AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

General Certificate of Education

Mathematics 6360
Statistics 6380

MS/SS1B   Statistics 1B

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.

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

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/SS1B

Q	Solution	Marks	Total	Comments
1(a)	Mean $(\bar{x})$ = 39.3 to 39.4	B1		AWFW (39.35)
	Standard Deviation (s_n, s_{n-1}) = 12.3 to 12.7	B2	3	AWFW (12.358 or 12.679)
	If **neither** correct **but** working shown, then			$\sum x = 787$ $\sum x^2 = 34023$
	Mean $(\bar{x}) = \dfrac{\sum x}{20}$	(M1)		Used
(b)	Median = 42	B2		CAO
	Median = 41.5 or 39 or 40	(B1)		CAO
	Interquartile Range = 55 – 31 = 24	B2	4	CAO; allow B1 for identification of 31 and 55; B0 if method shown is incorrect
	Interquartile Range = 21 to 27	(B1)		AWFW
(c)(i)	**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/SS1B (cont)

Q	Solution	Marks	Total	Comments
2(a)	Use of binomial in (a), (b) or (c)	M1		Can be implied
	$P(E = 5) = \binom{16}{5}(p)^5(1-p)^{11}$	M1		Allow $p = 0.45$, 0.25, 0.30 or $\frac{1}{3}$
	$= 0.112$	A1	3	AWRT (0.1123)
(b)(i)	B(50, 0.25)	B1		Used; can be implied
	$P(C \le 12) = 0.511$	B1	2	AWRT (0.5110)
(ii)	$P(10 < B' < 20) = 0.9152$ or 0.9522	M1		Allow 3 dp accuracy
	minus 0.0789 or 0.1390	M1		Allow 3 dp accuracy
	$= 0.836$	A1	3	AWRT (0.8363)
	or B(50, 0.30) expressions stated for **at least 3** terms within $10 \le B' \le 20$	(M1)		Or implied by a correct answer
	Answer $= 0.836$	(A2)		AWRT
(c)	$n = 40$, $p = 0.7$	B1		Both used; can be implied
	Mean $\mu = np = 28$	B1$\surd$		CAO; $\surd$ on p only
	Variance $\sigma^2 = np(1-p) = 8.4$	M1		Use of $np(1-p)$ even if SD
	Standard deviation $= \sqrt{8.4}$ or $= 2.89$ to 2.9	A1	4	CAO; AWFW
	Total		**12**	

MS/SS1B (cont)

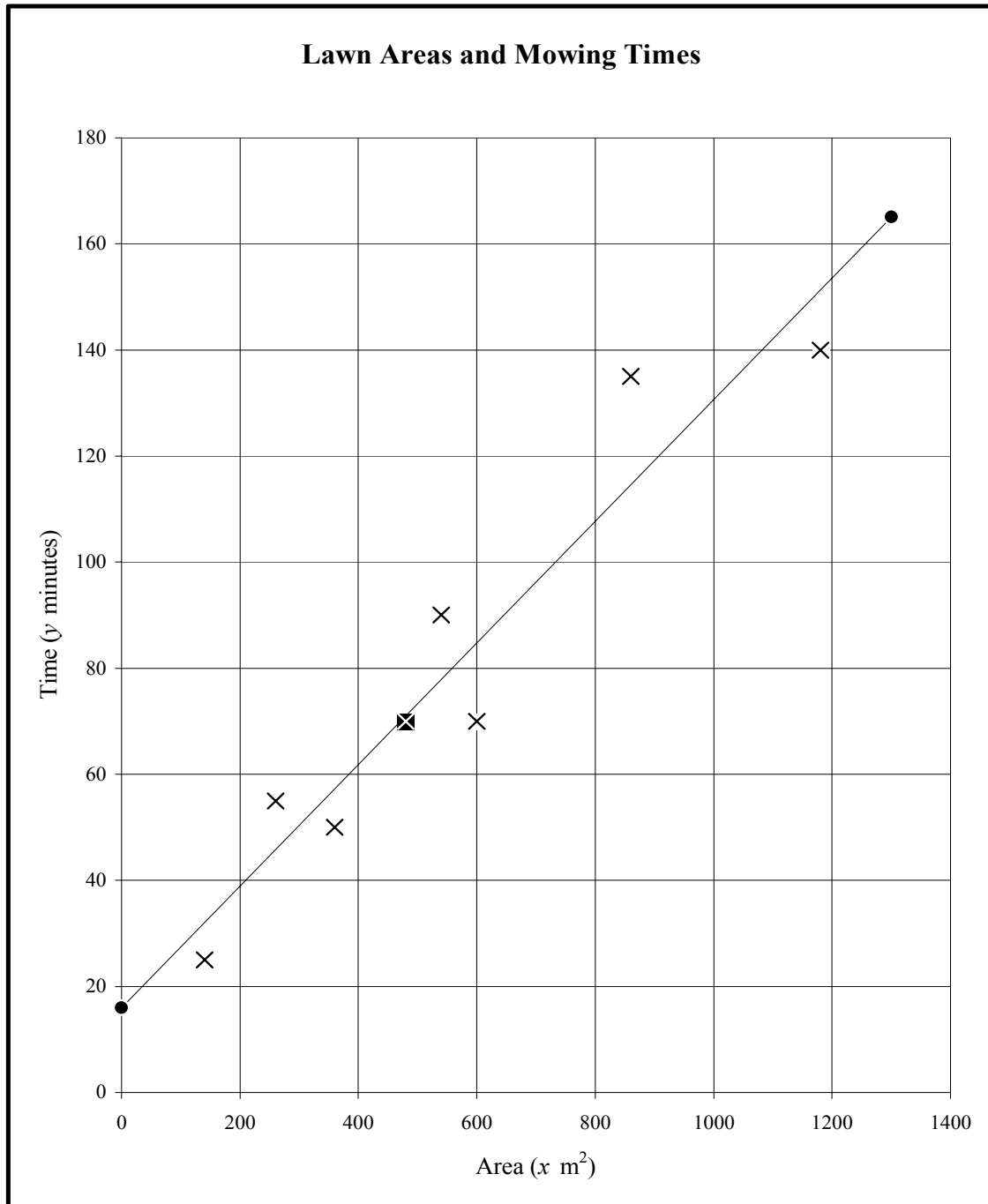| Q	Solution	Marks	Total	Comments
3(a)	$0.5 \leq$ Value ≤ 0.95 Positive value < 1 (and > 0)	B2 (B1)		Value is actually 0.8
(b)	$-0.2 \leq$ Value $\leq +0.2$	B1		Value is actually 0.0
(c)	$-0.95 \leq$ Value ≤ -0.5 Negative value > -1 (and < 0)	B2 (B1)	5	Value is actually -0.7
	Total		**5**	
4(a)	$90\% \Rightarrow z = 1.64$ to 1.65 **or** $90\% \Rightarrow t = 1.66$ to 1.67 (Knowledge of the t–distribution is **not** required in this unit)	B1 (B1)		AWFW (1.6449) AWFW (1.6649)
	CI for μ is $\quad \bar{x} \pm \left(z \,\text{or}\, t\right) \times \dfrac{\left(s_{n-1} \,\text{or}\, s_n\right)}{\sqrt{n}}$	M1		Used; must have $\sqrt{n}$ with $n > 1$
	Thus $184 \pm (1.6449 \text{ or } 1.6649) \times \dfrac{(32 \text{ or } 32.2)}{\left(\sqrt{78} \text{ or } \sqrt{77}\right)}$	A1√		√ on z or t only
	Hence $\quad 184 \pm (5.94$ 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 **Unlikely** to be **valid**	B1 ↑Dep↑ B1	3	Accept 'not valid' or equivalent
	Total		**7**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
5(a)	P($D' \cap E' \cap F'$) = 0.4 × 0.3 × 0.2	M1		At least 1 probability correct
	= 0.024	A1	2	CAO; OE
(b)	P($D' \cap E' \cap F$) = 0.4 × 0.3 × 0.8	M1		At least 2 probabilities correct
	= 0.096	A1	2	CAO; OE
(c)	P(One) = (b) + P($D \cap E' \cap F'$) + P($D' \cap E \cap F'$)	M1		Use of 3 possibilities; ignore multipliers
	=(b) + (0.6 × 0.3 × 0.2) + (0.4 × 0.7 × 0.2)	M1		At least 1 new term correct
	= 0.096 + 0.036 + 0.056 = 0.188	A1	3	CAO; OE
(d)	P(One or two) = (c) + (3 terms each of 3 probabilities) **or** = 1 – (a) – (1 term of 3 probabilities)	M1		(c) + P(Two) Used; OE; ignore multipliers 1 – (a) – P(Three)
	= 0.188 + (0.6 × 0.7 × 0.2) + (0.6 × 0.3 × 0.8) + (0.4 × 0.7 × 0.8) = 0.188 + 0.084 + 0.144 + 0.224 **or** = 1 – 0.024 – (0.6 × 0.7 × 0.8) = 1 – 0.024 – 0.336	M1		At least 1 new term correct
	= 0.64	A1	3	CAO; OE
	Total		**10**	

MS/SS1B (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$P(X < 45) = P\left(Z < \dfrac{45-37}{8}\right)$	M1		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	3	AWRT (0.84134)
(ii)	$P(30 < X < 45) = (i) - P(X < 30)$	M1		Used; OE
	$= (i) - P(Z < -0.875)$			
	$= (i) - [1 - (0.80785 \text{ to } 0.81057)]$	m1		Area change
	$= 0.648 \text{ to } 0.652$	A1	3	AWFW (0.65056)
(b)	$0.12 \Rightarrow z = 1.17 \text{ to } 1.18$	B1		AWFW; ignore sign (1.1750)
	$z = \dfrac{45 - 40}{\sigma}$	M1		Standardising 45 with 40 and σ
	$= 1.175$	m1		Equating z-term to z-value but not using 0.12, 0.88 or $\lvert 1 - z \rvert$
	$\sigma = 4.23 \text{ to } 4.28$	A1	4	AWFW
(c)	**Route A:** $P(X > 45) = 1 - (a)(i)$ **Route B:** $P(Y > 45) = 0.12$ so	B1 ↑Dep↑		OE; must use 45
	Monica should use **Route B** (smaller prob)	B1✓	2	✓ on (a)(i); allow Route Y
(d)	Mean of $\bar{W} = 18$	B1		CAO; can be implied by **use** in standardising
	Variance of $\bar{W} = \dfrac{12^2}{36} = 4$	B1		CAO; OE
	$P(\bar{W} > 20) = P\left(Z > \dfrac{20 - 18}{2}\right)$	M1		Standardising 20 with 18 and 2 and/or $(18 - 20)$
	$= P(Z > 1) = 0.159$	A1✓	4	AWRT (0.15866); ✓ on (a)(i) if used
(e)	In part (d)	B1	1	CAO; OE
	Total		17	

Question 7 (a) and (b)

Lawn Areas and Mowing Times

(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/SS1B (cont)

Q	Solution	Marks	Total	Comments
7(a)	8 or 7 points plotted accurately	B2	2	
	(6 or 5 points plotted accurately)	(B1)		
(b)	Gradient, b = 0.114 to 0.115	B2		AWFW (0.11469)
	(b = 0.11 to 0.12)	(B1)		
	Intercept, a = 15.9 to 16.1	B2		AWFW (16.00824)
	(a = 13 to 19)	(B1)		
	Attempt at $\sum x$, $\sum x^2$, $\sum y$ and $\sum xy$			4420, 3230800, 635 and 441300
	or	(M1)		
	Attempt at S_{xx} and S_{xy}			788750 and 90462.5
	Attempt at correct formula for b	(m1)		
	b = 0.114 to 0.115	(A1)		AWFW
	a = 15.9 to 16.1	(A1)		AWFW
	Accept a and b interchanged only if then identified correctly later in question			
	Line plotted accurately	B2	6	At least from x = 200 to 1000
	(Evidence of correct method for $\geq$ 2 points)	(M1)		
(c)	$\text{Res}_H = y_H - Y_H = 70 - (a + b \times 480)$	M1		Used; or implied by **correct** answer; allow for $Y_H - y_H$ **shown**
	$= -1.5$ to -0.5	A1		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	M1		Used
	= 79 to 81	A1		AWFW (80.2)
	Cost = $Y \times \dfrac{12}{60}$ or $\dfrac{Y}{5}$	M1		Used
	= £15.8 to £16.2	A1	4	AWFW; ignore units (£16.05)
	Total		**15**	
	TOTAL		**75**	