AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

General Certificate of Education

Statistics 6380

SS02 Statistics 2

Mark Scheme

2006 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.

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**.
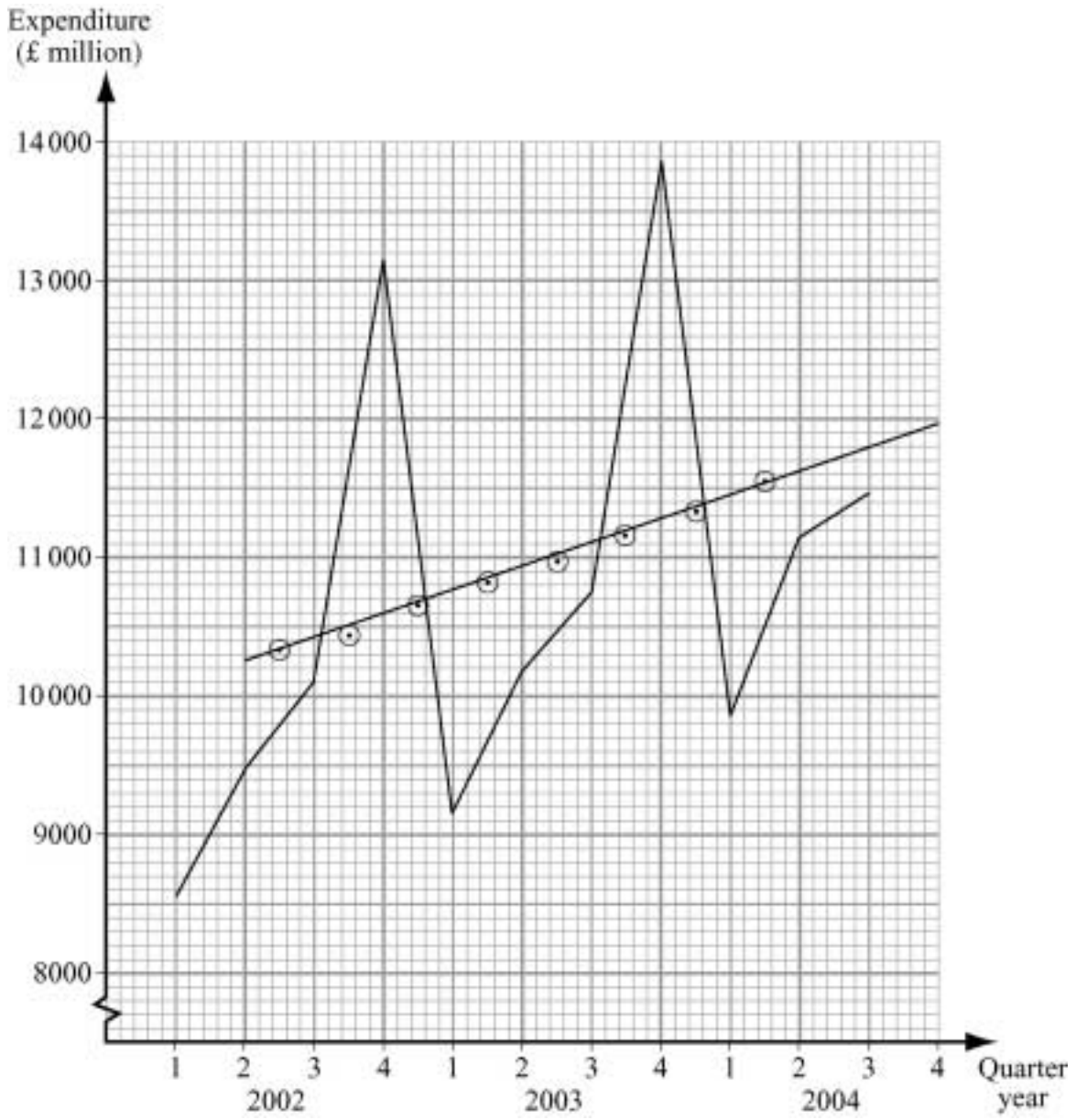
Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

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)	$\dfrac{(9113+10198+10748+13877)}{4}=10984$	M1 A1	2	method $10984(10980 \sim 11000)$
(b)	On insert	M1 B1 A1	3	attempt to plot m.a. in correct position trend line – generous reasonably accurate plot (by eye) and trend line
(c)	$\dfrac{13163 - \frac{10468 + 10643}{2} + 13877 - \frac{11162 + 11392}{2}}{2} = 2604$	M1 m1 A1	3	method for seasonal effect – generous – allow from graph method based on correct plot $2500 - 2700$
(d)	Estimate for Q4 2004 $12000 + 2604 = £14600$ million	M1 A1 B1	3	method of forecast – their figures $14600(14500 \sim 14700)$ - ignore units 2 or 3sf
(e)	Forecast reasonably accurate – method appears to be satisfactory	E1 E1✓	2	reasonably accurate ✓ method satisfactory
	Total		**13**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
2(a)(i)	$P(10 \text{ or fewer}) = 0.3472$	B1	1	$0.347 (0.347 \sim 0.3473)$
(ii)	$P(10) = 0.3472 - 0.2424 = 0.105$	M1		P(10 or fewer) - P(9 or fewer) or use of correct formula
		A1	2	$0.105 (0.1045 \sim 0.105)$
(b)(i)	$P(>3) = 1 - 0.8571$	M1		$P(>3) = 1 - P(3 \text{ or fewer})$
	$= 0.143$	A1	2	$0.143 (0.1429 \sim 0.1431)$
(ii)	Poisson mean 14	B1		use of Poisson mean 14
	$P(\geq 18) = 1 - 0.8272$	M1		$P(\geq 18) = 1 - P(17 \text{ or fewer})$
	$= 0.173$	A1	3	$0.173 (0.1725 - 0.173)$
(c)(i)	$E(X) = 0 \times 0.39 + 1 \times 0.25 + 2 \times 0.08 +$	M1		method
	$3 \times 0.09 + 4 \times 0.06 + 5 \times 0.05 + 6 \times 0.08$			
	$= 1.65$	A1	2	1.65 cao
(ii)	$E(X^2) = 0^2 \times 0.39 + 1^2 \times 0.25 + 2^2 \times 0.08 +$			
	$3^2 \times 0.09 + 4^2 \times 0.06 + 5^2 \times 0.05 +$			
	$6^2 \times 0.08 = 6.47$	M1	1	6.47 correct method shown ag
(iii)	$V(X) = 6.47 - 1.65^2 = 3.7475$	M1	1	method their $E(X)$
(iv)	$s.d = \sqrt{3.7475} = 1.94$	m1		method requires previous M1M1M1
		A1	2	$1.94 (1.93 \sim 1.94)$
d(i)	Mean and variance not similar	E1	1	reason
(ii)	Mean probably not constant throughout the year	E1	1	reason – disallow 'not independent' allow e.g. 'not independent – father of twins may buy two tricycles'. Allow both marks if reasons reversed
	Total		**16**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
3(a)	Random variation about a downward linear trend	E1 E1	2	random downward linear
(b)	Random variation about a downward non-linear trend	E1 E1	2	random downward non-linear
(c)	Seasonal variation about a downward linear trend	E1 E1	2	seasonal downward linear
(d)	Short-term variation about an upward linear trend	E1 E1	2	short term upward linear only penalise omission of 'downward/upward' twice. Only penalise omission of 'linear/non-linear' twice
	Total		**8**	
4(a)	$H_0 : \mu = 46.7$	B1		one correct hypothesis - generous
	$H_1 : \mu > 46.7$	B1		both hypotheses correct - ungenerous
	$\bar{x} = 64.286$ $z = \dfrac{(64.286 - 46.7)}{\left(\dfrac{14.3}{\sqrt{7}}\right)} = 3.25$	M1 m1 A1		use of $\dfrac{14.3}{\sqrt{7}}$ correct method for z – ignore sign $3.25\,(3.24 \sim 3.26)$
	c.v. 1.6449	B1		$1.6449\,(1.64 \sim 1.65)$ - ignore sign
	Significant evidence $\mu > 46.7$ i.e. the mean test score of pupils wishing to be considered for the team exceeds 46.7	A1√ A1√	8	√ correct conclusion their figures – must be compared with upper tail of z √ conclusion in context – requires previous A1√
(b)(i)	0.05, H_0 is true. Probability of making a Type 1 error is probability of rejecting i.e. the significance level.	B1 E1	2	0.05 cao explanation
(ii)	$0, H_0$ is untrue – impossible to make a Type 1 error	B1 E1	2	0 cao explanation
	Total		**12**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
5(a)	26515 megalitres	B1 B1	 2	26515 – allow 26500 megalitres
(b)	$54148 - 1083 - 4867 - 5428 - 26515$ $= 16255$	M1 A1	 2	method $16255 \, (16200 \sim 16300)$ - ignore units
(c)(i)	Electricity supply industry	B1	1	Electricity supply
(ii)	Fish farming (22.0%) [Electricity supply (21.4%)]	B1 M1 A1	 3	fish farming method for calculating percentage increases 22.0 $(21.9 \sim 22.1)$ and 21.4 $(21 \sim 21.5)$
(d)	Public water supply $\left(\dfrac{100}{360}\right) \times 60981 = 16939$ E.S.I. $\left(\dfrac{209.3}{360}\right) \times 60981 = 35454$ O.I. $\left(\dfrac{28.8}{360}\right) \times 60981 = 4878$ F.F. $\left(\dfrac{19}{360}\right) \times 60981 = 3218$ Other $60981 - 16939 - 35454 - 4878 - 3218$ $= 492$	M1 A1 B1 m1	 	method for one category 3 categories correct to 3 sf table complete – including total and units method for last category (either by subtraction of megalitres or by subtraction of angles – if angles ignore discrepancy in total due to round off)

	Megalitres per day
Public water supply	16939
Electricity supply industry	35454
Other industry	4878
Fish farming etc	3218
Other	492
Total	60981

A1   5   all categories correct ± 5

| | | | **Total** | | **13** | |

SS02 (cont)

Q	Solution	Marks	Total	Comments
6(a)	**A** quota	B1		quota
	Not equally likely – those who are easy to	B1		not equally likely
	contact most likely to be chosen	E1		explanation – allow – depends how secretaries choose samples
	B cluster	B1		cluster
	Not equally likely – those in small	B1		not equally likely
	branches most likely to be chosen	E1		explanation allow - equally likely if branches of equal size
	C stratified (random)	B1		stratified
	Equally likely	B1		equally likely
	D random	B1		random
	Equally likely	B1	10	equally likely
(b)(i)	**C** ensures all branches fairly represented	B1		**C**
	and all members equally likely to be	E1	2	all branches fairly represented
	chosen			
(ii)	Easier to carry out	E1	1	reason
	Total		**13**	
	TOTAL		**75**	