

General Certificate of Education
June 2004
Advanced Subsidiary Examination



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

MBS1

Friday 28 May 2004 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 3;
- an insert for use in Question 6 (enclosed);
- 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 Messages by email are received by Tariq's personal computer, independently, at random, at an average rate of 2.4 per day.
- (a) Name a distribution which provides a suitable model for the number of email messages received per day by Tariq's personal computer. *(1 mark)*
- (b) Find the probability that the number of messages received on a particular day is:
- (i) two or fewer;
- (ii) exactly four. *(3 marks)*
- (c) Find the probability that the number of messages received during a five-day period is:
- (i) fewer than six;
- (ii) more than 17. *(5 marks)*
- 2 As part of a biology project, the heights, in metres, and the weights, in kilograms, of all the students in a class were measured. The mean height was 1.71 and the standard deviation of the heights was 0.041. The product moment correlation coefficient between the heights and weights was 0.831.
- (a) If the heights had been measured in centimetres instead of metres, but the weights had still been measured in kilograms, write down the values of:
- (i) the mean height;
- (ii) the standard deviation of the heights;
- (iii) the product moment correlation coefficient between the heights and weights. *(3 marks)*
- (b) If the mean height was a parameter, define the population. *(2 marks)*

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

Customers of a Chinese takeaway can place orders by telephone, by fax or by visiting the shop. Julie, the owner, is considering stopping the option of ordering by fax. She collects the following data on the daily number of faxed orders.

Daily number of faxed orders	Frequency
0	30
1	27
2	14
3	9
4	5

(a) For the data above:

(i) draw a line diagram; *(3 marks)*

(ii) state the mode; *(1 mark)*

(iii) find the median. *(2 marks)*

(b) State, giving a reason, which of the measures of average found in part (a) would be more helpful when considering whether to stop the option of ordering by fax. *(1 mark)*

(c) Julie also collects the following data on shop takings over the last week.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Takings (£)	85	168	172	210	424	419	225

Suggest, **but do not draw**, the most appropriate type of diagram if she wishes to illustrate:

(i) the proportion of weekly takings achieved on Monday;

(ii) the day of the week on which takings were highest. *(2 marks)*

Turn over ►

- 4 The White Hot Peppers is a traditional jazz band. The length, in minutes, of each piece of music played by the band may be modelled by a normal distribution with mean 5 and standard deviation 1.5, and may be assumed to be independent of the lengths of all other pieces.
- (a) Find the probability that a particular piece will last between 3.5 minutes and 7.25 minutes. *(5 marks)*
- (b) Find the probability that the mean length of the next six pieces to be played by the band will be less than 4 minutes. *(4 marks)*
- (c) There is an interval of exactly one minute between the band finishing one piece and starting the next. The band starts to play its last six pieces at 10.31 pm. Using your answer to part (b), state whether you think it likely that the band will still be playing after 11.00 pm. Justify your answer. *(3 marks)*
- (d) Give a reason why the assumption that the lengths of all pieces are independent may be unrealistic. *(1 mark)*
- 5 A petrol station sells three types of fuel: lead replacement petrol (LRP), unleaded petrol and diesel. The probability that a randomly selected customer will buy a particular fuel is shown in the table.

Fuel	Probability
LRP	0.15
Unleaded	0.65
Diesel	0.20

- (a) Find the probability that of two randomly selected customers:
- (i) both will buy diesel;
- (ii) exactly one will buy diesel. *(5 marks)*
- (b) Find the probability that of three randomly selected customers:
- (i) all will buy unleaded;
- (ii) exactly two will buy diesel;
- (iii) one will buy LRP, one will buy unleaded and one will buy diesel. *(7 marks)*

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

Cermian Cycles build bicycles to customer specifications. Customers are offered the choice of *Bonti* tyres or *Vuton* tyres. Tests were carried out on a sample of tyres of each make. Each tyre in the sample was subjected to treatment which simulated the effect of a cyclist of a particular weight using a bicycle with this tyre on the rear wheel.

The results for *Bonti* tyres are shown in the table below. The table shows the weight, x kg, of the (simulated) cyclist and the (simulated) distance, y km, cycled before the tyre needed replacing.

x	50	60	70	80	90	100	110	120	130
y	3950	3810	3850	3870	3760	3740	3810	3720	3700

Figure 1 on the insert shows the results for the *Vuton* tyres together with the appropriate regression line.

- (a) Plot the points for the *Bonti* tyres on **Figure 1**. (2 marks)
- (b) Calculate the equation of the regression line of y on x for the *Bonti* tyres and draw this line on **Figure 1**. (6 marks)
- (c) Neeta weighs 65 kg. Predict the distance she would cycle before her rear tyre needs replacing if she uses:
- (i) *Bonti* tyres;
- (ii) *Vuton* tyres. (3 marks)
- (d) Comment on the likely accuracy of **each** of your predictions in part (c). (3 marks)
- (e) Ian weighs 108 kg. Compare the implications of Ian using *Bonti* tyres with those of him using *Vuton* tyres. (2 marks)

TURN OVER FOR THE NEXT QUESTION

Turn over ►

7 Gerhard walks to school each morning. The probability that he arrives late is 0.15 and is independent of whether he arrives late on any other morning.

(a) Find, for a week when he walks to school on five mornings:

- (i) the probability he arrives late on two or fewer mornings; *(3 marks)*
- (ii) the probability he arrives late on more than three mornings; *(2 marks)*
- (iii) the mean and the standard deviation of the number of mornings on which he arrives late. *(3 marks)*

(b) The following table summarises the number of late arrivals of all pupils who attended Gerhard's school on five mornings of a particular week.

Number of late arrivals	Number of pupils
0	275
1	111
2	33
3	12
4	13
5	16

- (i) Calculate the mean and the standard deviation of the data in the table. *(3 marks)*
 - (ii) Show that, for the pupils represented in the table, an estimate of the probability of a pupil arriving late on a particular morning is 0.15. *(1 mark)*
- (c) It is suggested that the data in the table could be modelled by a binomial distribution.
- (i) Comment on this suggestion in the light of your calculations in parts (a) and (b). *(2 marks)*
 - (ii) In the context of this question, give **two** possible reasons why the binomial distribution may **not** be a suitable model for the data in part (b). *(2 marks)*

END OF QUESTIONS

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Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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Insert for use in Question 6.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

TURN OVER FOR FIGURE 1

Turn over ►

Graph of Simulated Distance against Simulated Weight

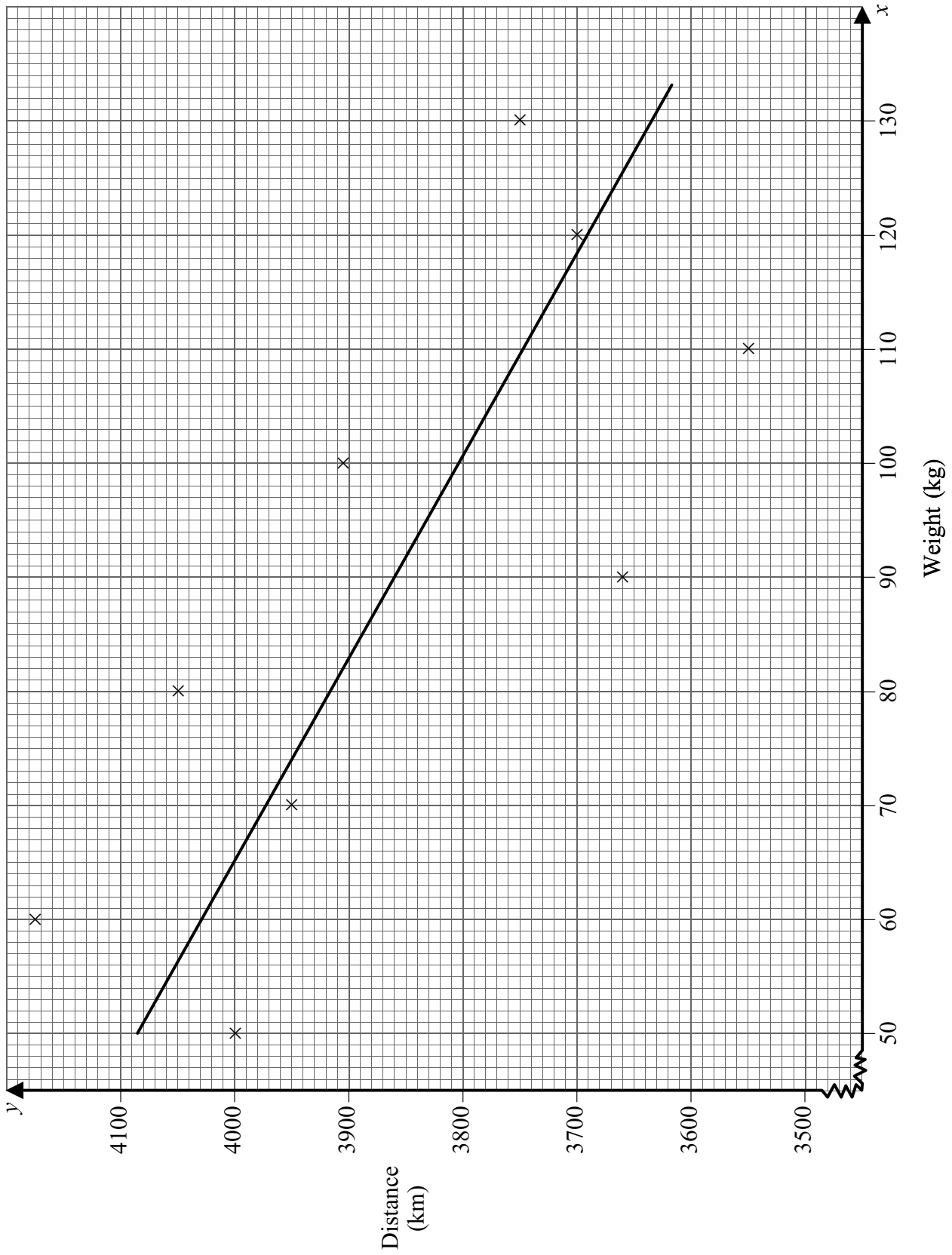


Figure 1