



**General Certificate of Education (A-level)**  
**January 2013**

**Statistics**

**SS02**

**(Specification 6380)**

**Statistics 2**

**Final**

***Mark Scheme***

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## Key to mark scheme abbreviations

|              |  |
|--------------|--|
| M            | mark is for method   |
| m or dM      | mark is dependent on one or more M marks and is for method         |
| A            | mark is dependent on M or m marks and is for accuracy              |
| B            | mark is independent of M or m marks and is for method and accuracy |
| E            | mark is for explanation  |
| ✓ or ft or F | follow through from previous incorrect result                      |
| CAO          | correct answer only  |
| CSO          | correct solution only  |
| AWFW         | anything which falls within  |
| AWRT         | anything which rounds to   |
| ACF          | any correct form   |
| AG           | answer given   |
| SC           | special case   |
| OE           | or equivalent  |
| A2,1         | 2 or 1 (or 0) accuracy marks                                       |
| –x EE        | deduct x marks for each error                                      |
| NMS          | no method shown  |
| PI           | possibly implied   |
| SCA          | substantially correct approach                                     |
| c            | candidate  |
| sf           | significant figure(s)  |
| dp           | decimal place(s)   |

## No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

**Otherwise we require evidence of a correct method for any marks to be awarded.**

## SS02

| Q              | Solution  | Marks              | Total     | Comments  |
|----------------|---|--------------------|-----------|---|
| <b>1(a)(i)</b> | $(255 + 166 + 244 + 338)/4$<br>$= 250.75 = 251$   | M1<br>A1           | <b>2</b>  | Exact or integer  |
| <b>(ii)</b>    | Plot moving average<br>And trend line   | B1<br>B1           | <b>2</b>  | Within 2mm radius circle<br>Generous, but must be straight  |
| <b>(b)(i)</b>  | $(-18) \text{ \& } (-20)$<br><br>added and divided by 2<br>$= -19 \text{ } (-15 \text{ to } -25)$   | M1<br><br>m1<br>A1 | <b>3</b>  | Attempt to find two winter effects<br><b>from graph</b><br>and average them (+ or –).<br>Must be negative.                                  |
| <b>(ii)</b>    | $215 - 19$<br><br>$= 196 \text{ } (180 \text{ to } 210)$  | M1<br><br>A1       | <b>2</b>  | Their winter value from trend line<br>'subtract' their value from <b>(i)</b><br>SC B1 for answer in range but with<br><b>no</b> method seen |
| <b>(c)</b>     | <ul style="list-style-type: none"> <li>• Extrapolating too far</li> <li>• trend likely to change</li> <li>• would give negative rainfall</li> <li>• climate change (etc)</li> <li>• data over too short a time</li> </ul> | E2,1               | <b>2</b>  | One mark for each valid point up to<br>a maximum of 2   |
| <b>(d)(i)</b>  | Not accurate, true value above, not<br>below, trend line.   | E1                 | <b>2</b>  | Not accurate  |
| <b>(ii)</b>    | Downward trend has stopped.   | E1                 | <b>2</b>  | Changed, or now upward  |
|                |   | <b>Total</b>       | <b>13</b> |   |

## SS02 (cont)

| Q    | Solution  | Marks        | Total     | Comments  |
|------|---|--------------|-----------|---|
| 2(a) | $H_0: \mu = 1005$   | B1           | 7         | Both<br>AWRT 1006.29 <b>used</b> .<br>Not given if only 1006.3 seen/used  |
|      | $H_1: \mu \neq 1005$  | B1           |           |   |
|      | $\bar{x} = 1006.2875$   |              |           |   |
|      | Test statistic = $z$<br>$= (1006.2875 - 1005) / (\frac{2.1}{\sqrt{8}})$   | M1<br>m1     |           |   |
|      | $= 1.734$   | A1           |           |   |
|      | c.v. = $\pm 1.645$<br>So test statistic in critical region.<br>Reject $H_0$ , evidence that mean has changed.   | B1<br>A1     |           |   |
| (b)  | $H_0: \mu = 1005$   | B1           | 5         | Both<br>Including $\sqrt{90}$   |
|      | $H_1: \mu > 1005$   | M1           |           |   |
|      | $z = (1005.48 - 1005) / \frac{2.41}{\sqrt{90}}$   | A1           |           |   |
|      | $= 1.88$ to $1.90$<br>c.v. = $2.0537$ ( $t_{89} = \text{approx } 2.0$ )<br>So test statistic not in critical region.<br>Accept $H_0$ , insufficient evidence that mean has increased. | B1<br>A1     |           |   |
| (c)  | Because a large sample  | M1           | 2         | Mention of flour not necessary<br>Dep on B1 for $H_0$ & $H_1$ , A1 and B1 for c.v.  |
|      | Can use the central limit theorem,<br>So the sample mean is normally distributed.   | E1           |           |   |
| (d)  | The test must be the one accepting $H_0$  | M1           | 2         | Just CLT mentioned scores B1<br>Anything showing understanding of Type II error <b>being specific about what is accepted/rejected</b> |
|      | Hence the test in part (b)  | A1           |           |   |
|      |   | <b>Total</b> | <b>16</b> |   |

## SS02 (cont)

| Q              | Solution   | Marks          | Total     | Comments   |
|----------------|--|----------------|-----------|--|
| <b>3(a)(i)</b> | $P(X \leq 2) = 0.9197$   | B1             | <b>1</b>  | AWFW 0.919 to 0.920  |
| <b>(ii)</b>    | $P(X = 4) = P(X \leq 4) - P(X \leq 3)$<br>$0.9963 - 0.9810 = 0.0153$   | M1<br>A1       |           | Or by use of formula<br>AWRT 0.0153  |
| <b>(b)</b>     | Po(10) used<br>$P(X > 8) = 1 - P(\leq 8)$<br>$1 - 0.3328 = 0.667(2)$   | M1<br>m1<br>A1 | <b>2</b>  | Allow if adjacent columns used.<br>AWRT 0.667  |
| <b>(c)(i)</b>  | So Po(12) altogether.<br>$P(X \geq 15) = 1 - P(\leq 14)$<br>$1 - 0.7720 = 0.228$   | M1<br>m1<br>A1 | <b>3</b>  |  |
| <b>(ii)</b>    | The coins buried in a hoard are no longer independent.<br>Poisson requires independence so brooches more likely to be Poisson. | E1<br><br>E1   | <b>3</b>  | Reference to independence in relation to coins or brooches.<br>Identification of brooches. |
|                |  |                | <b>2</b>  |  |
|                |  | <b>Total</b>   | <b>11</b> |  |

## SS02 (cont)

| Q             | Solution   | Marks          | Total                | Comments   |
|---------------|--|----------------|----------------------|--|
| <b>4 (a)</b>  | This is a rounding error because the percentages are shown to the nearest integer.   | E1             |                      | Rounding error.                                    |
| <b>(b)</b>    | $7\% \times 54070$<br>$= 4000 \quad (3785)$  | M1<br>A1       | <b>1</b><br><b>2</b> | CAO  |
| <b>(c)</b>    | Higher proportion of males get immediate custody<br>Higher proportion of males get community penalties<br>Lower proportion of males get fines  | E2             |                      | E1 each for suitable comments up to a maximum of 2 |
| <b>(d)(i)</b> | $66/100 \times 360$<br>$= 238^\circ$   | M1<br>A1       | <b>2</b>             | AWRT   |
| <b>(ii)</b>   | $257462/918380$<br>Square rooted<br>$\times 4 = 2.1 \text{ cm}$  | M1<br>m1<br>A1 | <b>2</b>             | AWRT   |
| <b>(e)(i)</b> | $(257462 + 918380)/51809.7$<br>$= 22.7$  | M1<br>A1       | <b>3</b><br><b>2</b> | AWRT   |
| <b>(ii)</b>   | No, because figures relate to sentencing, not original crime.<br><b>Accept:</b> No, because London figure only slightly higher than North East | E1             |                      | One mark for any suitable negative comment.        |
|               |  | <b>Total</b>   | <b>13</b>            |  |

## SS02 (cont)

| Q      | Solution   | Marks          | Total     | Comments                                 |
|--------|--|----------------|-----------|--|
| 5 (a)  | Mean = $1 \times 0.03 + 2 \times 0.12 + \text{etc.}$<br>= 3.51                                 | M1             |           | <b>Applied</b> in this case<br>AWRT 1.03 |
|        | $E(X^2) = 1 \times 0.03 + 4 \times 0.12 + \dots$   | M1             |           |  |
|        | $\text{Var}(X) = E(X^2) - E(X)^2$<br>= 1.0299  | m1<br>A1       |           |  |
|        |  |                | 4         |  |
|        | (b)(i) 0.51  | B1             |           |  |
|        |  |                | 1         |  |
|        | (ii) Mode = 3<br>$P(X \geq 3) = 0.85$  | M1<br>A1       |           |  |
|        |  |                | 2         |  |
|        | (ii) Median = 4<br>$P(X < 4) = 0.49$   | M1<br>A1       |           |  |
|        |  |                | 2         |  |
| (c)(i) | Poisson would have significant probability of greater than 5 which does not match the context. | E1             |           | Or similar reasoning in context.         |
|        |  |                | 1         |  |
| (ii)   | Mean of $B(5, 0.7) = 3.5$<br>variance of $B(5, 0.7) = 1.05$<br>So (a) answers good match       | B1<br>B1<br>E1 |           | Must have both B1                        |
|        |  |                | 3         |  |
|        |  | <b>Total</b>   | <b>13</b> |  |



## SS02 (cont)

| Q      | Solution  | Marks                          | Total     | Comments   |
|--------|---|--------------------------------|-----------|--|
| 6(a)   | Stratified  | B1                             | 1         |  |
| (b)    | Eg. No complete list of customers.<br>No contact details for customers.<br>Very time consuming<br>Very expensive<br>May not give desired proportions<br>People would not want to be delayed in a <b>fast</b> food outlet                | E3,2,1                         | 3         | Any three comments addressing different aspects. Expense and time count as separate points.  |
| (c)(i) | Convenient. They just go locally and question customers until they have reached the numbers required.   | E1                             |           | Convenience.   |
| (ii)   | Not representative.<br>Other parts of the country may have different views.   | E1                             |           | Not representative.  |
| (d)    | Eg. A small number of outlets.<br>Randomly selected<br>Or selected for spread of size etc<br>Decide on a quota for each type of customer at the chosen outlets.<br>Select the customers who will fulfil the quotas trying to avoid bias | E1<br>E1<br>E1<br>(E1)<br>(E1) | 2         | Small number<br>Random (outlets) <b>or</b> balanced<br>Quota<br>Avoid bias (customers) (Accept 'randomly select customers')<br>Any additional valid point<br><b>Maximum of 3 marks</b> |
|        |   | <b>Total</b>                   | <b>9</b>  |  |
|        | <b>TOTAL</b>  |                                | <b>75</b> |  |