GCE Examinations

Advanced Subsidiary / Advanced Level

Statistics

Module S2

Paper F

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.

Solomon Press

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S2 Paper F – Marking Guide

1.	*(a)*	$= e^{-1.4}(1 + 1.4 + \frac{1.4^2}{2} + \frac{1.4^3}{3!})$	M1 A1	
		$= 0.9463$ (4sf)	A1	
	(b)	let $A \sim B(20, 0.4)$	M1	
		$P(Y \leq 12) = P(A \geq 8)$	M1	
		$= 1 - P(A \leq 7)$	M1	
		$= 1 - 0.4159 = 0.5841$	A1	**(7)**
2.	*(a)*	frame – list of all learners she has taught	B1	
		units – individual learners	B1	
	(b)	let X = no. of learners failing first 2 attempts $\therefore X \sim B(120, \frac{1}{20})$	M1	
		$H_0 : p = \frac{1}{20}$ $\quad H_1 : p \neq \frac{1}{20}$	B1	
		Po approx. $X \approx\sim Po(6)$	M1	
		$P(X \leq 1) = 0.0174$, $P(X \leq 11) = 0.9799$	M1 A1	
		$\therefore$ C.R. is $X \leq 1$ or $X \geq 12$	A1	
	(c)	$0.0174 + 0.0201 = 0.0375$	A1	**(9)**
3.	*(a)*	mean = 16	A1	
		variance = $\frac{1}{12}(28 - 4)^2 = 48$	M1 A1	
	(b)	$= P(13 < X < 19)$	M1	
		$= 6 \times \frac{1}{24} = \frac{1}{4}$	M1 A1	
	(c)	let Y = no. within 3 cm of middle $\therefore Y \sim B(12, \frac{1}{4})$	M1	
		$P(Y > 4) = 1 - P(Y \leq 4) = 1 - 0.8424 = 0.1576$	M1 A1	**(9)**
4.	*(a)*	events must occur singly, at random, at constant rate	B2	
		fairly valid although rate may vary through evening	B1	
	(b)	let X = no. of visitors per 10 minutes $\therefore X \sim Po(5)$	M1	
		$P(X < 2) = P(X \leq 1) = 0.0404$	M1 A1	
	(c)	let Y = no. of visitors per 15 minutes $\therefore Y \sim Po(7.5)$	M1	
		$P(Y \geq 10) = 1 - P(Y \leq 9) = 1 - 0.7764 = 0.2236$	M1 A1	
	(d)	let A = no. of visitors per 3 hours $\therefore A \sim Po(90)$	M1	
		N approx. $B \sim N(90, 90)$	M1	
		$P(A > 100) \approx P(B > 100.5)$	M1	
		$= P(Z > \frac{100.5 - 90}{\sqrt{90}}) = P(Z > 1.11)$	A1	
		$= 1 - 0.8665 = 0.1335$	A1	**(14)**

5. *(a)* binomial, $n = 4$, $p = \frac{1}{2}$ B2

fixed no. of coins flipped, 2 outcomes, p fixed B2

(b) $H \sim B(4, \frac{1}{2})$

P(more heads) = $P(H \geq 3)$ M1

$= 4(\frac{1}{2})^3(\frac{1}{2}) + (\frac{1}{2})^4$ M1 A1

$= \frac{4}{16} + \frac{1}{16} = \frac{5}{16}$ A1

(c) let X = no. of times get more heads $\therefore X \sim B(5, \frac{5}{16})$ M1

$H_0 : p = \frac{5}{16}$ $H_1 : p > \frac{5}{16}$ B1

$P(X \geq 4) = 5(\frac{5}{16})^4(\frac{11}{16}) + (\frac{5}{16})^5$ M1

$= 0.0358$ (3sf) A1

less than 5% $\therefore$ significant, evidence of higher prob. A1

(d) P(head) : P(tail) = 1.5 : 1 = 3 : 2 $\therefore$ P(head) = $\frac{3}{5}$ M1

$\therefore H \sim B(4, \frac{3}{5})$

$P(H \geq 3) = 4(\frac{3}{5})^3(\frac{2}{5}) + (\frac{3}{5})^4$ M1 A1

$= \frac{297}{625}$ or 0.4752 (4sf) A1 **(17)**

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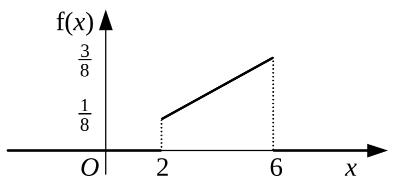
6. *(a)*



B2

(b) $E(X) = \int_2^6 x \times \frac{1}{16}x \; dx = \frac{1}{16}\int_2^6 x^2 \; dx$ M1

$= \frac{1}{48}[x^3]_2^6 = \frac{1}{48}(216 - 8) = \frac{13}{3}$ M1 A1

(c) $E(X^2) = \int_2^6 x^2 \times \frac{1}{16}x \; dx = \frac{1}{16}\int_2^6 x^3 \; dx$ M1

$= \frac{1}{64}[x^4]_2^6 = \frac{1}{64}(1296 - 16) = 20$ M1 A1

$\therefore \text{Var}(X) = 20 - (\frac{13}{3})^2 = \frac{11}{9}$ M1 A1

(d) $F(t) = \int_2^t \frac{1}{16}x \; dx$ M1

$= \frac{1}{32}[x^2]_2^t = \frac{1}{32}(t^2 - 4)$ M1 A1

$\therefore F(x) = \begin{cases} 0, & x < 2, \\ \frac{1}{32}(x^2 - 4) & 2 \leq x \leq 6, \\ 1, & x > 6. \end{cases}$ A1

(e) $F(Q_1) = \frac{1}{4}$ $\therefore \frac{1}{32}(x^2 - 4) = \frac{1}{4}$ M1

$x^2 - 4 = 8$; $x^2 = 12$; $x = \pm 2\sqrt{3}$; $2 \leq x \leq 6$ so $Q_1 = 2\sqrt{3}$ M1 A1

$F(Q_3) = \frac{3}{4}$ $\therefore \frac{1}{32}(x^2 - 4) = \frac{3}{4}$

$x^2 - 4 = 24$; $x^2 = 28$; $x = \pm 2\sqrt{7}$; $2 \leq x \leq 6$ so $Q_3 = 2\sqrt{7}$ M1

$\therefore$ IQR $= 2\sqrt{7} - 2\sqrt{3} = 2(\sqrt{7} - \sqrt{3})$ A1 **(19)**

Total **(75)**

Performance Record – S2 Paper F

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	Total
Topic(s)	Poisson, binomial	sampling, Po appr. to binomial, hyp. test	rect. dist., binomial	Poisson, N approx.	binomial, hyp. test	p.d.f., mean, variance, c.d.f., IQR	
Marks	7	9	9	14	17	19	75
Student							