Version 1.0 0607

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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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)	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 $\bar{x} \pm (z \text{ or } t) \times \frac{(s_{n-1} \text{ or } s_n)}{\sqrt{n}}$	M1		Used; must have $\sqrt{n}$ with $n > 1$
	Note that $25.1 \times \sqrt{\frac{50}{49}} = 25.35483$			$25.1 \times \frac{50}{49} = 25.61224$ Max of B1 M1 A0√ A1
	Thus $234 \pm (1.96 \text{ or } 2.009) \times \frac{(25.1 \text{ or } 25.3 \text{ to } 25.4)}{(\sqrt{50} \text{ or } \sqrt{49})}$	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 $\left(5.950\dot{0}\dot{9}\right)$
	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 $(\bar{x}) = \frac{\sum x}{13}$	(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**	