GCE Examinations

Advanced Subsidiary / Advanced Level

Statistics

Module S2

Paper E

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.

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S2 Paper E – Marking Guide

1. *(a)* advantage – e.g. more accurate — B1
disadvantage – e.g. takes longer — B1

(b) e.g. getting views of shop staff on changing opening hours
as small no. involved and will affect all so need views of all — B2 **(4)**

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2. *(a)* let X = no. of bags in F.P. with scratchcard $\therefore X \sim \text{B}(10, \frac{1}{10})$ — M1
$\text{P}(X = 0) = 0.3487$ — A1

(b) $\text{P}(X > 2) = 1 - \text{P}(X \leq 2) = 1 - 0.9298 = 0.0702$ — M1 A1

(c) let Y = no. of bags in box with scratchcard $\therefore Y \sim \text{B}(50, \frac{1}{10})$ — M1
$\text{H}_0 : p = \frac{1}{10}$ $\text{H}_1 : p < \frac{1}{10}$ — B1
$\text{P}(X \leq 2) = 0.1117$ — M1
more than 10% $\therefore$ not significant, insufficient evidence of lower prop^n — A1 **(8)**

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3. *(a)* continuous uniform — B1

(b) $\text{F}(t) = \int_{-4}^{t} \frac{1}{8} \, \text{d}x$ — M1
$= \frac{1}{8}[x]_{-4}^{t} = \frac{1}{8}(t + 4)$ — M1 A1
$$\text{F}(x) = \begin{cases} 0, & x < -4, \\ \frac{1}{8}(x + 4), & -4 \leq x \leq 4, \\ 1, & x > 4. \end{cases}$$ — A1

(c) $= \text{P}(-1.5 \leq x \leq 1.5)$ — M1
$= 3 \times \frac{1}{8} = \frac{3}{8}$ — M1 A1

(d) e.g. gives zero prob. of more than 4 cm error and doesn't suggest
higher prob. density near 0 as would be likely — B2 **(10)**

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4. *(a)* binomial, $n = 10$, $p = \frac{1}{2}$ — B2

(b) p would vary — B1

(c) (i) let X = no. of blue beads $\therefore X \sim \text{B}(10, \frac{1}{2})$
$\text{P}(X = 5) = 0.6230 - 0.3770 = 0.2460$ [0.2461 (4sf) using ${}^{10}\text{C}_5$..] — M1 A1
(ii) let Y = no. of red beads $\therefore Y \sim \text{B}(10, \frac{1}{8})$ — M1
$\text{P}(X > 0) = 1 - \text{P}(X = 0)$ — M1
$= 1 - (\frac{7}{8})^{10} = 0.7369$ (4sf) — M1 A1

(d) let R = no. of red beads in n picks $\therefore R \sim \text{B}(n, \frac{1}{8})$
$\text{P}(R > 0) > 0.99$ $\therefore \text{P}(R = 0) < 0.01$ $\therefore (\frac{7}{8})^n < \frac{1}{100}$ — M2 A1 **(12)**

5.	*(a)*	let X = no. of donations over £10000 per year $\therefore X \sim \text{Po}(25)$	M1	
		$\text{P}(X = 30) = \frac{e^{-25} \times 25^{30}}{30!} = 0.0454$ (3sf)	M1 A1	
	(b)	let Y = no. of donations over £10000 per month $\therefore Y \sim \text{Po}(\frac{25}{12})$	M1	
		$\text{P}(Y < 3) = \text{P}(Y \le 2)$	M1	
		$= e^{-\frac{25}{12}}(1 + \frac{25}{12} + \frac{(\frac{25}{12})^2}{2})$	M1 A1	
		$= 0.6541$ (4sf)	A1	
	(c)	let D = no. of donations over £10000 per 2 years $\therefore D \sim \text{Po}(50)$	M1	
		N approx. $E \sim \text{N}(50, 50)$	M1	
		$\text{P}(D > 45) \approx \text{P}(E > 45.5)$	M1	
		$= \text{P}(Z > \frac{45.5 - 50}{\sqrt{50}}) = \text{P}(Z > -0.64)$	A1	
		$= 0.7389$	A1	**(13)**
6.	*(a)*	$= \text{P}(T > 2) = 1 - \text{F}(2)$	M1	
		$= 1 - \frac{1}{135}(108 + 36 - 32) = \frac{23}{135}$	M1 A1	
	(b)	$\text{F}(m) = \frac{1}{2}$	M1	
		$\text{F}(1.1) = 0.4812$; $\text{F}(1.2) = 0.5248$	M1	
		$\therefore 1.1 < m < 1.2$ $\therefore$ median between 11 and 12 minutes	A1	
	(c)	$\text{f}(t) = \text{F}'(t) = \frac{1}{135}(54 + 18t - 12t^2)$	M1 A1	
		$\text{f}(t) = \begin{cases} \frac{2}{45}(9 + 3t - 2t^2), & 0 \le t \le 3, \\ 0, & \text{otherwise.} \end{cases}$	A1	
	(d)	$\text{f}'(t) = \frac{2}{45}(3 - 4t)$	M1	
		S.P. when $\text{f}'(t) = 0$ $\therefore t = \frac{3}{4}$	M1	
		some justification e.g. –ve quadratic $\therefore$ mode $= \frac{3}{4} \times 10 = 7.5$ mins	M1 A1	
	(e)	e.g. assumes patients never wait for more than 30 mins	B1	**(14)**
7.	*(a)*	Poisson	B1	
		e.g. reasonable to suggest bicycles passing will occur singly, at random and at constant rate	B2	
	(b)	$n = 36$, $\Sigma fx = 54$, $\therefore$ mean $= \frac{54}{36} = 1.5$	M1 A1	
		$\Sigma fx^2 = 0 + 14 + 40 + 18 + 16 + 50 = 138$	A1	
		variance $= \frac{138}{36} - 1.5^2 = 1.58$ (3sf)	M1 A1	
		values support Poisson as expect mean ≈ variance	B1	
	(c)	let X = no. of bicycles passing per 30-mins $\therefore X \sim \text{Po}(9)$	M1	
		$H_0 : \lambda = 9$ $H_1 : \lambda > 9$	B1	
		$\text{P}(X \ge 16) = 1 - \text{P}(X \le 15)$	M1	
		$= 1 - 0.9780 = 0.0220$	A1	
		less than 5% $\therefore$ significant, evidence of more bicycles	A1	**(14)**
			Total	**(75)**

Performance Record – S2 Paper E

Question no.	1	2	3	4	5	6	7	Total
Topic(s)	sampling	binomial, hyp. test	rect. dist., c.d.f.	binomial	Poisson, N approx.	c.d.f., median, p.d.f., mode	Poisson, hyp. test.	
Marks	4	8	10	12	13	14	14	75
Student								