Centre Number						Candidate Number				
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Other Names										
Candidate Signature										

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

General Certificate of Education
Advanced Subsidiary Examination
January 2012

Mathematics MS/SS1B

Unit Statistics 1B

Statistics

Unit Statistics 1B

Tuesday 17 January 2012 9.00 am to 10.30 am

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.
- Unit Statistics 1B has a **written paper only**.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

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

1 Giles, a keen gardener, rents a council allotment.

During early April 2011, he planted 27 seed potatoes.

When he harvested his potato crop during the following August, he counted the number of new potatoes that he obtained from each seed potato.

He recorded his results as follows.

Number of new potatoes	$\leqslant 6$	7	8	9	10	11	$\geqslant 12$
Frequency	2	2	1	4	8	6	4

(a) Calculate values for the median and the interquartile range of these data. *(3 marks)*

(b) Advise Giles on how to record his corresponding data for 2012 so that it would then be possible to calculate the mean number of new potatoes per seed potato. *(1 mark)*

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2 Dr Hanna has a special clinic for her older patients. She asked a medical student, Lenny, to select a random sample of 25 of her male patients, aged between 55 and 65 years, and, from their clinical records, to list their heights, weights and waist measurements.

Lenny was then asked to calculate three values of the product moment correlation coefficient based upon his collected data. His results were:

(a) 0.365 between height and waist measurement;

(b) 1.16 between height and weight;

(c) −0.583 between weight and waist measurement.

For **each** of Lenny's three calculated values, state whether the value is definitely correct, probably correct, probably incorrect or definitely incorrect. *(3 marks)*

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3 During June 2011, the volume, X litres, of unleaded petrol purchased per visit at a supermarket's filling station by private-car customers could be modelled by a normal distribution with a mean of 32 and a standard deviation of 10.

(a) Determine:

(i) $P(X < 40)$;

(ii) $P(X > 25)$;

(iii) $P(25 < X < 40)$. *(7 marks)*

(b) Given that during June 2011 unleaded petrol cost £1.34 per litre, calculate the probability that the unleaded petrol bill for a visit during June 2011 by a private-car customer exceeded £65. *(3 marks)*

(c) Give **two** reasons, in context, why the model $N(32, 10^2)$ is unlikely to be valid for a visit by **any** customer purchasing fuel at this filling station during June 2011. *(2 marks)*

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4 The records at a passport office show that, on average, 15 per cent of photographs that accompany applications for passport renewals are unusable.

Assume that exactly one photograph accompanies each application.

(a) Determine the probability that in a random sample of 40 applications:

(i) exactly 6 photographs are unusable;

(ii) at most 5 photographs are unusable;

(iii) more than 5 but fewer than 10 photographs are unusable. *(7 marks)*

(b) Calculate the mean and the standard deviation for the number of photographs that are unusable in a random sample of **32** applications. *(3 marks)*

(c) Mr Stickler processes 32 applications each day. His records for the previous 10 days show that the numbers of photographs that he deemed unusable were

8 6 10 7 9 7 8 9 6 7

By calculating the mean and the standard deviation of these values, comment, with reasons, on the suitability of the $B(32, 0.15)$ model for the number of photographs deemed unusable each day by Mr Stickler. *(4 marks)*

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5 An experiment was undertaken to collect information on the burning of a specific type of wood as a source of energy. At given fixed levels of the wood's moisture content, x per cent, its corresponding calorific value, y MWh/tonne, on burning was determined. The results are shown in the table.

x	5	10	15	20	25	30	35	40	45	50	55	60	65
y	5.2	4.7	4.3	4.0	3.2	2.8	2.5	2.2	1.8	1.5	1.3	1.0	0.6

(a) Explain why calorific value is the response variable. *(1 mark)*

(b) Calculate the equation of the least squares regression line of y on x, giving your answer in the form $y = a + bx$. *(5 marks)*

(c) Interpret, in context, your values for a and b. *(3 marks)*

(d) Use your equation to estimate the wood's calorific value when it has a moisture content of 27 per cent. *(2 marks)*

(e) Calculate the value of the residual for the point $(35, 2.5)$. *(2 marks)*

(f) Given that the values of the 13 residuals lie between -0.28 and $+0.23$, comment on the likely accuracy of your estimate in part **(d)**. *(1 mark)*

(g) (i) Give a **general reason** why your equation should not be used to estimate the wood's calorific value when it has a moisture content of 80 per cent. *(1 mark)*

(ii) Give a **specific reason**, based on the context of this question and with numerical support, why your equation cannot be used to estimate the wood's calorific value when it has a moisture content of 80 per cent. *(2 marks)*

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6 Twins Alec and Eric are members of the same local cricket club and play for the club's under 18 team.

The probability that Alec is selected to play in any particular game is 0.85.
The probability that Eric is selected to play in any particular game is 0.60.
The probability that both Alec and Eric are selected to play in any particular game is 0.55.

(a) By using a table, or otherwise:

(i) show that the probability that neither twin is selected for a particular game is 0.10;

(ii) find the probability that at least one of the twins is selected for a particular game;

(iii) find the probability that exactly one of the twins is selected for a particular game. *(5 marks)*

(b) The probability that the twins' younger brother, Cedric, is selected for a particular game is:

0.30 given that both of the twins have been selected;
0.75 given that exactly one of the twins has been selected;
0.40 given that neither of the twins has been selected.

Calculate the probability that, for a particular game:

(i) all three brothers are selected;

(ii) at least two of the three brothers are selected. *(6 marks)*

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7 A random sample of 50 full-time university employees was selected as part of a higher education salary survey.

The annual salary in thousands of pounds, x, of each employee was recorded, with the following summarised results.

$$\sum x = 2290.0 \quad \text{and} \quad \sum (x - \bar{x})^2 = 28\,225.50$$

Also recorded was the fact that 6 of the 50 salaries exceeded £60 000 .

(a) (i) Calculate values for $\bar{x}$ and s, where s^2 denotes the unbiased estimate of σ^2. *(3 marks)*

(ii) Hence show why the annual salary, X, of a full-time university employee is unlikely to be normally distributed. Give numerical support for your answer. *(2 marks)*

(b) (i) Indicate why the mean annual salary, $\overline{X}$, of a random sample of 50 full-time university employees may be assumed to be normally distributed. *(2 marks)*

(ii) Hence construct a 99% confidence interval for the mean annual salary of full-time university employees. *(4 marks)*

(c) It is claimed that the annual salaries of full-time university employees have an average which exceeds £55 000 and that more than 25% of such salaries exceed £60 000 .

Comment on **each** of these two claims. *(3 marks)*

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END OF QUESTIONS

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