. *(1 mark)*

(b) The statement '1 kg' is printed on each bag.

Comment on this statement using **both** the confidence interval that you constructed in part (a)(i) and the weights of the given sample of 12 bags. *(3 marks)*

(c) Given that $\mu = 1000$, state the probability that a 98% confidence interval for μ will **not** contain 1000. *(1 mark)*

6 During the winter, the probability that Barry's cat, Sylvester, chooses to stay outside all night is 0.35, and the cat's choice is independent from night to night.

(a) Determine the probability that, during a period of 2 weeks (14 nights) in winter, Sylvester chooses to stay outside:

  (i) on at most 7 nights; *(2 marks)*

  (ii) on at least 11 nights; *(2 marks)*

  (iii) on more than 5 nights but fewer than 10 nights. *(3 marks)*

(b) Calculate the probability that, during a period of **3 weeks** in winter, Sylvester chooses to stay outside on exactly 4 nights. *(3 marks)*

(c) Barry claims that, during the summer, the number of nights per week, S, on which Sylvester chooses to stay outside can be modelled by a binomial distribution with $n = 7$ and $p = \frac{5}{7}$.

  (i) Assuming that Barry's claim is correct, find the mean and the variance of S. *(2 marks)*

  (ii) For a period of 13 weeks during the summer, the number of nights per week on which Sylvester chose to stay outside had a mean of 5 and a variance of 1.5.

   Comment on Barry's claim. *(2 marks)*

Turn over for the next question

Turn over ▶

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

Harold considers himself to be an expert in assessing the auction value of antiques. He regularly visits car boot sales to buy items that he then sells at his local auction rooms.

Harold's father, Albert, who is not convinced of his son's expertise, collects the following data from a random sample of 12 items bought by Harold.

Item	Purchase price (£x)	Auction price (£y)
A	20	30
B	35	45
C	18	25
D	50	50
E	45	38
F	55	45
G	43	50
H	81	90
I	90	85
J	30	190
K	57	65
L	112	25

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

(3 marks)

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

(c) (i) On **Figure 1**, complete the scatter diagram for these data. *(3 marks)*

   (ii) Comment on what this reveals. *(2 marks)*

(d) When items J and L are omitted from the data, it is found that

$$S_{xx} = 4854.4 \qquad S_{yy} = 4216.1 \qquad S_{xy} = 4268.8$$

   (i) Calculate the value of the product moment correlation coefficient between x and y for the remaining 10 items. *(2 marks)*

   (ii) Hence revise as necessary your interpretation in part (b). *(1 mark)*

END OF QUESTIONS

There are no questions printed on this page

There are no questions printed on this page