

General Certificate of Education
June 2004
Advanced Subsidiary Examination



**MATHEMATICS AND STATISTICS
(SPECIFICATION B)
Unit Statistics 2**

MBS2

Wednesday 9 June 2004 Afternoon Session

In addition to this paper you will require:

- an 8-page answer book;
- the AQA booklet of formulae and statistical tables;
- an insert for use in Questions 3 and 4 (enclosed);
- a ruler.

You may use a graphics calculator.

Time allowed: 1 hour 15 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 MBS2.
- 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 60.
- Mark allocations are shown in brackets.

Advice

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

Answer **all** questions.

1 A stationery supplier receives a large batch of pens from a manufacturer. The supplier wishes to estimate the proportion of pens that are faulty. A random sample of 200 pens is tested and 18 are found to be faulty.

- (a) Calculate an approximate 90% confidence interval for the proportion of faulty pens in the batch. *(6 marks)*
- (b) The batch can be returned to the manufacturer if more than 5% of the pens are faulty. Explain, on the basis of your answer to part (a), whether or not the supplier can return this batch. *(2 marks)*

2 An athletics coach wishes to select randomly eight athletes from his group to take part in a new fitness training scheme. The names of all the athletes in his group are listed below.

Celia	Grace	Kieron	Oswald	Scarlett	Wesley
Denzil	Homer	Leokadia	Portia	Titus	Xavier
Edwin	Ivor	Marek	Quentin	Ursula	Yvette
Francis	Jasmine	Nathan	Reuben	Victor	Zygmunt

- (a) Using systematic sampling, write down the names of a sample of eight athletes. Explain how you have obtained your sample. *(5 marks)*
- (b) Explain whether or not each athlete in the group is equally likely to be included in your sample obtained in part (a). *(2 marks)*
- (c) Explain whether or not your sample of eight athletes obtained in part (a) will be a random sample of all the athletes in the group. *(2 marks)*

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

The quarterly sales revenue, in £000, of a chain of music stores is shown in the following table.

Year	2001		2002				2003				2004
Quarter	3	4	1	2	3	4	1	2	3	4	1
Sales revenue (£000)	421	498	366	313	378	444	364	289	384	416	318

A time series for the quarterly sales revenue is plotted on **Figure 1**.

Suitable moving averages for the above data are:

x	1	2	3	4	5	6	7	8
Moving averages, y	p	388.75	375.25	374.75	368.75	370.25	363.25	351.75

- (a) Show that the value of p is 399.5. (2 marks)
- (b) (i) Find the equation of the regression line for the moving averages in the form $y = mx + c$. (4 marks)
- (ii) Use your equation to predict the value of the moving average for the third quarter of 2004. State the value of x used. (3 marks)
- (c) (i) Draw the line from part (b)(i) on **Figure 1**. (2 marks)
- (ii) Use your graph to calculate an estimate of the third quarter seasonal effect. (3 marks)
- (iii) Hence estimate the sales revenue for the third quarter of 2004. (2 marks)

TURN OVER FOR THE NEXT QUESTION

4 [Figure 2, printed on the insert, is provided for use in this question.]

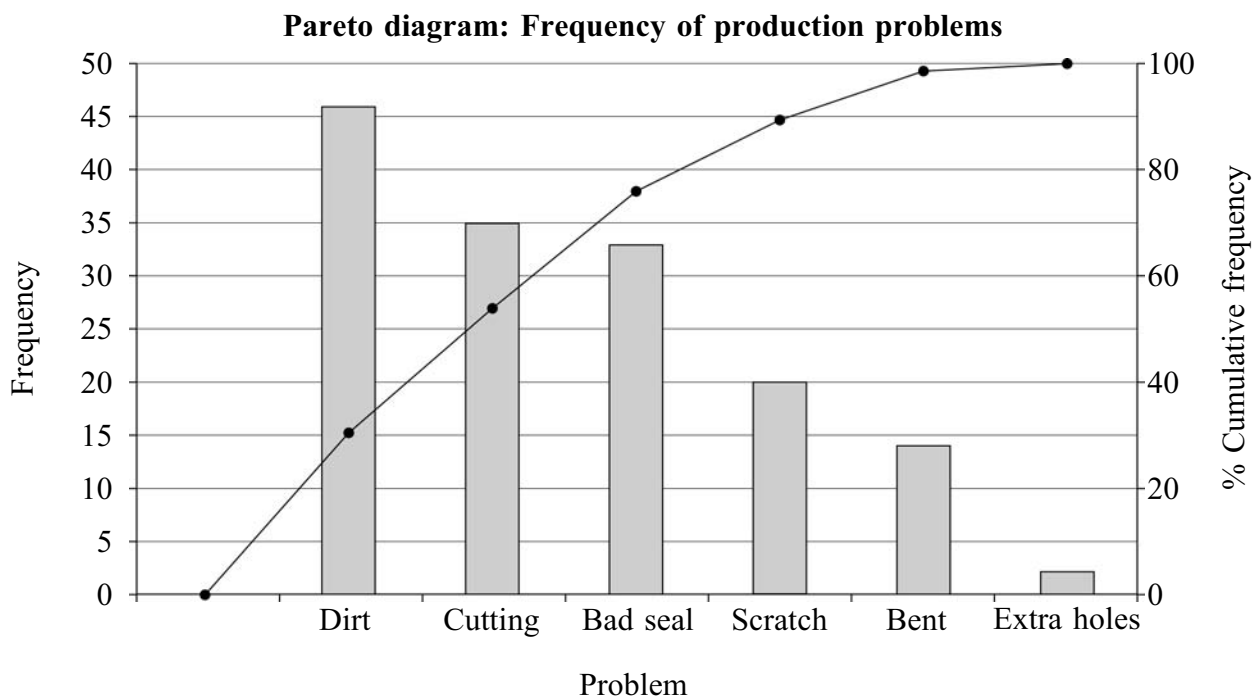
Pareto diagrams are widely used in the statistical control of process and product quality. They show graphically the relative importance of different production problems and hence show the priorities for the problem solving effort.

A Pareto diagram consists of a bar chart in which the problems are plotted in descending order of their frequencies of occurrence, or of their cost, with a percentage cumulative frequency polygon superimposed.

The table below shows the frequency and the cost per occurrence of each of the six production problems at a mechanical engineering firm over a period of one month.

Problem	Frequency	Cost per occurrence
Bad seal	33	£9.00
Bent	14	£11.50
Cutting	35	£11.00
Dirt	46	£2.00
Extra holes	2	£235.00
Scratch	20	£2.50

- (a) The Pareto diagram below illustrates the frequencies of the production problems shown in the table above.



Identify the most frequent problems which account for approximately 80% of production problems. (2 marks)

- (b) (i) Calculate the total cost associated with each problem over the one month period.
(2 marks)
- (ii) Arrange these total costs in descending order and calculate the percentage cumulative total costs.
(4 marks)
- (iii) Draw a Pareto diagram on **Figure 2** for the total costs of production problems.
(4 marks)
- (iv) Identify the problems which account for approximately 80% of total production costs.
(2 marks)
- (c) The operations manager wishes to reduce as much as possible both the total number of problems and the total cost of problems. Advise the production manager which **one** of the problems to address first.
(1 mark)

5 The random variable X is modelled by a binomial distribution with parameters n and p .

- (a) Using an appropriate distributional approximation, find the probability that $3 \leq X \leq 6$ when $n = 300$ and $p = 0.006$.
(5 marks)
- (b) Using an appropriate distributional approximation, find the probability that $X = 18$ when $n = 90$ and $p = 0.3$.
(7 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 Questions 3 and 4.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

TURN OVER FOR FIGURE 1

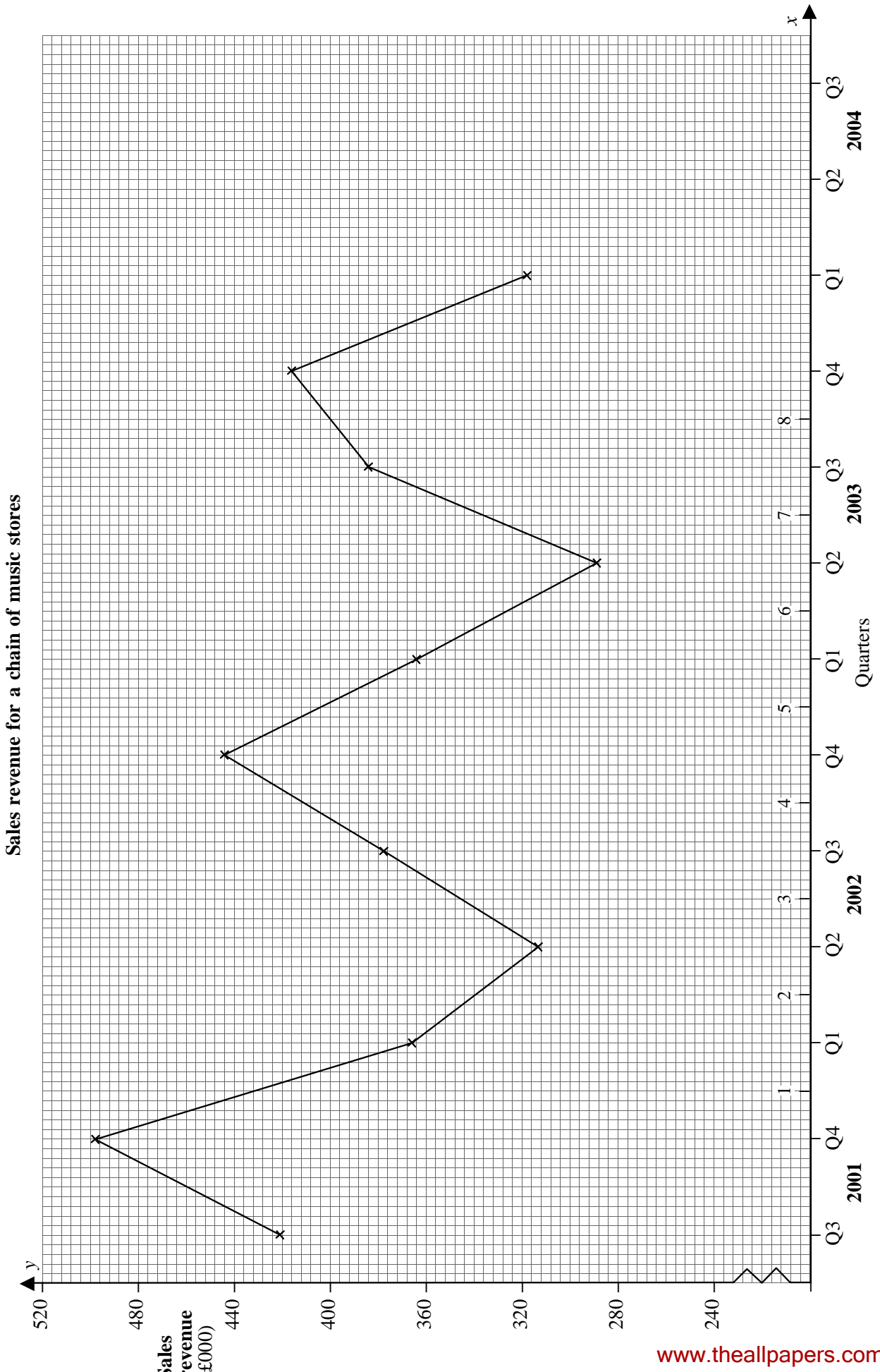


Figure 1

Pareto diagram: Total costs of production problems

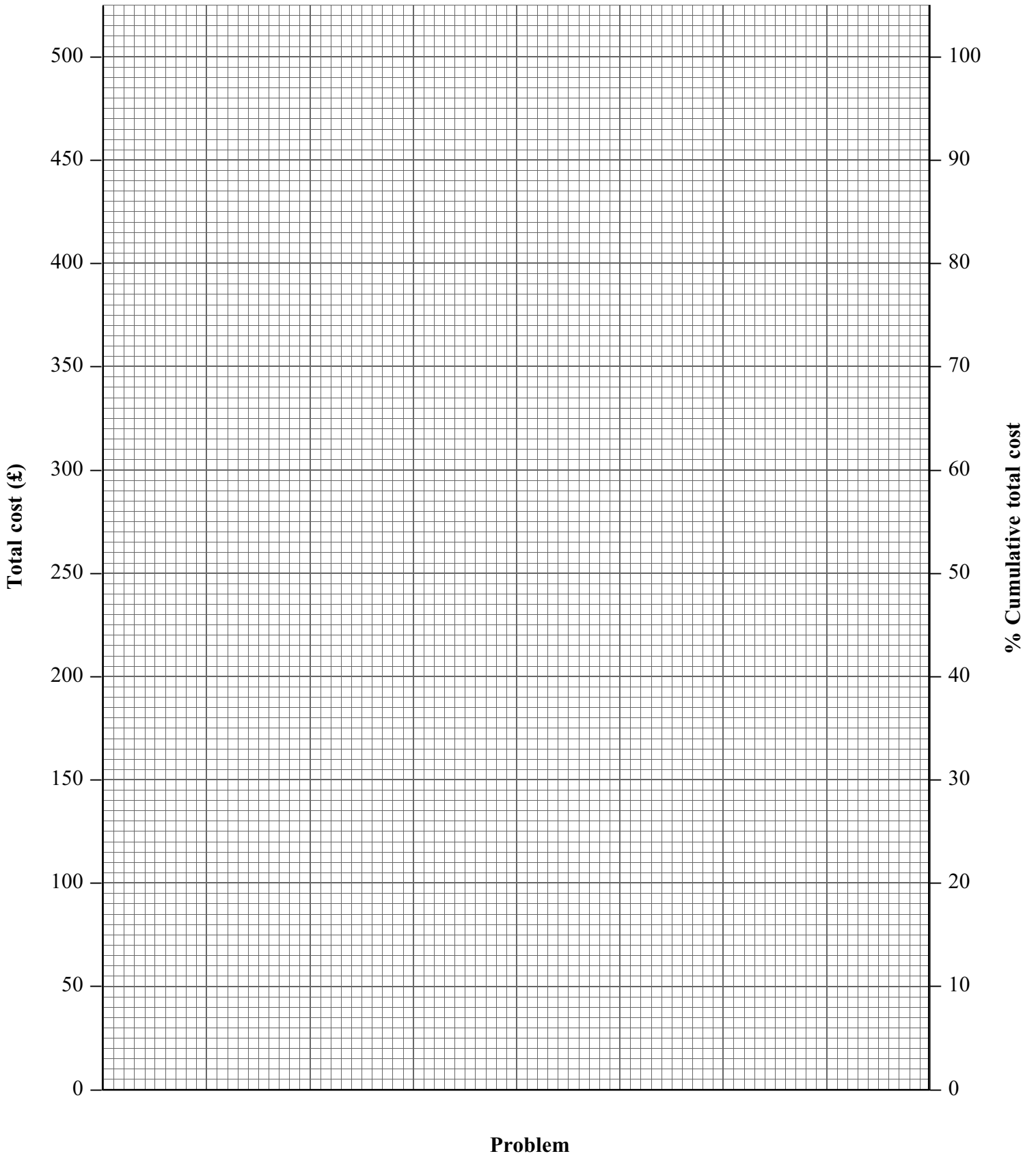


Figure 2

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