



General Certificate of Education

Mathematics 6360 Statistics 6380

MS/SS1B Statistics 1B

Mark Scheme

2008 examination - January series

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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)	$P(X < 3.5) = P\left(Z < \frac{3.5-3.3}{0.16}\right) =$	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, $ 1 - z $ 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)	$r = \frac{416.3}{\sqrt{1280.55 \times 281.8}} =$ 0.69 to 0.7(0)	M1 A1	 2	Allow no $\sqrt{\quad}$ AWFW (0.693) (0.00115)
(b)	(Quite or fairly) weak / some / moderate (quite or fairly) strong positive correlation (relationship / association) between head & body length and tail length <i>Ignore subsequent alternative comments only if A1 B1 already scored</i> OR Some evidence that mice with large head & body lengths also have long tails	A1 B1 (A1) (B1)	 2 2	OE; must qualify strength and indicate positive A0 for poor / reasonable / average / medium / good A0 for very weak / very strong etc Context; accept 'body and tail' or even 'head and tail' OE; must qualify strength and indicate positive in context
(c)	0.69 to 0.7(0) OR Answer to (a)	B1 \checkmark	1	$0 < r < 1$
(d)	Existence of: Non-linear relationship Outliers More than one relationship Sensible related sketch SC: Check on calculation \Rightarrow B1 B0	B1 B1	 2	Any one; OE Not reasons identifiable from context (eg spurious)
	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 $3.27 \pm (0.13 \text{ to } 0.14)$ 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 $\sum xy$			160, 2758, 230 and 3915.75
	OR Attempt at S_{xx} and S_{xy}	(M1)		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)	$P(G \cap S') =$ $0.70 - (0.25 \text{ or } 0.55 \text{ or } 0.45)$ or $1 - 0.55$	M1		Can be implied only if answer is correct
	$= 0.45$	A1	2	CAO; OE
(iii)	$P(1 \text{ only}) =$ $0.70 + 0.55 - (2 \times 0.25)$ or $1 - 0.25$ or $0.45 + 0.30$	M1		Can be implied only if answer is correct; allow no ($\times 2$) but not by implication 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)	$P(H_G) = P(A_G \cap H_G) + P(A_{G'} \cap H_G) =$ $(0.70 \times 0.60) \text{ or } 0.42$ $(0.30 \times 0.10) \text{ or } 0.03$ $= 0.42 + 0.03 = 0.45$	M1 M1 A1	3	Can be implied by correct answer Ignore additional terms Can be implied by correct answer CAO; OE
(d)	$P(H_O) = 1 - [0.35 + (c)]$ $= 0.2(0)$	M1 A1	2	Can be implied by correct answer 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 ($\approx 190.5^{\text{th}}$) = 2	B2		CAO; B0 if shown method incorrect
	Interquartile range ($\approx 285.75^{\text{th}} - \approx 95.25^{\text{th}}$) = 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 and matched correctly with ≥ 5 x -values	(M1) (A1)		Allow for median = $1 + \frac{x}{99}$
(ii)	Mean (\bar{x}) = 2.56 to 2.57 (2.5 to 2.6)	B2 (B1)		AWFW (2.56316) AWFW $\sum fx = 974$ and $\sum fx^2 = 3546$
	Standard Deviation (s_n, s_{n-1}) = 1.66 to 1.67 (1.6 to 1.7)	B2 (B1)	4	AWFW (1.66187) AWFW (1.66406)
	If neither is correct but $\sum fx$ attempted and result divided by 380	(M1) (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)	$P(X \geq x) = 1 - P(X \leq x - 1)$ OR $= 1 - B(\Sigma x, 50, 0.08)$ $= 1 - 0.0827 = 0.915$ to $0.92(0)$	M1		Identified from an answer / $1 -$ answer Can be implied from a correct answer Identified from an answer/expression
(ii)	$P(X \geq 3)$ $= 1 - 0.2260 = 0.77(0)$ to 0.775	A1	4	AWFW (0.9173) ≥ 1 correct \Rightarrow M1 M1 AWFW (0.7740)
(b)(i)	$P(Y = 0) = (1 - 0.025)^{15} = 0.975^{15}$ $= 0.68(0)$ to 0.685	M1		Can be implied from correct answer
(ii)	$P(Y \geq 1) = 1 - (i)$ $= 0.315$ to $0.32(0)$	M1		Can be implied from answer if $\varepsilon(0, 1)$
(c)	Probability = [(b)(ii) \times (a)(i)] or (0.316×0.917) [(b)(i) \times (a)(ii)] or (0.684×0.774) $= 0.2898 + 0.529$ $= 0.81$ to 0.83	M1 M1 A1 A1	4	Ignore additional terms 2 terms added with ≥ 1 correct AWFW (0.8193)
	Total		12	
	TOTAL		75	