GCE 2005
January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics A
(MAS4)

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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

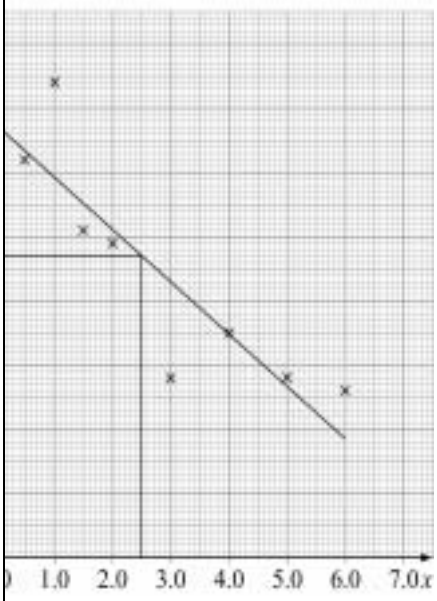
MAS4

Q	Solution	Marks	Total	Comments
1(a)(i)	<table><tr><th>Judge 1</th><th>Judge 2</th><th>d^2</th></tr><tr><td>1</td><td>4</td><td>9</td></tr><tr><td>2</td><td>2</td><td>0</td></tr><tr><td>3</td><td>6</td><td>9</td></tr><tr><td>4</td><td>7</td><td>9</td></tr><tr><td>5</td><td>1</td><td>16</td></tr><tr><td>6</td><td>3</td><td>9</td></tr><tr><td>7</td><td>5</td><td>4</td></tr><tr><td></td><td></td><td>56</td></tr></table>	M1 A1		$\sum d^2$
	$r_s = 1 - \frac{6\times 56}{7\times 48} = 0$	M1A1	4	(Accept *r* on ranks)
(ii)	The judges neither agree nor disagree	E1	1	
(b)(i)	They agree perfectly	E1	1	
(ii)	<table><tr><td>**Judge 1**</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>**Judge 2**</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr></table>	E1	1	OE
	Total		**7**	
2(a)	$S_{XX} = 219 - \frac{33^2}{7} = 63.428\ldots$	B1		
	$S_{YY} = 83.45 - \frac{16.1^2}{7} = 46.42$	B1		
	$S_{XY} = 35.6 - \frac{33\times 16.1}{7} = -40.3$	B1		
	$r_{xy} = \frac{-40.3}{\sqrt{63.428\ldots\times 46.42}}$	M1		
	$= -0.743$	A1	5	
(b)	$H_0 : \rho = 0 \qquad H_1 : \rho < 0$	B1		
	C.V. (5%) = – 0.6694	B1		
	– 0.743 < – 0.6694 $\Rightarrow$ Reject H_0	M1		Comparing
	So implying $\rho < 0$	A1√	4	
(c)	Letters which are little used have high points and vice versa	E1	1	
	Total		**10**	

MAS4 (cont)

Q	Solution	Marks	Total	Comments
3	$: p = 0.6 \quad H_1 : p < 0.6$	B1		h
	$\sim B(25, 0.4)$	M1		$X \sim B(25, 0.6)$
	$\leq 11 \Rightarrow X' \geq 14$			for Normal Approx.
	$X' \geq 14) = 1 - 0.9222$	M1		
	$= 0.0778$	A1		
	$778 > 0.05$	M1		
	accept H_0			
	ve is as good as claimed at 5% level	A1	6	
	Total		**6**	

MAS4 (cont)

Q	Solution	Marks	Total	Comments
4(a)		B2,1	2	
(b)	$= 93.5 - \frac{23^2}{8} = 27.375$			
	$= 799.5 - \frac{23\times353}{8} = -215.375$	M1		
	$= \frac{-215.375}{27.375} = -7.867\ldots$	A1		
	$= \frac{23}{8} = 2.875\ \ \bar{y} = \frac{353}{8} = 44.125$	B1		h
	$= 44.125 - (-7.867\ldots) \times 2.875$	M1		
	$66.744\ldots$			
	$= 66.7 - 7.87x$	A1		
	ws line	B1	6	
(c)(i)	$2.5) = 47.1$	B1	1	RT 47
(ii)	sonably accurate – line fits points ly well	B1	1	sensible alternative
(d)	ues of x are outside range of data re is a finite (positive) limit to how fast a rat can run.	E1		
	model becomes negative eventually	E1	2	
	Total		**12**	

MAS4 (cont)

Q	Solution	Marks	Total	Comments
5(a)	$: p = 0.21 \quad H_1 : p \neq 0.21$	B1		h
	$_c = \dfrac{0.16 - 0.21}{\sqrt{\dfrac{0.21 \times 0.79}{100}}} = -1.23$	M1 M1 A1		iance
	$_ = \pm 1.96$	B1		
	Retain H_0			
	0.21 at 5% level	A1√	6	
(b)	$3 \pm 2.5758\sqrt{\dfrac{0.16 \times 0.84}{100} + \dfrac{0.19 \times 0.81}{100}}$	M1 M1A1		riance (no pooling)
	$-0.108, 0.168)$	B1A1	5	lue
	Total		**11**	
6(a)(i)	$P_1) = \mathrm{E}\left(\dfrac{X_1}{n_1}\right) = \dfrac{1}{n_1}\mathrm{E}(X_1) = \dfrac{n_1 p}{n_1} = p$	M1A1	2	
(ii)	$\mathrm{r}(P_1) = \mathrm{Var}\left(\dfrac{X_1}{n_1}\right) = \dfrac{1}{n_1^2}\mathrm{Var}(X_1)$	M1		
	$\dfrac{n_1 p(1-p)}{n_1^2} = \dfrac{p(1-p)}{n_1}$	A1	2	
(b)(i)	$P) = \mathrm{E}\left(\dfrac{2}{3}P_1 + \dfrac{1}{3}P_2\right)$	M1		
	$= \dfrac{2}{3}\mathrm{E}(P_1) + \dfrac{1}{3}\mathrm{E}(P_2)$			
	$= \dfrac{2}{3}p + \dfrac{1}{3}p = p$	A1	2	
(ii)	$\mathrm{r}(P) = \mathrm{Var}\left(\dfrac{2}{3}P_1 + \dfrac{1}{3}P_2\right)$			
	$= \dfrac{4}{9}\mathrm{Var}(P_1) + \dfrac{1}{9}\mathrm{Var}(P_2)$	M1		
	$= \dfrac{1}{9}\left(\dfrac{4p(1-p)}{n_1} + \dfrac{p(1-p)}{n_2}\right)$	A1		
	$= p\left(\dfrac{1-p}{9}\right)\left(\dfrac{4}{n_1} + \dfrac{1}{n_2}\right)$	A1	3	

MAS4 (cont)

Q	Solution	Marks	Total	Comments
6(c)(i)	$\frac{(1-p)}{9}\left(\frac{4}{n_1}+\frac{1}{n_2}\right)<\frac{p(1-p)}{n_1}$	M1		
	$4n_2+n_1<9n_2$			
	$\frac{n_1}{n_2}<5$	A1		
	$\frac{1-p)}{9}\left(\frac{4}{n_1}+\frac{1}{n_2}\right)<\frac{p(1-p)}{n_2}$			
	$4n_2+n_1<9n_1$			
	$\frac{1}{2}<\frac{n_1}{n_2}$			
	$\Rightarrow\frac{1}{2}<\frac{n_1}{n_2}<5$	A1	3	
(ii)	$=3\Rightarrow P$ has least variance of $P,P_1,$	M1		
	P_2			
	nce P is the best estimator of p	A1	2	
	Total		**14**	
	Total		**60**	