

General Certificate of Education
June 2004
Advanced Level Examination



MATHEMATICS (SPECIFICATION A)
Unit Statistics 1

MAS1/W

Monday 21 June 2004 Morning 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 20 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 MAS1/W.
- 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.
- Tie loosely any additional sheets you have used to the back of your answer book before handing it to the invigilator.

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 The volume, L litres, of emulsion paint in a plastic tub may be assumed to be normally distributed with mean 10.25 and variance σ^2 .

(a) Assuming that $\sigma^2 = 0.04$, determine $P(L < 10)$. (4 marks)

(b) Find the value of σ so that 98% of tubs contain more than 10 litres of emulsion paint. (4 marks)

- 2 A town's library offers a booking system for free internet access. Users are allowed a maximum of one hour of connection time at any one booking.

The actual connection times, X minutes, of users may be modelled by the following probability density function, where k is a constant.

$$f(x) = \begin{cases} \frac{kx}{40} & 0 \leq x \leq 40 \\ k & 40 \leq x \leq 60 \\ 0 & \text{otherwise} \end{cases}$$

(a) Sketch the graph of f . (4 marks)

(b) By considering your sketch, or otherwise, show that the value of k is 0.025. (3 marks)

(c) Hence determine $P(X > 30)$. (3 marks)

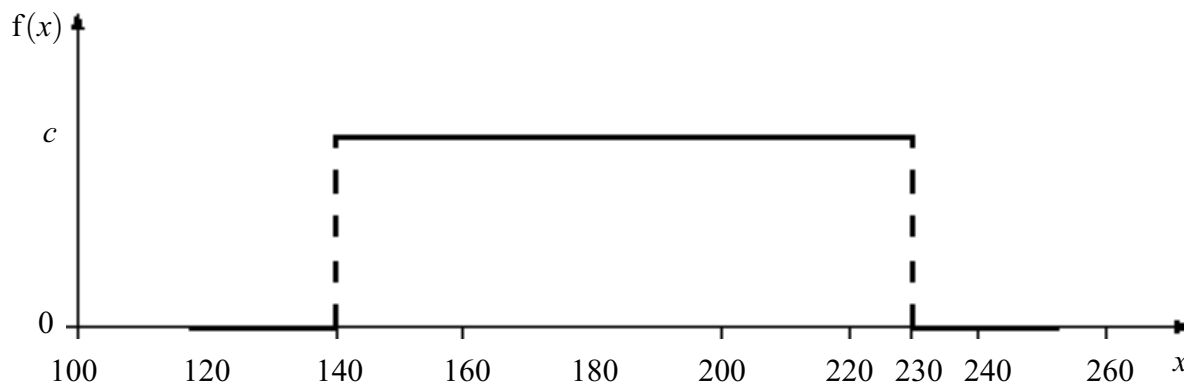
- 3 A bin contains 400 coloured erasers that fit on the ends of pencils. The number of erasers of each colour is as follows.

Colour	Green	Blue	Red	Yellow
Number	88	60	160	92

- (a) A random sample of 25 erasers is selected, **with replacement**, from the bin. Find the probability that:
- (i) exactly 2 erasers are green; (4 marks)
 - (ii) at most 3 erasers are blue; (2 marks)
 - (iii) between 8 erasers and 12 erasers, inclusive, are red. (4 marks)
- (b) Erasers are selected at random, **without replacement**, from the bin until 5 yellow erasers are obtained.

Give **two** reasons why a binomial distribution does **not** model the number of erasers selected. (2 marks)

- 4 The probability density function, $f(x)$, for the weight, X grams, of a banana is shown by the following graph.



- (a) Find the value of the constant c , as used on the vertical axis. (1 mark)
- (b) Determine $P(X < 200)$. (2 marks)
- (c) Find values for the mean and variance of X . (2 marks)
- (d) Specify, giving a reason, an appropriate distribution for \bar{X} , the mean of a random sample of 75 observations of X . (4 marks)

- 5 An internet service provider operates a telephone helpdesk. The random variable T denotes the duration, in minutes, of a telephone call to the helpdesk. The internet service provider recorded the duration, t minutes, of each of a random sample of 50 telephone calls.

From the recorded durations of these telephone calls, the following values were calculated, where \bar{t} denotes the sample mean.

$$\sum t = 143.50 \qquad \sum (t - \bar{t})^2 = 279.8929$$

- (a) Calculate an unbiased estimate of $\text{Var}(T)$ and hence estimate the standard error of \bar{T} .
(3 marks)
- (b) (i) Construct a 99% confidence interval for the mean duration, μ minutes, of telephone calls to the helpdesk.
(5 marks)
- (ii) Hence comment on the claim that $\mu = 3.5$.
(2 marks)
- (c) Three months later, from a random sample of 100 telephone calls, a 99% confidence interval for μ was determined correctly as (4.12, 5.38).

Indicate, giving reasons, what may now be concluded about the value of μ . (2 marks)

- 6 The discrete random variable S has the following probability distribution.

s	1	5	10	20
$\mathbf{P(S=s)}$	0.5	0.3	0.1	0.1

A rectangle has sides of length S and $\left(2 + \frac{40}{S}\right)$.

- (a) Given that $E(S) = 5$ and $\text{Var}(S) = 33$, find values for the mean and variance of the **area** of the rectangle.
(4 marks)
- (b) (i) By tabulating the probability distribution for $T = \frac{40}{S}$, or otherwise, show that $E(T) = 23$.
(3 marks)
- (ii) Hence find the mean of the **perimeter** of the rectangle.
(2 marks)

END OF QUESTIONS