



General Certificate of Education

Mathematics 6360

MS1B Statistics 1B

Mark Scheme

2006 examination - June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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.

MS1B

| Q | Solution | Marks | Total | Comments |
|----------------|---|--------------|--------------|--|
| 1(a)(i) | $r = 0.143$ to 0.1432 | B3 | | AWFW |
| | or $r = 0.142$ to 0.144 | B2 | | AWFW |
| | or $r = 0.1$ to 0.2 | B1 | | AWRT |
| | Attempt at $\Sigma x \quad \Sigma x^2$ $\Sigma y \quad \Sigma y^2$ Σxy | | | 3952, 2228282 47.00, 292.0000 23517.50 |
| | or Attempt at $S_{xx} \quad S_{yy} \quad S_{xy}$ | M1 | | 275994, 15.875, 299.5 |
| | Attempt at a correct formula for r | m1 | | |
| | $r = 0.143$ to 0.1432 | A1 | 3 | AWFW |
| (ii) | Little/weak/no correlation/relationship/association between number of pages and (retail) price | B1 | | or equivalent; but not poor |
| | | B1 | 2 | context |
| (iii) | Size (page, thickness), author, ranking, publicity/marketing, cover design, recommendations on back, publisher, font, popularity, quality, print-run, etc | B1 | 1 | or any sensible variable but not pictures, coloured pictures, age, words, weight, mass |
| (b) | (Very) strong/almost exact positive/perfect correlation/relationship/association between number of pages and sale/new price Sale price appears to be determined by number of pages | B1 | | or equivalent |
| | | B1 | 2 | context |
| | | B2 | | or equivalent |
| Total | | | 8 | |

MS1B (cont)

| Q | Solution | Marks | Total | Comments |
|--------------|---|---|--------------|---|
| 2(a) | Height, $X \sim N(185, 10^2)$ | | | |
| (i) | $P(X < 200) = P\left(Z < \frac{200-185}{10}\right)$ $= P(Z < 1.5)$ $= \Phi(1.5) = 0.933$ | M1 A1 A1 | 3 | standardising (199.5, 200 or 200.5) with 185 and $(\sqrt{10}, 10 \text{ or } 10^2)$ and/or $(185 - x)$ CAO; ignore sign AWRT (0.93319) |
| (ii) | $P(X > 175) = P\left(Z > \frac{175-185}{10}\right)$ $= P(Z > -1) = P(Z < 1)$ $= 0.841$ | M1 m1 A1 | 3 | standardising (174.5, 175 or 175.5) with 185 and $(\sqrt{10}, 10 \text{ or } 10^2)$ and/or $(185 - x)$ area change AWRT (0.84134) |
| (iii) | $P(175 < X < 200) = (i) - [1 - (ii)]$ $= 0.93319 - [1 - 0.84134]$ $= 0.774 \text{ to } 0.775$ | M1 A1 \checkmark | 2 | or equivalent AWFW (0.77453) \checkmark on (i) and (ii) providing > 0 |
| (b) | Mean of $\bar{X} = 185$ Variance of $\bar{X} = \frac{10^2}{4} = 25$ $P(\bar{X} > 190) = P\left(Z > \frac{190-185}{5}\right)$ $= P(Z > 1) = 1 - \Phi(1)$ $= 0.159$ | B1 B1 M1 A1 \checkmark | 4 | CAO; may be implied by use in standardising CAO; or equivalent standardising 190 with 185 and 5 and/or $(185 - 190)$ AWRT (0.15866) \checkmark on (a)(ii) if used |
| | | Total | 12 | |

MS1B (cont)

| Q | Solution | Marks | Total | Comments |
|----------------|---|-----------------------|-----------|--|
| 3(a)(i) | Gradient, $b = -3.24$ to -3.26 $b = -3.2$ to -3.3 | B2 B1 | | AWFW AWFW (-3.25) |
| | Intercept, $a = 262$ to 264 $a = 260$ to 270 | B2 B1 | | AWFW AWFW (262.88) |
| | Attempt at Σx Σx^2 Σy Σxy or Attempt at S_{xx} S_{xy} Attempt at a correct formula for b $b = -3.24$ to -3.26 $a = 262$ to 264 | | | 108, 1836, 2015, 22425 540, -1755 |
| | Accept a & b interchanged only if identified correctly in (b) and (c) | M1 m1 A1 A1 | 4 | AWRT AWFW |
| (ii) | Gradient, b : Decrease in pressure per month Change in pressure | B2 B1 | 2 | or equivalent or better |
| (iii) | Intercept, a : Initial pressure or pressure at $x = 0$ Reference to 265, actual or expected value | B1 B1 | 2 | or equivalent; not y -intercept |
| (b)(i) | Value for $b = 2 \times$ [gradient or b from (a)(i)] $= -6.4$ to -6.6 | M1 A1 \checkmark | 2 | accept $2b$; ignore sign AWFW (-6.5) \checkmark from (a)(i) but must be < 0 |
| (ii) | $P_8 = 265 - 6.5 \times 8$ $= 212$ to 214 (< 220) | M1 A1 | 2 | must use 265 and $x = 8$ and $2 \times [b (< 0)$ from (a)(i)] or [from (b)(i) (< 0)] AWFW AG |
| | Total | | 12 | |

MS1B (cont)

| Q | Solution | Marks | Total | Comments |
|----------------|---|--------------|--------------|---|
| 4(a)(i) | Mean, $\bar{x} = 505.2$ | B1 | | CAO; stated or implied |
| | 99% $\Rightarrow z = 2.57$ to 2.58 | B1 | | AWFW (2.5758) |
| | or 99% $\Rightarrow t = 3.25$ (Knowledge of the t -distribution is not required in this unit) | B1 | | AWRT (3.250) |
| | CI for μ is $\bar{x} \pm (z \text{ or } t) \times \frac{(\sigma \text{ or } s)}{\sqrt{n}}$ | M1 | | use of; must have $(\div \sqrt{n})$ with $n > 1$ |
| | Thus $505.2 \pm 2.5758 \times \frac{6}{\sqrt{10}}$ | A1✓ | | ✓ on \bar{x} and z only |
| | or $505.2 \pm 3.25 \times \left(\frac{5.96}{\sqrt{10}} \text{ or } \frac{5.65}{\sqrt{9}} \right)$ | A1✓ | | ✓ on \bar{x} only |
| | Hence 505.2 ± 4.9 or (500.3, 510.1) | A1 | 5 | use of $t \Rightarrow 505.2 \pm 6.1$ AWRT |
| (ii) | Weights of packets can be assumed to be normally distributed | B1 | 1 | accept 'population of weights'; not 'sample of weights' or 'it' |
| (iii) | Given sample: 3 in 10/ some of packets have weights below 500 grams | B1 | | or equivalent |
| | Confidence interval: CI > 500 | B1✓ | | ✓ on CI in (a)(i) |
| | Conclusion: Statement does not appear justified | B1 dep | 3 | or equivalent dependent on both B1 and B1✓ |
| (b) | 0.01 or 1% | B1 | 1 | CAO; or equivalent |
| | Total | | 10 | |

MS1B (cont)

| Q | Solution | Marks | Total | Comments |
|---------------|--|----------------------------|--------------|--|
| 5(a) | B(15, 0.3) | M1 | | use of in (a) |
| (i) | $P(K = 5) = P(K \leq 5) - P(K \leq 4)$ $P(K = 5) = \binom{15}{5} (0.3)^5 (0.7)^{10}$ $= 0.7216 - 0.5155 = 0.2055$ to 0.2065 | M1 A1 | 3 | may be implied AWFW (0.2061) |
| (ii) | (Fewer than) half $\Rightarrow 7$ or $7\frac{1}{2}$ or 8 Thus require $P(K \leq 7$ or $< 8)$ $= 0.9495$ to 0.9505 | B1 M1 A1 | 3 | stated or implied used or implied by correct answer AWFW (0.9500) |
| (iii) | $P(2 < K < 7) = 0.8689$ or 0.9500 minus 0.1268 or 0.2969 $= 0.7415$ to 0.7425 or B(15, 0.3) expressions stated for at least 3 terms within $2 \leq K \leq 7$ Answer | M1 M1 A1 M1 A2 | 3 | AWFW (0.7421) or implied by a correct answer |
| (b)(i) | Mean, $\mu = np = 15 \times 0.4 = 6$ Variance, $\sigma^2 = np(1-p) = 6 \times 0.6 = 3.6$ Standard deviation $= \sqrt{3.6} = 1.89$ to 1.9 | B1 M1 A1 | 3 | CAO use of $\sigma^2 = np(1-p)$ AWFW; or equivalent |
| (ii) | Mean, $\bar{x} = 6$ Standard deviation, s or $\sigma = 2.82$ to 2.99 | B1 B1 | 2 | CAO ($\Sigma x = 60$) CSO if evidence of $np(1-p)$ or 1.9 AWFW; or equivalent. ($\Sigma x^2 = 440$) |
| (iii) | Means are same/equal Standard deviations are different Reason to doubt validity of Kirk's claim | B1 ✓ B1 dep B1 dep | 3 | ✓ on 2 means; accept $\frac{6}{15} = 0.4$ if not contradicted by \bar{x} in (ii) dependent on 2 correct SDs dependent on 2 correct SDs |
| | Total | | 17 | |

MS1B (cont)

| Q | Solution | Marks | Total | Comments | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------|--|----------------|-----------|--|-------|-----|---|-------|----|----|----|----|-----|---------|----|----|----|----|-----|---|----|----|-----|----|-----|--|--|--|
| 6 | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td></td> <td>0 (R)</td> <td>1 (S)</td> <td>2 (T)</td> <td>≥3</td> <td>T</td> </tr> <tr> <td>D (D)</td> <td>24</td> <td>32</td> <td>41</td> <td>23</td> <td>120</td> </tr> <tr> <td>SD (D')</td> <td>40</td> <td>37</td> <td>88</td> <td>35</td> <td>200</td> </tr> <tr> <td>T</td> <td>64</td> <td>69</td> <td>129</td> <td>58</td> <td>320</td> </tr> </table> | | 0 (R) | 1 (S) | 2 (T) | ≥3 | T | D (D) | 24 | 32 | 41 | 23 | 120 | SD (D') | 40 | 37 | 88 | 35 | 200 | T | 64 | 69 | 129 | 58 | 320 | | | |
| | | 0 (R) | 1 (S) | 2 (T) | ≥3 | T | | | | | | | | | | | | | | | | | | | | | | |
| | D (D) | 24 | 32 | 41 | 23 | 120 | | | | | | | | | | | | | | | | | | | | | | |
| | SD (D') | 40 | 37 | 88 | 35 | 200 | | | | | | | | | | | | | | | | | | | | | | |
| T | 64 | 69 | 129 | 58 | 320 | | | | | | | | | | | | | | | | | | | | | | | |
| (a)(i) | $P(D) = \frac{120}{320}$ or $\frac{3}{8}$ or 0.375 | B1 | 1 | CAO; or equivalent | | | | | | | | | | | | | | | | | | | | | | | | |
| (ii) | $P(D \cap R) = \frac{24}{320}$ or $\frac{3}{40}$ or 0.075 | B1 | 1 | CSO; or equivalent | | | | | | | | | | | | | | | | | | | | | | | | |
| (iii) | $P(D \cup T) = \frac{120+88}{320} = \frac{129+24+32+23}{320}$ $= \frac{208}{320} \text{ or } \frac{13}{20} \text{ or } 0.65$ | M1 A1 | 2 | CAO; or equivalent | | | | | | | | | | | | | | | | | | | | | | | | |
| (iv) | $P(D R) = \frac{P(D \cap R)}{P(R)} = \frac{(ii)}{P(R)} = \frac{24/\cancel{(320)}}{64/\cancel{(320)}}$ $= \frac{24}{64} \text{ or } \frac{3}{8} \text{ or } 0.375$ | M1 A1 | 2 | M0 if independence assumed CAO; or equivalent | | | | | | | | | | | | | | | | | | | | | | | | |
| (v) | $P(R D') = \frac{P(R \cap D')}{P(D')} = \frac{40/\cancel{(320)}}{200/\cancel{(320)}}$ $= \frac{40}{200} \text{ or } \frac{1}{5} \text{ or } 0.2$ | M1 M1 A1 | 3 | numerator allow independence assumed denominator CAO; or equivalent | | | | | | | | | | | | | | | | | | | | | | | | |
| (b)(i) | R and S or R and T or S and T | B1 | 1 | not D and D' | | | | | | | | | | | | | | | | | | | | | | | | |
| (ii) | $P(D) = 0.375 = P(D R)$ or (i) = (iv) so YES | M1 A1 | 2 | $P(D) \times P(R) = 0.375 \times 0.2$ $= 0.075 = P(D \cap R)$ or (ii) or $P(R D) = P(R) = 0.2$, etc | | | | | | | | | | | | | | | | | | | | | | | | |
| (c)(i) | A semi-detached house or two children (or both) | B1 B1 | 2 | CAO or equivalent | | | | | | | | | | | | | | | | | | | | | | | | |
| (ii) | A detached house and/with less than two children | B1 B1 | 2 | CAO (0 or 1 must not include 'both') | | | | | | | | | | | | | | | | | | | | | | | | |
| | Total | | 16 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | TOTAL | | 75 | | | | | | | | | | | | | | | | | | | | | | | | | |