Version

AQA

General Certificate of Education (A-level)
January 2013

Statistics   **SS02**

(Specification 6380)

Statistics 2

Final

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised 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 students' 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 abbreviations

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
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
–x EE	deduct x marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
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.

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)(i)	(255 + 166 + 244 + 338)/4	M1		
	= 250.75 = 251	A1		Exact or integer
			2	
(ii)	Plot moving average	B1		Within 2mm radius circle
	And trend line	B1		Generous, but must be straight
			2	
(b)(i)	(−18) & (−20)	M1		Attempt to find two winter effects **from graph**
	added and divided by 2	m1		and average them (+ or −).
	= −19 (−15 to −25)	A1		Must be negative.
			3	
(ii)	215 − 19	M1		Their winter value from trend line 'subtract' their value from **(i)**
	= 196 (180 to 210)	A1		SC B1 for answer in range but with **no** method seen
			2	
(c)	• Extrapolating too far • trend likely to change • would give negative rainfall • climate change (etc) • data over too short a time	E2,1		One mark for each valid point up to a maximum of 2
			2	
(d)(i)	Not accurate, true value above, not below, trend line.	E1		Not accurate
(ii)	Downward trend has stopped.	E1		Changed, or now upward
			2	
		Total	**13**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
2(a)	H_0: $\mu = 1005$ H_1: $\mu \neq 1005$ $\bar{x} = 1006.2875$ Test statistic = z $= (1006.2875 - 1005)/(\dfrac{2.1}{\sqrt{8}})$ $= 1.734$ c.v. $= \pm 1.645$ So test statistic in critical region. Reject H_0, evidence that mean has changed.	 B1 B1 M1 m1 A1 B1 A1	 7	 Both AWRT 1006.29 **used**. Not given if only 1006.3 seen/used $\sqrt{8}$ rest of formula for z AWFW 1.73-1.74 (SC allow AWRT 1.75 if 1006.3 used) AWFW 1.64 to 1.65 Mention of flour not necessary Dep on B1 for H_0 & H_1, A1 and B1 for c.v.
(b)	H_0: $\mu = 1005$ H_1: $\mu > 1005$ $z = (1005.48 - 1005)/\dfrac{2.41}{\sqrt{90}}$ $= 1.88$ to 1.90 c.v. $= 2.0537$ (t_{89} = approx 2.0) So test statistic not in critical region. Accept H_0, insufficient evidence that mean has increased.	 B1 M1 A1 B1 A1	 5	 Both Including $\sqrt{90}$ Mention of flour not necessary Dep on B1 for H_0 & H_1, A1 and B1 for c.v.
(c)	Because a large sample Can use the central limit theorem, So the sample mean is normally distributed.	M1 E1	 2	 For either of these two points Just CLT mentioned scores B1
(d)	The test must be the one accepting H_0 Hence the test in part (b)	M1 A1	 2	Anything showing understanding of Type II error **being specific about what is accepted/rejected**
		Total	**16**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	P(X ≤ 2) = 0.9197	B1	**1**	AWFW 0.919 to 0.920
(ii)	P(X = 4) = P(X ≤ 4) – P(X ≤ 3)	M1		Or by use of formula
	0.9963 – 0.9810 = 0.0153	A1	**2**	AWRT 0.0153
(b)	Po(10) used	M1		
	P(X > 8) = 1 – P(≤ 8)	m1		Allow if adjacent columns used.
	1– 0.3328 = 0.667(2)	A1	**3**	AWRT 0.667
(c)(i)	So Po(12) altogether.	M1		
	P(X ≥ 15) = 1 – P(≤ 14)	m1		
	1– 0.7720 = 0.228	A1	**3**	AWRT 0.228
(ii)	The coins buried in a hoard are no longer independent.	E1		Reference to independence in relation to coins or brooches.
	Poisson requires independence so brooches more likely to be Poisson.	E1	**2**	Identification of brooches.
		Total	**11**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
4 (a)	This is a rounding error because the percentages are shown to the nearest integer.	E1		Rounding error.
			1	
(b)	7% × 54070 = 4000 (3785)	M1 A1		CAO
			2	
(c)	Higher proportion of males get immediate custody Higher proportion of males get community penalties Lower proportion of males get fines	E2		E1 each for suitable comments up to a maximum of 2
			2	
(d)(i)	66/100 × 360 = 238°	M1 A1		AWRT
			2	
(ii)	257462/918380 Square rooted × 4 = 2.1 cm	M1 m1 A1		AWRT
			3	
(e)(i)	(257462 + 918380)/51809.7 = 22.7	M1 A1		AWRT
			2	
(ii)	No, because figures relate to sentencing, not original crime. **Accept:** No, because London figure only slightly higher than North East	E1		One mark for any suitable negative comment.
			1	
		Total	**13**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
5 (a)	Mean = $1 \times 0.03 + 2 \times 0.12 +$ etc. $= 3.51$	M1		
	$E(X^2) = 1 \times 0.03 + 4 \times 0.12 + \dots$	M1		
	$\text{Var}(X) = E(X^2) - E(X)^2$	m1		**Applied** in this case
	$= 1.0299$	A1		AWRT 1.03
			4	
(b)(i)	0.51	B1		
			1	
(ii)	Mode = 3	M1		
	$P(X \geq 3) = 0.85$	A1		
			2	
(ii)	Median = 4	M1		
	$P(X < 4) = 0.49$	A1		
			2	
(c)(i)	Poisson would have significant probability of greater than 5 which does not match the context.	E1		Or similar reasoning in context.
			1	
(ii)	Mean of B(5, 0.7) = 3.5	B1		
	variance of B(5, 0.7) = 1.05	B1		
	So (a) answers good match	E1		Must have both B1
			3	
		Total	**13**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
6(a)	Stratified	B1	**1**	
(b)	Eg. No complete list of customers. No contact details for customers. Very time consuming Very expensive May not give desired proportions People would not want to be delayed in a **fast** food outlet	E3,2,1	**3**	Any three comments addressing different aspects. Expense and time count as separate points.
(c)(i)	Convenient. They just go locally and question customers until they have reached the numbers required.	E1		Convenience.
(ii)	Not representative. Other parts of the country may have different views.	E1	**2**	Not representative.
(d)	Eg. A small number of outlets. Randomly selected Or selected for spread of size etc Decide on a quota for each type of customer at the chosen outlets. Select the customers who will fulfil the quotas trying to avoid bias	E1 E1 E1 (E1) (E1)	**3**	Small number Random (outlets) **or** balanced Quota Avoid bias (customers) (Accept 'randomly select customers') Any additional valid point **Maximum of 3 marks**
		Total	**9**	
	TOTAL		**75**	