

# **General Certificate of Education**

# **Statistics 6380**

# SS02 Statistics 2

# **Mark Scheme**

2009 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

М	mark is for method					
m or dM	mark is dependent on one or more M marks and is for method					
А	mark is dependent on M or m marks and is for accuracy					
В	mark is independent of M or m marks and is for method and accuracy					
E	mark is for explanation					
$\sqrt{100}$ or ft or F	follow through from previous incorrect result	МС	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 <i>x</i> marks for each error	G	graph			
NMS	no method shown	с	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 - AQA GCE Mark Scheme 20 Mathscip

PERS

Q	Solution	Marks	Total	<b>Comments</b>
1(a)(i)	0.5488	B1		0.5485 ~ 0.549
(ii)	$P(X > 2) = 1 - P(X \le 2)$	M1		
(11)	= 1 - 0.9769	1011		
	= 0.0231	A1	3	0.023 ~ 0.0232
(b)(i)	Po(0.3)	B1		Attempted use of Po(0.3)
(ii)	$P(X \ge 1) = 1 - P(X = 0)$	M1		
(11)	= 1 - 0.7408	1011		
	= 0.259	A1		0.259 ~ 0.26
(ii)	P(X=2) = 0.9964 - 0.9631	M1		Method – includes Po(0.3)
	= 0.0333	A1	5	$0.033 \sim 0.0334$
	Total		8	
<b>2(a)</b>	$\mu = 101.6$	B2		CAO (allow 102)
				(or $E(X) = 50 \times 0.40 + 95 \times 0.16 + 135 \times 0.24 + 170 \times 0.20 = 101.6 \text{ M1A1}$ )
				$0.24 + 170 \times 0.20 - 101.0$ MIAI)
	$\sigma = 47.7$	B2	4	47.69 ~ 47.71
				(or $E(X^2) = 50^2 \times 0.40 + 95^2 \times 0.16 + 135^2$
				$\times 0.24 + 170^2 \times 0.20 = 12598$
				$V(X) = 12598 - 101.6^2 = 2275.44$
				$s.d. = \sqrt{2275.44} = 47.7 M1A1)$
(b)(i)	$E(X) = 95 \times 0.45 + 135 \times 0.30 + 170 \times$	M1		
(0)(1)	0.25 = 125.75	1011		
	= 126  to  3sf	A1	2	CAO; AG
				, -
(ii)	Will lose 20% of customers	M1		Any relevant calculation attempted
	$0.8 \times 125.75 = 100.6$			
	which is less than 101.6.	m1		Valid comparison - their figures
	Hence, if estimate is correct, she will take	A1	3	Correct conclusion based on correct
	less money.			working
				or lose $0.2 \times 50 = 10$ ;
				$\begin{array}{c} \text{or lose } 0.2 \times 30 - 10, \\ \text{gain } 0.2 \times (95 - 50) = 9 \end{array}$
				or $100 \times 101.6 = 101.60$
				$(100 - 120) \times 125.75 = 100.60$
	Total		9	

				SS02 - AQA GCE Mark Scheme 2
(cont)				SS02 - AQA GCE Mark Scheme 20 SS02 -
Q	Solution	Marks	Total	Comments
3(a)	113 million	B1 B1	2	113 113 million
(b)(i)	Upward trend in London - relatively slow 1994/95 (decrease in 1998/99) - increasing more rapidly 2000/01 onwards.	E1		E1 upward in London
(ii)	Outside London there is a slow downward trend (apart from 1998/99 to 2000/01 when there was little change).	E1 E1	3	E1 downward outside London E1 additional valid (but not trivial) poin
(c)(i)	Increase in fares index outside London far exceeds increase in RPI - this explains reduction in bus journeys outside London.	E1		E1 comparison of fares outside London with RPI
	Increase in fares index in London is similar to increase in RPI. Thus any reason for increased bus journeys (eg	E1		E1 comparison of fares in London with RPI E1 comparison of London with outside
	congestion charge / increased population) should not be inhibited by price.	E1	3	London E1 any sensible conclusion Maximum 3
(ii)	Outside London increase in bus fares > increase in rail fares > both RPI and increase in motoring costs (which have declined in real terms).			
	This may explain reduction in bus journeys. In London increase in bus fares is < increase in rail fares / similar to RPI / only	E1		E1 valid comparison outside London
	slightly > than increase in motoring costs. This may explain increase in bus journeys.	E1	2	E1 valid comparison in London
	Total		10	

				SS02 - AQA GCE Mark Scheme 20 Comments Scales labelled
(cont)	Solution	Marks	Total	Comments
Q 4(a)	On graph	B1	10121	Scales labelled
٦(٣)	Ongraph	M1	I	Method for plot
	I	A1	3	Accurate plot by eye - allow one small
	I		ł	slip. Disallow very small scale
(b)	Jun '05 Jan '06 Jun '06 Jan '07 Jun '07 Jan '08		ł	
	1188 192 1351 238 1499 290	ח1	I	2 mint marine arrange yeard
	m.a. 690.0 771.5 794.5 868.5 894.5	B1 M1	ł	2-point moving average used Method for moving average
	On graph	m1	I	Moving average plotted in correct
			I	position – must be 2-point
		A1	4	Moving average plotted accurately –
	I		I	allow one small slip
	Trand ling on group	B1	I	
(c)	Trend line on graph	ы	I	
	June effect $(500+570+610)/3 = 560$	M1	ł	Method for seasonal effect - ignore sign -
			I	may be earned in (d)
	l	m1	I	Method for seasonal effect – allow '06 and
			1,	'07 only
		A1	4	$560 (530 \sim 600)$ - may be earned in (d)
(d)	Estimate of m.a. June $2009 = 1100$	B1	I	1060 ~ 1140
			I	
	Estimated number of candidates	M1	I	Method for forecast - their figures for
	= 1100 + 560 = 1660	1		positive seasonal effect
	I	A1	3	$1660 (1620 \sim 1720)$
	I		I	SC allow B1 for in range, no working
(e)	Max for 4 examiners is $4 \times 400 = 1600$	M1	l	Method - their figures
		A 1		
	Estimate of 1660 suggests 5 examiners will be required.	A1	2	CAO SC allow B1 for 5 without explanation
	will be required.		ł	SC allow B1 for 5 without explanation
(f)(i)	Limited data available suggests January	E1	I	Limited data;
	and June figures are both increasing		I	Jan and June increasing at different rates;
	approximately linearly but at different		I	sensible method;
	rates. Using regression on June figures is	E1	I	current trends may not continue
	a sensible method but current trends may		ł	any 2 valid points
	not continue.		I	
(ii)	1800 would still need 5 examiners –	E1√	3	ft no effect - their figures
(,	no effect		-	It no one of them inguines

				SS02 - AQA GCE Mark Scheme 20
(cont)				SS02 - AQA GCE Mark Scheme 2L Comments B1 one correct hypothesis
Q	Solution	Marks	Total	Comments
5(a)	$H_0: \mu = 19$ $H_1: \mu \neq 19$	B1		B1 one correct hypothesis
	$\bar{x} = 19.667$	B1		B1 both hypotheses correct
	$z = (19.667 - 19)/(3.5/\sqrt{9}) = 0.571$	M1		Use of $3.5/\sqrt{9}$
	2 - (19.007 - 19)((3.3739) - 0.371)	ml		Method for $z$ – ignore sign
		A1		$0.571 (0.57 \sim 0.575)$
	c.v. ± 1.96	B1		$\pm 1.96$ – ignore sign
	Accept H <sub>0</sub>	A1√		Conclusion – must be compared with
			0	correct tail of normal
	Conclude that there is no significant evidence that the mean time for	A1√	8	In context – needs previous A1 $\checkmark$
	ambulance to arrive is not 19 minutes			
(b)(i)	$H_0: \mu = 19$ $H_1: \mu < 19$	B1		Both hypotheses – ignore any errors
				already penalised in (a)
	-1.6449	B1		1 6440 (1 64 1 65)
(ii)	-1.6449	B1 B1		1.6449 (1.64 ~ 1.65) Any negative <i>z</i> -value
		DI		Any negative 2-value
(iii)	No significant evidence that the mean	A1√	4	Needs m mark in (a) and – c.v.
	time for ambulance to arrive is less than			
	19 minutes.			
(a)	No gignificant avidance that target k	E1		E1 director's comment incorrect
(c)	No significant evidence that target has been achieved.	EI		E1 director's comment incorrect
	Indeed as $\overline{x} = 19.66$ there is no evidence	E1		E1 sample mean greater than 19
	at all.	21		21 campre mean greater and 19
	There is however no significant evidence	E1	3	E1 no significant evidence target has not
	that it has not been achieved.			been achieved.
				E1 no significant evidence target has been
				achieved
	Total		15	Maximum 3

Q       Solution       Marks       Total       Comments         6(a)       280 houses       B1       Description       OE - their total         Number houses 000 to 279       E1       OE - their total         Select 3-digit random numbers       E1       Description       OE - their total         Ignore repeats and > 279       E1       5       Consistent with their numbering         Continue until 8 numbers obtained Select corresponding houses       E1       5       Consistent with their numbering         (b)       Number houses street by street, eg North St 000-062       E1       E1 number houses street by street - may be earned in (a) but more detail required here         South St 140-185       West St 186-279       E1       E1 idea of systematic sampling E1 choose random starting point 34.         Choose this house and every 35th house thereafter.       B1       3       B1 every 35th house Maximum 3         (c)       Cluster       B1       1       Image: Street Stre					SS02 - AQA GCE Mark Scheme 2
Number houses 000 to 279E1OE - their totalSelect 3-digit random numbersE1F1Ignore repeats and > 279E15Continue until 8 numbers obtained Select corresponding housesE15Number houses street by street, eg North St 000-062 East St 063-139 South St 140-185 West St 186-279 Select a random number between 00 and 34. Choose this house and every 35th house thereafter.E15(d)(i)If Socrates misses a street there is a substantial probability (0.5) that John will not check any houses in this street.B11(d)(i)Systematic preferred John certain to check some houses in each streetE131(b)NortferenceB131(c)Not preferenceB11(d)(i)Systematic preferred bohn certain to check some houses in each streetE13(b)NortferenceB13(c)NortferenceB12(d)Both equally likely to check housesE12	(cont)	Solution	Marks	Tatal	Comments
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<ul> <li>(b) Number houses street by street, eg North St 000-062 East St 063-139 South St 140-185 West St 186-279 Select a random number between 00 and 34. Choose this house and every 35th house thereafter.</li> <li>(c) Cluster</li> <li>(d)(i) If Socrates misses a street there is a substantial probability (0.5) that John will not check any houses in this street.</li> <li>(ii) Systematic preferred</li> <li>(b) B1</li> <li>(c) No preference</li> <li>(</li></ul>					
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34. Choose this house and every 35th house thereafter.       B1       3       B1 every 35th house Maximum 3         (c)       Cluster       B1       1         (d)(i)       If Socrates misses a street there is a substantial probability (0.5) that John will not check any houses in this street.       E1       4         (ii)       Systematic preferred       B1       1         (bh certain to check some houses in each street       E1       3         (e)       No preference       B1       2			<b>F1</b>	i	
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John certain to check some houses in each streetE13(e)No preferenceB1Both equally likely to check housesE12				l	
street     B1       No preference     B1       Both equally likely to check houses     E1     2	(ii)	Systematic preferred	B1		
street     B1       No preference     B1       Both equally likely to check houses     E1     2		John certain to check some houses in each	F1	3	
Both equally likely to check houses E1 2					
	(e)	No preference	B1		
		Poth equally likely to check houses	F1	2	
		missed by Mary	L'I	2	SC allow B1 for systematic because easier