General Certificate of Education
January 2004
Advanced Subsidiary Examination

MATHEMATICS AND STATISTICS   **MBS1**
(SPECIFICATION B)
Unit Statistics 1

Monday 12 January 2004   Afternoon Session

In addition to this paper you will require:
- a 12-page answer book;
- the AQA booklet of formulae and statistical tables;
- two sheets of graph paper for use in Questions 4 and 8;
- 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.

MBS1

Answer **all** questions.

1   The number of smoke alarms sold by a store may be modelled by a Poisson distribution with mean 7.5 per day.

   (a)   Find the probability that during a particular day the store sells:

      (i)   6 or fewer smoke alarms;

      (ii)   exactly 8 smoke alarms.   *(4 marks)*

   (b)   Evaluate the standard deviation of the number of smoke alarms sold by the store per day.
                                                                                                 (2 marks)

2   Henri and Michelle are two journalists who write regular newspaper columns advising readers which wines offer good value for money.   They taste a number of wines and then estimate the retail prices of the corresponding bottles of wine.   Their estimates are shown in the following table.

Wine	A	B	C	D	E	F	G	H	I
Henri's estimate (£)	7	3	25	50	2	5	17	80	12
Michelle's estimate (£)	9	19	20	25	9	10	4	26	60

   (a)   Calculate the value of the product moment correlation coefficient between Henri's and Michelle's estimates.   *(3 marks)*

   (b)   Interpret, briefly, your value of the correlation coefficient.   *(2 marks)*

3 A university mathematics department organised a Saturday morning workshop on teaching statistics. Statistics teachers from local schools were invited to attend. As part of an exercise, the workshop leader asked the participants to record how many courses of dental treatment they had received during the previous year. The mean number recorded was found to be 1.09.

According to data published by the Office for National Statistics, the mean number of courses of dental treatment for adult dental patients registered in England during the same year was 1.57.

(a) In the paragraphs above, identify an item of:

   (i) secondary data;

   (ii) primary data. *(2 marks)*

(b) (i) Give a reason why the workshop participants could not be regarded as a random sample of adult dental patients in England.

   (ii) Explain whether or not the workshop participants could be regarded as a random sample of statistics teachers in England. *(3 marks)*

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

A train journey is scheduled to take 27 minutes. A regular commuter recorded the actual time taken for the journey on 15 **consecutive** weekdays. The times, in minutes, were as follows.

$$35 \quad 28 \quad 31 \quad 26 \quad 27 \quad 42 \quad 44 \quad 39 \quad 71 \quad 46 \quad 33 \quad 26 \quad 30 \quad 27 \quad 28$$

(a) Find the median and the upper and lower quartiles of the data. *(5 marks)*

(b) Identify any outliers, showing your calculations. *(3 marks)*

(c) Draw a box and whisker plot of the data. *(3 marks)*

(d) Identify an important feature of the data which is **not** illustrated by the box and whisker plot. *(2 marks)*

TURN OVER FOR THE NEXT QUESTION

5   The heights of female students attending a sixth form college have a mean of 168.0 cm and a standard deviation of 4.5 cm.   The heights can be modelled by a normal distribution.

   (a)   Find the probability that the height of a randomly selected female student attending this college is:

      (i)   less than 172.5 cm;

      (ii)   between 159 cm and 163.5 cm.   *(7 marks)*

   (b)   Find the probability that the mean height of a random sample of 11 female students from this college exceeds 172 cm.   *(4 marks)*

   (c)   The college was represented by 11 players in a ladies football match.   Comment on the fact that the mean height of these players was 173.0 cm.   *(2 marks)*

6   Eight friends take a picnic to a cricket match.   As her contribution to the picnic, Hilda buys eight sandwiches at a supermarket.   She selects the sandwiches at random from those on display.   The probability that a sandwich is suitable for vegetarians is independently 0.3 for each sandwich.

   (a)   Find the probability that, of the eight sandwiches, the number suitable for vegetarians is:

      (i)   2 or fewer;

      (ii)   exactly 2;

      (iii)   more than 3.   *(7 marks)*

   (b)   Two of the eight friends are vegetarians.   Hilda decides to ensure that the eight sandwiches she takes to the match will include at least two suitable for vegetarians. If, having selected eight sandwiches at random, she finds they include fewer than two suitable for vegetarians she will replace one, or if necessary two, of the sandwiches unsuitable for vegetarians with the appropriate number of sandwiches suitable for vegetarians.

      State whether or not the binomial distribution provides an appropriate model for the number of sandwiches suitable for vegetarians which Hilda takes to the match.   Explain your answer.   *(2 marks)*

   (c)   In fact the eight sandwiches which Hilda took to the match contained four suitable for vegetarians.   The first four friends to eat a sandwich were not vegetarians.   Each selected one of the available sandwiches at random and ate it.

      State whether or not the binomial distribution provides an appropriate model for the number of sandwiches suitable for vegetarians eaten by these four friends.   Explain your answer.   *(2 marks)*

7 Maurice works at home. At 2 pm he decides to take a break to buy a copy of the Chronicle newspaper. There are three nearby newsagents: Arif, Bob and Carol. However by 2 pm they may have sold all their Chronicles and so have none available. The independent probabilities that they have a Chronicle available at 2 pm are:

<div align="center">Arif   0.4   Bob   0.7   Carol   0.25</div>

  (a) State the probability that Bob does not have a Chronicle available at 2 pm.   *(1 mark)*

  (b) Find the probability that none of the three newsagents has a Chronicle available at 2 pm.
   (3 marks)

  (c) (i) Find the probability that Bob does not have a Chronicle available at 2 pm but Arif does.

     (ii) Find the probability that Carol does not have a Chronicle available at 2 pm but Arif does.   *(3 marks)*

  (d) Maurice decides to visit the newsagents in turn until he obtains a Chronicle or until he has visited all three. He tosses a coin. If it lands heads he will visit the three newsagents in the order Bob, Arif, Carol. If it lands tails he will visit them in the order Carol, Arif, Bob.

    Find the probability that he will obtain a Chronicle from Arif.   *(3 marks)*

<div align="center">**TURN OVER FOR THE NEXT QUESTION**</div>

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

Nasser organises a street collection for a mental health charity. The collection takes place in a large city on a particular Saturday. Volunteers, with collecting tins, stand in busy places and ask passers-by for donations. The following table shows, for ten volunteers, the times, x minutes, they spent collecting together with the amounts, to the nearest pound, y, they collected.

Collector	A	B	C	D	E	F	G	H	I	J
x	65	187	126	52	143	90	157	74	88	195
y	21	55	23	8	28	27	44	19	17	47

(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) The following table shows the residuals for some of the collectors.

Collector	A	B	C	D	E	F	G	H	I	J
Residual	6.25	7.50	−8.13	−3.26	−7.69	5.54	4.55	1.83		

   (i) Calculate the residuals for collectors I and J. *(3 marks)*

   (ii) Calculate the mean **magnitude** of the ten residuals. *(2 marks)*

(d) Karen, a new volunteer, collected for 110 minutes.

   (i) Use your regression equation to estimate the amount Karen collected. *(1 mark)*

   (ii) In fact Karen collected £22. Use the results of your calculations to advise Nasser on whether or not this suggests that Karen should have been supervised when collecting. Explain your answer. *(2 marks)*

END OF QUESTIONS