



General Certificate of Education

Mathematics and Statistics 6320 *Specification B*

MBS1 Statistics 1

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

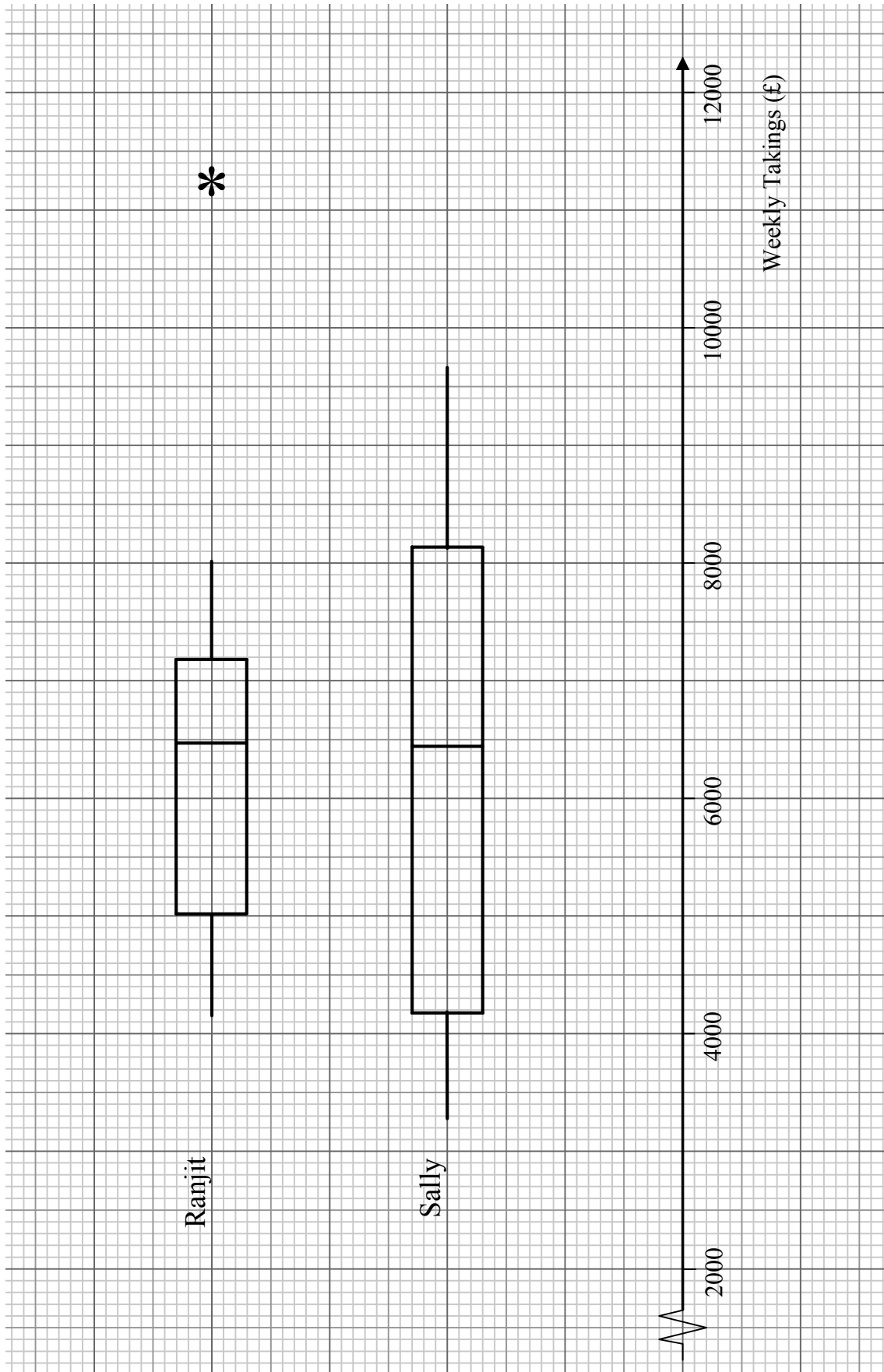
award method and accuracy marks as appropriate

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Q	Solution	Marks	Total	Comments
1(a)	Binomial $n = 6$ $p = 0.3$	B1		Binomial
	$P(2 \text{ or fewer}) = 0.744$	B1		$n = 6$ $p = 0.3$
		B1		0.744 (0.744 to 0.745)
(b)	$P(> 3) = 1 - P(3 \text{ or fewer})$	M1		$P(> 3) = 1 - P(3 \text{ or fewer})$ or equivalent
	$= 1 - 0.925$ $= 0.0705$	A1		0.0705 (0.07 to 0.071)
(c)	$P(6) = 1 - 0.9993 = 0.0007$	M1	7	0.0007(0.0007 to 0.0008)
		A1		
Total			7	
2(a)	Sally IQR $8132 - 4189 = 3943$	M1		Method for calculating limit for one upper outlier – allow 1, 1.5 or 2 times IQR Method for one lower outlier – allow 1, 1.5 or 2 times IQR
	Outliers $> 8132 + 1.5 \times 3943 = 14046.5$	M1		
	Or $< 4189 - 1.5 \times 3943 = -ve$ No outliers			
	Ranjit IQR $7189 - 5013 = 2176$	A1		
Outliers $> 7189 + 1.5 \times 2176 = 10453$			14046.5(14000 to 14100) and 10453(10400 to 10500)	
Or $< 5013 - 1.5 \times 2176 = 1749$ Only outlier is 11248	A1✓	4	ft 11248 correctly identified	
(b)	See plots on next page	M1	4	Method for Sally – ignore median Method for Ranjit – including outlier – ignore median Medians shown Accurate plots by eye & Sally and Ranjit identified
		M1		
		A1		
(c)	Similar average	E1	2	Similar average/median/mean Ranjit less variable/negative skew – must mention outlier
	Ranjit less variable apart from one outlier	E1		
Total			10	
3	Number members 000 to 649	E1	5	Valid numbering Select 3-digit random numbers Ignore repeats Ignore > 649 consistent with their numbering 12 obtained/select corresponding members
	Select 3 digit random numbers	E1		
	Ignore repeats and > 649	E1		
	Continue until 12 obtained	E1		
	Select corresponding members	E1		
Total			5	

MBS1 (cont)

Box and Whisker plots for question 2(b)



MBS1 (cont)

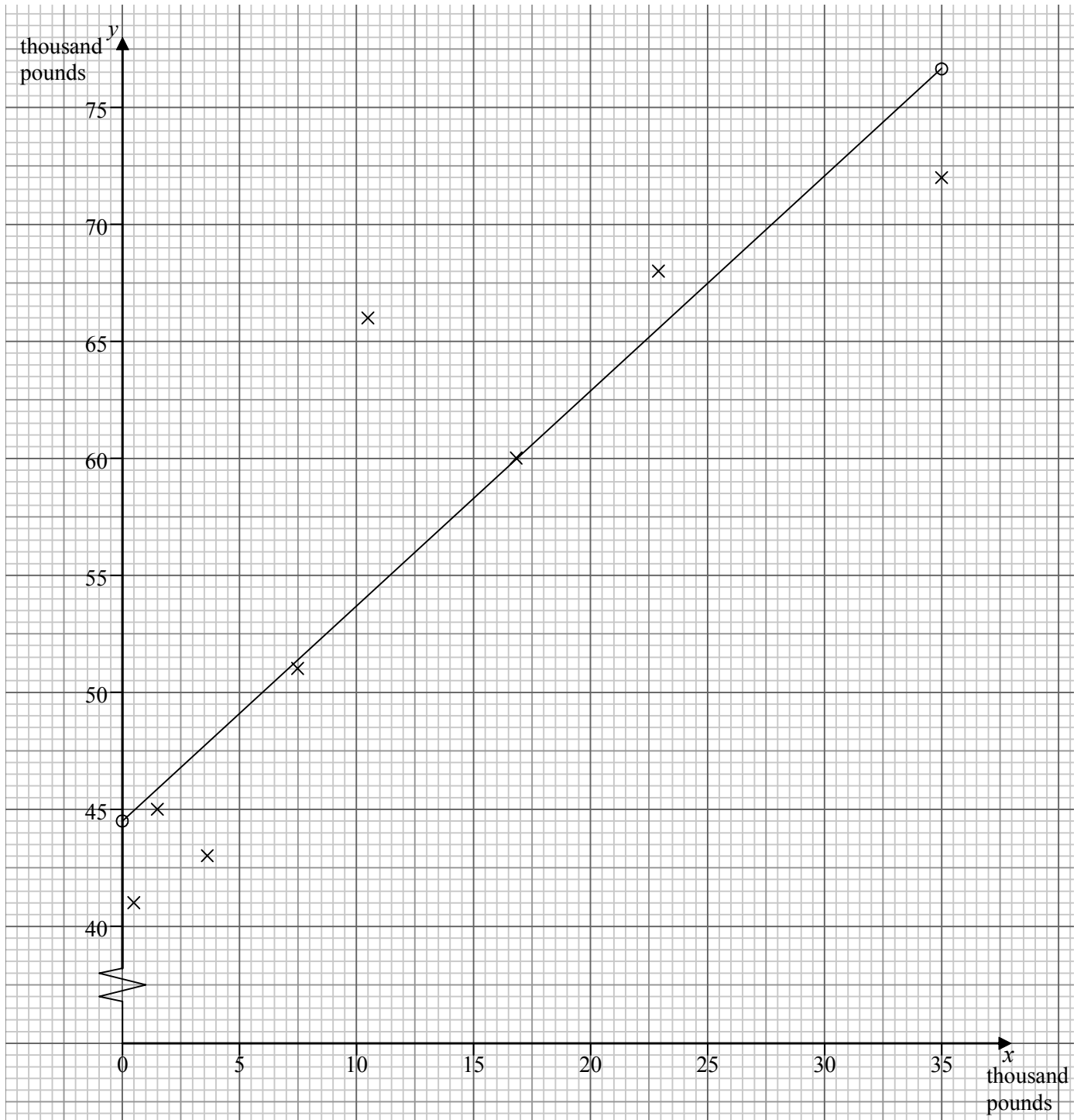
Q	Solution	Marks	Total	Comments		
4(a)(i)	$P(3) = 0.9212 - 0.7834 = 0.138$	M1	2	$P(3) = P(3 \text{ or fewer}) - P(2 \text{ or fewer})$ or use of correct formula 0.138(0.1375 to 0.1385)		
		A1				
	(ii)	Poisson mean 2.4 $P(0) = 0.0907$	B1	2	Poisson, mean 2.4 0.0907(0.0907 to 0.09075)	
			B1			
	(iii)	Poisson mean 12 $P(20 \text{ or more}) = 1 - P(19 \text{ or fewer})$ $= 1 - 0.9787$ $= 0.0213$	B1	3	Poisson mean 12 $P(20 \text{ or more}) = 1 - P(19 \text{ or fewer})$ 0.0213(0.021 to 0.0214) sc allow B2 for 0.0116 (0.011 to 0.0117)	
			M1			
			A1			
(b)(i)	Poisson mean 1.8 Standard deviation $= \sqrt{1.8} = 1.34$	M1	2	$\sqrt{\quad}$ their mean 1.34 (1.34 to 1.345)		
		A1				
(ii)	Cannot distinguish between 2-1 and 3-0	E1	1	Reason		
(c)	Mean not constant	E1	1	Reason - generous		
Total			11			
5(a)(i)	$\frac{3}{28} = 0.107$	M1	1	0.107(0.1065 to 0.1075) 0.231(0.23 to 0.231) 0.179(0.178 to 0.179) all acf		
		A1				
	(ii)	$\frac{5}{28} = 0.179$	M1		1	
			A1			
	(iii)	$\frac{3}{13} = 0.231$	M1		2	
			A1			
	(b)(i)	$\frac{6}{28} \times \frac{5}{27} = 0.0397$	M1		2	allow with replacement 0.0397 (0.0396 to 0.04) acf
			A1			
	(ii)	$2 \times \frac{15}{28} \times \frac{13}{27} = 0.516$	M1		2	allow with replacement 0.516 (0.516 to 0.52) acf
			A1			
(c)(i)	S,T	B1	1	S, T cao		
(ii)	$P(S)P(S) \neq P(S R)$ (0.179 \neq 0.231) No or $P(R).P(S) \neq P(R \cap S)$ $\frac{13}{28} \cdot \frac{5}{28} = 0.0829 \neq \frac{3}{28} = 0.107$ or $P(R) \neq P(R S)$ $\left(\frac{13}{28} \neq \frac{3}{5}\right)$	M1	2	Reason No - needs numerical support		
		A1				
Total			11			

MBS1 (cont)

Q	Solution	Marks	Total	Comments
6(a)	see graph on next page	M1 A1 B1	3	accurate plot by eye - allow one small slip scales and labels
(b)	$y = 44.5 + 0.198x$	B2 B2		44.5 (44.4 to 44.6) allow M1A1 if method shown 0.918 (0.917 to 0.92) allow M1A1 if method shown sc B2 $a = 44.5$ $b = 0.918$ without equation or incorrect equation
	$x = 0$ $y = 44.5$ $x = 35$ $y = 76.6$ + line	M1 A1	6	for line accurate line by eye
(c)	a estimate of sale price with no improvement b estimate, £, of average increase in sale price for each pound spent on improvement	E1 E1 E1	3	sale price no improvement change in sale price for each £ spent on improvement – ignore units mention of estimate / average
(d)	inadvisable – estimated increase in price less than amount spent on improvements.	E1✓ E1✓	2	Inadvisable Reason
(e)(i)	$66 - 44.5 - 0.918 \times 10.5 = 11.9$ (thousand £)	M1 A1	2	ignore sign 11.9 (11.8 to 12.0) or 11900 – ignore units
(ii)	Only E differed substantially from line – E's estimate of selling price higher than others	E1 E1	2	E far from line / inconsistent with others estimate of selling price higher than others
(f)	Actual selling price similar amount above line to E's estimate suggesting that E's estimate was better than others.	E1 E1	2	Selling price above line E's estimate better
	Total		20	

MBS1 (cont)

Graph for question 6



MBS1 (cont)

Q	Solution	Marks	Total	Comments
7(a)(i)	$z = \frac{1000 - 1460}{400} = -1.15$	M1		ignore sign
	Probability one carton sufficient $= 1 - 0.87493$ $= 0.125$	M1 A1		a correct use of normal tables
(ii)	$z_1 = \frac{2000 - 1460}{400} = 1.35$ Probability exactly 2 cartons required $0.91149 - (1 - 0.87493) = 0.786$	M1 A1	5	Completely correct method 0.786(0.786 to 0.787)
(b)(i)	Normal mean 1460 s.d. $\frac{400}{\sqrt{7}} = 151.2$	B1 B1	2	1460 - may be implied by later use 151.2 (151 to 152) or variance = 22857, (22800 to 22900), allow $\frac{400}{\sqrt{7}}$ s.d. or variance may be implied by later use
(ii)	$1460 + 2.3263 \times \frac{400}{\sqrt{7}} = 1812$	B1 M1 A1	3	2.3263 (2.32 to 2.33) ignore sign and $\sqrt{7}$ 1812 (1805 to 1815)
(iii)	mean 1812 \rightarrow total $1812 \times 7 = 12684$ requires 13 cartons to have probability of 0.99 of meeting demand	M1 A1	2	13 cao sc If \bar{x} interpreted as total for the week Allow: (i) B0, B0 (ii) B1, M1, A1 12684 (12600 to 12700) (iii) M1, A1
(c)	$\mu + 0.5828 \times 300 = 1000$ $\mu = 825$	B1 M1 m1 A1	4	0.5828 (0.58 to 0.59) their $z \times 300$ - must be a z - value completely correct method – their z and attempt to solve equation 825 (824 to 826)
	Total		16	
	TOTAL		80	