GCE Examinations Advanced Subsidiary / Advanced Level

Statistics Module S2

Paper C MARKING GUIDE

This guide is intended to be as helpful as possible to teachers by providing concise solutions and indicating how marks should be awarded. There are obviously alternative methods that would also gain full marks.

Method marks (M) are awarded for knowing and using a method.

Accuracy marks (A) can only be awarded when a correct method has been used.

(B) marks are independent of method marks.



Written by Shaun Armstrong & Chris Huffer © Solomon Press

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S2 Paper C – Marking Guide

1.	(a)	 (i) e.g. all individuals or items of relevance (ii) e.g. a selection of individuals or items from a population 	B1 B1	
	<i>(b)</i>	 (i) census – e.g. need to know requirements of all for catering (ii) sample – e.g. testing is destructive, none left after census 	B2 B2	(6)
2.	(a)	let $X = no.$ of complaints per day $\therefore X \sim Po(6)$ P(X = 3) = 0.1512 - 0.0620 = 0.0892	M1 M1 A1	
	<i>(b)</i>	$P(X \ge 10) = 1 - P(X \le 9) = 1 - 0.9161 = 0.0839$	M1 A1	
	(c)	let $Y =$ no. of days with 10 or more complaints $\therefore Y \sim B(6, 0.0839)$ $P(Y \le 1) = (0.9161)^6 + 6(0.0839)(0.9161)^5$ = 0.916 (3sf)	M1 M1 A1 A1	(9)
3.	(a)	let $X =$ no. out of 8 who take out policies $\therefore X \sim B(8, 0.3)$ P($X = 2$) = 0.5518 - 0.2553 = 0.2965	M1 M1 A1	
	<i>(b)</i>	$P(X > 4) = 1 - P(X \le 4) = 1 - 0.9420 = 0.0580$	M1 A1	
	(c)	let Y = no. out of 150 who take out policies \therefore Y ~ B(150, 0.3) N approx. S ~ N(45, 31.5) P(Y > 50) \approx P(S > 50.5) = P(Z > $\frac{50.5 - 45}{\sqrt{31.5}}$) = P(Z > 0.98)	M1 M1 A1	
		= 1 - 0.8365 = 0.1635	A1	(10)
4.	(a)	let X = no. of tries per match $\therefore X \sim Po(0.4)$ P(X \ge 2) = 1 - P(X \le 1) = 1 - e^{-0.4}(1 + 0.4) = 1 - 0.9384 = 0.0616 (3sf)	M1 M1 M1 A1 A1	
	<i>(b)</i>	let $Y =$ no. of tries per 5 matches $\therefore Y \sim Po(2)$ $H_0: \lambda = 2$ $H_1: \lambda > 2$ $P(Y \ge 6) = 1 - P(Y \le 5) = 1 - 0.9834 = 0.0166$ less than 5% \therefore significant, evidence of increase	M1 B1 M1 A1 A1	(10)

5.	(a)	$P(X < 2) = F(2) = \frac{1}{432} \times 4 \times (4 - 32 + 72) = \frac{11}{27}$	M1 A1	
	(b)	$F(x) = \frac{1}{432} \left(x^4 - 16x^3 + 72x^2 \right)$	M1	
		$f(x) = F'(x) = \frac{1}{432} (4x^3 - 48x^2 + 144x)$	M1 A1	
		$\therefore f(x) = \begin{cases} \frac{1}{108} (x^3 - 12x^2 + 36x), & 0 \le x \le 6, \\ 0, & \text{otherwise.} \end{cases} \text{ [or } \frac{1}{108} x(x-6)^2 \text{]}$	A1	
	(c)	$f'(x) = \frac{1}{108} \left(3x^2 - 24x + 36 \right)$	M1	
		for S.P. = 0 giving $x^2 - 8x + 12 = 0$	M1 A1	
		\therefore $(x-6)(x-2) = 0$ so $x = 2$ or 6 some justification, e.g. +ve cubic / $f(x) = 0$ at 0 and 6 \therefore mode = 2	M1 M1 A1	
	(d)	median higher as $P(X < 2)$ is less than $\frac{1}{2}$	B1	(13)
6.	(a)	fixed no. of eggs, eggs either broken or not, prob. of each egg being broken is same (assuming no accident breaking group together)	B3	
	<i>(b)</i>	let $X =$ no. of eggs broken in delivery $\therefore X \sim B(120, 0.008)$	M1	
		$P(X \le 1) = (0.992)^{120} + 120(0.008)(0.992)^{119}$	M1 A1	
		= 0.7505 (4sf)	A1	
	(c)	<i>n</i> large, <i>p</i> small	B1	
	(d)	$X \approx \sim \operatorname{Po}(0.96)$	M1	
		$P(X \le 1) \approx e^{-0.96} (1 + 0.96)$	M1 A1	
		= 0.7505 (4sf)	Al D1	(12)
		same value to 4st, very good approx. for these parameters	BI	(13)
7.	(a)	6.5	A1	
	(b)	$2.4 \times \frac{1}{9} = \frac{4}{15}$ or 0.2667 (4sf)	M1 A1	
	(c)	= P(3 < X < 7) = 4 × $\frac{1}{9}$ = $\frac{4}{9}$ or 0.4444 (4sf)	M1 A1	
	(d)	$f(y) = \frac{1}{b-a}$	B1	
		$\mathcal{E}(Y^2) = \int_a^b \frac{1}{b-a} y^2 \mathrm{d}y$	M1	
		$= \frac{1}{b-a} \left[\frac{1}{3} y^3 \right]_a^b$	A1	
		$= \frac{b^3 - a^3}{3(b-a)}$	M1	
		$= \frac{1}{3}(b^2 + ab + a^2)$	A1	
	(e)	$Var(Y) = E(Y^2) - [E(Y)]^2$	M1	
	(-)	$= \frac{1}{3}(b^2 + ab + a^2) - \frac{1}{4}(a^2 + 2ab + b^2)$	M1	
		$= \frac{1}{12}(4b^2 + 4ab + 4a^2 - 3a^2 - 6ab - 3b^2)$	M1	
		$= \frac{1}{12}(b^2 - 2ab + a^2) = \frac{1}{12}(b - a)^2$	A1	(14)

Total (75)

Performance Record – S2 Paper C

Question no.	1	2	3	4	5	6	7	Total
Topic(s)	sampling	Poisson, binomial	binomial, N approx.	Poisson, hyp. test	c.d.f., p.d.f., mode, median	binomial, Po appr. to binomial	rect. dist., deriving variance	
Marks	6	9	10	10	13	13	14	75
Student								