General Certificate of Education
November 2004
Advanced Level Examination

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

Tuesday 2 November 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.

Answer **all** questions.

1 A football club is contemplating a move from its town-centre ground to a new out-of-town stadium.

(a) The club decides to assess support for the move from local communities.

(i) With this in mind, the local newspaper interviews the first 50 season ticket holders entering the ground through one turnstile on a particular match day.

Give **two** reasons why the newspaper's sample is biased. *(2 marks)*

(ii) The Chairman suggests that opinions on the move should be sought by use of a stratified sample.

Give **two** reasons why the selection of a stratified random sample might be difficult in this context. *(2 marks)*

(b) A supporters' group has 7885 members.

Describe how a simple random sample of 100 members could be selected. *(3 marks)*

2 A small corner shop sells packs of sandwiches. The probability distribution for the number of packs sold per day, S, has

$$\mathrm{E}(S) = 15 \qquad \text{and} \qquad \mathrm{Var}(S) = 4.$$

The shop is supplied with 20 packs of sandwiches each day at a cost of £1.00 per pack. Packs are sold at £2.20 each. The shop receives a refund of £0.20 per pack for all those unsold at the end of each day.

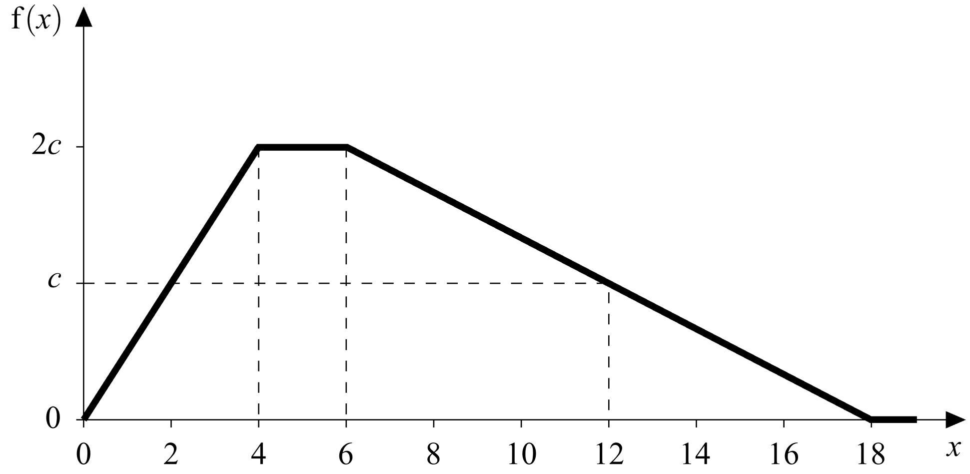
(a) Show that the shop's daily profit, £P, on the sale of packs of sandwiches is given by

$$P = 2S - 16.$$

(3 marks)

(b) Hence determine the mean and standard deviation of the shop's daily profit on the sale of packs of sandwiches. *(4 marks)*

3 The time, X minutes, by which an appointment is delayed at a health centre may be modelled by a probability density function represented by the graph below.



(a) Show that the value of the constant c, as used on the vertical axis, is 0.05. *(3 marks)*

(b) Determine the probability that an appointment is delayed:

(i) by more than 4 minutes; *(2 marks)*

(ii) by between 4 and 12 minutes; *(3 marks)*

(iii) by less than 12 minutes, given that it is delayed by more than 4 minutes. *(4 marks)*

(c) Give a reason why the probability density function, as represented by the graph above, is unlikely to provide a satisfactory model for **all** delay times at this health centre. *(1 mark)*

4 A recent large-scale survey established that 15 per cent of cars have faulty brake lights.

(a) Calculate the probability that, in a random sample of 18 cars, exactly 2 cars have faulty brake lights. *(3 marks)*

(b) Determine the probability that, in a random sample of 50 cars, more than 5 cars but fewer than 10 cars have faulty brake lights. *(3 marks)*

(c) Use a normal approximation to estimate the probability that, in a random sample of 900 cars, at most 150 cars have faulty brake lights. *(5 marks)*

(d) At a set of traffic lights, a policewoman records the number, R, of **vehicles** with faulty brake lights, out of 50 successive vehicles stopping at the traffic lights.

Give a reason why the binomial distribution, $B(50, 0.15)$, might **not** be an appropriate model for R. *(1 mark)*

Turn over ▶

5 A machine produces steel rods with lengths that are normally distributed with mean μ and variance σ^2.

A quality control inspector uses a gauge to measure the length, x centimetres, of each rod in a random sample of 100 rods from the machine's production. The summarised data are as follows.

$$\sum x = 1040.0 \qquad \sum x^2 = 11\,102.11$$

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

(b) Construct a 99% confidence interval for μ. *(4 marks)*

(c) State why, in answering part (b), you did **not** need to use the Central Limit Theorem. *(1 mark)*

(d) The gauge used to measure the length is faulty. As a consequence, each measurement taken is 0.2 cm more than the true length.

Use this additional information to write down a revised confidence interval for μ. *(2 marks)*

6 The continuous random variable X has a rectangular distribution over the interval c to $7c$, where c is a positive constant.

(a) (i) Find, in terms of c, expressions for the mean, μ, and variance, σ^2, of X. *(2 marks)*

(ii) Hence show that $\mathrm{E}(X^2) = 19c^2$. *(2 marks)*

(b) Given that $\mathrm{E}(X^2) = 171$, determine the value of c. *(1 mark)*

(c) Determine:

(i) $\mathrm{P}\left(X > \frac{\mu}{2} + \frac{\sigma}{\sqrt{3}}\right)$; *(3 marks)*

(ii) the value of d such that $\mathrm{P}(X < d) = 0.25$. *(3 marks)*

END OF QUESTIONS