GCE 2005
January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics and Statistics B
(MBS6)

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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 ..... method and accuracy
E ..... mark is for ..... explanation
√ **or ft or F** ..... follow through from previous incorrect result
CAO ..... correct answer only
AWFW ..... anything which falls within
AWRT ..... anything which rounds to
AG ..... answer given
SC ..... special case
OE ..... or equivalent
A2,1 ..... 2 or 1 (or 0) accuracy marks
-*x* EE ..... deduct *x* marks for each error
NMS ..... no method shown
PI ..... possibly implied
SCA ..... substantially correct approach
c ..... candidate
SF ..... significant figure(s)
DP ..... decimal place(s)

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 booklet

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

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Question Number and Part	Solution	Marks	Total	Comments
1(a)(i)	145/250 = 29/50 = 0.58 (or 58%)	B1		
(ii)	80/250 = 8/25 = 0.32 (or 32%)	B1		
(iii)	120/250 = 12/25 = 0.48 (or 48%)	B1		
(iv)	65/120 = 13/24 = 0.542 (or 54.2%)	M1		for using 120
		A1	5	
(b)(i)	$1 - (0.8)^4 = 0.590$ = 5904/10000 (or 59.0%)	M1		for 0.8^4
		A1	2	
(ii)	P(+ve response) =			
	$(0.2 \times 0.9) + (0.8 \times 0.15)$	M1		
	= 0.3	A1		
	P(not suffering | +ve response) =			
	$(0.8 \times 0.15) / 0.3$	M1		
	= 0.12 / 0.3 = 0.4 or 2/5 (or 40%)	A1	4	
	Total		**11**	
2(a)	H_0 Population median assessment mark same for both diets	B1		
	H_1 Population median assessment mark higher for diet A			
	1 tail test 1 % level			
	differences			
	1 2 3 4 5 6 7 8 9 10	M1		for differences
	12 10 -5 15 -1 7 13 7 9 4			
	ranks	M1		for ranks (1 = lowest) and
	8 7 -3 10 -1 4½ 9 4½ 6 2	A1		ties
	$T_+ = 8+ 7+ 10+ 4½+ 9 +4½ +6 +2 = 51$	M1		for totals
	$T_- = 1 + 3 = 4$			
	test stat $T = 4$	A1		correct test stat
	critical value = 5	B1		for cv
	test stat < 5 so Reject H_0	M1		for comparison ts/cv
	There is significant evidence that the median assessment mark is higher for diet A	A1	9	
(b)(i)	$T = 0$	B1		
(ii)	$T = 55$	M1		effort to total $\sum_{n=1}^{n=10} n$
		A1	3	
	Total		**12**	

MBS6 (cont)

Question Number and Part	Solution	Marks	Total	Comments
3(a)(i)	ranks IQ $2\frac{1}{2}$, $5\frac{1}{2}$, 10, $5\frac{1}{2}$,1 ,4 , 7, 12 , 8 ,$2\frac{1}{2}$, 9 ,11 MRI 2, 3, 10, 4 , 1 ,8 , 6, 11, 9 , 5 , 12 , 7	M1 A1		for ranks
	r_s (from calculator) = 0.793	B3	5	**alternatively** differences, d $\frac{1}{2}$, $2\frac{1}{2}$, 0, $1\frac{1}{2}$, 0, 4, 1, 1, 1, $2\frac{1}{2}$, 3, 4 $\sum d^2 = 59$ B1 $r_s = 1 - \frac{6\times 59}{12\times 143} = 0.794$ M1, A1
(ii)	H_0 $\rho_s = 0$ H_1 $\rho_s > 0$ 1 tail 5% test stat r_s = 0.793 (or 0.794) critical value = 0.5035 tests stat > 0.5035 so significant evidence exists to reject H_0 and conclude that a positive association exists. This suggests that students who have a higher IQ score also have a higher MRI count (brain size).	B1 B1 M1 A1	4	for cv comparison ts/cv explanation in context
(b)	r = –0.390 (from calculator)	B4	4	**or** $r = \frac{1826142 - \frac{11373\times 1932}{12}}{196.35\times 64.16}$ = –0.390 B1 for $\sum xy$ M1 for numerator M1 for denominator A1 awrt
(c)	Part (b) indicates that there is no obvious conclusion that heavier people have larger brains Part (a) indicates that people with a higher IQ do have larger brains. No causal link can be assumed however. Conclusions can only be drawn regarding right-handed male students – not in general	B1 B1 E1	3	
	Total		**16**	

MBS6 (cont)

Question Number and Part	Solution	Marks	Total	Comments
4(a)	H_0 samples from identical pops	B1		or H_0 blood pressures the same
	H_1 samples not from identical pops	B1		H_1 blood pressures differ allow B1 only
	2 tail 5% significance level			
	Ranks			
	'Thinking'	M1		for ranks as one group
	8 12 5½ 5½ 4 9½ 15 1 3	M1		for ties (9½ only needed)
	'Feeling'			
	11 9½ 14 7 17 18 2 16 13	A1		
	$T_{thinking}$ = 63½	M1		for totals, either correct
	$T_{feeling}$ = 107½	A1		
	$U_p = 63½ - ½(9 \times 10) = 18½$	M1		for U values, either
	$U_c = 107½ - ½(9 \times 10) = 62½$	A1		
	test stat $U = 18½$			note: various other alternative methods accepted
	critical value = 18	B1		for use of correct cv consistent with U
	test stat > 18 Accept H_0	M1		comparison of ts/cv
	No significant evidence (just) to doubt that the samples are from different populations (or no evidence to suggest that there is a difference in average diastolic blood pressure for the two personality groups)	A1	12	
(b)(i)	A paired comparison is preferred as it reduces experimental error/bias and is more likely to detect a difference if one exists.	B1	1	Idea of reduction of experimental error
(ii)	There are two distinct, different groups of men involved and the comparison required is between groups that are	E1		for idea of 2 groups
	different in nature. Therefore each pair, by definition, must differ.	E1	2	for coherent explanation
(c)	H_0 Managers have no specific preference ($\pi = ½$)	B1		
	H_1 Managers prefer new pay structure ($\pi > ½$)			
	1 tail test 1% sig level			
	discard 3 as they had 'no opinion'			
	test stat = 35+ or 15 –	M1		for signs
		B1		for correct test stat
	B(50, 0.5) model	M1		for Bin model $n = 50$
	P(at most 15-) = (at least 35+) = 0.0033 < 0.01 for 1 tail test	M1		probability and comparison with 0.01 or use of critical region $\{0,1\ldots16^{-}\}$ or $\{33,34\ldots50^{+}\}$ prob 0.0077
	Reject H_0			
	There is significant evidence to suggest that managers prefer new pay structure	A1	6	
	Total		**21**	
	TOTAL		**60**	