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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

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)	$P(X < 3.5) = P\left(Z < \frac{3.5-3.3}{0.16}\right) =$	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)	$r = \dfrac{416.3}{\sqrt{1280.55 \times 281.8}}$ =	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**	B1	2	Context; accept 'body and tail' or even 'head and tail'
	Ignore subsequent alternative comments only if A1 B1 already scored			
	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	B1	2	
	SC: Check on calculation $\Rightarrow$ B1 B0			
	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√	4	√ 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**	