



**General Certificate of Education (A-level)
January 2012**

Mathematics

MS/SS1A

(Specification 6360)

Statistics 1A

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 students' 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 students' 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/SS1A/W

Q	Solution	Marks	Total	Comments
1				
(a)	$U \sim B(40, 0.15)$	M1		Used somewhere in (a)
(i)	$P(U = 6) = 0.6067 - 0.4325$ or $= \binom{40}{6} (0.15)^6 (0.85)^{34}$ $= 0.174$	M1 A1	3	Accept 3 dp rounding or truncation Can be implied by a correct answer AWRT (0.1742)
(ii)	$P(U \leq 5) = 0.432 \text{ to } 0.433$	B1	1	AWFW (0.4325)
(iii)	See supplementary sheet for individual probabilities			
	$P(5 < U < 10) = 0.9328 \text{ or } 0.9701$ (p_1) MINUS $0.4325 \text{ or } 0.2633$ (p_2) $= 0.5(00) \text{ to } 0.501$	M1 M1 A1	3	Accept 3 dp rounding or truncation but allow 0.97 $p_2 - p_1 \Rightarrow$ M0 M0 A0 $(1 - p_2) - p_1 \Rightarrow$ M0 M0 A0 $p_1 - (1 - p_2) \Rightarrow$ M1 M0 A0 $(1 - p_2) - (1 - p_1) \Rightarrow$ M1 M1 (A1) only providing result > 0 Accept 3 dp rounding or truncation AWFW (0.5003)
(b)	Mean or $\mu = 32 \times 0.15 = 4.8$ (V or $\sigma^2 =$) $\frac{32 \times 0.15 \times 0.85}{}$ or (SD or $\sigma =$) $\sqrt{32 \times 0.15 \times 0.85}$ (SD or $\sigma = 2.02$	B1 M1 A1	3	CAO Either numerical expression; ignore terminology May be implied by 4.08 CAO seen or 2.02 AWRT seen AWRT (2.0199) Do not award if labelled V or σ^2
		Total	10	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
2(a) (i)	<p>Weight, $X \sim N(2200, 160^2)$</p> $P(X < 2500) = P\left(Z < \frac{2500 - 2200}{160}\right)$ $= P(Z < 1.87 \text{ to } 1.88)$ $= 0.969 \text{ to } 0.97(0)$	M1 A1 A1	3	<p>Standardising 2500 with 2200 and 160; allow (2200 – 2500)</p> <p>AWFW; ignore inequality and sign May be implied by a correct answer</p> <p>AWFW (0.96960)</p>
(ii)	$P(X > 2000) = P(Z > -1.25)$ $= P(Z < +1.25)$ $= 0.894 \text{ to } 0.895$	M1 A1	2	<p>Area change May be implied by a correct answer or an answer > 0.5</p> <p>AWFW (0.89435)</p>
(iii)	$P(2000 < X < 2500) = (i) - (1 - (ii))$ $= 0.96960 - (1 - 0.89435) = 0.863 \text{ to } 0.865$ <p>Note: If (ii) is 0.105 to 0.106, then (0.96960 – 0.10565) = 0.86395 \Rightarrow M0 A0</p>	M1 A1	2	<p>OE; allow new start ignoring (i) & (ii) Allow even if incorrect standardising providing $0 < \text{answer} < 1$ May be implied by a correct answer</p> <p>AWFW (0.86395)</p>
(b)	$10\% \Rightarrow 90\% (0.90) \Rightarrow z = 1.28$ $z = \frac{1000 - 1125}{\sigma}$ $= -1.2816$ $\sigma = 97 \text{ to } 98$ <p>Note: Inconsistent signs \Rightarrow B1 M1 A1 A0 max</p>	B1 M1 A1 A1	4	<p>AWRT (1.2816)</p> <p>Standardising 1000 with 1125 and σ; allow (1125 – 1000)</p> <p>Only allow: ± 1.28 $\pm 1.64 \text{ to } \pm 1.65$ $\pm 2.32 \text{ to } \pm 2.33$</p> <p>AWFW (97.53433)</p>
		Total	11	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
3	See supplementary sheet for alternative solutions and additional guidelines to parts (a), (c) and (d)			
(a)	b (gradient) = -0.076 b (gradient) = -0.07 to -0.08 a (intercept) = 5.35 to 5.36 a (intercept) = 5.1 to 5.6 Thus $y = (5.35 \text{ to } 5.36) - 0.076x$	B2 (B1) B2 (B1) BF1	5	AWRT; including $-ve$ sign (-0.07582) AWWF; including $-ve$ sign <i>Treat rounding of correct answers as ISW</i> AWWF (5.35385) AWWF F on a and b even if rounded
(b)	a : calorific value of wood with zero/no moisture or dry maximum calorific value b : each 1(%) rise in moisture content reduces calorific value by 0.076 MWh/tonne As x increases y decreases	B1 B2 (B1)	3	OE; $a \leq 0 \Rightarrow B0$ In context and with values; F on b $b \geq 0 \Rightarrow B0$ Negative relationship/correlation
(c)	$y_{27} = 3.28$ to 3.32 $= 2.5$ to 3.5	B2 (B1)	2	AWWF (3.30659) AWWF; even if by interpolation from original data giving likely values of 3 or 3.04
(d)	$r(35, 2.5) = -0.21$ to -0.19 $= 0.1$ to 0.3	B2 (B1)	2	AWWF; including $-ve$ sign (-0.20000) AWWF; ignore sign
(e)	Good/reasonable/accurate/correct/etc Accept more positive qualifying adjectives	B1	1	OE; ignore reasoning Very good (B1) Not good (B0)
			13	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments															
4	See supplementary sheet for alternative solutions to parts (a)(i) and (b)(ii)																		
	(a)(i) Table Method (2- way with either R or C totals) <table border="1" style="margin-left: 40px;"> <thead> <tr> <th></th> <th>A</th> <th>A'</th> <th>Total</th> </tr> </thead> <tbody> <tr> <th>E</th> <td>0.55</td> <td>0.05</td> <td>0.60</td> </tr> <tr> <th>E'</th> <td>0.30</td> <td>0.10</td> <td>0.40</td> </tr> <tr> <th>Total</th> <td>0.85</td> <td>0.15</td> <td>1.00</td> </tr> </tbody> </table>		A	A'	Total	E	0.55	0.05	0.60	E'	0.30	0.10	0.40	Total	0.85	0.15	1.00	B1 B1 Bdep1	3
	A	A'	Total																
E	0.55	0.05	0.60																
E'	0.30	0.10	0.40																
Total	0.85	0.15	1.00																
(ii)	$P(\geq 1) = 0.9$ or $9/10$	B1	1	CAO															
(iii)	$P(1) = 0.3 + 0.05 = 1 - (0.55 + 0.10)$ $= 0.35$ or $35/100$ or $7/20$	B1	1	CAO															
(b)(i)	$P(3) = 0.55 \times 0.30$ $= 0.165$ or $165/1000$ or $33/200$	B1		OE; implied by correct answer															
		B1	2	CAO															
(ii)	$0.55 \times (1 - 0.3)$ or 0.385 or (0.3×0.75) or 0.225 or (0.05×0.75) or 0.0375 or (0.35×0.75) or 0.2625 $(0.385 + 0.2625) + 0.165$ $= 0.812$ to 0.813	M1																	
		M1		At least one of these expressions or values															
		B1		OE; implied by correct answer															
		A1	4	AWFW (0.8125) CAO; for equivalent fraction															
		Total	11																

Q	Solution	Marks	Total	Comments
5	$151.5 \text{ cm} = 1.515 \text{ m} \approx 1.5 \text{ m}$ Thus (could be) correct $n \times 26.6 > 10$ Thus (likely to be) incorrect	B1		OE
		Bdep1		OE; dependent on B1
		B1		OE; accept any $n \geq 1$
		Bdep1	4	OE; dependent on B1
			4	

MS/SS1A/W (cont)

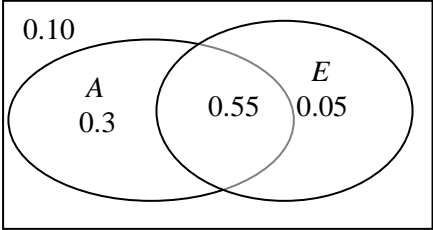
Q	Solution	Marks	Total	Comments
6(a)	See supplementary sheet for alternative solutions			
	$\bar{x} - ns = (45.8 - n \times 24.0) < 0$ SC: Accept quoted values of (-4 to -1) ($n = 2$) or (-28.5 to -23.5) ($n = 3$) (both AFWW) and negative salaries are impossible	M1 A1	2	Allow (45 to 47) and any multiple of (23.5 to 24.5) which gives value < 0 Must clearly state the value of a numerical expression OE; must be in context Negative values impossible \Rightarrow A0
(b)(i)	Large sample or $n > 25$ or 30 or $n = 50$ so	B1		OE
	CLT applies	Bdep1	2	Must indicate CLT; dependent on B1 Indication that other than sample mean is normally distributed \Rightarrow Bdep0
(ii)	99% (0.99) $\Rightarrow z = 2.57$ to 2.58	B1		AWFW (2.5758)
	CI for μ is $\bar{x} \pm z \times \frac{s}{\sqrt{n}}$	M1		Used with (45.8 & 24.0) and $z(1.64$ to $2.58)$ & $\div \sqrt{n}$ with $n > 1$
	Thus $45.8 \pm 2.5758 \times \frac{24.0}{\sqrt{50}}$	AF1		F on $z(1.64$ to 1.65 or 2.32 to 2.33 or 2.57 to $2.58)$ and $\div \sqrt{50}$ or 49
	Hence $45.8 \pm (8.7$ to $8.8)$ or $45800 \pm (8700$ to $8800)$ OR (37.0) to $37.1, 54.5$ to $54.6)$ or $(37000$ to $37100, 54500$ to $54600)$	A1	4	CAO/AWFW (8.74) Ignore (absence of) quoted units AWFW
(c)	See supplementary sheet for additional illustrations			
	Clear correct comparison of 55 or 55000 with c's UCL or CI	B1		Accept 55000 compared with c's 54.5 to 54.6 (ie different units)
	$(6/50$ or 0.12 or $12\%) < \neq 0.25$ or 25%	B1		OE; correct comparison mentioning both 12% and 25%
	Reject both/each of the two claims	Bdep1	3	Dependent on B1 B1
		Total	11	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments														
1	Alternative solution																	
	(a)(iii) B(40, 0.15) expressions stated for at least 3 terms within $5 \leq U \leq 10$ gives probability = 0.5(00) to 0.501	M2 A1	3	Can be implied by a correct answer AWFW (0.5003)														
	<table border="1"> <tr> <td>u</td> <td>(5)</td> <td>6</td> <td>7</td> <td>8</td> <td>9</td> <td>(10)</td> </tr> <tr> <td>$P(U = u)$</td> <td>(0.1692)</td> <td>0.1742</td> <td>0.1492</td> <td>0.1087</td> <td>0.0682</td> <td>(0.0373)</td> </tr> </table>	u	(5)	6	7	8	9	(10)	$P(U = u)$	(0.1692)	0.1742	0.1492	0.1087	0.0682	(0.0373)			
u	(5)	6	7	8	9	(10)												
$P(U = u)$	(0.1692)	0.1742	0.1492	0.1087	0.0682	(0.0373)												

Q	Solution	Marks	Total	Comments
3	Alternative solutions and additional guidelines			
	(a) 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) = -0.076 a (intercept) = 5.35 to 5.36 Thus $y = (5.35 \text{ to } 5.36) - 0.076x$ Notes: 1 If a and b interchanged and equation $y = ax + b$ used \Rightarrow max of 5 marks 2 If a and b interchanged and equation $y = a + bx$ used \Rightarrow maximum of BF1 3 Marks lost here cannot be gained from subsequent work in parts (d) and/or (e)	M1 m1 A1 A1 BF1	5	455 20475 35.1 & 883.5 (121.33) (all 4 attempted) 4550 & -345 (26.56) (both attempted) AWRT AWFW F on a and b even if rounded If a and b are not identified anywhere in equation, then: -0.07 to $-0.08 \Rightarrow$ B1 5.1 to $5.6 \Rightarrow$ B1
(c)	$y_{27} = (5.35 \text{ to } 5.36) - 0.076 \times 27$ $= 3.28$ to 3.32	M1 A1	2	Clear evidence of correct use of c 's equation with $x = 27$ AWFW (3.30659)
(d)	$r(35, 2.5) = 2.5 - y_{35}$ $= 2.5 - \{(5.35 \text{ to } 5.36) - 0.076 \times 35\}$ $= -0.21$ to -0.19	M1 A1	2	Used; allow $y_{35} - 2.5$ AWFW (-0.20000)

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
4 (a)(i)	Alternative solutions			
	Venn Diagram Method 	B1 B1 Bdep1	3	0.55; CAO 0.3 and 0.05; CAO 0.1; AG so dependent on B1 B1
	(a)(i) Formula Method $P(\geq 1) = 0.85 + 0.60 - 0.55$ OR $0.85 + 0.60 - 0.55 + p = 1$ OR $0.15 + 0.40 - 0.45$ $P(0) = 1 - P(\geq 1)$ OR $= 1 - 0.9 = 0.1$ $0.9 + p = 1$ OR $= 0.1$	M2 (M1) A1	3	Full justification for numerical expression Insufficient justification or numerical expression only AG; gained from M2 or M1
(b)(ii) $0.1 \times (1 - 0.4)$ or 0.06 or (0.3×0.25) or 0.075 or (0.05×0.25) or 0.0125 or (0.35×0.25) or 0.0875 or (0.1×0.4) or 0.04 $1 - (0.1875)$ = 0.812 to 0.813	M1 M1 B1 A1	4	At least one of these expressions or values OE; implied by correct answer AWFW (0.8125) CAO for equivalent fraction	
(b)(ii) $(0.55 + p)$ where $0 < p < 0.45$ or (0.3×0.75) or 0.225 or (0.05×0.75) or 0.0375 or (0.35×0.75) or 0.2625 $0.55 + 0.2625$ = 0.812 to 0.813	M1 M1 B1 A1	4	At least one of these expressions or values OE; implied by correct answer AWFW (0.8125) CAO for equivalent fraction	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
6(a)	Alternative solutions			
	$P(X < 0 \mid N(45.8, 24.0^2)) = P(Z < -1.91)$ $= 0.027$ to 0.03	M1 A1	2	Standardising 0 using 45.8 & 24.0 In addition to probability within range, must state that negative salaries are impossible
	$P(X > 60 \mid N(45.8, 24.0^2)) = P(Z > 0.59)$ $= 0.27$ to 0.28	M1 A1	2	Standardising 60 using 45.8 & 24.0 In addition to probability within range, must compare calculated value to $6/50 = 0.12$ OE
(c)	Additional comment illustrations			
	It/(claimed) mean/(claimed) value > UCL/CI	B0		Must indicate 55 or 55000
	99% have (mean) weights between CLs so ...	B0		
	Any comparison of 60 (£60 000) with UCL/CI	B0		Value of 60 does not refer to mean
$P(X > 60 \mid N(45.8, 24.0^2)) = P(Z > 0.59)$ $= (0.27 \text{ to } 0.28) > 6/50 = 0.12$	B0		Assumes salaries $\sim N$; cf (a)(ii)	