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# 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**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>1(a)(i)</b>	$r = 0.143$ 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 $\Sigma x \quad \Sigma x^2$ $\Sigma y \quad \Sigma y^2$ $\Sigma xy$			3952, 2228282 47.00, 292.0000 23517.50
	or Attempt at $S_{xx} \quad S_{yy} \quad S_{xy}$	M1		275994, 15.875, 299.5
	Attempt at a correct formula for $r$	m1		
	$r = 0.143$ to 0.1432	A1	3	AWFW
<b>(ii)</b>	Little/weak/no correlation/relationship/association between number of pages and (retail) price	B1		or equivalent; but not poor
		B1	2	context
<b>(iii)</b>	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>(b)</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
	<b>Total</b>		<b>8</b>	

**MS1B (cont)**

Q	Solution	Marks	Total	Comments
<b>2(a)</b>	Height, $X \sim N(185, 10^2)$			
<b>(i)</b>	$P(X < 200) = P\left(Z < \frac{200-185}{10}\right)$ $= P(Z < 1.5)$ $= \Phi(1.5) = 0.933$	M1  A1 A1	3	standardising (199.5, 200 or 200.5) with 185 and ( $\sqrt{10}$ , 10 or $10^2$ ) and/or $(185 - x)$  CAO; ignore sign AWRT (0.93319)
<b>(ii)</b>	$P(X > 175) = P\left(Z > \frac{175-185}{10}\right)$ $= P(Z > -1) = P(Z < 1)$ $= 0.841$	M1  m1 A1	3	standardising (174.5, 175 or 175.5) with 185 and ( $\sqrt{10}$ , 10 or $10^2$ ) and/or $(185 - x)$  area change AWRT (0.84134)
<b>(iii)</b>	$P(175 < X < 200) = (i) - [1 - (ii)]$ $= 0.93319 - [1 - 0.84134]$ $= 0.774 \text{ to } 0.775$	M1  A1 $\checkmark$	2	or equivalent  AWFW (0.77453) $\checkmark$ on (i) and (ii) providing $> 0$
<b>(b)</b>	Mean of $\bar{X} = 185$  Variance of $\bar{X} = \frac{10^2}{4} = 25$  $P(\bar{X} > 190) = P\left(Z > \frac{190-185}{5}\right)$ $= P(Z > 1) = 1 - \Phi(1)$ $= 0.159$	B1  B1  M1  A1 $\checkmark$	4	CAO; may be implied by use in standardising  CAO; or equivalent  standardising 190 with 185 and 5 and/or $(185 - 190)$  AWRT (0.15866) $\checkmark$ on (a)(ii) if used
		<b>Total</b>	<b>12</b>	

**MS1B (cont)**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>3(a)(i)</b>	Gradient, $b = -3.24$ to $-3.26$ $b = -3.2$ to $-3.3$	B2 B1		AWFW AWFW (-3.25)
	Intercept, $a = 262$ to $264$ $a = 260$ to $270$	B2 B1		AWFW AWFW (262.88)
	Attempt at $\Sigma x$ $\Sigma x^2$ $\Sigma y$ $\Sigma xy$ or Attempt at $S_{xx}$ $S_{xy}$			108, 1836, 2015, 22425 540, -1755
	Attempt at a correct formula for $b$ $b = -3.24$ to $-3.26$ $a = 262$ to $264$	M1 m1 A1 A1	4	AWRT AWFW
	Accept $a$ & $b$ interchanged only if identified correctly in (b) and (c)			
	<b>(ii)</b> Gradient, $b$ : Decrease in pressure per month Change in pressure	B2 B1	2	or equivalent or better
	<b>(iii)</b> Intercept, $a$ : Initial pressure or pressure at $x = 0$ Reference to 265, actual or expected value	B1 B1	2	or equivalent; not $y$ -intercept
	<b>(b)(i)</b> Value for $b = 2 \times$ [gradient or $b$ from (a)(i)] $= -6.4$ to $-6.6$	M1 A1 $\checkmark$	2	accept $2b$ ; ignore sign AWFW (-6.5) $\checkmark$ from (a)(i) but must be $< 0$
	<b>(ii)</b> $P_8 = 265 - 6.5 \times 8$  $= 212$ to $214$ ( $< 220$ )	M1  A1	2	must use 265 and $x = 8$ and $2 \times [b (< 0)$ from (a)(i)] or [from (b)(i) ( $< 0$ )] AWFW AG
	<b>Total</b>			<b>12</b>

**MS1B (cont)**

Q	Solution	Marks	Total	Comments
<b>4(a)(i)</b>	Mean, $\bar{x} = 505.2$	B1		CAO; stated or implied
	99% $\Rightarrow z = 2.57$ to 2.58	B1		AWFW (2.5758)
	or 99% $\Rightarrow t = 3.25$ (Knowledge of the $t$ -distribution is not required in this unit)	B1		AWRT (3.250)
	CI for $\mu$ is $\bar{x} \pm (z \text{ or } t) \times \frac{(\sigma \text{ or } s)}{\sqrt{n}}$	M1		use of; must have $(\div \sqrt{n})$ 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 $505.2 \pm 4.9$ or (500.3, 510.1)	A1	5	use of $t \Rightarrow 505.2 \pm 6.1$ AWRT
<b>(ii)</b>	Weights of packets can be assumed to be normally distributed	B1	1	accept ‘population of weights’; not ‘sample of weights’ or ‘it’
<b>(iii)</b>	Given sample: 3 in 10/ some of packets have weights below 500 grams	B1		or equivalent
	Confidence interval: CI > 500	B1✓		✓ on CI in (a)(i)
	Conclusion: Statement does not appear justified	B1 dep	3	or equivalent dependent on both B1 and B1✓
<b>(b)</b>	0.01 or 1%	B1	1	CAO; or equivalent
<b>Total</b>			<b>10</b>	

**MS1B (cont)**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>5(a)</b>	B(15, 0.3)	M1		use of in (a)
<b>(i)</b>	$P(K = 5) = P(K \leq 5) - P(K \leq 4)$ $P(K = 5) = \binom{15}{5} (0.3)^5 (0.7)^{10}$ $= 0.7216 - 0.5155 = 0.2055$ to 0.2065	M1 A1	3	may be implied AWFW (0.2061)
<b>(ii)</b>	(Fewer than) half $\Rightarrow 7$ or $7\frac{1}{2}$ or 8 Thus require $P(K \leq 7$ or $< 8)$ $= 0.9495$ to 0.9505	B1 M1 A1	3	stated or implied used or implied by correct answer AWFW (0.9500)
<b>(iii)</b>	$P(2 < K < 7) = 0.8689$ or 0.9500 minus 0.1268 or 0.2969 $= 0.7415$ to 0.7425 or B(15, 0.3) expressions stated for at least 3 terms within $2 \leq K \leq 7$ Answer	M1 M1 A1 M1 A2	3	AWFW (0.7421) or implied by a correct answer
<b>(b)(i)</b>	Mean, $\mu = np = 15 \times 0.4 = 6$ Variance, $\sigma^2 = np(1-p) = 6 \times 0.6 = 3.6$ Standard deviation $= \sqrt{3.6} = 1.89$ to 1.9	B1 M1 A1	3	CAO use of $\sigma^2 = np(1-p)$ AWFW; or equivalent
<b>(ii)</b>	Mean, $\bar{x} = 6$ Standard deviation, $s$ or $\sigma = 2.82$ to 2.99	B1 B1	2	CAO ( $\Sigma x = 60$ ) CSO if evidence of $np(1-p)$ or 1.9 AWFW; or equivalent. ( $\Sigma x^2 = 440$ )
<b>(iii)</b>	Means are same/equal Standard deviations are different Reason to doubt validity of Kirk's claim	B1 ✓ B1 dep B1 dep	3	✓ on 2 means; accept $\frac{6}{15} = 0.4$ if not contradicted by $\bar{x}$ in (ii) dependent on 2 correct SDs dependent on 2 correct SDs
	<b>Total</b>		<b>17</b>	

**MS1B (cont)**

Q	Solution	Marks	Total	Comments																								
<b>6</b>	<table border="1"> <tr> <td></td> <td>0 (R)</td> <td>1 (S)</td> <td>2 (T)</td> <td>≥3</td> <td>T</td> </tr> <tr> <td>D (D)</td> <td>24</td> <td>32</td> <td>41</td> <td>23</td> <td>120</td> </tr> <tr> <td>SD (D')</td> <td>40</td> <td>37</td> <td>88</td> <td>35</td> <td>200</td> </tr> <tr> <td>T</td> <td>64</td> <td>69</td> <td>129</td> <td>58</td> <td>320</td> </tr> </table>		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			
		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																							
<b>(a)(i)</b>	$P(D) = \frac{120}{320}$ or $\frac{3}{8}$ or 0.375	B1	1	CAO; or equivalent																								
<b>(ii)</b>	$P(D \cap R) = \frac{24}{320}$ or $\frac{3}{40}$ or 0.075	B1	1	CSO; or equivalent																								
<b>(iii)</b>	$P(D \cup T) = \frac{120+88}{320} = \frac{129+24+32+23}{320}$ $= \frac{208}{320} \text{ or } \frac{13}{20} \text{ or } 0.65$	M1 A1	2	CAO; or equivalent																								
<b>(iv)</b>	$P(D   R) = \frac{P(D \cap R)}{P(R)} = \frac{(ii)}{P(R)} = \frac{24/\cancel{(320)}}{64/\cancel{(320)}}$ $= \frac{24}{64} \text{ or } \frac{3}{8} \text{ or } 0.375$	M1 A1	2	M0 if independence assumed CAO; or equivalent																								
<b>(v)</b>	$P(R   D') = \frac{P(R \cap D')}{P(D')} = \frac{40/\cancel{(320)}}{200/\cancel{(320)}}$ $= \frac{40}{200} \text{ or } \frac{1}{5} \text{ or } 0.2$	M1 M1 A1	3	numerator allow independence assumed denominator CAO; or equivalent																								
<b>(b)(i)</b>	R and S or R and T or S and T	B1	1	not D and D'																								
<b>(ii)</b>	$P(D) = 0.375 = P(D   R)$ or (i) = (iv)  so YES	M1 A1	2	$P(D) \times P(R) = 0.375 \times 0.2$ $= 0.075 = P(D \cap R)$ or (ii) or $P(R   D) = P(R) = 0.2$ , etc																								
<b>(c)(i)</b>	A semi-detached house or two children (or both)	B1 B1	2	CAO or equivalent																								
<b>(ii)</b>	A detached house and/with less than two children	B1 B1	2	CAO (0 or 1 must not include 'both')																								
	<b>Total</b>		<b>16</b>																									
	<b>TOTAL</b>		<b>75</b>																									