



## **General Certificate of Education**

# **Mathematics 6360 Statistics 6380**

**MS/SS1A      Statistics 1A**

## **Mark Scheme**

*2007 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.

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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	
<b>1(a)</b>	$r = -0.526$ to $-0.525$	B3	3	AWFW	
	or $r = -0.53$ to $-0.52$	(B2)		AWFW; ignore sign	
	or $r = -0.6$ to $-0.4$	(B1)		AWFW; ignore sign	
	OR				
	Attempt at $\sum x$ , $\sum x^2$ , $\sum y$ , $\sum y^2$ and $\sum xy$	(M1)		260, 6970, 143, 2083 and 3671	
	or Attempt at $S_{xx}$ , $S_{yy}$ and $S_{xy}$			210, 38.1 and $-47$	
	Attempt at a correct formula for $r$	(m1)			
	$r = -0.526$ to $-0.525$	(A1)		AWFW	
	<b>(b)</b>	Weak/some/moderate negative correlation (relationship/association)		B1	OE; must qualify strength and indicate negative B0 for strong/poor/reasonable/average B0 if $r > 0$ or $r < -1$ B0 if contradictory statements
		between			
length and (maximum) diameter		B1	Context		
Ignore subsequent comments (as below) only if B1 B1 already scored					
OR					
Some evidence that large lengths are associated with small diameters		(B1) (B1)	OE; must qualify strength and indicate negative		
OR					
Longer melons tend to have smaller diameters / be thinner	(B1) (B1)	2	OE; must qualify strength and indicate negative		
	<b>Total</b>		<b>5</b>		

## MS/SS1A (cont)

Q	Solution	Marks	Total	Comments
2	Ratios: Penalise first occurrence only of a correct answer			
(a)(i)	$P(\text{English}) = \frac{14+8}{50} =$	B1		Correct expression; PI
	$\frac{22}{50}$ or $\frac{11}{25}$ or 0.44	B1	2	CAO; OE
(ii)	$P(\text{Irish}   \text{back}) =$ $\frac{P(\text{Irish} \cap \text{back})}{P(\text{back})} = \frac{6}{\sum(\text{back})} =$	M1		Used; may be implied by values or answer
	$\frac{6}{23}$ or 0.26 to 0.261	A1	2	CAO/AFWW ( $6/50 \Rightarrow 0$ )
(iii)	$P(\text{forward}   \text{not Scottish}) =$ $\frac{P(\text{forward} \cap \text{not Scottish})}{P(\text{not Scottish})} =$	M1		Used; OE May be implied by values or answer
	$\frac{14+5+6}{50-4} = \frac{27-2}{50-4} =$			
	$\frac{25}{46}$ or 0.54 to 0.544	A1	2	CAO/AFWW ( $25/50 \Rightarrow 0$ )
(b)	$P(4 \times \text{English}) =$ $\left(\frac{22}{50}\right) \times \left(\frac{21}{49}\right) \times \left(\frac{20}{48}\right) \times \left(\frac{19}{47}\right) =$	M1 M1		Reducing non-tabulated value 4 times Reducing 50 and multiplying 4 terms (ignore multipliers)
	$\frac{175560}{5527200}$ or $\frac{209}{6580}$			
	or 0.0317 to 0.032	A1	3	CAO/AFWW
	<b>Total</b>		<b>9</b>	

## MS/SS1A(cont)

Q	Solution	Marks	Total	Comments
<b>3(a)</b>	Use of binomial in (a) or (b)	M1		PI
	$P(R_7 = 3) = \binom{7}{3}(0.45)^3(0.55)^4$	A1		Correct expression
	or $= 0.6083 - 0.3164$ $= 0.29$ to 0.292	A1	3	AWFW (0.2919)
<b>(b)(i)</b>	$P(R_{30} < 15) = 0.64$ to 0.645	B2	2	AWFW (0.6448)
	SC: Answer = 0.769 to 0.77	(B1)		AWFW (0.7691)
<b>(ii)</b>	$P(R_{30} > 10) = 1 - 0.135$	M1		PI
	$= 0.86$ to 0.87	A1	2	AWFW (0.8650)
	SC: Answer = 0.93 to 0.931	(B1)		AWFW (0.9306)
<b>(iii)</b>	$P(12 \leq R_{30} \leq 18) = 0.9666$ or 0.9286	M1		Allow 3 dp accuracy
	minus 0.2327 or 0.3592	M1		Allow 3 dp accuracy
	$= 0.73$ to 0.734	A1		AWFW (0.7339)
	OR B(30, 0.30) expressions stated for at least 3 terms within $12 \leq R_{30} \leq 18$	(M1)		Or implied by a correct answer
	Answer = 0.73 to 0.734	(A2)	3	AWFW
	<b>Total</b>		<b>10</b>	

## MS/SS1A (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	Mode = 2	B1	2	CAO
	Range = 15	B1		CAO
(ii)	CF: 4 17 41 58 73 84 89 95 x: 0 1 2 3 4 9 14 15			
	Median (48 <sup>th</sup> ) = 3	B2		CAO; B0 if shown method is incorrect
	Interquartile Range (72 <sup>nd</sup> – 24 <sup>th</sup> ) = 4 – 2 = 2	B2		CAO Allow B1 for identification of 4 and 2 B0 if shown method is incorrect
	If neither correct but CF attempted and matched correctly with $\geq 5$ x-values	(M1) (A1)	4	Allow for median = $2 + \frac{x}{17}$
(iii)	Mean ( $\bar{x}$ ) = 4.2	B2		CAO $\sum fx = 399$
	Standard Deviation ( $s_n, s_{n-1}$ ) = 3.88 to 3.91	B2		AWFW $\sum fx^2 = 3111$ (3.887 or 3.907)
	If neither correct but mid-points of 7 and 12 seen and use of mean ( $\bar{x}$ ) = $\frac{\sum fx}{95}$	(B1) (M1)	4	Allow for $4.1 \leq \bar{x} \leq 4.3$
(b)(i)	Unknown values (16) have no effect on median and IQR <b>or</b> median and IQR are exact values but $\bar{x}$ and $s$ are estimates	B1	1	
(ii)	Use all available data or Enable further analyses	B1	1	
<b>Total</b>			<b>12</b>	

## MS/SS1A (cont)

Q	Solution	Marks	Total	Comments
<b>5(a)</b>	$b$ (gradient) = $-0.0873$ to $-0.087$	B2	4	AWFW ( $-0.087\dot{2}\dot{7}$ )
	$b$ (gradient) = $-0.09$ to $-0.08$	(B1)		AWFW; $-8.73^{-02} \Rightarrow$ B0
	$a$ (intercept) = $5.94$ to $5.96$	B2		AWFW ( $5.95\dot{0}\dot{9}$ )
	$a$ (intercept) = $5.6$ to $6.1$	(B1)		AWFW
	Attempt at $\sum x$ , $\sum x^2$ , $\sum y$ and $\sum xy$			396, 16016, 30.9 and 958.8
	or	(M1)		1760 and $-153.6$
	Attempt at $S_{xx}$ and $S_{xy}$			
	Attempt at correct formula for $b$	(m1)		
	$b = -0.0873$ to $-0.087$	(A1)		AWFW
	$a = 5.94$ to $5.96$	(A1)		AWFW
Accept $a$ and $b$ interchanged only if then identified correctly later in question				
<b>(b)(i)</b>	Each $1^\circ\text{C}$ rise in temperature results in an (average) decrease of $0.087$ m ( $5$ s) in time taken for pellets to dissolve	B1	2	Quantified rise in $x$ (results in) Decrease in $y$ OE
		B1		
<b>(ii)</b>	$a$ is $y$ -value at $x = 0$ at which water is solid/ice/frozen so pellets cannot dissolve	B1	2	Indication that it is $y$ at $x = 0$ Mention of solid or ice or frozen
		B1		
<b>Total</b>			<b>8</b>	



## MS/SS1A (cont)

Q	Solution	Marks	Total	Comments
<b>6(a)(i)</b>	$P(X < 40) = P\left(Z < \frac{40-38}{5}\right) =$	M1		Standardising (39.5, 40 or 40.5) with 38 and ( $\sqrt{5}$ , 5 or $5^2$ ) and/or $(38 - x)$
	$P(Z < 0.4) = 0.655$ to 0.66	A1	2	AWFW (0.65542)
<b>(ii)</b>	$P(30 < X < 40) =$ $P(X < 40) - P(X < 30) =$ (i) $- P(X < 30) =$ (i) $- P(Z < -1.6) =$	M1		Difference or equivalent Standardising other than 40 and 30 $\Rightarrow$ max of M1 m1 A0
	(i) $- \{1 - P(Z < +1.6)\} =$ $0.65542 - \{1 - 0.94520\} =$	m1		Area change
	0.6 to 0.601	A1	3	AWFW (0.60062)
<b>(iii)</b>	75% (0.75) $\Rightarrow z = \pm 0.674$ to $\pm 0.675$	B1		AWFW (0.6745)
	$z = \frac{x-38}{5}$	M1		Standardising $x$ with 38 and 5
	$= -0.6745$	m1		Equating $z$ -term to $z$ -value but not using 0.75, 0.25, $ 1-z $ or $\Phi(0.75) = 0.77337$
	$x = 34.6$ to 35	A1	4	AWFW

MS/SS1A (cont)

Q	Solution	Marks	Total	Comments
<b>6(a)</b>			(9)	
<b>(b)(i)</b>	98% $\Rightarrow z = 2.32$ to 2.33	B1		AWFW (2.3263)
	or 98% $\Rightarrow t = 2.42$ to 2.43 (Knowledge of the $t$ -distribution is not required in this unit)	(B1)		AWFW (2.426)
	CI for $\mu$ is $\bar{y} \pm (z \text{ or } t) \times \frac{(s_{n-1} \text{ or } s_n)}{\sqrt{n}}$	M1		Used; must have $\sqrt{n}$ with $n > 1$
	Note that $19.1 \times \sqrt{\frac{40}{39}} = 19.34332$			$19.1 \times \frac{40}{39} = 19.58974$ Max of B1 M1 A0 $\wedge$ A1
Thus				
$107 \pm (2.32 \text{ to } 2.43) \times \frac{(19.1 \text{ or } 19.3 \text{ to } 19.4)}{(\sqrt{40} \text{ or } \sqrt{39})}$	A1 $\wedge$		$\wedge$ on $z$ or $t$ only	
Hence $107 \pm (7.00 \text{ to } 7.55)$				
ie $107 \pm (7 \text{ to } 8)$ or $(99 \text{ to } 100, 114 \text{ to } 115)$	A1	4	AWFW	
<b>(ii)</b>	$2\frac{1}{2} \times (\text{mean for adult males eels})$			
	$= 2.5 \times 38 = 95$	B1		CAO
	Since $95 < \text{LCL}$	$\uparrow$ Dep $\uparrow$ B1 $\wedge$ $\uparrow$ Dep $\uparrow$		OE; $\wedge$ on CI
	Claim appears valid	B1 $\wedge$	3	OE; $\wedge$ on CI
	<b>Total</b>		<b>16</b>	
	<b>TOTAL</b>		<b>60</b>	