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General Certificate of Education

Statistics 6380

SS02 Statistics 2

Mark Scheme

2009 examination – January 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.

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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)(i)	$E(X) = 0 \times 0.925 + 1 \times 0.061 +$ $2 \times 0.01 + 6 \times 0.004 = 0.105$	M1 A1		M1 method A1 0.105 cao
(ii)	$E(X^2) = 0 \times 0.925 + 1 \times 0.061 +$ $4 \times 0.01 + 36 \times 0.004 = 0.245$ $V(X) = 0.245 - 0.105^2 = 0.233975$ sd = $\sqrt{0.233975}$ = 0.484 AG **SC allows method marks if sd given, correctly, to more than 3 sf and then rounded to 3sf.**	M1 m1 A1	 5	M1 method for $E(X^2)$ - may be implied m1 method for sd A1 0.484 AG
(b)	Christos' boxes have, on average, more cracked eggs than Johann's, but the number is less variable.	E1√ E1	 2	E1√ Christos average cracked eggs higher E1 Christos less variable
	Total		**7**	
2(a)	H_0: $\mu = 24$ H_1: $\mu \neq 24$ $z = \frac{23.3 - 24}{\frac{5.2}{\sqrt{130}}} = -1.53$ critical value for 10% 2-sided risk ± 1.6449 Accept H_0: i.e. accept that mean time to carry out a transaction is 24 seconds.	B1 B1 M1 m1 A1 B1 A1√ A1√	 8	B1 one correct hypothesis - generous B1 both correct - ungenerous M1 use of $\frac{5.2}{\sqrt{130}}$ m1 method for z - ignore sign A1 –1.53 (–1.53 ~ –1.54) B1 1.6449 (1.64 ~ 1.65) ignore sign A1√ conclusion - must be compared with correct tail of z A1√ in context
(b)	Any significance level can be used (although > 20% makes little sense). The levels 10%, 5%, 1% and 0.1% are conventionally used.	E1 E1	 2	E1 Sebastien wrong E1 any significance level can be used
	Total		**10**	
3(a)(i)	Po(0.3) P(1) = 0.9631 – 0.7408 = 0.222	B1 M1 A1	 3	B1 Poisson used M1 method A1 0.222 (0.222 ~ 0.223)
(ii)	P(≥ 5) = 1 – 0.8153 = 0.185	M1 M1 A1	 3	M1 P(≥ 5) = 1 – P(≤ 4) M1 use of Poisson, mean 3 A1 0.185 (0.184 ~ 0.185)
(b)(i)	B(20, 0.08) P(≤ 2) = 0.788	B1 B1 B1	 3	B1 Binomial used B1 $n = 20$, $p = 0.08$ B1 0.788 (0.787 ~ 0.789)
(ii)	$\frac{7}{10} \times \frac{6}{9} \times \frac{5}{8} \times \frac{4}{7} \times \frac{3}{6} \times \frac{2}{5}$ = 0.0333 **or** not binomial - p not constant not Poisson events don't occur at random at a constant average rate / maximum 6 seconds.	B1 M1 A1 (B1) (E1) (E1)	 3	B1 probability not constant M1 method A1 0.0333 (0.033 ~ 0.0334) B1 not binomial or Poisson E1 reason binomial E1 reason Poisson
	Total		**12**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
4(a)	Wk 1 2 3			
(i)	Fr Sa Th Fr Sa Th Fr			
	332.7 336.7 342.0 345.7 349.7 356.7 357.0	M1		M1 attempt at 3-point m.a.
		A1	2	A1 all correct ± 0.5 - allow one small slip
(ii)	on insert	M1		M1 method for plot
		A1		A1 reasonably accurate plot
		M1		M1 their m.a. plotted in correct position
		A1	4	A1 reasonably accurate plot
(iii)	on insert	B1		B1 trend line
	Estimated moving average, Saturday week 4 = 375	B1	2	B1 375 (370 ~ 380)
(iv)	Saturday effect	M1		M1 method - allow first 2 Saturdays only
	$\frac{119.3+117.3+107}{3} = 114.5$	A1		A1 114.5 (113 ~ 120)
	Predicted takings 375+114.5 = 489.5	M1		M1 method
	£490	A1	4	A1 490 (480 ~ 500) disallow if more than 3sf given
(b)	Takings were well below predicted value - probably due to no manager	E1		E1 below predicted value
		E1	2	E1 probably due to no manager
(c)	Moving averages for Friday			
	week 5 6 7	M1		M1 method for m.a.
	340 402 435.7	A1		A1 all correct 3sf
	on insert	B1		B1 reasonably accurate plot
	Week 5 below trend but weeks 6 and 7 above trend. Suggests new manager is increasing sales more than trend under previous manager.	E1		E1 weeks 6 and 7 above trend
		E1	5	E1 new manager increasing sales above previous trend/upward trend has increased.
	Total		**19**	

SS02 (cont)

Q	Solution	Marks	Total	Comments
5(a)	Select 4-digit random numbers	E1		E1 select 4-digit numbers
(i)	Ignore repeats and 0000 and >1390	E1		E1 ignore repeats
		E1		E1 ignore 0000 and >1390
	Continue until 80 obtained			
	Choose corresponding seats	E1	4	E1 continue until 80 obtained and choose corresponding seats
(ii)	Seat not sold	E1		E1 any relevant point
	Seat sold but occupant not in place	E1		E1 any independent relevant point
	Access to seat difficult in crowd	E1	3	E1 both points clearly expressed
	Occupant won't answer questionnaire			
(b)(i)	systematic	B1	1	B1 systematic
(ii)	all been to a football match → all interested in sport/geographically localised etc	E1	1	E1 any relevant point
(iii)	crowd would make it difficulty to identify	E1		E1 any relevant point
	100th person and difficult to carry out an interview.	E1	2	E1 any independent relevant point
(c)	Systematic sample identifies the particular person to be interviewed. Quota sample allows interviewer to choose anyone in a particular category e.g. male, over 60	E2(1)	2	E2(1) difference clearly explained
			13	

SS02 (cont)

Q	Solution	Marks	Total	Comments
6(a)	7	B1	1	B1 7 CAO
(b)	20 – 2 – 1 – 6 – 2 = 9	M1		M1 method
	or 603 – 595 = 8	A1	2	A1 8 or 9
(c)	The female prison population was much higher in June 2004 than in June 1999 (about 40%)	E1		E1 more females in prison in 2004
	The number of females found guilty of indictable offences in 2004 was similar to that in 1999.	E1		E1 similar number/slightly fewer offences in 2004
	Indicating that females who have committed indictable offences were more likely to be sent to prison in 2004 than in 1999 (those serving prison sentences in June 1999/2004 probably committed their offences before 1999/2004 so it is possible, but unlikely, that the number in prison reflected the number committing offences).	E1	3	E1 interpretation or additional point eg age distribution of prisoners similar in 2004
(d)(i)	age 15-17 18-20 21-24 25-29 cf 8 73 166 256 30-39 40-49 50-59 cf 370 390 392	M1 A1		M1 method for cf A1 correct cf
(ii)	on insert	m1 A1		m1 method of plotting cf - generous A1 accurate plot - by eye
(iii)	median = 26.2 years	m1 A1	 6	m1 method A1 26 ~ 26.6
(e)	Number of females imprisoned for robbery has more than doubled in 2004.	E1		E1 large increase in number
	The average age has increased very slightly	E1	2	E1 similar/slight increase in average age.
	Total		**14**	
	TOTAL		**75**	