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General Certificate of Education (A-level)
January 2012

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.

SS02

Q	Solution	Marks	Total	Comments
1 (a)	$P(X < 2) = P(X \le 1)$.	M1		Award for 0.267 or 0.199 from adjacent columns seen
	P = 0.231(1)	A1	2	
(b)	Use of Po(14)	B1		
	$P(X \le 8) - P(X \le 7)$	M1		Must be 8 – 7 Or formula applied to relevant λ
	= 0.0621 – 0.0316 = 0.0305 Calculator → 0.0304	A1	3	0.0304 to 0.0305
(c)	Use of Po(12) $1 - P(X \le 15)$ 1 – 0.8444 = 0.1556	B1 M1 A1	3	 0.156
(d)	Tyres will often be sold in multiples. So not independent as required by Poisson	E1 E1		NB. Not ‘customers are not independent’, or ‘tyres & other product not independent’
	or Garage has limited stock of tyres/time to change tyres Poisson is not limited	E1 E1		Must be clearly tied to restriction of context, not simply ‘Poisson can be infinite, number of tyres cannot be’
	or Rate of sales not likely to be constant through the day	E1	2	Must tie to context. Not simply ‘mean must be constant’
	Total		**10**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
2 (a)	H_0: $\mu = 72.8$	B1		
	H_1: $\mu \neq 72.8$	B1		
	$\bar{x} = 67.1$	B1		
	$z = \dfrac{(67.1 - 72.8)}{\frac{8.7}{\sqrt{10}}}$	M1 m1		Use of $\frac{8.7}{\sqrt{10}}$ Rest of method for z (ignore sign)
	$= -2.07$	A1		AWRT 2.07, must be –ve
	c.v. = ± 1.96	B1		
	Test statistic compared with negative critical value (diagram or statement). Reject H_0, evidence that prices have changed.	A1	8	Comparison must be seen. AG
	Alt. p value of 0.019 compared with 0.025 (or 0.038 compared with 0.05)			B1 for ± 1.96 becomes A1 for 0.019 Then A1 for $0.019 < 0.025$
(b)	Type I	M1		
	H_0 rejected or H_1 accepted	E1	2	Or 'if mean is still 72.80' Defining both Type I and Type II without saying which might apply in this case scores 0.
(c)	Method would not be valid.	E1		
	Only a small sample (so CLT does not apply)	E1	2	
(d)	Hotels on website may not be representative of hotels in Blackport **Or** Website prices may be inaccurate/out of date. **Or** Because the standard deviation may not actually be 8.7	E1	1	
	Total		**13**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$E(X) = 0 \times 0.1 + 1 \times 0.15 + 2 \times 0.25 + 3 \times 0.35 + 4 \times 0.15 = 2.3$	M1		Must see this working for this M1
	$E(X^2) = 0^2 \times 0.1 + 1^2 \times 0.15 + 2^2 \times 0.25 + 3^2 \times 0.35 + 4^2 \times 0.15$ (= 6.7)	M1		These 3 marks are to be given if CAO seen from calculator work.
	$\text{Var}(X) = \text{“}6.7\text{”} - 2.3^2 = 1.41$	m1		
	s.d. = 1.19	A1	4	AWRT 1.19
(ii)	$2.3 \times 24 - 1.7 \times 16$ = (£)28	M1 A1	2	Or by direct calculation of profit from probability distribution. AG
(b)(i)	0.5	B1	1	
(ii)	$E(X) = 0 \times 0.1 + 1 \times 0.15 + 2 \times 0.25 + 3 \times 0.5 = 2.15$	B1		
	$2.15 \times 24 - 0.85 \times 16$	M1		
	= (£)38	A1	3	
(iii)	More profit	E1	1	
(iv)	Might lose/disappoint customers who request lobster but cannot have it.	E1	1	OE Must refer to losing customers not profit
	Total		**12**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
4(a)(i)	5 013	B1		Consistent ignoring of thousands hereafter loses no further marks
	5 013 thousand or 5 013 000	B1	2	
(ii)	19545 – 2877 – 12538 – 3597	M1		
	= 533	A1	2	Accept 532 or 534 or 533000
(iii)	Figures are to nearest thousand.			"Rounding error" accepted.
	Two rounded down can lose a thousand Eg 1400 + 2400 = 1000 + 2000 = 3000	E1	1	
(b)(i)	Rising at first then decreasing later	B1		
	With peak at 1986	B1	2	Allow use of an appropriate sketch graph. Single statement of "decreasing" scores 0
(ii)	At least 2 attempts at proportions seen	M1		
	At least 2 accurate proportions seen (at least 2 s.f.) Proportion may be expressed as decimal, percentage, ratio or fraction.	A1		0.0388, 0.0382, 0.0376, 0.0364, 0.0374, 0.0374, 0.0362, 0.0339.
	Decreasing (with random variation)	A1	3	Allow M1 A0 A1 if working with proportion of widowed males.
(c)	Totals are single 14516, married 21774, divorced 3940, widowed 3264	M1		Attempt to obtain correct totals
	÷ 43494 and × 360	M1		Full method
	120°, 180°, 33°, 27°	A1	3	Allow one slip or extra s.f.
	Total		**13**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
5(a)	Points plotted correctly	B1	1	Allow single **small** slip
(b)	3 point averages calculated….	B1		
	..by correct method	M1		
	Correct values obtained	A1		4307, 4584, 4939, 5262, 5524, 5847, 6192 (3 s.f. acceptable)
	Located at correct *x* positions	m1		Monday Day through to Wed Day
	And plotted correctly	A1	5	Allow single **small** slip
(c)	Fair line for **their** points	B1	1	
(d)	From table & averages or from graph	M1		Seasonal effect measured three times and averaged
	(+1000+1112+1150) ÷ 3	m1		
	= +1087	A1	3	1040 – 1140
(e)	7150 +1090	M1		From their graph and (d) 8100 – 8400
	= 8240	A1	2	
(f)(i)	Points plotted correctly	B1	1	
(ii)	Day figure well above forecast from (e)	E1		
	Pattern of calls has changed (E higher than D)	E1	2	
	Total		**15**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	Use 3-figure random numbers	E1		
	Reject repeats, 000 and numbers > 500	E1		Condone not mentioning 000
	Continue until 50 numbers generated.	E1		
	Use the numbers to identify the animals from the stock book.	E1	4	If candidate uses 0 to 499 they must relate to stock number for this mark
(ii)	The random sample may not include any goats (or too many).	E1	1	For showing appreciation that number of goats may be disproportionate
(b)(i)	Systematic.	B1	1	
(ii)	Not random	B1		
	Not every group of 50 can be chosen (Eg if 7 then not 8).	E1	2	
(c)(i)	He decides how many of each type to test (Eg.33 sheep, 16 cattle and 1 goat)	M1		Not necessarily proportionately stratified.
	Then he tests **any** 33 sheep, 16 cattle and 1 goat that he finds.	E1	2	Consistent with above.
(ii)	Convenience **Or** Guarantees at least one of each type of animal. **Or** Gives correct proportions	E1	1	If stratified in (i)
(iii)	The sample may be **biased** – he might only test the slower animals.	E1	1	OE Not simply 'Not random' – must say why this is a disadvantage
	Total		**12**	
	TOTAL		**75**	