Version 1.0: 0206

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics/Statistics 6360/6380

MS/SS1A Statistics 1A

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 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	OE	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)

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

MS/SS1A/W

Q	Solution	Marks	Total	Comments
1				
(a)	$r = 0.797$ or $r = 0.79$ to 0.81 or $r = 0.8$	B3 (B2) (B1)		AWRT AWFW; accept 0.80 but not 0.8
(i)				
	Attempt at $\Sigma x \quad \Sigma x^2 \quad \Sigma y \quad \Sigma y^2 \quad \Sigma xy$ or Attempt at $S_{xx} \quad S_{yy} \quad S_{xy}$	 (M1)		115, 1725; 130, 2076.36; 1809.3 402.5; 386.36; 314.3
	Attempt at a correct formula for r	(m1)		
	$r = 0.797$	(A1)	3	AWRT
(ii)				Not 'some' or 'weak' or 'good'
	Strong (fairly strong) evidence of a **positive** (direct) linear **correlation** (association/relationship)	B1		Must use 'positive' or equivalent and 'correlation' or equivalent Accept 'high' as alternative to 'strong'
	time in store and **value of items purchased**	B1		Context
(b)	r = Answer to (a)(i) or $r = 0.797$	B1√	 1	√ on (a)(i) providing $-1 < r < 1$ AWRT
	Total		**6**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
2	Volume $X \sim N(56, 2.5^2)$			
(a)	$P(X < 60) = P\left(Z < \frac{60-56}{2.5}\right)$	M1		Standardising (59.5, 60 or 60.5) with 56 and ($\sqrt{2.5}$, 2.5 or 2.5^2) and/or $(56 - x)$
(i)	$= P(Z < 1.6)$	A1		CAO; ignore sign
	$= 0.945$	A1	3	AWRT (0.94520)
(ii)	$P(50 < X < 60) = (i) - P(X < 50)$	M1		Or equivalent
	$= (i) - P(Z < -2.4) = (i) - [1 - \Phi(2.4)]$	m1		Area change
	$= 0.94520 - (1 - 0.99180) = 0.937$	A1	3	AWRT (0.93700)
(iii)	$P(X = 55) = 0$	B1	1	CAO
(b)	98% $\Rightarrow z = 2.05$ to 2.06	B1		AWFW; ignore sign (–2.0537)
	$z = \frac{100-\mu}{3.4}$	M1		Standardising 100 with μ & 3.4 Allow $(\mu - 100)$
	Thus $\frac{100-\mu}{3.4} = -2.0537$	M1		Equating z-term to z-value Not using 0.98, 0.02 or $\lvert 1 - z \rvert$
	Thus $\mu = 107$	A1	4	AWRT
	Total		**11**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
3	$\underline{P(D) = 0.6\ (60\%)}$ $\underline{P(D') = 0.4\ (40\%)}$ $\underline{P(d \mid D) = 0.75}$ $\underline{P(d \mid D') = 0.05}$ $\underline{P(i \mid D) = 0.15}$ $\underline{P(i \mid D') = 0.15}$ $\underline{P(n \mid D) = 0.10}$ $\underline{P(n \mid D') = 0.80}$			$D \Rightarrow D$iseased fish $d \Rightarrow d$iseased ……) $i \Rightarrow i$nconclusive……) test $n \Rightarrow n$on-diseased……..)
(a)(i)	$P(D \cap d)$ $= P(D) \times P(d \mid D) = 0.6 \times 0.75$	M1		
	$= 0.45$	A1	2	CAO (9/20)
(ii)	$P(d) = P(D \cap d) + P(D' \cap d)$			
	$= \text{(i)} + P(D') \times P(d \mid D')$	M1		(a)(i) + (1 prob)
	$= 0.45 + (1 - 0.6) \times 0.05$	m1√		√ on (a)(i)
	$= 0.45 + 0.02 = 0.47$	A1	3	CAO
(iii)	$P(\text{correct}) = P(D \cap d) + P(D' \cap d')$ $= \text{(i)} + P(D') \times P(d' \mid D')$ Or $= 0.45 + (1 - 0.6) \times 0.80$	M1√		Correct expression/values √ on (a)(i)
	$= 0.45 + 0.32 = 0.77$	A1	2	CAO
(b)	$P([d \mid D] \cap [d \mid D] \cap [d' \mid D])$			
	$= [P(d \mid D)]^2 \times P(d' \mid D)$	M1		$(\text{Prob})^2 \times (\text{Prob})$; or equivalent
	multiplied by 3	M1		Multiplier of 3
	$= 0.75^2 \times 0.10 \times 3 = 0.168$ to 0.169	A1	3	AWFW (0.16875)
	Total		**10**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
4				
(a)	Gradient, $b = 0.0848$	B2		AWRT
	or			
	$b = 0.084$ to 0.085	(B1)		AWFW
	Intercept, $a = 1.72$ to 1.73	B2		AWFW
	or			
	$a = 1.7$	(B1)		CAO
	Attempt at $\Sigma x \quad \Sigma x^2 \quad \Sigma y \quad \Sigma xy$			224, 7180; 32.8; 995.4
	or	(M1)		
	Attempt at $S_{xx} \quad S_{xy}$			908; 77
	Attempt at a correct formula for b	(m1)		
	$b = 0.0848$	(A1)		AWRT
	$a = 1.72$ to 1.73	(A1)		AWFW
	Accept a & b interchanged only if $y = ax + b$ stated or subsequently used correctly in (b)		4	
(b)(i)				Res = |(Obs y) – (Pred y)| & used
	Residual = $y - a - bx$	M1		Allow use of $x = 3$ and/or $x = 7$
	$(\text{Residual})_3 = -0.465$ to -0.485	A1		AWFW
		(A1)		Both correct magnitude
	$(\text{Residual})_7 = -0.335$ to -0.365	A1		AWFW
			3	
(ii)	Residuals are small (relative to y-values)			Except for $(\text{Residual})_6$ *Any sensible comment;*
	No pattern to residuals	B1		Residuals random
	Fitted **equation is appropriate/suitable**	B1		Or equivalent Do not allow 'equation is good' or 'equation is accurate'
			2	
	Total		**9**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
5				
(a)(i)	B(n, 0.07)	M1		Use of in (a)
	$P(X = 2) = \binom{17}{2}(0.07)^2(0.93)^{15}$	A1		Fully correct expression May be implied
	$= 136 \times 0.0049 \times 0.33670$			
	= 0.224 to 0.225	A1	3	AWFW (0.22438)
(ii)				
	$P(X \leq 5 \mid B(50, 0.07))$	M1		Attempted; tables or formula (≥3 terms stated) May be implied
	= 0.865	A1	2	AWRT (0.8650)
(b)	B(50, 0.55)			
	$P(Y \geq 30) = P(Y' \leq 20)$	M1		Change from Y to Y' Must be clear evidence
	with $p = 0.45$	A1		Stated or implied
	= 0.286	A1	3	AWRT (0.2862)
	Total		**8**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
6				
(a)(i)	Mean ($\bar{x}$) = 24.7 to 25.7	B2		AWFW (25.2)
	Standard Deviation (s_n, s_{n-1}) = 16.7 to 17.7	B2		AWFW (17.1474 or 17.2338)
	MPs (x): 5.5, 15.5, 23, 28, 33, 38, 45.5, 75.5	(B1)		At least 4 correct
	Mean ($\bar{x}$) = $\frac{\sum fx}{100}$	(M1)		Use of
			4	
(b)	Data is skewed or not symmetric Discrete data or counts (Mean – 2 × SD) < 0 ⇒ negative counts	B1		One valid reason
			1	
(c)(i)	Since sample size large (n > 30) can use Central Limit Theorem	B1		Either point
			1	
(ii)	Mean = μ	B1		CAO; not $\bar{x}$ or its value
	Variance = $\frac{\sigma^2}{100}$	B1		Accept $\frac{\sigma^2}{n}$ or $\frac{(\text{their SD})^2}{100}$, etc
			2	
(d)	99% ⇒ z = 2.57 to 2.58	B1		AWFW (2.5758)
	CI for μ is $\bar{x} \pm z \times \frac{(\sigma \text{ or } s)}{\sqrt{n}}$	M1		Use of Must have $\left(\div\sqrt{n}\right)$ with n > 1
	Thus $25.2 \pm 2.5758 \times \frac{17.1 \text{ or } 17.2}{\sqrt{100}}$	A1√		√ on $\bar{x}$, z and s > 0; not on n
	(20.8, 29.6)	A1		AWRT
			4	
(e)	UCL < 30 so Reject claim that μ > 30	B1√ ↑dep B1√		√ on CI √ on CI
	7/100 or 7% of X > 50 (from table) so Reject claim that often X > 50	B1 ↑dep B1		CAO CAO
			4	
	Total		**16**	
	Total		**60**	