



**General Certificate of Education (A-level)
June 2011**

Mathematics

MS/SS1B

(Specification 6360)

Statistics 1B

Final

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process 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 standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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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.

MS/SS1B

Q	Solution	Marks	Total	Comments
1				
(a)(i)	Mode = 253	B1	1	CAO
(ii)	Median = 252	B1		CAO
	Upper quartile = 253	B1		CAO; either
	Lower quartile = 250			May be implied by IQR = 3
	Interquartile range = 3	B1	3	CAO; do not award if seen to be not based on 253 and 250
(b)(i)	Range = 271 – 227 = 44	B1	1	CAO; do not award if seen to be not based on 271 and 227
(ii)	Mean, $\bar{x} = \mathbf{251 \text{ to } 251.4}$ <i>Award B1 if divisor seen not to be 85 but answer in range</i>	B2		AWFW $\sum fx = 21352$ $\bar{x} = 251.2$
	Note: If B0 then can award M1 for attempt at $\sum fx \div 85$ seen			<i>Ignore notation and condone incorrect midpoints (eg upper or lower limits used)</i>
	Standard deviation, s or $\sigma = \mathbf{4.21 \text{ to } 4.28}$ <i>Award B1 if divisor seen not to be 84 or 85 but answer in range</i>	B2	4	AWFW $\sum fx^2 = 5365134$ $\sigma = 4.217$ $s = 4.242$
(c)	Interquartile range (IQR)	B1		Named
	Not affected by unknown/large/small/extreme/outlying/227 & 271 values	Bdep1	2	Or equivalent Dependent on previous B1 Only negative comments on other measures \Rightarrow Bdep0
	OR			<i>More than one named \Rightarrow B0 Bdep0</i> <i>Range \Rightarrow B0 Bdep0</i>
	Standard deviation (s or σ)	(B1)		Named
	Uses all data values	(Bdep1)		Or equivalent Dependent on previous (B1) Only negative comments on other measures \Rightarrow Bdep0
	Total		11	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2				
(a)(i)	<p>Diameter, $D \sim N(57.15, 0.04^2)$</p> $P(D < 57.2) = P\left(Z < \frac{57.2 - 57.15}{0.04}\right)$ $= P(Z < 1.25)$ $= \mathbf{0.894 \text{ to } 0.895}$	M1 A1 A1	3	<p>Standardising 57.2 with 57.15 and 0.04; allow (57.15 – 57.2)</p> <p>CAO; ignore inequality and sign May be implied by a correct answer</p> <p>AWFW (0.89435)</p>
(ii)	<p>$P(57.1 < D < 57.2)$</p> $= p - (1 - p)$ $= 2 \times 0.89435 - 1 = \mathbf{0.788 \text{ to } 0.79(0)}$	M1 A1	2	<p>Allow even if incorrect standardising providing $p - (1 - p)$ seen May be implied by a correct answer</p> <p>AWFW (0.78870)</p>
(b)(i)	<p>$P(16 \text{ balls} < 57.2) = p^{16}$ with $0 < p < 1$</p> $= [(a)(i)]^{16} = (0.89435)^{16} = \mathbf{0.166 \text{ to } 0.17(0)}$	M1 A1	2	<p>Any probability to power 16 or $1 - p^{16}$; do not allow multiplying factors <i>If only seen in (b)(ii), allow just M1</i></p> <p>AWFW (0.16754)</p>
(ii)	<p>Variance of $\bar{D}_{16} = 0.04^2/16 = \mathbf{0.0001}$</p> <p>or</p> <p>Sd of $\bar{D}_{16} = 0.04/\sqrt{16} = \mathbf{0.01}$</p> $P(\bar{D}_{16} > 57.16) = P\left(Z > \frac{57.16 - 57.15}{0.01}\right)$ $= P(Z > 1) = 1 - P(Z < 1)$ $= 1 - 0.84134 = \mathbf{0.158 \text{ to } 0.159}$	B1 M1 m1 A1	4	<p>CAO Stated or used (<i>see Notes below</i>) CAO <i>If only seen in (b)(i), allow just B1</i></p> <p>Standardising 57.16 with 57.15 and 0.01 or equivalent; allow (57.15 – 57.16)</p> <p>Area change May be implied by a correct answer or answer < 0.5</p> <p>AWFW (0.15866) (1 – answer) \Rightarrow B1 M1 max</p> <p>Mark two complete answers in (i) as two attempts so $(0 + 2)/2 \Rightarrow 1$ max</p> <p>Mark as per scheme; thus (2 max, 0) or (0, 4 max)</p>
	Total		11	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3				
(a)	b (gradient) = 191 b (gradient) = 190 to 192 a (intercept) = 115 a (intercept) = 93 to 137	B2 (B1) B2 (B1)	4	CAO AFWW <i>Treat rounding of correct answers as ISW</i> CAO AFWW
	OR Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ ($\sum y^2$) or Attempt at S_{xx} & S_{xy} (S_{yy}) Attempt at correct formula for b (gradient) b (gradient) = 191 a (intercept) = 115	(M1) (m1) (A1) (A1)		154 3452 30219 & 677042 (133170091) (all 4 attempted) 12224 & 64 (2714668) (both attempted) CAO CAO If a and b are not identified anywhere in question, then: 190 to 192 \Rightarrow B1 93 to 137 \Rightarrow B1
(ii)	$y_{24} = 115 + 191 \times 24$ $=$ £4699 or £4700 $=$ £4650 to £4750 SC: $(4290 + 5057)/2 = 4673$ to $4674 \Rightarrow$ B1 If B0 but clear evidence of correct use of c 's equation with $x = 24$	B2 (B1) (M1)	2	Either; ignore units (£4699) AFWW
(iii)	(Maximum) temperature (in February) is likely to be/will be lower/different Must imply a temperature comparison with July	B1	1	Or equivalent; must be clear indication that (max) temperature is less than/different Extrapolation/not July/not summer/winter/etc \Rightarrow B0
(iv)	Rainfall amount/wind strength/sunshine hours/daylight hours/opening times/day of week/visitor numbers/public holidays/school holidays/local attractions/etc Allow if at least 1 variable correctly identified	B1	1	Or equivalent Accept any sensible reason; do not penalise for dubious 'variable name' so, for example, accept 'rainfall' Minimum/average temp/etc \Rightarrow B0 Quality or price of food/staff/etc \Rightarrow B0
	Total		8	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3				
(b)	Any line (straight, freehand, curve) from $(0, -1)$ on Figure 1 or from $(0, 5)$ on Figure 2	B1		Accept clear marking of $(0, -1)$ or $(0, 5)$ with no line
(i)	Straight , not freehand, line from $(0, -1)$ to $(40, 5)$ on F1 only; allow line extensions and only very minor inaccuracies in points plotted	B1		$(10, 0.5)$ $(20, 2)$ $(30, 3.5)$
(ii)	Straight , not freehand, line from $(0, 5)$ to $(10, 1)$ on F2 only; allow line extensions and only very minor inaccuracies in points plotted	B1	3	$(2, 4.2)$ $(4, 3.4)$ $(6, 2.6)$ $(8, 1.8)$
	Notes: Both lines on F1 \Rightarrow B1 B1 B0 max Both lines on F2 \Rightarrow B1 B0 B1 max >1 undeleted line on either F1 or F2 \Rightarrow 2 max			
	Total		3	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4 (a)	$\sqrt{\frac{184.5}{49}}$ or $1.92 \times \sqrt{\frac{50}{49}}$ $= 1.94$	B1	1	Fully correct expression or equivalent must be seen Note: $s = \sqrt{184.5/50} = 1.939 \Rightarrow$ B0 AG
(b) (i)	96% (0.96) $\Rightarrow z = 2.05$ to 2.06	B1		AWFW (2.0537)
	CI for μ is $\bar{x} \pm z \times \frac{s}{\sqrt{n}}$	M1		Used with 251.1 and 1.94 correctly Must have \sqrt{n} with $n > 1$
	Thus $251.1 \pm 2.0537 \times \frac{1.94}{\sqrt{50 \text{ or } 49}}$	AF1		F on z only
	Hence or 251.1 ± 0.6 (250.5, 251.7)	Adep1	4	CAO/AWRT Dependent on AF1 but not on z so can be gained using an incorrect z AWRT
(ii)	Claim is $\mu > 250$			
	Clear correct comparison of 250 with LCL or CI so Claim is supported/reasonable/correct/true/etc Must be consistent with c's comparison	BF1		F on CI (250 < LCL or CI)
		Bdep1	2	Dependent on BF1
(c)	$\bar{x} - ns = 251.1 - n \times 1.94 < 250$ SC: Quoted values of 249.2, 247.2 or 245.3 (AWRT) \Rightarrow M1 so	M1		Allow any multiple of 1.94 Must clearly indicate the value of a numerical expression giving a result less than 250
	Some individual packets are likely to/will contain less than 250 grams	A1	2	Or equivalent
	Total		9	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments																
5 (a)(i)	<table border="1"> <thead> <tr> <th></th> <th>J</th> <th>J'</th> <th>Total</th> </tr> </thead> <tbody> <tr> <th>W</th> <td>0.55</td> <td>0.10</td> <td>0.65</td> </tr> <tr> <th>W'</th> <td>0.15</td> <td>0.20</td> <td>0.35</td> </tr> <tr> <th>Total</th> <td>0.70</td> <td>0.30</td> <td>1.00</td> </tr> </tbody> </table>		J	J'	Total	W	0.55	0.10	0.65	W'	0.15	0.20	0.35	Total	0.70	0.30	1.00	B1		0.35 and 0.7; CAO
		J	J'	Total																
	W	0.55	0.10	0.65																
	W'	0.15	0.20	0.35																
	Total	0.70	0.30	1.00																
			B1		0.55; CAO															
			B1	3	0.1 and 0.2; CAO															
		<p>Notes: Use of Venn or tree diagrams without table completion \Rightarrow B0 B0 B0 Printed table not completed but constructed and completed on Page 12/13 \Rightarrow B1 B1 B1 max</p>			Accept fractional answers Do not accept percentages															
	(ii)	<p>P(purchases exactly one) $= P(W \cap J') + 0.15$ $= 0.10 + 0.15$ $= 0.25$ or 25/100 or 5/20 or 1/4</p>	M1		Only c's equivalent to 0.10 shown and added to 0.15 Can be implied by correct answer															
			A1	2	CAO															
(iii) (A)	<p>$P(W \cup J) = 0.8$ $\&\neq P(W) + P(J) = 1.35$ or $P(W \cap J) = 0.55 (>0)$; accept if indicated in a Venn diagram or $P(W) + P(J) = 1.35 >0$ or impossible</p>	B1		Any one of these three seen <i>Ignore contradictions, explanations & justifications</i>																
(B)	<p>$P(W J) = 0.55/0.70 = 0.79$ $\&\neq P(W) = 0.65$ or $P(J W) = 0.55/0.65 = 0.85$ $\&\neq P(J) = 0.70$ or $P(W) \times P(J) = 0.45$ to 0.46 $\&\neq P(W \cap J) = 0.55$</p>	B1		<i>Do not accept use of W' and/or J'</i> AWRT																
		Bdep1	3	Any one of these three seen <i>Ignore contradictions, explanations & justifications</i>																
				AWFW																
(b) (i)	<p>Do not allow multiplying factors in (b) $P(0) = 0.15 \times 0.40 \times 0.45$ $= 0.027$ or 27/1000</p>	B1		Can be implied by correct answer or $1 - (0.2265 + 0.466 + 0.2805)$																
		B1	2	CAO																
(ii)	<p>$P(2) = 0.85 \times 0.60 \times 0.45 = 0.2295$ $+ 0.85 \times 0.40 \times 0.55 = 0.1870$ $+ 0.15 \times 0.60 \times 0.55 = 0.0495$ or $= 1 - (0.027 + 0.2265 + 0.2805)$ $= 0.466$ or 466/1000 or 233/500</p>	M2 (M1)		<i>For either method:</i> At least two bold expressions correct Only one bold expression correct Can be implied by correct answer <i>For second method:</i> Must have '1 -' for any marks																
		A1	3	CAO; do not imply this from (i)																
	Total		13																	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6				
(a)	$X \sim B(10, 0.15)$			
(i)	$P(X \leq 2) = \mathbf{0.82(0)}$	B1	1	AWRT (0.8202)
(ii)	$P(X \geq 2) = 1 - P(X \leq 1)$			Requires '1 -'
	$= \mathbf{1 - (0.5443 \text{ or } 0.8202)}$	M1		Accept 3/2 dp rounding or truncation Can be implied by 0.455 to 0.456 but not by 0.179 to 0.18(0)
	$= \mathbf{0.455 \text{ to } 0.456}$	A1	2	AWFW (0.4557)
(iii)	$P(1 < X < 5) = \mathbf{0.9901 \text{ or } 0.9986}$ (p_1)	M1		Accept 3 dp rounding or truncation $p_2 - p_1 \Rightarrow$ M0 M0 A0 $(1 - p_2) - p_1 \Rightarrow$ M0 M0 A0 $p_1 - (1 - p_2) \Rightarrow$ M1 M0 A0 only providing result > 0
	minus 0.5443 or 0.1969 (p_2)	M1		Accept 3 dp rounding or truncation
	$= \mathbf{0.445 \text{ to } 0.446}$	A1	3	AWFW (0.4458)
	OR B(10, 0.15) expressions stated for at least 3 terms within $1 \leq X \leq 5$ gives probability $= \mathbf{0.445 \text{ to } 0.446}$	(M1) (A2)		Can be implied by a correct answer AWFW (0.4458)
(b)	$Y \sim B(50, 0.15)$			Normal approximation \Rightarrow 0 marks
(i)	$P(Y > 5) = 1 - P(Y \leq 5)$			Requires '1 -'
	$= \mathbf{1 - (0.2194 \text{ or } 0.1121)}$	M1		Accept 3 dp rounding or truncation Can be implied by 0.78(0) to 0.781 but not by 0.888 to 0.89
	$= \mathbf{0.78(0) \text{ to } 0.781}$	A1	2	AWFW (0.7806)
(ii)	$P(5 \leq Y \leq 10) = \mathbf{0.8801 \text{ or } 0.7911}$ (p_1)	M1		Accept 2/3 dp rounding or truncation $p_2 - p_1 \Rightarrow$ M0 M0 A0 $(1 - p_2) - p_1 \Rightarrow$ M0 M0 A0 $p_1 - (1 - p_2) \Rightarrow$ M1 M0 A0 only providing result > 0
	minus 0.1121 or 0.2194 (p_2)	M1		Accept 3 dp rounding or truncation
	$= \mathbf{0.768}$	A1	3	AWRT (0.7680)
	OR B(50, 0.15) expressions stated for at least 3 terms within $4 \leq Y \leq 10$ gives probability $= \mathbf{0.768}$	(M1) (A2)		Can be implied by a correct answer AWRT (0.7680)
	Total		11	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7				
(a)	Ryan: Value indicates that as volume increases then weight decreases	B1		Or equivalent in context
	Sunil: Value indicates no correlation/relationship/association/link between volume and weight	B1	2	Or equivalent in context
	SC: If B0 B0: Would expect weight to increase with volume or Would expect strong(er) positive correlation between weight and volume	(B1)		Or equivalent in context
(b)	Ryan & Sunil: r is not affected by units/(linear) scaling	B1		Or equivalent
	Tim: r is not affected by sample size or $2 \times 0.612 > 1 \Rightarrow$ impossibility	B1	2	Either; or equivalent
(c)				
(i)	$r = 0.541$ to 0.543 $r = 0.54$ to 0.55 $r = 0.5$ to 0.6	B3 (B2) (B1)	3	AWFW AWFW AWFW (0.54186)
	OR			
	Attempt at $\sum v$ $\sum v^2$ $\sum w$ $\sum w^2$ & $\sum vw$ or Attempt at S_{vv} S_{ww} & S_{vw} Attempt at substitution into correct corresponding formula for r $r = 0.541$ to 0.543	(M1) (m1) (A1)		216 6633.16 136 2376.84 & 3795.5 (all 5 attempted) Accept notation of x and y 801.16 64.84 & 123.5 (all 3 attempted) AWFW
(ii)	(Quite or fairly) weak/some/moderate positive (linear) correlation/relationship/association/link (<i>but not 'trend'</i>) between volumes and weights of suitcases	Bdep1 B1	2	Dependent on $0.5 \leq r \leq 0.6$ Or equivalent; must qualify strength and state positive Bdep0 for very strong/strong/high/good/average/medium/reasonable/poor/very weak/little/etc Context; providing $0 < r < 1$
	Total		9	
	TOTAL		75	