



## 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

<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 marks and is for	accuracy
<b>B</b>	mark is independent of M or m marks and is for	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>cso</b>		correct solution only
<b>awfw</b>		anything which falls within
<b>awrt</b>		anything which rounds to
<b>acf</b>		any correct form
<b>ag</b>		answer given
<b>sc</b>		special case
<b>oe</b>		or equivalent
<b>sf</b>		significant figure(s)
<b>dp</b>		decimal place(s)
<b>A2,1</b>		2 or 1 (or 0) accuracy marks
<b>-x ee</b>		deduct $x$ marks for each error
<b>pi</b>		possibly implied
<b>sca</b>		substantially correct approach

## Abbreviations used in Marking

<b>MC – <math>x</math></b>	deducted $x$ marks for mis-copy
<b>MR – <math>x</math></b>	deducted $x$ marks for mis-read
<b>isw</b>	ignored subsequent working
<b>bod</b>	given benefit of doubt
<b>wr</b>	work replaced by candidate
<b>fb</b>	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

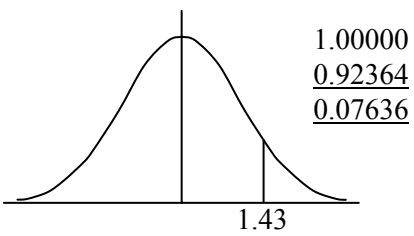
### **Crossed out work**

do not mark unless it has not been replaced

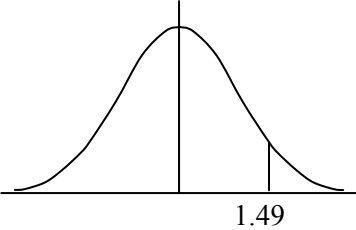
### **Alternative solution** using a correct or partially correct method

award method and accuracy marks as appropriate

**Mathematics and Statistics B Statistics 2 MBS2 June 2005**

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

## MBS2 (cont)

Q	Solution	Marks	Total	Comments																					
3(a)	<table border="1"> <thead> <tr> <th>Activity</th> <th>Mean</th> <th>s.d.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>5</td> <td><math>\frac{2}{3}</math></td> </tr> <tr> <td>B</td> <td>4</td> <td><math>\frac{1}{3}</math></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><math>1\frac{2}{3}</math></td> </tr> <tr> <td>F</td> <td>10</td> <td>2</td> </tr> </tbody> </table>	Activity	Mean	s.d.	A	5	$\frac{2}{3}$	B	4	$\frac{1}{3}$	C	17	3	D	4	1	E	7	$1\frac{2}{3}$	F	10	2	M1 A1 M1 A1	4	All means correct  All s.d's correct
Activity	Mean	s.d.																							
A	5	$\frac{2}{3}$																							
B	4	$\frac{1}{3}$																							
C	17	3																							
D	4	1																							
E	7	$1\frac{2}{3}$																							
F	10	2																							
(b)	$\text{Mean} = 5 + 17 + 7 + 10 = 39$ $\text{variance} = \frac{4}{9} + 9 + \frac{25}{9} + 4 = 16.222 \approx 16.2$	M1 A1✓  M1 A1✓	4	16.2 to 16.3																					
(c)	$z = \frac{45 - 39}{4.03} = 1.4896 \approx 1.49$  $P(\text{time} \leq 45) = 0.93189 \approx 0.932$	M1 M1  M1 A1✓	4	z no continuity correction their 39, $\sqrt{16.2}$  0.931 to 0.932																					
	<b>Total</b>		<b>12</b>																						

## 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)	<table border="1"> <thead> <tr> <th>x</th> <th>Actual – Trend</th> <th></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>298 – 308.37</td> <td>= –10.37</td> </tr> <tr> <td>5</td> <td>367 – 380.07</td> <td>= –13.07</td> </tr> <tr> <td>9</td> <td>447 – 451.76</td> <td>= –4.76</td> </tr> </tbody> </table>	x	Actual – Trend		1	298 – 308.37	= –10.37	5	367 – 380.07	= –13.07	9	447 – 451.76	= –4.76	M1		Trend values
	x	Actual – Trend														
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	<table border="1"> <tbody> <tr> <td>9</td> <td>447 – 451.76</td> <td>= –4.76</td> </tr> </tbody> </table>	9	447 – 451.76	= –4.76	M1		Actual – Trend									
9	447 – 451.76	= –4.76														
	Seasonal effect $\frac{-10.37 - 13.07 - 4.76}{3} = -9.40$	M1 A1✓	4	Differences / 3 (–9.5 to –9.2) Allow $\frac{3}{4}$ 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.												
<b>Total</b>			<b>15</b>													

**MBS2 (cont)**

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