Version : 1.0: 0805

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Statistics 6380

SS02 Statistics 2

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

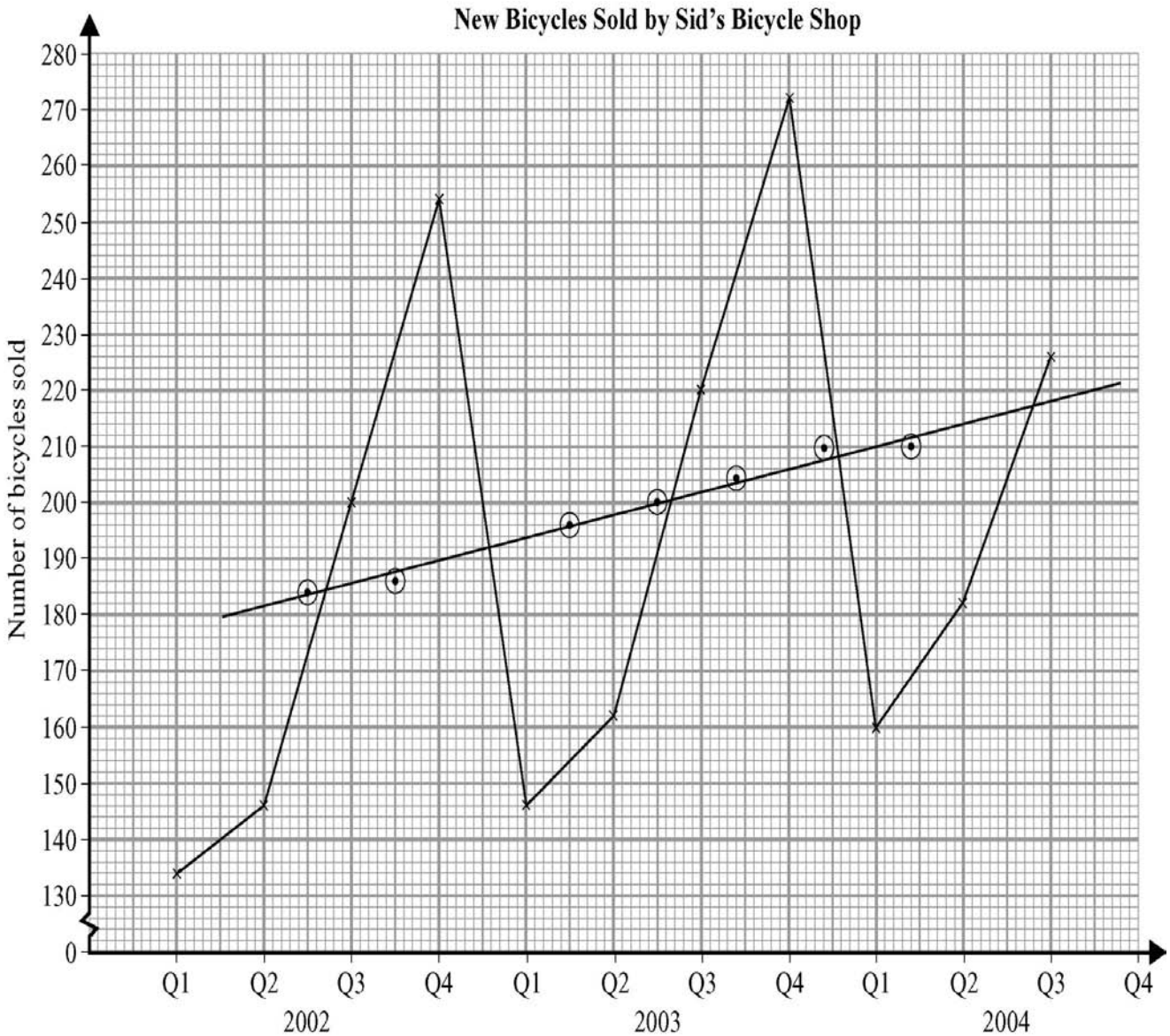
√or ft or F	follow through from previous incorrect result	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
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

SS02

Q	Solution	Marks	Total	Comments
1(a)	See graph	M1 A1	2	Method Reasonably accurate plot, by eye; allow one small slip; points not necessarily joined
(b)(i)	<table><tr><td></td><td></td><td>Sales</td><td>M.A</td></tr><tr><td></td><td>Q1</td><td>134</td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td>Q2</td><td>146</td><td></td></tr><tr><td>2002</td><td></td><td></td><td>184.0</td></tr><tr><td></td><td>Q3</td><td>201</td><td></td></tr><tr><td></td><td></td><td></td><td>187.25</td></tr><tr><td></td><td>Q4</td><td>255</td><td></td></tr><tr><td></td><td></td><td></td><td>191.25</td></tr><tr><td></td><td>Q1</td><td>147</td><td></td></tr><tr><td></td><td></td><td></td><td>196.25</td></tr><tr><td></td><td>Q2</td><td>162</td><td></td></tr><tr><td>2003</td><td></td><td></td><td>200.75</td></tr><tr><td></td><td>Q3</td><td>221</td><td></td></tr><tr><td></td><td></td><td></td><td>204.5</td></tr><tr><td></td><td>Q4</td><td>273</td><td></td></tr><tr><td></td><td></td><td></td><td>209.75</td></tr><tr><td></td><td>Q1</td><td>162</td><td></td></tr><tr><td></td><td></td><td></td><td>211.5</td></tr><tr><td></td><td>Q2</td><td>183</td><td></td></tr><tr><td>2004</td><td></td><td></td><td></td></tr><tr><td></td><td>Q3</td><td>228</td><td>+ graph</td></tr></table>	B1 M1 A1 M1 A1	5	Use of 4 –point moving averages; at least 2 Method of calculation; at least 2 At least 6 correct; allow rounding May be implied from graph Allow centred moving averages Plotted in correct position; must be 4 point; at least 2 Reasonably accurate plot by eye; allow one small slip
(ii)	Trend line on graph	B1	1	Trend line – generous, but must be a line
(c)(i)	Trend is upward so sales should exceed mean	E1	1	Reason – upward) mark as
(ii)	Seasonal effect for Q4 is positive so sales should exceed mean	E1	1	Reason – quarter 4 high) one part
(iii)	Estimate Q4 seasonal effect $[(255 - 189.25) + (273 - 207.1)]/2 = 66$ Projected trend for Q4, 2003 = 224 Suitable target 224 + 66 = 290 Pay bonus if sales exceed 290 Allow 216 = $\frac{162+183+228+x}{4}$	M1 A1 M1 A1 M1 A1	6	Method for seasonal effect – allow graphical, their or no trend line 66(64-67) Method of forecasting trend 224 (220-228) Method of combining their seasonal effect and trend 290 (284 – 296) – must be whole number or > sc B3 for 284 – 296 by any or no method B1 for 280 – 300 by any or no method Maximum 3 if only quarter 4 data used
	Total		**16**	



SS02 (cont)

Q	Solution	Marks	Total	Comments
2(a)(i)	$P(\leq 7) = 0.8095$	B1		$0.8095\ (0.8090 - 0.81)$
(ii)	$P(7) = 0.8095 - 0.6860 = 0.1235$	M1		P(7) = P (7 or fewer) – P(6 or fewer) or use of correct formula
		A1	3	0.1235 (0.123 – 0.124)
(b)(i)	$1 - 0.7029 = 0.297$	M1		1 – P(5 or fewer) or equivalent
		A1	2	0.297 (0.2965 – 0.2975)
(ii)	Poisson mean 10 $P(>12) = 1 - 0.7916$ $= 0.208$	B1 B1 M1 A1	 4	Use of Poisson mean 10 – may be implied 12 rooms available Completely correct method $0.208\ (0.208 - 0.209)$
	Total		**9**	
3(a)	$E(X) = 0 \times 0.45 + 1 \times 0.24 + 2 \times 0.14 + 3 \times 0.12 + 4 \times 0.05 = 1.08$	M1 A1		Method for $E(X)$ 1.08 CAO
	$E(X^2) = 0^2 \times 0.45 + 1^2 \times 0.24 + 2^2 \times 0.14 + 3^2 \times 0.12 + 4^2 \times 0.05 = 2.68$	M1		Method for $E(X^2)$; even if not called $E(X^2)$
	$V(X) = 2.68 - 1.08^2 = 1.5136$	m1		Method for $V(X)$; disallow if called standard deviation
	$s.d = \sqrt{1.5136} = 1.23$	A1	5	$1.23\ (1.225 - 1.235)$
(b)(i)	$0.45 + 0.24 = 0.69$	M1 A1	 2	Method –their mean 0.69 CAO
(b)ii)	Median 1 $P(<1) = 0.45$	B1 B1	 2	B1Median 1, B1 0.45 CAO $0.45 \rightarrow$ 2 marks
(c)	5% chance each night of all four engines being required. Consequences of it being unavailable could be drastic. Bad idea.	E1 E1	 2	Small chance of being needed Possible serious consequences
	Total		**11**	

SS02 (cont)

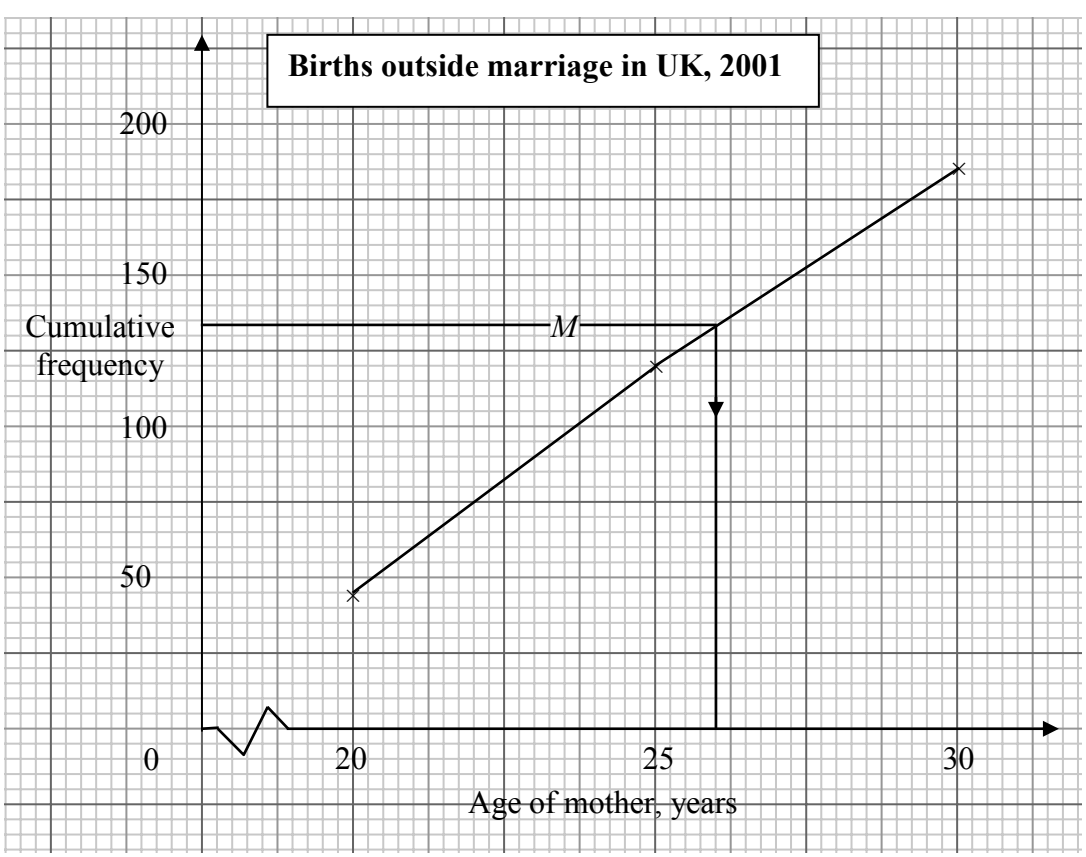
Q	Solution	Marks	Total	Comments
4(a)	$H_0: \mu = 145$	B1		One correct hypothesis – generous
	$H_1: \mu \neq 145$	B1		Both hypotheses correct - ungenerous, must be 'p', 'population' or 'all'
		M1		Use of $13\sqrt{95}$; allow $13\sqrt{\frac{95}{94}}$
	$z = (143.5–145)/(13/\sqrt{95})$ _ 1.12	m1		Method for z - ignore sign
		A1		–1.12 (–1.115 - –1.13)
	Critical values ± 1.96	B1		1.96 ignore sign
	Accept H_0, no significant evidence to show mean time is not 145 minutes	A1√		Correct conclusion their figures – must compare with lower tail of z
	Total		**7**	
(b)	$x = 135.778$	B1		135.778 (135.7 – 13.6)
	$H_0: \mu = 145$	B1		H_1 < used
	$H_1: \mu < 145$			
	$z = (135.778 – 145)/(13/\sqrt{9}) = –2.13$	M1		Method for z – ignore sign – allow 'corrected' σ
		A1		–2.13 (–2.12 –2.14)
	Critical value –1.6449	B1		1.6449 – ignore sign
	Reject H_0, evidence to show mean time is less than 145 minutes	A1√		Correct conclusion their figures – must compare with lower tail of z
		A1√	7	Conclusion in context – requires previous A1√
	Total		**14**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
4(a)	**ALTERNATIVE** p-values: 0.131 (0.129 ~ 0.133) compare 0.025 or 0.262 (0.258 ~ 0.266) compare 0.05			
(b)	0.0166 (0.016–0.017) compare 0.05			
5(a)	Confidence intervals: 143.5 ± 2.614 140.9~146.1 compare 145 Critical values: 145 ± 2.614 142.4~ 147.6 compare 143.5			
(b)	Confidence intervals: $135.778 + 1.6449 \times \frac{13}{\sqrt{9}} = 142.9$ compare 145 Critical values: $145 - 1.6449 \times \frac{13}{\sqrt{9}} = 137.9$ compare 135.8 Critical values from t ~ allow in (a) (1.985) disallow in (b)			
	Total			

SS02 (CONT)

Q	Solution	Marks	Total	Comments
5 (a)(i)	41 000	B1		41000 CAO
(ii)	556 000 + 236000 = 792 000	M1		Method
		A1	3	792000 (only penalise omission of 000 once)
(b)(i)	Mothers aged 20-24; inside marriage births have declined by more than 50% -	E1		Declined
	outside marriage births have declined but only by a small amount	E1		Bigger (proportionate) decline inside than outside marriage
(ii)	Mothers aged over 30; inside marriage births have increased a little (about 10%)	E1		Increased
	Now seems to have peaked. Outside marriage births have doubled	E1	4	Bigger (proportionate) increase outside than inside marriage
(c)(i)	See graph	B1		Attempt at cumulative frequency
		M1		Attempt to plot c.f. against ucb; allow 24,29
		A1	3	Accurate c.f. curve – by eye; disallow 24,29
(c)(ii)	25.8 years	M1		Method for median – allow 24,29; must be read at 134
		A1	2	25.8 (25.5 – 26.5)
	Total		**12**	



SS02 (cont)

Q	Solution	Marks	Total	Comments
6(a)	Number claims 000 – 509 Select 3-digit random numbers Ignore > 509 Ignore repeats Continue until 50 obtained, select corresponding claims	E1 E1 E1 E1	4	Valid numbering Select 3-digit numbers; consistent with their numbering Ignore >509; must be consistent with their numbering Ignore repeats
(b)(i)	Systematic	B1		Systamatic CAO
(ii)	Stratified (random)	B1	2	Stratified CAO
(c)(i)	Yes	B1		Yes
(ii)	Yes	B1	2	Yes
(d)	Not all subsets possible eg, two smallest claims cannot both be included in the same sample	E2(1)	2	E2 (1)Not all subsets possible
(e)(i)	All largest claims investigated	E1		Reason – disallow easier/quicker
(ii)	Easier to carry out/all sizes of claim investigated	E1	2	Reason
(iii)	All sizes of claim fairly represented	E1	3	Reason
	Total		**13**	
	Total		**75**	