General Certificate of Education
January 2004
Advanced Level Examination

MATHEMATICS AND STATISTICS
(SPECIFICATION B)
Unit Statistics 7

MBS7

AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Tuesday 27 January 2004   Afternoon Session

In addition to this paper you will require:
   • an 8-page answer book;
   • the AQA booklet of formulae and statistical tables.
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 MBS7.
• 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.

MBS7

Answer **all** questions.

1 The length, x metres, of baking foil on each of a random sample of 25 rolls is measured.

The recorded lengths gave

$$\sum(x - \bar{x})^2 = 4.08$$

where $\bar{x}$ denotes the sample mean.

(a) Stating the necessary distributional assumption, construct a 95% confidence interval for the variance of the length of foil on a roll. *(6 marks)*

(b) Hence comment on the claim that the standard deviation of the length of foil on a roll is more than 25 centimetres. *(2 marks)*

2 In a particular county, the distance between successive potholes on country roads may be modelled by an exponential distribution with mean 125 metres.

Determine the probability that the distance between successive potholes is:

(a) less than 100 metres; *(2 marks)*

(b) between 100 metres and 300 metres. *(3 marks)*

3 A least squares regression line of the form $y = \hat{\alpha} + \hat{\beta}x$ is to be fitted to data known to conform to the linear model

$$y = \alpha + \beta x + \varepsilon \quad \text{where} \quad \varepsilon \sim N(0, \sigma^2).$$

From 27 pairs of values (x, y), the following information is calculated.

$$S_{xx} = 441 \qquad S_{xy} = -1587.6 \qquad S_{yy} = 6940.36$$

(a) Calculate unbiased estimates of β and σ^2. *(3 marks)*

(b) Test, at the 10% level of significance, a claim that $\beta = -3$. *(6 marks)*

4 The number of calls per hour to a telephone hotline, during the period 9 am to 4 pm on weekdays, is recorded with the following results.

Period	9 – 10	10 – 11	11 – 12	12 – 1	1 – 2	2 – 3	3 – 4
Number of calls	132	151	143	129	117	134	125

Test, at the 10% level of significance, the hypothesis that the number of calls per hour during the period 9 am to 4 pm on weekdays follows a rectangular distribution. *(8 marks)*

5 At a particular university, all first year students are required to visit a Registry Desk and a Finance Desk as part of the enrolment process.

Times, X seconds, at the Registry Desk are normally distributed with mean 220 and standard deviation 20.

Times, Y seconds, at the Finance Desk are independent of those at the Registry Desk and are normally distributed with mean 175 and standard deviation 40.

Determine the probability that a first year student spends:

(a) a **total** of less than 5 minutes at the Registry and Finance Desks; *(5 marks)*

(b) more time at the Registry Desk than at the Finance Desk. *(4 marks)*

6 A large batch of potatoes is to be sampled by a buyer for possible frost damage.

(a) The buyer selects a random sample of 40 potatoes and finds that 7 of the potatoes show evidence of frost damage.

Investigate, at the 5% level of significance, the buyer's suspicion that more than 10 per cent of the potatoes will show evidence of frost damage. *(5 marks)*

(b) Not convinced by this result, the buyer selects a random sample of 400 potatoes and finds that 52 of the potatoes show evidence of frost damage.

Using an approximate test and the 5% level of significance, re-investigate the buyer's suspicion. *(6 marks)*

TURN OVER FOR THE NEXT QUESTION

7 A fruit grower, who suspects that pears of Variety P weigh, on average, more than pears of Variety Q, obtains the following information on weights, in grams, of pears.

Variety	Sample size	Sample mean	Unbiased estimate of population variance
P	11	201	124
Q	16	188	134

  (a) Show that the value of the pooled estimate of variance is 130. *(2 marks)*

  (b) Assuming that weights of pears are normally distributed, investigate, at the 1% level of significance, the fruit grower's suspicion. *(8 marks)*

END OF QUESTIONS