AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Mathematics & Statistics B

Unit MBS4

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.

Question Number and part	Solution	Marks	Total	Comments
1(a)	<table><tr><th></th><th colspan="2">CC</th><th colspan="2">IC</th><th colspan="2">S</th></tr><tr><td><120</td><td>2</td><td>16.94</td><td>58</td><td>32.94</td><td>20</td><td>30.12</td></tr><tr><td>≥120</td><td>34</td><td>19.06</td><td>12</td><td>37.06</td><td>44</td><td>33.88</td></tr></table>	M1 m1		Method for one E Method for all E's
	H_0 : No association between asking price and area H_1 : Asking price associated with area	B1		Correct H_0 - may be implied by conclusion
	$\sum \frac{(O-E)^2}{E} = 67.3$	M1 m1 A1		Attempt at $\sum \frac{(O-E)^2}{E} = 67.3$ Completely correct method 67.3 (67 , 68) - allow if demonstrated to be greater than c.v.
	Critical value χ_2^2 for 1% risk 9.210 Reject H_0, conclude asking price associated with area.	B1√ B1√ A1√	9	ft 2df ft c.v. – candidate's df ft correct conclusion - must be compared with upper tail of χ^2 (requires M1M1 only)
(b)	Houses appear to be cheapest/proportion costing <£120 000 greatest, in inner city followed by suburban areas and most expensive in city centre	E1 E1	2	Cheapest in inner city Most expensive in city centre
(c)(i)	Would need more detailed data, would not need such a large sample.	E1 E1		Need more details Smaller sample ok
(ii)	Relationship appears to be non-linear in this case , so PMCC not suitable	E1	3	Relationship non-linear PMCC not suitable } E1 each max 3
	Total		**14**	

Question Number and part	Solution	Marks	Total	Comments
2(a)	$\bar{x} = 1.33$	B1		1.33 cao
	90% confidence interval			
	$1.33 \pm 1.6449 \times \frac{0.11}{\sqrt{8}}$	M1		use of $\frac{0.11}{\sqrt{8}}$
		B1		1.6449 (1.64 , 1.65)
		m1		Completely correct method - candidate's z
	1.33 ± 0.0640	A1	5	1.33 ± 0.0640 (0.063 , 0.065)
	(1.266 , 1.394)			**or** 1.266 (1.265 , 1.267), allow 1.27 and 1.394 (1.393 , 1.395), allow 1.39
				sc $1.33 \pm 1.895 \frac{0.14}{\sqrt{8}}$ B1M1
				(1.236 , 1.424) B1m1A0
				mixture z & s or t & σ max B1M1
(b)	Evidence mean content at least 1.20 but	E1		Mean above 1.20
	some individual oranges less than 1.20	E1	2	Some individuals <1.20
2(c)	$2 \times 1.96 \times \frac{0.11}{\sqrt{n}} \leq 0.03$	M1		Reasonable attempt at equation/inequality
		B1		1.96 cao
		m1		Completely correct equation/inequality - allow incorrect z value
	$n \geq 206.6$	m1		Method of solution
	207 needed	A1	5	207 cao
				sc Trial & Improvement:
				205 – 210 B3
				200 – 220 B1
	Total		**12**	

Question Number and part	Solution	Marks	Total	Comments
3(a)	$\int_0^1 px + q \,\mathrm{d}x = 1$	M1		Any correct expression - ignore limits
	$\left[\frac{px^2}{2} + qx\right]_0^1 = 1$	M1		Any correct integration - anywhere
	$\frac{p}{2} + q = 1$	A1	3	Correct proof - **ag** - allow by diagram
(b)	$\mathrm{E}(X) = \int_0^1 px^2 + qx \,\mathrm{d}x$	M1		Correct expression - ignore limits
	$= \left[\frac{px^3}{3} + \frac{qx^2}{2}\right]_0^1$	m1		Correct method
	$= \frac{p}{3} + \frac{q}{2}$	A1	3	$\frac{p}{3} + \frac{q}{2}$ cao
(c)	$\frac{p}{3} + \frac{q}{2} = 0.6$	M1		Correct equation – candidate's (b) (assuming $p = 1.2$ and showing $q = 0.4$ M0)
	$q = 1 - \frac{p}{2}$ from (a)			
	$\frac{p}{3} + 0.5 - \frac{p}{4} = 0.6$			
	$\frac{p}{12} = 0.1$	m1		Completely correct method
	from (a) $q = 0.4$	A1	3	$p = 1.2$ **ag** $q = 0.4$ cao
(d)	$\mathrm{E}(X^2) = \int_0^1 1.2x^3 + 0.4x^2 \,\mathrm{d}x$	M1		Correct expression for E(X^2), candidate's p and q - allow in terms of p and q and if called variance
	$= \left[\frac{1.2x^4}{4} + \frac{0.4x^3}{3}\right]_0^1$	m1		Correct evaluation of E(X^2), candidate's p and q - allow in terms of p and q and if called variance
	$= 0.4333$			
	$\mathrm{V}(X) = 0.4333 - 0.6^2 = 0.07333$	m1		Completely correct method for σ - allow variance if called variance
	$\sigma = 0.271$	A1	4	0.271 (0.27 – 0.272)
	Total		**13**	

Question Number and part	Solution	Marks	Total	Comments
4(a)	$\bar{x} = 37.75 \quad s = 4.6928$	B1		37.75 (37.7 , 37.8) & 4.69 (4.69 , 4.7)
	$H_0 : \mu = 40$	B1		One correct hypothesis - generous
	$H_1 : \mu < 40$	B1		Both hypotheses correct - ungenerous
	$t = \dfrac{37.75 - 40}{\dfrac{4.6928}{\sqrt{12}}} = -1.66$	M1		use of candidate's $\dfrac{s}{\sqrt{12}}$
		m1		method for t - ignore sign
		m1		Completely correct method for t
		A1		-1.66 (-1.65 , -1.67)
	c.v. $t_{11} - 1.796$ accept H_0 , conclude no	B1		11df
	significant evidence to show mean is less	B1		-1.796 (-1.79 , -1.8) ignore sign
	than 40 months.	A1	10	Conclusion, must be compared with correct tail of t-distribution
(b)	$H_0 : \mu = 40$			
	$H_1 : \mu < 40$	B1		Both hypotheses correct
	$z = \dfrac{39.2 - 40}{\dfrac{4.2}{\sqrt{160}}} = -2.41$	M1		method for z
	c.v. -1.6449 reject H_0, significant	A1		-2.41 (-2.4 , -2.42) and
	evidence to show mean is less than 40.			-1.6449 (-1.64 , -1.655) ignore sign
		A1√	4	Conclusion, must be compared with correct tail of z or t.
4(c)(i)	neither, both 5%	B1		neither
		E1		both 5%
(ii)	neither - cannot make a Type II error if	B1		neither
	mean is 40	E1		No chance of Type II error
(iii)	(a), smaller sample	B1		(a)
		E1	6	Smaller sample
	Total		**20**	

Question Number and part	Solution	Marks	Total	Comments
5(a)(i)	$0.6\times0.8=0.48$	M1		Method shown
(ii)	$0.6\times0.2\times0.75=0.09$	M1		Method shown
(iii)	$1-0.4-0.48-0.09$	M1		Method shown
	or $0.6\times0.2\times0.25=0.03$	A1	4	All answers correct - **ag**
(b)	$1-0.6\times0.2\times0.25\times0.1=0.997$	M1		Attempt $1-$P (fail)
	or $0.4+0.48+0.09+0.03\times0.9=0.997$			**or** $\text{P(H)}+\text{P(O)}+\text{P(M)}+\text{P(W)}$
		m1		Completely correct method
		A1	3	0.997 cao
(c)(i)	$\text{E}(X)=14\times0.4+19\times0.48+25\times0.09+$ $32\times0.03=17.93$	M1		method - correct probabilities
		A1		$17.9(17.9\ ,\ 18)$
	$\text{E}(X^2)=14^2\times0.4+19^2\times0.48+25^2\times$ $0.09+32^2\times0.03=338.65$	M1		
	$\text{Var}(X)=338.65-17.93^3=17.1651$	m1		method for variance - disallow if called standard deviation
	s.d. $=4.14$	m1		method for s.d.
		A1	6	$4.14(4.1\ ,\ 4.2)$
				sc allow M1m1m0A1 for variance = 17.2 (17.1 , 17.2) M1m0m0A0 for s.d. = 17.2
(ii)	$z=\dfrac{19-17.93}{\frac{4.1431}{\sqrt{40}}}=1.633$	M1		Attempt to use normal
		M1		use of candidate's $\dfrac{\text{s.d.}}{\sqrt{40}}$
		m1		method for z, candidate's mean and s.d.
	P(>19) = 1 – 0.9488 = 0.0512	m1		Correct method requires all previous method marks in (c)
		A1	5	$0.0512(0.05\ ,\ 0.052)$
(iii)	Time away from home predictable	E1		No variation in time
	Mean time away from home longer	E1		Mean longer
	Less (slightly) chance of obtaining milk	E1	3	Less chance of obtaining milk
	Total		**21**	
	TOTAL		**80**	