

General Certificate of Education
June 2005
Advanced Level Examination



MATHEMATICS
Unit Statistics 2B

MS2B

Thursday 9 June 2005 Morning Session

In addition to this paper you will require:

- 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.
- 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.

Information

- The maximum mark for this paper is 75.
- Mark allocations are shown in brackets.
- Unit Statistics 2B has a **written paper only**.

Advice

- Unless stated otherwise, formulae may be quoted, without proof, from the booklet.

Answer **all** questions.

1 The number of cars, X , passing along a road each minute can be modelled by a Poisson distribution with a mean of 2.6.

(a) Calculate $P(X = 2)$. *(2 marks)*

(b) (i) Write down the distribution of Y , the number of cars passing along this road in a 5-minute interval. *(1 mark)*

(ii) Hence calculate the probability that at least 15 cars pass along this road in each of four successive 5-minute intervals. *(4 marks)*

2 Syd, a snooker player, believes that the outcome of any frame of snooker in which he plays may be influenced by the time of day that the frame takes place.

The results of 100 randomly selected frames of snooker, played by Syd, are recorded below.

	Afternoon	Evening	Total
Win	30	24	54
Lose	18	28	46
Total	48	52	100

Use a χ^2 test, at the 5% level of significance, to test Syd's belief. *(10 marks)*

3 The heights, in metres, of a random sample of 10 students attending Higrade School are recorded below.

1.76 1.59 1.54 1.62 1.49 1.52 1.56 1.47 1.75 1.50

Assume that the heights of students attending Higrade School are normally distributed.

(a) Calculate unbiased estimates for the mean and variance of the heights of students attending Higrade School. *(3 marks)*

(b) Construct a 90% confidence interval for the mean height of students attending Higrade School. *(5 marks)*

- 4 The error, X millimetres, made when the heights of prospective members of a new gym club are measured can be modelled by a rectangular distribution with the following probability density function.

$$f(x) = \begin{cases} k & -4 \leq x \leq 6 \\ 0 & \text{otherwise} \end{cases}$$

- (a) State the value of k . (1 mark)
- (b) Write down the value of $E(X)$. (1 mark)
- (c) Calculate $P(X > 0)$. (2 marks)
- (d) The height of a randomly selected prospective member is measured. Find the probability that the **magnitude** of the error made exceeds 3.5 millimetres. (3 marks)
- 5 The discrete random variable R has the following probability distribution.

r	1	2	4
$P(R = r)$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$

- (a) Calculate exact values for $E(R)$ and $\text{Var}(R)$. (4 marks)
- (b) (i) By tabulating the probability distribution for $X = \frac{1}{R^2}$, show that $E(X) = \frac{25}{64}$. (3 marks)
- (ii) Hence find the value of the mean of the **area** of a rectangle which has sides of length $\frac{8}{R}$ and $\left(R + \frac{8}{R}\right)$. (3 marks)
- 6 The contents, in millilitres, of cartons of milk produced at Kream Dairies, can be modelled by a normal distribution with mean 568 and variance σ^2 .

After receiving several complaints from their customers who thought that the average content of the cartons had been reduced, the production manager of Kream Dairies decided to investigate.

A random sample of 8 cartons of milk was taken, revealing the following contents, in millilitres.

560 568 561 562 564 567 565 563

Investigate, at the 1% level of significance, whether the average content of cartons of milk is less than 568 millilitres. (10 marks)

- 7 The time, T hours, that the supporters of Bracken Football Club have to queue in order to obtain their Cup Final tickets has the following probability density function.

$$f(t) = \begin{cases} \frac{1}{5} & 0 \leq t < 3 \\ \frac{1}{45}t(6-t) & 3 \leq t \leq 6 \\ 0 & \text{otherwise} \end{cases}$$

- (a) Sketch the graph of f . *(3 marks)*
- (b) Write down the value of $P(T = 3)$. *(1 mark)*
- (c) Find the probability that a randomly selected supporter has to queue for at least 3 hours in order to obtain tickets. *(2 marks)*
- (d) Show that the median queuing time is 2.5 hours. *(2 marks)*
- (e) Calculate $P(\text{median} < T < \text{mean})$. *(6 marks)*

- 8 The mean age of people attending a large concert is claimed to be 35 years.

A random sample of 100 people attending the concert was taken and their mean age was found to be 37.9 years.

- (a) Given that the standard deviation of the ages of the people attending the concert is 12 years, test, at the 1% level of significance, the claim that the mean age is 35 years. *(7 marks)*
- (b) Explain, in the context of this question, the meaning of a Type II error. *(2 marks)*

END OF QUESTIONS