General Certificate of Education
January 2004
Advanced Level Examination

AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

MATHEMATICS (SPECIFICATION A)   **MAS1/W**
Unit Statistics 1

Wednesday 21 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 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.

MAS1/W

Answer **all** questions.

1 At a hairdressers, the time, T minutes, required to attend to a male customer may be modelled by the probability density function, $f(t)$, as represented by the graph below.
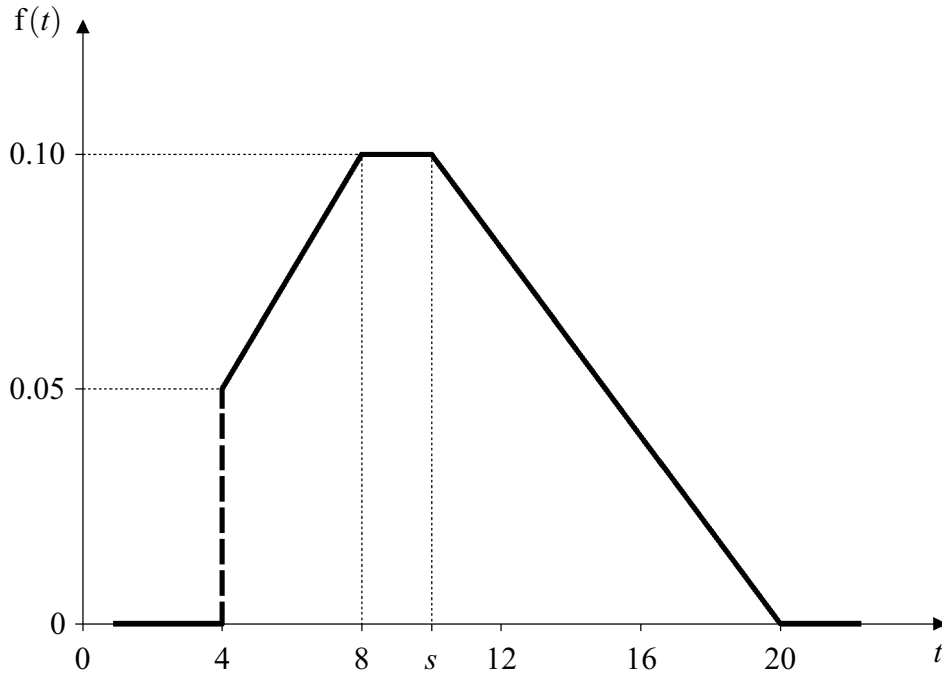
(a) Determine $P(T < 8)$. *(2 marks)*

(b) (i) Show why the value of s, marked on the graph above, must be 10. *(3 marks)*

(ii) Hence determine $P(T > 15)$. *(3 marks)*

2 At a particular supermarket, 85 per cent of customers have the supermarket clubcard.

(a) Determine the probability that, in a random sample of 5 customers, exactly 4 customers have the supermarket clubcard. *(2 marks)*

(b) Determine the probability that, in a random sample of 40 customers, more than 30 customers have the supermarket clubcard. *(3 marks)*

(c) Use a normal approximation to estimate the probability that, in a random sample of 250 customers, fewer than 200 customers have the supermarket clubcard. *(6 marks)*

3 As part of her marketing project, Pina is required to obtain information from a sample of students studying languages at her university.

Pina proposes to hand out questionnaires to students studying languages who enter the Students' Union building between 11.30 am and 1.30 pm on a particular day.

(a) Give **two** distinct reasons why this may result in Pina obtaining biased information.
(2 marks)

(b) Pina's supervisor, Farhad, suggests that she should obtain the information by interviewing a stratified random sample of 60 students from the population of 1032 students studying languages.

(i) Given that there are 86 students studying Italian, find how many such students should be included in Farhad's suggested stratified random sample. *(1 mark)*

(ii) Describe how Pina can use a table of random numbers to select the random sample of students studying Italian. *(3 marks)*

(iii) To illustrate your method in part (b)(ii), use Table 13 in the formulae booklet supplied. Starting at the **tenth column** of the **fourth row**, and **working across the row**, identify the sample of students studying Italian. *(2 marks)*

4 (a) The volume, X millilitres, of olive oil in one-litre bottles may be assumed to be a normally distributed random variable with mean μ_X and standard deviation 3.

(i) Assuming that $\mu_X = 1005$, determine the probability that the volume of olive oil in a randomly selected bottle is less than 1010 ml. *(3 marks)*

(ii) Find, to the nearest integer, the value of μ_X so that at most 1% of bottles contain less than 1 litre of olive oil. *(4 marks)*

(b) The volume, Y millilitres, of sunflower oil in one-litre bottles may be assumed to be a normally distributed random variable with mean μ_Y and standard deviation 3.

The volume, y millilitres, of sunflower oil in each of a random sample of 16 bottles was measured, with the result that

$$\sum y = 16\,136 \,.$$

Construct a 95% confidence interval for μ_Y, giving the limits to the nearest integer.
(5 marks)

5 The continuous random variable X has a rectangular distribution on the interval (a, b), where $0 < a < b$.

(a) Given that the mean, μ, is equal to 21 and that the variance, σ^2, is equal to 27, prove that $a = 12$ and $b = 30$. *(5 marks)*

(b) Hence determine:

   (i) $P(5 < X < 20)$; *(3 marks)*

   (ii) $P\left(X < \mu - \dfrac{\sigma\sqrt{3}}{2} \right)$. *(3 marks)*

6 The probability distribution for the number, R, of unwrapped sweets in a tin is given in the following table.

r	0	1	2	3	4
$P(R = r)$	0.1	0.2	0.4	0.2	0.1

(a) Show that:

   (i) $E(R) = 2$; *(1 mark)*

   (ii) $Var(R) = 1.2$. *(2 marks)*

(b) The number, P, of partially wrapped sweets in a tin is given by

$$P = 3R + 4.$$

Find values for $E(P)$ and $Var(P)$. *(3 marks)*

(c) The total number of sweets in a tin is 200. Sweets are either correctly wrapped, partially wrapped or unwrapped.

   (i) Express C, the number of correctly wrapped sweets in a tin, in terms of R. *(2 marks)*

   (ii) Hence find the mean and variance of C. *(2 marks)*

END OF QUESTIONS