

GCE Examinations

Advanced Subsidiary / Advanced Level

Statistics

Module S2

Paper D

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.



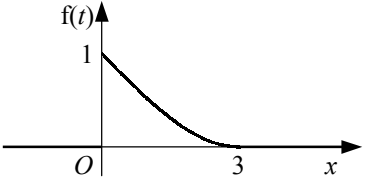
Written by Shaun Armstrong & Chris Huffer

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S2 Paper D – Marking Guide

1.	(a)	$F(5) = 1$ $k(95 - 25 - 34) = 1; 36k = 1 \therefore k = \frac{1}{36}$	M1 A1	
	(b)	$P(X > 4) = 1 - F(4)$ $= 1 - \frac{1}{36}(76 - 16 - 34) = \frac{5}{18}$	M1 A1	
	(c)	$f(x) = F'(x) = \frac{1}{36}(19 - 2x)$ $\therefore f(x) = \begin{cases} \frac{1}{36}(19 - 2x), & 2 \leq x \leq 5, \\ 0, & \text{otherwise.} \end{cases}$	M1 A1 A1	(7)
2.	(a)	Poisson e.g. J occurs singly, at random, at constant rate	B1 B2	
	(b)	continuous uniform e.g. initial lengths random \therefore equal chance of any length 0 to 3 left over	B1 B2	
	(c)	binomial e.g. fixed no. of spins, two outcomes, fixed prob. of head	B1 B2	(9)
3.	(a)	$H_0 : p = \frac{1}{2} \quad H_1 : p \neq \frac{1}{2}$	B1	
	(b)	let $X =$ no. with mobile phones $\therefore X \sim B(25, \frac{1}{2})$ $P(X \leq 7) = 0.0216; P(X \leq 17) = 0.9784$ \therefore C.R. is $X \leq 7$ or $X \geq 18$	M1 M1 A1 A1	
	(c)	$0.0216 + 0.0216 = 0.0432$	A1	
	(d)	$H_0 : p = \frac{1}{2} \quad H_1 : p < \frac{1}{2}$ $P(X \leq 8) = 0.0539$ more than 5% \therefore not significant	B1 M1 A1	(9)
4.	(a)	let $X =$ no. of sales per week $\therefore X \sim \text{Po}(8)$ $P(X \leq 4) = 0.0996$	M1 A1	
	(b)	let $Y =$ no. of sales per day $\therefore Y \sim \text{Po}(\frac{4}{3})$ $P(Y > 2) = 1 - P(Y \leq 2)$ $= 1 - e^{-\frac{4}{3}}(1 + \frac{4}{3} + \frac{(\frac{4}{3})^2}{2})$ $= 1 - 0.8494 = 0.1506$ (4sf)	M1 M1 M1 A1 A1	
	(c)	$P(X \leq 12) = 0.9362; P(X \leq 13) = 0.9658$ \therefore need 13 in stock	M1 A1 A1	(10)

5. (a) $13 \times \frac{1}{90} = \frac{13}{90}$ or 0.1444 (4sf) M1 A1
- (b) $P(44.5^\circ \text{ to } 45.5^\circ) \therefore \frac{1}{90}$ M1 A1
- (c) $P(< 10^\circ) = 10 \times \frac{1}{90} = \frac{1}{9}$ A1
 let $X = \text{no. of times } < 10^\circ \therefore X \sim B(10, \frac{1}{9})$ M1
 $P(X > 2) = 1 - P(X \leq 2)$ M1
 $= 1 - [(\frac{8}{9})^{10} + 10(\frac{1}{9})(\frac{8}{9})^9 + \frac{10 \times 9}{2}(\frac{1}{9})^2(\frac{8}{9})^8]$ M1 A1
 $= 1 - 0.9094 = 0.0906$ (3sf) A1 (10)
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6. (a) let $X = \text{no. absent per lesson} \therefore X \sim \text{Po}(2.5)$
 $P(X \geq 6) = 1 - P(X \leq 5) = 1 - 0.9580 = 0.0420$ M1 A1
- (b) assumes absences occur independently and at constant rate
 ill students may infect others and rate may vary at different times
 of year but assumptions fairly reasonable B3
- (c) registers for all classes B1
- (d) let $Y = \text{no. absent per 30 lessons} \therefore Y \sim \text{Po}(75)$ M1
 use N approx. $A \sim N(75, 75)$ M1
 $P(Y \geq 96) \approx P(A > 95.5)$ M1
 $= P(Z > \frac{95.5 - 75}{\sqrt{75}}) = P(Z > 2.367)$ A1
 $= 1 - 0.9909 = 0.0091$ A1
 less than 5% \therefore significant, there is evidence of more absent per lesson A1 (12)
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7. (a) $\int_0^3 k(t-3)^2 dt = 1$ M1
 $k \int_0^3 t^2 - 6t + 9 dt = 1$ M1
 $\therefore k[\frac{1}{3}t^3 - 3t^2 + 9t]_0^3 = 1$ A1
 $\therefore k[(9 - 27 + 27) - (0)] = 1; 9k = 1; k = \frac{1}{9}$ M1 A1
- (b)  B3
- (c) $E(T) = \int_0^3 t \times \frac{1}{9}(t-3)^2 dt = \frac{1}{9} \int_0^3 t^3 - 6t^2 + 9t dt$ M1
 $= \frac{1}{9} [\frac{1}{4}t^4 - 2t^3 + \frac{9}{2}t^2]_0^3$ A1
 $= \frac{1}{9} [(\frac{81}{4} - 54 + \frac{81}{2}) - (0)] = \frac{3}{4}$ M1 A1
 $\therefore \text{mean time} = \frac{3}{4} \times 10 = 7.5 \text{ s}$ A1
- (d) $E(S) = \int_0^2 s \times \frac{1}{12}(8-s^3) ds = \frac{1}{12} \int_0^2 8s - s^4 ds$ M1
 $= \frac{1}{12} [4s^2 + \frac{1}{5}s^5]_0^2$ A1
 $= \frac{1}{12} [(16 - \frac{32}{5}) - (0)] = \frac{4}{5}$ M1 A1
 $\therefore \text{new mean} = \frac{4}{5} \times 10 = 8 \text{ s} \therefore \text{increased by } 0.5 \text{ s}$ A1 (18)
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Total (75)

Performance Record – S2 Paper D

Question no.	1	2	3	4	5	6	7	Total
Topic(s)	c.d.f., p.d.f.	modelling	binomial, hyp. test	Poisson	rect. dist., binomial	Poisson, hyp. test., sampling, N approx.	p.d.f., mean	
Marks	7	9	9	10	10	12	18	75
Student								