GUÍA 6

C YN

6.1) $P(\text{"disco defectuoso"}) = 0{,}01$

$\{X_i = 1\} =$ "el disco es defectuoso" $X_i \sim Be(0{,}01)$

$Y =$ "cantidad de éxitos en 10 ensayos" $Y \sim Bi(10; 0{,}01)$

$P(Y>1) = 1 - P(Y\le 1) = 1 - P(Y=0) - P(Y=1) = 1 - \binom{10}{0}(0{,}01)^0 (1$
$-\binom{10}{1}(0{,}01)^1(1-0{,}01)^9 = 1 - \left(\frac{99}{100}\right)^{10} - \frac{1}{10}\left(\frac{99}{100}\right)^9 = 4{,}2662\,10^{-3}$

$W =$ "cantidad de paquetes devueltos de 3"

$W \sim Bi(3, p)$ $p = P(Y>1) = 4{,}2662\,10^{-3}$

$P(W=1) = \binom{3}{1}(4{,}2662\,10^{-3})^1(1-4{,}2662\,10^{-3})^2 = 1{,}27\,10^{-3}$

6.2) $\{X_i = 1\} =$ "el tirador dió en el blanco" $Be(p)$

$Y =$ "cantidad de blancos en 3 tiros" $\sim Bi(3, p)$

$Z =$ "cantidad de blancos en 5 tiros" $\sim Bi(5, p)$

$P(Y\ge 2) > P(Z\ge 3)$

$P(Y\ge 2) = 1 - P(Y<2) = 1 - P(Y=0) - P(Y=1) = 1 - \binom{3}{0}p^0(1$
$-\binom{3}{1}p^1(1-p)^2 = 1 - (1-p)^3 - 3p(1-p)^2 = 1 - (1-2p+p^2)(1-$
$-3p(1-2p+p^2) = \cancel{1} - (\cancel{1} - p - 2p + 2p^2 + p^2 - p^3) - 3p + 6p^2 -$
$3p^3 = \cancel{p} + \cancel{2p} - 2p^2 - p^2 + p^3 - \cancel{3p} + 6p^2 - 3p^3 = -2p^3 + 3p^2$

$P(Z\ge 3) = 1 - P(Z<3) = 1 - P(Z=0) - P(Z=1) - P(Z=2) =$
$\binom{5}{0}p^0(1-p)^5 - \binom{5}{1}p(1-p)^4 - \binom{5}{2}p^2(1-p)^2 = 1 - (1-p)^5 -$
$5p(1-p)^2(1-p)^2 - 10p^2(1-2p+p^2) = 1 - (1-p)(1-p)^4 -$
$5p(1-2p+p^2)(1-2p+p^2) - 10p^2 + 20p^3 - 10p^4 = 1 - (1-p$
$(1-p)^4 - 5p(1-2p+p^2-2p+4p^2-2p^3+p^2-2p^3+p^4) - 10p^2+$
$p^3 - 10p^4 = 1 - (1-p)(1-4p+6p^2-4p^3+p^4) - 5p + 20p^2 - 30p^3$
$+20p^4 - 5p^5 - 10p^2 + 20p^3 - 10p^4 = 1 - (1-4p+6p^2-4p^3+p^4-p+$
$4p^2-6p^3+4p^4-p^5) - 5p + 10p^2 - 10p^3 + 10p^4 - 5p^5 = \cancel{5p} - \cancel{10p^2}$
$+\cancel{10p^3} - 5p^4 + p^5 - \cancel{5p} + \cancel{10p^2} - \cancel{10p^3} + 10p^4 - 5p^5 = 5p^4 - 4p^5$

$$-2p^3+3p^2 > 5p^4-4p^5$$
$$\cancel{p^2}(-2p+3) > \cancel{p^2}(5p^2-4p^3)$$
$$4p^3-5p^2-2p+3>0$$
$$4\left(p^3-\frac{5}{4}p^2-\frac{1}{2}p+\frac{3}{4}\right)>0 \Rightarrow$$

6.3) a) P("13 caras") = P(C = 13)

C = "cantidad de caras en 18 tiros" $\sim Bi(18, 1/2)$

$$P(C=13)=\binom{18}{13}\left(\frac{1}{2}\right)^{13}\left(1-\frac{1}{2}\right)^{18-13}=\frac{1071}{32768}\simeq 0{,}03268$$

b) Modo = $\{x / P(X=x)$ es máx$\}$ = 9

6.4) $\{X_i = 1\}$ = "el pasajero no se presenta" $X_i \sim Be(0{,}04)$

Y = "cantidad de ausentes en las reservas" $Y \sim Bi(100, 0{,}04)$

$$P(Y\geq 2)=1-P(Y<2)=1-P(Y=0)-P(Y=1)=1-\binom{100}{0}(0{,}04)^0(0{,}96)^{100}-\binom{100}{1}0{,}04(0{,}$$
$$=1-0{,}01687-0{,}070293=0{,}912837$$

6.5) X_i = "sale 5" $X_i \sim Be(1/6)$ $\Rightarrow P(Y\geq 2)=0{,}9128$

$\bar{X}$ = "cant. de 5 en n tiros" $\bar{X}=\sum_{i=1}^{n}\frac{X_i}{n}$

$$P\left(\left|\bar{X}-\frac{1}{6}\right|\leq 0{,}01\right)\geq 0{,}95$$
$$P\left(\left|\bar{X}-\frac{1}{6}\right|>\underbrace{0{,}01}_{K}\right)<\underbrace{0{,}05}_{\frac{V(\bar{X})}{K^2}}$$

$$E(\bar{X})=\frac{1}{n}\sum_{i=1}^{n}(X_i)=\frac{1}{n}\frac{1}{6}n=\frac{1}{6}$$

$$Var(\bar{X})=V\left(\frac{\sum X_i}{n}\right)=\frac{1}{n^2}V\left(\sum X_i\right)=\frac{1}{n^2}\sum_{i=1}^{n}V(X_i)=\frac{5}{n36}$$

$$V(\bar{X})=\frac{5}{36n}<0{,}05\,(0{,}01)^2 \Rightarrow n>27777{,}7$$

6.6) X = "cantidad de tiros hasta el 1er dos"

$X\sim Geo(1/6)$ $P(X>3)=1-P(X\leq 3)=1-P(X=1)-P(X=2)-$
$$P(X=3)=1-\left(\frac{5}{6}\right)^0\left(\frac{1}{6}\right)-\left(\frac{5}{6}\right)^1\frac{1}{6}-\left(\frac{5}{6}\right)^2\frac{1}{6}=\frac{125}{216}=\left(\frac{5}{6}\right)^3$$
$$P(X>6\mid X>3)=\frac{P(X>6, X>3)}{P(X>3)}=\frac{P(X>6)}{P(X>3)}=\frac{1-\frac{1}{6}-\frac{5}{36}-\frac{25}{216}-}{\left(\frac{5}{6}\right)^3}$$

$$\frac{\left(\frac{5}{6}\right)^4 \frac{1}{6} \cdot \left(\frac{5}{6}\right)^5 \frac{1}{6}}{} = \frac{\left(\frac{5}{9}\right)^6}{\left(\frac{5}{6}\right)^3}$$

$\Rightarrow P(X>6 \mid X>3) = \left(\frac{5}{6}\right)^3 = \frac{125}{216}$

6.7) $\{X_i = 1\}$ = "apareció el dígito 6" $\quad X_i \sim Be(1/10)$

X = "cant de ensayos $Be(1/10)$ hasta el 1er 6"

$X \sim Geo(1/10) \quad P(X=x) = \left(1 - \frac{1}{10}\right)^{x-1} \frac{1}{10} \geq 0{,}99$

$\left(\frac{9}{10}\right)^{x-1} \frac{1}{10} \geq 0{,}99 \Rightarrow \left(\frac{9}{10}\right)^{x-1} \geq 9{,}9$

$$\frac{\left(\frac{9}{10}\right)^x}{\left(\frac{9}{10}\right)} \geq 9{,}9 \Rightarrow \left(\frac{9}{10}\right)^x \geq 8{,}91 \Rightarrow x \ln\left(\frac{9}{10}\right) \geq \ln(8{,}91)$$

$$x \geq \frac{\ln(8{,}91)}{\ln(9/10)} \Rightarrow x \geq -20{,}76 \Rightarrow x \leq 20{,}76$$

6.9) X = "tiempo entre la campana esta encendida"

$X \sim exp(1/3) \quad E[X] = 3h$

N = "cant de intervalos / pulsos"

$N \sim Geo\left(1 - e^{-\frac{1}{3} \cdot 20}\right) \quad (\times 4.8)$

Y = "cant de veces que veo el 3"

$Y \mid N=n \sim Bi(n, 1/6) \quad E[Y \mid N=n] = \frac{n}{6} \Rightarrow E[Y \mid N] = \frac{N}{6}$

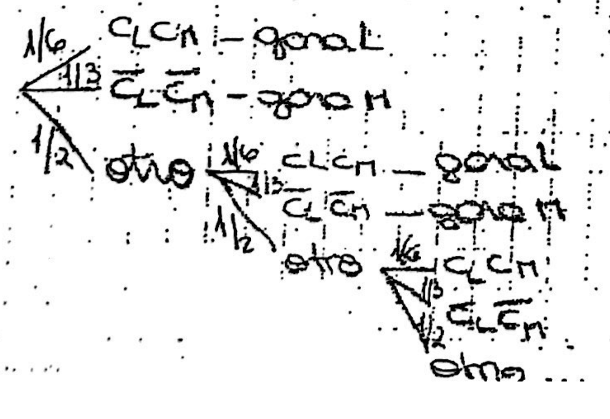
$$E[Y] = E[E[Y \mid N]] = E[N]\frac{1}{6} = \frac{1}{6}\left(\frac{1}{1-e^{-20/3}}\right) = \frac{1}{6} - \frac{1}{6}e^{20/3}$$

$$E[Y] = \frac{1}{6}\left(1 - e^{20/3}\right)$$

6.10) X_L: "cantidad de tiros hasta la 1^{era} $c_L c_M$" $\sim Geo(1/6)$

X_M: "cantidad de tiros hasta la 1^{era} $\bar{c}_L \bar{c}_M$" $\sim Geo(1/3)$

M = "la partida en que gana Monk"



$P(X_M < X_L) = P(\text{"gana Monk"}) =$

$$P\left(\bigcup_{m \in \mathbb{N}} \{M = m\}\right) \overset{\text{disjuntos}}{=} \sum_{m \in \mathbb{N}} P(M=m) =$$

$$\sum_{i=1}^{\infty} \left(\frac{1}{2}\right)^{m-1} \frac{1}{3} = \frac{1}{3} \sum \frac{(1/2)^m}{1/2} =$$

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$\frac{2}{3}\sum_{m=1}^{\infty}\left(\frac{1}{2}\right)^m = \frac{2}{3}\sum_{m=1}^{\infty}\frac{1}{2^m} = \frac{2}{3}\left(\frac{1}{1-1/2}-1\right) = \frac{2}{3}$

$\Rightarrow P(\text{"Gore Rock"}) = \frac{2}{3} = \frac{1/3}{1/6+1/3}$ (reducción de espacio)

6.11) N = "cant de chocolates que lucas debe comprar hasta completar la colección"

$N = 1 + N_2 + N_3 + N_4 + N_5$

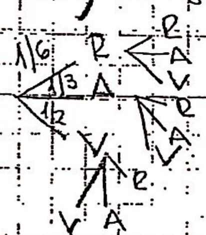
N_i = "cant de chocolates que debe comprar hasta encontrar el 1ero $\neq$ a los/el que tiene"

$N_2 \sim Geo(4/5)$; $N_3 \sim Geo(3/5)$; $N_4 \sim Geo(2/5)$, $N_5 \sim Geo(1/5)$

$E[N] = E[1+N_2+N_3+N_4+N_5] = 1 + E[N_2] + E[N_3] + E[N_4] + E[N_5] = 1 + \frac{5}{4} + \frac{5}{3} + \frac{5}{2} + 5 = \frac{137}{12} \approx 11{,}4\overset{\frown}{6}$

$Var[N] = Var[1+N_2+N_3+N_4+N_5] \underset{N_i \text{ indep}}{=} Var[N_2] + Var[N_3] + Var[N_4] + Var[N_5] = \frac{5}{16} + \frac{10}{9} + \frac{15}{4} + 20 = \frac{3625}{144} \approx 25{,}174$

6.12) 1 rojo, 2 amarillos, 3 verdes



N = "cantidad de lanzamientos hasta ver los 3 colores"

$N = 1 + N_2 + N_3$

N_2 = "cant de lanz hasta el 1ero $\neq$ del primer color"

N_3 = "cant de lanzamientos hasta obtener el color que falta"

C_1 = "color del 1ero que salio"

C_2 = "color del último que falta"

$N_2|_{C_1=A} \sim Geo(2/3)$ $N_2|_{C_1=R} \sim Geo(5/6)$ $N_2|_{C_1=V} \sim Geo(1/2)$

$N_3|_{C_2=A} \sim Geo(1/3)$ $N_3|_{C_2=R} \sim Geo(1/6)$ $N_3|_{C_2=V} \sim Geo(1/2)$

$E[N] = E[1+N_2+N_3] = 1 + E[N_2] + E[N_3] = *^1$

$E[N_2] = E[N_2|C_1=A]\,P(C_1=A) + E[N_2|C_1=R]\,P(C_1=R) + E[N_2|C_1=V]\,P(C_1=V) = \frac{3}{2}\cdot\frac{2}{6} + \frac{6}{5}\cdot\frac{1}{6} + 2\cdot\frac{1}{2} = \frac{1}{2} + \frac{1}{5} + 1 = \frac{17}{10}$

$E[N_3] = E[N_3|C_2=A]\,P(C_2=A) + E[N_3|C_2=V]\,P(C_2=V) + E[N_3|C_2=R]$

$P(C_2=R) = *^2$

$P(C_2=A) = P(R_1V_2 \cap R_2V_1) = P(R_1V_2) + P(R_2V_1) = P(R_1)P(V_2|R_1) +$

$P(R_2|V_1)P(V_1) = \frac{1}{6}\frac{3}{5} + \frac{1}{2}\frac{1}{3} = \frac{1}{10} + \frac{1}{6} = \frac{4}{15}$

$P(C_2=V) = P(R_2|A_1)P(A_1) + P(A_2|R_1)P(R_1) = \frac{1}{6}\frac{3}{5} + \frac{1}{3}\frac{1}{4} = \frac{3}{20}$

$P(C_2=R) = P(V_2|A_1)P(A_1) + P(A_2|V_1)P(V_1) = \frac{1}{3}\frac{3}{4} + \frac{1}{2}\frac{2}{3} = \frac{7}{12}$

$*^2 = 3\frac{4}{15} + 2\frac{3}{20} + 6\frac{7}{12} = \frac{23}{5}$

$*' = 1 + \frac{17}{10} + \frac{23}{5} = \frac{73}{10} \Rightarrow E[N] = 7{,}3$

6.13) P("quiere estacionarse") = 0,8 $X \sim Be(0{,}8)$

X = "cantidad de autos que desean estacionar"

$P(X \geq 3) = 1 - P(X < 3) = 1 - (0{,}2)^{10} - (0{,}2)^9\, 0{,}8 - (0{,}2)^8 (0{,}8)$

$= 0{,}9999979$

$N \sim P(3, 0{,}8)$

N = # de ensayos hasta el 3 éxito

$P(N \leq 10) = \sum_{n=3}^{10} \binom{n-1}{2}(0{,}8)^3 (0{,}2)^{n-3} =$

$(0{,}8)^3\left(1 + \frac{3}{5} + \frac{6}{25} + \frac{2}{25} + \frac{3}{125} + \ldots\right.$

$\frac{28}{15625} + \frac{36}{78125} =$

$= 0{,}999922$

6.14) $N_1, N_2 \sim Geo(p)$

$S_1 = N_1$, $S_2 = N_1 + N_2$

a) $S_1 \sim Geo(p)$, $S_2 \sim Pascal(2, p)$

$P_{N_1N_2}(n_1, n_2) = p^2(1-p)^{n_1-1}(1-p)^{n_2-1} = p^2(1-p)^{n_1+n_2-2}$

$(N_1, N_2) = (S_1, S_2) = (n_1, n_1+n_2) \Rightarrow S_1 = n_1$

$S_2 = S_1 + n_2 \Rightarrow n_2 = S_2 - S$

$g^{-1}(s_1, s_2) = (n_1, n_1+n_2)$

$P_{S_1S_2}(s_1, s_2) = P_{N_1N_2}(n_1, n_2)\Big|_{g^{-1}(s_1,s_2)} |Jac|$

$$|Jac| = \begin{vmatrix} \frac{dn_1}{ds_1} & \frac{dn_1}{ds_2} \\ \frac{dn_2}{ds_1} & \frac{dn_2}{ds_2} \end{vmatrix} = \begin{vmatrix} 1 & 0 \\ -1 & 1 \end{vmatrix} = 1$$

$P_{S_1S_2}(s_1, s_2) = p^2(1-p)^{s_2-2} = p^2(1-p)^{s_1-1}(1-p)^{s_2-s_1-1}$

b) $P_{S_1|S_2=m}(s_1) = \frac{P_{S_1S_2}(s_1,s_2)}{P_{S_2}(s_2)} = \frac{\cancel{p^2(1-p)^{s_2-2}}}{\binom{s_2-1}{1}\cancel{p^2(1-p)^{s_2-2}}} = \frac{1}{\binom{s_2-1}{1}}$

$\Rightarrow P_{S_1|S_2=m}(s_1) = \frac{1}{\binom{m-1}{1}}$

$P(3 \le S_1 \le 5 \mid S_2 = 8) = P(3 \le S_1 \mid S_2 = 8 \le 5) = 0$

6.15) A = "cantidad artículos producidos por la maq. A"

M_A = "Prob de que el artículo provenga de A"

$P(M_A) = 0{,}4$, $P(M_B) = 0{,}3$, $P(M_C) = 0{,}2$, $P(M_D) = 0{,}1$

a) 14 artículos al azar. $Mult(14, P_i)$

$P(A = 5, B = 4, C = 3, D = 2)$ = distribución multinomial

$$P(A=5, B=4, C=3, D=2) = \frac{14!}{5!\,4!\,3!\,2!}(0{,}4)^5(0{,}3)^4(0{,}2)^3(0{,}1)^2$$

$P(A=5, B=4, C=3, D=2) = 0{,}01674$

$P(C=3 \mid A=5) = P(C=3, B=4, D=2, A=5) + P(C=3, A=5, B=2, D=4) = 0{,}01674 + \frac{14!}{5!\,4!\,3!\,2!}(0{,}2)^3(0{,}4)^5(0{,}3)^2(0{,}1)^4 =$

$0{,}01674 + 1{,}8588 \cdot 10^{-3}$

$\Rightarrow P(C=3 \mid A=5) \simeq 0{,}0186$

6.16) R = "producto roto" $P(R) = 0{,}1$

A = "producto astillado" $P(A) = 0{,}2$

a) $P(A \cap R = 1, A \cap \overline{R} = 2, \overline{R} \cap A = 3, \overline{R} \cap \overline{A} = 2) = Mult(8, P_i)$

$P(A \cap R) = 0{,}1 \cdot 0{,}2 = \frac{1}{50}$ $P(A \cap \overline{R}) = 0{,}2 \cdot 0{,}9 = \frac{9}{50}$

$P(\overline{A} \cap R) = 0{,}8 \cdot 0{,}1 = \frac{2}{25}$, $P(\overline{R} \cap \overline{A}) = 0{,}9 \cdot 0{,}8 = \frac{18}{25}$

$$P(A\cap R = 1, A \cap \overline{R} = 2, \overline{R} \cap A = 3, \overline{R} \cap \overline{A} = 2) = \frac{8!}{1!\,2!\,3!\,2!}\left(\frac{1}{50}\right)^1\left(\frac{9}{50}\right)^2\left(\frac{2}{25}\right)^3\left(\frac{18}{25}\right)^2$$

$= 2{,}38895 \cdot 10^{-4}$

b) Z = "cantidad de piezas que tienen ambos defectos en 8 piezas" $Z \sim Bi(8, p_1)$

$p_1 = P(A \cap R) = 0{,}1 \times 0{,}2 = 0{,}02 \Rightarrow Z \sim Bi(8; 0{,}02)$

$P(Z \ge 1) = 1 - P(Z < 1) = 1 - P(Z = 0) = 1 - \binom{8}{0}(0{,}02)^0(1-0{,}02)^8$

$= 1 - (0{,}85076) \Rightarrow P(Z \ge 1) = 0{,}15$

c) B = "cantidad de piezas que tienen algún defecto de 8 piezas" $B \sim Bi(8, p_2)$, $p_2 = P(A \cup R) = P(A) + P(R) - P(A \cap$
$= 0,1 + 0,2 - 0,02 = 0,28 \Rightarrow B \sim Bi(8, 0,28)$

$P(B < 5) = P(B=0) + P(B=1) + P(B=2) + P(B=3) + P(B=4)$

$\binom{8}{0}(0,28)^0(1-0,28)^8 + 0,225 + 0,305 + 0,2378 + 0,1156 = 0,9556$

$\Rightarrow P(B<5) = 0,9556$

d) Y = "cantidad de piezas que no tienen defectos en 8 pie

$Y \sim Bi(8, p_3)$ $p_3 = P(\bar{A} \cap \bar{R}) = 0,9 \cdot 0,8 = \frac{18}{25}$

$P(Y \geq 3) = 1 - P(Y<3) = 1 - P(Y=0) - P(Y=1) - P(Y=2) = 0,992$

6.17) $P(I) = \frac{1}{3}$, $P(I) = \frac{1}{4}$ se produjeron 12 piezas y sólo 1 tiene los 2 defectos

X = "cant de piezas producidas hasta la 1era con los 2 de

$X \sim Geo(p)$ $p = P(1 \text{ pieza con 2 def}) = \frac{1}{12} \Rightarrow X \sim Geo(1/12)$

N = "cantidad de piezas producidas sin defectos"

$N|X=x \sim Bi(x-1, k)$ $k = P\left(\begin{matrix}\text{piezas sin}\\ \text{defectos}\end{matrix} \middle| \begin{matrix}\text{no tienen}\\ \text{los 2}\end{matrix}\right) = \frac{P(\text{sin def, no tiene los}}{P(\text{no tiene los 2}}$

$= \frac{(1-1/3)(1-1/4)}{11/12} = \frac{6}{11}$

$\Rightarrow E[N] = E[E[N|X]] = 11 \cdot \frac{6}{11} = 6$

6.18) $X \sim Mult(144(0,4; 0,3; 0,2; 0,1))$

$X_1 \sim Bi(144, 0,4)$
$X_2 \sim Bi(144, 0,3)$
$X_3 \sim Bi(144, 0,2)$
$X_4 \sim Bi(144, 0,1)$

Propiedad: $X \sim Bi(n, p_x)$, $Y \sim Bi(n, p_y)$
$X+Y \sim Bi(n, p_x + p_y)$

$V(X+Y) = V(X) + V(Y) + 2\,Cov(X,Y) \Rightarrow Cov(X,Y) = -n\,p_x\,p_y$

$$M = \begin{bmatrix} Cov(X_1,X_1) & Cov(X_1,X_2) & Cov(X_1,X_3) & Cov(X_1,X_4) \\ Cov(X_2,X_1) & Cov(X_2,X_2) & Cov(X_2,X_3) & Cov(X_2,X_4) \\ Cov(X_3,X_1) & Cov(X_3,X_2) & Cov(X_3,X_3) & Cov(X_3,X_4) \\ Cov(X_4,X_1) & Cov(X_4,X_2) & Cov(X_4,X_3) & Cov(X_4,X_4) \end{bmatrix} = 144 \begin{bmatrix} 0,24 & -0,12 & -0,08 & -0,0 \\ -0,12 & 0,21 & -0,06 & -0,0 \\ -0,08 & -0,06 & 0,16 & -0,0 \\ -0,04 & -0,03 & -0,02 & 0,0 \end{bmatrix}$$

6.19) N = " cantidad de tiradas necesarios hasta el 1er dos" $N \sim Geo(1/6)$

M = " cantidad de 4 observados "

a) $\hat{M} = \frac{COV(X,Y)}{Var(N)}\left[N - E[N]\right] + E[M]$

$M\Big|_{N=n} \sim Bi(n-1, 1/5)$

$E[M] = E\left[E[M|N]\right]$

$E[M|N=n] = \frac{n-1}{5} \Rightarrow E[M|N] = \underbrace{\frac{N-1}{5}}$ es una recta $\Rightarrow$

es la recta que mejor aproxima a M

$\hat{M} = \frac{N-1}{5}$ $\quad \hat{M} = \frac{COV(X,Y)}{30}\left[N - 6\right] + 1$

$\hat{M} = \frac{COV(X,Y)N}{30} - \frac{6\,COV(X,Y)}{30} + 1$

Con $COV(X,Y) = 6 \Rightarrow \hat{M} = \frac{N-1}{5}$ ✓

b) $E[M] = E\left[\frac{N-1}{5}\right] = \frac{1}{5}.6 - \frac{1}{5} = 1$

$Var[M] = V\left[E[M|N]\right] + E\left[Var[M|N]\right] = Var\left[\frac{N-1}{5}\right]$
$+ E\left[\frac{4N-4}{25}\right] = \frac{1}{25}Var[N] + \frac{4}{25}E[N] - \frac{4}{25} = \frac{1}{25}.30$
$+ \frac{4}{25}.6 = \frac{6}{5} + \frac{24}{25} = \frac{54}{25} = 2,16$

$COV(N,M) = 6$

6.20) $P(R) = 0,45$; $P(A) = 0,05$; $P(V) = 0,5$

a) N = " cant de luces verdes hasta el 1er rojo" . $N \sim Geo(p)$ $p = P(R)$
~~en mal espacio muestral~~

$P(R) = \frac{0,45}{0,45+0,5} = \frac{9}{19} \Rightarrow N \sim Geo(9/19)$

b) $P(N > 2) = 1 - P(N \leq 2) = 1 - P(N=1) - P(N=2) = 1 - \left(\frac{10}{19}\right)^0 \frac{9}{19} - \left(\frac{10}{19}\right)^1 \frac{9}{19}$
$= \frac{100}{361} \approx 0,277$