



## **General Certificate of Education**

# **Statistics 6380**

**SS02          Statistics Unit 2**

# **Mark Scheme**

*2007 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
<b>1(a)(i)</b>	$P(4 \text{ or fewer}) = 0.4405$	B1		0.4405 (0.440 ~ 0.441)
<b>(a)(ii)</b>	$P(4) = P(\leq 4) - P(\leq 3)$ $= 0.4405 - 0.2650$ $= 0.1755$	M1 A1		$P(4) = P(\leq 4) - P(\leq 3)$ or correct use of formula 0.1755 (0.175 ~ 0.176)
<b>(a)(iii)</b>	$P(\geq 4) = 1 - P(\leq 3)$ $= 1 - 0.265$ $= 0.735$	M1 A1	5	$P(\geq 4) = 1 - P(\leq 3)$ or correct use of formula 0.735 (0.734 ~ 0.736)
<b>(b)</b>	Poisson mean 15 $P(>12) = 1 - P(\leq 12)$ $= 1 - 0.2676$ $= 0.732$	B1 M1 A1	3	use of Poisson $3 \times 5$ $P(>12) = 1 - P(\leq 12)$ 0.732 (0.732 ~ 0.733)
	<b>Total</b>		<b>8</b>	

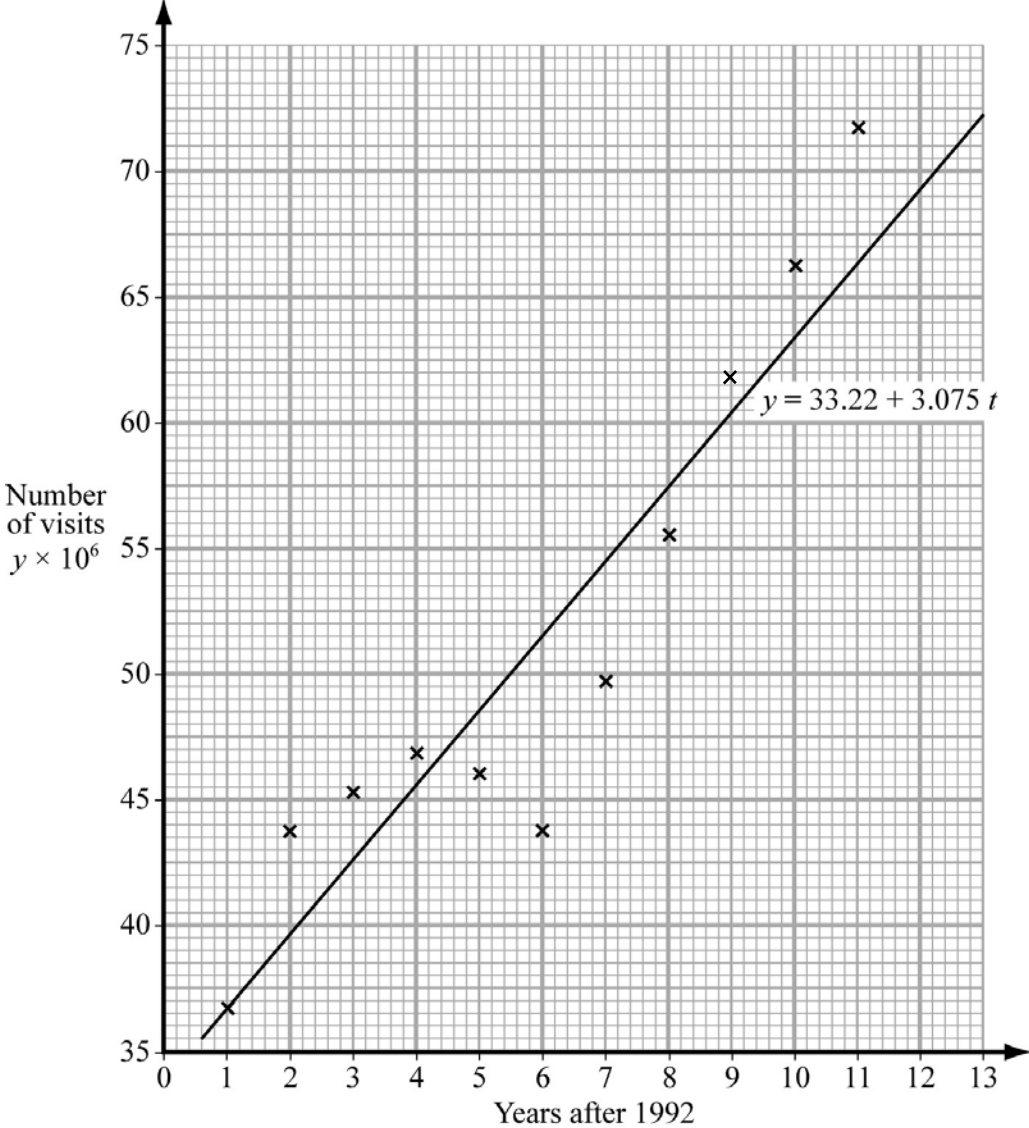
SS02 (cont)

Q	Solution	Marks	Total	Comments																											
2(a)(i)	T S T S T S T S 378 804 394 809 366 851 422 843	B1 M1		attempted use of 2pt m.a. correct method weeks 1-4 - allow any m.a.																											
	591 599 601.5 587.5 608.5 636.5 632.5	A1			correct $\pm 0.5$ - allow one slip																										
(a)(ii)	on graph below	m1 A1		m.a. plotted in correct position correct plot by eye - allow one small slip																											
(a)(iii)	on graph below	B1	6	trend line																											
<p>Market takings, £</p> <table border="1"> <caption>Market Takings Data</caption> <thead> <tr> <th>Week</th> <th>Tue</th> <th>Sat</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>378</td> <td>804</td> </tr> <tr> <td>2</td> <td>394</td> <td>809</td> </tr> <tr> <td>3</td> <td>366</td> <td>851</td> </tr> <tr> <td>4</td> <td>422</td> <td>843</td> </tr> <tr> <td>5</td> <td>591</td> <td>599</td> </tr> <tr> <td>6</td> <td>601.5</td> <td>587.5</td> </tr> <tr> <td>7</td> <td>608.5</td> <td>636.5</td> </tr> <tr> <td>8</td> <td>632.5</td> <td>900</td> </tr> </tbody> </table>					Week	Tue	Sat	1	378	804	2	394	809	3	366	851	4	422	843	5	591	599	6	601.5	587.5	7	608.5	636.5	8	632.5	900
Week	Tue	Sat																													
1	378	804																													
2	394	809																													
3	366	851																													
4	422	843																													
5	591	599																													
6	601.5	587.5																													
7	608.5	636.5																													
8	632.5	900																													
(b)	Saturday, week 7 Takings below trend line - usually above on Saturday	B1 E1	2	Sat, week 7 reason																											
(c)	Tuesday, week 6 Takings just below trend line - usually well below on Tuesday	B1 E1	2	Tue, week 6 reason																											
<b>Total</b>			<b>10</b>																												

## SS02 (cont)

Q	Solution	Marks	Total	Comments
3(a)	$E(X) = 225 \times 0.56 + 145 \times 0.32 + 249 \times 0.09 + 253 \times 0.03 = 202.4$	M1 A1	2	method correct expression - <b>AG</b>
(b)	s.d. = 40.2 $E(X^2) = 225^2 \times 0.56 + 145^2 \times 0.32 + 249^2 \times 0.09 + 253^2 \times 0.03 = 42578.36$ $V(X) = 42578.36 - 202.4^2 = 1612.6$ s.d. = 40.2	M1  m1 A1	3	B3 40.2 ( 40.1 ~ 40.3) or method for $E(X^2)$  method for $V(X)$ 40.2 (40.1 ~ 40.3)
(c)	mean 225 s.d. 0	B1 B1	2	225 cao 0 cao
(d)	more choice may attract more customers etc	E1	1	any sensible reason
	<b>Total</b>		<b>8</b>	

SS02 (cont)

Q	Solution	Marks	Total	Comments
4(a)	on graph below  	M1 B1 A1	3	method for scatter diagram scales and labels accurate plot by eye - allow one small slip.
(b)	$t = 1 \quad y = 36.3 \quad t = 11 \quad y = 67.0$ +line	M1 A1	2	method accurate line
(c)	$33.22 + 3.075 \times 12 = 70.1$ 70.1 million or 70 100 000	M1 A1	2	method - ignore units 70.1 million (70 ~ 70.2)
(d)	$70.11 + 5 = 75$ 75 million or 75 000 000	M1 A1  B1	3	answer to (c) + reasonable residual 75 million (74 ~ 80) - only penalise missing units once 2 or 3 sf (regression on last 6 points gives 77.8)
<b>Total</b>			<b>10</b>	

**SS02 (cont)**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>5(a)</b>	$H_0: \mu = 1.50$	B1		one correct hypothesis - generous
	$H_1: \mu < 1.50$	B1		both correct - ungenerous
	$z = (1.33 - 1.50)/(0.45/\sqrt{60}) = -2.93$	M1 m1		use of $0.45/\sqrt{60}$ method for $z$ - ignore sign - allow 'correction' of s.d $-2.93$ ( $-2.9 \sim -2.93$ )
	c.v. $-1.6449$ reject $H_0$ , significant evidence that mean value of popcorn and soft drinks consumed by customers is less than £1.50.	A1 A1 $\checkmark$ E1 $\checkmark$	8	$-1.6449$ ( $-1.64 \sim -1.65$ )-ignore sign ft correct conclusion - must compare correct tail ft correct conclusion in context
<b>(b)</b>	concluding mean value of items consumed is less than £1.50 when in fact it is equal to £1.50	E1 E1	2	idea of type I error in context
<b>(c)</b>	advert may attract people who wish to consume a lot of popcorn and soft drinks - i.e. population may change.	E2,1	2	both marks for clear explanation
	<b>Total</b>		<b>12</b>	



**SS02 (cont)**

Q	Solution	Marks	Total	Comments
6(a)(i)	200	B1 B1	2	0.2 200 acf
(a)(ii)	1sf - possible range 150 - 250, not very accurate	E1 E1	2	1sf/ few sf not very accurate
(b)	In 1993 Bosnia-Herzegovnia contributed 20700 out of a total of 54800 immigrants. In 1994 B-H and Former Yugoslavia contributed 41500 out of 74800 immigrants.	E1 E1	2	identification of B-H or former Yugoslavia both + supporting data
(c)(i)	Immigrants from EU shows a fairly steady upward linear trend (apart from dip in 1997).	E1 E1		increase steady/linear/dip in 1997
(c)(ii)	Proportion fairly constant	E1	3	fairly constant/slight increase Any three points
(d)(i)	UK 3700, Iran 3400, US 3200	M1 A1	2	method 3700, 3400, 3200 cao
(d)(ii)	on graph below	B1 M1 A1	3	scales and labels method accurate graph
(d)(iii)	Line diagram -easy to see which is largest. Pie chart - easy to see proportions of whole but comparisons not easy.	E1	1	reason
<b>Total</b>			<b>15</b>	

**SS02 (cont)**

<b>Q</b>	<b>Solution</b>	<b>Marks</b>	<b>Total</b>	<b>Comments</b>
<b>7(a)</b>	Number drivers 000 to 619	E1		number drivers 000 to 619 or mechanics/clerical staff/managers
	Select 3 digit random numbers	E1		select 3 digit random numbers
	Ignore repeats and >619 Continue until 62 numbers obtained	E1		ignore repeats
		E1		ignore >619 (must be consistent with numbering)
	Select corresponding drivers	E1		idea of stratified sample
	Similarly select 12 mechanics,13 clerical staff, 80 managers	E1	6	12,13,8 or explanation why not necessarily so
				allow max 3 for random sample
<b>(b)</b>	Number all employees 000 to 949	E1		number 000 to 949
	Choose a random digit between 0 and 9	E1		choose a random digit between 0 and 9
	Select every 10th employee e.g. if 7 picked select 007,017.....947	E1	3	select every 10th employee
<b>(c)</b>	No point in stratifying by employment categories if no difference between categories	E1		
	Would be worth stratifying by sex	E1		
	Systematic sample would not ensure a fair representation of sexes (unless men numbered together and women numbered together)	E1	3	a mark for any sensible point - max 3
	<b>Total</b>		<b>12</b>	
	<b>TOTAL</b>		<b>75</b>	