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General Certificate of Education (A-level)
June 2012

Statistics SS02

(Specification 6380)

Statistics 2

Mark Scheme

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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)	0.2, 0.3	B1, B1	**2**	
(b)	$E(X) = 0 \times 0.2 + 1 \times 0.3 + 3 \times 0.5$	M1		
	$= 1.8$	A1		CAO nms B2
	$E(X^2) = 0^2 \times 0.2 + 1^2 \times 0.3 + 3^2 \times 0.5$	M1		
	$Var(X) = E(X^2) - E(X)^2 = 4.8 - 1.8^2$	M1		Must be applied. Must be identified as $Var(X)$
	$s.d = \sqrt{1.56} = 1.25$	A1		AWRT nms B3
			5	
(c)	$P(\text{points} > 3.05) = 0$	B1F	**1**	If *their* $E(X)$ + s.d. < 3 accept 0.5
	Total		**8**	

Q	Solution	Marks	Total	Comments
2 (a)(i)	$n = 4$	B1	**1**	
(ii)	$(9.6 + 7.4 + 7.2 + 8.4) \div 4$	M1		Possibly implied
	$y = 8.15$	A1	**2**	8.15 must be seen
(iii)	$8.0 + 8.8 + 7.0 + x = 4 \times 7.4$	M1		Move beyond moving average equation.
	$x = 5.8$	A1	**2**	5.8 must be seen nms B2
(b)(i)	Correct position for x	B1		Within one square
	Correct position for y	B1	**2**	Within one square
(ii)	Short term (variation)……	B1		
	about a downward (trend)	B1	**2**	Accept negative/decreasing trend
(iii)	Residuals for Q2	M1		Ignore sign for method mark. Attempt at min of 2 residuals
	(+)0.3, (+)0.5 and (+)0.5	A1		Must be +ve Their answer to 1d.p. Must use 3 residuals
	Mean = 0.43	A1	**3**	Accept 0.4 to 0.45 Must use 3 residuals
(iv)	Read off from graph = 7.1	B1		Accept 7.05 to 7.15
	Add 0.4(3)	M1		Their 0.43
	7.5(3) **million**	A1	**3**	cao accept 7.5 to 7.6 **million**
(v)	Extrapolation far ahead is risky/not likely to be accurate.	E1	**1**	Anything indicating that things may be different two years later. Eg mention Olympics. Reason not necessary.
	Total		**16**	

Q	Solution	Marks	Total	Comments
3(a)	2791 – (1+9+72+366+1173+11+22) = 1137	M1 A1	**2**	Or B2 for answer only seen.
(b)	Adding at least 10 numbers and ÷ 10 65 ÷ 10 = 6.5	M1 A1	**2**	Must specify divided by 10 SC 5.9 B1
(c)(i)	0.043(0)	B1	**1**	awrt
(ii)	P(X >10) = 1 – P(X ≤10) = 1 – 0.9332 = 0.0668	M1 A1	**2**	Accept 0.067
(iii)	P(X =5) = P(X ≤5) – P(X ≤4) = 0.3690 – 0.2237 = 0.145	M1 A1	**2**	Or use of formula Answer alone scores B2
(d)(i)	9.6	B1	**1**	
(ii)	So Po(2.4) for 3 months P(=0) = 0.0907 **Or** Uses Po(1.625) and Po(0.775) And multiplies to give 0.0907	M1 A1 (M1) (A1)	**2**	Their '9.6'÷4 as λ for Poisson Accept 0.091 Must **use** these Using formula, not tables
(e)	Poisson requires independence. eg Earthquake greater than 7.0 has associated (so non-independent) 6.0 or greater earthquakes. **Or** Poisson requires constant average rate. eg An earthquake of magnitude 7.0 will change the average rate. Poisson inappropriate.	 E1 E1	**2**	 Must be in context
	Total		**14**	

Q	Solution	Marks	Total	Comments
4(a)(i)	Cluster sampling	B1	**1**	
(ii)	Hypothesis test needs random sample	E1	**1**	Reference to sample
(b)	H_0: $\mu = 50$	B1		μ or equivalent
	H_1: $\mu \neq 50$	B1		μ or equivalent
	$\mathbf{z = (52.1 - 50)/(\frac{7.8}{\sqrt{81}})}$	**M1**		**For general form for *z*** Condone sign error
		m1		**For use of $\sqrt{81}$**
	= +2.42	**A1**		Must be +ve
	c.v. $z = \pm 2.5758$ or $t_{80} = \pm 2.639$	**B1**		Or p value = 0.00776 Or $p < 0.01$
	So test statistic not in critical region. Accept H_0 PI	A1F		ft if M1 **and** A1 or B1 earned
	no significant evidence that mean mark for exam is not 50.	E1F	**8**	Dep on A1F. For consistent conclusion in context. Must mention mark or exam.
(c)(i)	**Large sample** so mean can be treated as normally distributed.	M1		Any relevant comments with a correct conclusion. eg CLT
	Conclusion still valid.	A1	**2**	
(ii)	The 81 may not be representative (or not random).	M1		Any relevant comments with a correct conclusion. eg biased **Not** reference to change in *n*.
	Conclusion not reliable.	A1	**2**	
	Alternatives for bold parts of (b)			
	$50 \pm 2.5758 \times (\frac{7.8}{\sqrt{81}})$	(B1)		For $z = \pm 2.5758$
		(M1)		For general form of equation
		(m1)		For use of $\sqrt{81}$
	= (47.768, 52.232)	(A1)		
	or			
	$50 \pm 2.639 \times (\frac{7.8}{\sqrt{81}})$	(B1)		For $t_{80} = \pm 2.639$
		(M1)		For general form of equation
		(m1)		For use of $\sqrt{81}$
	= (47.713, 52.287)	(A1)		
	Total		**14**	

Q	Solution	Marks	Total	Comments
5(a)(i)	28	B1	**1**	27 to 29 Must be an integer
(ii)	180 – "154"	M1		180 – (anything between 140 and 160)
	= 26	A1		Accept 25 – 27
	= 14.4%	A1	**3**	14% - 15%
(b)(i)	Lowest end of whisker = 100	B1		
	Q1 = 130 to 133	B1		
	Q2 = 145 to 147	B1		
	Q3 = 175 to 177	B1		
	Top of whisker = 275	B1	**5**	
(ii)	Eg. Women have:			
	Smaller range OE	B1		Any valid comments about the **distribution**.
	Smaller IQR OE	B1		
	Greater degree of skew OE	B1		Max 1 mark for a point value comparison
	Lower median OE	B1		
				Maximum of 3 marks
			3	
(c)	People visiting the doctor may not have representative weights.	E1	**1**	Or similar in context
	Total		**13**	

Q	Solution	Marks	Total	Comments
6(a)	Generate random numbers in pairs	E1		ie 2-digit
	Rejecting any greater than 79 and any repeats.	E1		For either of these.
	Continue until 10 numbers obtained	E1		
	Include the corresponding councillors in the sample	E1		If candidate uses 01 to 80, must relate these numbers to the stated 00 to 79 to earn 4th mark Lose 1 for any additional incorrect instruction
			4	
(b)	09,63,20,71,78,11,19,13,54,26 (or 09,63,07,18,78,11,37,54,26,62)	B2		B2 for completely correct list of 10. B1 for 9 or 11 or one included erroneously.
			2	
(c)(i)	A systematic sample picks regularly throughout the list,…	E1		What a systematic sample does.
	but the list is alphabetical, not sorted by party.	E1		What the problem is
			2	
(ii)	48/80 × 10 or 32/80 × 10 6 Preservative and 4 Action.	M1 A1		Or B2 for 6 Preservative and 4 Action.
			2	
	Total		**10**	
	TOTAL		**75**	