



General Certificate of Education

Statistics 6380

SS02 Statistics 2

Mark Scheme

2008 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.

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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.

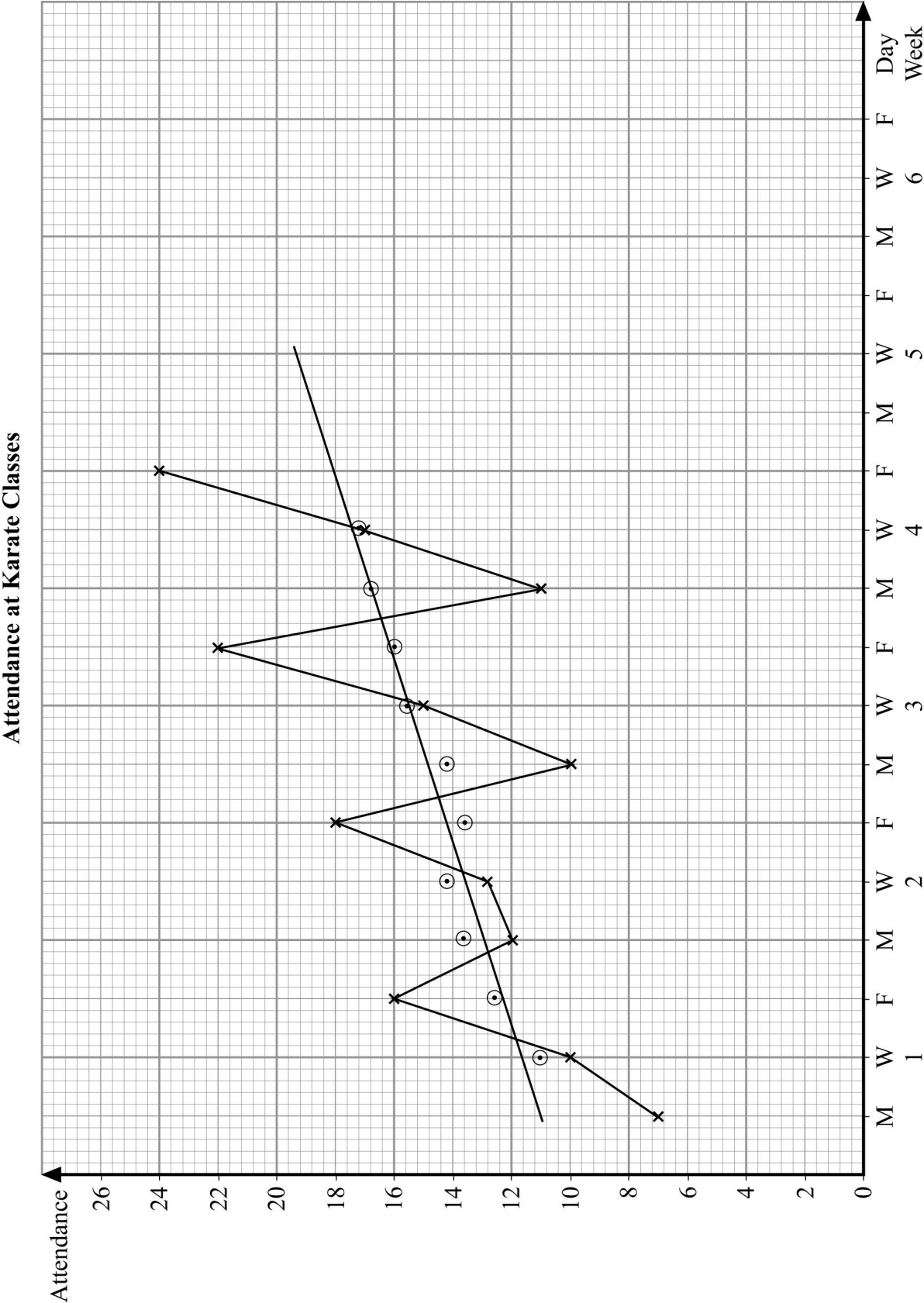
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

SS02

Q	Solution	Marks	Total	Comments																																										
1(a)	Box and whisker plot	M1 B1 A1	3	method - median, box and whiskers shown - not necessarily correct labelled 2007 accurate plot																																										
(b)(i)	Average mins late lower in 2007 variability lower in 2007 symmetrical 2006, positive skew 2007 sometimes on time or early 2007, never on time 2006.	E1 E1 E1	3	- average less/ more punctual in 2007 - variability less in 2007 - skew in 2007 - sometimes on time /early in 2007 <i>maximum 3</i>																																										
(ii)	Punctuality improves through the month	E2,1	2	award both marks for clear answer																																										
			8																																											
2(a)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">Week</td> <td style="width: 10%;">1</td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 10%;">2</td> <td style="width: 10%;"></td> </tr> <tr> <td>Day</td> <td>W</td> <td>F</td> <td>M</td> <td>W</td> <td>F</td> </tr> <tr> <td>M.A.</td> <td>11.0</td> <td>12.7</td> <td>13.7</td> <td>14.3</td> <td>13.7</td> </tr> <tr> <td colspan="6" style="border-top: 1px solid black;"></td> </tr> <tr> <td>Week</td> <td>3</td> <td></td> <td></td> <td>4</td> <td></td> </tr> <tr> <td>Day</td> <td>M</td> <td>W</td> <td>F</td> <td>M</td> <td>W</td> </tr> <tr> <td>M.A.</td> <td>14.3</td> <td>15.7</td> <td>16.0</td> <td>16.7</td> <td>17.3</td> </tr> </table>	Week	1			2		Day	W	F	M	W	F	M.A.	11.0	12.7	13.7	14.3	13.7							Week	3			4		Day	M	W	F	M	W	M.A.	14.3	15.7	16.0	16.7	17.3	B1 M1 A1	3	attempt at 3-point M.A. method for M.A. (any) all correct ± 0.1 - allow one small slip
Week	1			2																																										
Day	W	F	M	W	F																																									
M.A.	11.0	12.7	13.7	14.3	13.7																																									
Week	3			4																																										
Day	M	W	F	M	W																																									
M.A.	14.3	15.7	16.0	16.7	17.3																																									
(b)	(see diagram on page 5)	M1 A1 B1	3	plotted in correct position (their M.A.) accurate plot by eye - allow one small slip reasonable trend line - generous																																										
(c)	<p>Estimate of Monday effect</p> $\frac{7-10.5 + 12-12.4 + 10-13.9 + 11-16.2}{4}$ <p>= -3.25</p> <p>Forecast = 18.7 - 3.25 = 15</p>	M1 A1 B1	5	method for Monday effect - allow comparison with trend line or with M.A.; allow omission of 1st Monday -3.25 (-3 ~ -4) sign may be implied method for forecast - their values 15 (14 ~ 16) answer given as whole number																																										
(d)	Current trend suggests mean attendance will be above 19 in week 6 so classes likely to continue. There is no guarantee that trend will continue.	E1 \checkmark E1	2	classes likely to continue - consistent with their trend line trend above 19 in week 6 - or other comment.																																										
	Total		13																																											

SS02 (cont)



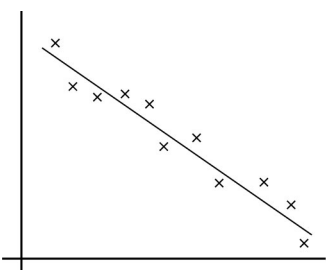
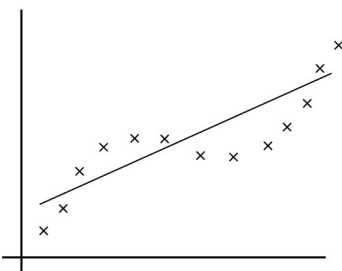
SS02 (cont)

Q	Solution	Marks	Total	Comments
3(a)	(i) $P(6 \text{ or fewer}) = 0.256$	B1	4	0.256 (0.256 ~ 0.257) reasonable attempt at $P(>9)$ allow $1 - P(8 \text{ or fewer})$ etc correct method 0.347 (0.3465 ~ 0.3475)
	(ii) $P(>9) = 1 - P(9 \text{ or fewer})$	M1		
	$= 1 - 0.6530$ $= 0.347$	m1 A1		
(b)	(i) $P(2) = 0.9856 - 0.9098$	M1	4	method 0.0758 (0.0755 ~ 0.076) use of Po(9) or attempt at $P(0 \text{ get on}) \times P(0 \text{ get off})$ 0.0001 (0.0001 ~ 0.00013)
	$= 0.0758$	A1		
	(ii) Poisson mean $8.5 + 0.5 = 9$ $P(0) = 0.0001$	B1 B1		
(c)	Probability bus will not need to stop at any particular stop is very small. Even if there are a large number of stops it is very likely she will need to stop at all of them.	E1 \checkmark	2	very unlikely will not need to stop at any particular stop very likely will need to stop at all stops
		E1		
			10	
4	$H_0: \mu = 1000 \quad H_1: \mu \neq 1000$ $x = 970.11$ $z = \frac{970.11 - 1000}{\frac{24}{\sqrt{9}}}$ $= -3.74$ critical values are ± 1.96 ($p = 0.00018$ compare with 0.05 or compare 0.00009 with 0.025) Reject H_0 . Significant evidence that mean weight of loaves is not equal to (less than) 1000 grams	B1	8	one correct hypothesis - generous both hypotheses correct use of $\frac{24}{\sqrt{9}}$ correct method for z - ignore sign -3.74 ($-3.73 \sim -3.74$) 1.96 ignore sign must compare negative z with negative c.v. correct conclusion in context
		B1		
		M1		
		m1		
		A1		
		B1		
		A1 \checkmark		
A1 \checkmark				
Total			8	

SS02 (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)	$E(X) = 0 \times 0.005 + 1 \times 0.015 + 2 \times 0.08 + 3 \times 0.15 + 4 \times 0.75 = 3.625$	M1		method $E(X)$
(ii)	$E(X^2) = 13.685$ $V(X) = 13.685 - 3.625^2$ $= 0.544375$ $s.d. = \sqrt{0.544375} = 0.738$	M1 m1 m1 A1	5	method $E(X^2)$ method for variance method for s.d. 0.738 (0.737 ~ 0.739)
(b)(i)	$s.d. = \sqrt{6.5} = 2.55$	M1 A1	2	method 2.55 (2.545 ~ 2.555)
(ii)	Y cannot exceed number of terminals. Poisson has no upper limit.	E1	1	
(iii)	All terminals usually in use at Molcar. The mean is low because only 4 terminals are available. Poisson model at Garsden suggests that there are usually sufficient terminals to meet demand. Suggest new terminal should be installed at Molcar.	E1 E1 E1	3	- mean and s.d. low at Molcar due to lack of terminals - most terminals in use most of the time at Molcar - Poisson at Garsden suggests no serious shortage of terminals - Install at Molcar <i>Maximum 3 - any 3 points</i>
			11	
6(a)	54.5	B1	1	54.5 CAO
(b)	(i) Steep upward trend. After a particularly large rise in 2003 there was a reduction in 2004 (ii) Upward trend. Not as steep as in London. average price in S.E greater than in London in 1994 but less than London in 2004.	E1 E1 E1 E1 E1	5	upward further comment e.g. large rise in 2003/non-linear upward less steep than London S.E > London in 1994 S.E < London in 2004
(c)	(i) $56054/24960 = 2.25$ New 94 (ii) $63775/29278 = 2.18$ Other 94 (iii) $217970/73495 = 2.97$ New 04 (iv) $172801/55315 = 3.12$ Other 04 In both 1994 and 2004 ratio is similar for new and other. However has increased from 1994 to 2004. i.e. the average advance relative to average earnings has increased.	M1 A1 E1 E1	4	method - at least 1 all ratios correct 1dp London and SE ratios similar in 1994 and 2004 Ratio larger in 2004 than in 1994 <i>Other sensible points accepted - for both E marks some context required</i>
	Total		10	

SS02 (cont)

Q	Solution	Marks	Total	Comments
7	<p>(a) </p> <p>(b) </p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p>	<p>4</p>	<p>downward linear trend</p> <p>random variation</p> <p>upward linear trend</p> <p>short-term variation</p>
Total			4	
8(a)	<p>Number staff 000 to 819</p> <p>Select 3-digit random numbers</p> <p>Ignore >819</p> <p>Ignore repeats</p> <p>Continue until 25 selected and choose corresponding staff</p>	<p>E1</p> <p>E1</p> <p>E1</p> <p>E1</p>	4	<p>Valid numbering</p> <p>3-digit random numbers</p> <p>ignore >819 and repeats</p> <p>continue until 25 selected</p>
(b)(i)	<p>Permit holder/waiting list/other</p> <p>male/female</p> <p>full-time/part-time etc</p>	<p>B1</p> <p>B1</p>	2	<p>permit holder status</p> <p>any other sensible strata</p>
(ii)	<p>(A) Choose a digit between 1 and 8 at random. Pick this space and every 8th thereafter.</p> <p>e.g. 3,11,19.....187,195</p> <p>(B) Easy and quick</p> <p>(C) Excludes anyone without a permit, favours those who usually arrive early etc</p>	<p>E1</p> <p>E1</p> <p>B1</p> <p>E1</p> <p>E1</p>	5	<p>idea of systematic sampling</p> <p>correct method including “every 8th”</p> <p>easy - or other valid advantage</p> <p>any reasonable source of possible bias</p> <p>any different reasonable source of possible bias</p>
Total			11	
TOTAL			75	