GCE Examinations

Advanced Subsidiary / Advanced Level

Statistics
Module S2

Paper A

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

S2 Paper A – Marking Guide

1. *(a)* median = 125 m — A1

IQR = middle half = 25 m (or 137.5 – 112.5) — M1 A1

(b) e.g. likely to have higher prob. dens. near median and some values more than 25 m away from median — B2 **(5)**

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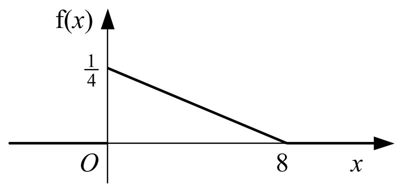
2. *(a)* $= 1 - \text{F}(5) = 1 - \frac{1}{64}(80 - 25) = \frac{9}{64}$ — M1 A1

(b) $\text{f}(x) = \text{F}'(x) = \frac{1}{64}(16 - 2x)$ — M1 A1

$\therefore \text{f}(x) = \begin{cases} \frac{1}{32}(8 - x), & 0 \le x \le 8, \\ 0, & \text{otherwise.} \end{cases}$ — A1

(c)



B3 **(8)**

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3. *(a)* e.g. requests for repairs likely to occur singly, at random and at a constant rate — B3

$\lambda = \frac{180}{40} = 4.5$ — A1

(b) let X = no. of repairs per day $\therefore X \sim \text{Po}(4.5)$

(i) $\text{P}(X = 0) = 0.0111$ — A1

(ii) $\text{P}(X > 6) = 1 - \text{P}(X \le 6) = 1 - 0.8311 = 0.1689$ — M1 A1

(c) let Y = no. of days he repairs more than 6 $\therefore Y \sim \text{B}(10, 0.1689)$ — M1

$\text{P}(Y = 3) = {}^{10}\text{C}_3(0.1689)^3(0.8311)^7 = 0.158$ (3sf) — M1 A1 **(10)**

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4. *(a)* e.g. quicker; may not be able to get all pupils to respond — B2

(b) school roll — B1

(c) let X = no. of students who play tennis $\therefore X \sim \text{B}(120, \frac{1}{20})$ — M1

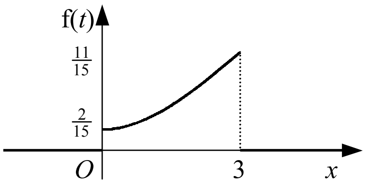
$\text{H}_0 : p = \frac{1}{20} \quad \text{H}_1 : p \ne \frac{1}{20}$ — B1

Using Po approx. $X \approx\sim \text{Po}(6)$ — M1

$\text{P}(X \le 2) = 0.0620;\ \text{P}(X \le 10) = 0.9574$ — M1 A1

$\therefore$ C.R. is $X \le 2$ or $X \ge 11$ — A1

(d) $0.0620 + 0.0426 = 0.1046$ — A1 **(10)**

5.	*(a)*	let X = no. out of 10 shares that have gone up $\therefore X \sim B(10, 0.35)$	M1	
		(i) $P(X = 6) = 0.9740 - 0.9051 = 0.0689$	M1 A1	
		(ii) $P(> 5 \text{ gone down}) = P(X \leq 4) = 0.7515$	M1 A1	
	(b)	let Y = no. out of 80 shares that have gone down $\therefore Y \sim B(80, 0.65)$	M1	
		N approx. $D \sim N(52, 18.2)$	M1 A1	
		$P(Y > 55) \approx P(D > 55.5)$	M1	
		$= P(Z > \frac{55.5 - 52}{\sqrt{18.2}}) = P(Z > 0.82)$	A1	
		$= 1 - 0.7939 = 0.2061$	A1	**(11)**
6.	*(a)*	Poisson with $\lambda = 4$	B1	
	(b)	e.g. more people shopping $\therefore$ probably sell more so λ higher	B1	
	(c)	(i) let X = no. of sales per hour $\therefore X \sim Po(4)$		
		$P(X > 4) = 1 - P(X \leq 4) = 1 - 0.6288 = 0.3712$	M1 A1	
		(ii) let Y = no. of sales per half-hour $\therefore Y \sim Po(2)$	M1	
		$P(Y = 0) = 0.1353$	A1	
		(iii) $(0.3712)^3 = 0.0511$ (3sf)	M1 A1	
	(d)	$H_0 : \lambda = 4 \quad H_1 : \lambda > 4$	B1	
		$P(X \geq 7) = 1 - P(X \leq 6) = 1 - 0.8893 = 0.1107$	M1 A1	
		more than 5% $\therefore$ not significant, insufficient evidence of increase	A1	**(12)**
7.	*(a)*	$\int_0^3 k(t^2 + 2)\ dt = 1$	M1	
		$\therefore k[\frac{1}{3}t^3 + 2t]_0^3 = 1$	A1	
		$\therefore k[(9 + 6) - (0)] = 1;\ 15k = 1;\ k = \frac{1}{15}$	M1 A1	
	(b)		B3	
	(c)	3	A1	
	(d)	$E(T) = \int_0^3 t \times \frac{1}{15}(t^2 + 2)\ dt = \frac{1}{15}\int_0^3 t^3 + 2t\ dt$	M1	
		$= \frac{1}{15}[\frac{1}{4}t^4 + t^2]_0^3$	M1 A1	
		$= \frac{1}{15}[(\frac{81}{4} + 9) - (0)] = \frac{39}{20}$ or 1.95	M1 A1	
	(e)	$E(T^2) = \int_0^3 t^2 \times \frac{1}{15}(t^2 + 2)\ dt = \frac{1}{15}\int_0^3 t^4 + 2t^2\ dt$	M1	
		$= \frac{1}{15}[\frac{1}{5}t^5 + \frac{2}{3}t^3]_0^3$	A1	
		$= \frac{1}{15}[(\frac{243}{5} + 18) - (0)] = \frac{111}{25}$	M1 A1	
		$Var(T) = \frac{111}{25} - (\frac{39}{20})^2 = \frac{255}{400} = \frac{51}{80} = 0.6375$	M1	
		$\therefore$ std. dev $= \sqrt{0.6375} = 0.798$ (3sf)	A1	**(19)**
			Total	**(75)**

Performance Record – S2 Paper A

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	Total
Topic(s)	rect. dist.	c.d.f., p.d.f.	Poisson, binomial	sampling, Po appr. to binomial, hyp. test	binomial, N approx.	Poisson, hyp. test	p.d.f., mode, mean, variance	
Marks	5	8	10	10	11	12	19	75
Student								