AQA

MATHEMATICS **MS/SS1A/W**
Unit Statistics 1A

STATISTICS
Unit Statistics 1A

Wednesday 20 May 2009   1.30 pm to 2.45 pm

> **For this paper you must have:**
> • an 8-page answer book
> • the blue AQA booklet of formulae and statistical tables
> • an insert for use in Question 2 (enclosed).
> 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.
* Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is MS/SS1A/W.
* 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.
* Fill in the boxes at the top of the insert.

Information
* The maximum mark for this paper is 60.
* The marks for questions are shown in brackets.
* Unit Statistics 1A has a **written paper and coursework**.

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

MS/SS1A/W

Answer **all** questions.

1 A large bookcase contains two types of book: hardback and paperback. The number of books of each type in each of four subject categories is shown in the table.

		Crime	**Romance**	**Science fiction**	**Thriller**	**Total**
Type	**Hardback**	8	16	18	18	60
	Paperback	16	40	14	30	100
	Total	24	56	32	48	160

(a) A book is selected at random from the bookcase. Calculate the probability that the book is:

  (i) a paperback; *(1 mark)*

 (ii) not science fiction; *(2 marks)*

(iii) science fiction or a hardback; *(2 marks)*

(iv) a thriller, given that it is a paperback. *(2 marks)*

(b) Three books are selected at random, without replacement, from the bookcase.

Calculate, to three decimal places, the probability that one is crime, one is romance and one is science fiction. *(4 marks)*

2 [**Figure 1**, printed on the insert, is provided for use in this question.]

Hermione, who is studying reptiles, measures the length, x cm, and the weight, y grams, of a sample of 11 adult snakes of the same type. Her results are shown in the table.

Snake	A	B	C	D	E	F	G	H	I	J	K
x	46	39	54	79	47	58	73	35	43	51	36
y	55	48	58	88	61	55	82	51	50	66	57

(a) Calculate the value of the product moment correlation coefficient, r, between x and y.
(3 marks)

(b) Interpret your value in context. *(2 marks)*

(c) On **Figure 1**, complete the scatter diagram for these data. *(2 marks)*

(d) Subsequently it is found that, of the 11 adult snakes, 9 are male and 2 are female.

   (i) Given that female adult snakes are generally larger than male adult snakes, identify the 2 snakes which are most likely to be female. *(1 mark)*

   (ii) Hence, **without further calculation**, estimate the value of r for the 9 male snakes and revise, as necessary, your interpretation in part (b). *(2 marks)*

3 The weight of gravel, in kilograms, collected by a power shovel may be modelled by a normal distribution with unknown mean, μ, and standard deviation 50.

The weights of a random sample of 20 collections have a mean of $1030\,\text{kg}$.

(a) Construct a 98% confidence interval for μ, giving the limits to four significant figures.
(4 marks)

(b) Comment on a claim that the power shovel is, on average, collecting more than $1000\,\text{kg}$ of gravel. *(2 marks)*

Turn over ▶

4 A survey of all the households on an estate is undertaken to provide information on the number of children per household.

The results, for the 99 households with children, are shown in the table.

Number of children (x)	1	2	3	4	5	6	7
Number of households (f)	14	35	25	13	9	2	1

(a) For these 99 households, calculate values for the mean and the standard deviation.
(3 marks)

(b) In fact, 163 households were surveyed, of which 64 contained no children.

(i) For all 163 households, calculate the value for the mean number of children per household. *(2 marks)*

(ii) State whether the value for the standard deviation, when calculated for all 163 households, will be smaller than, the same as, or greater than that calculated in part (a). *(1 mark)*

(iii) It is claimed that, for all 163 households on the estate, the number of children per household may be modelled approximately by a normal distribution.

Comment, with justification, on this claim. Your comment should refer to a fact other than the discrete nature of the data. *(2 marks)*

5 A machine fills boxes with wine. The volume, W litres, of wine delivered by the machine into a box may be modelled by a normal distribution with mean 3.12 and standard deviation σ.

(a) Given that $\sigma = 0.08$, determine $P(2.95 < W < 3.20)$. *(4 marks)*

(b) Assuming that the value of the mean remains unchanged, determine the value of σ necessary to ensure that at most 2.5% of boxes filled by the machine contain less than 3 litres of wine. *(4 marks)*

(c) After an adjustment to the machine, W can be modelled by a normal distribution with mean 3.12 and variance 0.00375.

Determine the probability that the **mean** volume of wine in 5 boxes, selected at random from those filled by the machine, is less than 3.15 litres. *(3 marks)*

6 Mr Alott and Miss Fewer work in a postal sorting office.

(a) The number of letters per batch, R, sorted incorrectly by Mr Alott when sorting batches of 50 letters may be modelled by the distribution $B(50, 0.15)$.

Determine:

  (i) $P(R < 10)$;

  (ii) $P(5 \leqslant R \leqslant 10)$.   *(4 marks)*

(b) It is assumed that the probability that Miss Fewer sorts a letter incorrectly is 0.06, and that her sorting of a letter incorrectly is independent from letter to letter.

  (i) Calculate the probability that, when sorting a batch of **22** letters, Miss Fewer sorts exactly 2 letters incorrectly.   *(3 marks)*

  (ii) Calculate the probability that, when sorting a batch of **35** letters, Miss Fewer sorts at least 1 letter incorrectly.   *(2 marks)*

  (iii) Calculate the mean and the variance for the number of letters sorted **correctly** by Miss Fewer when she sorts a batch of **120** letters.   *(2 marks)*

  (iv) Miss Fewer sorts a random sample of 20 batches, each containing 120 letters. The number of letters sorted **correctly** per batch has a mean of 112.8 and a variance of 56.86.

Comment on the assumptions that the probability that Miss Fewer sorts a letter incorrectly is 0.06, and that her sorting of a letter incorrectly is independent from letter to letter.   *(3 marks)*

END OF QUESTIONS

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General Certificate of Education
June 2009
Advanced Subsidiary Examination

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Insert

Insert for use in **Question 2**.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

Turn over for Figure 1

Turn over ▶

Figure 1 (for use in Question 2)

Lengths and Weights of Snakes