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

General Certificate of Education
Advanced Subsidiary Examination
June 2009

# Mathematics MS/SS1B
**Unit Statistics 1B**

# Statistics
**Unit Statistics 1B**

**Specimen paper for examinations in June 2010 onwards**

**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 space 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.

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

**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.

| | | Subject category | | | | |
|---|---|---|---|---|---|---|
| | | **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)*

QUESTION PART REFERENCE

QUESTION PART REFERENCE

**2** 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)** Complete the scatter diagram, opposite, 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)*

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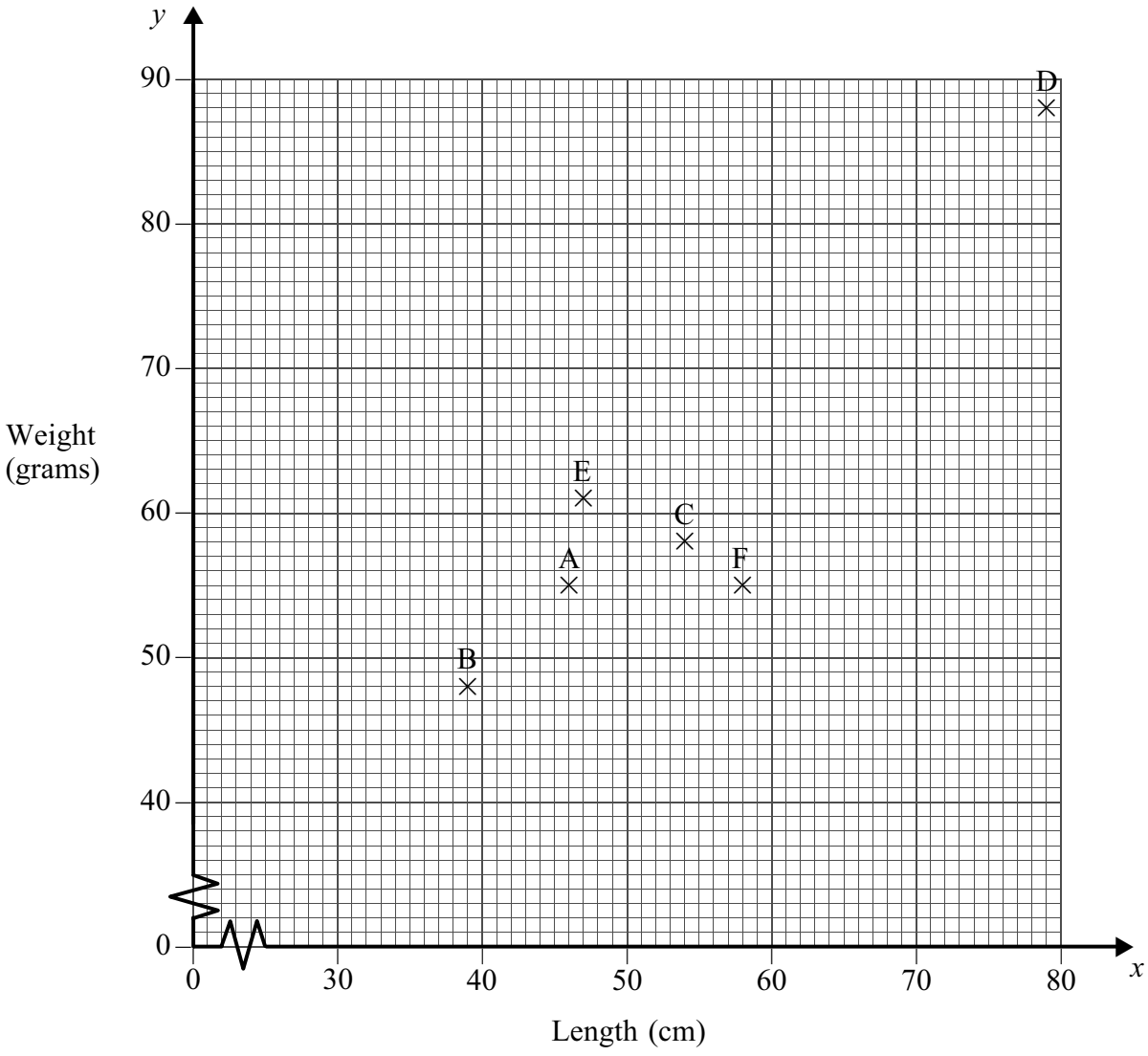
**(c)**

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**3** The weight, $X$ grams, of talcum powder in a tin may be modelled by a normal distribution with mean 253 and standard deviation $\sigma$.

**(a)** Given that $\sigma = 5$, determine:

**(i)** $P(X < 250)$; *(3 marks)*

**(ii)** $P(245 < X < 250)$; *(2 marks)*

**(iii)** $P(X = 245)$. *(1 mark)*

**(b)** Assuming that the value of the mean remains unchanged, determine the value of $\sigma$ necessary to ensure that 98% of tins contain more than 245 grams of talcum powder. *(4 marks)*

QUESTION PART REFERENCE

QUESTION PART REFERENCE

**4** As part of an investigation, a chlorine block is immersed in a large tank of water held at a constant temperature. The block slowly dissolves, and its weight, $y$ grams, is noted $x$ days after immersion. The results are shown in the table.

| $x$ **days** | 5 | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 75 |
|---|---|---|---|---|---|---|---|---|---|
| $y$ **grams** | 47 | 44 | 42 | 38 | 35 | 27 | 23 | 16 | 9 |

**(a)** Calculate the equation of the least squares regression line of $y$ on $x$. *(4 marks)*

**(b)** Hence estimate, to the nearest gram, the initial weight of the block. *(1 mark)*

**(c)** A company which markets the chlorine blocks claims that a block will usually dissolve completely after about 13 weeks. Comment, with justification, on this claim. *(3 marks)*

QUESTION PART REFERENCE

QUESTION PART REFERENCE

**5** 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:

**(i)** the median and the interquartile range; *(3 marks)*

**(ii)** 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)(ii)**. *(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)*

QUESTION PART REFERENCE

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*QUESTION PART REFERENCE*

**6 (a)** The time taken, in minutes, by *Domesat* to install a domestic satellite system may be modelled by a normal distribution with unknown mean, $\mu$, and standard deviation 15.

The times taken, in minutes, for a random sample of 10 installations are as follows.

47 39 25 51 47 36 63 41 78 43

Construct a 98% confidence interval for $\mu$. *(5 marks)*

**(b)** The time taken, $Y$ minutes, by *Teleair* to erect a TV aerial and then connect it to a TV is known to have a mean of 108 and a standard deviation of 28.

Estimate the probability that the mean of a random sample of 40 observations of $Y$ is more than 120. *(4 marks)*

**(c)** Indicate, with a reason, where, if at all, in this question you made use of the Central Limit Theorem. *(2 marks)*

QUESTION PART REFERENCE

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**7** 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 $\mathrm{B}(50, 0.15)$.

Determine:

**(i)** $\mathrm{P}(R < 10)$;

**(ii)** $\mathrm{P}(5 \leqslant R \leqslant 10)$. *(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)*

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**END OF QUESTIONS**

| Surname | | Other Names | |
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| Centre Number | | | Candidate Number | | | | |
| Candidate Signature | | | | | | | | | |

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**MATHEMATICS** **MS/SS1B**
**Unit Statistics 1B**

**STATISTICS**
**Unit Statistics 1B**

# 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**



P15525/Jun09/MS/SS1B 6/6/6/

**Figure 1 (for use in Question 2)**

**Lengths and Weights of Snakes**