

General Certificate of Education
June 2005
Advanced Subsidiary Examination



**MATHEMATICS AND STATISTICS
(SPECIFICATION B)
Unit Statistics 1**

MBS1

Wednesday 25 May 2005 Afternoon Session

In addition to this paper you will require:

- a 12-page answer book;
- the AQA booklet of formulae and statistical tables;
- one sheet of graph paper for use in Question 2;
- one sheet of graph paper for use in Question 6;
- a ruler.

You may use a graphics calculator.

Time allowed: 1 hour 45 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 MBS1.
- 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 80.
- Mark allocations are shown in brackets.

Advice

- Unless stated otherwise, formulae may be quoted, without proof, from the booklet.

Answer **all** questions.

- 1 Henry passes through 6 sets of traffic lights when he drives to work each morning. He estimates that the probability of each set of traffic lights showing green as he approaches is 0.3.

Assume that the probabilities are independent. As he drives to work one morning, find the probability that as he approaches:

- (a) 2 or fewer sets show green;
 (b) more than 3 sets show green;
 (c) all 6 sets show green.

(7 marks)

- 2 [A sheet of graph paper is provided for use in this question.]

Ranjit and Sally each manage a shop in a small town. The following table summarises their weekly takings over a one-year period.

Weekly takings (£)						
	Smallest	Lower quartile	Median	Upper quartile	Second largest	Largest
Ranjit	4157	5013	6477	7189	8003	11248
Sally	3280	4189	6430	8132	8923	9670

- (a) Demonstrate that Sally's weekly takings contain no outliers but Ranjit's weekly takings contain one outlier. (4 marks)
- (b) Draw, using the same axis, box and whisker plots for the takings of each of the two shops. (4 marks)
- (c) Compare, briefly, the weekly takings of the two shops. (2 marks)

- 3 Describe how random numbers could be used to select a simple random sample of size 12 from the 650 members of a model aeroplane club. (5 marks)

4 In the Parkside Sunday Football League, the number of goals scored in each match may be modelled by Poisson distributions.

(a) When the weather is dry, the mean number of goals scored is 1.6 per 60 minutes of play.

Find the probability that on a dry Sunday:

(i) exactly 3 goals are scored during the first 60 minutes of a particular match;
(2 marks)

(ii) a match lasting **90 minutes** ends with the score 0–0; (2 marks)

(iii) when 5 matches, each lasting 90 minutes, are played, a total of 20 or more goals is scored. (3 marks)

(b) When the weather is wet, the mean number of goals scored is 1.2 per 60 minutes of play.

For a match lasting 90 minutes played on a wet Sunday:

(i) find the standard deviation of the number of goals scored; (2 marks)

(ii) explain why there is insufficient data to calculate the probability of the final score being 3–0. (1 mark)

(c) A statistician plans to examine the distribution of the number of goals scored in all matches played during the 2004/5 season. Explain why a Poisson distribution is unlikely to provide an adequate model for this distribution. (1 mark)

TURN OVER FOR THE NEXT QUESTION

- 5 A co-operative owns and runs a shop specialising in organic vegetables. The number of members of the co-operative, classified by age and sex, is given in the table below.

	Age (years)		
	Under 30	30–49	50 and over
Female	3	6	4
Male	2	8	5

- (a) A member is selected at random to represent the co-operative at a meeting. Find the probability that the member selected is:
- (i) female and aged under 30; *(1 mark)*
 - (ii) aged under 30; *(1 mark)*
 - (iii) aged under 30, given that the member is female. *(2 marks)*
- (b) Two members are selected at random to represent the co-operative at another meeting. Find the probability that:
- (i) both are females aged 30–49; *(2 marks)*
 - (ii) one is male and one is female. *(2 marks)*
- (c) R denotes the event that the member selected in part (a) is female.
S denotes the event that the member selected in part (a) is aged under 30.
T denotes the event that the member selected in part (a) is aged 30–49.
- (i) Write down two of the events R, S and T which are mutually exclusive. *(1 mark)*
 - (ii) State whether or not events R and S are independent. Justify your answer. *(2 marks)*

6 [A sheet of graph paper is provided for use in this question.]

Effie inherited a small house from an elderly aunt. The house was in a poor condition. Effie intended to improve the house and then to sell it. She asked a number of estate agents to give an estimated price, y thousand pounds, that she would be able to obtain for the house if she first spent an amount, x thousand pounds, on improvements.

Estate Agent	A	B	C	D	E	F	G	H
x	0.5	7.5	3.6	22.9	10.5	16.8	1.5	35.0
y	41	51	43	68	66	60	45	72

- (a) Plot a scatter diagram of the data. (3 marks)
- (b) Calculate the equation of the regression line of y on x and draw the line on your scatter diagram. (6 marks)
- (c) If the line is of the form $y = a + bx$, give an interpretation, in the context of this question, to each of a and b . (3 marks)
- (d) What does the value of b suggest about the advisability, in purely financial terms, of improving the house before selling it? (2 marks)
- (e) For estate agent E:
- (i) calculate the residual; (2 marks)
- (ii) compare the estimate with the estimates made by the other estate agents. (2 marks)
- (f) After considering the estate agents' estimates, Effie spent £5500 on improvements and sold the house for £59 500. Comment further on the estimate made by estate agent E. (2 marks)

TURN OVER FOR THE NEXT QUESTION

7 Dafydd lives in the Lake District and offers bed and breakfast to visitors. At breakfast, visitors help themselves to orange juice. He observes that the total amount of orange juice required by visitors at each breakfast may be modelled by a normal distribution with mean 1460 ml and standard deviation 400 ml.

(a) Dafydd keeps the orange juice in a fridge in 1000 ml cartons.

Find the probability that at a particular breakfast:

- (i) one full carton of orange juice will be sufficient to meet the visitors' requirements;
- (ii) two, but not more than two, full cartons of orange juice will be needed to meet the visitors' requirements. *(5 marks)*

(b) The mean amount of orange juice required by visitors at the 7 breakfasts in a particular week is denoted by \bar{X} .

- (i) State the distribution of \bar{X} . Assume that the requirement for orange juice at each breakfast is independent. *(2 marks)*
- (ii) Find the value of \bar{X} which is exceeded in 1% of weeks. *(3 marks)*
- (iii) How many full cartons of orange juice must Dafydd have in his fridge, at the beginning of a particular week, to ensure that the probability of being able to meet the visitors' requirements for that week, without replenishing his supplies, is at least 0.99? *(2 marks)*

(c) Dafydd also provides grapefruit juice at breakfast. He observes that at 28% of breakfasts more than 1000 ml of grapefruit juice is required. The amount of grapefruit juice required may be modelled by a normal distribution with mean μ ml and standard deviation 300 ml. Find the value of μ . *(4 marks)*

END OF QUESTIONS

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