Centre Number						Candidate Number				
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Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
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TOTAL	

General Certificate of Education
Advanced Level Examination
June 2010

Mathematics MS2B

Unit Statistics 2B

Friday 18 June 2010 1.30 pm to 3.00 pm

For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed
- 1 hour 30 minutes

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer the questions in the spaces provided. Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

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

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Answer **all** questions in the spaces provided.

1 Judith, the village postmistress, believes that, since moving the post office counter into the local pharmacy, the mean daily number of customers that she serves has increased from 79 .

In order to investigate her belief, she counts the number of customers that she serves on 12 randomly selected days, with the following results.

88 81 84 89 90 77 72 80 82 81 75 85

Stating a necessary distributional assumption, test Judith's belief at the 5% level of significance. *(9 marks)*

QUESTION PART REFERENCE

QUESTION PART REFERENCE

2 It is claimed that a new drug is effective in the prevention of sickness in holiday-makers. A sample of 100 holiday-makers was surveyed, with the following results.

	Sickness	No sickness	Total
Drug taken	24	56	80
No drug taken	11	9	20
Total	35	65	100

Assuming that the 100 holiday-makers are a random sample, use a χ^2 test, at the 5% level of significance, to investigate the claim. *(8 marks)*

QUESTION PART REFERENCE

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3 The continuous random variable X has a rectangular distribution defined by

$$f(x) = \begin{cases} k & -3k \leqslant x \leqslant k \\ 0 & \text{otherwise} \end{cases}$$

(a) (i) Sketch the graph of f. *(2 marks)*

(ii) Hence show that $k = \frac{1}{2}$. *(2 marks)*

(b) Find the **exact** numerical values for the mean and the standard deviation of X. *(3 marks)*

(c) (i) Find $P\left(X \geqslant -\frac{1}{4}\right)$. *(2 marks)*

(ii) Write down the value of $P\left(X \neq -\frac{1}{4}\right)$. *(1 mark)*

QUESTION PART REFERENCE

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QUESTION PART REFERENCE

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4 The error, X °C, made in measuring a patient's temperature at a local doctors' surgery may be modelled by a normal distribution with mean μ and standard deviation σ .

The errors, x °C, made in measuring the temperature of each of a random sample of 10 patients are summarised below.

$$\sum x = 0.35 \quad \text{and} \quad \sum (x - \bar{x})^2 = 0.12705$$

Construct a 99% confidence interval for μ , giving the limits to three decimal places.

(5 marks)

QUESTION PART REFERENCE

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5 The number of telephone calls received, during an 8-hour period, by an IT company that request an urgent visit by an engineer may be modelled by a Poisson distribution with a mean of 7 .

(a) Determine the probability that, during a given 8-hour period, the number of telephone calls received that request an urgent visit by an engineer is:

(i) at most 5 ; *(1 mark)*

(ii) exactly 7 ; *(2 marks)*

(iii) at least 5 but fewer than 10 . *(3 marks)*

(b) Write down the distribution for the number of telephone calls received each hour that request an urgent visit by an engineer. *(1 mark)*

(c) The IT company has 4 engineers available for urgent visits and it may be assumed that each of these engineers takes exactly 1 hour for each such visit.

At 10 am on a particular day, all 4 engineers are available for urgent visits.

(i) State the maximum possible number of telephone calls received between 10 am and 11 am that request an urgent visit and for which an engineer is immediately available. *(1 mark)*

(ii) Calculate the probability that at 11 am an engineer will **not** be immediately available to make an urgent visit. *(4 marks)*

(d) Give a reason why a Poisson distribution may not be a suitable model for the number of telephone calls per hour received by the IT company that request an urgent visit by an engineer. *(1 mark)*

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6 (a) The number of strokes, R, taken by the members of Duffers Golf Club to complete the first hole may be modelled by the following discrete probability distribution.

r	$\leqslant 2$	3	4	5	6	7	8	$\geqslant 9$
$\mathbf{P}(R = r)$	0	0.1	0.2	0.3	0.25	0.1	0.05	0

(i) Determine the probability that a member, selected at random, takes at least 5 strokes to complete the first hole. *(1 mark)*

(ii) Calculate $\mathrm{E}(R)$. *(2 marks)*

(iii) Show that $\mathrm{Var}(R) = 1.66$. *(4 marks)*

(b) The number of strokes, S, taken by the members of Duffers Golf Club to complete the second hole may be modelled by the following discrete probability distribution.

s	$\leqslant 2$	3	4	5	6	7	8	$\geqslant 9$
$\mathbf{P}(S = s)$	0	0.15	0.4	0.3	0.1	0.03	0.02	0

Assuming that R and S are independent:

(i) show that $\mathrm{P}(R + S \leqslant 8) = 0.24$; *(5 marks)*

(ii) calculate the probability that, when 5 members are selected at random, at least 4 of them complete the first two holes in fewer than 9 strokes; *(3 marks)*

(iii) calculate $\mathrm{P}(R = 4 \mid R + S \leqslant 8)$. *(3 marks)*

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7 The random variable X has probability density function defined by

$$f(x) = \begin{cases} \frac{1}{2} & 0 \leqslant x \leqslant 1 \\ \frac{1}{18}(x-4)^2 & 1 \leqslant x \leqslant 4 \\ 0 & \text{otherwise} \end{cases}$$

(a) State values for the median and the lower quartile of X. *(2 marks)*

(b) Show that, for $1 \leqslant x \leqslant 4$, the cumulative distribution function, $F(x)$, of X is given by

$$F(x) = 1 + \frac{1}{54}(x-4)^3$$

(You may assume that $\int (x-4)^2 \, dx = \frac{1}{3}(x-4)^3 + c$.) *(4 marks)*

(c) Determine $P(2 \leqslant X \leqslant 3)$. *(2 marks)*

(d) (i) Show that q, the upper quartile of X, satisfies the equation $(q-4)^3 = -13.5$. *(3 marks)*

(ii) Hence evaluate q to three decimal places. *(1 mark)*

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END OF QUESTIONS