



General Certificate of Education

Mathematics 6360

Statistics 6380

MS/SS1A/W Statistics 1A

Mark Scheme

2008 examination - June series

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Key to mark scheme and abbreviations used in marking

| | |
|---------|--|
| 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 | MC | mis-copy |
| CAO | correct answer only | MR | mis-read |
| CSO | correct solution only | RA | required accuracy |
| AWFW | anything which falls within | FW | further work |
| AWRT | anything which rounds to | ISW | ignore subsequent work |
| ACF | any correct form | FIW | from incorrect work |
| AG | answer given | BOD | given benefit of doubt |
| SC | special case | WR | work replaced by candidate |
| OE | or equivalent | FB | formulae book |
| A2,1 | 2 or 1 (or 0) accuracy marks | NOS | not on scheme |
| -x EE | deduct x marks for each error | G | graph |
| NMS | no method shown | c | candidate |
| PI | possibly implied | sf | significant figure(s) |
| SCA | substantially correct approach | 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. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

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.

MS/SS1A/W

| Q | Solution | Marks | Total | Comments |
|--------------|---|-------|----------|------------------------|
| 1(a) | b (gradient) = -1.01 to $-1(.00)$ | B2 | 4 | AWFW (-1.00337) |
| | $(b$ (gradient) = -1.05 to -0.95) | (B1) | | |
| | a (intercept) = $53(.0)$ to 53.2 | B2 | | |
| | $(a$ (intercept) = $52(.0)$ to $54(.0)$) | (B1) | | |
| | OR | | | |
| | Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$ | | | |
| | or | | | |
| | Attempt at S_{xx} and S_{xy} | (M1) | | |
| | Attempt at correct formula for b (gradient) | (m1) | | |
| | b (gradient) = -1.01 to $-1(.00)$ | (A1) | | |
| | a (intercept) = $53(.0)$ to 53.2 | (A1) | | |
| | Accept a and b interchanged only if then identified correctly in part (b), but B2 in (b) does not necessarily imply 4 marks in (a) | | | |
| (b) | When $x = 21$, | | 2 | AWFW AWFW (32.0) |
| | $y = 31.7$ to 32.2 | B2 | | |
| | $(y = 29.9$ to $34.1)$ | (B1) | | |
| | Evidence of use of 21 in c's equation | (M1) | | |
| | <i>Special Cases (if seen):</i> | | | |
| | $y = \frac{33.0 + 30.7}{2} = 31.8$ to 31.9 | (B1) | | |
| | $y = 31.85$ without working | (B1) | | |
| Total | | | 6 | |

MS/SS1A/W (cont)

| Q | Solution | Marks | Total | Comments |
|--------------|---|--------------|----------|--|
| 2(a) | $P(\text{Blue}) = \frac{160}{400} = 0.4 \text{ or } \frac{2}{5} \text{ or } \frac{160}{400}$ <i>In (b) to (d), method marks are for single fractions, or equivalents, only</i> | B1 | 1 | CAO; or equivalent |
| (b) | $P(\text{Marker}) = \frac{280}{400}$ $= 0.7 \text{ or } \frac{7}{10} \text{ or } \frac{280}{400}$ | M1 A1 | 2 | $270 \leq \text{Numerator} \leq 290 \text{ and}$ $\text{Numerator} < \text{Denominator} \leq 400$ CAO; or equivalent |
| (c) | $P(B \text{ or } M) = P(B \cup M) =$ $\frac{160 + 280 - 119}{400} = \frac{280 + 41}{400} = \frac{321}{400}$ $= 0.802 \text{ to } 0.803 \text{ or } \frac{321}{400}$ | M1 A1 | 2 | $290 \leq \text{Numerator} \leq 321 \text{ and}$ $\text{Numerator} < \text{Denominator} \leq 400$ AWW/CAO (0.8025) |
| (d) | $P(\text{Green} \mid \text{Highlighter}) = P(G \mid H) = \frac{42}{120}$ $= 0.35 \text{ or } \frac{7}{20} \text{ or } \frac{42}{120}$ | M1 A1 | 2 | $\text{Numerator} = 42 \text{ and}$ $110 \leq \text{Denominator} \leq 120$ CAO; or equivalent |
| Total | | | 7 | |

MS/SS1A/W (cont)

| Q | Solution | Marks | Total | Comments |
|------|--|--|----------------|---|
| 3(a) | $r = 0.806$ to 0.807 $(r = 0.8(0)$ to $0.81)$ $(r = 0.7$ to $0.9)$ OR Attempt at $\sum x$, $\sum x^2$, $\sum y$, $\sum y^2$ and $\sum xy$ or Attempt at S_{xx} , S_{yy} and S_{xy} Attempt at correct formula for r $r = 0.806$ to 0.807 | B3 (B2) (B1) (M1) (m1) (A1) | 3 | AFWW (0.80656) AFWW AFWW 2859, 681575, 1428, 170342 and 340555 418.25, 410 and 334 AFWW |
| (b) | Moderate/fairly strong/strong positive correlation (relationship/association) between length and width of plaques | B1 B1 | 2 | Or equivalent; must qualify strength and indicate positive B0 for some/average/medium/very strong/etc Context; providing $0 < r < 1$ |
| (c) | Figure 1: 6 correct labelled points (5 correct labelled points) (4 correct labelled points) | B3 (B2) (B1) | 3 | Deduct 1 mark if not labelled |
| (d) | A to F: $r = -0.2$ to $+0.2$ Accept 'Zero' but not 'No' correlation G to L: $r = -0.2$ to $+0.2$ <i>Special Cases:</i> $r = -0.2$ to $+0.2$ with no sources $r = -0.2$ to $+0.2$ for each/both source(s) If B0 B0 but both values of $r = -0.4$ to $+0.4$ | B1 B1 (B1) (B2) (B1) | 2 2 | AFWW (−0.0275) No penalties for calculations Statements must include a single value within range AFWW (−0.0196) AFWW AFWW; or equivalent identification AFWW |
| | Total | | 10 | |

MS/SS1A/W (cont)

| Q | Solution | Marks | Total | Comments |
|----------|---|-------------|-----------|---|
| 4 | Binomial distribution | M1 | | Used somewhere in question |
| (a) | $M \sim B(40, 0.35)$ | A1 | | Used; may be implied |
| | $P(M \leq 15) = 0.69(0) \text{ to } 0.696$ | A1 | 3 | AWFW (0.6946) |
| (b) | $W \sim B(10, 0.29)$ | B1 | | Used; may be implied |
| | $P(W = 3) = \binom{10}{3} (0.29)^3 (0.71)^7$ | M1 | | Stated; may be implied |
| | $= 0.266 \text{ to } 0.2665$ | A1 | 3 | AWFW (0.2662) Note: $B(10, 0.3) \Rightarrow 0.2668$ |
| (c)(i) | $n = 20 \quad p = 0.71$ | B1 | | Stated or used; may be implied by 14.2 |
| | Mean, $\mu = np = 14.2$ | B1 | | CAO |
| | Variance, $\sigma^2 = np(1 - p)$ $= 4.11 \text{ to } 4.12$ | B1 | 3 | AWFW (4.118) |
| (ii) | Mean of 16.5 is greater/different or $16.5/20 = 0.825$ is greater/different to 0.71 | B1dep | | Dependent on $\mu = 14.2$ |
| | <i>Means and variances are different</i> | (B2, 1 dep) | | |
| | Variance of 2.50 is smaller/different | B1dep | | Dependent on $\sigma^2 = 4.11 \text{ to } 4.12$ |
| | Suggests claim that groups are not random samples is justified | B1dep | 3 | Dependent on previous 2 marks Or equivalent |
| | Total | | 12 | |

MS/SS1A/W (cont)

| Q | Solution | Marks | Total | Comments |
|-----|---|----------|----------|---|
| 5 | $n = 100 \quad \bar{x} = 1.90 \quad s = 3.32$ | | | |
| (a) | Mean = $60 + \bar{x}$ = 61.9 | M1 A1 | | CAO |
| | Standard deviation = 3.32 | B1 | 3 | CAO |
| (b) | 98% $\Rightarrow z = 2.32$ to 2.33 ($\Rightarrow t = 2.36$ to 2.37) | B1 | | AWFW (2.3263) AWFW (2.364) |
| | CI for μ is $\bar{x} \pm z/t \times \frac{s}{\sqrt{n}}$ | M1 | | Used; must have \sqrt{n} with $n > 1$ |
| | Thus $61.9 \pm 2.3263 \times \frac{3.32}{\sqrt{100}}$ | A1✓ | | ✓ on (a) and z/t only |
| | Hence $61.9 \pm (0.7 \text{ to } 0.8)$ | A1 | 4 | Accept $1.03 \pm (0.012 \text{ to } 0.013)$ AWFW |
| | or $(61.1 \text{ to } 61.2, 62.6 \text{ to } 62.7)$ | | | Accept (1.01 to 1.02, 1.04 to 1.05) |
| (c) | $\bar{S} \gg 1 \text{ hour or } 60 \text{ minutes:}$ Not valid as UCL ≈ 1 hour (Accept Both limits ≈ 1 hour) | B1dep | 1 | Dependent on UCL = 62.6 to 62.7 or UCL = 1.04 to 1.05 |
| | Total | | 8 | |

MS/SS1A/W (cont)

| Q | Solution | Marks | Total | Comments |
|---------------|--|----------------------------------|-----------|---|
| 6 | Length $L \sim N(69.5, 0.55^2)$ | | | |
| (a)(i) | $P(L < 70) = P\left(Z < \frac{70 - 69.5}{0.55}\right) =$ $P(Z < 0.91) =$ $0.818 \text{ to } 0.82(0)$ | M1 A1 A1 | 3 | Standardising (69.5, 70 or 70.5) with 69.5 and $(\sqrt{0.55}, 0.55 \text{ or } 0.55^2)$ and/or $(69.5 - x)$ 0.91 AWRT; ignore sign AWFW (0.81835) |
| (ii) | $P(69 < L < 70) =$ $P(L < 70) - P(L < 69) =$ $P(Z < 0.91) - P(Z < -0.91) =$ $P(Z < 0.91) - \{1 - P(Z < 0.91)\} =$ $(0.81835) - (1 - 0.81835) =$ $0.636 \text{ to } 0.64(0)$ | M1 m1 A1 | 3 | Difference (70 - 69) Correct area change AWFW (0.63670) |
| (iii) | $P(L = 70) = 0$ | B1 | 1 | CAO |
| (b) | $0.90 (90\%) \Rightarrow z = -1.28$ $z = \frac{l - 69.5}{0.55}$ $= \pm 1.28(16)$ Hence $l = 68.7 \text{ to } 68.9$ | B1 M1 A1 A1 | 4 | AWRT; ignore sign (-1.2816) Standardising l with 69.5 and 0.55; allow $(69.5 - l)$ Equating z -term to the z -value AWFW; CSO (68.796) |
| (c)(i) | $P(20L < 70) = \{(a)(i)\}^{20} =$ $0.018 \text{ to } 0.02(0)$ | M1 A1 | 2 | Stated or used AWFW |
| (ii) | Variance of $\bar{L}_{20} = \frac{0.55^2}{20} = 0.0151(25)$ SD of $\bar{L}_{20} = \frac{0.55}{\sqrt{20}} = 0.123$ $P(\bar{L}_{20} > 69.25) = P\left(Z > \frac{69.25 - 69.5}{\sqrt{0.55^2/20}}\right)$ $= P(Z > -2.03) = P(Z < 2.03) =$ $0.978 \text{ to } 0.98(0)$ | B1 M1 m1 A1 | 4 | CAO/AWRT; stated or used Standardising 69.25 with 69.5 and 0.123; allow $(69.5 - 69.25)$ Correct area change AWFW (0.97896) |
| | Total | | 17 | |
| | TOTAL | | 60 | |