



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

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
2 (a)	Volume $X \sim N(56, 2.5^2)$			
	$P(X < 60) = P\left(Z < \frac{60 - 56}{2.5}\right)$	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		AWRT (0.94520)
			3	
	(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		AWRT (0.93700)
			3	
	(iii) $P(X = 55) = 0$	B1		CAO
		1		
(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 $ 1 - z $	
Thus $\mu = 107$	A1		AWRT	
			4	
	Total		11	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
3	$P(D) = 0.6$ (60%) $P(D') = 0.4$ (40%) $P(d D) = 0.75$ $P(d D') = 0.05$ $P(i D) = 0.15$ $P(i D') = 0.15$ $P(n D) = 0.10$ $P(n D') = 0.80$			$D \Rightarrow$ Diseased fish $d \Rightarrow$ diseased) $i \Rightarrow$ inconclusive.....) test $n \Rightarrow$ non-diseased.....)
(a)(i)	$P(D \cap d)$ $= P(D) \times P(d D) = 0.6 \times 0.75$ $= 0.45$	M1 A1	2	CAO (9/20)
(ii)	$P(d) = P(D \cap d) + P(D' \cap d)$ $= (i) + P(D') \times P(d D')$ $= 0.45 + (1 - 0.6) \times 0.05$ $= 0.45 + 0.02 = 0.47$	M1 m1√ A1	3	(a)(i) + (1 prob) √ on (a)(i) CAO
(iii)	$P(\text{correct}) = P(D \cap d) + P(D' \cap d')$ $= (i) + P(D') \times P(d' D')$ Or $= 0.45 + (1 - 0.6) \times 0.80$ $= 0.45 + 0.32 = 0.77$	M1√ A1	2	Correct expression/values √ on (a)(i) CAO
(b)	$P([d D] \cap [d D] \cap [d' D])$ $= [P(d D)]^2 \times P(d' D)$ multiplied by 3 $= 0.75^2 \times 0.10 \times 3 = 0.168$ to 0.169	M1 M1 A1	3	(Prob) ² × (Prob); or equivalent Multiplier of 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			AWFW
		or $a = 1.7$	B2		
			(B1)		CAO
		Attempt at Σx Σx^2 Σy Σxy			224, 7180; 32.8; 995.4
		or Attempt at S_{xx} S_{xy}	(M1)		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)	Residual = $y - a - bx$	M1		Res = (Obs y) - (Pred y) & used Allow use of $x = 3$ and/or $x = 7$	
	(Residual) ₃ = -0.465 to -0.485	A1		AWFW	
	(Residual) ₇ = -0.335 to -0.365	(A1) A1		Both correct magnitude AWFW	
			3		
(ii)	Residuals are small (relative to y -values)			Except for (Residual) ₆ <i>Any sensible comment;</i>	
	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) <u>B(n, 0.07)</u> $P(X = 2) = \binom{17}{2} (0.07)^2 (0.93)^{15}$ $= 136 \times 0.0049 \times 0.33670$ $= 0.224$ to 0.225	M1	3	Use of in (a)	
		A1		Fully correct expression May be implied	
		A1		AWFW (0.22438)	
	(ii)	$P(X \leq 5 \mid B(50, 0.07))$ $= 0.865$	M1	2	Attempted; tables or formula (≥ 3 terms stated) May be implied
			A1		AWRT (0.8650)
	(b) <u>B(50, 0.55)</u> $P(Y \geq 30) = P(Y' \leq 20)$ with $p = 0.45$ $= 0.286$	M1	3	Change from Y to Y' Must be clear evidence	
		A1		Stated or implied	
		A1		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	4	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
	(b) Data is skewed or not symmetric Discrete data or counts (Mean – 2 × SD) < 0 ⇒ negative counts	B1		One valid reason
	(c)(i) Since sample size large ($n > 30$) can use Central Limit Theorem	B1		Either point
	(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
	(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 $(\div \sqrt{n})$ with $n > 1$
	Thus $25.2 \pm 2.5758 \times \frac{17.1 \text{ or } 17.2}{\sqrt{100}}$ (20.8, 29.6)	A1✓ A1		✓ on \bar{x} , z and $s > 0$; not on n AWRT
	(e) UCL < 30 so Reject claim that $\mu > 30$	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		
	Total		16	
	Total		60	