

GCE 2004

June Series



Mark Scheme

Mathematics A

Unit MAS4/W

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.

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Dr Michael Cresswell Director General

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

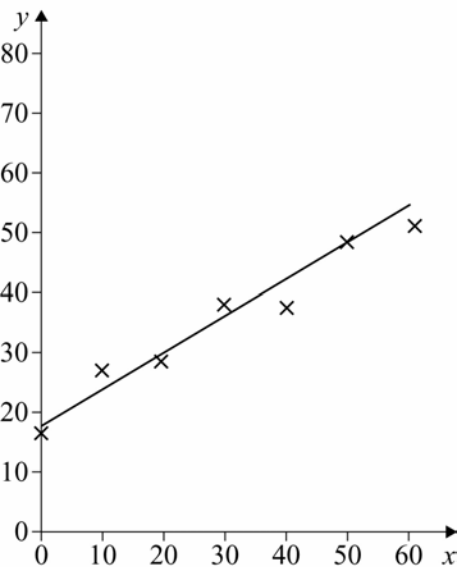
MAS4/W

Q	Solution				Marks	Total	Comments
1(a)	Rank	Judge 1	Judge 2	Rank			
	3	46	56	1			
	5	42	47	3			
	8	33	35	7	M1		Ranking
	1	57	32	8			
	5	42	51	2	A1		
	7	38	45	4			
	2	54	40	5			
	5	42	38	6			
		$\sum d^2 = 4+4+1+49+9+9+9+1$ $= 86$				M1	
					A1		Accept r on ranks
	$r^2 = 1 - \frac{6 \times 86}{8 \times 63} = -0.0238$				A1	5	-0.0488
(b)	D, C, H, G, F, B, E, A				B2	2	Accept in reverse order
(c)	Difficult to choose winner				E1		
	No correlation between 1 and 2 3 totally disagrees with 2				E1	2	
Total						9	

MAS4/W (Cont)

Q	Solution	Marks	Total	Comments			
2(a)	$S_{xy} = 1335 - \frac{52 \times 225}{8} = -127.5$	B1	5				
	$S_{xx} = 380 - \frac{52^2}{8} = 42$	B1					
	$S_{yy} = 7007 - \frac{225^2}{8} = 678.875$	B1					
	$r = \frac{-127.5}{\sqrt{42 \times 678.875}} = -0.755$	M1 A1					
(b)	$H_0: p = 0 \quad H_1: p < 0$	B1	4	Both			
	C.V (2.5%) = -0.7067	B1		Comparing			
	-0.755 < -0.7067	M1					
	\Rightarrow Reject H_0 so implying $p < 0$	A1					
(c)	Increase foot patrols to reduce crime	E1✓	1				
Total			10				
3(a)	$E(p) = \theta, \text{Var}(p) = \theta \frac{(1-\theta)}{n}$	B1, B1	2				
(b)	n is large (≥ 30)	B1	2				
	p not small or not large ($0.1 < p < 0.9$)	B1					
(c)	$0.9 \pm 1.96 \sqrt{\frac{0.9 \times 0.1}{200}}$	B1 M1 A1 A1	4	Z } variance			
	(0.858, 0.942)						
	Total					8	

MAS4/W (Cont)

Q	Solution	Marks	Total	Comments
4(a)		B3	3	Plots B2 Axes and scale B1
(b)(i)	$S_{xy} = 9020 - \frac{210 \times 248}{7} = 1580$ $S_{xx} = 9100 - \frac{210^2}{7} = 2800$ $b = \frac{1580}{2800} = 0.564$ $\bar{x} = \frac{210}{7} = 30, \bar{y} = \frac{248}{7}$ $a = \frac{248}{7} - \left(\frac{158}{280}\right) \times 30 = 18.5$ $y = 18.5 + 0.564x$	M1 A1 B1 M1	5	Both
(ii)	Draws a line (0, 18.5, 60, 52.4)	B1	1	
(c)(i)	$z = \text{Time available} - \text{Time taken}$ $= (100 - x) - (a + bx)$ $= (100 - a) - (1 + b)x$	M1 A1 A1	3	
(ii)	$z = 81.5 - 1.564x$ <p>For $z = 0$</p> $x = \frac{81.5}{1.564} \Rightarrow 52$ <p>The latest is 7.52 a.m.</p>	B1√ M1 A1	3	CAO
Total			15	

MAS4/W (Cont)

Q	Solution	Marks	Total	Comments
5(a)	$H_0: P_m - P_E = 0 \quad H_1: P_m - P_E \neq 0$	B1		Both
	$\text{Var (diff)} = \frac{0.49 \times 0.51}{200} + \frac{0.37 \times 0.63}{200}$	M1		Accept pooling
	$z_{\text{calc}} = \frac{0.12 - 0}{0.04914\dots} = 2.4419$	M1 A1		$z = 2.424$ z
	$z_{\text{calc}} = \frac{0.12 - 0}{0.04914\dots} = 2.4419$	B1		Condone absence of minus (looking at upper tail)
	\Rightarrow Reject H_0 . The proportions are not the same at the 5% level.	A1 \checkmark	6	
(b)(i)	$0.12 \pm 2.5758 \times 0.04914$	M1		
	$(-0.0066, 0.2466)$	A1	2	Accept $(-0.0065, 0.2465)$
(ii)	The conclusion would be different, since zero lies in the C.I. found in (b)	E1 E1	2	
Total			10	

MAS4/W (Cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$\sigma^2 = E(X_i^2) - \mu^2$ $\Rightarrow E(X_i^2) = \sigma^2 + \mu^2$ $\text{Var}(\bar{X}) = E(\bar{X}^2) - \mu^2 = \frac{\sigma^2}{n}$ $\Rightarrow E(\bar{X}^2) = \frac{\sigma^2}{n} + \mu^2$	B1	2	
		B1		
(ii)	$nV = \sum_1^n X_i^2 - n\bar{X}^2$ $\Rightarrow E(nV) = E\left(\sum_1^n X_i^2\right) - E(n\bar{X}^2)$ $= n(\sigma^2 + \mu^2) - (\sigma^2 + n\mu^2)$ $= (n-1)\sigma^2$ $\Rightarrow E\left(\frac{nV}{n-1}\right) = \sigma^2$	M1	3	AG
		M1		
		A1		
		A1		
(b)	$S^2 = \frac{2700}{10} - \left(\frac{150}{10}\right)^2$ $= 270 - 225$ $= 45$ $\sigma^2 = \frac{10}{9} \times 45$ $= \frac{450}{9}$ $= 50$	M1	3	
		A1		
		A1		
		A1		
	Total		8	
	Total		60	