

# Inferencia

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## 1. Representacion

$P(A) \times P(B)$   $B_1 < G_1, P_1 >$   
 $G_1 :$

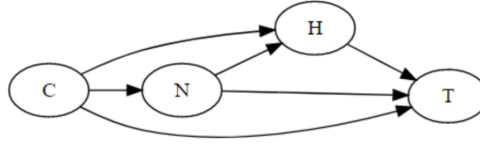


Figura 1: DAG con 4 variables aleatorias.

$G_1 = \langle V_1, A_1 \rangle$

$V_1 = T, H, N, C$

$A_1 = C \rightarrow H, C \rightarrow N, C \rightarrow T, N \rightarrow H, H \rightarrow T, N \rightarrow T$

$P = p_T, p_H, p_N, p_C$

$$1. p_T = P(T|H, N, C)$$

$$2. p_H = P(H|N, C)$$

$$3. p_N = P(N|C)$$

$$4. p_C = P(C)$$

$$1) P(T|H, N, C) = \frac{P(T=0 \cap H=0 \cap N=0 \cap C=0) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha}$$

$$= \frac{\frac{2}{10} + 1}{\frac{2}{10} + 2} = \frac{1,20}{2,20} = 0,545454$$

$$P(T|H, N, C) = \frac{P(T=1 \cap H=0 \cap N=0 \cap C=0) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha}$$

$$= \frac{\frac{0}{10} + 1}{\frac{2}{10} + 2} = \frac{1}{2,20} = 0,4545454$$

$$P(T|H, N, C) = \frac{P(T=0 \cap H=0 \cap N=0 \cap C=1) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha}$$

$$= \frac{\frac{0}{10} + 1}{\frac{1}{10} + 2} = \frac{1,00}{2,10} = 0,47619$$

$$P(T|H, N, C) = \frac{P(T=1 \cap H=0 \cap N=0 \cap C=1) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha}$$

$$= \frac{\frac{1}{10} + 1}{\frac{1}{10} + 2} = \frac{1,1}{2,1} = 0,5238095$$

$$P(T|H, N, C) = \frac{P(T=0 \cap H=0 \cap N=1 \cap C=0) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha}$$

$$= \frac{\frac{0}{10} + 1}{\frac{3}{10} + 2} = \frac{1}{2,30} = 0,434783$$

$$\begin{aligned}
P(T|H, N, C) &= \frac{P(T=1 \cap H=0 \cap N=1 \cap C=0) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{3}{10} + 1}{\frac{3}{10} + 2} = \frac{1,3}{2,3} = 0,565217 \\
P(T|H, N, C) &= \frac{P(T=0 \cap H=0 \cap N=1 \cap C=1) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{0}{10} + 1}{\frac{0}{10} + 2} = \frac{1}{2} = 0,5 \\
P(T|H, N, C) &= \frac{P(T=1 \cap H=0 \cap N=1 \cap C=1) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{0}{10} + 1}{\frac{0}{10} + 2} = \frac{1}{2} = 0,5 \\
P(T|H, N, C) &= \frac{P(T=0 \cap H=1 \cap N=0 \cap C=0) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{0}{10} + 1}{\frac{0}{10} + 2} = \frac{1}{2} = 0,5 \\
P(T|H, N, C) &= \frac{P(T=1 \cap H=1 \cap N=0 \cap C=0) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{0}{10} + 1}{\frac{0}{10} + 2} = \frac{1}{2} = 0,5 \\
P(T|H, N, C) &= \frac{P(T=0 \cap H=1 \cap N=0 \cap C=1) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{0}{10} + 1}{\frac{1}{10} + 2} = \frac{1,1}{2,1} = 0,476190 \\
P(T|H, N, C) &= \frac{P(T=1 \cap H=1 \cap N=0 \cap C=1) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{1}{10} + 1}{\frac{1}{10} + 2} = \frac{1,1}{2,1} = 0,523810 \\
P(T|H, N, C) &= \frac{P(T=0 \cap H=1 \cap N=1 \cap C=0) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{2}{10} + 1}{\frac{2}{10} + 2} = \frac{1,20}{2,20} = 0,545454 \\
P(T|H, N, C) &= \frac{P(T=1 \cap H=1 \cap N=1 \cap C=0) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{0}{10} + 1}{\frac{2}{10} + 2} = \frac{1,0}{2,20} = 0,454545 \\
P(T|H, N, C) &= \frac{P(T=0 \cap H=1 \cap N=1 \cap C=1) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{0}{10} + 1}{\frac{1}{10} + 2} = \frac{1}{2,1} = 0,476190476 \\
P(T|H, N, C) &= \frac{P(T=1 \cap H=1 \cap N=1 \cap C=1) + \alpha_1}{P(H=0 \cap N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{1}{10} + 1}{\frac{1}{10} + 2} = \frac{1,1}{2,10} = 0,523809524
\end{aligned}$$

$$2) P(H|N, C)$$

$$P(H|N = 0, C = 0)$$

$$\begin{aligned}
P(H = 0|N = 0, C = 0) &= \frac{P(H=0 \cap N=0 \cap C=0) + \alpha_1}{P(N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{2}{10} + 1}{\frac{2}{10} + 2} = \frac{1,2}{2,2} = 0,5454545455
\end{aligned}$$

$$\begin{aligned}
P(H = 1|N = 0, C = 0) &= \frac{P(H=1 \cap N=0 \cap C=0) + \alpha_1}{P(N=0 \cap C=0) + \alpha} \\
&= \frac{\frac{0}{10} + 1}{\frac{2}{10} + 2} = \frac{1}{2,2} = 0,4545454545
\end{aligned}$$

$$P(H|N = 0, C = 1)$$

$$P(H = 0|N = 0, C = 1) = \frac{H=0 \cap N=0 \cap C=1 + \alpha_1}{P(N=0 \cap C=1) + \alpha}$$

$$= \frac{\frac{1}{10} + 1}{\frac{2}{10} + 2} = \frac{1,1}{2,2} = 0,5$$

$$P(H = 1|N = 0, C = 1) = \frac{H=1 \cap N=0 \cap C=1 + \alpha_1}{P(N=0 \cap C=1) + \alpha}$$

$$= \frac{\frac{1}{10} + 1}{\frac{2}{10} + 2} = \frac{1,1}{2,2} = 0,5$$

$$P(H|N = 1, C = 0)$$

$$P(H = 0|N = 1, C = 0) = \frac{H=0 \cap N=1 \cap C=0 + \alpha_1}{P(N=1 \cap C=0) + \alpha}$$

$$= \frac{\frac{3}{10} + 1}{\frac{5}{10} + 2} = \frac{1,3}{2,5} = 0,52$$

$$P(H = 1|N = 1, C = 0) = \frac{H=1 \cap N=1 \cap C=0 + \alpha_1}{P(N=1 \cap C=0) + \alpha}$$

$$= \frac{\frac{2}{10} + 1}{\frac{5}{10} + 2} = \frac{1,2}{2,5} = 0,48$$

$$P(H|N = 1, C = 1)$$

$$P(H = 0|N = 1, C = 1) = \frac{H=0 \cap N=1 \cap C=1 + \alpha_1}{P(N=1 \cap C=1) + \alpha}$$

$$= \frac{\frac{0}{10} + 1}{\frac{1}{10} + 2} = \frac{1}{2,1} = 0,4761904762$$

$$P(H = 1|N = 1, C = 1) = \frac{H=1 \cap N=1 \cap C=1 + \alpha_1}{P(N=1 \cap C=1) + \alpha}$$

$$= \frac{\frac{1}{10} + 1}{\frac{1}{10} + 2} = \frac{1,1}{2,1} = 0,5238095238$$

$$3)P(N|C)$$

$$P(N|C = 0)$$

$$P(N = 0|C = 0) = \frac{P(N=0 \cap C=0) + \alpha_1}{P(C=0) + \alpha}$$

$$= \frac{\frac{2}{10} + 1}{\frac{7}{10} + 2} = \frac{1,2}{2,7} = 0,4444444444$$

$$P(N = 1|C = 0) = \frac{P(N=1 \cap C=0) + \alpha_2}{P(C=0) + \alpha}$$

$$= \frac{\frac{5}{10} + 1}{\frac{7}{10} + 2} = \frac{1,5}{2,7} = 0,5555555556$$

$$P(N|C = 1)$$

$$P(N = 0|C = 1) = \frac{P(N=0 \cap C=1) + \alpha_2}{P(C=1) + \alpha}$$

$$= \frac{\frac{2}{10} + 1}{\frac{3}{10} + 2} = \frac{1,2}{2,3} = 0,5217391304$$

$$P(N = 1|C = 1) = \frac{P(N=1 \cap C=1) + \alpha_2}{P(C=1) + \alpha}$$

$$= \frac{\frac{1}{10} + 1}{\frac{3}{10} + 2} = \frac{1,1}{2,3} = 0,4782608696$$

$$4)P(C) \quad P(C = 0)$$

$$= \frac{7+1}{10+2} = \frac{8}{12} = 0,666666667$$

$$P(C = 1)$$

$$= \frac{3+1}{10+2} = \frac{4}{12} = 0,333333333$$

T H N C	P(T H,N,C)
0 0 0 0	0,5454545
0 0 0 1	0,4761905
0 0 1 0	0,4347826
0 0 1 1	0,5000000
0 1 0 0	0,5000000
0 1 0 1	0,4761905
0 1 1 0	0,5454545
0 1 1 1	0,4761905
1 0 0 0	0,454545
1 0 0 1	0,523810
1 0 1 0	0,565217
1 0 1 1	0,500000
1 1 0 0	0,500000
1 1 0 1	0,523810
1 1 1 0	0,454545455
1 1 1 1	0,523809524

H N C	P(H N,C)
0 0 0	0,5454545455
0 0 1	0.5
0 1 0	0.52
0 1 1	0.4761904762
1 0 0	0,4545454545
1 0 1	0.5
1 1 0	0.48
1 1 1	0.5238095238

N C	P(N C)
0 0	0.4444444444
0 1	0.5217391304
1 0	0.5555555556
1 1	0.4782608696

C	P(C)
0	0,666666667
1	0,333333333

## 2. Inferencia

$$Test1 = \{0, 1, 0, ?\}$$

$$C=0$$

$$\begin{aligned} P(T, H, N, C) &= P(T = 0, H = 1, N = 0, C = 0) \cap P(H = 1, N = 0, C = 0) \cap P(N = 0, C = 0) \cap P(C = 0) \\ &= (0,5) \times (0,454545) \times (0,444444) \times (0,66666667) = 0,067340 \end{aligned}$$

$$C=1$$

$$\begin{aligned} P(T, H, N, C) &= P(T = 0, H = 1, N = 0, C = 1) \cap P(H = 1, N = 0, C = 1) \cap P(N = 0, C = 1) \cap P(C = 1) \\ &= (0,4761905) \times (0,5) \times (0,52173913) \times (0,33333333) = 0,0414079 \end{aligned}$$

$$Test2 = \{0, 1, 1, ?\}$$

$$C=0$$

$$\begin{aligned} P(T, H, N, C) &= P(T = 0, H = 1, N = 1, C = 0) \cap P(H = 1, N = 1, C = 0) \cap P(N = 1, C = 0) \cap P(C = 0) \\ &= (0,5454545) \times (0,48) \times (0,55555555) \times (0,66666667) = 0,096969696 \end{aligned}$$

$$C=1$$

$$\begin{aligned} P(T, H, N, C) &= P(T = 0, H = 1, N = 1, C = 1) \cap P(H = 1, N = 1, C = 1) \cap P(N = 1, C = 1) \cap P(C = 1) \\ &= (0,4761905) \times (0,5238095238) \times (0,4782608696) \times (0,33333333) = 0,03976 \end{aligned}$$

$$Test3 = \{0, 0, 1, ?\}$$

$$C=0$$

$$\begin{aligned} P(T, H, N, C) &= P(T = 0, H = 0, N = 1, C = 0) \cap P(H = 0, N = 1, C = 0) \cap P(N = 1, C = 0) \cap P(C = 0) \\ &= 0,4347826) \times (0,52) \times (0,55555555) \times (0,66666667) = 0,0837359081 \end{aligned}$$

$$C=1$$

$$\begin{aligned} P(T, H, N, C) &= P(T = 0, H = 0, N = 1, C = 1) \cap P(H = 0, N = 1, C = 1) \cap P(N = 1, C = 1) \cap P(C = 1) \\ &= (0,5) \times (0,4761904762) \times (0,4782608696) \times (0,33333333) = 0,037957 \end{aligned}$$