AQA Maths Statistics 1

Mark Scheme Pack

2006-2015

Version 1.1: 0607

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B Statistics 1B

Mark Scheme

2006 examination – January 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.

MS/SS1B

Q	Solution	Marks	Total	Comments
1(a)	Gradient, $b = 0.886$ to 0.887	B2		AWFW
	$b = 0.88$ to 0.89	(B1)		AWFW
	Intercept, $a = 2.31$ to 2.33	B2		AWFW
	$a = 2.3$	(B1)		AWRT
	Attempt at Σx Σx^2 Σy Σxy			
	or	(M1)		72, 624, 87, 720
	Attempt at S_{xx} S_{xy}			105.6, 93.6
	Attempt at a **correct** formula for b	(m1)		
	$b = 0.886$ to 0.887	(A1)		AWFW
	$a = 2.31$ to 2.33	(A1)		AWFW
	Accept a & b interchanged only if $y = ax + b$ stated or subsequently used correctly in either (b) or (c)		4	
(b)	a: average **waiting time** of 2.32 minutes (139 seconds) when entering **empty restaurant**	B1		OE; accept minimum waiting time
	b: average **increase in waiting time** of 0.886 minutes (53 seconds) **for each customer in restaurant** on entry	B1	2	OE
(c)	Use of $y = a + 5b$ or $y = a + 25b$	M1		
(i)	For $x = 5$ $y = 6.6$ to 6.8			
(ii)	For $x = 25$ $y = 24.3$ to 24.6	A1	2	Both; AWFW
(d)(i)	**Reliable as interpolation** and **small residuals**	B1		Within range OE
		B1		OE
	or			
	Reliable as interpolation	(B1)		
	but large percentage residuals so inconclusive	(B1)		
	or			
	Large percentage residuals so unreliable	(B1)		
(ii)	Unreliable as extrapolation	B1	3	Outside range OE
	Total		**11**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)	P(X) = 0.3 P(Y) = 0.4 P(Z) = 0.2			
(i)	$P(X \cap Y \cap Z) = 0.3 \times 0.4 \times 0.2 = 0.024$	M1	1	
(ii)	$P(X' \cap Y' \cap Z') = 0.7 \times 0.6 \times 0.8$	M1		At least 2 correct terms
	$= 0.336$	A1	2	CAO
(iii)	$P(X' \cap Y' \cap Z) = 0.7 \times 0.6 \times 0.2$	M1		Correct numerical expression
	$= 0.084$	A1		CAO
(b)	P(W | Z) = 0.9 P(W | Z') = 0.25			
(i)	$P(Z \cap W) = 0.2 \times 0.9$	M1		Correct numerical expression
	$= 0.18$	A1	2	CAO
(ii)	$P((Z \cap W') \cup (Z' \cap W))$ **or** $1 - [P((Z \cap W) \cup (Z' \cap W'))]$			
	$= 0.2 \times (1 - 0.9)$	M1		0.2×0.9 or (b)(i)
	+			
	$(1 - 0.2) \times 0.25$	M1		$(1 - 0.2) \times (1 - 0.25)$
				Cannot score an M1 in both methods
	$= 0.02 + 0.20$			$1 - (0.18 + 0.60)$
	$= 0.22$	A1	3	CAO
	Total		**11**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3(a)	Mean = $\frac{286.5}{50} = 5.73$	B1		CAO
	Standard deviation = $\sqrt{\frac{45.16}{49 \text{ or } 50}}$ =			
	0.95 to 0.961	B1	2	AWFW
(b)	99% $\Rightarrow z$ = 2.57 to 2.58	B1		AWFW 2.5758
	CI for μ is $\bar{x} \pm z \times \frac{(\sigma \text{ or } s)}{\sqrt{n}}$	M1		Use of Must have $\left(\div\sqrt{n}\right)$ with $n > 1$
	Thus $5.73 \pm 2.5758 \times \frac{(0.95 \text{ to } 0.961)}{\sqrt{50}}$	A1√		√ on z and $s^2 > 0$ but not on $\bar{x}$ Accept only 50 or 49 for n
	5.73 ± (0.34 to 0.36)	↑		Dependent
	5.37 to 5.39, 6.07 to 6.09)	A1	4	AWFW
(c)	**CI excludes both values** of 5 and 6½ so **Neither claim** appears **valid**	B1√ ↑ B1√		√ on (b); OE Dependent √ on (b); OE
	or			
	CI excludes 5 so claim not valid and CI excludes 6½ so claim not valid	(B1√) (B1√)	2	√ on (b); OE √ on (b); OE
	Total		**8**	

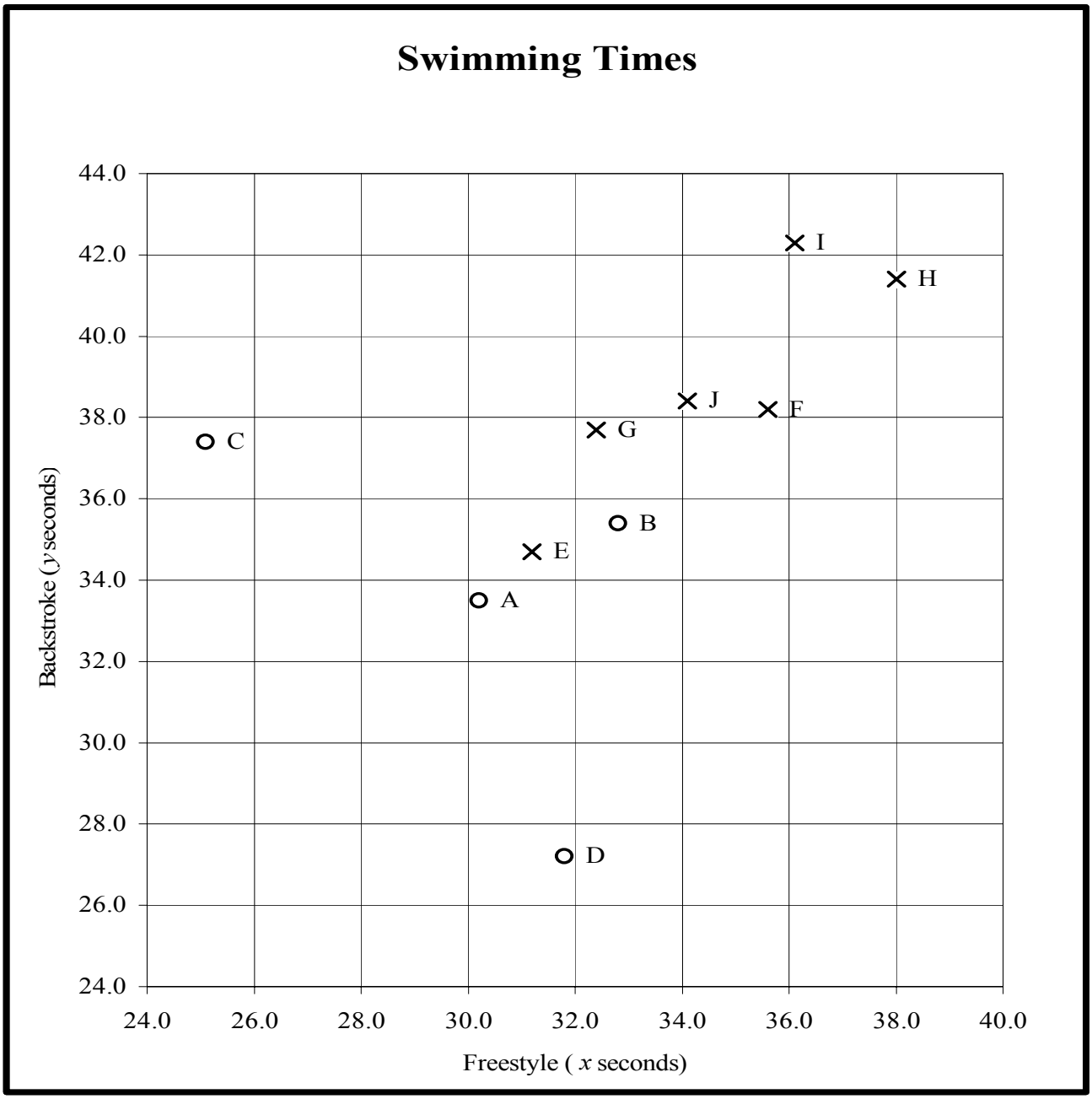
MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	$\Sigma fx = 8025$ $\Sigma fx^2 = 739975$			
	Mean ($\bar{x}$) = 80.2 to 80.3	B2		AWFW 80.25
	Standard Deviation (s_n, s_{n-1}) = 30.9 to 31.2	B2		AWFW 30.97882 or 31.13489
	MPs (x): 25, 35, 50, 70, 90, 110, 135, 165	(B1)		At least 4 correct
	Mean $\left(\bar{x}\right) = \frac{\Sigma fx}{100}$	(M1)	4	Use of
(b)(i)	**Large** ($n > 30$) **sample** **or** **Central Limit Theorem**	B1	1	OE
(ii)	Mean $\left(\bar{Y}\right)$ = 80.2 to 80.3	B1√		√ on (a)
	Standard error $\left(\bar{Y}\right) = \frac{30.9 \text{ to } 31.2}{\sqrt{36}}$			
	= 5.1 to 5.25	M1	2	$\sqrt{s^2} > 0$ in (a) ÷ $\sqrt{36}$ or 6
(iii)	$P\left(\bar{Y} < 90\right) = P\left(Z < \frac{90 - \left(80.2 \text{ to } 80.3\right)}{\left(5.1 \text{ to } 5.25\right)}\right)$	M1 M1		Standardising 90 Using values from (b)(ii) with $\sqrt{s^2/36} > 0$ or $\sqrt{s^2/100} > 0$
	= P(Z < 1.84 to 1.93)			
	= 0.967 to 0.974	A1	3	AWFW
	Total		**10**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5(a)	Scatter Diagram **or** **or**	B2 (B1) (B1)	2	4 labelled points plotted 3 labelled points plotted 4 unlabelled points plotted
(b)(i)	Positive/linear correlation/relationship except for two unusual values/results	B1 B1	 2	OE OE
(ii)	0.462	B1	1	CAO; accept 3rd/final/last value
(c)	C and D **C** is likely **freestyle** champion **D** is likely **backstroke** champion **or** C is likely freestyle champion D is likely backstroke champion	B1 B1 (B1) (B1)	 2	CAO Style identified
(d)(i)	r = 0.912 to 0.913 **or** r = 0.91 to 0.92 or 0.46 to 0.47 **or** r = 0.9	B3 B2 B1	 	AWFW AWFW AWRT
	Attempt at Σx Σx^2 Σy Σy^2 Σxy **or** Attempt at S_{xx} S_{yy} S_{xy}			270.4, 9188.46 301.6, 11437.84 10246.53 48.94, 67.52, 52.45
	Attempt at a **correct** formula for r	(m1)		
	r = 0.912 to 0.913	A1	3	AWFW
(ii)	Boys are **faster/slower** at **both strokes** **or** Boys are **equally good** at **both strokes**	B1	1	OE;do not accept freestyle times are proportional to backstroke times
	Total		**11**	

Question 5(a)



(a) Scatter Diagram	
4 labelled points plotted	B2
3 labelled points plotted	(B1)
4 unlabelled points plotted	(B1)
Graph = 2	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	B(50, 0.2)	M1		Use of in (a)
	$P(R \leq 15) = 0.969$ to 0.97	A1	2	AWFW 0.9692
(ii)	$P(R = 10) = P(R \leq 10) - P(R \leq 9)$			Stated or implied
	or	M1		
	$P(R = 10) = \binom{50}{10}(0.2)^{10}(0.8)^{40}$			Stated or implied
	$= 0.5836 - 0.4437 = 0.139$ to 0.141	A1	2	AWFW 0.1399
(iii)	$P(5 < R < 15) =$			
	$P(R \leq 14$ or $15) = 0.9393$ or 0.9692	M1		Accept values to 3 dp
	minus $P(R \leq 5$ or $4) = 0.0480$ or 0.0185	M1		Accept values to 3 dp
	$= 0.89$ to 0.893	A1		AWFW 0.8913
	or			
	B(50, 0.2) expressions stated for at least 3 of $5 \leq R \leq 15$	(M1)		Or implied by a correct answer
	Answer	(A2)	3	
(b)	Mean, $\mu = np = 50 \times 0.2 = 10$	B1		Either; CAO
	or			
	Estimate of p, $\hat{p} = 0.21$			
	Variance, $\sigma^2 = np(1-p) = 10 \times 0.8 = 8$	B1		CAO
	Mean or **Estimate of *p*** **is similar** to that expected			10.5 and 10 or 0.21 and 0.2
	but	B1		Either point
	Variance (standard deviation) **is different** from that expected			20.41 and 8 or 4.5 and 2.8
	Reason to **doubt validity** of Sly's claim	B1	4	Must be based on both 10 or 0.2 and 8 or on both 10 or 0.2 and 2.8 correctly
	Total		**11**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7 (a)	Weight, $X \sim N(406, 4.2^2)$			
(i)	$P(X < 400) = P\left(Z < \frac{400 - 406}{4.2}\right)$	M1		Standardising (399.5, 400 or 400.5) with 406 and ($\sqrt{4.2}$, 4.2 or 4.2^2) and/or (406 – x)
	$= P(Z < -1.428$ to $-1.43)$			
	$= 1 - P(Z < 1.428$ to $1.43)$	m1		$\Phi(-z) = 1 - \Phi(z)$
	$= 0.076$ to 0.077	A1	3	AWRT 0.07636
(ii)	$P(402.5 < X < 407.5) =$			
	$P(X < 407.5) - P(X < 402.5) =$	M1		Difference OE
	$P(Z < 0.36) - P(Z < -0.83)$	B2,1		AWRT; ignoring signs
	$= 0.64058 - (1 - 0.79673) = 0.433$ to 0.44	A1	4	AWFW 0.43731
(b)(i)	$0.975 \Rightarrow z = 1.96$	M1		Accept explanation in words
	$P(Y < 310) = P\left(Z < \frac{310 - \mu}{\sigma}\right)$	M1		Standardising 310 using μ and σ
	or $x = \mu +/\pm z\sigma$			Accept in words
	Thus $\frac{310 - \mu}{\sigma} = 1.96 \Rightarrow$ result	m1		Equating
	or			AG
	$310 = \mu + 1.96\sigma \Rightarrow$ result			Substitution
	NB: Working backwards from given equation $\Rightarrow$ at most M1 M0 mo		3	
(ii)	$0.86 \Rightarrow z = 1.08$	B1		AWRT 1.0803
	$310 - \mu = 1.96\sigma$ $307.5 - \mu = 1.08\sigma$			
	$2.5 = 0.88\sigma$	M1		Attempt at solving 2 equations each of form $x - \mu = z\sigma$
	$\sigma = 2.84$ to 2.842	A1		AWFW 2.841
	$\mu = 304.4$ to 304.5	A1	4	AWFW 304.43
	Total		**14**	
	TOTAL		**75**	

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MS1B Statistics 1B

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2006 examination – June series

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MS1B

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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 Σx Σx^2			3952, 2228282
	Σy Σy^2			47.00, 292.0000
	Σxy			23517.50
	or			
	Attempt at S_{xx} S_{yy} 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)	B1		or equivalent; but not poor
	price	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	B1		or equivalent
	number of pages and sale/new price	B1	2	context
	Sale price appears to be determined by number of pages	B2		or equivalent
	Total		**8**	

MS1B (cont)

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

MS1B (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	Gradient, $b = -3.24$ to -3.26	B2		AWFW (–3.25)
	$b = -3.2$ to -3.3	B1		AWFW
	Intercept, $a = 262$ to 264	B2		AWFW $\left(262.8\dot{8}\right)$
	$a = 260$ to 270	B1		AWFW
	Attempt at Σx Σx^2 Σy Σxy or			108, 1836, 2015, 22425
	Attempt at S_{xx} S_{xy}	M1		540, –1755
	Attempt at a correct formula for b	m1		
	$b = -3.24$ to -3.26	A1		AWRT
	$a = 262$ to 264	A1	4	AWFW
	Accept a & b interchanged only if identified correctly in (b) and (c)			
(ii)	Gradient, b:			
	Decrease in pressure per month	B2		or equivalent
	Change in pressure	B1	2	or better
(iii)	Intercept, a:			
	Initial pressure or pressure at $x = 0$	B1		or equivalent; not y-intercept
	Reference to 265, actual or expected value	B1	2	
(b)(i)	Value for $b = 2 \times$ [gradient or b from (a)(i)]	M1		accept $2b$; ignore sign
	$= -6.4$ to -6.6	A1√	2	AWFW (–6.5) √ from (a)(i) but must be < 0
(ii)	$P_8 = 265 - 6.5 \times 8$	M1		must use 265 and $x = 8$ and $2 \times [b\ (< 0)$ from (a)(i)] or [from (b)(i) (< 0)]
	$= 212$ to 214	A1	2	AWFW
	(< 220)			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 or 99% $\Rightarrow$ $t = 3.25$ (Knowledge of the *t*-distribution is not required in this unit)	B1 B1		AWFW (2.5758) 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 $\left(\div \sqrt{n}\right)$ 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 ± 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 ≤ 5) – P(K ≤ 4)			
	P(K = 5) = $\binom{15}{5}(0.3)^5(0.7)^{10}$	M1		may be implied
	= 0.7216 – 0.5155 = 0.2055 to 0.2065	A1	3	AWFW (0.2061)
(ii)	(Fewer than) half ⇒ 7 or 7½ or 8	B1		stated or implied
	Thus require P(K ≤ 7 or < 8)	M1		used or implied by correct answer
	= 0.9495 to 0.9505	A1	3	AWFW (0.9500)
(iii)	P(2 < K < 7) = 0.8689 or 0.9500	M1		
	minus 0.1268 or 0.2969	M1		
	= 0.7415 to 0.7425	A1	3	AWFW (0.7421)
	or			
	B(15, 0.3) expressions stated for at least 3 terms within 2 ≤ K ≤ 7	M1		or implied by a correct answer
	Answer	A2		
(b)(i)	Mean, $\mu = np$ = 15 × 0.4 = 6	B1		CAO
	Variance, $\sigma^2 = np(1-p)$ = 6 × 0.6 = 3.6	M1		use of $\sigma^2 = np(1-p)$
	Standard deviation = $\sqrt{3.6}$ = 1.89 to 1.9	A1	3	AWFW; or equivalent
(ii)	Mean, $\bar{x}$ = 6	B1		CAO ($\Sigma x = 60$)
				CSO if evidence of $np(1–p)$ or 1.9
	Standard deviation, s or σ = 2.82 to 2.99	B1	2	AWFW; or equivalent. ($\Sigma x^2 = 440$)
(iii)	Means are same/equal	B1√		√ on 2 means; accept $\frac{6}{15} = 0.4$ if not contradicted by $\bar{x}$ in (ii)
	Standard deviations are different	B1 dep		dependent on 2 correct SDs
	Reason to doubt validity of Kirk's claim	B1 dep	3	dependent on 2 correct SDs
	Total		**17**	

MS1B (cont)

Q	Solution	Marks	Total	Comments
6				

	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)	$P(D \cup T) = \frac{120+88}{320} = \frac{129+24+32+23}{320}$	M1		
	$= \frac{208}{320}$ or $\frac{13}{20}$ or 0.65	A1	2	CAO; or equivalent
(iv)	$P(D \mid R) = \frac{P(D \cap R)}{P(R)} = \frac{\text{(ii)}}{P(R)} = \frac{24/(320)}{64/(320)}$	M1		M0 if independence assumed
	$= \frac{24}{64}$ or $\frac{3}{8}$ or 0.375	A1	2	CAO; or equivalent
(v)	$P(R \mid D') = \frac{P(R \cap D')}{P(D')} = \frac{40/(320)}{200/(320)}$	M1 M1		numerator allow independence assumed denominator
	$= \frac{40}{200}$ or $\frac{1}{5}$ or 0.2	A1	3	CAO; or equivalent
(b)(i)	R and S or R and T or S and T	B1	1	not D and D'
(ii)	$P(D) = 0.375 = P(D \mid R)$ or (i) = (iv)	M1		$P(D) \times P(R) = 0.375 \times 0.2$ $= 0.075 = P(D \cap R)$ or (ii) or $P(R \mid D) = P(R) = 0.2$, etc
	so YES	A1	2	
(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**	

Version 1.0 0107

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B Statistics 1B

Mark Scheme

2007 examination - January series

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Set and published by the Assessment and Qualifications Alliance.

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.

Jan 07

MS/SS1B

Q	Solution	Marks	Total	Comments
1(a)	Mean $(\bar{x})$ = 39.3 to 39.4	B1		AWFW (39.35)
	Standard Deviation (s_n, s_{n-1}) = 12.3 to 12.7	B2	3	AWFW (12.358 or 12.679)
	If **neither** correct **but** working shown, then			$\sum x = 787$ $\sum x^2 = 34023$
	Mean $(\bar{x}) = \frac{\sum x}{20}$	(M1)		Used
(b)	Median = 42	B2		CAO
	Median = 41.5 or 39 or 40	(B1)		CAO
	Interquartile Range = 55 – 31 = 24	B2	4	CAO; allow B1 for identification of 31 and 55; B0 if method shown is incorrect
	Interquartile Range = 21 to 27	(B1)		AWFW
(c)(i)	**Mode:** eg Does not exist If exists, must be > 60 or 58 All / too many different values Sparse data	B1		OE
(ii)	**Range:** eg **Maximum value** is unknown / > 60 or 58	B1	2	OE; accept 'slowest' but not 'smallest'
		Total	**9**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)	Use of binomial in (a), (b) or (c)	M1		Can be implied
	$P(E = 5) = \binom{16}{5}(p)^5(1-p)^{11}$	M1		Allow $p = 0.45, 0.25, 0.30$ or $\frac{1}{3}$
	$= 0.112$	A1	3	AWRT (0.1123)
(b)(i)	B(50, 0.25)	B1		Used; can be implied
	$P(C \leq 12) = 0.511$	B1	2	AWRT (0.5110)
(ii)	$P(10 < B' < 20) = 0.9152$ or 0.9522	M1		Allow 3 dp accuracy
	minus 0.0789 or 0.1390	M1		Allow 3 dp accuracy
	$= 0.836$	A1	3	AWRT (0.8363)
	or			
	B(50, 0.30) expressions stated for **at least 3** terms within $10 \leq B' \leq 20$	(M1)		Or implied by a correct answer
	Answer = 0.836	(A2)		AWRT
(c)	$n = 40,\ p = 0.7$	B1		Both used; can be implied
	Mean $\mu = np = 28$	B1√		CAO; √ on p only
	Variance $\sigma^2 = np(1-p) = 8.4$	M1		Use of $np(1-p)$ even if SD
	Standard deviation = $\sqrt{8.4}$ or = 2.89 to 2.9	A1	4	CAO; AWFW
	Total		**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3(a)	$0.5 \le$ Value ≤ 0.95 Positive value < 1 (and > 0)	B2 (B1)		Value is actually 0.8
(b)	$-0.2 \le$ Value $\le +0.2$	B1		Value is actually 0.0
(c)	$-0.95 \le$ Value ≤ -0.5 Negative value > -1 (and < 0)	B2 (B1)	5	Value is actually –0.7
	Total		**5**	
4(a)	90% $\Rightarrow$ $z = 1.64$ to 1.65 **or** 90% $\Rightarrow$ $t = 1.66$ to 1.67 (Knowledge of the t–distribution is **not** required in this unit)	B1 (B1)		AWFW (1.6449) AWFW (1.6649)
	CI for μ is $\bar{x} \pm (z \text{ or } t) \times \dfrac{(s_{n-1} \text{ or } s_n)}{\sqrt{n}}$	M1		Used; must have $\sqrt{n}$ with $n > 1$
	Thus $184 \pm (1.6449 \text{ or } 1.6649) \times \dfrac{(32 \text{ or } 32.2)}{(\sqrt{78} \text{ or } \sqrt{77})}$	A1√		√ on z or t only
	Hence $184 \pm (5.94$ to $6.13)$ **or** £184 ± £6 **or** (£178, £190)	A1	4	AWRT; ignore units
(b)(i)	**Likely** to be **valid**	B1		Accept ‘valid’ or equivalent
(ii)	Different plays have different: programme prices, sales, marketing, etc theatre or audience sizes, etc popularity, artists, etc so **Unlikely** to be **valid**	B1 ↑Dep↑ B1	3	Accept ‘not valid’ or equivalent
	Total		**7**	

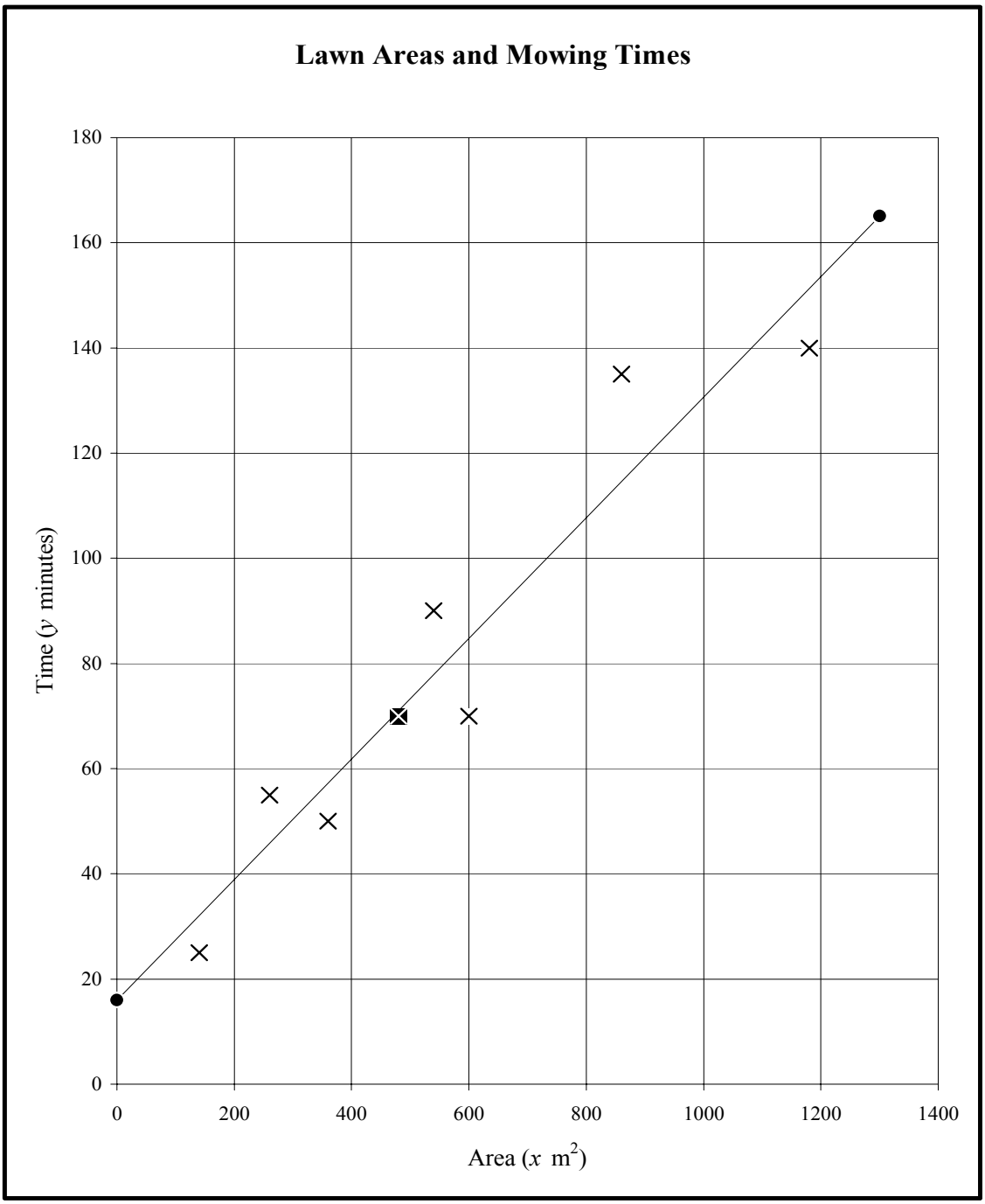
MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5(a)	$P(D' \cap E' \cap F') = 0.4 \times 0.3 \times 0.2$	M1		At least 1 probability correct
	$= 0.024$	A1	2	CAO; OE
(b)	$P(D' \cap E' \cap F) = 0.4 \times 0.3 \times 0.8$	M1		At least 2 probabilities correct
	$= 0.096$	A1	2	CAO; OE
(c)	P(One) = (b) + $P(D \cap E' \cap F') + P(D' \cap E \cap F')$	M1		Use of 3 possibilities; ignore multipliers
	$=$(b) + $(0.6 \times 0.3 \times 0.2) + (0.4 \times 0.7 \times 0.2)$	M1		At least 1 new term correct
	$= 0.096 + 0.036 + 0.056 = 0.188$	A1	3	CAO; OE
(d)	P(One or two) = (c) + (3 terms each of 3 probabilities) **or** = 1 – (a) – (1 term of 3 probabilities)	M1		(c) + P(Two) Used; OE; ignore multipliers 1 – (a) – P(Three)
	$= 0.188 + (0.6 \times 0.7 \times 0.2) + (0.6 \times 0.3 \times 0.8) + (0.4 \times 0.7 \times 0.8)$ $= 0.188 + 0.084 + 0.144 + 0.224$ **or** $= 1 - 0.024 - (0.6 \times 0.7 \times 0.8)$ $= 1 - 0.024 - 0.336$	M1		At least 1 new term correct
	$= 0.64$	A1	3	CAO; OE
	Total		**10**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$P(X < 45) = P\left(Z < \frac{45-37}{8}\right)$	M1		Standardising (44.5, 45 or 45.5) with 37 and ($\sqrt{8}$, 8 or 8^2) and/or $(37 - x)$
	$= P(Z < 1)$	A1		CAO; ignore sign
	$= 0.841$	A1	3	AWRT (0.84134)
(ii)	$P(30 < X < 45) =$ (i) $- P(X < 30)$	M1		Used; OE
	$=$ (i) $- P(Z < -0.875)$			
	$=$ (i) $- [1 -$ (0.80785 to 0.81057)]	m1		Area change
	$= 0.648$ to 0.652	A1	3	AWFW (0.65056)
(b)	$0.12 \Rightarrow z = 1.17$ to 1.18	B1		AWFW; ignore sign (1.1750)
	$z = \frac{45-40}{\sigma}$	M1		Standardising 45 with 40 and σ
	$= 1.175$	m1		Equating z-term to z-value but not using 0.12, 0.88 or $\lvert 1 - z \rvert$
	$\sigma = 4.23$ to 4.28	A1	4	AWFW
(c)	**Route A:** $P(X > 45) = 1 -$ (a)(i) **Route B:** $P(Y > 45) = 0.12$ so	B1 ↑Dep↑		OE; must use 45
	Monica should use **Route B** (smaller prob)	B1√	2	√ on (a)(i); allow Route Y
(d)	Mean of $\bar{W} = 18$	B1		CAO; can be implied by **use** in standardising
	Variance of $\bar{W} = \frac{12^2}{36} = 4$	B1		CAO; OE
	$P(\bar{W} > 20) = P\left(Z > \frac{20-18}{2}\right)$	M1		Standardising 20 with 18 and 2 and/or $(18 - 20)$
	$= P(Z > 1) = 0.159$	A1√	4	AWRT (0.15866); √ on (a)(i) if used
(e)	In part (d)	B1	1	CAO; OE
	Total		**17**	

Question 7 (a) and (b)



(a) **8 or 7** points plotted accurately B2
(**6 or 5** points plotted accurately B1)

(b) **Line** plotted accurately B2
(Evidence of correct method for ≥ 2 points M1)

(**Graph = 4**)

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7(a)	8 or 7 points plotted accurately (6 or 5 points plotted accurately)	B2 (B1)	2	
(b)	Gradient, $b = 0.114$ to 0.115 ($b = 0.11$ to 0.12)	B2 (B1)		AWFW (0.11469)
	Intercept, $a = 15.9$ to 16.1 ($a = 13$ to 19)	B2 (B1)		AWFW (16.00824)
	Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$ or Attempt at S_{xx} and S_{xy}	 (M1)		4420, 3230800, 635 and 441300 788750 and 90462.5
	Attempt at correct formula for b $b = 0.114$ to 0.115 $a = 15.9$ to 16.1	(m1) (A1) (A1)		 AWFW AWFW
	Accept a and b interchanged only if then identified correctly later in question			
	Line plotted accurately (Evidence of correct method for ≥ 2 points)	B2 (M1)	6	At least from $x = 200$ to 1000
(c)	$\text{Res}_H = y_H - Y_H = 70 - (a + b \times 480)$	M1		Used; or implied by **correct** answer; allow for $Y_H - y_H$ **shown**
	$= -1.5$ to -0.5	A1		AWFW (-1.06)
	Point H is (almost) **on** / **just below** the line	B1	3	Accept near / close / just above or equivalent
(d)	$Y = a + b \times 560$ or reading from scatter diagram	M1		Used
	$= 79$ to 81	A1		AWFW (80.2)
	Cost = $Y \times \frac{12}{60}$ or $\frac{Y}{5}$	M1		Used
	= £15.8 to £16.2	A1	4	AWFW; ignore units (£16.05)
	Total		**15**	
	TOTAL		**75**	

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B Statistics 1B

Mark Scheme

2007 examination - June series

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Registered address: AQA, Devas Street, Manchester M15 6EX
Dr Michael Cresswell Director General

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Otherwise we require evidence of a correct method for any marks to be awarded.

MS/SS1B

Q	Solution	Marks	Total	Comments
1(a)	r = –0.526 to –0.525	B3		AWFW
	or			
	r = –0.53 to –0.52	(B2)		AWFW; ignore sign
	or			
	r = –0.6 to –0.4	(B1)		AWFW; ignore sign
	OR			
	Attempt at $\sum x$, $\sum x^2$, $\sum y$, $\sum y^2$ and $\sum xy$			260, 6970, 143, 2083 and 3671
	or	(M1)		
	Attempt at S_{xx}, S_{yy} and S_{xy}			210, 38.1 and –47
	Attempt at a correct formula for r	(m1)		
	r = –0.526 to –0.525	(A1)	3	AWFW
(b)				OE; must qualify strength and indicate negative
	Weak/some/moderate negative correlation (relationship/association)	B1		B0 for strong/poor/reasonable/average B0 if $r > 0$ or $r < –1$ B0 if contradictory statements
	between			
	length and (maximum) diameter	B1		Context
	Ignore subsequent comments (as below) only if B1 B1 already scored			
	OR			
	Some evidence that large lengths are associated with small diameters	(B1) (B1)		OE; must qualify strength and indicate negative
	OR			
	Longer melons tend to have smaller diameters / be thinner	(B1) (B1)	2	OE; must qualify strength and indicate negative
	Total		**5**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2	Ratios: Penalise first occurrence only of a correct answer			
(a)(i)	P(Welsh back) = $\frac{7}{50}$ or 0.14	B1	1	CAO; OE
(ii)	P(English) = $\frac{14+8}{50}$ =	B1		Correct expression; PI
	$\frac{22}{50}$ or $\frac{11}{25}$ or 0.44	B1	2	CAO; OE
(iii)	P(not English) = 1 – (ii) =			
	$\frac{28}{50}$ or $\frac{14}{25}$ or 0.56	B1√	1	√ on (ii) if used; $0 < p < 1$
(iv)	P(Irish | back) = $\frac{P(\text{Irish} \cap \text{back})}{P(\text{back})} = \frac{6}{\sum(\text{back})}$ =	M1		Used; may be implied by values or answer
	$\frac{6}{23}$ or 0.26 to 0.261	A1	2	CAO/AWFW (6/50 ⇒ 0)
(v)	P(forward | not Scottish) = $\frac{P(\text{forward} \cap \text{not Scottish})}{P(\text{not Scottish})}$ = $\frac{14+5+6}{50-4}$ = $\frac{27-2}{50-4}$ =	M1		Used; OE May be implied by values or answer
	$\frac{25}{46}$ or 0.54 to 0.544	A1	2	CAO/AWFW (25/50 ⇒ 0)
(b)	P(4 × English) =			
	$\left(\frac{22}{50}\right)\times\left(\frac{21}{49}\right)\times\left(\frac{20}{48}\right)\times\left(\frac{19}{47}\right)$ =	M1 M1		Reducing non-tabulated value 4 times Reducing 50 and multiplying 4 terms (ignore multipliers)
	$\frac{175560}{5527200}$ or $\frac{209}{6580}$			
	or 0.0317 to 0.032	A1	3	CAO/AWFW
	Total		**11**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3(a)	95% $\Rightarrow$ z = 1.96 or 95% $\Rightarrow$ t = 2.0 to 2.01 (Knowledge of the t–distribution is not required in this unit)	B1 (B1)		CAO AWFW (2.009)
	CI for μ is $\bar{x} \pm (z \text{ or } t) \times \dfrac{(s_{n-1} \text{ or } s_n)}{\sqrt{n}}$	M1		Used; must have $\sqrt{n}$ with $n > 1$
	Note that $25.1 \times \sqrt{\dfrac{50}{49}} = 25.35483$			$25.1 \times \dfrac{50}{49} = 25.61224$ Max of B1 M1 A0√ A1
	Thus $234 \pm (1.96 \text{ or } 2.009) \times \dfrac{(25.1 \text{ or } 25.3 \text{ to } 25.4)}{(\sqrt{50} \text{ or } \sqrt{49})}$	A1√		√ on z or t only
	Hence 234 ± (6.95 to 7.30) ie 234 ± 7 or (227, 241)	A1	4	AWRT
(b)	Customers are likely to choose large / similar sized potatoes	B1	1	OE; accept any sensible alternative
	Total		**5**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	Mode = 2	B1		CAO
	Range = 15	B1	2	CAO
(ii)	CF: 4 17 41 58 73 84 89 95 x: 0 1 2 3 4 9 14 15			
	Median (48^{th}) = 3	B2		CAO; B0 if shown method is incorrect
	Interquartile Range (72^{nd} – 24^{th}) = 4 – 2 = 2	B2		CAO Allow B1 for identification of 4 and 2 B0 if shown method is incorrect
	If neither correct but CF attempted and matched correctly with ≥ 5 x–values	(M1) (A1)	4	Allow for median = $2 + \frac{x}{17}$
(iii)	Mean $(\bar{x})$ = 4.2	B2		CAO $\sum fx = 399$
	Standard Deviation $(s_n,\ s_{n-1})$ = 3.88 to 3.91	B2		$\sum fx^2 = 3111$ AWFW (3.887 or 3.907)
	If neither correct but mid-points of 7 and 12 seen	(B1)		
	and use of mean $(\bar{x}) = \frac{\sum fx}{95}$	(M1)	4	Allow for $4.1 \leq \bar{x} \leq 4.3$
(b)(i)	Unknown values (16) have no effect on median and IQR **or** median and IQR are exact values but $\bar{x}$ and s are estimates	B1	1	
(ii)	Use all available data or Enable further analyses	B1	1	
	Total		**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5(a)	Time taken depends upon temperature	B1	1	OE; **not** x set values
(b)	b (gradient) = –0.0873 to –0.087	B2		AWFW $\left(-0.087\dot{2}\dot{7}\right)$
	b (gradient) = –0.09 to –0.08	(B1)		AWFW; $-8.73^{-02} \Rightarrow$ B0
	a (intercept) = 5.94 to 5.96	B2		AWFW $\left(5.950\dot{9}\dot{9}\right)$
	a (intercept) = 5.6 to 6.1	(B1)		AWFW
	Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$			396, 16016, 30.9 and 958.8
	or	(M1)		
	Attempt at S_{xx} and S_{xy}			1760 and –153.6
	Attempt at correct formula for b	(m1)		
	b = –0.0873 to –0.087	(A1)		AWFW
	a = 5.94 to 5.96	(A1)	4	AWFW
	Accept a and b interchanged only if then identified correctly later in question			
(c)(i)	Each 1 ºC rise in temperature results in an	B1		Quantified rise in x (results in)
	(average) decrease of 0.087 m (5 s)	B1	2	Decrease in y
	in time taken for pellets to dissolve			OE
(ii)	a is y–value at $x = 0$ at which water is	B1		Indication that it is y at $x = 0$
	solid/ice/frozen so pellets cannot dissolve	B1	2	Mention of solid or ice or frozen
(d)(i)	When x = 30			
	y = 3.3 to 3.4	B2		AWFW $\left(3.33\dot{2}\dot{7}\right)$
	y = 2.9 to 3.7	(B1)		AWFW
	If B0, use of their equation with x = 30	(M1)	2	
(ii)	When x = 75			
	y < 0 or negative	B1		OE
	which	↑Dep↑		
	is impossible	B1	2	OE; **not** extrapolation
	Total		**13**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6(a)	Use of binomial in (a) or (b)(i)	M1		PI
(i)	$P(T_{10} \leq 3) = 0.38$ to 0.383	B1	2	AWFW (0.3823)
(ii)	$P(10 < T_{40} < 20) =$ 0.8702 or 0.9256	M1		Allow 3 dp accuracy
	minus 0.0352 or 0.0156	M1		Allow 3 dp accuracy
	$=$ 0.83 to 0.84	A1		AWFW (0.835)
	OR			
	B(40, 0.40) expressions stated for at least 3 terms within $10 \leq T_{40} \leq 20$	(M1)		Or implied by a correct answer
	Answer = 0.83 to 0.84	(A2)	3	AWFW
(b)(i)	$n = 5 \quad p = 0.4$			
	Mean, $\mu = np = 2$	B1		CAO
	Variance, $\sigma^2 = np(1-p) = 1.2$	M1		Use of $np(1-p)$ even if SD
	Standard deviation $= \sqrt{1.2}$ or $= 1.09$ to 1.1	A1	3	CAO AWFW
(ii)	Mean $(\bar{x}) = 2$	B1		CAO $\sum x = 26$
	Standard Deviation $(s_n,\ s_{n-1})$ = 1.1 to 1.16	B2		$\sum x^2 = 68$ AWFW (1.1094 or 1.1547)
	If neither correct but use of mean $(\bar{x}) = \dfrac{\sum x}{13}$	(M1)	3	
(iii)	Means are same and SDs are similar/same Means are same but SDs are different so Trina's claims appear valid / invalid	B1 ↑Dep↑ B1	2	Must have scored full marks in (b)(i) and (b)(ii)
	Total		**13**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7(a)	Time, $X \sim N(48, 20^2)$			
(i)	$P(X < 60) = P\left(Z < \frac{60-48}{20}\right) =$	M1		Standardising (59.5, 60 or 60.5) with 48 and ($\sqrt{20}$,20 or 20^2) and/or $(48 - x)$
	$P(Z < 0.6) = 0.725$ to 0.73	A1	2	AWFW (0.72575)
(ii)	$P(30 < X < 60) =$ $P(X < 60) - P(X < 30) =$ (i) $- P(X < 30) =$ (i) $- P(Z < -0.9) =$	M1		Difference or equivalent Standardising other than 60 and 30 $\Rightarrow$ max of M1 m1 A0
	(i) $- \{1 - P(Z < +0.9)\} =$ $0.72575 - \{1 - 0.81594\} =$	m1		Area change
	0.54 to 0.542	A1	3	AWFW (0.54169)
(iii)	$0.9 \Rightarrow z = 1.28$ to 1.282	B1		AWFW (1.2816)
	$z = \frac{k-48}{20}$	M1		Standardising k with 48 and 20
	$= 1.2816$	m1		Equating z-term to z-value; not using 0.9, 0.1, $\lvert 1 - z \rvert$ or $\Phi(0.9) = 0.81594$
	$k = 73.6$ to 74	A1	4	AWFW
(b)	Time, $Y \sim N(37, 25^2)$			
(i)	Use of $\mu - (2 \text{ or } 3) \times \sigma =$ $37 - (50 \text{ or } 75)$	M1		Or equivalent justification
	$< 0 \Rightarrow$ likely negative times	B1	2	for (likely) negative times
(ii)	Central Limit Theorem or n large / > 30	B1	1	
(iii)	Variance of $\bar{Y} = \frac{25^2}{35}$	B1		OE; stated or used
	$P(\bar{Y} > 40) = P\left(Z > \frac{40-37}{25/\sqrt{35}}\right) =$	M1		Standardising 40 with 37 and $25/\sqrt{35}$ and/or $(37 - 40)$
	$P(Z > 0.71) = 1 - P(Z < 0.71) =$	m1		Area change
	0.238 to 0.24	A1	4	AWFW (1 – 0.76115)
	Total		**16**	
	TOTAL		**75**	

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B Statistics 1B

Mark Scheme

2008 examination - January series

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Registered address: AQA, Devas Street, Manchester M15 6EX *Dr Michael Cresswell Director General*

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/SS1B

Q	Solution	Marks	Total	Comments
1(a)(i)	$P(X < 3.5) = P\left(Z < \frac{3.5-3.3}{0.16}\right) =$	M1		Standardising (3.45, 3.5 or 3.55) with 3.3 & ($\sqrt{0.16}$, 0.16 or 0.16^2) and/or $(3.3 - x)$
	$P(Z < 1.25) =$	A1		CAO; ignore sign
	0.894 to 0.895	A1	3	AWFW (0.89435)
(ii)	$P(X > 3.0) = P\left(Z > \frac{3.0-3.3}{0.16}\right) =$	M1		Standardising (2.95, 3 or 3.05) with 3.3 & ($\sqrt{0.16}$, 0.16 or 0.16^2) and/or $(3.3 - x)$
	$P(Z > -1.875) = P(Z < 1.875) =$	m1		Correct area change
	0.969 to 0.97(0)	A1	3	AWFW (0.96960)
(iii)	$P(3.0 < X < 3.5) =$ (i) – [1 – (ii)] =	M1		OE
	0.863 to 0.865	A1	2	AWFW: CSO (0.86395)
(b)	$0.025 \Rightarrow z = 1.96$	B1		CAO; ignore sign
	$z = \frac{3.1-\mu}{0.16}$	M1		Standardising 3.1 with μ and 0.16; allow $(\mu - 3.1)$
	$= -1.96$	m1		Equating z-term to z-value; not using 0.025, 0.975, $\lvert 1 - z \rvert$ or $\Phi(0.025) = 0.507$ to 0.512
	Hence $\mu = 3.4(0)$ to 3.42	A1	4	AWFW; CSO (3.4136)
	Total		**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)	$r = \frac{416.3}{\sqrt{1280.55 \times 281.8}}$ =	M1		Allow no $\sqrt{}$
	0.69 to 0.7(0)	A1	2	AWFW (0.693) (0.00115)
(b)	(Quite or fairly) **weak / some / moderate** (quite or fairly) **strong positive correlation** (relationship / association)	A1		OE; must qualify strength and indicate positive A0 for poor / reasonable / average / medium / good A0 for very weak / very strong etc
	between **head & body length** and **tail length** *Ignore subsequent alternative comments only if A1 B1 already scored*	B1	2	Context; accept 'body and tail' or even 'head and tail'
	OR **Some** evidence that mice with large head & body lengths also have long tails	(A1) (B1)		OE; must qualify strength and indicate positive in context
(c)	0.69 to 0.7(0) **OR** Answer to (a)	B1$\surd$	1	$0 < r < 1$
(d)	Existence of: **Non-linear** relationship **Outliers** **More than one** relationship	B1		Any one; OE Not reasons identifiable from context (eg spurious)
	Sensible related sketch SC: Check on calculation $\Rightarrow$ B1 B0	B1	2	
	Total		**7**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3(a)	12 elephants are a **random sample** **OR** are **selected independently**	B1		OE; eg representative
	Mean $\bar{x} = \frac{39.24}{12} = 3.27$	B1		CAO
	98% $\Rightarrow$ z = 2.32 to 2.33	B1		AWFW (2.3263)
	CI for μ is $\bar{x} \pm z \times \frac{\sigma}{\sqrt{n}}$	M1		Used; must have $\sqrt{n}$ with $n > 1$
	Thus $3.27 \pm 2.3263 \times \frac{0.20}{\sqrt{12}}$	A1√		√ on $\bar{x}$ and z only
	Hence 3.27 ± 0.1343			
	Hence $3.27 \pm$ (0.13 to 0.14) **OR** (3.13 to 3.14, 3.4(0) to 3.41)	A1	6	AWFW
(b)	Value of 2.90 is **below / outside** CI	B1√		√ on (a); OE
	Suggests **mean height** of adult male **Asian elephants** is **less than / different from that / mean height** of adult male **African elephants**	B1√ dep	2	√ on (a); OE
	Total		**8**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	≥ 8 points plotted accurately (≥ 6 points plotted accurately)	B2 (B1)	2	
(b)	*b* (gradient) = 1.19 to 1.2(0) (*b* (gradient) = 1.1 to 1.3)	B2 (B1)		AWFW (1.19066)
	a (intercept) = 3.8 to 4(.0) (*a* (intercept) = 2.2 to 5.4)	B2 (B1)	4	AWFW (3.94949)
	Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$ **OR** Attempt at S_{xx} and S_{xy}	(M1)		160, 2758, 230 and 3915.75 198 and 235.75
	Attempt at correct formula for *b* (gradient) *b* (gradient) = 1.19 to 1.2(0) *a* (intercept) = 3.8 to 4(.0)	(m1) (A1) (A1)		 AWFW AWFW
	Accept *a* and *b* interchanged only if then identified correctly later in question			
(c)	Line plotted accurately (Evidence of correct method for ≥ 2 points)	B2 (M1)	2	At least from $x \approx 7.5$ to 22.0 $x = 10 \Rightarrow y = 15.5$ to 16.5 $x = 20 \Rightarrow y = 27.0$ to 28.5
(d)(i)	When $x = 15$:			
	y = 21.5 to 22(.0) (*y* = 18.5 to 25(.0))	B2 (B1)	2	AWFW (21.8) AWFW
	If B0, then use of c's equation with $x = 15$	(M1)		
(ii)	**Points** are quite **widely scattered** about line	B1		When $x = 14$ then $y = 14.5$ When $x = 16$ then $y = 27.5$
	Hence **not** very **reliable**	B1 dep	2	B0 B0 for 'interpolation so reliable'
	Total		**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)	$P(G') = 1 - 0.70 = 0.3(0)$	B1	1	CAO; OE
(ii)	$P(G \cap S') =$			
	$0.70 - (0.25 \text{ or } 0.55 \text{ or } 0.45)$	M1		Can be implied only if answer is correct
	or $1 - 0.55$			
	$= 0.45$	A1	2	CAO; OE
(iii)	$P(1 \text{ only}) =$			
	$0.70 + 0.55 - (2 \times 0.25)$			Can be implied only if answer is correct;
	or $1 - 0.25$	M1		allow no $(\times 2)$ but not by implication
	or $0.45 + 0.30$			from answer
	$= 0.75$	A1	2	CAO; OE
(b)	$P(G' \cap G' \cap G' \cap G') = [(a)(i)]^4$	M1		Can be implied by correct answer Ignore multiplier of 4
	$= 0.0081$	A1	2	CAO; OE
(c)	$P(H_G) = P(A_G \cap H_G) + P(A_{G'} \cap H_G) =$			
	(0.70×0.60) or 0.42	M1		Can be implied by correct answer Ignore additional terms
	(0.30×0.10) or 0.03	M1		Can be implied by correct answer
	$= 0.42 + 0.03 = 0.45$	A1	3	CAO; OE
(d)	$P(H_O) = 1 - [0.35 + (c)]$	M1		Can be implied by correct answer
	$= 0.2(0)$	A1	2	CAO; OE
	Total		**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6 (a)(i)	x: 0 1 2 3 4 5 6 7 8 9 F: 30 109 208 276 336 360 371 377 379 380			
	Median ($\approx 190.5^{th}$) = 2	B2		CAO; B0 if shown method incorrect
	Interquartile range ($\approx 285.75^{th} - \approx 95.25^{th}$)			
	= 4 – 1 = 3	B2	4	CAO; B0 if shown method incorrect B1 for identification of 4 and 1
	If neither is correct but F attempted	(M1)		Allow for median = $1+\frac{x}{99}$
	and matched correctly with ≥ 5 x-values	(A1)		
(ii)	Mean $(\bar{x})$ = 2.56 to 2.57	B2		AWFW (2.56316)
	(2.5 to 2.6)	(B1)		AWFW $\sum fx = 974$ and $\sum fx^2 = 3546$
	Standard Deviation (s_n, s_{n-1}) =			
	1.66 to 1.67	B2	4	AWFW (1.66187)
	(1.6 to 1.7)	(B1)		AWFW (1.66406)
	If neither is correct but $\sum fx$ attempted	(M1)		
	and result divided by 380	(M1)		
(b)(i)	Average: Same/similar/greater in 2004/05	B1 dep		OE; dep on 2 and 2.5 to 2.6
	Spread: Similar/greater in 2004/05	B1 dep	2	OE; dep on 3 and 1.6 to 1.7
(ii)	Rule applies to data that is (approximately) symmetric/normal/bell-shaped	B1		OE
	Data for 2005/06 is (positively) skewed/ not symmetric/not normal/not bell-shaped	B1	2	OE
	Total		**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7(a)	Use of binomial in (a) or (b)	M1		Can be implied by answers
(i)	$P(X \geq x) = 1 - P(X \leq x - 1)$			Identified from an answer / 1 – answer
	OR	M1		Can be implied from a correct answer
	$= 1 - B(\Sigma x, 50, 0.08)$			Identified from an answer/expression
	$= 1 - 0.0827 = 0.915$ to $0.92(0)$	A1		AWFW (0.9173)
				≥ 1 correct $\Rightarrow$ M1 M1
(ii)	$P(X \geq 3)$			
	$= 1 - 0.2260 = 0.77(0)$ to 0.775	A1	4	AWFW (0.7740)
(b)(i)	$P(Y = 0) = (1 - 0.025)^{15} = 0.975^{15}$	M1		Can be implied from correct answer
	$= 0.68(0)$ to 0.685	A1		AWFW (0.6840)
(ii)	$P(Y \geq 1) = 1 -$ (i)	M1		Can be implied from answer if ε (0, 1)
	$= 0.315$ to $0.32(0)$	A1$\surd$	4	$\surd$ on (i) if ε (0, 1) (0.3160)
(c)	Probability =			
	[(b)(ii) × (a)(i)] or (0.316×0.917)	M1		Ignore additional terms
	[(b)(i) × (a)(ii)] or (0.684×0.774)	M1		
	$= 0.2898 + 0.529$	A1		2 terms added with ≥ 1 correct
	$= 0.81$ to 0.83	A1	4	AWFW (0.8193)
	Total		**12**	
	TOTAL		**75**	

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B Statistics 1B

Mark Scheme

2008 examination - June series

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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)	*b* (gradient) = –1.01 to –1(.00) (*b* (gradient) = –1.05 to –0.95)	B2 (B1)		AWFW (–1.00337)
	a (intercept) = 53(.0) to 53.2 (*a* (intercept) = 52(.0) to 54(.0))	B2 (B1)	4	AWFW (53.06736)
	OR			
	Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$ **or** Attempt at S_{xx} and S_{xy}	(M1)		180, 3986, 297 and 5552.7 386 and –387.3
	Attempt at **correct** formula for *b* (gradient)	(m1)		
	b (gradient) = –1.01 to –1(.00) *a* (intercept) = 53(.0) to 53.2	(A1) (A1)		AWFW AWFW
	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,			
	y = 31.7 to 32.2 (y = 29.9 to 34.1)	B2 (B1)	2	AWFW (32.0) AWFW
	Evidence of use of 21 in c's equation	(M1)		
	Special Cases (if seen):			
	$y = \frac{33.0+30.7}{2}$ = 31.8 to 31.9	(B1)		AWFW; or equivalent
	y = 31.85 without working	(B1)		
	Total		**6**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)	P(*B*lue) = $\frac{160}{400}$ = 0.4 or $\frac{2}{5}$ or $\frac{160}{400}$	B1	1	CAO; or equivalent
	In (b) to (e), method marks are for single fractions, or equivalents, only			
(b)	P(*M*arker) = $\frac{280}{400}$	M1		270 ≤ Numerator ≤ 290 and Numerator < Denominator ≤ 400
	= 0.7 or $\frac{7}{10}$ or $\frac{280}{400}$	A1	2	CAO; or equivalent
(c)	P(*B* or *M*) = P($B \cup M$) =			
	$\frac{160+280-119}{400} = \frac{280+41}{400} = \frac{321}{400}$	M1		290 ≤ Numerator ≤ 321 and Numerator < Denominator ≤ 400
	= 0.802 to 0.803 or $\frac{321}{400}$	A1	2	AWFW/CAO (0.8025)
(d)	P(*G*reen | *H*ighlighter) = P($G \mid H$) = $\frac{42}{120}$	M1		Numerator = 42 and 110 ≤ Denominator ≤ 120
	= 0.35 or $\frac{7}{20}$ or $\frac{42}{120}$	A1	2	CAO; or equivalent
(e)	P(*N*on-*P*ermanent | *R*ed) = P($P' \mid R$) = $\frac{21}{90}$	M1		Numerator = 21 and 80 ≤ Denominator ≤ 90
	= 0.233 to 0.234 or $\frac{7}{30}$ or $\frac{21}{90}$	A1	2	AWFW/CAO (0.2333)
	Total		**9**	

MS/SS1B (cont)

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

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	Ordering: 0 0 13 28 35 40 47 51 63 77 *a*	M1		May be implied by 40 and/or 63 and 13
	Median (6^{th}) = 40	B1		CAO
	IQR = $Q_3(9^{th})$ – $Q_1(3^{rd})$			
	= 63 – 13	(B1)		Identification of 63 and 13
	= 50	B2	4	CAO
(b)(i)	*Mode*: Zero is not representative / sensible reason Wide range of (known) values Small number of values mostly different	B1		Or equivalent
(ii)	*Range*: Largest value, *a*, is unknown Cannot be calculated	B1	2	Or equivalent
	Total		**6**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5	Height $X \sim N(140, 2.5^2)$			
(a)(i)	$P(X < 145) = P\left(Z < \frac{145-140}{2.5}\right) =$	M1		Standardising (144.5, 145 or 145.5) with 140 and ($\sqrt{2.5}$, 2.5 or 2.5^2) and/or (140 – x)
	$P(Z < 2) =$	A1		2 CAO; ignore sign
	0.977 to 0.98(0)	A1	3	AWFW (0.97725)
(ii)	$P(138 < X < 142) =$			
	$P(X < 142) - P(X < 138) =$	M1		Difference (142 – 138)
	$P(Z < 0.8) - P(Z < -0.8) =$	B1		0.8 CAO
	$P(Z < 0.8) - \{1 - P(Z < 0.8)\} =$ $(0.78814) - (1 - 0.78814) =$	m1		Correct area change
	0.576 to 0.58(0)	A1	4	AWFW (0.57628)
(b)	0.85 (85%) $\Rightarrow z = -1.03$ to -1.04	B1		AWFW; ignore sign (–1.0364)
	$z = \frac{x-140}{2.5}$	M1		Standardising x with 140 and 2.5; allow (140 – x)
	$= \pm 1.03$ to ± 1.04	A1		Equating z-term to the z-value
	Hence $x = 137.3$ to 137.5	A1	4	AWFW; CSO (137.41)
(c)	Variance of $\bar{X}_4 = \frac{2.5^2}{4} = 1.56(25)$ SD of $\bar{X}_4 = \frac{2.5}{2} = 1.25$	B1		CAO; stated or used
	$P(\bar{X}_4 > 139) = P\left(Z > \frac{139-140}{\sqrt{2.5^2/4}}\right) =$	M1		Standardising 139 with 140 and 1.25; allow (140 – 139)
	$P(Z > -0.8) = P(Z < 0.8) =$	m1		Correct area change
	0.788 to 0.79(0)	A1	4	AWFW (0.78814)
	Total		**15**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6	Binomial distribution	M1		Used somewhere in question
(a)(i)	$M \sim$ B(40, 0.35)	A1		Used; may be implied
	P($M \leq 15$) = 0.69(0) to 0.696	A1	3	AWFW (0.6946)
(ii)	P($10 < M < 20$) =			
	0.9637 or 0.9827	M1		Accept 3 dp accuracy
	minus 0.1215 or 0.0644	M1		Accept 3 dp accuracy
	= 0.84(0) to 0.843	A1	3	AWFW (0.8422)
	OR			
	B(40, 0.35) expressions stated for **at least 3** terms within $10 \leq M \leq 20$	(M1)		Or implied by a correct answer
	Answer = 0.84(0) to 0.843	(A2)		AWFW
(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 to 0.2665	A1	3	AWFW (0.2662) **Note**: B(10, 0.3) $\Rightarrow$ 0.2668
(c)(i)	$n = 20$ $p = 0.71$	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 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 $\mu = 14.2$
	Means and variances are different	*(B2,1 dep)*		
	Variance of 2.50 is smaller/different	B1dep		Dependent on σ^2 = 4.11 to 4.12
	Suggests **claim** that groups are not random samples **is justified**	B1dep	3	Dependent on previous 2 marks Or equivalent
	Total		**15**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7(a)(i)	x: –5 –3 –1 1 3 5 7 9 f: 4 9 13 27 21 15 7 4			
	Mean ($\bar{x}$) = 1.9 (0.9 to 2.9)	B2 (B1)		CAO (190) AWFW
	Standard deviation (s_{n-1} or σ_n) = 3.3(0) to 3.32 (3(.00) to 3.5(0))	 B2 (B1)	 4	(1452) AWFW (3.31967) AWFW (3.30303)
	If no marks scored but $\sum fx$ attempted and result divided by 100	(M1)		
(ii)	Mean = 60 + $\bar{x}$ = 61.9	M1 A1√		√ on (a)(i)
	Standard deviation = 3.3(0) to 3.32	B1√	3	√ on (a)(i); accept 'same as' only providing answer in (a)(i)
(b)(i)	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 $\bar{x} \pm z/t \times \frac{s_{n-1} \text{ or } \sigma_n}{\sqrt{n \text{ or } n-1}}$	M1		Used; must have $\sqrt{n}$ with $n > 1$
	Thus $61.9 \pm 2.3263 \times \frac{3.3 \text{ to } 3.32}{\sqrt{100 \text{ or } 99}}$	A1√		√ on (a)(ii) and z/t only
	Hence 61.9 ± (0.7 to 0.8) **or** (61.1 to 61.2, 62.6 to 62.7)	A1	4	Accept 1.03 ± (0.012 to 0.013) AWFW Accept (1.01 to 1.02, 1.04 to 1.05)
(ii)	Mean and SD based upon grouped data SD (**not mean**) calculated from a sample CLT used / Times (may) not (be) normal	B1	1	Actual times/values unknown Or equivalent
(c)	S > *1 hour or 60 minutes*: **Valid** as 74/100 or 0.74 or 74% > 50%	B1		Must use 74 etc Or equivalent
	$\bar{S}$ >> *1 hour or 60 minutes*: **Not valid** as UCL ≈ 1 hour (Accept Both limits ≈ 1 hour)	B1dep	2	Dependent on UCL = 62.6 to 62.7 or UCL = 1.04 to 1.05
	Total		**14**	
	TOTAL		**75**	

Version 1.0: 0109

General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B Statistics 1B

Mark Scheme

2009 examination - January series

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Dr Michael Cresswell Director General

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/SS1B

Q	Solution	Marks	Total	Comments
1 (a)	Mean = $\frac{\sum fx}{\sum x} = \frac{247}{52} = 4.75$ or $4\frac{3}{4}$	B2		$\frac{247}{52} \Rightarrow$ B1 CAO ($4.75 = 5 \Rightarrow$ ISW) $4\frac{39}{52} \Rightarrow$ B2
	If B0 but evidence of $\frac{\sum fx}{52}$	(M1)		
	Median (26, 26½) = 5	B2		CAO
		(B1)		Stated identification of 26 or 26½
	If B0 but evidence of cumulative frequencies *F*: (0) 1 3 12 25 32 45 51 52			Need to see attempt at ≥ 4 *F*–values
	or If data assumed continuous so use of $4+\frac{x}{7}$ where $0 < x < 2$	(M1)		(4 < median < 4.29)
	Mode(s) = 4 and 6	B1	5	CAO both (so mode = 5 $\Rightarrow$ B0)
(b)	Mode(s) More than one mode/value Two modes/values No unique mode/value	B1 B1dep		CAO Or equivalent; eg not unique Dep only on previous B1 scored
	Notes: If data treated as two separate sets, then only marks available are B1 B1dep in (b) If averages confused then mark (a) as stated eg median = 4 and 6 ⇒ B0 in (a) and in (b) "median, as two values" ⇒ B0 B0		2	Modes = 1 and 13 ⇒ B0 in (a) but B1 B1dep available in (b)
		Total	**7**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2 (a)(i)	r = 0.022 to 0.023	B3		AWFW (0.022557)
	r = 0.02 to 0.03	(B2)		AWFW
	r = –0.1 to 0.1	(B1)		AWFW
	OR			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$			118.8 1619.36 31.5 114.43 & 416.13 (all 5 attempted)
	or	(M1)		
	Attempt at S_{xx} S_{yy} & S_{xy}			51.2 4.18 & 0.33 (all 3 attempted)
	Attempt at **correct** formula for r	(m1)		
	r = 0.022 to 0.023	(A1)	3	AWFW
(ii)	(Almost/virtually) **no/zero** (linear) **correlation** (relationship/association/link)	B1		Or equivalent qualification of **NO** strength; do not follow-through from (i) B0 for very weak/weak/some/ little/slight/positive/hardly any/etc unless correct qualification also stated
	between **length** and (maximum) **diameter** of carrots	B1	2	Context; providing $-1 < r < 1$
(b)	**Unlikely**/wrong/incorrect/invalid	B1		Or equivalent
	Would expect a **positive value** **or** Would expect **weight to increase with length** **or** Would imply **shorter carrots are heavier**	B1	2	Or equivalent reason
		Total	**7**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3	$X \sim \text{N}(5.08, 0.05^2)$			
(a)(i)	$\text{P}(X < 5) = \text{P}\left(Z < \frac{5-5.08}{0.05}\right) =$ $\text{P}(Z < -1.6)$	M1		Standardising (4.5, 4.95, 5, 5.05 or 5.5) with 5.08 and ($\sqrt{0.05}$, 0.05 or 0.05^2) and/or $(5.08 - x)$
	$= 1 - \text{P}(Z < 1.6) = 1 - 0.9452$	m1		Area change; may be implied
	$= 0.0545$ to 0.055	A1	3	AWFW (0.0548) (1 – answer) ⇒ M1 max
(ii)	$P(5 < X < 5.10) = \text{P}(X < 5.10) -$ (i)	M1		Or equivalent; must be clear correct method if answer incorrect and answer > 0
	$= \text{P}(Z < 0.4) -$ (i) $= 0.65542 - 0.0548$			
	$= 0.6$ to 0.601	A1	2	AWFW (0.60062)
(b)(i)	Variance of $\bar{X}_4 = 0.05^2/4 = 0.000625$ SD of $\bar{X}_4 = 0.05/2 = 0.025$	B1		CAO; stated or used
	$\text{P}(\bar{X}_4 > 5.05) = \text{P}\left(Z > \frac{5.05-5.08}{0.025}\right)$	M1		Standardising 5.05 with 5.08 and 0.025; allow $(5.08 - 5.05)$
	$= \text{P}(Z > -1.2) = \text{P}(Z < 1.2)$	m1		Area change; may be implied
	$= 0.884$ to 0.886	A1	4	AWFW (0.88493) (1 – answer) ⇒ B1 M1 max
(ii)	Zero	B1	1	CAO; or equivalent (ignore any working)
(c)	1% (0.01) ⇒ $z = -2.33$ to -2.32	B1		AWFW; ignore sign (–2.3263)
	$z = \frac{5-\mu}{0.05}$	M1		Standardising 5 with μ and 0.05 or 0.025; allow $(\mu - 5)$
	$= -2.3263$	A1		Only allow: ±2.05 to ±2.06 ±2.32 to ±2.33 ±2.57 to ±2.58
	$\mu = 5.11$ to 5.12	A1		AWFW (5.1163)
	Note: $\frac{5-\mu}{0.05} = 2.3263 \Rightarrow 5.116$ ⇒ B1 M1 A1 A0			Or equivalent inconsistent signs
			4	
		Total	**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4	$P(C) = 0.6 \quad P(C \cap B) = 0.25$ $\{P(C \text{ only}) = 0.35 \quad P(B \text{ only}) = 0.4\}$			*In (a), ratios (eg 4 : 10) are only penalised by 1 mark at first correct answer*
(a) (i)	$P(C') = 1 - P(C) = 1 - 0.6 = 0.4$	B1	1	CAO; or equivalent
(ii)	$P(C \cap B') = 0.6 - 0.25$ $= 1 - (0.4 + 0.25)$ $= 0.35$	M1 A1	2	Can be implied by correct answer CAO; or equivalent
(iii)	$P(B) = \text{(i)} + p$ with $p < 0.6$ $= \text{(i)} + 0.25$ $= 0.65$ **OR** $P(B) = 1 - \text{(ii)}$ $= 0.65$ **OR** $1 = P(C) + P(B) - P(C \cap B)$ Thus $P(B) = 1 - (0.6 - 0.25)$ $= 0.65$	M1 A1 A1 (M2) (A1) (M1) (A1) (A1)	 3	Can be implied by correct answer Can be implied by correct answer CAO; or equivalent Can be implied by correct answer Can be implied by correct answer Can be implied by correct answer CAO; or equivalent
(b)	$P(L \mid G_C) = 0.9 \quad P(L \mid G_{CB}) = 0.7$ $P(L \mid G_B) = 0.3$			
(i)	$P(G \cap L) \Rightarrow$ (a)(ii) $\times$ 0.9 (0.315) 0.25×0.7 (0.175) [(a)(iii) – 0.25] $\times$ 0.3 (0.12) Note: Each pair of multiplied probabilities must be > 0 to score the corresponding method mark $\Rightarrow 0.315 + 0.175 + 0.12 = 0.61$	M1 M1 M1 A1	 4	Follow through or correct Follow through or correct Ignore any multiplying factors Ignore any additional terms CAO
(ii)	Probability = $\{1 - \text{(b)(i)}\}^5$ $= 0.39^5 = 0.009$	M1 A1	 2	Allow $5 \times \{1 - \text{(b)(i)}\}^5$ AWRT (0.00902)
		Total	**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5 (a)	Mean = $\frac{1620}{30}$ = 54	B1	1	CAO; cannot be gained in (b)
(b)	98% (0.98) $\Rightarrow$ z = 2.32 to 2.33	B1		AWFW (2.3263)
	CI for μ is $\bar{x} \pm z \times \frac{\sigma}{\sqrt{n}}$	M1		Used Must have $\sqrt{n}$ with $n > 1$
	Thus $54 \pm 2.3263 \times \frac{8}{\sqrt{30}}$	A1F		F on $\bar{x}$ (but not 1620) and z only Allow $\bar{x}$ = 54 even if B0 in (a)
	Hence 54 ± (3.38 to 3.42)			CAO & AWFW (54 & 3.4)
	or	A1	4	
	(50.58 to 50.62, 57.38 to 57.42)			AWFW (50.6, 57.4)
	Notes: Use of n = 1 in (b) must not be deemed as answer to (c) Use of n = 1 in (b) followed by use of n = 1 in (c) $\Rightarrow$ (b) B1, (c) M1 A1 max Use of n = 1 with (b) or (c) not identified $\Rightarrow$ (b) B1, (c) 0 max			
(c)	Repeat of structure in (b) but with n = 1 and $1.96 \le z \le 3.03$	M1		Or equivalent
	Thus 54 ± (18.56 to 18.64)			CAO & AWFW (54 & 18.6)
	or	A1F		If z-value incorrect, then must use $54 \pm 8 \times [z \text{ from (b)}]$
	(35.36 to 35.44, 72.56 to 72.64)		2	AWFW (35.4, 72.6)
	Note: Accept sensible non-symmetric intervals such as: (0, 54 + 2.0537 × 8) = (0, 70.4 to 70.5)			
(d)	Nowhere **or** No	B1	1	CAO; or equivalent (ignore any reasoning)
		Total	**8**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6(a)	Figure 1: **3** correct labelled points **2** correct labelled points	B2 (B1)	2	Deduct 1 mark if not labelled
(b)				
	b (gradient) = 0.685	B2		AWRT (0.68502)
	b (gradient) = 0.68 to 0.69	(B1)		AWFW
	a (intercept) = 0.344	B2		AWRT (0.34404)
	a (intercept) = 0.34 to 0.35	(B1)		AWFW
	OR			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$			630 40344 435 & 27853 (all 4 attempted)
	or	(M1)		
	Attempt at S_{xx} & S_{xy}			654 & 448 (both attempted)
	Attempt at correct formula for b (gradient)	(m1)		
	b (gradient) = 0.685	(A1)		AWRT
	a (intercept) = 0.344	(A1)		AWRT
	Accept a & b interchanged only if then identified correctly by a stated or used equation in (c) or (d)		4	
(c)	Figure 1: Correct line (50, 34 to 35) (60, 40½ to 42) (70, 47¼ to 49) (80, 54 to 56)	B2dep		Dep on ≥ B1 B1 or ≥A1 A0 in (b) At least from $x \approx$ 55 to 70 Any two
	If B0 but evidence of use of line for ≥ 2 points within range $50 \leq x \leq 80$	(M1)	**2**	Calc^n or points shown on graph
(d)(i)	Residual = $y - (a + bx)$ [**or** $(a + bx) - y$]	M1		Used or implied; or equivalent (using graph); ≥ 1 residual correct (2.98)
	H I J 2.5 to 4(.0) 2.5 to 4(.0) 2(.0) to 4(.0)	A2,1 (–1 EE)		AWFW; ignore signs only (3.19) providing all the same (2.70)
	Mean = 2.3 to 4(.0)	A1dep	4	AWFW; do not ignore sign (2.96) Dep on previous A2 scored
(ii)	$y_{65} = a + b \times 65$	M1		Use shown or AWFW (44.9)
	or y_{65} = 44 to 45.5			
	+ [(d)(i)] **or** [2.95 to 2.97]	m1		Use shown or AWFW; ignore sign of mean residual
	= 46 to 50	A1		AWFW (47.8)
	Special Cases: Line drawn/calc^d on H, I & J **or** linear interp^n using I & J = 47 to 49	(B2)		$y_M = 4.51 + 0.666x \Rightarrow 47.8$ **OR** no evidence of method {from (d)(i) and/or (d)(ii)} Evidence of incorrect method ⇒ B0
	44 to 45.5 seen with no evidence ⇒ B1		3	
		Total	**15**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7 (a)(i)	B(16 or 25 or 40, 0.45)	M1		Used at least once in (a)(i) to (iii)
	$P(S = 3) = \binom{16}{3}(0.45)^3(0.55)^{13}$	A1		May be implied by correct answer Ignore any additional terms
	$= 0.021$ to 0.022	A1	3	AWFW (0.0215)
(ii)	$P(S < 10) = 0.3843$ or 0.2424	B1		Accept 3 dp accuracy from tables or calculation
	$= 0.242$ to 0.243	B1	2	AWFW (0.2424)
(iii)	$P(15 \leq S \leq 20)$	M1		Accept 3 dp accuracy
	$= 0.7870$ or 0.6844 (p_1)			$p_2 - p_1 \Rightarrow$ M0 M0 A0 $p_1 - (1 - p_2) \Rightarrow$ M1 M0 A0
	minus 0.1326 or 0.2142 (p_2)	M1		Accept 3 dp accuracy / truncation
	$= 0.654$ to 0.655	A1		AWFW (0.6544)
	OR			
	B(40, 0.45) expressions stated for at least 3 terms within $14 \leq S \leq 20$ gives probability	(M1)		Or implied by a correct answer
	$= 0.654$ to 0.655	(A2)	3	AWFW
(iv)	Mean, $\mu = np = 50 \times 0.45$	B1		CAO ($22.5 = 22$ or $23 \Rightarrow$ ISW)
	$= 22.5$ or $22\frac{1}{2}$			
	Variance, $\sigma^2 = np(1-p)$			Accept $12\frac{3}{8}$ or $\frac{99}{8}$
	$= 50 \times 0.45 \times 0.55$			
	$= 12.3$ to 12.4	B1	2	AWFW (12.375)
(b)(i)	**Non-independence** of senior citizens travel Senior citizens tend to **travel in pairs/groups**	B1	1	Or equivalent; but must be a clear indication of non-independent events
(ii)	7.15 am is outside 9.30 am to 11.30 am Cannot use SCPs before 9.30 am Cannot use SCPs @ 7.15 am Cannot use SCPs during morning 'rush hour'			
	Value of p likely to be smaller/different/zero Data not available Senior citizens not out at this time Passengers likely to be workers/school children	B1	1	Or equivalent Accept other **sensible** reasons Distribution of **types of** passenger different
		Total	**12**	
		Paper	**75**	

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General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B/W Statistics 1B

Mark Scheme

2009 examination - June series

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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/SS1B/W

Q	Solution	Marks	Total	Comments
1(a)				**In (a), ratios (eg 100:160) are only penalised by 1 mark at first correct answer**
(i)	P(P) = 100/160 = 50/80 = 25/40 = 10/16 = 5/8 = 0.625	B1	1	CAO
(ii)	P(S') = $1-\frac{32}{160}$ **or** P(S) = $\frac{32}{160}$	M1		Or equivalent Ignore labels of S' & S Can be implied by **correct** answer
	= 128/160 = 64/80 = 32/40 = 16/20 = 8/10 = 4/5 = 0.8	A1	2	CAO
(iii)	P(S or H) = P($S \cup H$) = $\frac{60+32-18}{160}$ **or** $\frac{60+14}{160}$ **or** $\frac{32+8+16+18}{160}$	M1		Or equivalent Can be implied by **correct** answer
	= 74/160 = 37/80 = 0.462 to 0.463	A1	2	CAO/AWFW (0.4625)
(iv)	P($T \mid P$) = $\frac{30/160}{\text{(i)}}$	M1		Or equivalent Can be implied by **correct** answer But watch for $18/160$ or $48/160$
	= 3/100 = 3/10 = 0.3	A1	2	CAO
(b)	P(1C & 1R & 1S) =			
	$\frac{24}{160} \times \frac{56}{159} \times \frac{32}{158}$	M1		Multiplication of any 3 different given subject totals
		M1		Multiplication of 160, 159 & 158
	(0.15 × 0.35220 × 0.20253) × 6	M1		Accept 3dp accuracy Award for $3 \leq$ multiplier ≤ 6
	= 0.064 to 0.0644	A1		AWFW (0.0642) Do not accept a fraction as answer A **correct** answer can imply 4 marks
	Special Case: (Any given subject total) ÷ 160 seen anywhere in (b)	(M1)	4	Can award if no marks scored in (b) Accept a decimal equivalent
		Total	**11**	

MS/SS1B/W (cont)

Q	Solution	Marks	Total	Comments
2(a)	r = 0.893 to 0.8933	B3		AWFW (0.89319)
	r = 0.89 to 0.896	(B2)		AWFW
	r = 0.8 to 0.95	(B1)		AWFW
	or			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$	(M1)		561 30667 671 42613 & **35882** (all 5 attempted)
	or Attempt at S_{xx} S_{yy} & S_{xy}			2056 1682 & **1661** (all 3 attempted)
	Attempt at **correct** corresponding formula for r	(m1)		
	r = 0.893 to 0.8933	(A1)	3	AWFW
(b)	Fairly strong / strong / very strong positive (linear) correlation / relationship / association / link (but not trend)	B1dep		Or equivalent; must qualify strength and indicate positive Dependant on $0.8 \leq r \leq 0.95$ B0 for some/average/medium/etc
	between			
	length and weight of adult snakes	B1	2	Context; providing $0 < r < 1$
(c)	Figure 1: 5 correct labelled points	B2		Deduct 1 mark if points not labelled
	4 or 3 correct labelled points	(B1)	2	
(d)(i)	D and G	B1	1	Both CAO
(ii)	r = 0.25 to 0.75	B1		AWFW (0.48790) No penalty for calculation Accept a range only if whole of it falls within 0.25 to 0.75
	Fairly weak / weak / some / moderate positive (linear) correlation / relationship / association / link	B1dep	2	Or equivalent; must qualify strength and indicate positive Dependant on $0.25 \leq r \leq 0.75$ B0 for very weak/little/slight/hardly any/fair/average/medium/anything involving strong/etc
	Do not accept comparison with value in (a) or statement in (b)			
		Total	**10**	

MS/SS1B/W (cont)

Q	Solution	Marks	Total	Comments
3(a)	$X \sim \text{N}(253,\ 5^2)$			
(i)	$\text{P}(X < 250) = \text{P}\left(Z < \frac{250-253}{5}\right) =$	M1		Standardising (249.5, 250 or 250.5) with 253 and ($\sqrt{5}$, 5 or 5^2) and/or $(253 - x)$
	$\text{P}(Z < -0.6) = 1 - \text{P}(Z < 0.6)$			
	$= 1 - 0.72575$	m1		Area change; may be implied
	$= 0.274$ to 0.275	A1	3	AWFW (0.27425) (1 – answer) ⇒ M1 max
(ii)	$\text{P}(245 < X < 250) = [\text{C's(a)(i)}] - \text{P}(X < 245)$	M1		Or equivalent; must be clear correct method if answer incorrect and answer > 0
	$=$ (i) $- \text{P}(Z < -1.6) = 0.27425 - 0.0548$			
	$= 0.219$ to $0.22(0)$	A1	2	AWFW (0.21945) M1 A0 for [1 – (i)] – 0.0548 = 0.67095 M0 A0 for 0.9452 – [(i)] = 0.67095 M1 A1 for 0.9452 – [1 – (i)] = 0.21945
(iii)	$\text{P}(X = 245) = 0$ or zero or impossible	B1	1	Ignore any working B0 for 'for impossible to calculate'
(b)	98% (0.98) ⇒ $z = -2.05$ to -2.06	B1		AWFW; ignore sign (–2.0537)
	$z = \frac{245-253}{\sigma}$	M1		Standardising 245 with 253 and σ; allow $(253 - 245)$
	$= -2.0537$	A1		Only allow: ±2.05 to ±2.06 ±2.32 to ±2.33
	$\sigma = 3.88$ to $3.9(0)$	A1		AWFW (3.8954)
	Note: $\frac{245-253}{\sigma} = 2.0537 \Rightarrow \sigma = 3.8954$ ⇒ B1 M1 A1 A0		4	Or equivalent inconsistent signs
		Total	**10**	

MS/SS1B/W (cont)

Q	Solution	Marks	Total	Comments
4(a)	b (gradient) = –0.5485 to – 0.5475	B2		AWFW (–0.54814)
	b (gradient) = –0.55 to – 0.54	(B1)		AWFW
	Omission of –ve sign	(B0)		
	a (intercept) = 49.7 to 49.9	B2		AWFW (49.7982)
	a (intercept) = 49 to 50	(B1)		AWFW
	or			
	Attempt at $\sum x \quad \sum x^2 \quad \sum y \quad \& \quad \sum xy \left(\sum y^2\right)$			305 14975 281 & **6980** (10173) (all 4 attempted)
	or	(M1)		
	Attempt at S_{xx} & S_{xy}			4638.89 & **–2542.78** (both attempted)
	Attempt at **correct** formula for b (gradient)	(m1)		
	b (gradient) = –0.5485 to –0.5475	(A1)		AWFW
	a (intercept) = 49.7 to 49.9	(A1)	4	AWFW
	Accept a & b interchanged only if identified correctly by a **clearly shown equation** (stated answers are not sufficient) in (b) or (c)			If a and b not identified anywhere in question, then: –0.5485 to –0.5475 ⇒ B1 49.7 to 49.9 ⇒ B1
(b)	C's value of intercept from (a) providing > 47 **or** Value 50 stated even if (a) incorrect or not attempted	B1F	1	Accept value rounded to nearest integer (50)
(c)	13 weeks ⇒ 91 days	B1		Stated or used Accept a descriptive answer that includes 91 and a value in range
	y = –1.1 to + 1.1	B1		AWFW (–0.08254)
	or			
	y = 0 ⇒ x = 89 to 93	(B1)		AWFW (90.84942) Accept a descriptive answer that includes a value in range and 13
	⇒ 13 weeks (approximately)	(B1)		Stated
	Note: B1 B1 or (B1) (B1) are available even if (a) not attempted			
	Thus claim appears **justified** **or** Thus tablet likely to have **dissolved**	B1 dep		Or equivalent; ignore reasoning unless contradictory Dependent upon 2nd B1 in (c) or 2nd (B1) in (c)
	or			
	Extrapolation required so cannot comment	(B1)		Not dependent
	Note: If (B1) for extrapolation maximum mark is 2; other mark available is for 91		**3**	

		Total	**8**	

MS/SS1B/W (cont)

Q	Solution	Marks	Total	Comments
5(a) (i)	Median (50) = **3**	B1		CAO
	If not identified, then assume order is median then IQR			Do not award marks if correct answers are based on shown incorrect method; eg accept use of 99/2, etc but not 276/2, etc
	IQR (75 – 25) = 4 – 2 = **2**	B2		CAO; but 25th value ⇒ IQR = 2 ⇒ B0
	Special Cases:			
	Identification that LQ = 2 and UQ = 4	(B1)		Both CAO
	Statement of ≥ 4 cumulative frequencies *F*: 14 49 74 87 96 98 99	(M1)	3	Can award if no marks scored in (i) even if then applied to continuous data
(ii)	Mean = $\frac{\sum fx}{\sum f} = \frac{275}{99}$ = 2.77 to 2.78	B1		AWFW (2.778)
	If not identified, assume order is $\bar{x}$ then s			Treat rounding to integers as ISW
	SD $\left(\sum fx^2 = 933\right)$ = 1.3(0) to 1.32	B2		AWFW (1.307 & 1.314)
	Special Case:			
	Evidence of $\frac{\sum fx}{99}$	(M1)	3	Can award if no marks scored in (ii)
(b)(i)	$\text{Mean}_{163} = \frac{99 \times \text{Mean}_{99}}{163}$ or $\frac{\sum fx \text{ from(a)(ii)}}{163}$	M1		Or equivalent; may be implied by an answer within range
	= 1.68 to 1.69	A1	2	AWFW (1.687)
(ii)	Increase	B1	1	CAO; or equivalent (1.696) Ignore any working (1.702)
(iii)	Data is (positively/negatively) skewed / not symmetric / bimodal / not bell-shaped from frequency distribution / given table			
	or [C's mean in (b)(i)] – 2 × [C's SD in (a)(ii)] < 0	B1		Or equivalent
	or [C's mean in (b)(i)] – 2 × [1.69 to 1.71] < 0			(–1.75 to –0.90)
	Thus claim appears **not valid**	B1 dep	2	Or equivalent Dependent upon previous B1
	Total		**11**	

MS/SS1B/W (cont)

Q	Solution	Marks	Total	Comments
6(a)	Mean = $\frac{470}{10}$ = **47**	B1		CAO
	98% (0.98) $\Rightarrow$ z = 2.32 to 2.33	B1		AWFW (2.3263)
	CI for μ is $\bar{x} \pm z \times \frac{\sigma}{\sqrt{n}}$	M1		Used Must have $\sqrt{n}$ with $n > 1$
	Thus $47 \pm 2.3263 \times \frac{15}{\sqrt{10}}$	A1F		F on $\bar{x}$ and z only
	Hence 47 ± 11.0 to 11.1 **Or** (35.9 to 36.0, 58.0 to 58.1)	A1	5	CAO & AWRT (accept 11) AWRT (accept 36 & 58)
(b)	$Y \sim N(108, 28^2)$			
	Variance of $\bar{Y}_{40}$ = $28^2/40$ = 19.6 $\sqrt{}$SD of $\bar{Y}_{40}$ = $28\sqrt{40}$ = 4.425 to 4.43	B1		CAO Stated or used AWFW
	$P(\bar{Y}_{40} > 120)$ = $P\left(Z > \frac{120-108}{28/\sqrt{40}}\right)$	M1		Standardising 120 with 108 and $\sqrt{19.6}$ or (4.425 to 4.43) or equivalent; allow (108 – 120)
	= $P(Z > 2.71)$ = 1 – $P(Z < 2.71)$	m1		Area change; may be implied
	= 1 – 0.99664 = 0.0033 to 0.0034	A1	4	AWFW (0.00336) (1 – answer) $\Rightarrow$ B1 M1 max
(c)	Part (b) or Teleair times	B1		Or equivalent; ignore reasoning
	Distribution of Y not known	B1		Or equivalent; must be clear reference to Y or population B0 for $n > 30$
	Note: To score B1 B1 there must be **both** a clear indication of where in question **and** a valid reason		2	Any reference to part (a) $\Rightarrow$ B0 B0
		Total	**11**	

MS/SS1B/W (cont)

Q	Solution	Marks	Total	Comments
7(a)	$R \sim$ B(50, 0.15)			
(i)	P($R < 10$) = **0.791**	B1		AWRT (0.7911)
(ii)	P($5 \leq R \leq 10$) = 0.8801 or 0.7911 (p_1)	M1		Accept 3 dp accuracy $(1 - p_2) - p_1 \Rightarrow$ 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 accuracy
	= 0.768	A1		AWRT (0.7680)
	or			
	B(50, 0.15) expressions stated for **at least 3** terms within $4 \leq R \leq 10$ gives probability	(M1)		Can be implied by correct answer
	= 0.768	(A2)	4	AWRT
(b)	**Confusion of** 22, 35, 120 and/or 0.15, 0.06			Do **not** treat as misreads
(i)	$S \sim$ B(22, 0.06)	M1		Used in (b)(i) as evidenced by any correct binominal term for $S > 0$
	P($S = 2$) = $\binom{22}{2}(0.06)^2(0.94)^{20}$	A1		Can be implied by correct answer Ignore any additional terms
	= 0.24 to 0.242	A1	3	AWFW (0.24125)
(ii)	P($S \geq 1$) = 1 – q^{35} where $0.84 \leq q \leq 0.96$	M1 (B1)		Can be implied by correct answer Award for $(0.94)^{35}$ seen in an expression but not if accompanied by a multiplier $\neq 1$
	= 0.885 to 0.89	A1	2	AWFW (0.88532)
(iii)	Mean = np = 120 × 0.94 = 112.8 or 113 If not identified, assume order is μ then σ^2	B1		Either
	Variance = $np(1-p)$ = 120 × 0.94 × 0.06 = 6.76 to 6.78	B1	2	Must clearly state variance value AWFW (6.768)
(iv)	**Means** are (approximately) the **same** stated or **Variances** are (very) **different** stated	B1		Must have scored 1st B1 in (iii) Must have scored 2nd B1 in (iii)
	Agree with P(sorts letter incorrectly) = 0.06	B1 dep		Dependent on 'means same' stated
	Disagree with independent from letter to letter	B1 dep	3	Dependent on 'variances different' stated
		Total	**14**	
		Paper	**75**	

Version 1.0: 0110

General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B/W Statistics 1B

Mark Scheme

2010 examination - January 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.

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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/SS1B

Q	Solution	Marks	Total	Comments
1(a)(i)	$X \sim N(10.2,\ 0.15^2)$			
	$P(X < 10.5) = P\left(Z < \frac{10.5-10.2}{0.15}\right)$	M1		Standardising (10.45, 10.5 or 10.55) with 10.2 and ($\sqrt{0.15}$, 0.15 or 0.15^2) and/or $(10.2 - x)$
	$= P(Z < 2)$	A1		CAO; ignore inequality and sign May be implied by a correct answer
	$= 0.977$	A1	3	AWRT (0.97725)
(ii)	$P(10.0 < X < 10.5)$ $=$ [C's (a)(i)] $-$ $P(X < 10.0)$	M1		Or equivalent; must be clear correct method if answer incorrect and answer > 0
	$=$ (a)(i) $-$ $P(Z < -1.33)$			Method correct using -1.3 gives 0.88 to 0.881 $\Rightarrow$ M1 m1 A0
	$=$ (a)(i) $-$ $(1 - p)$			
	$= 0.97725 - (1 - 0.90824)$	m1		Area change May be implied by a correct answer or answer > 0.5
	$= 0.885$ to 0.887	A1	3	AWFW (0.88604) M1 m1 A1 for $0.90824 - [1 - (a)(i)]$ $= 0.886$ M1 m0 A0 for (a)(i) $- 0.90824$ $= 0.0685$ M0 mo A0 for answer < 0
(b)	$P(X > 10) = p$[from (a)(ii)] $= 0.908$ to 0.909	B1F		Correct value **or** F on value used or implied in (a)(ii) providing > 0.5 Use of -1.3 gives 0.9032
	$P(6 \text{ rolls} > 10) = 0.90824^6$	M1		Accept any probability to power 6
	0.56 to 0.565	A1	3	AWFW
	Note: B0F M1 A0 is possible			
		Total	**9**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)	Ordering values gives: (*a*) 14 15 18 20 25 25 26 27 29 32 34 37 37 (*b*) Median = 26 IQR = 34 – 18 = 16 **Special Case:** Identification that LQ = 18 and UQ = 34	 M1 A1 A2 (A1)	 4	May be implied by correct median or correct IQR Ignore any reference to *a* and *b* CAO CAO Both CAO
(b)(i)	Two values (25 and 37) of mode No unique value Sparse data Many different values	 B1	 	 Or equivalent
(ii)	*a* **and** *b* (two values) unknown Impossible to calculate Cannot be calculated	 B1	 2	 Or equivalent
(c)	Mean = $\frac{\sum x}{n} = \frac{390}{15} = 26$ If not identified, assume order is $\bar{x}$ then *s* SD $\left(\sum x^2 = 11472\right)$ = 9.4 to 9.8 **Special Case:** Evidence of $\frac{\sum x}{15}$	B1 B1 (M1)	 2 	CAO AWFW (9.423 & 9.754) Treat rounding of a correct stated answer to an integer as ISW Can only be awarded if no marks scored elsewhere in (c)
		Total	**8**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3(a)	b (gradient) = 7.05 b (gradient) = 7(.00) to 7.1(0)	B2 (B1)		AWRT (7.05134) AWFW Treat rounding of correct stated answers as ISW
	a (intercept) = 2500 to 2502 a (intercept) = 2490 to 2510	B2 (B1)	4	AWFW (2501.091) AWFW
	or Attempt at $\sum x \ \ \sum x^2 \ \ \sum y \ \ \& \sum xy \ \ \left(\sum y^2\right)$ **or** Attempt at S_{xx} & S_{xy} $\left(S_{yy}\right)$	(M1)		1351 268047 27034 & 5269065 (105653202) (all 4 attempted) 7304 & 51503 (1247894) (both attempted)
	Attempt at **correct** formula for b (gradient)	(m1)		
	b (gradient) = 7.05 a (intercept) = 2500 to 2502	(A1) (A1)		AWRT AWFW
	Accept a & b interchanged only if identified correctly by a **clearly shown equation** (stated answers are not sufficient) in (b)			If a and b are not identified anywhere in solution, then: 7.05 $\Rightarrow$ B1 2500 to 2502 $\Rightarrow$ B1
(b)	$y_{200} = a + b \times 200$	M1		Used May be implied by correct answer
	= 3890 to 3930	A1	2	AWFW (3911.36)
(c)	Large residuals / residual range suggest estimate may be unreliable **or** Largest residuals only small in relation to y-values (10%) so estimate may be reliable (unreliable) **Special Case:** If B0 B0dep then: Involves interpolation Does not involve extrapolation Within observed range	B1 B1dep B1 B1dep (B1)	2	(unreliable) requires (10% or equivalent) Any one; or equivalent
		Total	**8**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
				Ratios (eg 65:1000) are only penalised by 1 mark at first correct answer
4(a)(i)	P(all 3 walk) = 0.65 × 0.40 × 0.25	M1		Can be implied by **correct** answer
	= 65/1000 = 13/200 = 0.065	A1	2	CAO; do not confuse with 0.65
(ii)	P(Rita by bus) = 0.25×(1– 0.15)×(1– 0.20)	M1		Can be implied by **correct** answer
	= 17/100 = 0.17	A1	2	CAO
(iii)	P(2 cycle) = 0.10 × 0.45 × (0.25 + 0.20) = 0.02025 + 0.10 × (0.40 + 0.15) × 0.55 = 0.03025 + (0.65 + 0.25) × 0.45 × 0.55 = 0.22275 (0.27325)	B1		CAO at least 1 of these 3 terms or equivalent but allow a '× 3'
	P(3 cycle) = 0.10 × 0.45× 0.55 = 0.02475	B1		CAO
	P(≥ 2 cycle) = P(2 cycle) + P(3 cycle)	M1		Sum of 4 or 7 terms each a product of 3 probabilities but not '× 3'
	= 0.298	A1	4	CAO
	or P(0 cycle) = 0.90 × 0.55 × 0.45 = 0.22275	(B1)		CAO
	P(1 cycles) = 0.10 × 0.55 × 0.45 = 0.02475 + 0.90 × 0.45 × 0.45 = 0.18225 (0.47925) + 0.90 × 0.55 × 0.55 = 0.27225	(B1)		CAO at least 1 of these 3 terms but allow a '× 3'
	P(≥ 2 cycle) = 1 – [P(0 cycle) + P(1 cycles)]	(M1)		1 – [sum of 4 terms each a product of 3 probabilities but not '× 3']
	1 – 0.702 = 0.298	(A1)		CAO
(b)(i)	P(WW) = (0.65 × 0.90) = 0.585 P(CC) = (0.10 × 0.70) = 0.070	B1		CAO either
	P(WW or CC) = 0.585 + 0.070	M1		Sum of 2 terms each a product of 2 probabilities
	= 0.655	A1	3	CAO; or equivalent
(ii)	P(different) = 1 – (b)(i) = 0.345	B1F	1	F on (b)(i) providing $0 < p < 1$
		Total	**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)	Mean = $\frac{12120}{12}$ = 1010	B1		CAO
	98% (0.98) $\Rightarrow$ z = 2.32 to 2.33	B1		AWFW (2.3263)
	CI for μ is $\bar{x} \pm z \times \frac{\sigma}{\sqrt{n}}$	M1		Used Must have $\sqrt{n}$ with $n > 1$
	Thus $1010 \pm 2.3263 \times \frac{10.5}{\sqrt{12}}$	A1F		F on $\bar{x}$ and z only
	Hence 1010 ± (7(.0) to 7.1) **or** (1003, 1017)	A1dep	5	CAO & AWFW (accept 7) Dependent on A1F AWRT
	Notes: Use of $t_{11}(0.99) = 2.718$ $\Rightarrow$ maximum of B1 B0 M1 A0F A0 Use of a 'corrected' 10.5 $\Rightarrow$ maximum of B1 B1 M1 A0F A0			
(ii)	**Weight** of flour in a bag (may be assumed to be) is **normally distributed**	B1	1	Or equivalent; must refer to **weight**
(iii)	Any number such that 20 ≤ number ≤ 50	B1	1	Must be **a single integer value** Ignore any reasoning
(b)	1 kg or 1000 grams is outside / below CI **or** From CI, (population) mean weight is **greater than** 1kg or 1000 grams	B1F		Or equivalent F on (a)(i) Any reference to 1010 $\Rightarrow$ B0F
	3 or 3/12 or 25% of bags in sample weigh **less than** 1kg or 1000 grams	B1		Or equivalent; but not 'some'
	Statement appears dubious/incorrect/invalid	B1dep	3	Dependent on both B1F and B1
(c)	2/100 or 1/50 or 0.02 or 2%	B1	1	CAO; not 0.02%
		Total	**11**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$R \sim$ B(14, 0.35)	M1		Used somewhere in (a); may be implied
	P($R \leq 7$) = 0.924 to 0.925	A1	2	AWFW (0.92466)
(ii)	P($R \geq 11$) = 1 – P($R \leq 10$)			
	= 1 – (0.9989 or 0.9999)	M1		Requires '1 –'and $\geq$ 4 dp accuracy
	= 0.0011	A1	2	AWRT (0.001106)
(iii)	P($5 < R < 10$) = 0.9940 or 0.9989 (p_1)	M1		Accept 3 dp accuracy $p_2 - p_1 \Rightarrow$ 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 0.6405 or 0.4227 (p_2)	M1		Accept 3 dp accuracy
	= 0.353 to 0.354	A1	3	AWFW (0.35346)
	or			
	B(14, 0.35) expressions stated for **at least 3** terms within $4 \leq R \leq 11$ gives probability	(M1)		Can be implied by correct answer
	= 0.353 to 0.354	(A2)		AWFW (0.35346)
(b)	$R \sim$ B(21, 0.35)	M1		Implied from correct stated formula; do not accept misreads
	P($R = 4$) = $\binom{21}{4}(0.35)^4(0.65)^{17}$	A1		Can be implied by a correct answer Ignore any additional terms
	= 0.059 to 0.0595	A1	3	AWFW (0.059274)
(c)(i)	$S \sim$ B(7, 5/7)			
	Mean = np = 7 × 5/7 = 5	B1		CAO
	If not identified, assume order is μ then σ^2			
	Variance = $np(1 - p)$			Must clearly state variance value if standard deviation (also) stated
	= 7 × 5/7 × 2/7 = 10/7 or 1.42 to 1.43	B1	2	CAO / AWFW
(ii)	**Means** are the **same** **and (both comparisons clearly stated)** **Variances**/standard deviations are **similar** Do not accept statements involving correct/incorrect/exact/etc	B1dep		Must have scored B1 B1 in (i) or B1 B0 plus 10/7 v 1.5 or $\sqrt{10/7}$ v $\sqrt{1.5}$ **stated**
	Barry's claim appears/is **sound/valid/correct/likely**	B1dep	2	Must have scored previous B1dep
		Total	**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7(a)	$r = -0.0355$ to -0.035	B3	3	AWFW (– 0.03546)
	$r = -0.036$ to -0.034	(B2)		AWFW
	$r = -0.04$ to $+0.04$	(B1)		AWFW
	or			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$			636 42702 738 68294 &38605 (all 5 attempted)
	or			
	Attempt at S_{xx} S_{yy} & S_{xy}	(M1)		8994 22907 & –509 (all 3 attempted)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	$r = -0.0355$ to -0.035	(A1)		AWFW
(b)	Almost/virtually/practically **no / zero** (linear) **correlation** / relationship / association / link (**but not 'no trend'**)	B1dep		Dependent on $-0.1 < r < 0.1$ Or equivalent; must qualify strength as 'zero'; B0dep for very weak/weak/etc unless then qualified correctly
	between **purchase and auction prices** of antiques	B1	2	Context; providing $-1 < r < 1$
(c)(i)	Figure 1: **6** correct labelled points	B3	3	Deduct 1 mark if > **1 point** not labelled or labelled incorrectly
	5 or 4 correct labelled points	(B2)		
	3 correct labelled points	(B1)		
(ii)	**(Two) outlier/anomaly/unusual** or identification of **J and L**	B1		Or equivalent
	(Otherwise) a **positive/linear correlation**	B1	2	Or equivalent; ignore any qualification of 'strength'
(d)(i)	$r = \frac{4268.8}{\sqrt{4854.4 \times 4216.1}}$	M1		Used Award B2 for a **correct** answer without/with different method
	$r = 0.943$ to 0.944	A1	2	AWFW (0.94359)
(ii)	**Very strong/strong positive** (linear) **correlation**/relationship/association/link	B1dep	1	Dependent on $0.9 < r < 1$ Or equivalent; must qualify strength and indicate positive; B0dep for high/etc
	Previous calculation of r was not appropriate (due to outliers)	(B1)		
		Total	**13**	
		TOTAL	**75**	

Version 1.0

General Certificate of Education
June 2010

Mathematics MS1B
Statistics SS1B

Statistics 1B

Mark Scheme

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Registered address: AQA, Devas Street, Manchester M15 6EX

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/SS1B

Q	Solution	Marks	Total	Comments
1(a)	r = **0.915**	B3		AWRT (0.91504)
	r = **0.91 to 0.92**	(B2)		AWFW
	r = **0.88 to 0.95**	(B1)		AWFW
	OR			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ and $\sum xy$			12510 15835890 1180 146616 and **1510062** (all 5 attempted)
	or			
	Attempt at S_{xx} S_{yy} and S_{xy}	(M1)		185880 7376 and **33882** (all 3 attempted)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	r = **0.915**	(A1)	3	AWRT
(b)	**Very strong / strong / fairly strong positive** (linear) **correlation** / relationship / association / link (*but not* ' *trend*') between	B1dep		Dependent on **0.88 < *r* < 0.95** Or equivalent; must qualify strength and indicate positive B0dep for (almost) perfect / high / average / medium / some / etc
	weight and **(**engine) **power/bhp** of (hatchback) cars	B1	2	Context; providing **0 < *r* < 1**
	Examples:			
	The more weight/heavier the more/greater power ⇒ B0dep B1			No mention of strength
	Strong correlation and as weight/kg increases so does engine power / bhp ⇒ B0dep B1			Mention of strength but implied suggestion of positive not sufficient
	Total		**5**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2	–18 –11 1 15 7 –1 17 –16 18 –3 0 9			
(a)(i)	Mean, $\bar{d}$ = **1.5**	B1		CAO $\sum d = 18$
	Standard deviation, σ_d or s_d = **11.7 to 12.3**	B1	2	Ignore notation and units (11.737 or 12.259) AWFW $\sum d^2 = 1680$
(ii)	Mean, $\bar{x} = 50 + \bar{d}$ = **51.5**	B1F		F on (a)(i) or correct
	x: 32 39 51 65 57 49 67 4 68 47 50 59			$\sum x = 618$ $\sum x^2 = 33480$ Ignore notation and units
	Standard deviation, σ_x or s_x = **11.7 to 12.3**	B1F	2	F on (a)(i) providing > 0 or correct
(b)	[Values, mean or sd in (a)(i) or (a)(ii)] $\times \frac{1.22}{100}$ or 1.22	M1		Award if use seen or implied by ≥1 Subsequent correct or (correct × 100) answer
	Mean = **0.628 to 0.63**	A1		AWFW (0.6283)
	Standard deviation = **0.14 to 0.151**	A1	3	AWFW (0.1432 or 0.1496)
	Special Cases: **At least one** answer correct with no stated units or incorrect stated units ⇒ M1 A1 A1 max			
	At least one answer × 100 with its units stated as 'cents' ⇒ M1 A1 A1 max			'cents' attached to **≥ 1** answer × 100
	At least one answer × 100 with no units stated or units stated as euros / pence / £ ⇒ M1 only			
	Total		**7**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3	Time, $X \sim N(65, 20^2)$			
(a)				
(i)	$P(X < 90) = P\left(Z < \frac{90-65}{20}\right) -$			
	$\left[P\left(Z < \frac{0-65}{20}\right) = P(Z < -3.25) = 0.00058\right]$	M1		Standardising (89.5, 90 or 90.5 or 59.5, 60 or 60.5) with 65 and ($\sqrt{20}$, 20 or 20^2) and/or $(65 - x)$ **May be gained in (a)(i) or (a)(ii)**
	$= P(Z <$ **1.25**$)$	A1		CAO; ignore inequality and sign May be implied by a correct answer
	= **0.893 to 0.895**	A1		AWFW (0.89435)
(ii)	$P(X > 60) = P(Z > -0.25)$			
	$= P(Z < 0.25)$	M1		Area change May be implied by a correct answer or answer > 0.5
	= **0.598 to 0.599**	A1	5	AWFW (0.59871)
(b)				
(i)	P(1 in 6 = 60) = **0 or zero or impossible**	B1	1	Ignore any working B0 for 'impossible to calculate'
(ii)	$P(X < 60) = 1 -$ [(a)(ii)] **or** (0.401 to 0.402)	M1		May be implied
	P(6 in 6 < 60) = p^6 with $0 < p < 1$	M1		Any probability to power 6; do **not** allow multiplying factors
	$= (0.40129)^6 =$ **0.004 to 0.00425**	A1dep	3	Dependent on M1 M1 (0.0041759)
(iii)	Variance of $\bar{X}_6$ = **20^2/6 = 66.6 to 66.7**			CAO/AWFW
	or	B1		Stated or used **anywhere in (b)**
	Sd of $\bar{X}_6$ = **20/$\sqrt{6}$ = 8.16 to 8.17**			CAO/AWFW
	$P(\bar{X}_6 < 60) = P\left(Z < \frac{60-65}{20/\sqrt{6}}\right) =$	M1		Standardising 60 with 65 and **20/$\sqrt{6}$ or equivalent** allow (65 – 60)
	$P(Z < -0.61) = 1 - P(Z < 0.61)$	m1		Area change May be implied by a correct answer or answer < 0.5
	$= 1 - 0.72907 =$ = **0.27(0) to 0.271**	A1	4	AWFW (0.27093) (1 – answer) ⇒ B1 M1 max
	Note: Watch for answers to (ii) and (iii) interchanged			
	Total		**13**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	$\underline{M \sim B(50,\ 0.15)}$	M1		Used somewhere in (a); may be implied
(i)	$P(M \leq 10) =$ **0.88(0)**	A1	2	AWRT (0.8801)
(ii)	$P(M \geq 5) = 1 - P(M \leq 4)$ = **1 – (0.1121 or 0.2194)**	M1		Requires '1 –'; accept 3 dp accuracy Implied by 0.888 but **not** by 0.781
	= **0.888**	A1	2	AWRT (0.8879)
(iii)	$P(6 < R < 12)$ = **0.9372 or 0.9699** (p_1)	M1		Accept 3 dp accuracy 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 0.3613 or 0.2194 (p_2)	M1		Accept 3 dp accuracy
	= **0.576**	A1		AWRT (0.5759)
	OR			
	B(50, 0.15) expressions stated for **at least 3** terms within $5 \leq R \leq 12$ gives probability = **0.576**	(M1) (A2)	3	Can be implied by correct answer AWFW (0.5759)
(b)	$\underline{F \sim B(35,\ 0.11)}$	M1		Implied from correct stated formula; do not accept misreads
	$P(F = 4) = \binom{35}{4}(0.11)^4(0.89)^{31}$	A1		Can be implied by a correct answer Ignore any additional terms
	= **0.206 to 0.208**	A1	3	AWFW (0.20685)
(c)	$P(M \text{ and } LH) = 0.52 \times 0.15 =$ **0.078**) **or** $N(M) = 2000 \times 0.52 =$ **1040**)	M1		**≥1** of these 2 probabilities or **≥1** of these 2 numbers attempted; may be implied
	$P(F \text{ and } LH) = 0.48 \times 0.1 =$ **0.0528**) **or** $N(F) = 2000 \times 0.48 =$ **960**)	A1		**2** probabilities or **2** numbers evaluated correctly
	$N(M \text{ and } LH) =$ $2000 \times 0.078 = 1040 \times 0.15 =$ **156**) $N(F \text{ and } LH) =$ $2000 \times 0.0528 = 960 \times 0.11 =$ **105.6**)			Evaluation of **≥1** of these 2 numbers
	or $P(LH) = 0.078 + 0.0528 =$ **0.1308**)	A1		**or** Addition of these 2 probabilities
	$N(LH) = 156 + 105.6 = 2000 \times 0.1308$ = **261 to 262**	A1	4	262/2000 $\Rightarrow$ A0 AWFW (261.6)
	Total		**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5				*Ratios (eg 63:100) are only penalised by1 mark at first correct answer F marks can only be awarded if $0 < p < 1$*
(a)	$P(J) = 0.9$ $P(R \mid J) = 0.7$ $P(R \mid J') = 0.2$			
(i)	P(both at trough) = 0.9×0.7 **= 0.63 = 63/100**	M1 A1	 2	Can be implied by **correct** answer CAO
(ii)	P(neither at trough) = $(1 - 0.9) \times (1 - 0.2)$ $= 0.1 \times 0.8$	M1		Can be implied by **correct** answer
	= 0.08 = 8/100 = 4/50 = 2/25	A1	2	CAO
(iii)	P(at least one at trough) = (1 – (ii))			
	= 0.92 = 92/100 = 46/50 = 23/25	B1F	1	F on (ii) or **correct** answer
(b)(i)		B1		**Both** row and column totals ie 0.25 and 0.40; CAO
		B1	2	**Three** table values ie 0.35 and 0.20 and 0.05; CAO
	Notes: Use of Venn or tree diagrams **without** table completion ⇒ B0 B0 Table not completed on page 13 but completed on page 10 ⇒ max of B1 B1			
(ii)	**Accept answers ÷ 1.00**			
(A)	P(neither at gate) = **0.05**	B1F	1	F on table or **correct** answer by 'otherwise'
(B)	P(only Daisy at gate) = **0.35**	B1F	1	F on table or **correct** answer by 'otherwise'
(C)	P(exactly one at gate) = $P(D \cap M') + P(D' \cap M)$	M1		Only **correct two** values from c's table **shown and added** Can be implied by **correct** answer
	0.35 + 0.20 = **0.55**	A1F	2	F on table or **correct** answer by 'otherwise'
	Total		**11**	

	M	***M′***	**Total**
D	0.40	**0.35**	0.75
D′	**0.20**	**0.05**	**0.25**
Total	0.60	**0.40**	1.00

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6				
(a)	*b* (gradient) = **3.25 to 3.26**	B2		AWFW (3.25472)
	b (gradient) = **3.2 to 3.3**	(B1)		AWFW Treat rounding of correct answers as ISW
	a (intercept) = **509 to 510**	B2		AWFW (509.71698)
	a (intercept) = **507 to 513**	(B1)		AWFW
	OR			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ and $\sum xy$ $\left(\sum y^2\right)$			720 44472 8460 and **511740** (6399400) (all 4 attempted)
	or	(M1)		
	Attempt at S_{xx} and S_{xy} $\left(S_{yy}\right)$			1272 and **4140** (435100) (both attempted)
	Attempt at **correct** formula for *b* (gradient)	(m1)		
	b (gradient) = **3.25 to 3.26**	(A1)		AWFW
	a (intercept) = **509 to 510**	(A1)	4	AWFW
	Accept *a* and *b* interchanged only if identified correctly by a **clearly shown or drawn equation**			If *a* and *b* are not identified anywhere in question, then: 3.25 to 3.26 ⇒ B1 509 to 510 ⇒ B1
(b)				
(i)	**Correct line drawn on graph** (40, 630 to 650) (80, 750 to 790)	B2dep		Dep on ≥ B1 B1 or ≥ A1 A0 in (a) From $x \approx 40$ to 80
	If B0 but evidence of use of line for ≥ 2 points within range $0 \le x \le 80$ **or** 'intercept' and means	(M1)	2	Calc^n or points shown on graph Allow point ('0', 500 to 520)
				Graph
(ii)	Outliers / at least E and H identified / wide scatter (of points) / large residuals	B1		Or equivalent words
	Evidence of a (+ ve) relationship or correlation /model is not appropriate	B1	2	Or equivalent words; none of strong/ negative/trend/etc or unreliable/invalid
(c)				
(i)	**Correct two points marked on graph**	B1	1	Labels are **not** required; nor is ⊙ **Graph**
(ii)	*b* (gradient) = **11.6**	B1		AWRT (11.60377)
	a (intercept) = **23 to 24**	B1		AWFW (23.77358)
	Correct line on graph (40, 480 to 500) (80, 930 to 970)	B1dep	3	**Graph** Dependent on B1 B1
(iii)	No outliers / less scatter / small residuals	B1		Or equivalent words
	Strong(er)/more evidence of a **positive** link/ relationship or **more rapid increase** (of reaction time with age) or model is more appropriate	B1	2	Or equivalent words; **must indicate change** from (b)(ii) in context; not some/weak/etc or reliable/valid References to correlation alone ⇒ B0
	Total		**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7(a)(i)	$\bar{t} - 2s = 6.31 - 2\sqrt{19.3}$ = **–2.48 to –2.47**	B1		AWRT (–2.4764)
	Negative value is **impossible** for a measurement of **time**	B1	2	Or equivalent; allow if negative value incorrect or not stated
(ii)	Sample size, n = 80 is large / > 25	B1		Indication that **given** sample is 'large'
	Thus sample **mean** $(\bar{T})$ ~ approximately **normal** due to **CLT**	B1dep	2	Dependent on previous B1 Requires 'mean' and 'normal' and 'CLT'
(b)	98% (0.98) $\Rightarrow z$ = **2.32 to 2.33**	B1 (B1)		AWFW (2.3263) $t_{79}(0.99)$ = 2.37 AWRT
	CI for μ is $\bar{t} \pm z/t \times \frac{s}{\sqrt{n}}$	M1		Used Must have $\sqrt{n}$ with $n > 1$
	Thus $6.31 \pm 2.3263 \times \frac{\sqrt{19.3}}{\sqrt{80}}$	A1F		F on z/t only
	Hence **6.31 ± (1.13 to 1.15)** or **(5.16 to 5.18, 7.44 to 7.46)**	A1		CAO and AWFW AWFW (5.17, 7.45)
	Note: Use of t gives 6.31 ± (1.17) or (5.14, 7.48)	(A1)	4	AWRT
(c)	μ_T < 8 Since **CI / UCL < 8** $\Rightarrow$ **Yes**	B1F		F on (b); must clearly compare 8 with CI/UCL and state a correct follow-through conclusion
	P($T \leq 20$) > 95% P($T > 20$) = **1/80 = 0.01 to 0.013** **or** P($T \leq 20$) = **79/80 = 0.987 to 0.99**	B1		CAO/AWFW; accept eg '1 in 80' B0 for use of normal distribution CAO/AWFW; accept eg '79 in 80'
	P($T > 20$) < **0.05 or 5%** **or** $\Rightarrow$ **Yes** P($T \leq 20$) > **0.95 or 95%**	B1dep	3	Dependent on previous B1 A **correct** comparison must be **clearly** stated together with **clear** conclusion Do **not** accept use of 2% or 98% OE
	Total		**11**	
	TOTAL		**75**	

Version 1.0

General Certificate of Education (A-level)
January 2011

Mathematics MS/SS1B

(Specification 6360)

Statistics 1B

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CSO	correct solution only
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AWRT	anything which rounds to
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MS/SS1B

Q	Solution	Marks	Total	Comments
1(a)(i)	$r = 0.6$ to 0.98	B1		AWFW (≈ 0.8) If answers are not labelled, assume order is (a)(i) then (a)(ii)
(ii)	$r = -0.5$ to -0.02 Accept answers as ranges if and only if contained entirely within given ranges	B1	2	AWFW (≈ -0.3) Eg: (a)(i) 0.7 to $0.9 \Rightarrow$ B1 (a)(ii) -0.6 to $-0.4 \Rightarrow$ B0
(b)(i)	$r = 0.757$ $r = 0.75$ to 0.77 $r = 0.65$ to 0.85 **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 substitution into correct corresponding formula for r $r = 0.757$	B3 (B2) (B1) (M1) (m1) (A1)	3	AWRT (0.75708) AWFW AWFW 271.5 6142.97 1911.9 304650.01 and 43259.17 (all 5 attempted) 0.2825 36.5425 and 2.4325 (all 3 attempted) AWRT
(ii)	Strong/fairly strong/moderate positive (linear) correlation/relationship/ association/link (but not 'trend') between Circumference/size and weight of (cricket) balls	Bdep1 B1	2	Dependent on $0.65 < r < 0.85$ Or equivalent; must qualify strength and indicate positive Bdep0 for very strong/high/average/ medium/some etc. Context; providing $0 < r < 1$
	Total		**7**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)(i)	$P(M \cap C) = \frac{175}{645} = \frac{35}{129} = 0.271$	B1	1	AWRT; accept either correct fraction
(ii)	$P(M) = \frac{519}{645} = \frac{173}{215} = 0.804$ to 0.805	B1	1	AWFW; accept either correct fraction
(iii)	$P(LD) = \frac{63}{645} = \frac{21}{215} = 0.097$ to 0.098	B1	1	AWFW; accept either correct fraction
(iv)	$P(L\|F) = \frac{94}{126} = \frac{47}{63}$	M1		Accept $\frac{94}{645} \div \frac{126}{645}$
	$= 0.746$	A1	2	AWRT
(v)	$P(M\|L') = \frac{519-255}{645-349} = \frac{175+54+35}{193+63+40}$	M1 M1		Allow one arithmetic slip Allow one arithmetic slip
	$= \frac{264}{296} = \frac{132}{148} = \frac{66}{74} = \frac{33}{37}$			Any of these implies M1 M1
	$= 0.891$ to 0.893	A1	3	AWFW
(b)	$P(L \cap L\|F) = \left(\frac{94}{126} \times \frac{93}{125}\right)$ or $\frac{8742}{15750}$	B1		Or $\left(\frac{47}{63} \times \frac{93}{125}\right)$ or $\frac{4371}{7875}$ or $\frac{1457}{2625}$
	$= 0.555$	B1	2	AWRT
(c)	$P(L \cap C \cap (LD + O))$			
	$= \frac{349}{645} \times \frac{193}{644} \times \frac{63+40}{643}$	M1 M1		Correct numerator Correct denominator
	SC The three correct fractions identified but not multiplied $\Rightarrow$ M1 M0 M0 A0			
	$\times$ 6 or 3	M1		Note that a denominator of $\binom{645}{3}$ $\Rightarrow$ M2 (second and third M1 marks)
	$= 0.155$ to 0.157	A1	4	AWFW
	NB: 0.026 with no working $\Rightarrow$ M1 only $0.026 \times 6 = 0.156$ with no working $\Rightarrow$ 4 marks			
	Total		**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$\frac{0.98+1.00}{2}$ or $\frac{0.975+1.005}{2}$ or $0.98+\frac{0.02}{2}$ or $0.975+\frac{0.03}{2}$ $=0.99$	B1		AG (At least) one correct expression seen Ignore contradictions Accept any valid equivalent
(ii)	$\frac{0.97+0.98}{2}=0.975$ and $\frac{1.00+1.01}{2}=1.005$	B1	2	Both CAO Can not be implied from (a)(i)
	SC In (a)(i) and (a)(ii) allow $1.004\dot{9}$ or 1.0049… etc			Similar forms for lower boundary
(b)	Mean, $\bar{x}=1.062$	B1		CAO $\sum fx=106.2$ Ignore notation
	Standard deviation, s or $\sigma=0.043$	B2	3	AWRT $\sum fx^2=112.9662$ If B0 B0, M1 can be awarded for attempt at $\frac{\sum fx}{100}$
(c)(i)	$99\%(0.99)\Rightarrow z=2.57$ to 2.58	B1 (B1)		AWFW (2.5758) $t_{99}(0.995)=2.626$ AWRT
	CI for μ is $\bar{x}\pm(z \text{ or } t)\times\frac{(s \text{ or } \sigma)}{\sqrt{n}}$	M1		Used Must have $\sqrt{n}$ with $n > 1$
	Thus $1.062\pm2.5758\times\frac{0.043}{\sqrt{100 \text{ or } 99}}$	A1F		F on $\bar{x}$, s/σ and z/t
	Hence 1.06 ± 0.01 or (1.05, 1.07)	A1	4	AWRT; award even if previous inaccuracies in $\bar{x}$, s/σ or z/t Dependent on A1F
(ii)	Volumes/ X / (parent) population may be modelled by a normal distribution / is normally distributed (Ignore contradictions)	B1	1	Or equivalent; not distribution, data, values (in table), sample, n large, nor simply 'It is stated in question'
(iii)	Sample data grouped Exact sample values unknown / mid-points used $\bar{x}$ and s calculated from grouped data	B1	1	σ unknown s calculated from a sample $\bar{x}$ (not μ) and s are estimates NOT data values rounded
(d)(i)	CI for μ or CI in (c)(i) > 1 LCL of CI for μ or LCL of CI in (c)(i) > 1	B1		Or equivalent; must compare CI to 1 Dependent on CI in (c)(i) > 1
(ii)	99 or 100 or all sample/ table/ data volumes/ values/ x-values/ cartons are within this range (or none/0 or 1 volumes outside)	B1	2	
	Total		**13**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	$R \sim B(15, 0.45)$			
(i)	$P(R \leq 5) = 0.26(0)$ to 0.261	B1	1	AWFW (0.2608)
(ii)	$P(R > 10) = 1 - P(R \leq 10)$			Requires '1 –' Accept 3dp rounding or truncation
	$= 1 - (0.9745 \text{ or } 0.9231)$	M1		Can be implied by 0.025 to 0.026 but not by 0.0769 to 0.077
	= 0.025 to 0.026	A1	2	AWFW (0.0255)
(iii)	$P(R = 6) = 0.4522 - $ (a)(i)			
	or $= \binom{15}{6}(0.45)^6(0.55)^9$	M1		Can be implied by a correct answer
	= 0.191 to 0.192	A1	2	AWFW (0.1914)
(iv)	$P(5 \leq R \leq 10) = 0.9745 \text{ or } 0.9231 \quad (p_1)$	M1		Accept 3dp 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 0.1204 or 0.2608 (p_2)	M1		Accept 3dp rounding or truncation
	= 0.853 to 0.855	A1	3	AWFW (0.8541)
	Or B (15, 0.45) terms stated for at least 3 values within $4 \leq R \leq 11$ gives probability	(M1)		Can be implied by a correct answer
	= 0.853 to 0.855	(A2)		AWFW (0.8541)
(b)(i)	$P(S) = 0.85$ plus 1 minus	B1		CAO; requires 'plus' or 'minus'
	(0.15×0.80) (0.15×0.20)	B1	2	CAO; not simply 0.12 or 0.03
	= 0.97			AG
	NB: $(0.85 \times 0.20) + 0.80 \Rightarrow$ B0 B0 $(0.85 \times 0.20) + (0.85 \times 0.80)$ $+ (0.15 \times 0.80) \Rightarrow$ B0 B1			
(ii)	$P(S \geq 48) = 0.81$ to 0.82 or 0.5553 or 0.9372	M2		Accept 3dp rounding or truncation M2 for the three correctly expressed terms for B (50, 0.03) or B (50, 0.97) added
	=0.81(0) to 0.811	A1	3	AWFW (0.8108)
	NB: Answer = 0.4447 or 0.1892 or 0.0628 $\Rightarrow$ M1 only			
(iii)	p = 1 – 0.85 = 0.15	B1		CAO; may be implied by correct answer or correct expression for mean
	Mean, $\mu = 80 \times 0.15 = 12$	B1	2	CAO
	SC Mean = 9.6 $\Rightarrow$ B1 only			
	Total		**15**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5(a)	Time taken is dependent upon leaving time	B1	1	Or equivalent
(b)	b (gradient) = 1.28 (or 141/110)	B2		AWRT; (CAO or equivalent) (1.28182)
	b (gradient) = 1.25 to 1.35	(B1)		AWFW Treat rounding of correct answers as ISW
	a (intercept) = 29.95 to 30 (or 659/22)	B2		AWFW; (CAO or equivalent) (29.95455)
	a (intercept) = 29 to 31	(B1)		AWFW
	Thus $y = 30 + 1.28x$	B1F	5	F on a and b
	or			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ and $\sum xy$ $\left(\sum y^2\right)$			275 9625 682 and 20575 (47494) (All four attempted)
	or	(M1)		
	Attempt at S_{xx} and S_{xy} $\left(S_{yy}\right)$			2750 and 3525 (5210) (Both attempted)
	Attempt at correct formula for b gradient	(m1)		
	b (gradient) = 1.28 (or 141/110)	(A1)		AWRT; (CAO or equivalent)
	a (intercept) = 29.95 to 30 (or 659/22)	(A1)		AWFW; (CAO or equivalent)
	Thus $y = 30 + 1.28x$	(B1F)		F on a and b
	Accept a and b interchanged only if identified correctly by a clearly shown equation			If a and b are not identified anywhere in the question, then: 1.25 to 1.35 $\Rightarrow$ B1 29 to 30 $\Rightarrow$ B1
(c)	7.45 am $\Rightarrow x = 15$	B1		CAO; stated, used or implied
	$\Rightarrow y_{15} = 30 + 1.28 \times 15$	M1		Use of $10 < x < 20$
	= 47 to 52	A1		AWFW (49.2)
	Time before 9.00 am = 9.00 – (7.45 + c's y_{15})	M1		May be implied
	= 23 to 28	A1	5	AWFW (25.8)
	SC Answer of 17 CAO (use of c's y_{15} = 58) gains 2 marks			**NB:** An answer of 8.32 to 8.37 gains B1 M1 A1 M0 A0
(d)(i)	$y_{85} = 30 + 1.28 \times 85 = 135$ to 146	B1	1	AWFW (138.9)
(ii)	Extrapolation/ outside/ above range of x-values	B1		Or equivalent
	Implies leaves home at 8.55 so different traffic conditions	B1	2	Or equivalent; 8.55 may be implied by 5 minutes
	Total		**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6(a)	Volume, $V \sim N\left(412, 8^2\right)$			
(i)	$\mathrm{P}(V < 400) = \mathrm{P}\left(Z < \dfrac{400-412}{8}\right)$	M1		Standardising 400 with 412 and 8 and/or $(412 - x)$
	$= \mathrm{P}(Z < -1.5) = 1 - \mathrm{P}(Z < 1.5)$	M1		Area change May be implied by a correct answer or an answer < 0.5
	$= 1 - 0.93319 = 0.066$ to 0.067	A1	3	AWFW (0.06681)
(ii)	$\mathrm{P}(V > 420) = \mathrm{P}(Z > 1)$	B1		CAO but ignore inequality and sign May be implied by a correct answer
	$= 1 - P(Z < 1) = 1 - 0.84134$ $= 0.158$ to 0.159	B1	2	AWFW (0.15866)
(iii)	$\mathrm{P}(V = 410) = 0$ or zero or impossible	B1	1	Ignore any working B0 for 'impossible to calculate' or 'no answer'
(b)(i)	A statement/indication that (–) 1.6449 and/or 2.3263 are *z*-values Do **not** allow $\Phi(0.99) = 2.3263$, etc but **allow** $\Phi^{-1}(0.99) = 2.3263$ Do **not** award for *z*-value(s) simply embedded in standardisation statement(s)	B1		Simple statement that $z = \pm 1.6449$ and/or $z = \pm 2.3263$ **or** sketch of normal curve with at least one *z*-value marked
	A clear use of $z = \dfrac{v-\mu}{\sigma}$ or $v = \mu + 2\sigma$ with 400 and/or 420 (condone sign errors)	M1		**SC** Immediate algebraic use of $v - \mu = z\sigma \Rightarrow$ B1 M1 A0
	The two given equations correctly derived	A1	3	AG; watch for sign inconsistencies
(ii)	Thus $20 = (2.3263 + 1.6449)\sigma$	M1		A sensible (one that would lead to values required if completed correctly) attempt at solving the two given equations by eliminating μ or σ Do **NOT** allow MC or MR
	$\sigma = 5.04$	A1		AWRT (5.03626)
	$\mu = 408$	A1	3	AWRT (408.284)
	Total		**12**	
	TOTAL		**75**	

Version 1.0

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** Lower quartile = **250**	B1		CAO; either 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, $\bar{x}$ = **251 to 251.4** *Award B1 if divisor **seen** not to be 85 but answer in range*	B2		AWFW $\sum fx$ = 21352 $\bar{x}$ = 251.2
	Note: If B0 then can award M1 for attempt at $\sum fx \div 85$ **seen**			*Ignore notation and condone incorrect midpoints (eg upper or lower limits used)*
	Standard deviation, s or σ = **4.21 to 4.28** *Award B1 if divisor **seen** not to be 84 or 85 but answer in range*	B2	4	AWFW $\sum fx^2$ = 5365134 σ = 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 ⇒ Bdep0
	OR			*More than one named ⇒ B0 Bdep0* *Range ⇒ B0 Bdep0*
	Standard deviation (s or σ)	(B1)		Named
	Uses all data values	(Bdep1)		Or equivalent Dependent on previous (B1) Only negative comments on other measures ⇒ Bdep0
	Total		**11**	

MS/SS1B (cont)

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

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3				
(a)	*b* (gradient) = **191**	B2		CAO
	b (gradient) = **190 to 192**	(B1)		AWFW
				Treat rounding of correct answers as ISW
	a (intercept) = **115**	B2	4	CAO
	a (intercept) = **93 to 137**	(B1)		AWFW
	OR			
	Attempt at $\sum x \quad \sum x^2 \quad \sum y$ & $\sum xy \quad \left(\sum y^2\right)$			154 3452 30219 & **677042** (133170091) (all 4 attempted)
	or	(M1)		
	Attempt at S_{xx} & $S_{xy} \quad \left(S_{yy}\right)$			12224 & **64** (2714668) (both attempted)
	Attempt at **correct** formula for *b* (gradient)	(m1)		
	b (gradient) = **191**	(A1)		CAO
	a (intercept) = **115**	(A1)		CAO
	Accept *a* & *b* interchanged only if identified and used correctly in (ii)			If *a* and *b* are not identified anywhere in question, then: 190 to 192 ⇒ B1 93 to 137 ⇒ B1
(ii)	$y_{24} = 115 + 191 \times 24$			
	= **£4699 or £4700**	B2	2	Either; ignore units (£4699)
	= **£4650 to £4750**	(B1)		AWFW
	SC: (4290 + 5057)/2 = 4673 to 4674 ⇒ B1			
	If B0 but **clear evidence** of correct use of c's equation with $x = 24$	(M1)		
(iii)	(Maximum) **temperature** (in February) is likely to be/will be lower/different	B1	1	Or equivalent; must be **clear indication** that (max) **temperature** is less than/different
	Must imply a temperature comparison with July			Extrapolation/not July/not summer/winter/etc ⇒ B0
(iv)	Rainfall amount/wind strength/sunshine hours/ daylight hours/opening times/day of week/ visitor numbers/public holidays/school holidays/ local attractions/etc	B1	1	Or equivalent Accept any sensible reason; do **not** penalise for dubious 'variable name' so, for example, accept 'rainfall' Minimum/average temp/etc ⇒ B0 Quality or price of food/ staff/etc ⇒ B0
	Allow if at least 1 variable correctly identified			
	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 **Notes:** Both lines on F1 ⇒ B1 B1 B0 max Both lines on F2 ⇒ B1 B0 B1 max >1 undeleted line on either F1 or F2 ⇒ 2 max	B1	3	(2, 4.2) (4, 3.4) (6, 2.6) (8, 1.8)
	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 **251.1 ± 0.6** **or** **(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**	BF1		F on CI (250 < LCL or CI)
	so Claim is supported/reasonable/correct/true/etc Must be consistent with c's comparison	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	M1		Allow any multiple of 1.94 Must **clearly indicate** the value of a numerical expression giving a result less than 250
	so 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)				
		B1		**0.35 and 0.7**; CAO
		B1		**0.55**; CAO
		B1	3	**0.1 and 0.2**; CAO
	Notes: Use of Venn or tree diagrams **without** table completion ⇒ B0 B0 B0 Printed table not completed but constructed and completed on Page 12/13 ⇒ B1 B1 B1 max			Accept fractional answers Do not accept percentages
(ii)	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**	M1 A1	2	Only c's equivalent to 0.10 **shown and added to** 0.15 Can be implied by **correct** answer CAO
(iii) (A)	$P(W \cup J) =$ **0.8** **&/≠** $P(W) + P(J) =$ **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**	B1		Any one of these three **seen** *Ignore contradictions, explanations & justifications* *Do **not** accept use of W' and/or J'*
(B)	$P(W \mid J) = 0.55/0.70 =$ **0.79** **&/≠** $P(W) =$ **0.65** **or** $P(J \mid W) = 0.55/0.65 =$ **0.85** **&/≠** $P(J) =$ **0.70** **or** $P(W) \times P(J) =$ **0.45 to 0.46** **&/≠** $P(W \cap J) =$ **0.55**	B1 Bdep1	3	AWRT Any one of these three **seen** *Ignore contradictions, explanations & justifications* AWFW
(b)	**Do not allow multiplying factors in (b)**			
(i)	P(0) = 0.15 × 0.40 × 0.45 = **0.027 or 27/1000**	B1 B1	2	Can be implied by **correct** answer or 1 – (0.2265 + 0.466 + 0.2805) CAO
(ii)	P(2) = **0.85 × 0.60 × 0.45** = 0.2295 + **0.85 × 0.40 × 0.55** = 0.1870 + **0.15 × 0.60 × 0.55** = 0.0495 **or** = 1 – (**0.027** + **0.2265** + **0.2805**) = **0.466 or 466/1000 or 233/500**	M2 (M1) A1	3	*For either method:* **At least two bold** expressions correct **Only one bold** expression correct Can be implied by **correct** answer *For second method:* Must have '1 –' for any marks CAO; **do not** imply this from (i)
	Total		**13**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6				
(a)	$\underline{X \sim B(10,\ 0.15)}$			
(i)	$P(X \leq 2) =$ **0.82(0)**	B1	1	AWRT (0.8202)
(ii)	$P(X \geq 2) = 1 - P(X \leq 1)$			Requires '1 –'
	= **1 – (0.5443 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)
	= **0.455 to 0.456**	A1	2	AWFW (0.4557)
(iii)	$P(1 < X < 5) =$ **0.9901 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
	= **0.445 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	(M1)		Can be implied by a correct answer
	= **0.445 to 0.446**	(A2)		AWFW (0.4458)
(b)	$\underline{Y \sim B(50,\ 0.15)}$			Normal approximation $\Rightarrow$ 0 marks
(i)	$P(Y > 5) = 1 - P(Y \leq 5)$			Requires '1 –'
	= **1 – (0.2194 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
	= **0.78(0) to 0.781**	A1	2	AWFW (0.7806)
(ii)	$P(5 \leq Y \leq 10) =$ **0.8801 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
	= **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	(M1)		Can be implied by a correct answer
	= **0.768**	(A2)		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 (0.54186) AWFW AWFW
	OR			
	Attempt at $\sum v$ $\sum v^2$ $\sum w$ $\sum w^2$ & $\sum vw$ **or** Attempt at S_{vv} S_{ww} & S_{vw}	(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)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	r = **0.541 to 0.543**	(A1)		AWFW
(ii)	(Quite or fairly) **weak/some/moderate** **positive** (linear) **correlation**/relationship/ association/link (*but not ' trend'*)	Bdep1		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
	between **volumes** and **weights** of suitcases	B1	2	Context; providing **$0 < r < 1$**
	Total		**9**	
	TOTAL		**75**	

Version 1.0

General Certificate of Education (A-level)
January 2012

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 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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

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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)**	Median = 10	B1		CAO
	Upper quartile = 11 Lower quartile = 9	B1		CAO; either May be implied by IQR = 2
	Interquartile range = 2	B1	3	CAO; do not award if seen to be not based on 11 and 9
(b)	Do not group results **Illustrations for B1:** Use all values Replace ≤ 6 by or use (0), 1, ..., 6 Replace ≥ 12 by or use 12, 13, ... Record exact values/frequencies	B1	1	OE statement that implies non grouping **or** recording of all separate observed values **Illustrations for B0:** Record max and/or min values Construct frequency table Use 1, 2 or 12, 13
		Total	**4**	

Q	Solution	Marks	Total	Comments
2 **(a)**	Probably correct	B1		CAO; accept minimum of PC or Pc or pC or pc
(b)	Definitely incorrect	B1		CAO; accept minimum of DI or Di or dI or di
(c)	Probably incorrect	B1	3	CAO; accept minimum of PI or Pi or pI or pi
	Notes: Ignore reasoning in all parts, unless it includes 2 of the 4 statements in which case $\Rightarrow$ B0 If answers not labelled, then assume above order			Definitely wrong, etc $\Rightarrow$ B0 Likely correct, etc $\Rightarrow$ B0
		Total	**3**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3(a) (i)	Volume, $X \sim N(32, 10^2)$			
	$P(X < 40) = P\left(Z < \frac{40-32}{10}\right)$	M1		Standardising 40 with 32 and 10; allow $(32 - 40)$
	$= P(Z < 0.8)$	A1		CAO; ignore inequality and sign May be implied by a correct answer
	$= 0.788$	A1	3	AWRT (0.78814)
(ii)	$P(X > 25) = P(Z > -0.7)$			
	$= P(Z < +0.7)$	M1		Area change May be implied by a correct answer or an answer > 0.5
	$= 0.758$	A1	2	AWRT (0.75804)
(iii)	$P(25 < X < 40) =$ (i) – (1 – (ii))	M1		OE; allow new start ignoring (i) & (ii) Allow even if incorrect standardising providing 0 < answer < 1 May be implied by a **correct** answer
	$= 0.78814 - (1 - 0.75804) = 0.546$ **Note:** If (ii) is 0.242, then $(0.788 - 0\ 242) = 0.546 \Rightarrow$ M0 A0	A1	2	AWRT (0.54618)
(b)	$P(B > £65) =$ $P\left(Z > \frac{48.5-32}{10}\right)$ or $P\left(Z > \frac{65-42.88}{13.4}\right)$	M1		Attempt to change from B to X using (48 to 49), 32 and 10 or Attempt to work with distribution of B using 65, (42.8 to 42.9) and 13.4
	$= P(Z > 1.65) = 1 - P(Z < 1.65)$	m1		Area change May be implied by a correct answer or an answer < 0.5
	$= 1 - 0.95053 = 0.049$ to $0.05(0)$	A1	3	AWFW (0.04947)
(c)	Other **fuels** Other **vehicles** with an example (not other cars) Other types of **customer** Minimum purchase (policy) Purchases in integer/fixed £s Customers filling fuel cans	B2,1	2	Size of car/engine/fuel tank $\Rightarrow$ B0 Price of fuel $\Rightarrow$ B0 Customer paying capacity $\Rightarrow$ B0 Must be **two clearly different** valid reasons for award of B2 Drivers and vehicles related $\Rightarrow$ B1 eg lorry drivers & lorries
		Total	**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	$\underline{U \sim B(40,\ 0.15)}$	M1		Used somewhere in (a)
(i)	$P(U = 6) = 0.6067 - 0.4325$ or $= \binom{40}{6}(0.15)^6(0.85)^{34}$	M1		Accept 3 dp rounding or truncation Can be implied by a correct answer
	$= 0.174$	A1	3	AWRT (0.1742)
(ii)	$P(U \leq 5)$ = 0.432 to 0.433	B1	1	AWFW (0.4325)
(iii)	**See supplementary sheet for individual probabilities**			
	$P(5 < U < 10) = 0.9328$ or 0.9701 (p_1)	M1		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
	MINUS 0.4325 or 0.2633 (p_2)	M1		Accept 3 dp rounding or truncation
	= 0.5(00) to 0.501	A1	3	AWFW (0.5003)
(b)	Mean or $\mu = 32 \times 0.15$ = 4.8	B1		CAO
	(V or σ^2 =) $\underline{32 \times 0.15 \times 0.85}$ or (SD or σ =) $\underline{\sqrt{32 \times 0.15 \times 0.85}}$	M1		Either numerical expression; ignore terminology May be implied by 4.08 CAO seen or 2.02 AWRT seen
	(SD or σ) = 2.02	A1	3	AWRT (2.0199) Do not award if labelled V or σ^2
(c)	Mean = 7.7	B1		CAO $\left(\sum x = 77\right)$
	SD = 1.26 to 1.34	B1		AWFW $\left(\sum x^2 = 609\right)$
	(Sample) mean is bigger / greater / different or 7.7/32 = 0.24 > 0.15 and (Sample) SD is smaller / less / different	Bdep1		Both; dependent on all previous 5 marks of B1 M1 A1 B1 B1 Can be scored for incorrect (b) re-done correctly in (c) Means & SDs different $\Rightarrow$ Bdep0
	So model appears unsuitable	Bdep1	4	OE; dependent on Bdep1
		Total	**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5	**See supplementary sheet for alternative solutions and additional guidelines to parts (b), (d) and (e)**			
(a)	Calorific value depends upon moisture content Moisture (content) is set/are fixed values	B1	1	Must be in context; **not** "it", etc Use of x and y $\Rightarrow$ B0
(b)	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 to 5.36) –0.076x	B2 (B1) B2 (B1) BF1	5	AWRT; including –ve sign (–0.07582) AWFW; including –ve sign *Treat rounding of correct answers as ISW* AWFW (5.35385) AWFW F on a and b even if rounded
(c)	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
(d)	y_{27} = 3.28 to 3.32 = 2.5 to 3.5	B2 (B1)	2	AWFW (3.30659) AWFW; even if by interpolation from original data giving likely values of 3 or 3.04
(e)	r(35, 2.5) = –0.21 to –0.19 = 0.1 to 0.3	B2 (B1)	2	AWFW; including –ve sign (–0.20000) AWFW; ignore sign
(f)	Good/reasonable/accurate/correct/etc Accept more positive qualifying adjectives	B1	1	OE; ignore reasoning Very good (B1) Not good (B0)
(g)(i)	Extrapolation/outside (observed) range (of x)	B1	1	OE
(ii)	y_{80} = –0.5 to –1 Negative value for calorific value is impossible or More energy needed than is generated	B1 Bdep1	2	AWFW (–0.71209) OE; dependent on B1 Must be in context; negative value impossible $\Rightarrow$ Bdep0
		Total	**17**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6	**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) ***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	0.15 or 0.4; CAO; allow fractions 0.05 and 0.3; CAO; allow fractions 0.1; AG so dependent on B1 B1
(ii)	P(≥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 × 0.30 = 0.165 or 165/1000 or 33/200	B1 B1	2	OE; implied by correct answer CAO
(ii)	0.55 × (1 – 0.3) or 0.385 (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 or $\frac{8125}{10000}$ or $\frac{1625}{2000}$ or $\frac{325}{400}$ or $\frac{65}{80}$ or $\frac{13}{16}$	M1 M1 B1 A1	4	At least one of these expressions or values OE; implied by correct answer AWFW (0.8125) CAO
		Total	**11**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7(a)				
(i)	$\bar{x} = \frac{2290}{50}$ = 45.8 or 45800	B1		CAO
	$\left(s^2 =\right)\frac{28225.5}{49 \text{ or } 50}$ **or** $\left(s =\right)\sqrt{\frac{28225.5}{49 \text{ or } 50}}$	M1		Ignore notation
	s = 24(.0) or 24000 to 24001	A1	3	AWRT/AWFW (24.00064) (σ = 23.75942)
	SCs: (for no seen working) M1 A1 for 24.0 or 24000 to 24001 M1 A0 for 24 or 23700 to 23800			
(ii)	**See supplementary sheet for alternative solutions**			
	$\bar{x} - ns = \left(45.8 - n \times 24.0\right) < 0$ SC**:** Accept quoted values of (–4 to –1) (n = 2) or (–28.5 to –23.5) (n = 3) (both AWFW) and	M1		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
	negative salaries are impossible	A1	2	OE; must be in context Negative values impossible ⇒ 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 ⇒ Bdep0
(ii)	99% (0.99) ⇒ 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 ($\bar{x}$ & s) from (a)(i) 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 ($\bar{x}$ & s) with $\div\sqrt{50 \text{ or } 49}$ & z(1.64 to 1.65 or 2.32 to 2.33 or 2.57 to 2.58)
	Hence 45.8 ± (8.7 to 8.8) or 45800 ± (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%) </≠ 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	**14**	

MS/SS1B (cont)

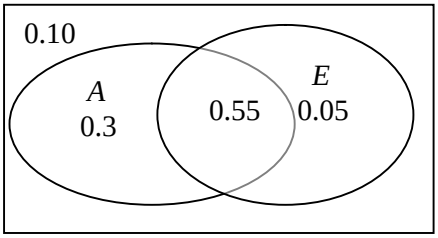
Q	Solution	Marks	Total	Comments
4	**Alternative solution**			
(a)(iii)	B(40, 0.15) expressions stated for at least 3 terms within $5 \leq U \leq 10$ gives probability = 0.5(00) to 0.501	M2 A1		Can be implied by a correct answer AWFW (0.5003)

u	(5)	6	7	8	9	(10)
P($U = u$)	(0.1692)	0.1742	0.1492	0.1087	0.0682	(0.0373)

			3	

Q	Solution	Marks	Total	Comments
5	**Alternative solutions and additional guidelines**			
(b)	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ $\left(\sum y^2\right)$ or Attempt at S_{xx} & S_{xy} $\left(S_{yy}\right)$	M1		455 20475 35.1 & 883.5 (121.33) (all 4 attempted) 4550 & –345 (26.56) (both attempted)
	Attempt at correct formula for b (gradient) b (gradient) = –0.076 a (intercept) = 5.35 to 5.36 Thus y = (5.35 to 5.36) –0.076x	m1 A1 A1 BF1		 AWRT AWFW F on a and b even if rounded
	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)		5	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
(d)	y_{27} = (5.35 to 5.36) –0.076 × 27 = 3.28 to 3.32	M1 A1	2	Clear evidence of correct use of c's equation with $x = 27$ AWFW (3.30659)
(e)	$r(35, 2.5) = 2.5 - y_{35}$ = 2.5 – {(5.35 to 5.36) –0.076 × 35} = –0.21 to –0.19	M1 A1	2	Used; allow $y_{35} - 2.5$ AWFW (–0.20000)

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6	**Alternative solutions**			
(a)(i)	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(≥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(≥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 × (1 – 0.4) or 0.06 (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 $0 < p < 0.45$ (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/SS1B (cont)

Q	Solution	Marks	Total	Comments
7 (a)(ii)	**Alternative solutions**			
	$P(X < 0 \mid N(45.8, 24.0^2) = P(Z < -1.91)$	M1		Standardising 0 using 45.8 & 24.0
	$= 0.027$ to 0.03	A1	2	In addition to probability within range, must state that negative salaries are impossible
	$P(X > 60 \mid N(45.8, 24.0^2)) = P(Z > 0.59)$	M1		Standardising 60 using 45.8 & 24.0
	$= 0.27$ to 0.28	A1	2	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
	$P(X > 60 \mid N(45.8, 24.0^2)) = P(Z > 0.59)$ $= (0.27$ to $0.28) > 6/50 = 0.12$	B0		Assumes salaries ~ N; cf (a)(ii)

Version 1.0

General Certificate of Education (A-level)
June 2012

Mathematics MS/SS1B

(Specification 6360)

Statistics 1B

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

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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**.

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Otherwise we require evidence of a correct method for any marks to be awarded.

MS/SS1B

Q	Solution	Marks	Total	Comments
1				
(a)	$r = \dfrac{S_{xy}}{\sqrt{S_{xx} \times S_{yy}}} = \dfrac{-0.410}{\sqrt{2.030 \times 1.498}} =$ **<u>–0.235</u>**	M1		Correct substitution into **correct** formula May be implied by a **correct** answer
		A1	2	AWRT (–0.235115)
(b)				Dependent on **–0.235 or –0.24**
	Some / (very) weak / (very) little / (very)slight negative correlation/relationship/association/link	Adep1		OE; must qualify strength **and** state negative Ignore extra words unless contradict Not 'no', 'low', 'small', 'unlikely' or 'trend'
	between **width and thickness** of lengths of steel	B1	2	Context; do **not** allow 'cms' or 'mms'
SC	r = (+)0.235 ⇒ M1 A0 Adep0 B1 max			
	Total		**4**	

Q	Solution	Marks	Total	Comments
2				
(a)(i)	Mode = **<u>23</u>**	B1	1	CAO
(ii)	Median (88^{th} value) = **<u>22</u>**	B1		CAO
	Upper quartile (132^{nd} value) = **<u>23</u>**	B1		CAO; either May be implied by IQR = 3
	Lower quartile (44^{th} value) = **<u>20</u>**			
	Interquartile range = **<u>3</u>**	B1	3	CAO; do **not** award if **seen** to be not based on 23 and 20
(b)	Mean = **<u>22.3</u>**	B2		CAO; but only award B1 (22.3) if incorrect mid-points or Σfx **seen**
	Mean = **<u>21 to 23</u>**	(B1)		AWFW (Σfx = 3902.5)
	Standard deviation = **<u>6.37 or 6.39</u>**	B2		AWRT (s = 6.391 σ = 6.372)
	Standard deviation = **<u>5 to 7</u>**	(B1)	4	AWFW (Σfx^2 = 94132.25)
SC	Only if B0 B0 or B1 B0 then award as follows but only up to a **maximum total part mark of 2** **1** At least 2 correct mid-points 4.5, 14.5, 27, 32, 37, 44.5, 54 seen ⇒ M1 **2** Clear use of Σfx/(175 or 174) ⇒ M1			
(c)	Mean = (c's mean from (b)) + $\dfrac{280}{175}$ = 22.3 + 1.6	M1		Adding (1.6 or equivalent) CAO to (c's mean from (b)) **or** to (c's new mean)
	Mean = **<u>23.9</u>**	AF1	2	F on (c's mean from (b)) **or** on (c's new mean)
	Total		**10**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3				
(a)	b (gradient) = **2.27**	B2		AWRT (2.27075)
	b (gradient) = **2.2 to 2.3**	(B1)		AWFW *Treat rounding of correct answers as ISW*
	a (intercept) = **4.16 to 4.2**	B2		AWFW (4.16981)
	a (intercept) = **3 to 7**	(B1)		AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ $\left(\sum y^2\right)$			480 24500 1140 & **57635** (135908) (all 4 attempted)
	or	(M1)		
	Attempt at S_{xx} & S_{xy} $\left(S_{yy}\right)$			5300 & **12035** (27608) (both attempted)
	Attempt at **correct** formula for b (gradient)	(m1)		
	b (gradient) = **2.27**	(A1)		AWRT
	a (intercept) = **4.16 to 4.2**	(A1)	4	AWFW
Notes	**1** Values of a and b interchanged and equation $y = ax + b$ stated in (a) ⇒ max of 4 marks **2** Values of a and b interchanged and equation $y = a + bx$ stated in (a) ⇒ 0 marks **3** Values are **not** identified or simply a = # and b = #, then 2.2 to 2.3 ⇒ B1 and 3 to 7 ⇒ B1 but accept, for example, as identification, [a = #, b = # with $y = a + bx$ but no substitution for a & b] **or** [intercept(a) = #, gradient(b) = #] **4** b = **2407/1060** CAO ⇒ B2, otherwise B1 if fraction equates to 2.2 to 2.3 (Notes 1, 2 & 3 also apply) a = **221/53** CAO ⇒ B2, otherwise B1 if fraction equates to 3 to 7 (Notes 1, 2 & 3 also apply) **5** Some/all of marks can be scored in (b), and in c(ii) & (iii), even if some/all of marks are lost in (a) but marks lost in (a) **cannot** be recouped by subsequent working in (b)			
(b)	Correct **straight** line drawn on scatter diagram	B2		Line must go from $x \leq 20$ to $x \geq 70$ and fall between the following 2 lines: Lower: (10, 25) (80, 180) Upper: (10, 30) (80, 190)
	Correct shortened and/or freehand line drawn on scatter diagram	(B1)	2	
Notes	**1** If B0 but **seen** correct attempt at ≥2 points even if incorrectly evaluated ⇒ M1 **2** If B0 but **no seen** evidence to support ≥2 points (correct or incorrect) marked on scatter diagram ⇒ M0			
(c)(i)	Correct **straight** line drawn on scatter diagram	B2		Line must go from $x \leq 20$ to $x \geq 70$ and fall between the following 2 lines: Lower: (10, 60) (80, 75) Upper: (10, 65) (80, 85)
	Correct shortened and/or freehand line drawn on scatter diagram	(B1)	2	
Notes	**1** If B0 but **seen** correct attempt at ≥2 points even if incorrectly evaluated ⇒ M1 **2** If B0 but **no seen** evidence to support ≥2 points (correct or incorrect) marked on scatter diagram ⇒ M0			
(ii)	**27 to 29**	B1	1	AWFW (calculation ⇒ 27.75) Must clearly identify x-value Thus (27 to 29, y-value) ⇒ B0
(iii)	At low temperatures more B (than A) dissolves At high temperatures more A (than B) dissolves	B1		Either; OE (eg a comparison using lines and/or data at a specific temperature but **not** at 0°C)
	Amount increases more rapidly for A (than B) Amount increases more slowly for B (than A)	B1	2	Either; OE Any comments about b or a ⇒ B0 Comment about 'rate' must relate to temp
	Total		**11**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4				**Ratios (eg 194:640) are only penalised by 1 accuracy mark at first correct answer**
(a)(i)	P(B = 3) = **<u>194/640 or 97/320 or 0.303 or 30.3%</u>**	B1	1	CAO or AWRT (0.303125)
(ii)	P(T ≥ 2) = $\frac{172+256+135}{640}$ **or** $1-\frac{77}{640}$ **or** $\frac{563}{640}$	M1		
	= **<u>563/640</u>**	A1	2	CAO
	<u>or (0.879 to 0.88) or (87.9% to 88%)</u>			AWFW (0.879688)
(iii)	P(B = 3 & T ≥ 2) = $\frac{72+99+16}{640}$ **or** $\frac{194-7}{640}$ **or** $\frac{187}{640}$	M1		
	= **<u>187/640 or 0.292 or 29.2%</u>**	A1	2	CAO or AWRT (0.292188)
(iv)	P(B ≤ 3 | T = 2) = $\frac{(14+67+72)}{172}$ **or** $\frac{172-19}{172}$ **or** $\frac{153}{172}$	M1 M1		Correct numerator (accept both ÷ 640) Correct denominator
	= **<u>153/172</u>**	A1	3	CAO
	<u>or (0.888 to 0.89) or (88.8% to 89%)</u>			AWFW (0.889535)
				Answers as fractions, percentages or ratios lose accuracy (A & B) marks in (b) & (c)
(b)	(a)(i) × (a)(ii) ≠ (a)(iii) since	M1		Attempted
	0.303 × 0.88 = **<u>0.265 to 0.27 ≠ 0.292</u>**	A1	2	AWFW & AWRT
SC	Any **correct fully-explained** reasoning, using other than answers from part (a), which results in an inequality (≠) **with both sides as numerically correct decimals** (to 3 dp) ⇒ B1 (eg P(B = 3) = 0.303 ≠ P(B = 3| T = 2) = 72/172 = 0.419) but no/unclear/incomplete reasoning or no/incorrect/incomplete numerical work ⇒ B0			
(c)	P(2T ∩ 3T ∩ ≥4T | B = 3) = $\frac{72}{194}\times\frac{99}{193}\times\frac{16}{192}$	M1 M1		Correct 3 values multiplied in numerator Correct 3 values multiplied in denominator 0.371 × 0.513 × 0.083 (all AWRT) ⇒ M1 M1 (OE products)
	abc multiplied by 6 or 3	M1		0 < (*a*, *b* & *c*) < 1
	= **<u>0.095 to 0.0952</u>**	A1	4	AWFW (0.095187)
Notes	**1** Incorrect answer with no working ⇒ 0 marks **2** The **3 correct fractions/decimals** identified but not multiplied (eg added) ⇒ M1 M0 M0 A0 **3** The **3 correct fractions/decimals** identified together with 0.016 (AWRT) ⇒ M1 M1 M0 A0 **4** A denominator of $^{194}C_3$ = 1198144 ⇒ M2 (2nd & 3rd M1 marks)			
	Total		**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5				**In (a)(i) & (c), ignore the inclusion of a lower limit of 0; it has no effect on either answer**
(a)	Weight, $W \sim N(2.75, 0.15^2)$			
(i)	$P(W < 2.8) = P\left(Z < \frac{2.8 - 2.75}{0.15}\right)$	M1		Standardising 2.8 with 2.75 and 0.15; allow $(2.75 - 2.8)$
	$= P(Z <$ **0.33 or 1/3**$)$	A1		AWRT/CAO; ignore inequality and sign May be implied by a **correct** answer
	= **0.629 to 0.633**	A1		AWFW (0.63056)
(ii)	$P(W > 2.5) = P(Z > -1.67) = P(Z < +1.67)$	M1		**Correct** area change May be implied by a **correct** answer **or** an answer > **0.5**
	= **0.951 to 0.953**	A1	5	AWFW (0.95221)
(b)	Weight, $X \sim N(5.25, 0.20^2)$			
(i)	$P(5.1 < X < 5.3) = P(Z < 0.25) - P(Z < -0.75)$ = **0.59871**	B1		Must have diff of 2 probs for each B1 Accept 0.599
	MINUS [(1 – 0.77337) or 0.22663]	B1	2	Accept 0.773 or 0.227
	= **0.372(08)**			AG; do **not** mark simply on answer
(ii)	$P(0 \text{ in } 4) = [1 - 0.372]^4$	M1		Accept $[1 -$ c's (b)(i)$]^4$
	$= 0.628^4 =$ **0.155 to 0.156**	A1	2	AWFW (0.15554)
(c)	Weight, $Y \sim N(10.75, 0.50^2)$			
	Variance of $\bar{Y}_6$ = **$0.5^2/6$ = 0.0416 to 0.0417** **or** Sd of $\bar{Y}_6$ = **$0.5/\sqrt{6}$ = 0.204**	B1		CAO or AWFW Stated or used CAO or AWRT
	$P(\bar{Y}_6 < 10.5) = P\left(Z < \frac{10.5 - 10.75}{\sqrt{0.041\dot{6}}}\right) =$	M1		Standardising 10.5 with 10.75 and $\sqrt{0.041\dot{6}}$ OE; allow $(10.75 - 10.5)$
	$P(Z < -1.22) = 1 - P(Z < 1.22) =$	m1		**Correct** area change May be implied by a correct answer **or** an answer < **0.5**; but do **not** award for use of $z = \pm 0.22$
	$1 -$ (0.88877 to 0.89065) = **0.109 to 0.112**	A1	4	AWFW (0.11034) (1 – answer) ⇒ B1 M1 max
	Total		**13**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6				
(a)(i)	$\underline{U \sim B(30,\ 0.13, 0.35 \text{ or } 0.20)}$	M1		Used correctly anywhere in (a)
	$P(P = 2) = \binom{30}{2}(0.13)^2(0.87)^{28}$	A1		Can be implied by a **correct** answer
	$= \underline{\mathbf{0.148 \text{ to } 0.15}}$	A1	3	AWFW (0.1489)
(ii)	$p = \underline{\mathbf{0.35}}$	B1		CAO
	$P(R \cup P > 10) = \underline{\mathbf{1 - (0.5078 \text{ or } 0.3575)}}$	M1		Requires '1 –' Accept 3 dp rounding or truncation Can be implied by 0.49 to 0.493 but **not** by 0.642 to 0.643
	$= \underline{\mathbf{0.49 \text{ to } 0.493}}$	A1	3	AWFW (0.4922)
(iii)	$P(5 \le G \le 10) =$ **0.9744 or 0.9389** (p_1)	M1		Accept 3 dp rounding or truncation
	MINUS 0.2552 or 0.4275 (p_2)	M1		Accept 3 dp rounding or truncation
	$= \underline{\mathbf{0.719 \text{ to } 0.72}}$ (p_3)	A1	3	AWFW (0.7192)
Notes	**1** $p_3 \le 0$ or $p_3 \ge 1$ ⇒ M0 M0 A0 **2** $p_2 - p_1$ ⇒ M0 M0 A0 **3** $(1 - p_2) - p_1$ ⇒ M0 M0 A0			**4** $p_1 - (1 - p_2)$ ⇒ M1 M0 A0 **5** $p_1 \times p_2$ ⇒ M1 M0 A0 **6** $(1 - p_2) - (1 - p_1)$ ⇒ M1 M1 (A1)
(b)(i)	Mean or $\mu = 100 \times 0.22$ $= \underline{\mathbf{22}}$	B1		CAO
	Variance or $\sigma^2 = 100 \times 0.22 \times 0.78$ $= \underline{\mathbf{17.1 \text{ to } 17.2}}$	B1	2	AWFW (ignore notation) (17.16) ISW all subsequent working
(ii)	22.1 ≈/= 22 or means similar/equal **or** 0.221 ≈/= 0.22 or proportions similar/equal so **reject claim** (that $p > 0.22$) **or** **accept that p = 0.22**	B1		Dependent on 22 seen in (b)(i) or (ii) Accept diff = 0.1 CAO **Correct** (numerical) comparison with **correct** conclusion (even if at end and stated as 'reject (both) claims')
	$\sqrt{17.1 \text{ to } 17.2} = \underline{\mathbf{4.13 \text{ to } 4.15 \approx/= 4.17}}$ **or** $\underline{\mathbf{17.1 \text{ to } 17.2 \approx/= 17.3 \text{ to } 17.4}}$ so **reject claim that not random samples** **or** **accept that are random samples**	B1 Bdep1	3	Comparison using two values **or** one value + diff (0.02 to 0.04 AWFW) Comparison using two values **or** one value + diff (0.1 to 0.3 AWFW) Dependent on previous B1 **Correct** conclusion regarding randomness of sample
	Total		**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7				
(a)	$\bar{x} = \frac{181.8}{36}$ = **5.05 or 5050**	B1		CAO
	98% (0.98) $\Rightarrow$ z = **2.32 to 2.33**	B1		AWFW (2.3263)
	CI for μ is $\bar{x} \pm z \times \frac{\sigma}{\sqrt{n}}$	M1		Used with z (2.05 to 2.58), $\bar{x}$ (5.05, 5050 or 181.8), σ (0.0075, 0.075, 0.75, 7.5 or 75) and $\div\sqrt{n}$ with $n > 1$
	Thus $5.05 \pm 2.3263 \times \frac{0.075}{\sqrt{36}}$	A1		z (2.05 to 2.06 or 2.32 to 2.33 or 2.57 to 2.58), $\bar{x}$ (5.05) & σ (0.075) or $\bar{x}$ (5050) & σ (75) and $\div\sqrt{36 \text{ or } 35}$
	Hence **5.05 ± 0.03 or 5050 ± 30**			CAO/AWRT
	OR	Adep1	5	Dependent on previous A1 so can be scored with $z \neq$ 2.32 to 2.33
	(5.02, 5.08) or (5020, 5080)			Ignore (absence of) quoted units AWRT to 3sf accuracy
Note	Use of t(2.43 to 2.72) $\Rightarrow$ B1 B0 M1 A0 A0 max			
(b)	**Clear correct comparison** of **5 or 5000** with **LCL or CI** so **agree** with (first) claim (about mean)	Adep1		Dependent on Adep1 in (a) Must use consistent units
	(8/36 **or** 0.22 **or** 22%) v (1/10 **or** 0.10 **or** 10%) **or** 8 v 3.6 (3 to 4)	B1		Mention of a value on LHS **and** a value on RHS
	8/36 OE >/≠ 1/10 OE so **disagree** with (second) claim (about individuals)	Bdep1	3	Dependent on B1 Explicit comparison of values and correct conclusion
Notes	**1** It/(claimed) mean/(claimed) value < LCL/CI $\Rightarrow$ Adep0 Must indicate 5 or 5000 **2** 98% have (mean) weights between CLs so ... $\Rightarrow$ Adep0 **3** Any reference to CI for second claim $\Rightarrow$ B0 Bdep0 Claim refers to individual bottles			
(c)	**Yes** because **volumes/bleach/litres/bottles/** (parent) **population** are **not (stated as) normally distributed**	B1	1	OE; but do **not** accept 'data' or 'sample' or 'it' Reference to sample size only $\Rightarrow$ B0 (eg $n > 25$ or $n > 30$)
	Total		**9**	
	TOTAL		**75**	

Version

General Certificate of Education (A-level)
January 2013

Mathematics MS/SS1B

(Specification 6360)

Statistics 1B

Final

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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)

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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)	a = **30**	B1	**1**	CAO
(b)(i)	b (gradient) = **–0.64** b (gradient) = **–0.6 to –0.7**	B2 (B1)		CAO (–0.64) AWFW *Treat rounding of correct answers as ISW* *Written form of equation is **not** required*
	a (intercept) = **31** a (intercept) = **30 to 32**	B2 (B1)		CAO (31) AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ $\left(\sum y^2\right)$ **or** Attempt at S_{xx} & S_{xy} $\left(S_{yy}\right)$ Attempt at **correct** formula for b (gradient) b (gradient) = **–0.64** a (intercept) = **31**	(M1) (m1) (A1 A1)	**4**	225 7125 135 & **2415** (2643) (all 4 attempted) 1500 & **–960** (618) (both attempted) CAO both
(ii)	Candle **length reduces** by **0.64 (**cm) **per hour** Candle **burns 0.64 (**cm) **each/per hour** Candle **reduces** by **–0.64 (**cm) **each/per hour** (Length, y, cm) **decreases** with (time, x, hours) **or** As (time, x, hours) **increases** then (length, y, cm) **decreases**	B1 BF1 (BF2) (BF1) (B1)	**2**	OE; must be in context OE; must be in context OE; must be in context OE; must be in context (double –ve) F on $-0.6 \leq b \leq -0.7$ from (i) OE; context **not** required B0 for reference only to correlation
(iii)	When x = 50, y = (31 or 30) – 0.64 × 50 = **–1 or –2** **or** When y = 0, x = 31 ÷ 0.64 = **48 to 48.5** **or** 30 ÷ 0.64 = **46.8 to 47**	B1		CAO; accept **correct** comparison of 32 with either 30 or 31 AWFW AWFW
	Claim **not** justified **or** –1 is impossible **or** value < 50 Claim cannot be answered due to uneven burning **or** unlikely to burn completely	Bdep1 (B1)	**2**	OE; dependent on previous B1 Extrapolation required
			9	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2				**In (a), ignore the inclusion of a lower limit of 0; it has no effect on the answer**
	Volume, $V \sim N(106, 2.5^2)$			
(a)	$P(V < 110) = P\left(Z < \frac{110-106}{2.5}\right)$	M1		Standardising 110 with 106 and 2.5; allow (106 – 110)
	$= P(Z < \underline{\mathbf{1.6}})$	A1		CAO; ignore inequality and sign May be implied by a **correct** answer
	$= \underline{\mathbf{0.945}}$	A1	**3**	AWRT (0.94520)
(b)	$P(V > 100) = P(Z > -2.4) = P(Z < +2.4)$	M1		**Correct** area change May be implied by a **correct** answer **or** by an answer **> 0.5**
	$= \underline{\mathbf{0.991 \text{ to } 0.992}}$	A1	**2**	AWFW (0.99180)
(c)	$P(104 < V < 108) = P(-a < Z < a) =$			
	$P(Z < a) - (1 - P(Z < a))$ **or** $2 \times P(Z < a) - 1$	M1		OE; $a = 0.8$ is **not** a requirement May be implied by **0.788 seen** **or** by a **correct** answer
	$= 0.788 - (1 - 0.788) = 0.788 - 0.212$ **or** $= 2 \times 0.788 - 1$	A1		AWRT (0.78814/0.21186) Condone 0.211 May be implied by a **correct** answer
	$= \underline{\mathbf{0.576}}$	A1	**3**	AWRT (0.57628)
(d)	$P(V \neq 106) = \underline{\mathbf{1 \text{ or one or unity or } 100\%}}$	B1	**1**	CAO; accept nothing else but ignore additional words providing they are not contradictory (eg certain so = 1)
		Total	**9**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
3				
(a)	$\underline{E \sim B(40,\ 0.30)}$	M1		Used anywhere in (a) even only by implication from a **correct** value
(i)	$P(E \leq 10) = \underline{\mathbf{0.308\ to\ 0.309}}$	A1	**(2)**	AWFW (0.3087)
SC	For calc^{n} of individual terms: award B2 for answer within above range; award B1 for answer within range 0.3 to 0.32			
(ii)	$P(E \geq 15) = \underline{\mathbf{1 - (0.8074\ or\ 0.8849)}}$	M1		Requires '1 –' Accept 3 dp rounding or truncation Can be implied by 0.192 to 0.193 but **not** by 0.115 to 0.116
	$= \underline{\mathbf{0.192\ to\ 0.193}}$	A1	**(2)**	AWFW (0.1926)
SC	For calc^{n} of individual terms: award B2 for answer within above range; award B1 for answer within range 0.18 to 0.2			
(iii)	$P(E \leq 12) = \mathbf{0.5772 - 0.4406}$ **or** $P(E \leq 12) = \binom{40}{12}0.3^{12}0.7^{28}$	M1		Accept 3 dp rounding or truncation Correct expression; may be implied by a **correct** answer
	$= \underline{\mathbf{0.136\ to\ 0.138}}$	A1	**(2)**	AWFW (0.1366)
			6	
(b)	Means = $\underline{\mathbf{3.2\ and\ 2}}$	B1		CAO both **values**; ignore notation *If not labelled, assume order in question*
	Variances = $\underline{\mathbf{2.56\ and\ 1.75}}$	B1 B1	**3**	CAO each **value**; ignore notation ISW all subsequent working
(c)(i)	Mean = $\underline{\mathbf{2}}$	B1		CAO **value**; ignore notation
	Variance = $\underline{\mathbf{2.54\ to\ 2.55\ or\ 2.33\ to\ 2.34}}$	B1		Any **value** within either range; ignore notation
	(SD = 1.59 to 1.6 or 1.52 to 1.53)		**2**	ISW all subsequent working
(ii)	$\underline{B(16, 0.20)}$ **or** eg "One dist^{n}" **Different/larger** mean **Similar/same** variance or standard deviation	Bdep1		Identification of distribution **not** required Both; dep on 3.2, 2.56 /1.6 & (c)(i)
	$\underline{B(16, 0.125)}$ **or** eg "Other dist^{n}" **Equal/same** mean **Different/smaller** variance or standard deviation	Bdep1		Identification of distribution **not** required Both; dep on 2, 1.75/1.3 & (c)(i)
	Neither likely to provide satisfactory model	Bdep1	**3**	Dep on Bdep1 and on Bdep1
SC	Award Bdep1 Bdep0 Bdep0 for comparison of 3 correct means only **or** for comparison of 3 correct variances/SDs only Award up to Bdep1 Bdep1 Bdep1 for comparison of 3 correct means **and** for comparison of 3 correct variances/SDs			
		Total	**14**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	r = **–0.326 to –0.325**	B3		AWFW (–0.32569)
	r = **–0.33 to –0.32**	(B2)		AWFW
	r = **–0.4 to –0.2**	(B1)		AWFW
	r = **0.2 to 0.4**	(B1)		AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$			756 50004 738 48200 & **45652** (all 5 attempted)
	or	(M1)		
	Attempt at S_{xx} S_{yy} & S_{xy}			2376 2813 & **–842** (all 3 attempted)
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	r = **–0.326 to –0.325**	(A1)	**3**	AWFW
(ii)	**Some/little/slight/(fairly/quite) weak/ (fairly/quite) moderate**	Bdep1		Dependent on **$-0.4 \leq r \leq -0.2$** OE; must **qualify strength** and **state negative** Ignore extra words unless contradict Bdep0 for 'low', 'small', 'poor', 'unlikely', 'medium', 'average', or adjective 'very'
	negative (linear) **correlation**/relationship/ association/link (*but not 'trend'*) between			
	marks/percentages in the two examination papers	B1	**2**	Context; providing **$-1 < r < 1$**
(b)(i)	Identifying linear patterns/non-linear patterns/ multiple patterns/no pattern (*allow 'trend'*)			
	Identifying outliers/anomalies	B2,1		OE; only one mark from each set
	Estimating/gives idea of value of *r*/sign of *r*		**2**	B0 for reference to **checking** calculated value
(ii)	**Graph** (**6** labelled points correct)	B2		Correct $\Rightarrow$ within a circle of radius equal to distance between 2 grid lines Deduct 1 mark for any unlabelled or incorrectly labelled point
	(**5 or 4** labelled points correct)	(B1)	**2**	
(iii)	**Two** separate correlations/relationships/lines/ associations/links/sets of data (*but not 'trends'*)	B1	**1**	OE; eg A to F and G to L
(c)	A to F: **(+)0.7 to (+)0.99**	B1		AWFW; allow calculation (0.937) *If not labelled, assume order A to F then G to L*
	G to L: **–0.9 to –0.5**	B1	**2**	AWFW; allow calculation (–0.757)
		Total	**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5				**Ratios (eg 3:10) are only penalised by 1 accuracy mark at first correct answer**
(a)(i)	P(F & C) = **<u>0.3 or 3/10 or 30%</u>**	B1	**(1)**	CAO (0.3)
(ii)	P(G or S) = **<u>0.45 or 45/100 or 45%</u>**	B1	**(1)**	CAO (0.45)
(iii)	$P(C \mid F) = \frac{0.3 \text{ or } (i)}{0.55} =$ **<u>30/55 or 6/11</u>** **or** **<u>(0.54 to 0.55) or (54% to 55%)</u>**	M1 A1	**(2)**	CAO (6/11) AWFW (0.54545)
(iv)	$P(R' \mid D) = \frac{0.25 \text{ or } (0.30-0.05)}{0.30}$ **<u>25/30 or 5/6</u>** **or** **<u>(0.83 to 0.834) or (83% to 83.4%)</u>**	M1 M1 A1	**(3)**	Correct numerator Correct denominator CAO (5/6) AWFW (0.83333)
(v)	$P(F \mid C') = \frac{0.25 \text{ or } (0.60-0.35)}{0.60}$ **<u>25/60 or 5/12</u>** **or** **<u>(0.416 to 0.42) or (41.6% to 42%)</u>**	M1 A1	**(2, 3)**	Correct expression CAO (5/12) AWRT (0.41667)
			9	
(b)	$P = [P(F \& C)]^2 + [P(F \& G)]^2$ $0.30^2 + 0.25^2$ **or** $0.09 + 0.0625 =$ **<u>1525/10000 or 305/2000 or 61/400</u>** **or** **<u>(0.152 to 0.153) or (15.2% to 15.3%)</u>**	M1 A1 A1	**3**	Attempt at **sum of at least 2 squared terms; 0 < term < 1**; not $(a+b)^2$ May be implied by a **correct** expression or a **correct** answer OE Ignore additional terms or integer multipliers May be implied by a **correct** answer CAO (0.1525) AWFW
		Total	**12**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6 (a)	$\underline{L \sim N(1005, 15^2)}$			
	V(pack) = **$\underline{15^2/12$ or $225/12$ or $75/4}$**	B1		CAO
	or			
	$\underline{18.7$ to $18.8}$			AWFW (18.75)
	OR			
	SD (pack) = **$\underline{15/\sqrt{12}$ or $15/2\sqrt{3}$ or $5\sqrt{3}/2}$**			CAO; OE
	or			
	$\underline{4.3$ to $4.4}$			AWFW (4.33013)
	$P(L < 1000) = P\left(\frac{1000-1005}{15/\sqrt{12}}\right) =$	M1		Standardising 1000 using 1005 and **$15/\sqrt{12}$ OE**; allow (1005 – 1000)
	$P(Z < -1.1547) = 1 - P(Z < 1.1547) =$	m1		**Correct** area change May be implied by a correct answer **or** an answer **< 0.5**
	$1 - (0.87698$ to $0.87493) =$ **$\underline{0.123$ to $0.126}$**	A1	**4**	AWFW (0.12411) (1 – answer) ⇒ B1 M1 max
(b)(i)	99% (0.99) ⇒ z = **$\underline{2.57$ to $2.58}$**	B1		AWFW (2.5758)
	CI for μ is $\bar{x} \pm z \times \frac{\sigma}{\sqrt{n}}$	M1		Used with z (2.05 to 2.58), $\bar{x}$ (4.65) & σ (0.15) and $\div\sqrt{n}$ with $n > 1$
	Thus $4.65 \pm 2.5758 \times \frac{0.15}{\sqrt{24}}$	A1		z (2.05 to 2.06 or 2.32 to 2.33 or 2.57 to 2.58), $\bar{x}$ (4.65) & σ (0.15) and $\div\sqrt{24$ or 23 or 12 or $11}$
	Hence **$\underline{4.65 \pm 0.08}$**			CAO/AWRT
	OR	A1		
	$\underline{(4.57, 4.73)}$		**4**	AWRT
(b)(ii)	**Clear correct comparison** of **4.5** with **LCL or CI** (eg 4.5 < LCL or its value or 4.5 < CI or its limits	BF1		F on CI only providing LCL > 4.5 (ie whole of CI > 4.5) Quoting values for LCL or for CI is **not** required BF0 for '4.5 is outside CI'; OE
	so **Agree** with manufacturer's specification	Bdep1	**2**	OE; dependent on previous BF1
		Total	**10**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
7 (a)	$\sigma \approx \frac{10}{a}$ **or** $\frac{20}{b}$ **or** $\frac{\text{range}}{b}$ **or** $10c$ **or** $20d$	M1		OE; with $2 \le a \le 4$ $4 \le b \le 8$ **or** with c or d in equiv percentages **Cannot** be implied from a **correct** answer (justification required)
	2.5 or 3.3(OE) or 5	A1	**2**	
SC	Award B1 for only **2.5 or 3.3(OE) or 5** with no justification Award B0 for any other answer with no justification or with incorrect justification (eg $\sqrt{10} = 3.16$)			
(b)	**Valid statement** involving: 391 and 405 **OR** 401 and 415 **OR** 24 and 10 **OR** 391 and 415 and 10/24 with linking statement	B1		Allow 'set weight' to imply 415 and/or 'mean' to imply 391 B0 for 10 linked to σ
	95.5 > (**value** of σ of **2.5 or 3.3(OE) or 5**)	B1		Accept $\neq$ rather than > **Clear correct numerical** comparison
	Neither (likely to be) **correct**	Bdep1	**3**	Dependent on B1 B1
(c)	Mean **or** $\bar{y} = \frac{8210.0}{10} = \underline{\mathbf{821}}$ **OR** $\sum y = \underline{\mathbf{8200}}$	B1		CAO;
	Variance $\frac{110.00}{9} = \underline{\mathbf{12.2}}$ **or** $\frac{110.00}{10} = \underline{\mathbf{11}}$ **OR** SD **3.5 or 3.3**	B1		AWRT CAO Award on **value**; ignore notation AWRT
	821 **is similar to/within 10 of** 820 **OR** 8210 **is within 100 of** 8200	B1		OE; **clear correct numerical** comparison of **821** with **820** Allow 'set weight' to imply 820 **Or** OE; **clear correct numerical** comparison of **8210** with **8200** but do **not** accept 'within 10' here
	3.5 **or** 3.3 is **similar to** **a value** of σ of **3.3(OE) or 2.5**	B1	**4**	**Clear correct numerical** comparison
		Total	**9**	
	TOTAL		**75**	

Version 1.0

General Certificate of Education (A-level)
June 2013

Mathematics/Statistics MS/SS1B

(Specification 6360/6380)

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 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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

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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)	Mean = **62.2 to 62.3**	B1		AWFW (62.25)
	SD = **17.4 to 17.6 or 16.7 to 16.9**	B1	2	AWFW (17.519 or 16.774)
(ii)				AWFW (16.806)
	Mean = **16.77 to 16.84**	BF1		F on (a)(i) only providing **45 < mean < 65**
	SD = **9.66 to 9.78 or 9.27 to 9.39**	BF2	3	AWFW (9.733 or 9.319) F on (a)(i) only providing **10 < SD < 20**
(b)				CAO
	r_{xy} = **0.997**	B1		Award on value only; ignore any explanation or working $r_{xy} = r_{uv}$ with no value stated $\Rightarrow$ B0
	r **not affected** by **change(s) in/different units** **or** *r* **not affected** by **linear scaling** **or** **Scaling/coding/transformation/change/ conversion** to *u* and *v* is **linear**	B1	2	Accept 'Formula' or 'It' for *r* and reference to '**linear**' is **not** necessary Accept 'Formula' or 'It' for *r* but reference to '**linear**' is necessary OE; but reference to '**linear**' is necessary
	Total		**7**	

Q	Solution	Marks	Total	Comments
				Accept percentage equivalents in (a)
2(a)(i)	Weight, $X \sim N(421, 2.5^2)$ $P(X = 421) =$ **0 or zero or nought or 0%**	B1		CAO; accept nothing else but ignore additional words providing that they are not contradictory (eg impossible so = 0)
(ii)	$P(X < 425) = P\left(Z < \frac{425 - 421}{2.5}\right)$	M1		Standardising 425 with 421 and 2.5 but allow (421 – 425)
	$= P(Z < 1.6) =$ **0.945 to 0.946**	A1		AWRT (0.94520)
(iii)	$P(418 < X < 424) = P(-a < Z < a) =$			
	$P(Z < a) - (1 - P(Z < a))$ **or** $2 \times P(Z < a) - 1$	M1		OE; $a = 1.2$ or correct standardising are **not** required May be implied by **0.885** (AWRT) **seen anywhere** **or** by a **correct** answer
	$= 0.885 - (1 - 0.885) = 0.885 - 0.115$ **or** $= 2 \times 0.885 - 1$	A1		AWRT (0.88493/0.11507) Implied by a **correct** answer
	$=$ **0.769 to 0.77**	A1	6	AWFW (0.76986)
(b)	$0.98 \Rightarrow z =$ **2.05 to 2.06**	B1		AWFW (2.0537)
	$\left(\frac{x - 421}{2.5}\right) = 2(.0)$ to 2.4	M1		Standardising x with 421 and 2.5 but allow $(421 - x)$; **and** equating to a ***z*-value** (*ignore sign*) May be implied by a **correct** answer
	$x =$ **426 to 426.3**	A1	3	AWFW (426.13) ***Must be consistent signs throughout***
(c)	$0.01 \Rightarrow z =$ **–2.33 to –2.32**	B1		AWFW; (*ignore sign*) (–2.3263)
	$z = \left(\frac{410 - \mu}{3.0 \text{ or } 2.5}\right)$	M1		Standardising 410 with μ and (3.0 or 2.5) but allow $(\mu - 410)$
	$\left(\frac{410 - \mu}{3.0}\right) = -2.6$ to -2.3	A1		Equating to a ***z*-value** (*ignore sign*) May be implied by a **correct** answer
	$\mu =$ **417**	Adep1	4	AWRT (416.98) Dependent on previous A1 ***Must be consistent signs throughout***
	Total		**13**	

Q	Solution	Marks	Total	Comments
				Accept percentage equivalents except for 27
3(a)(i)	$\underline{O \sim \text{B}(40, p)}$			
	$\text{P}(NS \leq 10) = \underline{\mathbf{0.97}}$	B1	1	AWRT (0.9701)
(ii)				Requires '1 –'
	$\text{P}(LPE \geq 25) = \underline{\mathbf{1 - (0.9231 \text{ or } 0.9597)}}$	M1		Accept 3 dp rounding Can be implied by (0.0769 to 0.077) but **not** by (0.04 to 0.0403)
	$= \underline{\mathbf{0.077}}$	A1	2	AWRT (0.0769)
(iii)				Correct expression; may be implied by a **correct** answer Ignore extra terms
	$\text{P}(UPE = 2) = \binom{40}{2}(0.175)^2(0.825)^{38}$	M1		
	$= \underline{\mathbf{0.016}}$	A1	2	AWRT (0.0160)
(iv)				CAO; award on value only May be implied by any of four probabilities below or by a **correct** answer
	$p = 0.85 - 0.50 = \underline{\mathbf{0.35}}$	B1		
	$\text{P}(10 < X < 15) =$ **0.5721 or 0.6946** (p_1)	M1		Accept 3 dp rounding May be implied by a **correct** answer
	MINUS 0.1215 or 0.0644 (p_2)	M1		Accept 3 dp rounding May be implied by a **correct** answer
	$= \underline{\mathbf{0.45 \text{ to } 0.451}}$	A1	4	AWFW (0.4506)
(b)	$p = 0.85 - 0.175 = \underline{\mathbf{0.675}}$ **or** $p' = \underline{\mathbf{0.325}}$	B1		CAO; may be implied by 27 Each can be found in several ways CAO; may be implied by 13 or 27
	Number $= 40 \times 0.675 = \underline{\mathbf{27}}$	B1	2	CAO; can be found in several ways
	Total		**11**	

Q	Solution	Marks	Total	Comments
4(a)(i)	$r_{gy} = \dfrac{24.15}{\sqrt{0.1196 \times 5880}} =$ **0.91 to 0.911**	M1 A1		May be implied by a **correct** answer in (a)(i) or (a)(ii) or (c)(i) AWFW (0.91067)
(ii)	$r_{ly} = \dfrac{10.25}{\sqrt{0.0436 \times 5880}} =$ **0.64 to 0.641**	A1	3	AWFW (0.64017)
(b)	(Very) **Strong positive** correlation	Bdep1		Dependent on $0.9 \leq r_{gy} < 1$
	(Some) **Moderate positive** correlation	Bdep1		Dependent on $0.6 \leq r_{ly} \leq 0.7$ Bdep0 for any mention of 'strong'
	between girth and weight **and/or** length and weight	B1	3	At least one interpretation in context
(c)(i)	$r_{xy} = \dfrac{5662.97}{\sqrt{5656.15 \times 5880}} =$ **0.98 to 0.982**	B1		AWFW (0.98196)
	Most strongly correlated with y is ***x***	Bdep1	2	CAO; dependent on $0.97 \leq r_{xy} < 1$
(ii)	$x = 69.3 \times 1.25^2 \times 1.15$ $=$ **124 to 125**	M1 A1	2	May be implied by a **correct** answer AWFW (124.52)
(iii)	$b = \dfrac{5662.97}{5656.15}$	M1		116/115.4 (= 1.005) ⇒ M0 A0
	$=$ **1 to 1.002**	A1		AWFW (1.00121)
	$a = 116 - 115.4b =$ **0.3 to 0.6**	B1	3	AWFW (0.46085)
(iv)	r_{xy} ≈/nearly/almost/close to (+)**1 or very strong/almost exact** (positive) **correlation** (Stating r_{xy} =0.98 to 0.982 ⇒ Bdep0)	Bdep1		OE Dependent on $0.97 \leq r_{xy} < 1$ OE; 'strong' is not sufficient
	b =/≈/nearly/almost/close to (+)**1**	Bdep1		OE; must reference value of 1 or unity Dependent on M1 A1 in (c)(iii)
	a ≈/nearly/almost/close to **0** (Stating a = 0.4 to 0.6 ⇒ Bdep0)	Bdep1		OE; must reference value of 0 or origin Dependent on B1 in (c)(iii)
	Estimate (not 'it' or 'this' or 'value', etc) is (very/highly/likely to be) accurate/precise/ reliable **or** (almost) exact/correct	Bdep1	4	OE; dependent on scoring **at least 2** of the previous 3 marks in (c)(iv) Fairly accurate, good approximation, (quite) likely, (very) close, reasonable, etc ⇒ Bdep0
	Total		**17**	

Q	Solution	Marks	Total	Comments
5(a)(i)	$P(A = 2) = 0.90 \times 0.95 =$ **<u>0.85 to 0.86</u>**	B1		AWFW (0.855 or 171/200 OE)
(ii)	$P(A = 1) = (0.90 \times 0.05) + (0.10 \times 0.95)$ **or** $= 1 - [0.855 + (0.10 \times 0.05)]$	M1		May be implied by a **correct** answer Do **not** ignore extra terms
	$=$ **<u>0.14</u>**	A1	3	CAO (7/50 OE)
(b)(i)	$P(A_W \cap D_W) = 0.90 \times 0.80$	M1		May be implied by a **correct** answer
	$=$ **<u>0.72</u>**	A1	2	CAO (18/25 OE)
(ii)	$P(A_B \cap D_B) = $ (b)(i) $\times 0.95$ ($\times 1$) **or** $= 0.90 \times 0.80 \times 0.95$ ($\times 1$) **or** = (a)(i) $\times 0.80$	M1		May be implied by a **correct** answer
	<u>0.68 to 0.685</u>	A1	2	AWFW (0.684 or 171/250 OE)
(iii)	$P(A_T \cap D'_T) = 0.95 \times 0 =$ **<u>0</u>**	B1	1	CAO; award on value only
(iv)	P(neither) = $P([A'_W \cap D'_W] \cap [A'_T \cap D'_T])$			
	$(1 - 0.90) \times (1 - 0.15)$	M1		Accept 0.085 or 17/200 OE Award M1 and m1 on value(s) only
	$(1 - 0.95) \times (1 - 0)$	m1		Accept 0.05 or 1/20 OE
	or P(neither) = $P(A'_W \cap A'_T) \cap P(D'_W \mid A'_W) \cap P(D'_T \mid A'_T)$			
	$(1 - 0.90) \times (1 - 0.95)$	(M1)		Accept 0.005 or 1/200 OE Award M1 and m1 on value(s) only
	$(1 - 0.15) \times (1 - 0)$	(m1)		Accept 0.85 or 17/20 OE
	$= 0.085 \times 0.05$ **or** 0.005×0.85			OE
	$=$ **<u>0.0042 to 0.0043</u>**	A1	3	AWFW (0.00425 or 17/4000 OE)
	Total		**11**	

Q	Solution	Marks	Total	Comments
6(a)(i)	$\overline{x} = \frac{497.5}{25} =$ **<u>19.9</u>**	B1		CAO
	98% (0.98) $\Rightarrow$ $z =$ **<u>2.32 to 2.33</u>**	B1		AWFW (2.3263)
	CI for μ is $\overline{x} \pm z \times \frac{\sigma}{\sqrt{n}}$	M1		Used with z (2.05 to 2.58), $\overline{x}$ (497.5 or 19 to 21) and σ(0.4) and $\div\sqrt{n}$ with $n > 1$
	Thus $19.9 \pm 2.3263 \times \frac{0.4}{\sqrt{25}}$	A1		z (2.05 to 2.06 or 2.32 to 2.33 or 2.57 to 2.58), $\overline{x}$ (19.9) and σ(0.4) and $\div\sqrt{25 \text{ or } 24}$
	Hence **<u>19.9 ± 0.2</u>** **or** **<u>(19.7, 20.1)</u>**	A1	5	CAO/AWRT (0.186104) AWRT
(ii)	**Clear correct comparison** of **20** with **CI** eg 20 is within CI **or** LCL < 20 < UCL so Agree with claim **or** no reason to doubt claim	BF1 Bdep1	2	F on CI providing it contains 20 Quoting values for CI is **not** required OE; dependent on previous BF1
(iii)	**Weight** of sand in a bag or ***X*/*x*** or **original distribution** or **parent population** is **normal**	B1	1	It/mean/data/sample/information/sand is normal $\Rightarrow$ B0 Reference **only to** sample size **or** standard deviation $\Rightarrow$ B0

Q	Solution	Marks	Total	Comments
6(b)(i)	$\underline{Y \sim N(25.25,\ 0\ 35^2)}$			**Accept percentage equivalent probabilities**
	V(mean) = **$\underline{0.35^2/10$ or 0.0122 to 0.0123}$** **or** SD (mean) = **$\underline{0.35/\sqrt{10}$ or 0.11 to 0.111}$**	B1		CAO/AWFW (0.01225) CAO/AWFW (0.11068)
	$P(\bar{Y} < 25) = P\left(Z < \frac{25 - 25.25}{0.35/\sqrt{10}}\right)$	M1		Standardising 25 using 25.25 and **$0.35/\sqrt{10}$ OE** but allow (25.25 – 25)
	$= P(Z < -2.25877) = 1 - P(Z < 2.25877)$	m1		**Correct** area change May be implied by a **correct** answer **or** an answer **< 0.5**
	$= 1 - (0.98809$ to $0.98778)$			
	$= \underline{\mathbf{0.011 \text{ to } 0.013}}$	A1	4	AWFW (0.01195) (0.987 to 0.989) ⇒ B1 M1 m0 A0
(ii)	$P(Y > 25) = P\left(Z > \frac{25 - 25.25}{0.35}\right)$	M1		Standardising 25 using 25.25 and 0.35 but allow (25.25 – 25)
	$= P(Z > -0.71429) = P(Z < 0.71429)$			
	$= \underline{\mathbf{0.761 \text{ to } 0.764}}$	A1		AWFW (0.76247) (0.236 to 0.239) ⇒ M1 A0
	$P(Y > 25$ in each of 10$) = \underline{\boldsymbol{p^{10}}}$	M1		Any p^{10} providing $0 < p < 1$ May be implied by a **correct** answer
	$= \underline{\mathbf{0.065 \text{ to } 0.068}}$	A1	4	AWFW (0.06641)
	Total		**8**	
	TOTAL		**75**	

A-LEVEL
Statistics

Statistics 1B – SS1B
Mark scheme

6380
June 2014

Version/Stage: Final

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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)

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Otherwise we require evidence of a correct method for any marks to be awarded.

Q	Solution	Marks	Total	Comments
1	**No MR or MC in this question**			
(a)	Ordered data: 3.3 3.6 3.7 3.8 3.9 4.0 4.1 4.5 4.6 4.7 4.8 4.9 5.0 5.1 5.2	M1		*May be near printed values* If seen, then ≥5 correctly ordered If not seen, then can be implied from ≥1 of M, UQ, LQ or IQR correct
	Median = **4.5**	A1		CAO
	UQ = **4.9** LQ = **3.8**	A1		Either CAO; ignore notation Can be implied by IQR = 1.1
	IQR = **1.1**	A1	**4**	CAO
Notes	**1** If values are not ordered, then M = 5.2, UQ = 3.3 and LQ = 4.5 so IQR = (–)1.2 ⇒ M0 **2** If answers are not identified, then assume that order of values is median, IQR			
(b)	Range = 5.2 – 3.3 = **1.9**	B1	**1**	CAO
Note	**1** If values are not ordered, then Range = 0.2 ⇒ B0			
(c)	All values are different/each value occurs once/ there is no mode	B1	**1**	OE
		Total	**6**	

Q	Solution	Marks	Total	Comments
2	**No MR or MC in this question**			**Accept %age equivalents in (a)(i) to (iii)**
(a)	Time, $X \sim N(7.5,\ 1.6^2)$			
(i)	$P(X < 10) = P\left(Z < \frac{10-7.5}{1.6}\right)$	M1		Standardising 10 with 7.5 and 1.6 but allow $(7.5 - 10)$; $z^2 \Rightarrow$ M0
	$= P(Z < 1.5625) =$ **0.94**	A1	**(2)**	AWRT (0.94091)
(ii)	$P(X > 6) = P(Z > -0.9375) = P(Z < 0.9375)$	M1		**Correct** area change; 0.9375 or correct standardising are **not** required Can be implied by final **answer > 0.5**
	= **0.82 to 0.83**	A1	**(2)**	AWFW (0.82575)
(iii)	$P(5 < X < 10) =$ $P(Z < 1.5625) - P(Z < -1.5625) =$ (i) − [1 − (i)] **or** 1 − 2 × [1 − (i)] $= [2 \times (i)] - 1$	M1		OE; any **correct** difference in areas using (a)(i) or $P(5 < X < 10)$ Can be implied by a **correct** final answer
	$= 2 \times 0.94091 - 1 =$ = **0.88**	A1	**(2)**	AWRT (0.88182)
			6	
(b)	80% (0.8) $\Rightarrow z =$ **0.84**	B1		AWRT; ignore sign (0.8416)
	$P(Y < 15) = P\left(Z < \frac{15-\mu}{2.4 \text{ or } 1.6}\right)$	M1		Standardising 15 with μ and (2.4 or 1.6) but allow $(\mu - 15)$
	$\left(\frac{15-\mu}{2.4}\right) = 0.84(16)$ or $1.28(16)$	m1		Equating expression with σ = **2.4** to either ***z*-value** (*ignore sign*) Can be implied by a **correct** answer
	$\mu =$ **12.95 to 13**	A1	**4**	AWFW (12.9802) ***Must be consistent signs throughout***
		Total	**10**	

Q	Solution	Marks	Total	Comments
3	**No MR or MC in this question**			
(a)	b (gradient/slope) = **0.85** b (gradient/slope) = **0.8 to 0.9**	B2 (B1)		AWRT (0.85055) AWFW
	a (intercept) = **94.6 to 94.8** a (intercept) = **93 to 97**	B2 (B1)		AWFW (94.69602) AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ **or** Attempt at S_{xx} & S_{xy} Attempt at **correct** formula for b b = **0.85** (AWRT) a = **94.6 to 94.8** (AWFW)	(M1) (m1) (A1 A1)	**4**	254 6924 1163 & **29942** (all 4 attempted) ($\sum y^2$ = 135693) 472.4 & **401.8** (both attempted) (S_{yy} = 436.1) ($\bar{x}$ = 25.4 & $\bar{y}$ = 116.3)
Notes	**1** Treat rounding of correct answers as ISW **2** Written form of equation is **not** required **3** Award 4 marks for y = (94.6 to 94.8) + 0.85 or for (94.6 to 94.8) + 0.85x **4** Values of a and b interchanged and equation $y = ax + b$ stated in (b) ⇒ max of 4 marks **5** Values of a and b interchanged and equation $y = a + bx$ stated in (b) ⇒ 0 marks **6** Values are **not** identified or simply b/a = # and a/b = #, then 0.8 to 0.9 ⇒ B1 and 93 to 97 ⇒ B1 but accept, for example, as identification, [b = #, a = # with $y = a + bx$ but no substitution for b & a] **or** [slope/gradient(b) = #, intercept(a) = #] **7** Answers in fractions can score at most M1 m1 **8** Some/all of marks can be scored in (b) & (d), even if some/all of marks are lost in (a), but marks lost in (a) **cannot** be recouped by subsequent working in (b) or (d)			
(b)	y_{30} = **120 to 120.5** y_{30} = **117 to 123**	B2 (B1)	**2**	AWFW (120.21253) AWFW
Note	**1** If, and only if, B0, then award M1 for seen use of $y = a + b\times30$			
(c)(i)	**Extrapolation** **BMI** is **outside/above range** **45 is outside/above range** of **BMI** or ***x***	B1		OE; accept references to sample/data but not to population
(ii)	**Extrapolation** **Age** is **outside/above range** **50** is **outside/above range** of **age**	B1	**2**	OE; accept references to sample/data but not to population
Notes	**1** Extrapolation only stated in each of (i) & (ii) ⇒ B1 B0 **2** Two debateable answers ⇒ B1 max			
(d)	r_{20} = 117 – (a + $b\times20$) = **5.3** = **5 to 6**	B2 (B1)	**2**	AWRT; do not ignore sign (5.29297) AWFW; ignore sign
Note	**1** If, and only if, B0, then award M1 for seen use of ±[117 – (a + $b\times20$)]			
(e)	As 2.71/(mean) value is small (in comparison to y-values), estimate is likely to be (quite/fairly/very/extremely) accurate	B1	**1**	OE; justification & conclusion
			11	

Q	Solution	Marks	Total	Comments
4	**No MR or MC in this question**			
Notes	**1** **Percentage** answers must be penalised by **1 accuracy mark** at first **correct** answer only if no indication of percentage shown **2** **Ratio** answers (eg 4:5) are only acceptable in **(a)** and must be penalised by **1 accuracy mark** at first **correct** answer			
(a)(i)	$P(\geq 1) = 0.70 + 0.55 - 0.45 =$	M1		OE; eg 0.25 + 0.45 + 0.1
	0.8 or 4/5 or 80%	A1	**(2)**	CAO
(ii)	$P(=1) =$ (i) $- 0.45 = 0.25 + 0.1$			
	0.35 or 35/100 or 7/20 or 35%	AF1	**(1)**	F on (i) $0 < p < 1$
			3	
Note	**1** If answers to (i) & (ii) are correct but reversed, then award M1 A0 AF0			
(b)	$P(A) \times P(M) =$ **0.70 × 0.55 or 0.385**	B1		OE
	0.385 ≠ 0.45 or < 0.45	B1	**2**	Must compare to 0.45 OE **and** compare 'like with like'
Notes	**1** $P(M \mid A) =$ **0.45/0.70** $\neq P(M \mid A') =$ **0.10/0.30** $\neq P(M) =$ **0.55** $\Rightarrow$ B1 for any 2 (OE) values, B1 for comparison **2** $P(A \mid M) =$ **0.45/0.55** $\neq P(A \mid M') =$ **0.25/0.45** $\neq P(A) =$ **0.70** $\Rightarrow$ B1 for any 2 (OE) values, B1 for comparison			
(c)(i)	$P(AMBN) = (0.45$ **or** 0.385 **or** $0.70 \times 0.55) \times 0.85 \times 0.65$	M1		Can be implied by a **correct** answer Ignore any integer multipliers (eg 4)
	= **0.248 to 0.25 or 24.8% to 25%**	A1	**2**	AWFW (0.248625)
Notes	**1** Use of 0.385 gives an answer of 0.2127125 (0.212 to 0.213 AWFW) $\Rightarrow$ M1 A0 **2** The **3 correct terms** identified but not multiplied (eg added) $\Rightarrow$ M0 A0			
(ii)	$P(A'M'B'N') = P(A'M') \times P(B'N') = p \times P(B'N')$			
	$p =$ **0.2**	B1		CAO; can be implied from working or from a **correct** answer
				$0 < p < 1$
	$p \times (0.15 \times 0.35)$	M1		Can be implied by a **correct** answer Ignore any integer multipliers (eg 4)
	= **0.01 to 0.011 or 1% to 1.1%**	A1	**3**	AWFW (0.0105)
Notes	**1** Use of $p = 0.3 \times 0.45 = 0.135$ gives answer of 0.0070875 (0.007 AWRT) $\Rightarrow$ B0 M1 A0 **2** The **3 correct terms** identified but not multiplied (eg added) $\Rightarrow$ B1 M0 A0			
		Total	**10**	

Q	Solution	Marks	Total	Comments
5	**No MR or MC in this question**			
(a)				
(i)	r = **0.848 to 0.849** r = **0.84 to 0.86** r = **0.8 to 0.9**	B3 (B2) (B1)		AWFW (0.84856) AWFW AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$ **or** Attempt at S_{xx} S_{yy} & S_{xy} Attempt at substitution into **correct** corresponding formula for r r = **0.848 to 0.849**	(M1) (m1) (A1)	**3**	696 46896 1128 129832 & **76001** (all 5 attempted) 6528 23800 & **10577** (all 3 attempted) AWFW
(ii)	(Fairly/quite) **strong positive** (linear) correlation between **Shop *X*** (daily) **takings** and **Shop *Y*** (daily) **takings** of two shops **or** (daily) **takings** of (two) **shops**	Bdep1 B1	**2**	Dependent on **$0.8 \leq r < 0.9$** OE; must **qualify strength** and **state positive** Context OE; providing **$-1 < r_{xy} < 1$**
Notes	**1** Only accept phrase stated; ignore additional comments unless contradictory **2** Use of: "very/extremely/relatively strong or high or big or good or moderate or medium or average" ⇒ Bdep0 **3** Accept "relationship/association/link" but not "trend" instead of "correlation" **4** Do **not** accept "£x" and "£y" without further identification			
(b)	Scatter diagram **4** points correct & labelled **3 or 2** points correct & labelled	B2 (B1)	**2**	Deduct 1 mark if not labelled
(c)	Days **D & I** **Day D**: more shoppers **or** increased takings **Day I**: fewer shoppers **or** reduced takings	B1 B1 B1	**3**	 OE OE
Notes	**1** D stated with valid reason & I stated with valid reason ⇒ B3 **2** I & D stated with valid matching reasons ⇒ B1 B1 B1 **3** D & I stated with no (matching) reasons ⇒ B1 B0 B0 **4** I & D stated with no (matching) reasons ⇒ B0 B0 B0			
(d)(i)	$r = \dfrac{407.5}{\sqrt{1292.5 \times 3850.1}}$ = **0.182 to 0.183**	M1 A1		 AWFW (0.18267)
(ii)	**Some**/(fairly/quite/very) **weak or little or slight** (almost) **no**/**hardly any** (positive) correlation	Bdep1	**3**	Dependent on **$0.1 \leq r < 0.2$** OE; must **qualify strength**
Notes	**1** Only accept phrases listed; ignore additional comments unless contradictory **2** Use of: "low or small or poor or bad or unlikely or relatively" ⇒ B0 **3** Accept "relationship/association/link" but not "trend" instead of "correlation"			
		Total	**13**	

Q	Solution	Marks	Total	Comments
6	**No MR or MC in this question**			**Accept percentage equivalents in (a) & (b)**
(a)	Use of B(26, 0.06) **or** B(50, 0.15)	M1		Indicated by an expression **or** by any one probability in **(a) or (b)**
	$P(M = 2) = \binom{26}{2}(0.06)^2(0.94)^{24}$	M1		Correct expression Can be implied by a **correct** answer Ignore extra terms
	= **0.265**	A1	**3**	AWRT (0.26501)
(b) (i)	P(I < 10) = **0.791**	B1	**(1)**	AWRT (0.7911)
(ii)	P(I > 5) = **1 – (0.2194 or 0.1121)**	M1		Requires "1 – probability" Accept 3 dp rounding Can be implied by (0.78 to 0.781) but **not** by (0.888)
	= **0.78 to 0.781**	A1	**(2)**	AWFW (0.7806)
SC	For calculation of individual terms: award B2 for 0.78 to 0.781 AWFW; award B1 for 0.888 AWRT			
(iii)	P(6 < I < 12) = **0.9372 or 0.9699** (p_1)	M1		Accept 3 dp rounding May be implied by a **correct** answer
	MINUS 0.3613 or 0.2194 (p_2)	M1		Accept 3 dp rounding May be implied by a **correct** answer
	= **0.575 to 0.577**	A1	**(3)**	AWFW (0.5759)
Notes	**1 First M1** is for $(+p_1)$ in calculation **2 Second M1** is for $(-p_2)$ in calculation **3** $(1-p_2)-(1-p_1) \Rightarrow$ M1 M1 (A1) **4** B(50, 0.15) probabilities shown for **at least 3** values within $5 \le X \le 12 \Rightarrow$ M2 May be implied by a **correct** answer Ans = **0.575 to 0.577** $\Rightarrow$ A1			

x	5	6	7	8	9	10	11	12
$P(X = x)$	0.1073	0.1419	0.1575	0.1493	0.1230	0.0890	0.0571	0.0327/8

			6	
(c)	**Chain** (or Farokh's)**:** Mean = 50 × 0.15 = **7.5**	B1		CAO
	Var = 50 × 0.15 × 0.85 = **6.37 to 6.38**			(6.375)
	or SD = **2.52 to 2.53**	B1		AWFW
	(Farokh's) mean < Chain's mean **or** 4.33 < C's mean	B1		Not available for incorrect labelling
	(Farokh's) Var/SD < Chain's Var/SD **or** 3.94 < C's Variance	B1		Not available for incorrect labelling (1.98 to 1.99) < C's SD
	Farokh's store (performance) is **better** than that of the supermarket chain as a whole	Bdep1		Dependent on previous four B1 marks
			5	
SC	A **correct** comparison of 433 with 750 **or** (0.086 to 0.087) with 0.15 scores B1 B0 B1 B0 Bdep0			
		Total	**14**	

Q	Solution	Marks	Total	Comments
7	**No MR or MC in this question**			
(a)	Mid-points (x): 37.5 42.5 47.5 52.5 57.5 62.5 67.5 72.5 77.5 82.5 87.5 92.5 97.5	M1		*May be near printed table* If seen, then ≥5 correct If not seen, then can be implied from mean of 62.9 or 67.5 or from 10065
	Mean = **62.9**	A1		AWRT (62.90625)
	SD = **12.3 to 12.4**	B2	**4**	AWFW (12.3234 **or** 12.3621)
Notes	**1** $\sum fx = 10065$ and $\sum fx^2 = 657450$ **2** Using *LCB*-values or *UCB*-values and f-values gives Mean = 65.0 or 70.0 and SD = 12.3 to 12.4 ⇒ M0 A0 B2 **3** Using only x-values gives Mean = 67.5 and SD = 18.7 to 19.5 ⇒ M1 A0 B0 **4** Using only f-values gives Mean = 12.3 and SD = 8.6 to 9.0 ⇒ M0 A0 B0 **5** If, and only if, M0 A0 B0, then award M1 for seen attempt at $\sum f(LCB \text{ to } UCB) \div 160$			
(b)(i)	98% (0.98) ⇒ z = **2.32 to 2.33**	B1		AWFW (2.3263)
	CI for μ is $\bar{x} \pm z \times \frac{s \text{ or } \sigma}{\sqrt{n \text{ or } (n-1)}}$	M1		Used; must $\div\sqrt{n}$ with $n > 1$ Evaluation of only one CL ⇒ M0
	$(\text{C's-mean}) \pm (2.05 \text{ to } 2.33) \times \frac{(\text{C's-SD})}{\sqrt{160 \text{ or } 159}}$	AF1		F on (a)
	Thus $62.9 \pm (2.32 \text{ to } 2.33) \times \frac{(12.3 \text{ to } 12.4)}{\sqrt{160 \text{ or } 159}}$	A1		
	Hence **62.9 ± (2.2 to 2.4)** **or** **(60.5 to 60.7, 65.1 to 65.3)**	Adep1	**5**	AWRT/AWFW (±2.2735) Dependent on previous A1 AWFW
Notes	**1** Use of t-value of (2.34 to 2.35) gives ±2.3 ⇒ B1 M1 AF1 A1 A1 **2** A **correct** answer with no working (ignore (a)) ⇒ B1 M1 AF1 A1 A1			
(ii)	**Clear correct comparison** of **61.7** with **CI** eg 61.7 is within CI **or** LCL < 61.7	BF1		F on CI providing it **contain**s 61.7 Must be an **interval** but quoting values for limits is **not** required
	Disagree with claim **or** reason to doubt claim	Bdep1	**2**	OE; dependent on BF1
Notes	**1** Statement must clearly indicate that "61.7 is within the CI" OE **2** "It/mean/value/etc" is within CI ⇒ BF0 **3** Statements of the form "61.7 is within 98% of the data" ⇒ BF0 **4** Statements such as "Claim unlikely/unreasonable/unsupported/incorrect/false/impossible/invalid" ⇒ Bdep1 providing BF1			
		Total	**11**	

A-LEVEL
Statistics

Statistics 1B – SS1B
Mark scheme

6380
June 2015

Version/Stage: 1.0 Final

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Otherwise we require evidence of a correct method for any marks to be awarded.

General Notes for SS1B

GN1 There is no allowance for misreads (MR) or miscopies (MC) unless specifically stated in a question

GN2 In general, a correct answer (to accuracy required) without working scores full marks but an incorrect answer (or an answer not to required accuracy) scores no marks

GN3 Where percentage equivalent answers are permitted in a question, penalise by **one accuracy mark** at the first **correct** answer but only if no indication of percentage (eg %) is shown

GN4 In probability questions, do **not** award **accuracy** marks for answers in the form of a ratio or odds (eg 7/20 as 7:20 or 7:13)

Q	Solution	Marks	Total	Comments
1 (a)	Mode = **10**	B1		CAO; ignore any reference to 9 unless stated as the/a mode
	Median = **11**	B1		CAO; providing not based on shown incorrect working
	UQ = **14** LQ = **10**	B1		Either CAO; ignore notation Can be implied from IQR = 4 with no working or from IQR = 4 not from incorrect working
	IQR = **4**	B1	**4**	CAO
Notes	**1** If values are not identified, then assume that order of values is mode, median, IQR **2** Ordering of days (1, 1, 2, 3, 3, 4, 5, 7, 9) $\Rightarrow$ mode = 3, median = 3, IQR = 6 – 1.5 = 4.5 $\Rightarrow$ no marks			
(b)	Mean = **11.8**	B2		CAO $\left(\sum f = 35 \text{ and } \sum fx = 413\right)$
	Mean = **11.7 to 11.9**	(B1)	**2**	AWFW
Notes	**1** Using only x-values gives mean = 11.22 $\Rightarrow$ B0 **2** Using only f-values gives mean = 3.889 $\Rightarrow$ B0 **3** If, and only if, B0, then award M1 for **seen** attempt at $\sum fx \div 35$ or for **seen** attempt at $413 \div 35$			
		Total	**6**	

Q	Solution	Marks	Total	Comments
2				**Accept percentage equivalent answers in (a) but see GN3**
(a)(i)	$P(X < 90) = P\left(Z < \frac{90-91}{0.8}\right)$	M1		Standardising 90 with 91 and 0.8; allow (91 – 90)
	$= P(Z < -1.25) = 1 - P(Z < -1.25)$	m1		**Correct** area change Can be implied by a **correct** answer **or** by an **answer < 0.5**
	$= (1 - 0.89435) = \underline{\mathbf{0.105 \text{ to } 0.106}}$	A1	**(3)**	AWFW (0.10565)
(ii)	$P(X \neq 90) = \underline{\mathbf{1 \text{ or one or unity or } 100\%}}$	B1	**(1)**	CAO; accept nothing else but ignore zeros after decimal point (eg 1.00) Ignore additional words providing that they are not contradictory (eg certain so = 1)
Note	**1** $P(X \neq 90) = P(Z \neq 0) \Rightarrow$ B0 unless followed by 1 OE			
(iii)	$P(91 < X < 92.5) = P(0 < Z < 1.875)$			
	$= (0.969 \text{ to } 0.972) - 0.5$ **or** $= 0.5 - (0.028 \text{ to } 0.031)$	B1		AWFW/CAO OE; can be implied by a **correct** final answer
	$= \underline{\mathbf{0.47}}$	B1	**(2)**	CAO/AWFW AWRT (0.46960)
			6	
(b)	$1\% \, (0.01) \Rightarrow z = \underline{\mathbf{-2.33 \text{ to } -2.32}}$	B1		AWFW; seen anywhere, ignore sign (–2.3263)
	$P(Y < 150) = P\left(Z < \frac{150-153}{\sigma}\right)$	M1		Standardising 150 with 153 and σ/s; allow (153 – 150)
				(–1.2816)
	$\frac{\pm(150-153)}{\sigma} = \begin{pmatrix} \pm 1.28 \text{ AWRT} \\ \text{or} \\ \pm 2.32 \text{ to } \pm 2.33 \text{ AWFW} \end{pmatrix}$	m1		Can be implied by a **correct** answer
				(–2.3263)
	$\sigma = \underline{\mathbf{1.3}}$	A1	**4**	AWRT (1.28960)
Note	**1** Award A0 if the signs are not consistent throughout, so, for example, (150 – 153)/+2.3263 gives $\sigma = 1.3 \Rightarrow$ B1, M1, m1, A0			
		Total	**10**	

Q	Solution	Marks	Total	Comments
3 (a)(i)	$r =$ **0.748**	B3		AWRT (0.74802)
	$r =$ **0.74 to 0.76**	(B2)		AWFW
	$r =$ **0.7 to 0.8**	(B1)		AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$	(M1)		364 10916 406 13688 & **11803** (all 5 attempted)
	or			
	Attempt at S_{xx} S_{yy} & S_{xy}			1452 1914 & **1247** (all 3 attempted)
	Attempt at substitution into correct corresponding formula for r	(m1)		
	$r =$ **0.748**	(A1)	**3**	AWRT
(ii)	**Moderate/(fairly/quite) strong positive** (linear) correlation	Bdep1		Dependent on **$0.7 \leq r \leq 0.8$** OE; must **qualify strength** and state **positive**
	between **marks** on (the two) papers	B1	**2**	OE; providing **$-1 < r < +1$**
Notes	**1** Only accept phrases stated; ignore additional comments unless contradictory **2** Use of: "very/extremely/relatively strong or high or big or good or some or medium or average" ⇒ Bdep0 **3** Accept "relationship/association/link" but not "trend" instead of "correlation" **4** Do **not** accept "between papers" without further reference to marks			
(b) (i)	Group U: $r = \dfrac{34.57}{\sqrt{279.71 \times 112.86}}$	M1		Correct **numerical** form; can be implied by a **correct** answer
	$=$ **0.19 to 0.2**	A1	**2**	AWFW (0.19457)
(ii)	Group T **Some**/(fairly/quite/very) **weak**/**little**/**slight**/ (almost) **no**/**hardly any** (positive) correlation	B1		OE; must **qualify stren**gth
	Group U **Some**/(fairly/quite/very) **weak**/**little**/**slight**/ (almost) **no**/**hardly any** (positive) correlation	Bdep1	**2**	Dependent on **$0.19 \leq r_U \leq 0.2$** OE; must **qualify stren**gth
Notes	**1** Only accept phrases listed; ignore additional comments unless contradictory **2** Use of: "low or small or poor or bad or unlikely or relatively" ⇒ B0 **3** Accept "relationship/association/link" but not "trend" instead of "correlation" **4** "For each group" ⇒ B1 Bdep1 **5** "For both groups" ⇒ Bdep2 **6** "No reference to groups (OE)" ⇒ B0			
SC	**1** "Correlation in (a)(ii) is spurious (OE)" ⇒ B1			
(iii)	(Both mean) **marks** for Group T are (much) **larger** than those for Group U	B1		OE
	so extra **tuition** appears beneficial/effective	Bdep1	**2**	Ignore comments about r_T and r_U OE; dependent on B1
SC	**1** "Group T candidates may have been more motivated so would have performed better even without extra tuition (OE)" ⇒ B0 B1			
		Total	**11**	

Q	Solution	Marks	Total	Comments
4				**Accept percentage equivalent answers in (a)(ii) & (a)(iii) but see GN3**
(a)(i)	<table><tr><th></th><th>***M***</th><th>***M′***</th><th>**Total**</th></tr><tr><td>***E***</td><td>0.16</td><td>**0.12**</td><td>0.28</td></tr><tr><td>***E′***</td><td>**0.24**</td><td>**0.48**</td><td>**0.72**</td></tr><tr><td>**Total**</td><td>**0.40**</td><td>0.60</td><td>1.00</td></tr></table>	B1 B1 B1	**3**	0.12; CAO 0.4(0) and 0.72; CAO 0.24 and 0.48; CAO
(ii)	P(Buys exactly 1) = 0.12 + [0.24 or P($E' \cap M$) from (i)] = **0.36**	M1 A1	**2**	 CAO
(iii)	P($M \cap E$) = **0.16** which is **greater than/not equal to 0** **or** P($M \cup E$) = 1 – 0.48 = **0.52** but P(M) + P(E) = 0.40 + 0.28 = **0.68**	B2 (B2)	**2**	**Correct** comparison of 0.16 with 0 **Correct** comparison of 0.52 with 0.68
	Part (a)	**Total**	**7**	

Q	Solution	Marks	Total	Comments
4	**Continued** **Part (a)**	**Total**	**7**	
(b)	<table><tr><th></th><th>S</th><th>S'</th><th>Total</th></tr><tr><td>T</td><td>0.1700</td><td>0.1125</td><td>0.2825</td></tr><tr><td>T'</td><td>0.6800</td><td>0.0375</td><td>0.7175</td></tr><tr><td>Total</td><td>0.8500</td><td>0.1500</td><td>1.0000</td></tr></table>			**Accept percentage equivalent answers in (b) & (c)(ii) but see GN3** (No marks for this table; it is simply here to help marking)
(i)	P(4 papers) = P($M \cap E \cap S \cap T$) = $0.16 \times (0.85 \times 0.20)$ **or** 0.16×0.17 = **0.027**	M1 A1	**2**	All correct Can be implied by a **correct** answer AWRT (0.0272)
(ii)	P(0 papers) = P($M' \cap E' \cap S' \cap T'$) = $0.48 \times$ **(0.15 × 0.25)** **or** $0.48 \times$ **0.0375** = **0.018**	M1 A1	**2**	Seen Can be implied by a **correct** answer CAO (0.018)
(c) **(i)**	Chris (only) buys a **Friday morning** (newspaper) and a **Saturday** (morning) newspaper	B1 B1	**2**	Ignore additional comments about what he also does not buy
SCs	**1** "Chris does not buy either a Friday evening or a Sunday (morning) newspaper" (OE) ⇒ B1 **2** Statements of the form "(Friday morning) × (Saturday morning)" (OE) ⇒ B1 **3** Statements involving "probability and/or intersection" ⇒ B1 max			
(ii)	P($M \cap E' \cap S \cap T'$) = $0.24 \times$ **(0.85 × 0.80)** **or** $0.24 \times$ **0.68** = **0.163**	M1 A1	**2**	Seen Can be implied by a **correct** answer AWRT (0.1632)
Note	**1** $(0.40 \times 0.72 \times 0.85 \times 0.80) = 0.19584$ ⇒ M0 A0			
		Total	**15**	

Q	Solution	Marks	Total	Comments
5 (a)	Scatter diagram **4 or 3** points correct	B1	**1**	(within tolerances on template)
(b) (i)	b (gradient/slope) = **10.0** b (gradient/slope) = **9.75 to 10.25**	B2 (B1)		AWRT (10.00503) AWFW
	a (intercept) = **67.6 to 67.7** a (intercept) = **50 to 90**	B2 (B1)		AWFW (67.65292) AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ & $\sum xy$ **or** Attempt at S_{xx} & S_{xy} Attempt at substitution into correct corresponding formula for b	(M1) (m1)		690 49598 7580 & **542910** (all 4 attempted) $\left(\sum y^2 = 5995000\right)$ 1988 & **19890** (both attempted) (S_{yy} = 249360)
	b = **10.0** (AWRT) a = **67.6 to 67.7** (AWFW)	(A1 A1)	**(4)**	$\left(\overline{x} = 69 \text{ & } \overline{y} = 758\right)$
Notes	**1** Treat rounding of correct, but **not** of incorrect, answers as ISW **2** Written form of equation is **not** required **3** Award 4 marks for y = (67.6 to 67.7) + 10x **or** for (67.6 to 67.7) + 10x **4** Values of a and b interchanged and equation $y = ax + b$ **used** for drawing line ⇒ max of 4 marks **5** Values of a and b interchanged and equation $y = a + bx$ used for drawing line ⇒ 0 marks **6** Values are **not** identified or simply b/a = # and a/b = #, then 9.75 to 10.25 ⇒ B1 and 50 to 90 ⇒ B1 but accept, for example, as identification, [b = #, a = # with $y = a + bx$ but no substitution for b & a] **or** [slope/gradient(b) = #, intercept(a) = #] **7** Answers in fractions can score at most M1 m1 **8** Some/all of marks can be scored in (b)(ii), (b)(iii) & (c), even if some/all of marks are lost in (b)(i), but marks lost in (b)(i) **cannot** be recouped by subsequent working in (b)(ii), (b)(iii) or (c)			
	Scatter diagram **line** correct	B2	**(2)**	Within tolerance on template at least from x = 50 to x = 80
Notes	**1** If, and only if, B0, then award M1 for **seen correct** use of an equation for at least two points in range x = 35 to x = 100 **2** If, and only if, B0, then award M0 for points or line marked on scatter diagram without supportive working			
			6	
(ii)	b: **each/every customer** generates on average **£10** in **takings**	B1 BF1	**2**	F on b providing **$9.75 \le b \le 10.25$**
Notes	**1** To score any marks, an explanation must indicate change in x affecting change in y, **not** change in y affecting change in x **2** As x increases then y increases by 10 (OE; context **not** required) ⇒ B1 BF0 **3** Reference **only** to correlation ⇒ B0 BF0			
(iii)	a: takings when no customers cannot be > 0 **or** when $x = 0$ then $y = 0$ **or** never no customers/x never 0/x always > 0 **or** $x = 0$ is outside range/extrapolation	B1	**1**	OE
(c)	$y(50)$ = **£570**	B1	**1**	CAO; £ **not** required (£567.90) From calculation/graph/guesswork
		Total	**11**	

Q	Solution	Marks	Total	Comments
6	**Accept 3 dp rounding of probabilities from tables in (b)**			**Accept percentage equivalent answers in (a) & (b) but see GN3**
(a)	Use of B(24, 0.22) **or** B(40, 0.45)	M1		Indicated by an expression **or** by any one **correct** probability in **(a) or (b)**
	$P(C = 2) = \binom{24}{2}(0.22)^2(0.78)^{22}$	M1		**Fully correct** expression Can be implied by a **correct** answer Ignore extra terms
	= **0.056 to 0.057**	A1	**3**	AWFW (0.05647)
(b) **(i)**	$P(DC < 20)$ = **0.684 to 0.685**	B1	**(1)**	AWFW (0.6844)
(ii)	$P(DC > 15) = 1 -$ (**0.2142 or 0.1326**)	M1		Requires '1 – (either value)'
	= **0.785 to 0.786**	A1	**(2)**	AWFW (0.7858)
Note	**1** For stated answers: award **B2** for 0.785 to 0.786 (AWFW); **B1** for 0.867 to 0.868 (AWFW)			
(iii)	$P(12 \leq DC \leq 24)$ = **0.9804 or 0.9595** (p_1)	M1		Can be implied by a **correct** answer
	MINUS 0.0179 or 0.0386 (p_2)	M1		Can be implied by a **correct** answer
	= **0.96 to 0.963**	A1	**(3)**	AWFW (0.9625)
Notes	**1 First M1** is for $(+\boldsymbol{p_1})$ in a subtraction **2 Second M1** is for $(-\boldsymbol{p_2})$ in a subtraction **3** $(1 - p_2) - (1 - p_1) \Rightarrow$ M1 M1 (A1) **4** For stated answers: award **B3** for 0.96 to 0.963 (AWFW); **B2** for 0.94 (AWRT); **B1** for 0.92 (AWRT)			
			6	
(c)	$p = 1 - 0.22 - 0.45$ = **0.33**	B1		CAO; can be implied
	Mean $(\mu$ or $\bar{x})$ = 200×0.33 = **66**	B1		CAO
	Variance $(\sigma^2$ or $s^2)$ = $200 \times 0.33 \times 0.67$			
	= **44 to 44.3**	B1	**3**	AWFW (44.22)
Notes	**1** If answers are not identified, then assume that order of values is (p), mean, variance **2** When 44 to 44.3 is labelled as Sd(σ or s) $\Rightarrow$ B0			
SC	**1** If mean is calculated from $200p$ with $p \neq 0.33$ but $0 < p < 1 \Rightarrow$ B0 M1 B0			
		Total	**12**	

Q	Solution	Marks	Total	Comments
7				
(a)	Sd of $\bar{A}$ = **<u>0.43/√10 or 0.135 to 0.137</u>** **or** Var of $\bar{A}$ = **<u>0.43^2/10 or 0.0184 to 0.0186</u>**	B1		CAO/AWFW (0.13598) Can be implied in what follows CAO/AWFW (0.01849)
	$P(\bar{A} > 1.25) = P\left(Z > \dfrac{1.25-1.16}{0.43/\sqrt{10}}\right)$	M1		Standardising 1.25 with 1.16 and **(0.43/√10) OE**; allow (1.16 – 1.25)
	$= P(Z > 0.6619) = 1 - P(Z < 0.6619)$	m1		Correct area change Can be implied by a **correct** answer **or** by an **answer < 0.5**
	$= 1 - 0.74597$ = **<u>0.253 to 0.255</u>**	A1	**4**	AWFW (0.25403)
(b) **(i)**	96% (0.96) ⇒ z = **<u>2.05 to 2.06</u>** **<u>or</u>** ⇒ t = **<u>2.12 to 2.13</u>**	B1		AWFW (2.0537) AWFW (2.1247)
	CI for μ is $0.86 \pm \begin{pmatrix} 2.05 \text{ to } 2.06 \\ 2.12 \text{ to } 2.13 \\ 1.75 \text{ or } 1.80 \end{pmatrix} \times \dfrac{(0.65 \text{ to } 0.66)}{\sqrt{40 \text{ or } 39}}$	M2,1 (–1 ee)		Ignore any notation (1.75 & 1.80) are AWRT $0.65 \times \sqrt{\dfrac{40}{39}} = 0.65828$ No $\sqrt{n}$ ⇒ M0
	Hence **<u>0.86 ± (0.21 to 0.23)</u>** **or** **<u>(0.63 to 0.65, 1.07 to 1.09)</u>**	Adep1	**4**	CAO ± AWFW Dependent on award of M2 AWFW
Notes	**1** An incorrect expression for CI followed by a numerically correct CI ⇒ 2 solutions ⇒ ((0 or 1) + 4)/2 ⇒ 2 marks **2** Evaluation of only one CL ⇒ (B1) M0 Adep0 **3** Accept answers in grams			
(ii)	**Clear correct comparison** of **1.16** with **CI** eg 1.16 is above CI **or** UCL < 1.16	BF1		F on CI providing it does **not** contain 1.16 Must have found an **interval** in (i) but quoting values for CI or CLs is **not** required
	Agree with claim or accept claim **or** Weight of apples is (likely to be) greater than that of pears	Bdep1	**2**	OE; dependent on BF1
Notes	**1** Statement must clearly indicate that "1.16 is above/outside/not within the CI" OE **2** Statements of the form "It/mean/value/etc is above/outside/not within the CI" ⇒ BF0 **3** Statements of the form "1.16 is above/outside/not within 96% of the data/values/weights" ⇒ BF0 **4** Statements such as "Claim is likely/reasonable/supported/correct/true/possible/valid" ⇒ Bdep1 providing BF1			
			10	