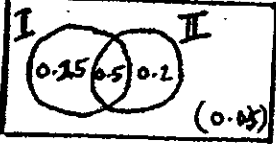


Question Number	Scheme	Marks
1 (a)	$M'_x(t) = 13 + 198t + (1731t^2 + \dots)$ $E(x) = M'_x(0) = \underline{13}$	M' and t=0 13 AI (2)
1 (b)	$M''_x(t) = 198 + (3462t) + \dots$ $\text{Var}(x) = M''_x(0) - [M'_x(0)]^2$ $= 198 - 169 = \underline{29}$	M'' Formula and t=0 29 AI (3)
		Total (5)
2 (a)	 <p>Method for 0.25 & 0.2 Both correct</p> $P(\text{Pass Exam}) = 0.5 + 0.6 \times 0.25 + 0.4 \times 0.2$ $= 0.5 + 0.15 + 0.08$ $= \underline{0.73}$	MI AI MI, MIAI AI (6)
2 (b)	$P(\text{Fail I or Fail II} \text{Pass Exam}) = \frac{0.15 + 0.08}{0.73} = \frac{23}{73} \text{ or } \frac{\text{AWRT}}{0.315}$	AI MI AI (4)
		Total (10)
3 (a)	$G(1) = 1 \Rightarrow k [1 \times 5 + 2^4] = 1 \text{ i.e. } k = \frac{1}{21} \text{ (*)}$	MIAI (2)
3 (b)	$E(x) = G'_x(1)$ $G'_x(t) = k [6t^2 + 12t^3 + 4(1+t)^3]$ $G'_x(1) = k [6 + 12 + 4 \times 8]$ $\therefore E(x) = \frac{50}{21} \text{ or } 2\frac{8}{21} \text{ or } 2.38 \text{ (AWRT)}$	G'_x(t) G'_x(1) AI (3)
3 (c)	$G''_x(t) = k [12t + 36t^2 + 12(1+t)^2]$ $G''_x(1) = 96k$ $\text{Var}(x) = G''_x(1) + G'_x(1) - G'_x(1)^2$ $= \frac{96}{21} + \frac{50}{21} - \frac{2500}{21^2} = \frac{566}{441} \text{ or } 1.28 \text{ (AWRT)}$	G''_x(1) MI MI MI AI (4)
3 (d)	$P(X=3) = \text{coefficient of } t^3 \text{ in expansion of } G_x(t)$ $= k [2 + \binom{4}{3}] = \frac{6}{21} = \frac{2}{7} \text{ or } \underline{0.286}$	MI, AI Total (11)

Question Number	Scheme	Marks
4 (a)	$X = \text{no. of coughs in next 5 minutes} \quad X \sim P_0(2) \text{ Implied}$ $P(X=3) = \frac{e^{-2} 2^3}{3!} = 0.1804 \dots = \underline{0.180 \text{ or } 0.18 \text{ or } 0.1804}$	M1 A1 (2)
4 (b)	$T = \text{time between coughs} \quad T \sim \text{Exp}(2/5) \text{ Implied}$ $P(2 < T < 3) = \int_2^3 \frac{2}{5} e^{-\frac{2}{5}t} dt$ $= \left[-e^{-\frac{2}{5}t} \right]_2^3 = e^{-\frac{4}{5}} - e^{-\frac{6}{5}} = \underline{0.148}$ (or 0.15 or 0.148)	M1, A1 (3)
4 (c)	$(b)^2 = 0.02194 \dots = \underline{0.022 \text{ or } 0.0219}$	M1, A1 (2)
4 (d)	Probability is small so <u>unlikely coughs at random</u> or suggests <u>there is some ground for the accusation</u>	B1 (1)
Total 8		
5 (a)	$M_X(t) = \frac{1/2}{1/2 - t} \quad \text{or} \quad \frac{1}{1-2t}$	B1 (1)
5 (b)	$M_Y(t) = M_{X_1}(t) \cdot M_{X_2}(t) \dots M_{X_n}(t)$ $= \left(\frac{1}{1-2t} \right)^4 \quad \text{o.e.}$	M1 A1 (2)
5 (c)	$M_Y(t) = \frac{1}{(1-2t)^4}$ is same form as $M_C(t) \therefore Y \sim \chi^2$ $\nu = 2n, \quad n=4 \quad \therefore \underline{\nu=8}$	B1 B1 (2)
5 (d)	Time to leave store $\sim \chi^2_8 \quad P(\chi^2_8 < 3.5) = 1 - 0.90 = \underline{0.10}$	B1 (1)
5 (e)	$P(\chi^2_8 > 20) = P(\chi^2_8 > 20.090) = 0.010 \therefore \underline{0.01}$	B1 (1)
Total 7		

6(a)	$X = \text{no. of spin when 1st red occurs}$ $X \sim \text{Geo}(0.4)$ $P(X \leq 7) = 1 - P(X > 7) = 1 - (0.6)^7 = 0.972 \text{ ap } \textcircled{*}$	M1 M1, A1 (3)
(b)	$Y = \text{no. of reds in 7 spins}$ $Y \sim \text{Bin}(7, 0.4)$ Implied $P(Y=3) = \binom{7}{3} (0.4)^3 (0.6)^4 \text{ (or Tables)} = 0.2903 \text{ or } 0.290 \text{ or } 0.29$	M1 A1 (2)
(c)	$R = \text{no. of spin on which 3rd red occurs}$ $R \sim \text{Neg Bin}(0.4, 3)$ Implied $P(R=7) = \binom{6}{2} (0.4)^2 (0.6)^4 \times 0.4 = 0.1244 \text{ or } 0.124$	M1 M1, A1 (3)
(d)	$P(R \leq 7) = (c) + P(R=6) + P(R=5) + P(R=4) + P(R=3)$ $= (0.4)^3 [15 \times (0.6)^4 + 10 \times (0.6)^3 + 6 \times (0.6)^2 + 3 \times 0.6 + 1]$ $= 0.580096 \dots = 0.58 \text{ or } 0.580 \text{ or } 0.5801$	M1 M1, A1 A1 (4)
(e)	$P(\text{A wins}) = 0.4 + (0.6)^3 \times 0.4 + (0.6)^6 \times 0.4 + \dots$ i.e. G.P. $= \frac{0.4}{1 - (0.6)^3} = 0.510 \text{ or } 0.51 \text{ or } 0.5102$ Use of Sum formula	M1 M1, A1 (3)
(f)	$P(\text{A wins} X \leq 7) = \frac{(0.4 + (0.6)^3 \times 0.4 + (0.6)^6 \times 0.4)}{(a)} = 0.5196 \text{ or } 0.520$	M1, A1 Total (17) (2)
7(a)	$X \sim B(10, p)$. $P(\text{Accept}) = P(X \leq 1) + P(X=2) \times P(X=0)$	M1
(i)	$p = 0.10 \Rightarrow P(\text{Accept}) = 0.7361 + (0.9298 - 0.7361) \times 0.3487 = 0.804$	A1
(ii)	$p = 0.15 \Rightarrow P(\text{Accept}) = 0.5443 + (0.8202 - 0.5443) \times 0.1969 = 0.599$	M1, A1 (4)
(b)	Expected proportion accepted is $P(\text{Accept}) \times p$ $= 0.08036 \dots$ (ii) $= 0.0897 \dots$ (both < 9%)	M1 A1, A1 (3)
(c)	Expected no. sampled is: $20 \times P(X=2) + 10 [1 - P(X=2)]$ $p = 0.10 \Rightarrow = 20 [0.9298 - 0.7361] + 10 [0.8063] = 11.937 \approx 12$	M1 A1, CSO (2)
(d)	$Y = \text{no. of defectives}$. $Y \sim B(12, 0.10)$. Require $P(Y \leq c) < 0.90$ $P(Y \leq 3) = 0.9744$, $P(Y \leq 2) = 0.8891$, Accept if $Y \leq 2$	B1, B1 (2)
(e)	$P(\text{Acceptance}) = 0.7358$, \therefore proportion accepted = $0.11 \dots \approx 11\%$	M1, A1 (2)
(f) (i)	$p = 0.10$ $P(\text{acceptance})$ using single scheme is greater than double scheme So use of double scheme a disadvantage cao	M1 (cf above) A1
	$p = 0.15$ Expected proportion accepted using single scheme is > 9% So use of double scheme is an advantage cao	M1 (cf above) A1 Total (17) (4)