

General Certificate of Education
January 2007
Advanced Level Examination



MATHEMATICS
Unit Statistics 2B

MS2B

Friday 12 January 2007 9.00 am to 10.30 am

For this paper you must have:

- an 8-page answer book
- the **blue** AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed: 1 hour 30 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 MS2B.
- Answer **all** questions.
- Show all necessary working; 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 75.
- The marks for questions are shown in brackets.
- Unit Statistics 2B has a **written paper only**.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.

Answer **all** questions.

- 1 Alan's journey time, in minutes, to travel home from work each day is known to be normally distributed with mean μ .

Alan records his journey time, in minutes, on a random sample of 8 days as being

36 38 39 40 50 35 36 42

Construct a 95% confidence interval for μ . (5 marks)

- 2 The number of computers, A , bought during one day from the Amplebuy computer store can be modelled by a Poisson distribution with a mean of 3.5.

The number of computers, B , bought during one day from the Bestbuy computer store can be modelled by a Poisson distribution with a mean of 5.0.

(a) (i) Calculate $P(A = 4)$. (2 marks)

(ii) Determine $P(B \leq 6)$. (1 mark)

(iii) Find the probability that a total of fewer than 10 computers is bought from these two stores on one particular day. (3 marks)

(b) Calculate the probability that a total of fewer than 10 computers is bought from these two stores on at least 4 out of 5 consecutive days. (3 marks)

(c) The numbers of computers bought from the Choicebuy computer store over a 10-day period are recorded as

8 12 6 6 9 15 10 8 6 12

(i) Calculate the mean and variance of these data. (2 marks)

(ii) State, giving a reason based on your results in part (c)(i), whether or not a Poisson distribution provides a suitable model for these data. (2 marks)

- 3 The handicap committee of a golf club has indicated that the mean score achieved by the club's members in the past was 85.9.

A group of members believes that recent changes to the golf course have led to a change in the mean score achieved by the club's members and decides to investigate this belief.

A random sample of the scores, x , of 100 club members was taken and is summarised by

$$\sum x = 8350 \quad \text{and} \quad \sum (x - \bar{x})^2 = 15\,321$$

where \bar{x} denotes the sample mean.

Test, at the 5% level of significance, the group's belief that the mean score of 85.9 has changed. (8 marks)

- 4 The number of fish, X , caught by Pearl when she goes fishing can be modelled by the following discrete probability distribution:

| | | | | | | | |
|---------------------|------|------|------|------|-----|------|----------|
| x | 1 | 2 | 3 | 4 | 5 | 6 | ≥ 7 |
| $\mathbf{P}(X = x)$ | 0.01 | 0.05 | 0.14 | 0.30 | k | 0.12 | 0 |

- (a) Find the value of k . (1 mark)
- (b) Find:
- (i) $E(X)$; (1 mark)
- (ii) $\text{Var}(X)$. (3 marks)
- (c) When Pearl sells her fish, she earns a profit, in pounds, given by

$$Y = 5X + 2$$

Find:

- (i) $E(Y)$; (1 mark)
- (ii) the standard deviation of Y . (3 marks)

Turn over ►

- 5 Jasmine's French teacher states that a homework assignment should take, on average, 30 minutes to complete.

Jasmine believes that he is understating the mean time that the assignment takes to complete and so decides to investigate. She records the times, in minutes, that it takes for a random sample of 10 students to complete the French assignment, with the following results:

29 33 36 42 30 28 31 34 37 35

- (a) Test, at the 1% level of significance, Jasmine's belief that her French teacher has understated the mean time that it should take to complete the homework assignment. (7 marks)
- (b) State an assumption that you must make in order for the test used in part (a) to be valid. (1 mark)
- 6 The waiting time, T minutes, before being served at a local newsagents can be modelled by a continuous random variable with probability density function

$$f(t) = \begin{cases} \frac{3}{8}t^2 & 0 \leq t < 1 \\ \frac{1}{16}(t+5) & 1 \leq t \leq 3 \\ 0 & \text{otherwise} \end{cases}$$

- (a) Sketch the graph of f . (3 marks)
- (b) For a customer selected at random, calculate $P(T \geq 1)$. (2 marks)
- (c) (i) Show that the cumulative distribution function for $1 \leq t \leq 3$ is given by

$$F(t) = \frac{1}{32}(t^2 + 10t - 7) \quad (5 \text{ marks})$$

- (ii) Hence find the median waiting time. (4 marks)

- 7 A statistics unit is required to determine whether or not there is an association between students' performances in mathematics at Key Stage 3 and at GCE.

A survey of the results of 500 students showed the following information:

| | | GCE Grade | | | | Total |
|-------------------------|---|-----------|-----|-----|---------|-------|
| | | A | B | C | Below C | |
| Key Stage 3 Level | 8 | 60 | 55 | 47 | 43 | 205 |
| | 7 | 55 | 32 | 31 | 26 | 144 |
| | 6 | 40 | 38 | 35 | 38 | 151 |
| Total | | 155 | 125 | 113 | 107 | 500 |

- (a) Use a χ^2 test at the 10% level of significance to determine whether there is an association between students' performances in mathematics at Key Stage 3 and at GCE. (9 marks)
- (b) Comment on the number of students who gained a grade A at GCE having gained a level 7 at Key Stage 3. (1 mark)

- 8 The continuous random variable X has the cumulative distribution function

$$F(x) = \begin{cases} 0 & x \leq -4 \\ \frac{x+4}{9} & -4 \leq x \leq 5 \\ 1 & x \geq 5 \end{cases}$$

- (a) Determine the probability density function, $f(x)$, of X . (2 marks)
- (b) Sketch the graph of f . (2 marks)
- (c) Determine $P(X > 2)$. (2 marks)
- (d) Evaluate the mean and variance of X . (2 marks)

END OF QUESTIONS

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