GCE 2004
June Series

AQA

Mark Scheme

Mathematics and Statistics B
MBS6

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.

Further copies of this Mark Scheme are available from:

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or

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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 6 MBS6 June 2004

Question Number And Part	Solution	Marks	Total	Comments
1(a)	$r = 0.846$ (calculator) **Or** $r =$ $\dfrac{\dfrac{150605}{15} - \left(\dfrac{2169 \times 1004}{15}\right)}{\left(\sqrt{318889 - \dfrac{2169^2}{15}}\right) \times \left(\sqrt{75030 - \dfrac{1004^2}{15}}\right)}$	B4	4	**sc** 2 marks for awrt 0.85 $\sum x = 2169 \quad \sum x^2 = 318889$ $\sum y = 1004 \quad \sum y^2 = 75030$ $\sum xy = 150605 \quad$ B1 Numerator = 5426.6 M1 Denominator = 72.468 × 88.481 M1 A1
1(b)	$H_0 \ \rho = 0$ $H_1 \ \rho > 0$ 1 tail 1% sig level	B1		
	cv = 0.5923	B1		For cv
	ts = $r = 0.846$ since ts > 0.5923 Reject H_0	M1		For comparison ts /cv
	Significant evidence to suggest that there is a positive correlation between height and pulmonary anatomical dead space as the paediatric doctor believed.	A1	4	Conclusion in context
	Total		**8**	

MBS6 (cont)

Question Number And Part	Solution	Marks	Total	Comments
2(a)	H_0 Populations of catalytic/non-catalytic systems are distributed identically	B1		Or H_0 : Pop average CO emissions for catalytic/non-catalytic systems are the same
	H_1 Populations of catalytic/non catalytic systems are not distributed identically – non-catalytic systems contain less carbon monoxide on average	B1		H_1: Pop average CO emissions are less for catalytic systems NB Many other methods acceptable
	1 tail 5% sig level			
	ranks 1 2 8 5 3 6 catalytic	M1 A1		For ranks as one group (can be reversed) For catalytic correct
	ranks 7 9 10 12 13 4 11 non-catalytic	A1		For non-catalytic correct
	$T_{\text{catalytic}} = 25$ $T_{\text{non-catalytic}} = 66$	m1		Totals
	$U = 25 - \dfrac{6 \times 7}{2} = 4$	m1		Method consistent for test stat
	test stat = 4	m1		Or $U = 66 - \dfrac{7 \times 8}{2} = 38$ upper tail
		A1		Either test stat OK, upper or lower
	cv = 9 (lower tail)	B1		For either tail cv, consistent with test stat Allow B1 ft provided sensible/correct method
	Since $4 < 9$, reject H_0	M1		For comparison t.s./critical value (ft if cv sensible , cv =7 allowed M1)
	Significant evidence to suggest that populations are not identical and that exhausts with a catalytic system contain less carbon monoxide on average	A1	12	
(b)	Minimum value for T is $1 + 2 + 3 + 4 + 5 + 6 = 21$	M1		Or equivalent
	Minimum value for $U = 21 - \dfrac{6 \times 7}{2}$ $= 0$	A1		
	Maximum value for T is $7 + 8 + 9 + 10 + 11 + 12 + 13 = 70$	M1		Or equivalent
	Maximum value for $U = 70 - \dfrac{7 \times 8}{2}$ $= 42$	A1	4	
	Total		**16**	

MBS6 (cont)

Question Number And Part	Solution	Marks	Total	Comments
3 (a)(i)	$P(B \cup C) = P(B) + P(C) - P(B \cap C)$ $= P(B) + P(C) - P(B) \times P(C)$ Let $x = P(C)$ $0.28 = 0.1 + x - (0.1x)$ so $0.18 = 0.9x$ $x = 0.2$	M1 M1 M1 A1	 4	For attempt at formula For independent events **sc** M2 if $P(C) = 0.28 - 0.1 + 0.02$ For attempt at $x = P(C)$ For showing $P(C) = 0.2$ or using 0.2 and demonstrating 0.28 **ag**
(ii)	$P(C' \cup B') = P(C') + P(B') - P(C' \cap B')$ $= 0.8 + 0.9 - (0.8 \times 0.9)$ $= 0.98$	M1 A1	 2	 For attempt at formula
(b)(i)	$0.1 \times 0.7 \times 0.8 = 0.056$	M1 A1	 2	
(ii)	(i) $+ (0.9 \times 0.7 \times 0.2)$ $+ (0.9 \times 0.3 \times 0.8)$ $= 0.056 + 0.126 + 0.216 = 0.398$	M1 M1 A1	 3	
(iii)	$\dfrac{0.216}{0.398} = 0.543$	M1✓ M1✓ A1	 3	For 0.216 ft For 0.398 ft
Total			**14**	
4 (a)	H_o Population median $= 6.6$ hours H_1 Population median $\neq 6.6$ hours 2 tail test 10% sig level Signs $- + + + + + + + . + + + - - + +$ t.s. $12+$ or $3-$ B(15,0.5) model P(12 or more $+$) = P(3 or less $-$) $= 0.0176 < 0.05$ Reject H_0 Significant evidence to suggest patients taking new tablet have a different median number of hours sleep	B1 M1 A1 M1 M1 M1 A1	 7	 Signs If Wilcoxon allow M1 A1 Model used Correct prob Compare probability and 5%

MBS6 (cont)

Question Number And Part	Solution	Marks	Total	Comments
4(b)(i)	H_0 Population average hours sleep same for new and existing tablet	B1		
	H_1 Population average hours sleep greater for new tablet.			
	1 tail test 5% sig level			
	Differences			
	8, .1, –.1, –.4, .7, 1.0, .3, .9, –.5, .2	M1		For differences
	Ranks			
	8, 1½, –1½, -5, 7, 10, 4, 9, –6, 3	m1		For ranks
		A1		Ranks correct
	$T_+ = 12½$	m1		For attempting totals - either
	$T_- = 42½$	A1		
	critical value = 11	B1		
	test statistic = 12½			
	test statistic > 11	M1		For comparison ts/cv
	No significant evidence to reject H_0			
	Conclude that the average number of hours slept is not greater with the new tablet	A1	9	
(ii)	So that any effect of taking one of the tablets before or after the other is fairly dealt with and the effect the tablets taken can be detected.	B1	1	Order effect noted Concept of 'fair' order enabling any difference to be detected
(iii)	A paired design is preferred because it ensures that any differences between individual patients are eliminated so that a difference in tablets taken can be detected.	B1 B1	2	Generous Well explained Or, it is a more powerful test
	Results are contradictory –more powerful Wilcoxon test would be expected to detect a difference and yet it did not, when the single sample sign test in (a) did detect a difference	B1 E1 E1	3	Contradictory Allow Type 1 or Type II error in context Unexpected that paired test did not detect difference when single sample test did - with valid reason
	Total		**22**	
	TOTAL		**60**	