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## **General Certificate of Education**

# **Statistics 6380**

**SS02          Statistics 2**

# **Mark Scheme**

*2008 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.

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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)	$\frac{9.1 + 13.6 + 16.8 + 9.4}{4}$	M1	2	12.23 (12.22 ~ 12.23); allow 12.2
	= 12.225	A1		
(b)(i)	Moving averages plotted in correct position – at least 3	M1		
	Accurate plot – by eye	A1		
(ii)	Trend line	B1	3	Allow reasonable line even if moving averages incorrect
(c)(i)	Q1 effect: $\frac{(9.1 - 11.6) + (11.5 - 13.5)}{2}$	M1		Method for seasonal effect – either – ignore sign, allow use of 3 Qs
	= -2.25			
	Q4 effect: $\frac{(8.9 - 11.2) + (9.4 - 13.0)}{2}$	m1		Method for both – ignore sign
	= -2.95	A1		
(ii)	Prediction for	M1	6	Prediction of moving average from their (reasonable) trend line
	Q1, 2007: 15.4 - 2.25 = 13 Q4, 2007: 16.8 - 2.95 = 14	m1 A1		
(d)(i)	Accurate plot – by eye	B1		13 (12.9 ~ 13.3) and 14 (13.5 ~ 14.1) disallow if more than 3sf given NMS: one answer in range B1 both answers in range B3
(ii)	Q2 (Charlie) and Q3 (Eddie) should be well above trend line, but both are below trend line. (Harry and Annie are below trend line as expected.)	E1		Comment based on seasonal variation
		E1		
(iii)	Harry slightly (0.5 tonnes) above prediction, Annie above (1.5 tonnes) prediction. Choose Annie.	E1	5	Explanation
		B1		
<b>Total</b>			<b>16</b>	

## SS02 (cont)

Q	Solution	Marks	Total	Comments
2(a)(i)	$E(X) = 120 \times 0.22 + 80 \times 0.28 + 75 \times 0.12 + 30 \times 0.38 = 69.2$	M1		Method for $E(X)$ ; AG
(ii)	$E(X^2) = 120^2 \times 0.22 + 80^2 \times 0.28 + 75^2 \times 0.12 + 30^2 \times 0.38 = 5977$ $V(X) = 5977 - 69.2^2 = 1188.36$ s.d. = £34.50	M1  m1 m1		Method for $E(X^2)$ – may be implied  Method for variance Method for s.d. – dependent on previous 3 marks
(b)	$\frac{69.2 \times 400}{120} = 230.7$ 231 full members needed	A1  A1	5  2	34.50 (34.45 ~ 35.5) – ignore units  CAO
(c)	No junior members bad for future of club. May be less than 231 applications for full membership.	E1	1	Any sensible reason
<b>Total</b>			<b>8</b>	
3(a)	1023000	B2	2	B1 for 1023
(b)	N.Ireland > Scotland > Wales at each election 2003 election less than 1998/9 (about 5% less in N.I., 8 or 9% less in Wales and Scotland) All less than 70%	E1  E1  E1		Any valid comparison of % in different countries Any valid comparison of % in different years
(c)(i)	Welsh assembly 2003	M1 B1	3	Complete answer  Any valid calculation – may be implied Welsh assembly 2003
(ii)	Labour	B1	3	
(d)	Welsh assembly $\frac{2230000}{60} = 37200$ Scottish parliament $\frac{3879000}{129} = 30100$ N.I. assembly $\frac{1098000}{108} = 10200$ N.Ireland has many less electors per member than Wales or Scotland.	M1  A1  E1		Method of calculation  All correct 3sf  Any sensible comment – method mark not essential
<b>Total</b>			<b>11</b>	

## SS02 (cont)

Q	Solution	Marks	Total	Comments	
4(a)(i)	0.5488	B1		0.5488 (0.5485 ~ 0.5495)	
(ii)	$P(\geq 3) = 1 - P(\leq 2)$ $= 1 - 0.9769$ $= 0.0231$	M1 A1	3	0.0231 (0.023 ~ 0.0232)	
(b)	$\bar{x} = 0.606$ $s^2 = 1.104$	B1 B1	2	0.606 (0.606 ~ 0.6061) 1.104 (1.08 ~ 1.11)	
(c)(i)	Observed 3 or more = $8/66 = 0.12$ Predicted by Po(0.6) is 0.023 – not similar (or observed zero 0.7, predicted 0.55)	E1		Observed probabilities not similar to those expected from Poisson	
(ii)	Mean (0.606) not similar to variance (1.10)	E1			
(iii)	Car parks not likely to be distributed at random. Likely to be near shopping centres, country parks etc, not in housing estates.	E1 E1	4		Allow not constant average rate, not independent Award for explanation in (iii) or for accurate numerical illustration in (i)
	<b>Total</b>		<b>9</b>		
5(a)(i)	Cluster	B1		If renumbered 00 to 71, max E1 E0 E1 E1	
(ii)	Select 2-digit random numbers Ignore 00 and > 72 Ignore repeats Continue until 7 numbers obtained and choose passengers sitting in corresponding seats	E1 E1 E1 E1	5		
(b)(i)	Stratified	B1			Stratified / stratified random
(ii)	18:8 is ratio of number of seated standard class passengers (432) to seated first-class passengers (192) $18 + 8 = 26$ in range of likely number of interviews	E1 E1	4		Ratio of standard to first-class Total in right range Numerical support for ratio or demonstration that 18 and 8 is only possibility giving total in desired range
(c)(i)	No Passengers in seats numbered 49–72 have no chance of being selected	B1 E1			
(ii)	Yes, all have a chance of $3/48$ of being selected	B1	3		
(d)	Xavier's sample preferred First-class and standard-class passengers fairly represented in sample	B1 E1	2		
	<b>Total</b>		<b>14</b>		

## SS02 (cont)

Q	Solution	Marks	Total	Comments
6(a)	$H_0: \mu = 40$ $H_1: \mu \neq 40$	B1 B1		One hypothesis correct Both hypotheses correct – must use $\mu$ or state ‘population’
	$\bar{x} = 47.56$ $z = \frac{47.56 - 40}{17/\sqrt{9}} = 1.33$ Critical values $\pm 1.96$ Accept $H_0$ – no significant evidence that mean time to deal with queries differs from 40 seconds	M1 m1 A1 B1 A1 $\checkmark$ A1 $\checkmark$	8	Use of (their s.d.)/ $\sqrt{9}$ Correct method for $z$ – ignore sign 1.33 (1.33 ~ 1.34) Ignore sign ft conclusion – must be compared with upper tail of $z$ ft conclusion in context – requires M1m1A1 $\checkmark$
(b)(i)	$H_0: \mu = 40$ $H_1: \mu < 40$ $z = \frac{35 - 40}{12/\sqrt{120}} = -4.56$ c.v. $-1.6449$ Reject $H_0$ – significant evidence that mean time to deal with queries is less than 40 seconds	B1 M1 A1 B1 A1 $\checkmark$	5	Both – don’t penalise same mistake twice Method for $z$ – ignore sign $-4.56$ ( $-4.54 \sim -4.57$ ) Ignore sign; $-1.64 \sim -1.65$ Conclusion in context – must compare lower tail of $z$
(b)(ii)	Queries were a random sample	B1	1	Random
(c)	Training appears to have reduced mean time to deal with queries and also to have reduced variability. Mean may now be too small to deal with queries adequately.	E1		Mean reduced
		E1		Variability reduced
		E1	3	Mean may now be too small – context required for full marks
	<b>Total</b>		<b>17</b>	
	<b>TOTAL</b>		<b>75</b>	