

Mark scheme January 2004

GCE

Mathematics & Statistics B

Unit MBS2

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Key to mark scheme

Μ	mark is for	method
m	mark is dependent on one or more M marks and is for	method
Α	mark is dependent on M or m mark and is for	accuracy
В	mark is independent of M or m marks and is for	method and accuracy
Ε	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 <i>x</i> 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
1(a)	$c = \frac{47.2 + 33.8 + 40.4 + 41.9 + 36.1}{5}$	M1		
	= 39.9	A1		awrt 39.9
	$d = \frac{36.1 + 35.4 + 29.8 + 36.0 + 39.0}{5}$			
	= 35.3	A1	3	awrt 35.3
(b)	<i>n</i> = 7	B1	1	
	Total		4	
2(a)	Random variation about a downward	B1		Random variation
	linear trend	B1	2	Downward linear
(b)	Seasonal variation about an upward linear	B1		Seasonal variation
(-)	trend	B1	2	Upward linear
(c)	Short term variation about an upward non-	B1		Short term variation
(0)	linear trend	B1 B1	2	Upward non-linear
(d)	Random variation but no trend	B1		Random variation
		B1	2	No trend
	Total		8	
3(a)(i)	300×52			
	= 15600	B1	1	
(ii)	$2 \times 200 \times 15600$	M1		$2 \times 200 \times a(i)$
	V 6			\bigvee 6
	= 1019.8	A1√		
	= 1020 (int)	A1	3	
(b)(i)	$1.645 \times 40 \times \sqrt{3}$	B1		1.645, 1.6449, 1.64
	= 113.97	M1		
	i.e. 114	A1	3	
(ii)	$3 \times 300 + 114$	M1		3×300
	= 900 + 114	M1		900 + b(i)
	= 1014	A1√	3	
(c)	$114 \times \pounds 6$	M1		$b(i) \times 6$
	= £684	A1√	2	
(d)	The best policy is to order 1020 fans	B 1√		a(ii)
	whenever stock declines to 1014 fans. On	B 1√		b(ii)
	average, orders should arrive when there are 114 fans remaining.	B 1√	3	b(i)
	Total		15	

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Number and partB114(a)PoissonB11(b)C.I. for 12 weeksB11 $16 \pm 2.326\sqrt{16}$ for 1 weekB1 B1 M1Mean 16 s.d. $\sqrt{16}$ 2.326 using normal Poisson parametersAlternative: C.I. for 1 weekM1Mean 16 s.d. $\sqrt{16}$ 2.326 $\sqrt{12}$ $\frac{16}{12} \pm \frac{2.326\sqrt{16}}{12}$ $\sqrt{12}$ M1Mean 16 s.d. $\sqrt{16}$ 2.326 $\sqrt{112}$ $= \frac{4}{12} \pm 2.326\sqrt{\frac{16}{12}}$ $\sqrt{12}$ Mean 16 s.d. $\sqrt{16}$ 12 $= \frac{4}{3} \pm 2.326\sqrt{\frac{16}{12}}$ $= 0.558 \sim 2.10$ Mean $\frac{16}{12} s.d. \sqrt{\frac{16}{12}}$ $= 1.3333 \pm 0.7753$ $= 0.558 \sim 2.10$ $= 0.558 \sim 2.11$ m1 A1Completely correct (0.55, 0.56) (2.10, 2.11)(c)Have used the Normal approx. to the Poisson.E1E1Poisson requires a constant mean; the observed value of $\frac{16}{12}$ is unlikely to be exactly equal to the mean, so the valueE1 $\sqrt{16}$ used for the standard deviation isM1M1	Question	Solution	Marks	Total	Comments
4(a)PoissonB11(b)C.I. for 12 weeksB11 $16 \pm 2.326\sqrt{16}$ B1B1for 1 weekB1 $16 \pm 2.326\sqrt{16}$ M1 $16 \pm 2.326\sqrt{16}$ Mean 16 s.d. $\sqrt{16}$ $16 \pm 2.326\sqrt{12}$ Mean 16 s.d. $\sqrt{16}$ $16 \pm 2.326\sqrt{12}$ Mean 16 s.d. $\sqrt{16}$ $16 \pm 2.326\sqrt{12}$ Mean 16 s.d. $\sqrt{16}$ $16 \pm 3.333 \pm 0.7753$ M1 $10 \pm 0.558 \sim 2.10$ A1 $10 \pm 0.558 \sim 2.10$ A1 $10 \pm 0.558 \sim 2.10$ E1 <t< th=""><th></th><th></th><th></th><th></th><th></th></t<>					
$16 \pm 2.326\sqrt{16}$ for 1 weekB1 B1 M1Mean 16 s.d. $\sqrt{16}$ 2.326 using normal Poisson parametersAlternative: C.I. for 1 weekM1Mean $\frac{16}{12} \pm \frac{2.326\sqrt{16}}{12}$ $\sqrt{12}$ Mean $\frac{16}{12} s.d. \sqrt{16}$ $\frac{16}{12} s.d. \sqrt{16}$ $\frac{16}{12} \pm \frac{2.326\sqrt{16}}{\sqrt{12}}$ $= \frac{4}{3} \pm 2.326 \times \frac{1}{3}$ m1 A1Completely correct $(0.55, 0.56)$ $(2.10, 2.11)$ (c)Have used the Normal approx. to the Poisson.E1E1Poisson requires a constant mean; the observed value of $\frac{16}{12}$ is unlikely to be exactly equal to the mean, so the valueE1		Poisson	B1	1	
Intervent for 1 weekB1 M12.326 using normal Poisson parameters $1\frac{6}{12} \pm \frac{2.326\sqrt{16}}{12}$ M1M1 $\frac{16}{12} \pm \frac{2.326\sqrt{16}}{12}$ Mean $\frac{16}{12}$ s.d. $\sqrt{\frac{16}{12}}$ $= \frac{4}{3} \pm 2.326 \times \frac{1}{3}$ m1Mean $\frac{16}{12}$ s.d. $\sqrt{\frac{16}{12}}$ $= 1.3333 \pm 0.7753$ m1G $= 0.558 \sim 2.109$ A16 $= 0.558 \sim 2.11$ A1(c)Have used the Normal approx. to the Poisson.E1Poisson requires a constant mean; the observed value of $\frac{16}{12}$ is unlikely to be exactly equal to the mean, so the value	(b)	C.I. for 12 weeks			
C.I. for 1 week $\frac{16}{12} \pm \frac{2.326\sqrt{\frac{16}{12}}}{\sqrt{12}}$ $= \frac{4}{3} \pm 2.326 \times \frac{1}{3}$ $= 1.3333 \pm 0.7753$ $= 0.558 \sim 2.109$ $= 0.558 \sim 2.11$ (c) Have used the Normal approx. to the Poisson. E1 Poisson requires a constant mean; the observed value of $\frac{16}{12}$ is unlikely to be exactly equal to the mean, so the value		for 1 week	B1 M1		2.326 using normal
$=\frac{4}{3} \pm 2.326 \times \frac{1}{3}$ $= 1.3333 \pm 0.7753$ $= 0.558 \sim 2.109$ $= 0.558 \sim 2.11$ (c) Have used the Normal approx. to the Poisson. (c) Have used the Normal approx. The Poisson Poisson. (c) Have used the Normal approx. The Poisson Poisson. (c) Have used the Normal approx. The Poisson Poisson. (c) Have used the Poisson. (c) Have use		C.I. for 1 week			Mapp $\frac{16}{16}$ d $\sqrt{16}$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$\frac{16}{12} \pm \frac{\sqrt{12}}{\sqrt{12}} = \frac{4}{3} \pm 2.326 \times \frac{1}{3}$			Mean $\frac{1}{12}$ s.d. $\sqrt{12}$
$= 0.558 \sim 2.11$ A16 $(2.10, 2.11)$ (c)Have used the Normal approx. to the Poisson.E1E1Poisson requires a constant mean; the observed value of $\frac{16}{12}$ is unlikely to be exactly equal to the mean, so the value $=$			m1		- ·
Poisson.E1Poisson requires a constant mean; the observed value of $\frac{16}{12}$ is unlikely to be exactly equal to the mean, so the value			A1	6	
observed value of $\frac{16}{12}$ is unlikely to be exactly equal to the mean, so the value	(c)		E1		
$\sqrt{12}$		exactly equal to the mean, so the value $\sqrt{\frac{16}{12}}$ used for the standard deviation is			
only an approximation. E1 2 Total 9		* **	E1		

Question Number	Solution	Marks	Total	Comments
and part				
5(a)(i)	B (500, 0.001)	B1	1	
(ii)	$n = 500 \ p = 0.001$ np = 0.5 hence use Po(0.5)	B1		
	$P(X \ge 2) = 1 - P(X \le 1) = 1 - 0.9098$	M1		
	= 0.0902	A1	3	
(b)	$\lambda = 30 / \text{day} P(250 < X < 260)$ $\lambda = 240 / \text{eight days}$	B1		
	$\frac{250.5 - 240}{\sqrt{240}} = 0.678$	M1		Use of $z = \frac{x - \mu}{\sigma}$
	$\frac{259.5 - 240}{\sqrt{240}} = 1.259$	M1 A1 A1		Use of continuity correction At least one correct continuity correction Both <i>z</i> correct
	0.678 1.259			Needs first M1
	0.89599 - 0.75111 = 0.14488 = 0.145 (3 sig fig)	m1 A1√	7	(0.144,0.148)
	Total		11	

Question	Solution	Marks	Total	Comments
Number				
and part				
6(a)(i)	Systematic	B1	1	
(ii)	80	B1	1	
(iii)	Easier to obtain because only need to select one random number.	E1	1	
(b)(i)	Y1 Y2 Y3 Y4 Tot	M1		
	F 18 13 12 12 55	1411		
	M 14 12 10 9 45	A1		3 correct
	Tot 32 25 22 21 100	A1	3	All correct (no marks for totals)
(ii)	No because sample cannot consist of all males	E1	1	oe
(c)				Many possible answers
(-)	Randomly select two Halls of Residence.	B1		Cluster
	This will give sample of size 200.	B1		
				Describe random sampling
	Number Halls 00-19	B1		
	Select a 2 digit random number	B1		
	Ignore repeats and	B1		
	> 19	B1	6	
	Total		13	
	TOTAL		60	