



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

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# Mark scheme January 2004

## GCE

### Mathematics & Statistics B

### Unit MBS5

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## Key to mark scheme

<b>M</b>	mark is for	method
<b>m</b>	mark is dependent on one or more M marks and is for	method
<b>A</b>	mark is dependent on M or m mark and is for	accuracy
<b>B</b>	mark is independent of M or m marks and is for	method and accuracy
<b>E</b>	mark is for	explanation
<b>√ or ft or F</b>		follow through from previous incorrect result
<b>CAO</b>		correct answer only
<b>AWFW</b>		anything which falls within
<b>AWRT</b>		anything which rounds to
<b>AG</b>		answer given
<b>SC</b>		special case
<b>OE</b>		or equivalent
<b>A2,1</b>		2 or 1 (or 0) accuracy marks
<b>– x EE</b>		Deduct $x$ marks for each error
<b>NMS</b>		No method shown
<b>PI</b>		Perhaps implied
<b>c</b>		Candidate

## Abbreviations used in marking

<b>MC – <math>x</math></b>	deducted $x$ marks for miscopy
<b>MR – <math>x</math></b>	deducted $x$ marks for misread
<b>ISW</b>	ignored subsequent working
<b>BOD</b>	gave benefit of doubt
<b>WR</b>	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)(i)	$z_1 = \frac{475 - 490}{10} = -1.5$ $z_2 = \frac{510 - 490}{10} = 2.0$ Probability between 475 and 510 = $0.97725 - (1 - 0.93319) = 0.910$	M1 m1 M1 m1	5	Method for $z$ - ignore sign Both $z$ 's correct sign A correct use of normal tables - generous Completely correct method 0.910 (0.91 - 0.911)
(ii)	$490 - 1.8808 \times 10 = 471.2 \text{ ml}$	B1 M1 m1 A1		4
(b)	$\mu - 1.0364 \times 10 = 475$  $\mu = 485.4$	B1 M1 m1 A1	4	1.0364 (1.03 - 1.04) Candidate's $z \times 10$ Completely correct method 485.4 (485.3 - 485.4 or 485)
<b>Total</b>			<b>13</b>	
2(a)	$\bar{x} = 1.33$ 90% confidence interval $1.33 \pm 1.6449 \times \frac{0.11}{\sqrt{8}}$  $1.33 \pm 0.0640$ (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 $\pm$ 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
(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
(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
<b>Total</b>			<b>12</b>	

Question Number and part	Solution	Marks	Total	Comments
3(a)	$\bar{x} = 37.75$ $H_0 : \mu = 40$ $H_1 : \mu < 40$ $z = \frac{37.75 - 40}{\frac{5}{\sqrt{12}}} = -1.56$ c.v. $-1.6449$ accept $H_0$ , conclude no significant evidence to show mean is less than 40 months.	B1 B1 B1 M1 m1 A1 B1 A1	8	$37.75$ ( $37.7$ , $37.8$ ) One correct hypothesis - generous Both hypotheses correct - ungenerous use of $\frac{5}{\sqrt{12}}$ method for $z$ - ignore sign $-1.56$ ( $-1.55$ , $-1.57$ ) $-1.6449$ ( $-1.64$ , $-1.655$ ) ignore sign Conclusion, must be compared with correct tail of $z$
(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 B1 A1	3	Both hypotheses correct $-2.41$ ( $-2.4$ , $-2.42$ ) Conclusion, must be compared with correct tail of $z$
(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
			<b>17</b>	

Question Number and part	Solution	Marks	Total	Comments
4(a)(i)	$\frac{38}{150} = 0.253$	M1		
(ii)	$\frac{3}{79} = 0.0380$	M1 A1	3	0.253 (0.253 – 0.254) and 0.0380 (0.379 – 0.38) or acf
(b)	$6 \times \frac{38}{150} \times \frac{84}{149} \times \frac{28}{148} = 0.162$	B1 M1 m1 A1	6 4	6 method - allow without replacement, or omitted or incorrect 6 Completely correct method 0.162 (0.162 – 0.163) or acf
(c)(i)	$\frac{38}{150} \times 0.5 = 0.127$	M1 A1	2	0.127 (0.126 – 0.127) or acf
(ii)	$\frac{38}{150} \times 0.5 + \frac{84}{150} \times 0.25 + \frac{28}{150} \times 0.75 = 0.407$	M1 m1 A1	3	Addition of 3 probabilities Completely correct method 0.407 (0.406 – 0.407) or acf
(iii)	$\left(1 - \frac{19}{150}\right)\left(1 - \frac{19}{149}\right) = 0.762$	M1 m1 A1	3	Reasonable attempt Wholly correct method - allow without replacement - allow at least 4 0.762 (0.761 - 0.7625) or acf
			<b>15</b>	

Question Number and part	Solution	Marks	Total	Comments
5(a)	(See graph on next page)	M1 B1 A1	3	method Scales and labels Reasonably accurate plot
(b)	$y = -8.65 + 0.460x$ $x = 20 \ y = 0.5$ ; $x = 320 \ y = 138.5$ + line	B1 B2 M1 A1	5	- 8.65 (- 8.64 – - 8.66) 0.460 (0.459 – 0.461) method for line Accurate line
(c)(i)	A $23 - (-8.648) - 0.4598 \times 78 = -4.2$ B $78 - (-8.648) - 0.4598 \times 162 = 12.2$	M1  m1 A1	3	method one residual - candidate's line, ignore sign Both residuals – consistent signs - 4.2 (- 4.1 , - 4.3) and 12.2 (12 , 12.3)
(ii)	mean magnitude = 13.1	m1 A1	2	Requires previous M only 13.1 (13 , 13.2)
(d)	Equation predicts Bryn will collect £43, about £12 more than actually predicted. Consistent with mean magnitude of residuals. No cause for concern.	B1 E1  E1	3	Use of equation to predict Bryn's takings Comparison with mean magnitude of residuals Completely correct argument- candidate's figures
5(e)(i)	Residual is $y_i - a - bx_i$ Mean residual is $\bar{y} - a - b\bar{x}$ Since $\bar{y} = \bar{a} + b\bar{x}$ mean residual = 0	E1 E1 E1	3	Expression for residual Expression for mean residual Complete explanation
(ii)	Sum of given residuals is 10.6. Hence residual for Bryn is - 10.6.	M1 A1	2	method - ignore sign - 10.6 cao or (- 10.45 , - 10.5) if line recalculated.
(iii)	Answer unaffected - Bryn's residual still similar to mean magnitude	E1  E1	2	Comparison of candidate's residual with candidate's mean magnitude Complete answer based on reasonably correct figures
	<b>Total</b>		<b>23</b>	
	<b>TOTAL</b>		<b>80</b>	

Graph for Q5 (a)

