GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics and Statistics B
MBS5

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Key to Mark Scheme

M	mark is for	method
m	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	accuracy
E	mark is for	explanation
√ or ft or F		follow through from previous incorrect result
cao		correct answer only
cso		correct solution only
awfw		anything which falls within
awrt		anything which rounds to
acf		any correct form
ag		answer given
sc		special case
oe		or equivalent
sf		significant figure(s)
dp		decimal place(s)
A2,1		2 or 1 (or 0) accuracy marks
–*x* ee		deduct *x* marks for each error
pi		possibly implied
sca		substantially correct approach

Abbreviations used in Marking

MC – *x*	deducted *x* marks for mis-copy
MR – *x*	deducted *x* marks for mis-read
isw	ignored subsequent working
bod	given benefit of doubt
wr	work replaced by candidate
fb	formulae book

Application of Mark Scheme

No method shown:	
Correct answer without working	**mark as in scheme**
Incorrect answer without working	**zero marks unless specified otherwise**
More than one method / choice of solution:	
2 or more complete attempts, neither/none crossed out	**mark both/all fully and award the mean mark rounded down**
1 complete and 1 partial attempt, neither crossed out	**award credit for the complete solution only**
Crossed out work	**do not mark unless it has not been replaced**
Alternative solution **using a correct or partially correct method**	**award method and accuracy marks as appropriate**

Mathematics and Statistics B Statistics 5 MBS5 June 2004

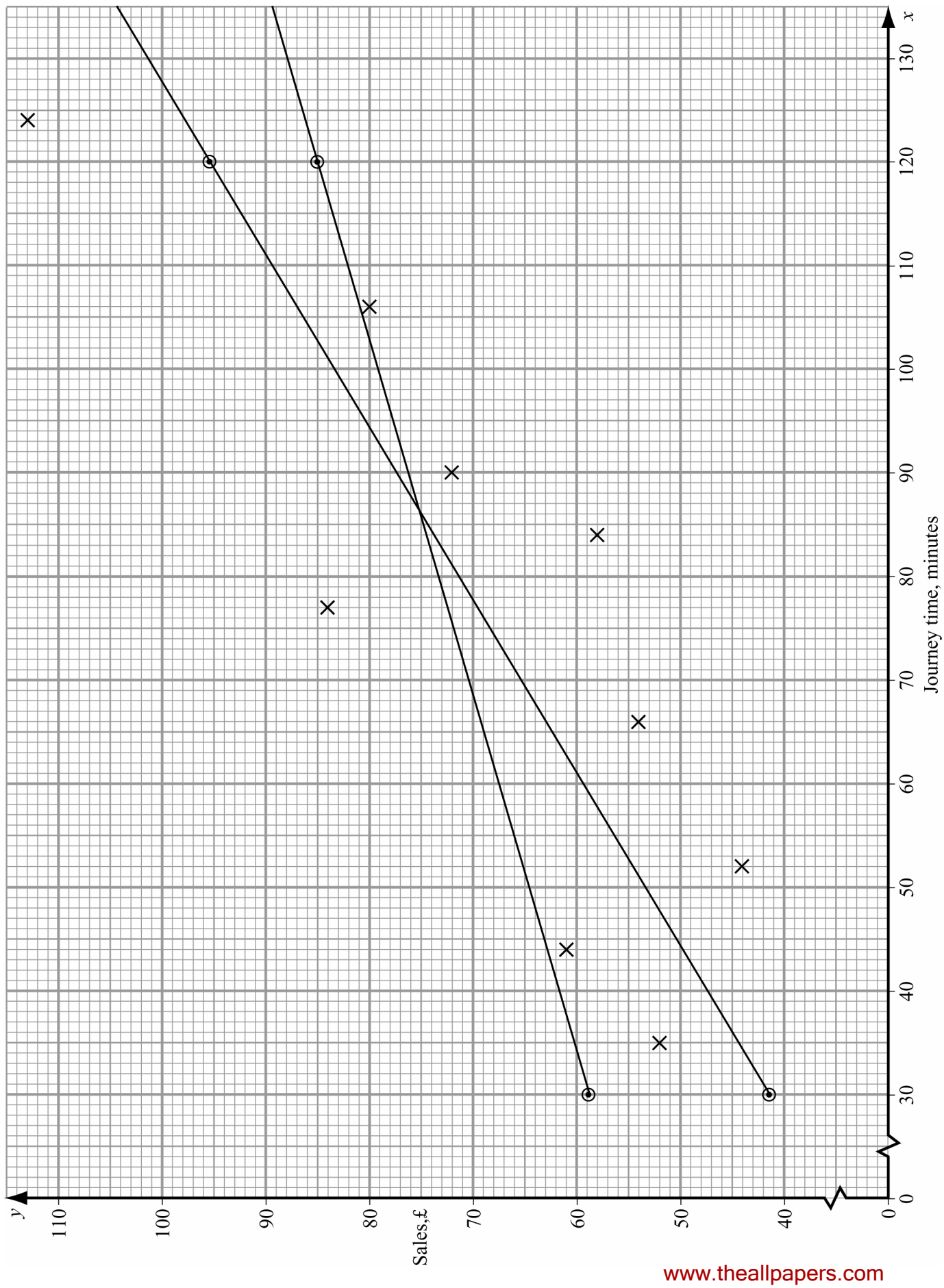
Question Number and Part	Solution	Marks	Total	Comments
1(a)	$r = 0.925$	B3	3	0.925 (0.924 to 0.925) Allow B2 (0.92 to 0.93) Allow M2 A1 if method shown
(b)	Although correlation coefficients are almost identical , data set A shows a distinct non-linear pattern while data set B appears to be random variation about a straight line.	E1 E1	2	Correlation coefficients similar but patterns differ A non-linear Allow correlation coefficient not suitable for A
	Total		**5**	
2(a)	H_0: $\mu = 200$ H_1: $\mu > 200$ $\bar{x} = 205.545$ $z = \frac{205.545 - 200}{\frac{6}{\sqrt{11}}} = 3.07$ cv for 5% 1-sided risk 1.6449 Reject H_0 Conclude mean time to spoilage is greater than 200 hours.	B1 B1 M1 m1 A1 B1 A1√	7	one correct hypothesis - generous both hypotheses correct - ungenerous use of $\frac{6}{\sqrt{11}}$ correct method for z - ignore sign 3.07 (3.06 to 3.07) 1.6449 (1.64 to 1.65) Correct conclusion - must be compared with correct tail of z
(b)	No problem unless the 3 containers sold could not be treated as a random sample. Unlikely to bias sample.	E1 E1	2	Comment on randomness of 3 containers Correct deduction Allow comment on reduced sample size
(c)	Claiming mean time to spoilage is more than 200 hours when it isn't	E1 E1	2	Idea of Type 1 error In context - must be 1-sided
(d)(i)	0.05	B1		0.05 cao
(ii)	0	B2	3	0 cao
	Total		**14**	

MBS5 (cont)

Question Number and Part	Solution	Marks	Total	Comments
3(a)	(see graph on next page)	M1		Method
		A1	2	Reasonably accurate plot by eye - allow one small slip.
(b)	$y = 23.4 + 0.601x$	B2		23.4 (23.35 to 23.45)
		B2		0.601 (0.6 to 0.602)
				Allow M1 A1 if method shown
	$x = 30$, $y = 41.4$ $x = 120$, $y = 95.5$ + line	M1		Method - their line
		A1	6	Accurate plot - by eye
(c)(i)	$72 - 23.39 - 0.6010 \times 90 = -5.5$	M1		Method for one residual - ignore sign
	$44 - 23.39 - 0.6010 \times 52 = -10.6$	m1		Method for both residuals - consistent signs
		A1	3	–5.5 (–5.4 to –5.6) and –10.6 (–10.6 to –10.7)
(ii)	12.0 allow 11.3	B1	1	12.0 (11.9 to 12) or 11.3(11.2 to 11.3)
(d)(i)	$x = 30$, $y = 58.9$ $x = 120$, $y = 85.0$ + line	M1		Method
		A1	2	Reasonably accurate plot (by eye)
(ii)	On average Ariane's sales are low on short journeys and higher on long journeys when compared to Desmond.	E1		Ariane lower on short journeys
		E1		Ariane higher on long journeys
	Desmond's sales more predictable	E1	3	Desmond more predictable/lower residuals
	Total		**17**	

MBS5 (cont)

Graph for Question 3



MBS5 (cont)

Question Number and Part	Solution	Marks	Total	Comments
4(a)	$\bar{x} = 135.6$	B1		135.6 cao
	95% confidence interval for mean is			
	$135.6 \pm 1.96 \times \frac{0.42}{\sqrt{9}}$	B1		1.96
		M1		Use of $\frac{0.42}{\sqrt{9}}$
	i.e. 135.6 ± 0.274	m1		Correct method for interval
	135.33 to 135.87	A1		Answer given to 4,5 or 6 sf
		A1	6	135.33 (135.3 to 135.4) and 135.87 (135.8 to 135.9) **Or** 135.6 cao ± 0.274 (0.274 to 0.275)
(b)	$135.8 \pm 1.96 \times \frac{3.9}{\sqrt{60}}$	M1		Correct method - their *z*
	135.8 ± 0.987			
	134.81 to 136.79	A1	2	134.81 (134.8 to 134.820) and 136.79 (136.78 to 136.8) **Or** 135.8cao ± 0.987 (0.98 to 1)
(c)(i)	Decrease	B1	1	Decrease
(ii)	Increase - narrower interval → more likely to identify need for overhaul if $\mu \neq 135.0$	E1		Increase
		E1	2	Reason
(d)	Large variability as in (b) will lead to unsatisfactory production even if mean on target. Might prefer small variability as in (a) even if mean slightly off target.	E1		Large variability unsatisfactory/makes deviation from 135 difficult to detect.
		E1	2	Small variability with mean slightly off target may be preferable
	Total		**13**	
5(a)	$0.6^3 = 0.216$	M1		Method
		A1	2	0.216 cao acf
(b)	$1 - 0.6^3 - 0.4^3$	M1		Attempt at 1 – P(GGG) – P(LLL) oe
		m1		Completely correct method
	$= 0.72$	A1	3	0.72 cao acf
(c)	L | LGL $0.4 \times 0.6 \times 0.4$	M1		Reasonable attempt at enumerating possibilities
	L | GLL $+ 0.6 \times 0.4 \times 0.4$			
		m1		Correct method
	$= 0.192$	A1	3	0.192 cao
(d)	0.4	M1		Method
		A1	2	0.4
(e)	L | GGG 0.6^3	M1		Reasonable attempt at enumerating possibilities
	L | LGGG $+ 0.4 \times 0.6^3$			
	L | GLGG $+ 0.4 \times 0.6^3$	m1		Reasonable attempt at evaluating probability
	L | GGLG $+ 0.4 \times 0.6^3$			
		ml		Completely correct method
	$= 0.475$	A1	4	0.475 (0.475 to 0.4755)
	Total		**14**	

MBS5 (cont)

Question Number and Part	Solution	Marks	Total	Comments
6(a)	$z_1 = \frac{18-19.5}{1.2} = -1.25$			
	$z_2 = \frac{16.5-19.5}{1.2} = -2.5$	M1 A1		Method for z ignore sign Both z's correct
	$P(16.5 < X < 18) = 0.99379 - 0.89435$	M1 m1		A correct use of normal tables Completely correct method
	$= 0.0994$	A1	5	0.0994 (0.099 to 0.1)
(b)(i)	$z = \frac{20-19.5}{\frac{1.2}{\sqrt{6}}} = 1.0206$	B1		use of $\frac{1.2}{\sqrt{6}}$
		M1 m1		Correct method for z Wholly correct method
	$P(\text{mean} > 20) = 1 - 0.8463 = 0.154$	A1	4	0.154 (0.153 to 0.155)
(ii)	2 hours allows 20 minutes per match. Assuming length of games are independent - even if no time is lost between games there is a non-trivial probability that 6 games will take longer than 2 hours.	E1 E1	2	Attempt to calculate average time per game Sensible conclusion
(c)	$\mu + 0.8416\sigma = 18$	B1		0.8416 and 1.7507
	$\mu + 1.7507\sigma = 19$	B1		Their $z \times \sigma$
	$0.9091\sigma = 1$	B1		Both correct equations ignore signs
	$\sigma = 1.10$ min	M1		Method for σ
	$\mu = 17.1$ min	m1		Method for μ
		A1	6	1.10 (1.09 to 1.11) and 17.1 (17 to 17.1)
	Total		**17**	
	TOTAL		**80**	