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Tutorial - 7

Travel → Foreign Purchase
Travel → Fraud ← Foreign Purchase

→ Increased prob. of travel makes fraud more likely

→ Increased probability of foreign purchase makes fraud more likely.
Foreign purchase is evidence for fraud.
→ Travel & fraud can cause foreign purchase
Travel explains foreign purchase & is thus evidence against fraud.

True	False
0.05	0.95

travel	T	F
T	0.01	0.99
F	0.002	0.998

Travel	Fraud	T	F
T	T	0.9	0.1
F	T	0.1	0.9
T	F	0.9	0.1
F	F	0.01	0.99

1) travel = ? F.P. = true, fraud = ? [classify hidden variables]

$$P(fraud = T \mid F.P. = T) = \alpha [P(fraud = T, travel = T) \times P(F.P. = T)$$

$$= \alpha [P(fraud = T \mid travel = F) \times P(F.P. = T) + P(travel = F, fraud = T) \times P(travel = F)$$

$$= \alpha [0.01 \times 0.9 \times 0.05 + 0.002 \times 0.1 \times 0.95]$$

$$= 0.00064\alpha$$

Similarly, $P[fraud = F \mid F.P. = T]$

$= \alpha [0.99 \times 0.9 \times 0.05 + 0.998 \times 0.01 \times 0.95]$

$= 0.054051\alpha$

$\therefore \alpha = \frac{1}{0.00064 + 0.05403} = 0.0117$

$\Rightarrow P(fraud = T \mid F.P. = T) = 1.17\%$

2) $P(fraud = T \mid F.P. = T, travel = T)$

$= 0.00045\alpha$

$P(fraud = F \mid F.P. = T, travel = T)$

$= 0.04455\alpha$

$\therefore \alpha = \frac{1}{0.04455 + 0.00045} = 22.222$

$\therefore P(fraud = T \mid F.P. = T, travel = T)$

$= 0.00045\alpha$

$\Rightarrow P = 0.01 = 1\%$