



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme January 2004

GCE

Mathematics & Statistics B

Unit MBS4

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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
2(a)	$\bar{x} = 1.33$ 90% confidence interval $1.33 \pm 1.6449 \times \frac{0.11}{\sqrt{8}}$ 1.33 ± 0.0640 (1.266 , 1.394)	B1 M1 B1 m1 A1	5	1.33 cao use of $\frac{0.11}{\sqrt{8}}$ 1.6449 (1.64 , 1.65) Completely correct method - candidate's z 1.33 ± 0.0640 (0.063 , 0.065) 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 some individual oranges less than 1.20	E1 E1	2	Mean above 1.20 Some individuals <1.20
2(c)	$2 \times 1.96 \times \frac{0.11}{\sqrt{n}} \leq 0.03$ $n \geq 206.6$ 207 needed	M1 B1 m1 m1 A1	5	Reasonable attempt at equation/inequality 1.96 cao Completely correct equation/inequality - allow incorrect z value Method of solution 207 cao sc Trial & Improvement: 205 – 210 B3 200 – 220 B1
Total			12	

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

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

Question Number and part	Solution	Marks	Total	Comments
5(a)(i)	$0.6 \times 0.8 = 0.48$	M1	4	Method shown
(ii)	$0.6 \times 0.2 \times 0.75 = 0.09$	M1		Method shown
(iii)	$1 - 0.4 - 0.48 - 0.09$ or $0.6 \times 0.2 \times 0.25 = 0.03$	M1 A1		Method shown All answers correct - ag
(b)	$1 - 0.6 \times 0.2 \times 0.25 \times 0.1 = 0.997$ or $0.4 + 0.48 + 0.09 + 0.03 \times 0.9 = 0.997$	M1 m1 A1	3	Attempt $1 - P(\text{fail})$ or $P(H) + P(O) + P(M) + P(W)$ Completely correct method 0.997 cao
(c)(i)	$E(X) = 14 \times 0.4 + 19 \times 0.48 + 25 \times 0.09 + 32 \times 0.03 = 17.93$ $E(X^2) = 14^2 \times 0.4 + 19^2 \times 0.48 + 25^2 \times 0.09 + 32^2 \times 0.03 = 338.65$ $\text{Var}(X) = 338.65 - 17.93^2 = 17.1651$ s.d. = 4.14	M1 A1 M1 m1 m1 A1	6	method - correct probabilities 17.9(17.9 , 18) method for variance - disallow if called standard deviation method for s.d. 4.14(4.1 , 4.2) sc allow M1m1m0A1 for variance = 17.2 (17.1 , 17.2) M1m0m0A0 for s.d. = 17.2
(ii)	$z = \frac{19 - 17.93}{\frac{4.1431}{\sqrt{40}}} = 1.633$ $P(>19) = 1 - 0.9488 = 0.0512$	M1 M1 m1 m1	5	Attempt to use normal use of candidate's $\frac{\text{s.d.}}{\sqrt{40}}$ method for z, candidate's mean and s.d. Correct method requires all previous method marks in (c) 0.0512(0.05 , 0.052)
(iii)	Time away from home predictable Mean time away from home longer Less (slightly) chance of obtaining milk	A1 E1 E1 E1		3
	Total		21	
	TOTAL		80	