



# General Certificate of Education

## Statistics 6380

*SS02 Statistics 2*

## Mark Scheme

*2006 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.

## 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

Question	Solution	Marks	Total	Comments
<b>1(a)</b>	blue star more variable	E1	3	BS more variable
	longer wait on average	E1		BS bigger average
	2 very long waits (outliers)	E1		BS outliers
<b>(b)(i)</b>	blue star – sometimes arrived within 5 minutes – GS never has	E1		reason
<b>(ii)</b>	green star – always arrived within 25 minutes – BS sometimes hasn't	B1	3	both choices correct reason for GS
		E1		
	<b>Total</b>		<b>6</b>	

SS02 (cont)

Question	Solution	Marks	Total	Comments																																		
2(a)	<p>marks for graph above</p>	M1 A1	2	method accurate plot – by eye – allow one small slip																																		
(b)	<table border="1"> <thead> <tr> <th>Week</th> <th>Day</th> <th></th> <th>M.A.</th> </tr> </thead> <tbody> <tr> <td rowspan="3">1</td> <td>T</td> <td>194</td> <td></td> </tr> <tr> <td>F</td> <td>360</td> <td>321.0</td> </tr> <tr> <td>S</td> <td>409</td> <td>310.7</td> </tr> <tr> <td rowspan="3">2</td> <td>T</td> <td>163</td> <td>304.0</td> </tr> <tr> <td>F</td> <td>340</td> <td>295.0</td> </tr> <tr> <td>S</td> <td>382</td> <td>285.0</td> </tr> <tr> <td rowspan="3">3</td> <td>T</td> <td>133</td> <td>269.0</td> </tr> <tr> <td>F</td> <td>292</td> <td>257.0</td> </tr> <tr> <td>S</td> <td>346</td> <td></td> </tr> </tbody> </table>	Week	Day		M.A.	1	T	194		F	360	321.0	S	409	310.7	2	T	163	304.0	F	340	295.0	S	382	285.0	3	T	133	269.0	F	292	257.0	S	346		M1 M1 m1 m1 A1	4	method for M.A. - at least 3, not necessarily 3-point method for M.A. – all 7, must be 3-point M.A. plotted in correct position – requires previous M accurate plot – by eye – allow one small slip  (if M.A. incorrectly plotted allow max M1A1M1m1M0A0B0M1M1m1m1A1B0E0)
Week	Day		M.A.																																			
1	T	194																																				
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3	T	133	269.0																																			
	F	292	257.0																																			
	S	346																																				
(c)(i)	see graph	B1	1	generous – but must be a line; pass through points; extend over at least 6 days																																		
(ii)	estimated M.A. Friday week 4 is 230 attendance – M.A. on Friday week 1 – 39.0 week 2 – 45.0 week 3 – 35.0 mean 39.7 forecast $230 + 39.7 = 270$	M1 M1 m1 m1A1	5	method for forecasting M.A.  comparison of actual with moving average on Fridays method for ‘Friday’ effect method for forecast 270 (264-275) s.c. B2 270 (260-275) by any or no method																																		
(d)	change film during/at end of week 5 – because trend line falls below 200 during 5 <sup>th</sup> week.	B1 E1	2	5 <sup>th</sup> week reason																																		
<b>Total</b>			<b>14</b>																																			

## SS02 (cont)

Question	Solution	Marks	Total	Comments
<b>3(a)</b>	$\bar{x} = 192.56$ $H_0 : \mu = 170$ $H_1 : \mu \neq 170$  $z = \frac{(192.56 - 170)}{(45/\sqrt{9})} = 1.50$  critical values $\pm 1.96$  accept $H_0 : \mu = 170$ i.e. no significant evidence to doubt mean waiting time is not equal to 170 minutes  <b>s.c.</b> 1. confidence interval $192.56 \pm 1.96 \times \frac{45}{\sqrt{9}}$ 163 ~ 222 170 > 163 (or between 163 and 222)  2. critical values $170 \pm 1.96 \times \frac{45}{\sqrt{9}}$ 141 ~ 199 $192.6 < 199$ (or between 141 and 199)  3. $t = \frac{(192.56 - 170)}{(54.59/\sqrt{9})}$ = 1.24 c.v. $\pm 2.306$	B1 B1 B1  M1 m1 A1 B1  A1 $\checkmark$	8	192.56 (192-193) one hypothesis correct – generous both hypotheses correct – ungenerous – must use $\mu$ or population for use of $45/\sqrt{9}$ m1 method for z – ignore sign 1.50 (1.50 – 1.51) 1.96 (allow 1.64 – 1.65 if $H_1 : \mu > 170$ used) conclusion – must be compared with correct tail of z – disallow ‘significant evidence $\mu = 170$ ’  allow all marks  allow all marks  allow B1B1B1M1m1A0B0A1 $\checkmark$
<b>(b)</b>	$z = \frac{(197.56 - 170)}{(45/\sqrt{9})} = 1.84$  no change to critical values or conclusion  <b>s.c.</b> 1. 168 2. $197.6 < 199$ 3. 1.51	B1 $\checkmark$  B1 A1 $\checkmark$	3	mean increased by 5 1.84 (1.83 – 1.845) conclusion – must be compared with correct tail of z.  allow all marks
	<b>Total</b>		<b>11</b>	

Question	Solution	Marks	Total	Comments
<b>4(a)(i)</b>	$P(\leq 3) = 0.9942$	B1		B1 0.9942 (0.994-0.995)
<b>(ii)</b>	$P(3) = 0.9942 - 0.9659$ $= 0.0283$	M1 A1	3	$P(\leq 3) - P(\leq 2)$ or use of correct formula 0.0283 (0.0283-0.0285)
<b>(b)(i)</b>	$P(> 1) = 1 - 0.9825$ $= 0.0175$	M1 A1	2	$P(> 1) = 1 - P(\leq 1)$ 0.0175 (0.017-0.018)
<b>(ii)</b>	Poisson mean 2 $P(4 \text{ or more}) = 1 - 0.8571$ $= 0.143$	B1 M1 A1	3	Use of Poisson mean 2 Method 0.143 (0.142-0.144)
<b>(c)</b>	no – customers in groups do not enter independently	E2(1)	2	one answer no for a clearly expressed reason
<b>(d)</b>	no – mean not constant	B1 E1	2	both answers no second reason
<b>Total</b>			<b>12</b>	
<b>5(a)(i)</b>	0	B1		0 cao
<b>(ii)</b>	$E(X) = 0 \times 0.51 + 1 \times 0.04 + 2 \times 0.02 + 3 \times 0.03 + 4 \times 0.40 = 1.77$	M1A1		method must be shown 1.77 ag
<b>(iii)</b>	$E(X^2) = 0^2 \times 0.51 + 1^2 \times 0.04 + 2^2 \times 0.02 + 3^2 \times 0.03 + 4^2 \times 0.40 = 6.79$ $V(X) = 6.79 - 1.77^2 = 3.6571$  $\text{s.d.} = \sqrt{3.6571} = 1.91$	M1  m1  A1	6	method for $E(X^2)$  method for standard deviation allow for variance if called variance 1.91 (1.91-1.92)
<b>(b)</b>	0 is lowest number of books – not representative	E1	1	lowest/not representative
<b>(c)(i)</b>	most members have zero or maximum (4) books out on loan. U-shaped.	E1		U-shaped, may be implied
<b>(ii)</b>	a substantial proportion (0.4) already have maximum number of books on loan and may increase their borrowing – possibly by a large amount. This could lead to a big increase in the total number of books out on loan.	E1	2	effect could be large
<b>Total</b>			<b>9</b>	

Question	Solution	Marks	Total	Comments
6(a)	400 000	B2(1)	2	400 000, allow B1 for 400
(b)	722 – 456 = 266 or 68 + 198 = 266 or 812 – 241 – 216 – 87 = 268	M1 A1	2	method 266 or 268 or 266 000 or 268 000
(c)(i)	downward trend – has levelled out in later years	E1 E1		downward levelling out
(ii)	age group 16 – 17 has no obvious trend	B1 E1	4	16 – 17 no trend
(d)	more men than women unemployed both have downward trend proportionately greater reduction for men than for women	E1 E1 E1	3	more men than women both downward trend proportionately greater reduction for men than women
	<b>Total</b>		<b>11</b>	
7(a)(i)	cluster sampling	B1		cluster
(ii)	reduces travelling time/expense head teachers in same region may be more homogenous than all head teachers/sample not representative/random	E1 E1	3	less travelling/expense more homogenous/not representative/random
(b)(i)	systematic sampling	B1		systematic
(ii)	no – many head teachers have no chance of being selected e.g. 0034	B1 E1	3	no reason
(c)(i)	yes – there is one number between 00 and 99 corresponding to each head teacher. Probability 0.01	B1 E1	2	yes explanation or 0.01
(ii)	not all combinations possible e.g. numbers 0000 and 0001 can not both be included in the sample	E2(1)	2	two marks for clear explanation
(iii)	sample size would depend on number picked 00 - 33 → sample of 20 34 - 99 → sample of 19	E1 E1	2	sample size variable explanation or statement that size may be 19 or 20
	<b>Total</b>		<b>12</b>	
	<b>Total for paper</b>		<b>75</b>	