AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Mathematics & Statistics B

Unit MBS3

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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 mark 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		Perhaps implied
c		Candidate

Abbreviations used in marking

MC – *x*	deducted *x* marks for miscopy
MR – *x*	deducted *x* marks for misread
ISW	ignored subsequent working
BOD	gave benefit of doubt
WR	work replaced by candidate

Application of mark scheme

Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

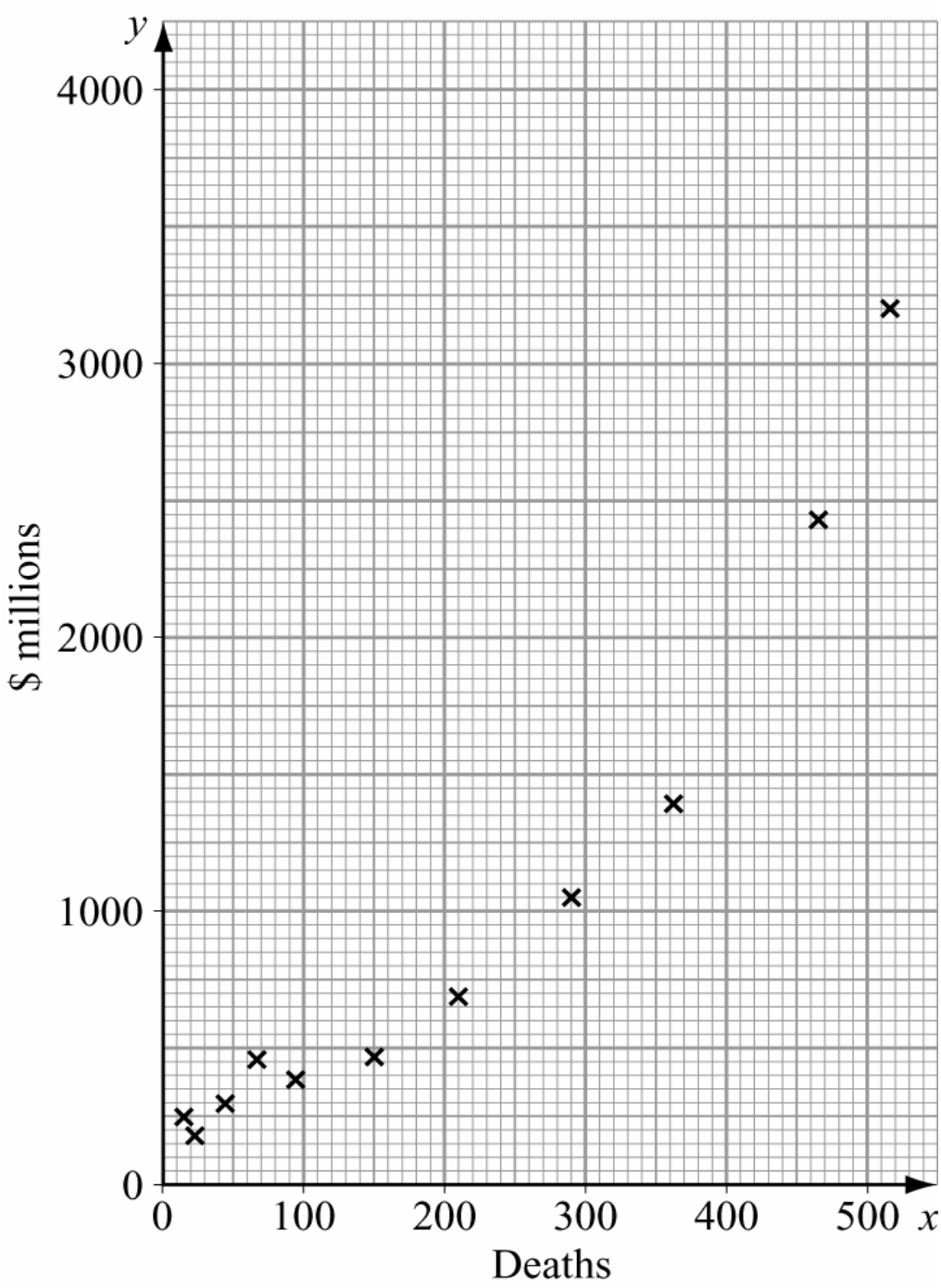
Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

Question Number and Part	Solution	Marks	Total	Comments
1(a)	H_0 Population median purchases = 11 H_1 Population median purchases > 11 1 tail test 10% level	B1		
	signs - - + - + + + + + - + + + + - + - + - -	M1		For signs
	test stat = 8 -/12 +	A1		For test stat (6 and 12 M1A0)
	Bin (20, 0.5) model	M1		For use of Bin model
	P(≤ 8 -) = 0.2517 > 0.10	M1		For comparison ts and 10%
	Accept H_0 . No significant evidence to suggest median has increased	A1	6	
(b)	Distribution of purchases is skew or Wilcoxon requires symmetric distribution	B1	1	
	Total		**7**	
2(a)(i)	$0.4\times 50 + 0.1\times 30 = 23$	M1		M1 for 0.4×50 etc
		M1		M1 for total 23
	prob = $\frac{23}{80}$ or 0.287(5)	A1	3	A1 correct (accept %)
(ii)	$\frac{20}{23}$ or 0.870	M1		M1 for denominator
		A1	2	A1 correct
(b)(i)	$0.10 + 0.20 - 0.25 = 0.05\left(\frac{1}{20}\right)$	M1A1	2	
(ii)	$\frac{0.05}{0.20} = \frac{5}{20} = \frac{1}{4} = 0.25$	M1		for denominator
		A1	2	
	Total		**9**	

Question Number and Part	Solution	Marks	Total	Comments
3(a)	H_0 Samples of MTBE levels are from identical popluations			H_0 pop median weekend = pop median midweek
	H_1 Populations are not identical – MTBE levels are higher during weekends	B1		H_1 pop median weekend < pop median midweek
	1tail 5% level			
	ranks			N.B. Many other acceptable methods
	weekend			
	19, 8, 16, 7, 11, 5, 15, 18, 14, 17	M1		For ranks together
	midweek-	A1		A1 for 15 correct
	10, 2, 12, 3, 1, 9, 13, 6, 4	A1		
	$T_{\text{weekend}} = 130$			
	$T_{\text{midweek}} = 60$	m1A1		For totals (either)
	test stat			
	$U = 60 - (\frac{9\times10}{2}) = 15$ lower tail	M1A1		For test stat either correct (upper tail $U = 130 - (\frac{10\times11}{2}) = 75$)
	cv = 24	B1		
		B1		For cv/consistent with tail used for U
	$U < 24$ Reject H_0	M1A1		For comparison ts/cv
	There is significant evidence to reject H_0 and conclude that levels of MTBE are higher at weekends than midweek.	E1√	13	ft if cv B0B1
(b)	A Type II error would be to conclude that there was no increase in MTBE levels at the weekend when, in fact, there was an increase.	B1		Concept of Type II
		B1	2	In context
	Total		**15**	

Question Number and Part	Solution	Marks	Total	Comments
4(a)	(See scatter diagram on next page)	B1 M1 A1	3	Axes/scales
(b)	ranks	M1		For ranks
	x 2, 6, 11, 9, 10, 1, 8, 4, 5, 7, 3	A1		
	y 2, 7, 10, 9, 11, 1, 6, 4, 5, 8, 3	A1		
	r_s (from calculator) = 0.964	B3	6	**Alternatively:** Differences, d 0, 1, 1, 0, 1, 0, 2, 0, 0, 1, 0 $\sum d^2 = 8$ B1 $r_s = 1 - \frac{6\times 8}{11\times 120} = 0.964$ M1, A1
(c)	H_0 $\rho_s = 0$ H_1 $\rho_s > 0$ 1 tail 1% test stat r_s = 0.964 critical value = 0.700	B1		
	tests stat > 0.700 so significant evidence exists to reject H_0 and conclude that a direct association exists	B1 M1		
	This suggests that floods, in which there is a higher death toll, also result in a greater cost in property damage.	A1	4	Must be in context
(d)	There is clear evidence of a non linear relationship.	B1	1	
	Total		**14**	

Graph for Q 4(a)



Question Number and Part	Solution	Marks	Total	Comments
5(a)	H_0 Population average scores same for both tests H_1 Population average scores differ 2 tail test 5% level differences	B1		Or H_0 $\eta_{diff} = 0$ H_1 $\eta_{diff} \neq 0$
	A B C D E F G H I J K L 4 -9 3 -5 15 12 -4 -8 -3 -1 -2 -7 ranks	M1		For differences
	5½ 10 3½ 7 12 11 5½ 9 3½ 1 2 8	m1m1		For ranks (1 = lowest) and
	$T_+ = 5½ + 3½ + 12 + 11 = 32$	A1		ties
	$T_- = 10+ 7 + 5½ + 9 + 3½ + 1 + 2 + 8 = 46$	m1		For totals $T = 34$ M0 etc
	test stat $T = 32$	A1		correct test stat
	critical value = 14	B1		for cv
	test stat > 14 so Accept H_0	M1		for comparison ts/cv
	There is no significant evidence of a difference in average scores for the two tests	A1	10	
(b)	PMCC $r = 0.891$ (3 sf) (from calculator)	B3	3	or $r = \dfrac{53856 - \dfrac{783\times788}{12}}{49.115\times55.737}$
	sc $r = 0.89$ or 0.890 M2A0			= 0.891 (3 sf) M1, M1, A1
(c)	There is no significant difference in average scores and there is high direct correlation which implies the two tests are consistent and equally effective.	B1 E1	2	for linking similar averages/high PMCC no ft for interpretation
	Total		**15**	
	TOTAL		**60**	