

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.



Written by Shaun Armstrong & Chris Huffer

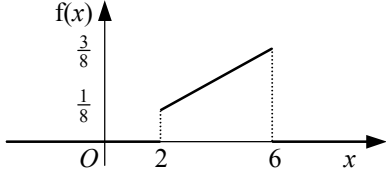
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S2 Paper F – Marking Guide

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

5. (a) binomial, $n = 4, p = \frac{1}{2}$ B2
 fixed no. of coins flipped, 2 outcomes, p fixed B2
- (b) $H \sim B(4, \frac{1}{2})$
 $P(\text{more heads}) = P(H \geq 3)$ 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) $P(\text{head}) : P(\text{tail}) = 1.5 : 1 = 3 : 2 \therefore P(\text{head}) = \frac{3}{5}$ 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)

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

Total (75)

