



General Certificate of Education

Mathematics 6360 Statistics 6380

MS/SS1B Statistics 1B

Mark Scheme

2008 examination - June 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.

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

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)	$P(\text{Blue}) = \frac{160}{400} = 0.4 \text{ or } \frac{2}{5} \text{ or } \frac{160}{400}$ <i>In (b) to (e), method marks are for single fractions, or equivalents, only</i>	B1	1	CAO; or equivalent
(b)	$P(\text{Marker}) = \frac{280}{400}$ $= 0.7 \text{ or } \frac{7}{10} \text{ or } \frac{280}{400}$	M1 A1	2	$270 \leq \text{Numerator} \leq 290 \text{ and}$ $\text{Numerator} < \text{Denominator} \leq 400$ CAO; or equivalent
(c)	$P(B \text{ or } M) = P(B \cup M) =$ $\frac{160 + 280 - 119}{400} = \frac{280 + 41}{400} = \frac{321}{400}$ $= 0.802 \text{ to } 0.803 \text{ or } \frac{321}{400}$	M1 A1	2	$290 \leq \text{Numerator} \leq 321 \text{ and}$ $\text{Numerator} < \text{Denominator} \leq 400$ AFW/CAO (0.8025)
(d)	$P(\text{Green} \mid \text{Highlighter}) = P(G \mid H) = \frac{42}{120}$ $= 0.35 \text{ or } \frac{7}{20} \text{ or } \frac{42}{120}$	M1 A1	2	$\text{Numerator} = 42 \text{ and}$ $110 \leq \text{Denominator} \leq 120$ CAO; or equivalent
(e)	$P(\text{Non-Permanent} \mid \text{Red}) = P(P' \mid R) = \frac{21}{90}$ $= 0.233 \text{ to } 0.234 \text{ or } \frac{7}{30} \text{ or } \frac{21}{90}$	M1 A1	2	$\text{Numerator} = 21 \text{ and}$ $80 \leq \text{Denominator} \leq 90$ AFW/CAO (0.2333)
Total			9	

MS/SS1B (cont)

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

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	Ordering: 0 0 13 28 35 40 47 51 63 77 a Median (6^{th}) = 40 IQR = $Q_3(9^{\text{th}}) - Q_1(3^{\text{rd}})$ = 63 – 13 = 50	M1 B1 (B1) B2	 4	May be implied by 40 and/or 63 and 13 CAO Identification of 63 and 13 CAO
(b)(i)	<i>Mode:</i> Zero is not representative / sensible reason Wide range of (known) values Small number of values mostly different	B1		Or equivalent
(ii)	<i>Range:</i> 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)	$P(X < 145) = P\left(Z < \frac{145-140}{2.5}\right) =$ $P(Z < 2) =$ $0.977 \text{ to } 0.98(0)$	M1 A1 A1	3	Standardising (144.5, 145 or 145.5) with 140 and $(\sqrt{2.5}, 2.5 \text{ or } 2.5^2)$ and/or $(140 - x)$ 2 CAO; ignore sign AWFW (0.97725)
(ii)	$P(138 < X < 142) =$ $P(X < 142) - P(X < 138) =$ $P(Z < 0.8) - P(Z < -0.8) =$ $P(Z < 0.8) - \{1 - P(Z < 0.8)\} =$ $(0.78814) - (1 - 0.78814) =$ $0.576 \text{ to } 0.58(0)$	M1 B1 m1 A1	4	Difference (142 - 138) 0.8 CAO Correct area change AWFW (0.57628)
(b)	$0.85 \text{ (85\%)} \Rightarrow z = -1.03 \text{ to } -1.04$ $z = \frac{x-140}{2.5}$ $= \pm 1.03 \text{ to } \pm 1.04$ <p>Hence $x = 137.3 \text{ to } 137.5$</p>	B1 M1 A1 A1	4	AWFW; ignore sign (-1.0364) Standardising x with 140 and 2.5; allow $(140 - x)$ Equating z -term to the z -value AWFW; CSO (137.41)
(c)	<p>Variance of $\bar{X}_4 = \frac{2.5^2}{4} = 1.56(25)$</p> <p>SD of $\bar{X}_4 = \frac{2.5}{2} = 1.25$</p> $P(\bar{X}_4 > 139) = P\left(Z > \frac{139-140}{\sqrt{2.5^2/4}}\right) =$ $P(Z > -0.8) = P(Z < 0.8) =$ $0.788 \text{ to } 0.79(0)$	B1 M1 m1 A1	4	CAO; stated or used Standardising 139 with 140 and 1.25; allow $(140 - 139)$ Correct area change 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
	$P(M \leq 15) = 0.69(0) \text{ to } 0.696$	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
	$= 0.84(0) \text{ to } 0.843$	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
	$= 0.266 \text{ to } 0.2665$	A1	3	AWFW (0.2662) Note: $B(10, 0.3) \Rightarrow 0.2668$
(c)(i)	$n = 20 \quad p = 0.71$	B1		Stated or used; may be implied by 14.2
	Mean, $\mu = np = 14.2$	B1		CAO
	Variance, $\sigma^2 = np(1-p) = 4.11 \text{ to } 4.12$	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 $\mu = 14.2$
	<i>Means and variances are different</i>	(B2, 1 dep)		
	Variance of 2.50 is smaller/different	B1dep		Dependent on $\sigma^2 = 4.11 \text{ to } 4.12$
	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) Standard deviation (s_{n-1} or σ_n) = 3.3(0) to 3.32 (3.00) to 3.5(0)) If no marks scored but $\sum fx$ attempted and result divided by 100	B2 (B1) B2 (B1) (M1)	 4 	CAO (190) AWFW AWFW (1452) AWFW (3.31967) AWFW (3.30303)
(ii)	Mean = $60 + \bar{x}$ = 61.9 Standard deviation = 3.3(0) to 3.32	M1 A1✓ B1✓	 3	✓ on (a)(i) ✓ 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) CI for μ is $\bar{x} \pm z/t \times \frac{s_{n-1} \text{ or } \sigma_n}{\sqrt{n \text{ or } n-1}}$ Thus $61.9 \pm 2.3263 \times \frac{3.3 \text{ to } 3.32}{\sqrt{100 \text{ or } 99}}$ Hence $61.9 \pm (0.7 \text{ to } 0.8)$ or $(61.1 \text{ to } 61.2, 62.6 \text{ to } 62.7)$	B1 M1 A1✓ A1	 4	AWFW (2.3263) AWFW (2.364) Used; must have \sqrt{n} with $n > 1$ ✓ on (a)(ii) and z/t only Accept $1.03 \pm (0.012 \text{ to } 0.013)$ AWFW Accept $(1.01 \text{ to } 1.02, 1.04 \text{ to } 1.05)$
(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)	$S > 1 \text{ hour or } 60 \text{ minutes:}$ Valid as $74/100$ or 0.74 or $74\% > 50\%$ $\bar{S} \gg 1 \text{ hour or } 60 \text{ minutes:}$ Not valid as $\text{UCL} \approx 1 \text{ hour}$ (Accept Both limits $\approx 1 \text{ hour}$)	B1 B1dep	 2	Must use 74 etc Or equivalent Dependent on UCL = 62.6 to 62.7 or UCL = 1.04 to 1.05
	Total		14	
	TOTAL		75	