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General Certificate of Education (A-level)
June 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.

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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.

Q	Solution	Marks	Total	Comments
1(a)(i)	$P(\leq 4) - P(\leq 3) = 0.8774 - 0.7360$	M1		Or by using formula or calculator Allow for use of adjacent columns, 0.8477 – 0.6919 = 0.1558 or 0.9041 – 0.7787 = 0.1254 or a hybrid eg 0.8774 – 0.6919
	= 0.141(4)	A1	2	AWFW 0.141-0.142 Unsupported answer scores B2
(ii)	1 – P(= 0) using Po(2.6)	M1		
	= 0.926 (0.9257)	A1	2	AWFW 0.925 to 0.926 Unsupported answer scores B2
(b)	Using Po(13)	M1		Stated or sight of 0.675, **0.764**, 0.836
	P(≤ 15) = 0.764 (0.7636)	A1	2	AWFW 0.763 to 0.764 Unsupported answer scores B2
(c)	Using Po(6)	B1		Stated or sight of 0.744, **0.847**, 0.919 or 0.356, **0.153**, 0.094
	1 – P(≤ 8)	M1		
	= 0.153 (0.1528)	A1	3	AWFW 0.152 to 0.153 Unsupported answer scores B3 SC Use of 1 – 0.9917 (= 0.0083) scores 1
	Total		**9**	

Q	Solution	Marks	Total	Comments
2(a)	H_0: $\mu = 453.6$			
	H_1: $\mu < 453.6$	B1		Both
	$\bar{x} = 447.8$	B1		
	$z = (447.8 – 453.6)/(10/\sqrt{6})$	M1		Using $10/\sqrt{6}$
		m1		rest of formula for z (either way round in numerator)
	$= –1.421$	A1		AWFW –1.41 to –1.43 [SC 1.421 with no working scores B1 M1 m1]
	c.v. = –1.28(16)	B1		AWRT –1.28
	So test statistic in critical region. Reject H_0, evidence that Sophie's suspicion is true.	A1	7	Must refer to Sophie's suspicion or equivalent context statement. Dep on A1 and c.v. B1
(b)	Now $z = (442.8 – 453.6)/(10/\sqrt{6})$	M1		For use of 442.8 (their $\bar{x} – 5$) or equivalent using original data
	$= –2.645$	A1		AWFW –2.64 to –2.65
	c.v. = –2.3263	B1		–2.32 to –2.33
	$–2.645 < –2.3263$ so test statistic in critical region. Reject H_0, evidence that Sophie's suspicion is true.	A1	4	Justification for reaching given answer must be shown, numbers or diagram AG Dep on A1 and c.v. B1
(c)	Because H_0 has been rejected (or H_1 accepted)……	E1		Stating reason in terms of H_0 / H_1 or context
	…..must be Type I error	E1	2	Dependent on previous E1
	Total		**13**	

Q	Solution	Marks	Total	Comments
3(a)(i)	$E(X) = 10 \times 0.18 + 20 \times 0.44$ etc $= 59.1$	M1 A1	2	Or B2 for answer
(ii)	$E(X^2) = 10^2 \times 0.18 + 20^2 \times 0.44$ etc	B1		Showing what E(X^2) comes from
	$= 8119. \text{Var}(X) = E(X^2) - E(X)^2$			
	= '8119' – '59.1^2'	M1		**Complete** method. Dep on B1
	= 4626.19 So s.d. = $\sqrt{}$ 4626.19 = 68.0	A1	3	AG Condone 68
(iii)	0.08 + 0.17 = 0.25 or 0.18 + 0.44 + 0.13 = 0.75	B1		
	$1 - 0.75^3$ or use of B(3, 0.25)	M1		Allow for sight of 0.4219
	= 0.578	A1	3	AWRT
(b)(i)	Increase	B1		
(ii)	Increase	B1	2	
(c)	Probability for 0 adds nothing extra to E(X), while other probabilities fall reducing E(X) **Or** Total withdrawn does not increase, but number of customers does **Or** £0 is below the original mean and adding extra values below the original mean will reduce the mean	E2	2	Some statement conveying correct concept. E1 for partial explanation
	Total		**12**	

Q	Solution	Marks	Total	Comments
4(a)(i)	Three	B1	1	
(ii)	(104 + 82 + 102) ÷ 3	M1		
	= 96 accurately plotted	A1	2	Marked with a dot or a cross
(b)(i)	Approx $+8+10+10+11$	M1		Attempt to find **total** excess for Sat using graph or table
	÷ 4	m1		Total divided by 4
	= +9 or +10	A1	3	AWRT +9 or +10
	NB If an incorrect answer for "seasonal effect for Saturday" is given in part **(b)(i)** the marks cannot be given retrospectively for use of the correct calculation in **(b)(ii)** although the 3 marks for **(b)(ii)** itself can be earned.			
(ii)	AWFW 103 to 104	B1		Reading Saturday 1 Dec value
	+ (9 or 10)	M1F		Adding their (b)(i)
	AWFW 112 to 114	A1	3	
(iii)	Eg More bad weather Christmas effect on numbers Restaurant may reach capacity Extrapolation is risky – the trend may change	E1	1	Any sensible reason
(c)(i)	Friday 16th	B1		
	Other Fridays above trend line, this one below	E1	2	Or similar reasoning. Dep on B1
(ii)	Sunday 18th	B1		
	Other Sundays well below trend line, this one close to it	E1	2	Or similar reasoning. Dep on B1
	Total		**14**	

Q	Solution	Marks	Total	Comments
5(a)(i)	• Use 2-digit random numbers • Reject repeats… • …and 00 or > 90. • Continue until 15 numbers obtained Use the sites with these numbers	E1 E1 E1 E1		If candidates use numbering 00 to 89 they can be awarded up to 3 marks but must say how these tie in to the stated 1 to 90 to obtain the fourth mark
(ii)	May not cover all 3 orders of stream	E1		Any suitable statistical point
	Teams may be spread out all along the stream making supervision hard.	E1	6	Any suitable practical point
(b)(i)	Systematic sampling	B1		
(ii)	Not random	B1		For clear statement
	because every different group of 15 cannot be chosen	E1		For correct feature that makes it not random
(iii)	Stratified	B1		For clear statement
	This picks 7 1st order, 3 2nd order and 5 3rd order,	M1		Method selects streams of each order
	which is correct proportions.	A1	6	For 7:3:5 seen (or equivalent)
(c)(i)	Cluster sampling	B1		
(ii)	Eg: All the teams are close together, making supervision easier.	E1		Accept "convenient" but not "lack of travelling" or "quicker"
	Every student/team collects data on each order of stream.	E1		Any two distinct valid points
(ii)	Eg: The blocks may not be representative of the whole stream. Five from each order is not the right proportions	E1	4	Any valid disadvantage.
	Total		**16**	

Q	Solution	Marks	Total	Comments
6(a)	1616.6 – 706.2 = 910.4	B1		Accept 910
	thousand hectares	B1	2	Dep on first B1
(b)	$(528.0 + 631.3 + 692.0 + 374.3 + 281.2) \div 5$	M1		Allow M1 A0 if wrong row used.
	= 501.(36) thousand hectares	A1	2	AWRT 501. Do not penalise omission of thousands more than once. Unsupported answer scores B2
(c)	$256 / 360 \times$	M1		Anywhere
	$2.2 \times (8718100)$	M1		Anywhere
	= 136(38983)	A1		
	= 13.6 million tonnes. (13 600 000)	A1	4	CAO
(d)(i)	Oats because positive correlation	B1		Or their plot from data (shown)
(ii)	Corn for grain, because quantity stays approximately constant.	B1		Or their plot from data (shown)
(iii)	Soybeans because negative correlation	B1	3	Or their plot from data (shown) SC If **no** reasons given but all three correctly identified allow B1
	Total		**11**	
	TOTAL		**75**	