Mark scheme January 2004

GCE

Mathematics A

Unit MAS4

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334.
Registered address AQA, Devas Street, Manchester M15 6EX. *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 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.

Q	Solution	Marks	Total	Comments
1	$S_{xy} = 6140 - \dfrac{135 \times 301}{6} = -632.5$			
	$S_{xx} = 3475 - \dfrac{135^2}{6} = 437.5$	M1		
	$b = -\dfrac{632.5}{437.5} = -1.446$	A1		
	$\bar{x} = \dfrac{135}{6} = 22.5$ $\bar{y} = \dfrac{301}{6} = 50.1\dot{6}$	B1		Both
	$a = 50.1\dot{6} - (-1.446) \times 22.5 = 82.70$	M1		
	$y = 82.7 - 1.45x$	A1	5	AWRT
	Total		**5**	
2	$H_0 : P = 0.2$ $H_1 : P > 0.2$	B1		Both
	$X \sim$ B in (20, 0.2)	B1		Stated or implied
	$P(X \leq 6) = 0.9133$	M1		Use of tables
	$P(X \geq 7) = 0.0867$	A1		
	$> 0.05 \Rightarrow$ Retain H_0			
	So selecting randomly	A1√	5	
	Total		**5**	
3 **(a)**	A straight line fits the points well	E1	1	OE
(b)	$S_{wy} = 1812 - \dfrac{91 \times 190}{6} = -1069.\dot{6}$	B1		
	$S_{ww} = 2275 - \dfrac{91^2}{6} = 894.8\dot{3}$	B1		
	$S_{yy} = 7296 - \dfrac{190^2}{6} = 1279.\dot{3}$	B1		
	$r = \dfrac{-1069.\dot{6}}{\sqrt{894.83 \times 1279.3}} = -0.9997$	M1 A1	5	
(c)	A curve fits almost exactly (or better than the line)	E1	1	
	Total		**7**	

Q	Solution	Marks	Total	Comments
4 (a)	$\frac{160}{500} = 0.32 \qquad \frac{205}{500} = 0.41$	B1		
	Variance $= \frac{0.32 \times 0.68 + 0.41 \times 0.59}{500}$	M1 A1		
	$z = 2.5758$	B1		
	$0.09 \pm 2.5758\sqrt{\frac{0.32 \times 0.68 + 0.41 \times 0.59}{500}}$	M1		
	(0.0119, 0.168)	A1	6	
(b)	Do not agree	E1$\surd$		
	Zero not within CI	E1$\surd$	2	
	Total		**8**	
5 (a)(i)	Rank Actual Estimate Rank 7 140 100 6.5 5 210 150 5 2 630 500 1.5 4 320 250 4 6 160 100 6.5 1 700 500 1.5 3 450 350 3	M1 A1		Ranking
	$\sum d^2 = \frac{1}{4} + 0 + \frac{1}{4} + 0 + \frac{1}{4} + \frac{1}{4} + 0$	M1 A1		
	$r_s = 1 - \frac{6 \times 1}{7 \times 48} = \frac{55}{56} = 0.982$	A1	5	Accept r on ranks = 0.982
(ii)	The trainee estimates order well but underestimates the weight	E1$\surd$ E1	2	Accept 'Not close to the true values'
(b)	$H_0 : \rho_s = 0 \qquad H_1 : \rho_s > 0$	B1		Both
	CV $\rho_s = 0.8571$	B1		
	$0.982 > 0.8571$	M1		Comparing
	Reject H_0 so implying $\rho_s > 0$	A1$\surd$	4	
	Total		**11**	

Q	Solution	Marks	Total	Comments
6 (a)	variance = $\dfrac{0.84 \times 0.16}{200}$	M1 A1		
	$z = 1.96$	B1		
	$0.84 \pm 1.96\sqrt{\dfrac{0.84 \times 0.16}{200}}$	M1		SC: Numbers (157.83, 178.16) 3/5
	(0.789, 0.891)	A1	5	
(b)	19	B1	1	
(c)	$H_0 : P = 0.9$ $\quad H_1 : P < 0.9$	B1		Both
	$z\text{calc} = \dfrac{0.84 - 0.9}{\sqrt{\dfrac{0.9 \times 0.1}{200}}}$	M1 A1		Accept working with numbers
	$= -2.828$	A1		
	$z\text{crit} = -2.3263$	B1		
	Reject $H_0 \Rightarrow$ overstating	E1√	6	Allow 'wrong' for 'overstating'
	Total		**12**	
7 (a)	$\text{E}(\overline{X}_1 - \overline{X}_2) = \text{E}(\overline{X}_1) - \text{E}(\overline{X}_2)$	M1		
	$= \mu_1 - \mu_2$	A1	2	
	$\text{Var}(\overline{X}_1 - \overline{X}_2) = \text{Var}(\overline{X}_1) + \text{Var}(\overline{X}_2)$	M1		
	$= \dfrac{\sigma_1^{\ 2}}{n_1} + \dfrac{\sigma_2^{\ 2}}{n_1}$	A1	2	
(b) (i)	$V = \dfrac{\sigma_1^{\ 2}}{n_1} + \dfrac{\sigma_2^{\ 2}}{n - n_1}$	M1		
	$\Rightarrow \dfrac{\text{d}v}{\text{d}n_1} = \dfrac{-\sigma_1^2}{n_1^2} - \dfrac{\sigma_2^{\ 2}}{(n - n_1)^2} \times (-1)$	M1 A1		
	$\dfrac{\text{d}v}{\text{d}n_1} = 0 \Rightarrow \dfrac{-\sigma_1^2}{n_1^2} = \dfrac{\sigma_2^{\ 2}}{(n - n_1)^2} = \dfrac{\sigma_2^{\ 2}}{n_2^{\ 2}}$	M1		
	$\Rightarrow n_1 : n_2 = \sigma_1 : \sigma_2$	A1	5	
(ii)	$\dfrac{\sigma_1}{\sigma_2} = \sqrt{\dfrac{0.0025}{0.0081}} = \dfrac{5}{9}$	M1		
	$\Rightarrow n_1 = \dfrac{5}{14} \times 560 = 200$	M1		or $n_2 = \dfrac{9}{14} \times 560$
	$n_2 = 360$	A1	3	
	Total		**12**	
	Total		**60**	