GCE Examinations

Advanced Subsidiary / Advanced Level

Statistics

Module S2

Paper B

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 B – Marking Guide

1. *(a)* e.g. list of all the sampling units — B1

(b) (i) frame – list of cars serviced at garage — B1
units – individual cars — B1
(ii) frame – list of people involved in trial — B1
units – individual people — B1 **(5)**

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2. *(a)* Poisson (with $\lambda = 4.2$) — B1

(b) (i) e.g. may be more or less species that like nuts — B1
(ii) e.g. will last longer so may get more species visiting — B1

(c) let X = no. of species that visit $\therefore X \sim \text{Po}(4.2)$
$P(X = 6) = \frac{e^{-4.2} \times 4.2^6}{6!} = 0.1143$ (4sf) — M1 A1

(d) $P(X > 2) = 1 - P(X \leq 2)$ — M1
$= 1 - e^{-4.2}(1 + 4.2 + \frac{4.2^2}{2})$ — M1 A1
$= 1 - 0.2102 = 0.7898$ (4sf) — A1 **(9)**

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3. *(a)* $1.6 \times \frac{1}{20} = 0.08$ — M1 A1

(b) mean = 10 — A1
variance $= \frac{1}{12}(20 - 0)^2 = \frac{100}{3}$ — M1 A1

(c) $= P(X \text{ in middle 4 cm}) \times P(Y \text{ in middle 4 cm})$ — M1
$= (4 \times \frac{1}{20}) \times (4 \times \frac{1}{16})$ — M1 A1
$= \frac{1}{5} \times \frac{1}{4} = \frac{1}{20}$ — A1

(d) $= 1 - [P(X \text{ in middle 16 cm}) \times P(Y \text{ in middle 12 cm})]$ — M1 A1
$= 1 - [(16 \times \frac{1}{20}) \times (12 \times \frac{1}{16})]$ — M1
$= 1 - (\frac{4}{5} \times \frac{3}{4}) = 1 - \frac{3}{5} = \frac{2}{5}$ — A1 **(13)**

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4. *(a)* let X = no. of failures per hour $\therefore X \sim \text{Po}(3)$
$P(X = 0) = 0.0498$ — A1

(b) let Y = no. of failures per half-hour $\therefore Y \sim \text{Po}(1.5)$ — M1
$P(Y > 4) = 1 - P(Y \leq 4) = 1 - 0.9814 = 0.0186$ — M1 A1

(c) let F = no. of failures per 24 hrs $\therefore F \sim \text{Po}(72)$ — M1
N approx. $G \sim \text{N}(72, 72)$ — M1
$P(F < 60) \approx P(G < 59.5)$ — M1
$= P(Z < \frac{59.5 - 72}{\sqrt{72}}) = P(Z < \bar{}1.47)$ — A1
$= 1 - 0.9292 = 0.0708$ — A1

(d) $P(F = 72) \approx P(71.5 < G < 72.5)$ — M1
$= P(Z < \frac{72.5 - 72}{\sqrt{72}}) - P(Z < \frac{71.5 - 72}{\sqrt{72}})$ — M1
$= P(Z < 0.06) - P(Z < \bar{}0.06)$ — A1
$= 0.5239 - 0.4761 = 0.0478$ — A1 **(13)**

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5. *(a)* let X = no. of dice showing 6 $\therefore X \sim B(6, \frac{1}{6})$ M1

$P(X = 0) = (\frac{5}{6})^6 = 0.3349$ (4sf) M1 A1

(b) $P(X > 1) = 1 - P(X \leq 1)$ M1

$= 1 - [(\frac{5}{6})^6 + 6(\frac{1}{6})(\frac{5}{6})^5]$ M1 A1

$= 1 - 0.7368 = 0.2632$ (4sf) A1

(c) let Y = no. of dice showing odd $\therefore Y \sim B(6, \frac{1}{2})$ M1

$P(Y = 3) = 0.6563 - 0.3438 = 0.3125$ M1 A1

(d) let S = no. of times it shows a 6 $\therefore S \sim B(8, \frac{1}{6})$ M1

$H_0 : p = \frac{1}{6}$ $H_1 : p > \frac{1}{6}$ B1

$P(S \geq 3) = 1 - P(S \leq 2)$ M1

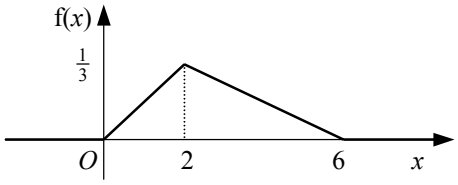
$= 1 - [(\frac{5}{6})^8 + 8(\frac{1}{6})(\frac{5}{6})^7 + \frac{8\times7}{2}(\frac{1}{6})^2(\frac{5}{6})^6]$ M1 A1

$= 1 - 0.8652 = 0.1348$ A1

more than 5% $\therefore$ not significant, insufficient evidence of bias A1 **(17)**

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6. *(a)*



B4

(b) 2 A1

(c) 0 to 2: $F(t) = \int_0^t \frac{1}{6}x \, dx$ M1

$= [\frac{1}{12}x^2]_0^t = \frac{1}{12}t^2$ M1 A1

2 to 6: $F(t) = \frac{1}{2}\times2\times\frac{1}{3} + \int_2^t \frac{1}{12}(6 - x) \, dx$ M1

$= \frac{1}{3} + \frac{1}{12}[6x - \frac{1}{2}x^2]_2^t$ M1 A1

$= \frac{1}{3} + \frac{1}{12}[(6t - \frac{1}{2}t^2) - (12 - 2)]$ M1

$= \frac{1}{24}(12t - t^2 - 12)$ A1

$\therefore F(x) = \begin{cases} 0, & x < 0, \\ \frac{1}{12}x^2 & 0 \leq x \leq 2, \\ \frac{1}{24}(12x - x^2 - 12) & 2 \leq x \leq 6, \\ 1, & x > 6. \end{cases}$ A1

(d) $\frac{1}{24}(12m - m^2 - 12) = \frac{1}{2}$ M1

$m^2 - 12m + 24 = 0$ A1

$m = 2.536$ or 9.464; $2 \leq m \leq 6$ $\therefore$ median = 2.536 (4sf) M1 A1 **(18)**

Total **(75)**

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Performance Record – S2 Paper B

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	Total
Topic(s)	sampling	Poisson	rect. dist.	Poisson, N approx.	binomial, hyp. test	p.d.f., mode, c.d.f., median	
Marks	5	9	13	13	17	18	75
Student							

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