General Certificate of Education
January 2005
Advanced Subsidiary Examination

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

**STATISTICS**
**Unit Statistics 1A**

Thursday 27 January 2005   Afternoon Session

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**In addition to this paper you will require:**
- an 8-page answer book;
- the **blue** AQA booklet of formulae and statistical tables;
- an insert for use in Question 4 (enclosed).

You may use a graphics calculator.

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Time allowed: 1 hour 15 minutes

**Instructions**
- Use blue or black ink or 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.
- All necessary working should be shown; 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.
- Mark allocations are shown in brackets.
- Unit Statistics 1A has a **written paper and coursework**.

**Advice**
- Unless stated otherwise, formulae may be quoted, without proof, from the booklet.

**MS/SS1A/W**

Answer **all** questions.

1  Each Monday, Azher has a stall at a town's outdoor market. The table below shows, for each of a random sample of 10 Mondays during 2003, the air temperature, $x\,°C$, at 9 am and Azher's takings, £$y$.

| Monday | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------|---|---|---|----|---|---|---|----|----|----|
| $x$ | 2 | 6 | 9 | 18 | 1 | 3 | 7 | 12 | 13 | 4 |
| $y$ | 97 | 103 | 136 | 245 | 121 | 78 | 145 | 128 | 141 | 312 |

(a)  A scatter diagram of these data is shown below.



**Scatter Diagram of Azher's Takings versus Air Temperature at 9 am**
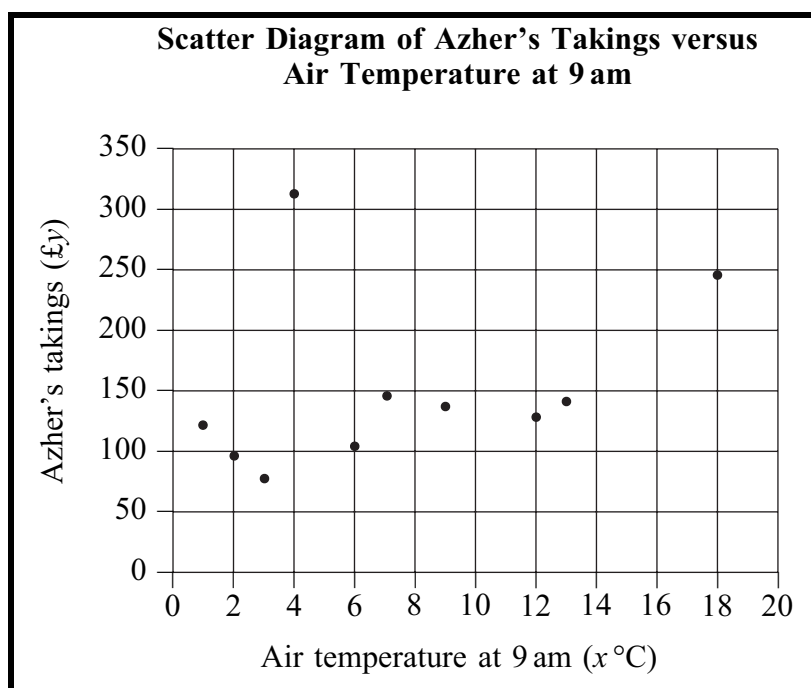
Give **two** distinct comments, in context, on what this diagram reveals. *(2 marks)*

(b)  One of the Mondays is found to be Easter Monday, the busiest Monday market of the year.

Identify which Monday this is most likely to be. *(1 mark)*

(c)  **Removing the data for the Monday you identified in part (b)**, calculate the value of the product moment correlation coefficient for the remaining 9 pairs of values of $x$ and $y$.
*(3 marks)*

(d)  Name one other variable that would have been likely to affect Azher's takings at this town's outdoor market. *(1 mark)*

**2** Katrina receives e-mail messages. The table below shows, for a random sample of 40 weekdays, the number of e-mail messages received by Katrina.

| Number of e-mail messages | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Number of weekdays | 2 | 3 | 5 | 6 | 11 | 7 | 3 | 2 | 1 |

Calculate estimates for the mean and the standard deviation of the number of e-mail messages received per weekday by Katrina. *(3 marks)*

**3** Chopped lettuce is sold in bags nominally containing 100 grams.

The weight, $X$ grams, of chopped lettuce, delivered by the machine filling the bags, may be assumed to be normally distributed with mean $\mu$ and standard deviation 4.

(a) Assuming that $\mu = 106$, determine the probability that a randomly selected bag of chopped lettuce:

  (i) weighs less than 110 grams; *(3 marks)*

  (ii) is underweight. *(3 marks)*

(b) Determine the minimum value of $\mu$ so that at most 2 per cent of bags of chopped lettuce are underweight. Give your answer to one decimal place. *(4 marks)*

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

A parcel delivery company has a depot on the outskirts of a town.

Each weekday, a van leaves the depot to deliver parcels across a nearby area. The table below shows, for a random sample of 10 weekdays, the number, $x$, of parcels to be delivered and the total time, $y$ minutes, that the van is out of the depot.

| $x$ | 9 | 16 | 22 | 11 | 19 | 26 | 14 | 10 | 11 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|
| $y$ | 79 | 127 | 172 | 109 | 152 | 214 | 131 | 80 | 94 | 148 |

(a) On **Figure 1**, plot a scatter diagram of these data. *(2 marks)*

(b) Calculate the equation of the least squares regression line of $y$ on $x$ and draw your line on **Figure 1**. *(6 marks)*

(c) The time that the van is out of the depot delivering parcels may be thought of as the time needed to travel to and from the area plus an amount of time proportional to the number of parcels to be delivered.

Given that the regression line of $y$ on $x$ is of the form $y = a + bx$, give an interpretation, in context, for each of your values of $a$ and $b$. *(2 marks)*

**Turn over ▶**

**5** (a) An analysis of a random sample of 40 customer visits to Lucy, a car saleswoman, results in a mean duration of 72 minutes and a standard deviation of 32 minutes.

Construct a 99% confidence interval for the mean duration of a customer visit to Lucy.

*(4 marks)*

(b) The time, $Y$ minutes, that Ken, a car salesman, spends with a customer at a single visit has a mean of 53 and a standard deviation of 42.

(i) Explain why a normal distribution is **unlikely** to provide an adequate model for $Y$.

*(2 marks)*

(ii) State why the distribution of $\overline{Y}$, the mean of a random sample of 60 single visits, is approximately normal. *(1 mark)*

(iii) Hence determine the probability that $\overline{Y}$ is less than 60. *(4 marks)*

**6** An express coach travels daily between Middlesbrough and London. The coach calls at Thirsk only when seats have been reserved in advance. On any day, the probability that the coach calls at Thirsk is 0.5, and is independent of that on any other day.

(a) Determine the probability that, during a 14-day period, the coach calls at Thirsk:

(i) on at most 10 days;

(ii) on more than 5 days but fewer than 10 days. *(5 marks)*

(b) When the coach calls at Thirsk, it is possible to purchase a seat on the coach providing seats are available. The probability that the coach calls at Thirsk with at least one seat available on any day is 0.4, and is independent of that on any other day.

Calculate the probability that, during a 28-day period, the coach calls at Thirsk with at least one seat available on exactly 7 days. *(3 marks)*

(c) Indicate why a single binomial model would **not** be appropriate for the number of calls **per month** of the coach at Thirsk. *(1 mark)*

**7** The table below shows the numbers of males and females in each of three employment categories at a university on 31 July 2003.

| | Employment category | | |
|---|---|---|---|
| | **Managerial** | **Academic** | **Support** |
| **Male** | 38 | 369 | 303 |
| **Female** | 26 | 275 | 643 |

(a) An employee is selected at random. Determine the probability that the employee is:

  (i) female; *(1 mark)*

  (ii) a female academic; *(1 mark)*

  (iii) female, given that the employee is academic. *(2 marks)*

(b) Three employees are selected at random, without replacement. Determine the probability that exactly one employee is male. *(3 marks)*

(c) The event "employee selected is academic" is denoted by $A$. The event "employee selected is female" is denoted by $F$.

Describe in context, as simply as possible, the events denoted by:

  (i) $F \cap A$; *(1 mark)*

  (ii) $F' \cup A$. *(2 marks)*

**END OF QUESTIONS**

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Insert for use in Question 4.

Fill in the boxes at the top of this page.

Fasten this insert securely to your answer book.

**TURN OVER FOR FIGURE 1**

**Scatter diagram for parcel deliveries by a van**



Total time out of depot (minutes) — y-axis

Number of parcels — x-axis

**Figure 1 (for Question 4)**