

General Certificate of Education
June 2005
Advanced Level Examination



MATHEMATICS (SPECIFICATION A)
Unit Statistics 1

MAS1/W

Monday 20 June 2005 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.

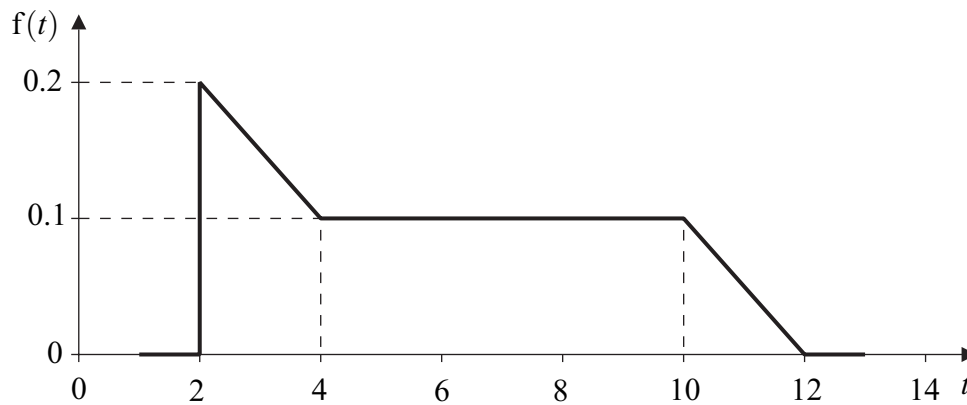
Answer **all** questions.

- 1 The length, X centimetres, of eels in a river may be assumed to be normally distributed with mean 48 and standard deviation 8.

An angler catches an eel from the river. Determine the probability that the length of the eel is:

- (a) exactly 60 cm; *(1 mark)*
- (b) less than 60 cm; *(2 marks)*
- (c) within 5% of the mean length. *(5 marks)*

- 2 The probability density function, $f(t)$, for the time, T minutes, taken by five-year-old children to complete a puzzle is shown by the following graph.



- (a) Determine:
- (i) $P(T < 10)$;
- (ii) $P(T > 5)$. *(3 marks)*
- (b) Hence determine the probability that a randomly selected five-year-old child completes the puzzle in less than 10 minutes, given that the child has not completed the puzzle within 5 minutes. *(4 marks)*

- 3 A Tourist Information Office organises guided walks. An analysis shows that 68% of its customers reserve places on Walk A, 45% of its customers reserve places on Walk B, and 25% of its customers reserve places on Walk C. Reservations may be assumed to be independent.
- (a) Calculate the probability that, in a random sample of 15 customers, exactly 10 reserve places on Walk A. *(3 marks)*
 - (b) Determine the probability that, in a random sample of 40 customers, at least 15 but at most 20 reserve places on Walk B. *(3 marks)*
 - (c) Use a distributional approximation to estimate the probability that, in a random sample of 2700 customers, fewer than 700 reserve places on Walk C. *(5 marks)*
 - (d) During a particular week, Walk A attracts exactly 60 people for each of the 15 times that it is offered. On each walk, each person is given, at random, a ticket on which there is a unique integer between 1 and 60, inclusive.

Explain how random numbers could be used to select a stratified random sample of 90 people from all those persons on Walk A during the week. *(3 marks)*

- 4 A Trading Standards Officer suspects that the contents of a coal merchant's 50 kg bags of coal are, on average, underweight.

He weighs the contents of a random sample of 10 bags of coal filled by the merchant. From these weights he calculates a mean of 49.2 kg.

- (a) (i) Assuming that the weights of the contents of bags of coal are approximately normally distributed with mean μ kg and standard deviation 1.6 kg, construct a 95% confidence interval for μ . *(4 marks)*
- (ii) Hence comment on the Officer's suspicion. *(2 marks)*
- (b) The Officer decides that he requires the width of a 95% confidence interval for μ to be at most 0.75 kg.

Find the minimum sample size to achieve this requirement. *(4 marks)*

5 Boxes contain screws of varying nominal lengths.

The number of screws with nominal lengths less than 2 inches in a box may be modelled by a discrete random variable, L , with mean 580 and variance 1600.

The number of screws with nominal lengths greater than 2 inches in a box may be modelled by a discrete random variable, G , defined by:

$$G = \frac{L}{2} + 80.$$

- (a) Find values for the mean and variance of G . *(3 marks)*
- (b) Each box contains 1000 screws.
- (i) Deduce, in terms of L , an expression for the number, R , of screws with a nominal length of exactly 2 inches in a box. *(2 marks)*
- (ii) Hence determine values for the mean and variance of R . *(3 marks)*

6 The continuous random variable X has a rectangular distribution on the interval $(a, a + k)$, where a and k are constants and $k > 0$.

- (a) (i) Given that $\text{Var}(X) = 48$, show that $k = 24$. *(2 marks)*
- (ii) Given also that $E(X) = 6$, show that $a = -6$. *(2 marks)*
- (b) Hence calculate $P(X > 0)$. *(2 marks)*
- (c) The random variable \bar{X} denotes the mean of a random sample of 75 observations of X .
- (i) Find values for the mean and standard error of \bar{X} . *(3 marks)*
- (ii) Give a reason why \bar{X} may be assumed to be approximately normally distributed. *(1 mark)*
- (iii) Hence determine $P(\bar{X} > 7)$. *(3 marks)*

END OF QUESTIONS