



General Certificate of Education

Mathematics 6360 Statistics 6380

MS/SS1A Statistics 1A

Mark Scheme

2007 examination - January 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.

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Key to mark scheme and abbreviations used in marking

M	mark is for method		
m or dM	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	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	or equivalent	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
-x EE	deduct x marks for each error	G	graph
NMS	no method shown	C	candidate
PI	possibly implied	Sf	significant figure(s)
SCA	substantially correct approach	Dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

MS/SS1A

Q	Solution	Marks	Total	Comments
1(a)	Mean (\bar{x}) = 39.3 to 39.4	B1	3	AWFW (39.35)
	Standard Deviation (s_n, s_{n-1}) = 12.3 to 12.7	B2		AWFW (12.358 or 12.679)
	If neither correct but working shown, then Mean (\bar{x}) = $\frac{\sum x}{20}$	(M1)		$\sum x = 787$ $\sum x^2 = 34023$ Used
	(b) Median = 42	B2	4	CAO
	Median = 41.5 or 39 or 40	(B1)		CAO
(c)(i)	Interquartile Range = 55 – 31 = 24	B2		CAO; allow B1 for identification of 31 and 55; B0 if shown method is incorrect
	Interquartile Range = 21 to 27	(B1)		AWFW
	Mode: eg Does not exist If exists, must be > 60 or 58 All / too many different values Sparse data	B1		OE
	(ii) Range: eg Maximum value is unknown / > 60 or 58	B1	2	OE; accept 'slowest' but not 'smallest'
Total			9	

MS/SS1A (cont)

Q	Solution	Marks	Total	Comments
2(a)	Use of binomial in (a), (b) or (c)	M1		Can be implied
	$P(P = 5) = \binom{12}{5}(p)^5(1-p)^7$	M1		Allow $p = 0.45, 0.30, 0.22$ or $\frac{1}{3}$
	$= 0.207$ to 0.208	A1	3	AWFW (0.2075)
(b)(i)	$P(10 < S < 15) = 0.8074$ or 0.8849	M1		Allow 3dp accuracy
	minus 0.3087 or 0.4406	M1		Allow 3dp accuracy
	$= 0.498$ to 0.499	A1	3	AWFW (0.4987)
	or B(40 0.30) expressions stated for at least 3 terms within $10 \leq B' \leq 20$ Answer = 0.498 to 0.499	(M1) (A2)		Or implied by a correct answer AWFW
(c)	Mean, $\mu = np = 22$	B1✓		CAO; ✓ on p only ($0 < p < 1$)
	Variance, $\sigma^2 = np(1-p) = 17.16$	M1		Use of $np(1-p)$ even if SD
	Standard deviation = $\sqrt{17.1}$ to 17.2 or = 4.14 to 4.15	A1	3	AWFW
	Total		9	

MS/SS1A (cont)

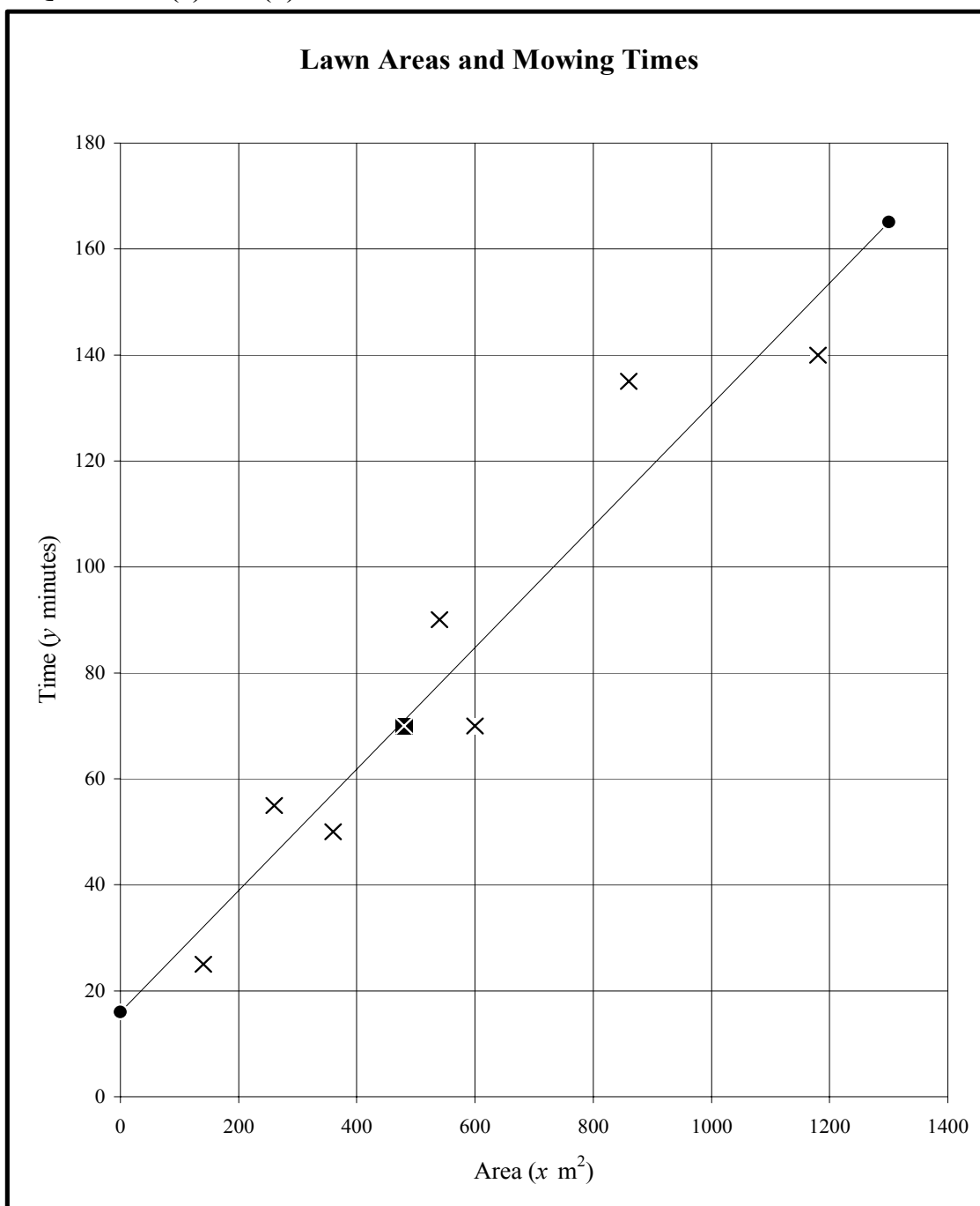
Q	Solution	Marks	Total	Comments
3(a)	90% $\Rightarrow z = 1.64$ to 1.65	B1		AWFW (1.6449)
	or 90% $\Rightarrow t = 1.66$ to 1.67 (Knowledge of the t -distribution is not required in this unit)	(B1)		AWFW (1.6649)
	CI for μ is $\bar{x} \pm (z \text{ or } t) \times \frac{(s_{n-1} \text{ or } s_n)}{\sqrt{n}}$	M1		Used; must have \sqrt{n} with $n > 1$
	Thus $184 \pm (1.6449 \text{ or } 1.6649) \times \frac{(32 \text{ or } 32.2)}{(\sqrt{78} \text{ or } \sqrt{77})}$	A1✓		✓ on z or t only
	Hence $184 \pm (5.94 \text{ to } 6.13)$			
	or £184 \pm £6			
	or (£178, £190)	A1	4	AWRT; ignore units
(b)(i)	Likely to be valid	B1		Accept 'valid' or equivalent
(ii)	Different plays have different: programme prices, sales, marketing, etc theatre or audience sizes, etc popularity, artists, etc so	B1		
	Unlikely to be valid	↑Dep↑ B1	3	Accept 'not valid' or equivalent
	Total		7	

MS/SS1A (cont)

Q	Solution	Marks	Total	Comments
4(a)	$P(R' \cap S' \cap T) = 0.3 \times 0.4 \times 0.8$ $= 0.096$	M1 A1	2	At least 1 probability correct CAO; OE
(b)	$P(\text{One}) =$ $(a) + P(R \cap S' \cap T') + P(R' \cap S' \cap T')$ $= (a) + (0.7 \times 0.4 \times 0.2) + (0.3 \times 0.6 \times 0.2)$ $= 0.096 + 0.056 + 0.036 = 0.188$	M1 M1 A1	3	Use of 3 possibilities, ignore multipliers At least 1 new term correct CAO; OE
(c)	$P(\text{At least one}) = 1 - P(\text{None})$ or $= P(\text{One or two or three})$ $= 1 - (0.3 \times 0.4 \times 0.2)$ $= 1 - 0.024$ or $= (b) + (0.7 \times 0.6 \times 0.2) + (0.7 \times 0.4 \times 0.8)$ $+ (0.3 \times 0.6 \times 0.8) + (0.7 \times 0.6 \times 0.8)$ $= 0.188 + 0.084 + 0.224 + 0.144 + 0.336$ $= 0.976$	M1 M1 A1	3	Used; OE; ignore multipliers At least 1 new term correct CAO; OE
	Total		8	

MS/SS1A (cont)

Q	Solution	Marks	Total	Comments	
5(a)(i)	$P(X < 45) = P\left(Z < \frac{45 - 37}{8}\right)$	M1	3	Standardising (44.5, 45 or 45.5) with 37 and ($\sqrt{8}$, 8 or 8^2) and/or $(37 - x)$	
	$= P(Z < 1)$	A1		CAO; ignore sign	
	$= 0.841$	A1		AWRT (0.84134)	
	(ii)	$P(30 < X < 45) = (i) - P(X < 30)$	M1	3	Used; OE
		$= (i) - P(Z < -0.875)$	m1		Area change
		$= (i) - [1 - (0.80785 \text{ to } 0.81057)]$			
		$= 0.648 \text{ to } 0.652$	A1	AWFW (0.65056)	
	(b)	$0.12 \Rightarrow z = 1.17 \text{ to } 1.18$	B1	4	AWFW; ignore sign (1.1750)
		$z = \frac{45 - 40}{\sigma}$	M1		Standardising 45 with 40 and σ
		$= 1.175$	m1		Equating z-term to z-value but not using 0.12, 0.88 or $ 1 - z $
		$\sigma = 4.23 \text{ to } 4.28$	A1		AWFW
	(c)	Route A: $P(X > 45) = 1 - (a)(i)$	B1	2	OE; must use 45
Route B: $P(Y > 45) = 0.12$		\uparrow Dep \uparrow B1 \checkmark	\checkmark on (a)(i); allow Route Y		
so Monica should use Route B (smaller prob)					
	Total		12		

Question 6 (a) and (b)

- | | | |
|------------|---|------------|
| (a) | 8 or 7 points plotted accurately | B2 |
| | (6 or 5 points plotted accurately | B1) |
| (b) | Line plotted accurately | B2 |
| | (Evidence of correct method for ≥ 2 points | M1) |

(Graph = 4)

MS/SS1A (cont)

Q	Solution	Marks	Total	Comments
6(a)	8 or 7 points plotted accurately (6 or 5 points plotted accurately)	B2 (B1)	2	
(b)	Gradient, $b = 0.114$ to 0.115 ($b = 0.11$ to 0.12)	B2 (B1)		AWFW (0.11469)
	Intercept, $a = 15.9$ to 16.1 ($a = 13$ to 19)	B2 (B1)		AWFW (16.00824)
	Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$ or Attempt at S_{xx} and S_{xy} Attempt at correct formula for b $b = 0.114$ to 0.115 $a = 15.9$ to 16.1	(M1) (m1) (A1) (A1)		4420, 3230800, 635 and 441300 788750 and 90462.5 AWFW AWFW
	Accept a and b interchanged only if then identified correctly later in question			
	Line plotted accurately (Evidence of correct method for ≥ 2 points)	B2 (M1)	6	At least from $x = 200$ to 1000
(c)	$\text{Res}_H = y_H - Y_H = 70 - (a + b \times 480)$ $= -1.5$ to -0.5	M1 A1		Used; or implied by correct answer; allow for $Y_H - y_H$ shown AWFW (-1.06)
	Point H is (almost) on / just below the line	B1	3	Accept near / close / just above or equivalent
(d)	$Y = a + b \times 560$ or reading from scatter diagram $= 79$ to 81	M1 A1		Used AWFW (80.2)
	Cost = $Y \times \frac{12}{60}$ or $\frac{Y}{5}$ $= \text{£}15.8$ to $\text{£}16.2$	M1 A1		Used AWFW; ignore units (£16.05)
	Total		15	
	TOTAL		60	