Roll - M21AIE265 Name - Udayan Ghosh.

1. Independent events:

In the context of probability an independent event is defined as the event whose occurrence is not dependent upon any other event.

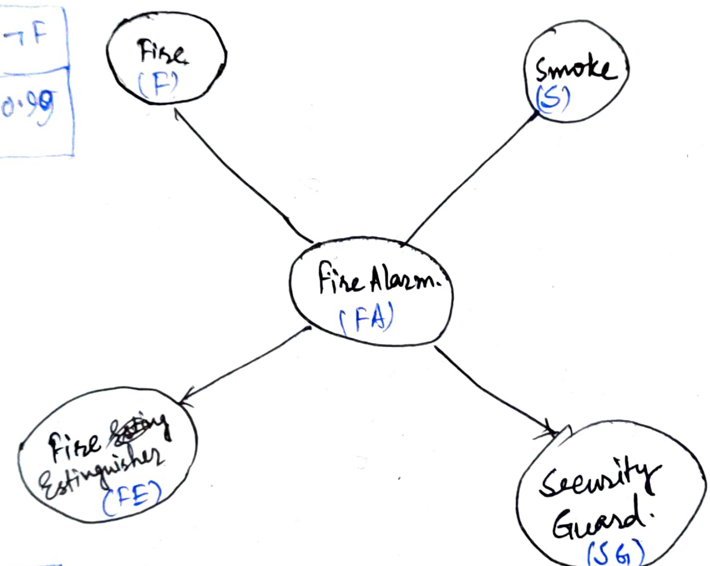
Ex: If we throw a dice and getting a no. as 2 is not dependent upon any other event.

Conditional Independence:

conditional independence are called as the situations where a observation is irrelevant when evaluating the certainty of a hypothesis.

Ex.

F	¬F
0.01	0.99



S	¬S
0.05	0.95

	P(FA|F,S)
F=¬F, S=¬S	0.02
F=¬F, S=S	0.78
F=F, S=¬S	0.72
F=F, S=S	0.98

	P(FE|FA)
FA=FA	0.8
FA=¬FA	0.2

	P(SG|FA)
FA=FA	0.9
FA=¬FA	0.1

Here $P(FE, SG, FA, F, S) = P(FE|FA) \times P(SG|FA) \times P(FA|F,S) \times P(F) \times P(S)$

where $P(FE|FA)$ is probabality of charging fire estinguisher given fire alarm has been initiated.

$P(SG|FA)$ is probabality of coming security guard given fire alarm has been initiated.

P.T.O

P(FA | F,S) is the probablity of initiating fire alarm given Fire and or Smoke found.

P(F) is the probablity of finding fire

P(S) is the probablity of finding smoke.

For the previous example. the Markov Blanket for Node FA is

MB(FA) = F, S, FE and SG

MB (FE) = FA.

MB (SG) = FA

MB (F) = FA

MB (S) = FA.

2. (C) Lets assume.

$P(A) \rightarrow a_1 = 0.183;\quad a_2 = 0.462;\quad a_3 = 0.355.$

$P(B) \rightarrow b_1 = 0.407\quad b_2 = 0.593$

$P(C) \rightarrow c_1 = 0.697\quad c_2 = 0.303$

$P(M|X) \rightarrow$

	x_1	x_2
m_1	0.564	0.436
m_2	0.278	0.722
m_3	0.807	0.193

$P(M|Y) =$

	y_1	y_2	y_3
m_1	0.523	0.138	0.339
m_2	0.327	0.397	0.276
m_3	0.260	0.474	0.266

From here we can calculate.

$P(M|x_2y_3) = P(m_1|x_2y_3)\quad P(m_2|x_2y_3)\quad P(m_3|x_2y_3)$

$= 0.436 \times 0.339\quad 0.722 \times 0.276\quad 0.193 \times 0.266$

$= 0.148\quad 0.199\quad 0.051$

$$P(a_2 \mid x_2 y_3) = \alpha P(a_2, x_2, y_3)$$

$$= \alpha \sum_{B,C,M} P(a_2, B, C, M, x_2, y_3)$$

$$P(a_2, B, C, M, x_2, y_3)$$

$$= P(M \mid a_2 B, C)\, P(M \mid x_2)\, P(M \mid y_3)\, P(a_2)\, P(B)\, P(C)$$

~~note denoting $P(a_2)$ as a_2 similarly for others.~~

$$P(a_2, B, C, M, x_2, y_3)$$

$$= P(a_2) \times P(b_1) \times P(c_1) \times P(M \mid a_2 b_1 c_1)\big(P(m_1 \mid x_2 y_3) + P(m_2 \mid x_2 y_3) + P(m_3 \mid x_2 y_3)\big)$$

$$+ P(a_2) \times P(b_1) \times P(c_2) \times P(M \mid a_2 b_1 c_2)\big(P(m_1 \mid x_2 y_3) + P(m_2 \mid x_2 y_3) + P(m_3 \mid x_2 y_3)\big)$$

$$+ P(a_2) \times P(b_2) \times P(c_1) \times P(M \mid a_2 b_2 c_1)\big(P(m_1 \mid x_2 y_3) + P(m_2 \mid x_2 y_3) + P(m_3 \mid x_2 y_3)\big)$$

$$+ P(a_2) \times P(b_2) \times P(c_1) \times P(M \mid a_2 b_2 c_2)\big(P(m_1 \mid x_2 y_3) + P(m_2 \mid x_2 y_3) + P(m_3 \mid x_2 y_3)\big)$$

~~= 0.462 × 0.407 × 0.697 ×~~

$$P(a_2, B, C, M, x_2, y_3)$$

$$= P(a_2)\, P(b_1) \times P(c_1)\big(P(m_1 \mid a_2 b_1 c_1) P(m_1 \mid x_2 y_3) + P(m_2 \mid a_2 b_1 c_1) P(m_2 \mid x_2 y_3) + P(m_3 \mid a_2 b_1 c_1)\, P(m_2 \mid x_2 y_3)\big)$$

$$+ P(a_2)\, P(b_1) \times P(c_2)\big(P(m_1 \mid a_2 b_1 c_2) P(m_1 \mid x_2 y_3) + P(m_2 \mid a_2 b_1 c_2) P(m_2 \mid x_2 y_3) + P(m_3 \mid a_2 b_1 c_2)\, P(m_2 \mid x_2 y_3)\big)$$

$$+ P(a_2)\, P(b_2)\, P(c_1)\big(P(m_1 \mid a_2 b_2 c_1) P(m_1 \mid x_2 y_3) + P(m_2 \mid a_2 b_2 c_1) P(m_2 \mid x_2 y_3) + P(m_3 \mid a_2 b_2 c_1)\, P(m_2 \mid x_2 y_3)\big)$$

$$+ P(a_2)\, P(b_2)\, P(c_2)\big(P(m_1 \mid a_2 b_2 c_2) P(m_1 \mid x_2 y_3) + P(m_2 \mid a_2 b_2 c_2) P(m_2 \mid x_2 y_3) + P(m_3 \mid a_2 b_2 c_2)\, P(m_2 \mid x_2 y_3)\big)$$

$$= 0.462 \times 0.407 \times 0.697\,(0.109 \times 0.148 + 0.316 \times 0.199 + 0.573 \times 0.051)$$

$$+ 0.462 \times 0.407 \times 0.303\,(0.454 \times 0.148 + 0.320 \times 0.199 + 0.221 \times 0.051)$$

$$+ 0.462 \times 0.593 \times 0.697\,(0.370 \times 0.148 + 0.330 \times 0.199 + 0.299 \times 0.051)$$

$$+ 0.462 \times 0.593 \times 0.303\,(0.888 \times 0.148 + 0.079 \times 0.199 + 0.032 \times 0.051)$$

$$= 0.0593 + 0.0556 + 0.0163$$

$$= 0.0132.$$

(M | ABC) table is given in the next page

	m_1	m_2	m_3
$a_1 b_1 c_1$	0.426	0.262	0.310
$a_1 b_1 c_2$	0.718	0.179	0.109
$a_1 b_2 c_1$	0.485	0.272	0.242.
$a_1 b_2 c_2$	0.452	0.453	0.094
$a_2 b_1 c_1$	0.109	0.316	0.573
$a_2 b_1 c_2$	0.457	0.320	0.221
$a_2 b_2 c_1$	0.370	0.330	0.299
$a_2 b_2 c_2$	0.888	0.079	0.032
$a_3 b_1 c_1$	0.334	0.261	0.404
$a_3 b_1 c_2$	0.482	0.240	0.277
$a_3 b_2 c_1$	0.363	0.266	0.369
$a_3 b_2 c_2$	0.382	0.116	0.500

2.

(a) **Psucode:**

a[3]
for i = 1 to 3.
a[i] = random value between 0 to 1.
~~a[i] / sum~~
for i = 1 to 3
a[i] / ~~sum~~ (a[1] + a[2] + a[3])

b [2]
for i = 1 to 2
b[i] = random value between 0 to 1.

for i = 1 to 2
b [i] / (b[1] + b [2]

c [2]
for i = 1 to 2.
c[i] = random between 0 to 1.
divide each element by sum of 2.

m[12][3].

for i = 1 to 12.

for j = 1 to 3.

m[i][j] = random value between 0 to 1.

sum[12].

for i = 1 to 12.

sum i = sum of element of ith row of m.

~~m[i][j] = m[i]~~

for i = 1 to 12

for j = 1 to 3.

m[i][j] = m[i][j] / sum[i].

~~x_y[3]~~

~~for i = 1 to 3.~~

~~x[i] = x_y[i] = x[~~

x[3][2].

for i = 1 to 3.

for j = 1 to 2.

x[i][j] = random. value between 0 to 1.

divide each element of each row by the sum of the elements of the row.

y[3][3]

for i = 1 to 3.

for j = 1 to 3.

y[i][j] = random value between 0 to 1

divide each element of each row by the sum of the elements of the row.

P.T.O

x_y[3]

for i = 1 to 3

x_y[i] = x[i][3] × y[i][3]

a_1[4][3] , a_2[4][3] , a[4][3]

for i = 1 to 4

for j = 1 to 3

a_1[i][j] = m[i][j

for i = 5 to 8

for j = 1 to 3

~~a_2[i][j] = m[i][j]~~

a_2[i-4][j] = m[i][j]

for i = 9 to 12

for j = 1 to 3

a_3[i-8][j] = m[i][j]

a_1_x_2_y_3[3] , a_2_x_2_y_3[3] , a_3_x_2_y_3[3]

for i = 1 to 4

for j = 1 to 3

a_1_x_2_y_3[j] = a_1[i][j] × x_y[j] × b[⌊i/2⌋] × c[i%2]

a_2_x_2_y_3[j] = a_2[i][j] × x_y[j] × b[⌊i/2⌋] × c[i%2]

a_3_x_2_y_3[j] = a_3[i][j] × x_y[j] × b[⌊i/2⌋] × c[i%2] for i = 1 to 3

$a_1 x_2 y_3 = a_1 x_2 y_3 + a_1 - x_2 - y_3 [i]$

$a_2 x_2 y_3 = a_2 x_2 y_3 + a_2 - x_2 - y_3 [i]$

$a_3 x_2 y_3 = a_3 x_2 y_3 + a_2 - x_2 - y_3 [i]$.