

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.



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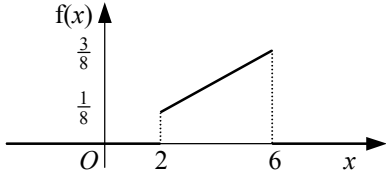
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## S2 Paper F – Marking Guide

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

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  $X = \text{no. of times get more heads} \therefore X \sim B(5, \frac{5}{16})$  M1  
 $H_0 : p = \frac{5}{16} \quad H_1 : p > \frac{5}{16}$  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)

