

General Certificate of Education  
June 2007  
Advanced Level Examination



**MATHEMATICS**  
**Unit Statistics 2B**

**MS2B**

Tuesday 5 June 2007 1.30 pm to 3.00 pm

**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.

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Answer **all** questions.

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- 1 Two groups of patients, suffering from the same medical condition, took part in a clinical trial of a new drug. One of the groups was given the drug whilst the other group was given a placebo, a drug that has no physical effect on their medical condition.

The table shows the number of patients in each group and whether or not their condition improved.

	Placebo	Drug
Condition improved	20	46
Condition did not improve	55	29

Conduct a  $\chi^2$  test, at the 5% level of significance, to determine whether the condition of the patients at the conclusion of the trial is associated with the treatment that they were given.  
(10 marks)

- 2 The number of telephone calls per day,  $X$ , received by Candice may be modelled by a Poisson distribution with mean 3.5.

The number of e-mails per day,  $Y$ , received by Candice may be modelled by a Poisson distribution with mean 6.0.

(a) For any particular day, find:

(i)  $P(X = 3)$ ; (2 marks)

(ii)  $P(Y \geq 5)$ . (2 marks)

(b) (i) Write down the distribution of  $T$ , the total number of telephone calls and e-mails per day received by Candice. (1 mark)

(ii) Determine  $P(7 \leq T \leq 10)$ . (3 marks)

(iii) Hence calculate the probability that, on each of three consecutive days, Candice will receive a total of at least 7 but at most 10 telephone calls and e-mails.  
(2 marks)

- 3 David is the professional coach at the golf club where Becki is a member. He claims that, after having a series of lessons with him, the mean number of putts that Becki takes per round of golf will reduce from her present mean of 36.

After having the series of lessons with David, Becki decides to investigate his claim.

She therefore records, for each of a random sample of 50 rounds of golf, the number of putts,  $x$ , that she takes to complete the round. Her results are summarised below, where  $\bar{x}$  denotes the sample mean.

$$\sum x = 1730 \quad \text{and} \quad \sum (x - \bar{x})^2 = 784$$

Using a z-test and the 1% level of significance, investigate David's claim. (8 marks)

- 4 Students are each asked to measure the distance between two points to the nearest tenth of a metre.
- (a) Given that the rounding error,  $X$  metres, in these measurements has a rectangular distribution, explain why its probability density function is

$$f(x) = \begin{cases} 10 & -0.05 < x \leq 0.05 \\ 0 & \text{otherwise} \end{cases} \quad (3 \text{ marks})$$

- (b) Calculate  $P(-0.01 < X < 0.02)$ . (2 marks)
- (c) Find the mean and the standard deviation of  $X$ . (2 marks)

**Turn over for the next question**

**Turn over ►**

- 5 Members of a residents' association are concerned about the speeds of cars travelling through their village. They decide to record the speed, in mph, of each of a random sample of 10 cars travelling through their village, with the following results:

33    27    34    30    48    35    34    33    43    39

- (a) Construct a 99% confidence interval for  $\mu$ , the mean speed of cars travelling through the village, stating any assumption that you make. *(7 marks)*
- (b) Comment on the claim that a 30 mph speed limit is being adhered to by most motorists. *(3 marks)*

- 6 The continuous random variable  $X$  has the probability density function given by

$$f(x) = \begin{cases} 3x^2 & 0 < x \leq 1 \\ 0 & \text{otherwise} \end{cases}$$

- (a) Determine:

(i)  $E\left(\frac{1}{X}\right)$ ; *(3 marks)*

(ii)  $\text{Var}\left(\frac{1}{X}\right)$ . *(4 marks)*

- (b) Hence, or otherwise, find the mean and the variance of  $\left(\frac{5 + 2X}{X}\right)$ . *(5 marks)*

7 On a multiple choice examination paper, each question has five alternative answers given, only one of which is correct. For each question, candidates gain 4 marks for a correct answer but lose 1 mark for an incorrect answer.

(a) James guesses the answer to each question.

(i) Copy and complete the following table for the probability distribution of  $X$ , the number of marks obtained by James for each question.

$x$	4	-1
$P(X=x)$		

(1 mark)

(ii) Hence find  $E(X)$ .

(2 marks)

(b) Karen is able to eliminate two of the incorrect answers from the five alternative answers given for each question before guessing the answer from those remaining.

Given that the examination paper contains 24 questions, calculate Karen's expected total mark.

(4 marks)

8 A jam producer claims that the mean weight of jam in a jar is 230 grams.

(a) A random sample of 8 jars is selected and the weight of jam in each jar is determined. The results, in grams, are

220    228    232    219    221    223    230    229

Assuming that the weight of jam in a jar is normally distributed, test, at the 5% level of significance, the jam producer's claim. (9 marks)

(b) It is later discovered that the mean weight of jam in a jar is indeed 230 grams.

Indicate whether a Type I error, a Type II error or neither has occurred in carrying out the hypothesis test in part (a). Give a reason for your answer. (2 marks)

**END OF QUESTIONS**

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