

GCE 2005
January Series



Mark Scheme

Mathematics and Statistics B

(MBS2)

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.

Further copies of this Mark Scheme are available to download from the AQA Website:
www.aqa.org.uk

Copyright © 2005 AQA and its licensors. All rights reserved.

COPYRIGHT

AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

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 marks 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	possibly implied	
SCA	substantially correct approach	
c	candidate	
SF	significant figure(s)	
DP	decimal place(s)	

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 booklet

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

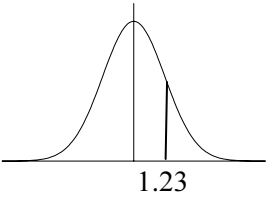
Crossed out work

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 January 2005

Question Number and Part	Solution	Marks	Total	Comments
1(a)	$P(X > 5) = 1 - P(X \leq 5)$ $= 1 - 0.7851$ $= 0.2149$ ≈ 0.215	M1	2	0.214 ~ 0.215
(b)	$\lambda = 5 \times 4 = 20$ $z = \frac{25.5 - 20}{\sqrt{20}} = 1.23$ 	A1 B1 M1 M1		
(c)	$P(X > 25) = 0.109$ <p>Daily Higher probability of bonus payment</p>	A1 B1 \checkmark B1 \checkmark	5 2	(0.109 , 0.110)
Total			9	
2(a)	$p = \frac{44}{400} = 0.11$ $\text{CI: } 0.11 \pm 1.6449 \sqrt{\frac{0.11 \times 0.89}{400}}$ 0.11 ± 0.02573 $(0.08427, 0.13573)$ $(0.0843, 0.136)$	B1 B1 M1 M1	6	$p = 0.11$ 1.6449 attempted use of Normal $\sqrt{\frac{0.11 \times 0.89}{400}}$ completely correct
(b)	<p>More than 85% success \Rightarrow At most 15% fail $0.15 >$ upper confidence limit Company's claim justified</p>	m1 A1 B1		
(c)(i)	<p>Increase in the level of confidence widens the confidence interval obtained – a higher degree of assurance of including the population mean within the interval but less useful for decision making purposes.</p>	B1 B1	2	(i) wider (ii) narrower (cannot say) Both correct
(ii)	<p>Increasing the number of trials narrows the confidence interval – greater precision is obtained</p>	E1	3	Allow if n is increased, p will change. Hence width of CI will change.
Total			11	

MBS2 (cont)

Question Number and Part	Solution	Marks	Total	Comments																																																																																																														
<p>3(a)</p> <p>A Simple random B Stratified random C Systematic</p> <p>(b)</p> <p>For A: Adv. No bias where quadrats are placed Disad. Some areas may be underrepresented</p> <p>For B: Adv. All areas are represented taking into account conditions across site may differ. Disad. There is no purpose in taking stratified random sample if there is no difference between each stratum. Very time consuming c.f. systematic.</p> <p>For C: Adv. Easy and B comment Disad. May be underlying pattern of plant diversity that has 10m periodicity.</p> <p>(c)</p> <p>Require 1 sample in each 10m square.</p> <p>Divide 10m square into a grid and number 0 – 9.</p> <table border="1" data-bbox="245 1166 655 1549"> <tr><td>9</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td></td> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td> </tr> </table> <p>Take 100, 2 digit random numbers.</p> <p>Use as coordinates e.g. 32 → (3 , 2)</p>	9										8										7										6										5										4										3										2										1										0											0	1	2	3	4	5	6	7	8	9	<p>B1 B1 B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>E1</p> <p>E1</p> <p>E1</p>	<p>3</p> <p>6</p> <p>3</p>	<p>Accept random Accept stratified</p> <p>Wrong to say repeats are ignored.</p>
9																																																																																																																		
8																																																																																																																		
7																																																																																																																		
6																																																																																																																		
5																																																																																																																		
4																																																																																																																		
3																																																																																																																		
2																																																																																																																		
1																																																																																																																		
0																																																																																																																		
	0	1	2	3	4	5	6	7	8	9																																																																																																								
	Total		12																																																																																																															

MBS2 (cont)

Question Number and Part	Solution	Marks	Total	Comments																		
4(a)(i)	$p = \frac{1620 + 758 + 704 + 1262}{4} = 1086$ $q = \frac{758 + 704 + 1262 + 1747}{4}$ $= 1117.75$	M1 A1 A1	3	1117.7 ~ 1117.8																		
(ii)	$r = \frac{1086 + 1117.75}{2} = 1101.875$	M1 A1	2	1101.8 ~ 1101.9																		
(b)	$y = 15.276x + 990.673$ $y = 15.28x + 990.7$	B3	3	M1, M1, A1 if eqns used $(\bar{x}, \bar{y}) = (8.5, 1120.52)$ M1 M1 990.7 A1																		
(c)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 40%;">Actual - Trend</th> <th style="width: 50%;"></th> </tr> </thead> <tbody> <tr> <td>x</td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>$1048 - 1021.225$</td> <td>$= 26.775$</td> </tr> <tr> <td>6</td> <td>$1091 - 1082.328$</td> <td>$= 8.670$</td> </tr> <tr> <td>10</td> <td>$1262 - 1143.432$</td> <td>$= 118.565$</td> </tr> <tr> <td>14</td> <td>$1336 - 1204.536$</td> <td>$= 131.460$</td> </tr> </tbody> </table> <p>Seasonal effect</p> $\frac{26.78 + 8.67 + 118.57 + 131.46}{4}$ $= 71.34 \approx 71.3$		Actual - Trend		x			2	$1048 - 1021.225$	$= 26.775$	6	$1091 - 1082.328$	$= 8.670$	10	$1262 - 1143.432$	$= 118.565$	14	$1336 - 1204.536$	$= 131.460$	M1 M1		Trend values Actual – trend
	Actual - Trend																					
x																						
2	$1048 - 1021.225$	$= 26.775$																				
6	$1091 - 1082.328$	$= 8.670$																				
10	$1262 - 1143.432$	$= 118.565$																				
14	$1336 - 1204.536$	$= 131.460$																				
(d)	$x = 18 \quad y = 1265.64$ $\text{visits} = 1265.64 + 71.3$ $= 1336.94$	M1 M1 A1	4	Differences / 4 71.3 ~ 71.4 Use of $x = 18$ Applying seasonal 1336.5 ~ 1337.5																		
(e)	<p>i.e. 1,337,000</p> <p>Forecast has overestimated by 14,000</p> <p>Reasonable $\approx 1\%$ error</p>	A1✓ B1✓ B1✓	4 2																			
Total			18																			

MBS2 (cont)

Question Number and Part	Solution	Marks	Total	Comments
5(a)	£479.90	B1	1	
(b)	75% of workers in a particular occupation earn less than upper quartile value.	E1	1	Or 25% earn more
(c)	Health & Social Welfare Associate Professionals	B1	1	
(d)	Box and whisker – see graph below	B1 M1 A1 A1	4	Labelling axis Method of construction
(e)	Males have higher average gross weekly earnings. Variability of earnings is greater in males. Both distributions are positively skewed. Higher percentage of males have high earnings. Lowest earnings \approx same. Etc.	B1 B1 B1	3	Any 3
	Total		10	
	TOTAL		60	

Question 5 (d) **Box and Whisker Plot**

