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

General Certificate of Education
Advanced Subsidiary Examination
June 2013

Mathematics MS/SS1A/W

Unit Statistics 1A

Statistics

Unit Statistics 1A

Friday 17 May 2013 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.

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 each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- 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.

Answer each question in the space provided for that question.

1 The weight of sand in a bag can be modelled by a normal random variable with unknown mean μ kilograms and known standard deviation 0.4 kilograms.

The sand in each of a random sample of 25 bags from a large batch is weighed. The mean weight of sand in these 25 bags is found to be 19.9 kg.

(a) Construct a 98% confidence interval for the mean weight of sand in bags in the batch. *(4 marks)*

(b) Hence comment on the claim that bags in the batch contain an average of 20 kg of sand. *(2 marks)*

QUESTION PART REFERENCE

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2 An auction house offers items of jewellery for sale at its public auctions. Each item has a reserve price which is less than the lower price estimate which, in turn, is less than the upper price estimate. The outcome for any item is independent of the outcomes for all other items.

The auction house has found, from past records, the following probabilities for the outcomes of items of jewellery offered for sale.

Outcome	Probability
Item does not achieve its reserve price	0.15
Item achieves at least its reserve price	0.85
Item achieves at least its lower price estimate	0.50
Item achieves at least its upper price estimate	0.175

For example, the probability that an item achieves at least its lower price estimate but not its upper price estimate is 0.325 .

A particular auction includes exactly 40 items of jewellery that may be assumed to be a random sample of such items.

(a) Use binomial distributions to find the probability that:

(i) at most 10 items do not achieve their reserve prices; *(1 mark)*

(ii) 25 or more items achieve at least their lower price estimates; *(2 marks)*

(iii) exactly 2 items achieve at least their upper price estimates; *(2 marks)*

(iv) more than 10 items but fewer than 15 items achieve at least their reserve prices but not their lower price estimates. *(4 marks)*

(b) How many of the 40 items of jewellery would you expect to achieve at least their reserve prices but not their upper price estimates? *(2 marks)*

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3 The volume, X millilitres, of energy drink in a bottle can be modelled by a normal random variable with mean 507.5 and standard deviation 4.0.

(a) Find:

(i) $P(X < 515)$;

(ii) $P(500 < X < 515)$;

(iii) $P(X \neq 507.5)$. *(5 marks)*

(b) Determine the value of x such that $P(X < x) = 0.96$. *(3 marks)*

(c) The energy drink is sold in packs of 6 bottles. The bottles in each pack may be regarded as a random sample.

(i) Calculate the probability that the volume of energy drink in at least 5 of the 6 bottles in a pack is between 500 ml and 515 ml. *(3 marks)*

(ii) Determine the probability that the **mean** volume of energy drink in bottles in a pack is more than 505 ml. *(4 marks)*

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4 The girth, g metres, the length, l metres, and the weight, y kilograms, of each of a sample of 20 pigs were measured.

The data collected is summarised as follows.

$$S_{gg} = 0.1196 \quad S_{ll} = 0.0436 \quad S_{yy} = 5880 \quad S_{gy} = 24.15 \quad S_{ly} = 10.25$$

(a) Calculate the value of the product moment correlation coefficient between:

(i) girth and weight;

(ii) length and weight. *(3 marks)*

(b) Interpret, in context, **each** of the values that you obtained in part **(a)**. *(3 marks)*

(c) Weighing pigs requires expensive equipment, whereas measuring their girths and lengths simply requires a tape measure. With this in mind, the following formula is proposed to make an estimate of a pig's weight, x kilograms, from its girth and length.

$$x = 69.3 \times g^2 \times l$$

Applying this formula to the relevant data on the 20 pigs resulted in

$$S_{xx} = 5656.15 \quad S_{xy} = 5662.97$$

(i) By calculating a third value of the product moment correlation coefficient, state which of g, l or x is the most strongly correlated with y, the weight. *(2 marks)*

(ii) Estimate the weight of a pig that has a girth of 1.25 metres and a length of 1.15 metres. *(2 marks)*

(iii) Given the additional information that $\overline{x} = 115.4$ and $\overline{y} = 116.0$, calculate the equation of the least squares regression line of y on x, in the form $y = a + bx$. *(3 marks)*

(iv) Comment on the likely accuracy of the estimated weight found in part **(c)(ii)**. Your answer should make reference to the value of the product moment correlation coefficient found in part **(c)(i)** and to the values of b and a found in part **(c)(iii)**. *(4 marks)*

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5 Alison is a member of a tenpin bowling club which meets at a bowling alley on Wednesday and Thursday evenings.

The probability that she bowls on a Wednesday evening is 0.90. Independently, the probability that she bowls on a Thursday evening is 0.95.

(a) Calculate the probability that, during a particular week, Alison bowls on:

(i) two evenings;

(ii) exactly one evening. *(3 marks)*

(b) David, a friend of Alison, is a member of the same club.

The probability that he bowls on a Wednesday evening, given that Alison bowls on that evening, is 0.80. The probability that he bowls on a Wednesday evening, given that Alison does not bowl on that evening, is 0.15.

The probability that he bowls on a Thursday evening, given that Alison bowls on that evening, is 1. The probability that he bowls on a Thursday evening, given that Alison does not bowl on that evening, is 0.

Calculate the probability that, during a particular week:

(i) Alison and David bowl on a Wednesday evening; *(2 marks)*

(ii) Alison and David bowl on both evenings; *(2 marks)*

(iii) Alison, but not David, bowls on a Thursday evening; *(1 mark)*

(iv) neither bowls on either evening. *(3 marks)*

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END OF QUESTIONS

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