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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MS1B Statistics 1B

Mark Scheme

2006 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.

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.

MS1B

Q	Solution	Marks	Total	Comments
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 Conclusion: Statement does not appear justified	 B1√ B1 dep	 3	 √ on CI in (a)(i) 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		numerator allow independence assumed
		M1		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	B1		CAO
	or two children (or both)	B1	2	or equivalent
(ii)	A detached house and/with	B1		CAO
	less than two children	B1	2	(0 or 1 must not include 'both')
	Total		**16**	
	TOTAL		**75**	