



General Certificate of Education (A-level)
June 2011

Mathematics

MS/SS1A

(Specification 6360)

Statistics 1A

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.

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)	Mean, $\bar{x} = \mathbf{251 \text{ to } 251.4}$ <i>Award B1 if divisor seen not to be 85 but answer in range</i> Note: If B0 then can award M1 for attempt at $\sum fx \div 85$ seen	B2		AWFW $\sum fx = 21352$ $\bar{x} = 251.2$
	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		10	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
2				
(a)	<u>Weight, $W \sim N(165, 2.5^2)$</u>			
(i)	$P(W < 167) = P\left(Z < \frac{167-165}{2.5}\right)$ $= P(Z < \mathbf{0.8})$ $= \mathbf{0.788}$	M1 A1 A1	3	Standardising 167 with 165 and 2.5; allow (165 – 167) CAO; ignore inequality and sign May be implied by a correct answer AWRT (0.78814)
(ii)	$P(W > 162) = P(Z > -1.2)$ $= P(Z < 1.2)$ $= \mathbf{0.884 \text{ to } 0.886}$	M1 A1	2	Area change; may be implied by correct answer or answer > 0.5 AWFW (0.88493)
(b)	$P(12 \text{ pucks} < 167) = p^{12} \quad \text{with} \quad 0 < p < 1$ $= [(a)(i)]^{12} = (0.78814)^{12} = \mathbf{0.057 \text{ to } 0.058}$	M1 A1	2	Any probability to power 12 or $1 - p^{12}$; do not allow multiplying factors AWFW (0.05744)
(c)	$1\% \Rightarrow 99.5\% (0.995) \Rightarrow z = \mathbf{2.57 \text{ to } 2.58}$ $z = \frac{170-165}{\sigma} \text{ or } \frac{160-165}{\sigma}$ $= 2.5758 \text{ or } -2.5758$ $\sigma = \mathbf{1.94}$	B1 M1 A1 A1	4	AWFW (2.5758) Standardising 170 or 160 with 165 and σ ; allow (165 – x) Only allow: ± 2.05 to ± 2.06 ± 2.32 to ± 2.33 ± 2.57 to ± 2.58 AWRT (1.94114)
Note: Inconsistent signs \Rightarrow B1 M1 A1 max				
	Total		11	

MS/SS1A/W(cont)

Q	Solution	Marks	Total	Comments
3(a)				
(i)	<p>96% (0.96) $\Rightarrow z = 2.05$ to 2.06</p> <p>CI for μ is $\bar{x} \pm z \times \frac{s}{\sqrt{n}}$</p> <p>Thus $251.1 \pm 2.0537 \times \frac{1.94}{\sqrt{50 \text{ or } 49}}$</p> <p>Hence 251.1 \pm 0.6 or (250.5, 251.7)</p>	<p>B1</p> <p>M1</p> <p>AF1</p> <p>Adep1</p>	<p>4</p>	<p>AWFW (2.0537)</p> <p>Used with 251.1 and 1.94 correctly Must have \sqrt{n} with $n > 1$</p> <p>F on z only</p> <p>CAO/AWRT Dependent on AF1 but not on z so can be gained using an incorrect z AWRT</p>
(ii)	<p>Claim is $\mu > 250$</p> <p>Clear correct comparison of 250 with LCL or CI so Claim is supported/reasonable/correct/true/etc Must be consistent with c's comparison</p>	<p>BF1</p> <p>Bdep1</p>	<p>2</p>	<p>F on CI (250 < LCL or CI)</p> <p>Dependent on BF1</p>
(b)				
(i)	<p>I for x is $\bar{x} \pm z \times s$ $= 251.1 \pm 2.0537 \times 1.94$</p> <p>Hence 251.1 \pm 4(.0) or (247, 255)</p>	<p>M1</p> <p>AF1</p>	<p>2</p>	<p>Must have $n = 1$ and correct or same z as in (a)(i)</p> <p>CAO/AWRT</p> <p>F on z in (a)(i); can be gained using an incorrect z AWRT</p>
(ii)	Some individual packets are likely to/will contain less than 250 grams	BF1	1	Or equivalent F on (b)(i)
	Total		9	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments																
4 (a)	<table><tr><td></td><td><i>J</i></td><td><i>J'</i></td><td>Total</td></tr><tr><td>W</td><td>0.55</td><td>0.10</td><td>0.65</td></tr><tr><td>W'</td><td>0.15</td><td>0.20</td><td>0.35</td></tr><tr><td>Total</td><td>0.70</td><td>0.30</td><td>1.00</td></tr></table>		<i>J</i>	<i>J'</i>	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
		<i>J</i>	<i>J'</i>	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																
	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			Accept fractional answers Do not accept percentages																
	(b) P(purchases exactly one) $= P(W \cap J') + 0.15$ $= 0.10 + 0.15$ $= \mathbf{0.25}$ or 25/100 or 5/20 or 1/4	M1		Only c's equivalent to 0.10 shown and added to 0.15 Can be implied by correct answer																
		A1	2	CAO																
(c) (i) $P(W \cup J) = \mathbf{0.8} \neq P(W) + P(J) = \mathbf{1.35}$ or $P(W \cap J) = \mathbf{0.55}$ (>0); accept if indicated in a Venn diagram or $P(W) + P(J) = \mathbf{1.35} > \mathbf{0}$ or impossible	B1		Any one of these three seen <i>Ignore contradictions, explanations & justifications</i>																	
(ii) $P(W J) = 0.55/0.70 = \mathbf{0.79}$ $\neq P(W) = \mathbf{0.65}$ or $P(J W) = 0.55/0.65 = \mathbf{0.85}$ $\neq P(J) = \mathbf{0.70}$ or $P(W) \times P(J) = \mathbf{0.45}$ to $\mathbf{0.46}$ $\neq P(W \cap J) = \mathbf{0.55}$	B1 Bdep1	3	<i>Do not accept use of W' and/or J'</i> AWRT Any one of these three seen <i>Ignore contradictions, explanations & justifications</i> AWFW																	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
5(a)	$X \sim B(10, 0.15)$			
(i)	$P(X \leq 2) = \mathbf{0.82(0)}$	B1	1	AWRT (0.8202)
(ii)	$P(X \geq 2) = 1 - P(X \leq 1)$ $= \mathbf{1 - (0.5443 \text{ or } 0.8202)}$ $= \mathbf{0.455 \text{ to } 0.456}$	M1 A1	2	Requires '1 -' 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) AWFW (0.4557)
(iii)	$P(1 < X < 5) = \mathbf{0.9901 \text{ or } 0.9986} \quad (p_1)$ $\mathbf{minus \ 0.5443 \text{ or } 0.1969} \quad (p_2)$ $= \mathbf{0.445 \text{ to } 0.446}$	M1 M1 A1	3	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 Accept 3 dp rounding or truncation AWFW (0.8541)
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 (0.8541)
(b)	$Y \sim B(50, 0.15)$			
(i)	$P(Y > 5) = 1 - P(Y \leq 5)$ $= \mathbf{1 - (0.2194 \text{ or } 0.1121)}$ $= \mathbf{0.78(0) \text{ to } 0.781}$	M1 A1	2	Requires '1 -' Accept 3 dp rounding or truncation Can be implied by 0.78(0) to 0.781 but not by 0.888 to 0.89 AWFW (0.7806)
(ii)	$P(5 \leq Y \leq 10) = \mathbf{0.8801 \text{ or } 0.7911} \quad (p_1)$ $\mathbf{minus \ 0.1121 \text{ or } 0.2194} \quad (p_2)$ $= \mathbf{0.768}$	M1 M1 A1	3	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 Accept 3 dp rounding or truncation 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)
(c)	Mean, $\mu = 50 \times 10 \times 0.15 = \mathbf{75}$	B1		CAO SC: 7.5 & 6.37 to 6.38 \Rightarrow B1
	Variance, $\sigma^2 = 50 \times 10 \times 0.15 \times 0.85$ $= \mathbf{63.7 \text{ to } 63.8}$	B1	2	AWFW (63.75)
Total			13	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
6				
(a)	<p>Ryan: Value indicates that as volume increases then weight decreases</p> <p>Sunil: Value indicates no correlation/relationship/association/link between volume and weight</p> <p>SC: If B0 B0: Would expect weight to increase with volume or Would expect strong(er) positive correlation between weight and volume</p>	B1		Or equivalent in context
		B1	2	Or equivalent in context
		(B1)		Or equivalent in context
(b)	<p>Ryan & Sunil: r is not affected by units/(linear) scaling</p> <p>Tim: r is not affected by sample size or $2 \times 0.612 > 1 \Rightarrow$ impossibility</p>	B1		Or equivalent
		B1	2	Either; or equivalent
(c)				
(i)	<p>$r = 0.541$ to 0.543 $r = 0.54$ to 0.55 $r = 0.5$ to 0.6</p> <p>OR</p> <p>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</p>	B3 (B2) (B1)	3	AWFW AWFW AWFW (0.54186)
		(M1)		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)
		(m1)		
		(A1)		AWFW
(ii)	<p>(Quite or fairly) weak/some/moderate</p> <p>positive (linear) correlation/relationship/association/link (<i>but not 'trend'</i>)</p> <p>between volumes and weights of suitcases</p>	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		60	