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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics and Statistics 6320
Specification B

MBS2 Statistics 2

Mark Scheme

2005 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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	accuracy
E	mark is for	explanation
√or ft or F		follow through from previous incorrect result
cao		correct answer only
cso		correct solution only
awfw		anything which falls within
awrt		anything which rounds to
acf		any correct form
ag		answer given
sc		special case
oe		or equivalent
sf		significant figure(s)
dp		decimal place(s)
A2,1		2 or 1 (or 0) accuracy marks
–*x* ee		deduct *x* marks for each error
pi		possibly implied
sca		substantially correct approach

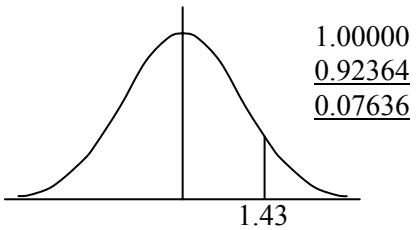
Abbreviations used in Marking

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 book

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

Mathematics and Statistics B Statistics 2 MBS2 June 2005

Q	Solution	Marks	Total	Comments
1(a)	$\hat{p} = \frac{113}{130} = 0.8692$	B1		$\hat{p} = 0.869$
	CI	B1		1.96
	$0.8692 \pm 1.96\sqrt{\frac{0.8692 \times 0.1308}{130}}$	M1 M1		attempted use of normal $\sqrt{\frac{0.8692 \times 0.1308}{130}}$
	0.8692 ± 0.05796	m1		completely correct
	(0.81124 , 0.92716) (0.811 , 0.927)	A1	6	(0.811 to 0.812 , 0.927 to 0.928)
(b)	0.85 is within CI hence manager's claim is supported	E1 B1	2	
	Total		**8**	
2(a)(i)	$n = 350$ $p = 0.008$ Binomial n large p small, approx to Poisson $\lambda = 2.8$	B1		$\lambda = 350 \times 0.008 = 2.8$
	P(Q day) = P($X > 5$) = 1 – P($X \leq 5$) = 1 – 0.9349 = 0.0651	M1 m1 A1	4	Answer given
(ii)	B (7 , 0.0651) P ($X = 2$) = ${}_7C_2(0.0651)^2(0.9349)^5$ = 0.06356 ≈ 0.0636	B1 M1 A1	3	0.0635 to 0.0636
(iii)	P(Q day) = 0.0651 $n = 365$ $np = 23.7615 > 10$ Use approx to normal $\frac{30.5 - 23.7615}{\sqrt{22.2146}} = 1.4297$	B1 B1 M1 M1		$np = 23.7615$ $npq = 22.2146$ use of continuity correction their np, $\sqrt{npq}$
		m1		correct area
	P($X > 30$) = 0.0764	A1	6	0.0763 to 0.0764
(b)	Flight delays are independent	E1	1	Flight delays occur at random
	Total		**14**	

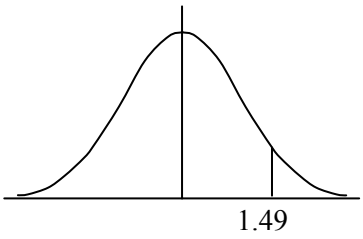
MBS2 (cont)

<table>
<tr><th>Q</th><th>Solution</th><th>Marks</th><th>Total</th><th>Comments</th></tr>
<tr><td>3(a)</td><td>
<table>
<tr><td>Activity</td><td>Mean</td><td>s.d.</td></tr>
<tr><td>A</td><td>5</td><td>$\frac{2}{3}$</td></tr>
<tr><td>B</td><td>4</td><td>$\frac{1}{3}$</td></tr>
<tr><td>C</td><td>17</td><td>3</td></tr>
<tr><td>D</td><td>4</td><td>1</td></tr>
<tr><td>E</td><td>7</td><td>$1\frac{2}{3}$</td></tr>
<tr><td>F</td><td>10</td><td>2</td></tr>
</table>
</td><td>M1
A1
M1
A1</td><td>4</td><td>All means correct
All s.d’s correct</td></tr>
<tr><td>(b)</td><td>Mean = 5 + 17 + 7 + 10
= 39

variance = $\frac{4}{9}+9+\frac{25}{9}+4$
= 16.222
≈ 16.2</td><td>M1
A1√

M1

A1√</td><td>4</td><td>

16.2 to 16.3</td></tr>
<tr><td>(c)</td><td>$z=\frac{45-39}{4.03}=1.4896$
≈ 1.49
 
1.49

P(time ≤ 45) = 0.93189
≈ 0.932</td><td>M1
M1

M1
A1√</td><td>4</td><td>z no continuity correcton
their 39, √16.2

0.931 to 0.932</td></tr>
<tr><td></td><td>Total</td><td></td><td>12</td><td></td></tr>
</table>

MBS2 (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	$p = \frac{399 + 367 + 380 + 410}{4} = 389$	M1 A1		
	$q = \frac{367 + 380 + 410 + 469}{4} = 406.5$	A1	3	
(ii)	$r = \frac{389 + 406.5}{2} = 397.75$	M1 A1	2	
(b)	$y = 17.9241x + 290.446$ $y = 17.92x + 290.4$ $a = 290.4$	B3	3	M1, A1, A1 for method shown
(c)	x | Actual – Trend 1 | 298 – 308.37 | = –10.37 5 | 367 – 380.07 | = –13.07 9 | 447 – 451.76 | = – 4.76	M1 M1		Trend values Actual – Trend
	Seasonal effect $\frac{-10.37 - 13.07 - 4.76}{3} = -9.40$	M1 A1√	4	Differences / 3 (–9.5 to –9.2) Allow ¾ if not using all available data
(d)	Seasonal effect $Q_4 - Q_1 = 37.8 - (-9.4)$ $= 47.2$ If trend constant, sales in Q1 are approx 50 below Q4 due to seasonal effects. d = 60 would be reasonable evidence that sales are falling.	B1√ E1 B1√	3	Accept 80 with valid reason.
	Total		**15**	

MBS2 (cont)

Q	Solution	Marks	Total	Comments
5(a)				
	A Cluster	B1		
	B Stratified random	B1	2	
(b)	Obtain list of 200 companies	B1		
	$\frac{200}{25} = 8$			
	Select a random number between 1 – 8	B1		Or equivalent
	Select corresponding company on list and every 8^{th} company thereafter.	B1	3	
(c)	A: Yes, each cluster has prob 1/8 hence each company will have prob 1/8.	E1		
	B: Yes, each company has prob 1/8.	E1		Allow no if reason 'rounding occurs in practice' or similar
	C: No, names are unlikely to be distributed equally over the alphabet.	E1		
	D: Yes, each company has prob 1/8.	E1	4	(Allow any valid reason) Y/N 2 correct B1 4 correct B1, B1 E1 reason for C B1 prob = 1/8
(d)	Method B Stratified random	B1		
	Obtain a representative sample of all 200 companies.	E1	2	
	Total		**11**	
	TOTAL		**60**	