Centre Number						Candidate Number				
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Other Names										
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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5	
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TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
January 2012

Mathematics MS/SS1A/W
Unit Statistics 1A

Statistics
Unit Statistics 1A

Tuesday 17 January 2012 9.00 am to 10.15 am

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

You may use a graphics calculator.

A

Time allowed
- 1 hour 15 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 60.
- Unit Statistics 1A has a **written paper and coursework**.

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 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)*

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2 To supplement her pension, Cordelia bakes cakes which are then sold in Amir's nearby shop.

(a) The weight, X grams, of her square fruit cake may be modelled by a normal random variable with a mean of 2200 and a standard deviation of 160.

Determine:

(i) $P(X < 2500)$;

(ii) $P(X > 2000)$;

(iii) $P(2000 < X < 2500)$. *(7 marks)*

(b) The weight, Y grams, of Cordelia's round fruit cake may be modelled by a normal random variable with a mean of 1125 and a standard deviation of σ.

If Amir requests that at most 10 per cent of these cakes should weigh less than 1000 grams, find the maximum value for σ. *(4 marks)*

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

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

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

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

(e) 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 **(c)**. *(1 mark)*

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4 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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5 A sawmill's machine cuts stakes for use in constructing agricultural fences. The lengths of the cut stakes may be modelled approximately by a normal distribution.

The machine is set to cut stakes of length 1.5 m and is known to cut stakes to within 10 cm of any set length.

Elmer, the sawmill's foreman, asked Ashley, a trainee office junior, to calculate the mean and the standard deviation for the lengths of a random sample of 10 such stakes selected from the machine's output.

Ashley reported back to Elmer that the mean length of his 10 selected stakes was 151.5 cm and that the standard deviation of their lengths was 26.6 cm.

Advise Elmer on whether **each** of Ashley's values could be correct. Give numerical support for your answers. *(4 marks)*

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6 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.

$$\bar{x} = 45.8 \quad \text{and} \quad s = 24.0$$

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

(a) 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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