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Tutorial 7

(Bayesian network)

travel \rightarrow foreign purchase
 \rightarrow fraud \rightarrow

- \rightarrow increased probability of travel makes fraud more likely.
- \rightarrow increased probability of foreign purchase makes fraud more likely. Foreign purchase is evidence for fraud.
- \rightarrow travel & fraud can cause foreign purchase. Travel explains foreign purchase & so is evidence against fraud.

True	False
0.05	0.95

	Travel True	Travel False
True	0.01	0.99
False	0.002	0.998

	Travel True	Travel False
True	0.9	0.1
False	0.1	0.9

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

$$\begin{aligned}
 & P(\text{fraud} = \text{true} \mid \text{F.P.} = \text{true}) \\
 &= \alpha [(P(\text{fraud} = \text{true} \mid \text{travel} = \text{true}) \times P(\text{F.P.} = \text{true} \mid \text{travel} = \text{true})) \\
 &+ (P(\text{fraud} = \text{true} \mid \text{travel} = \text{false}) \times P(\text{F.P.} = \text{true} \mid \text{travel} = \text{false}))] \\
 &= \alpha [0.01 \times 0.9 \times 0.05 + 0.002 \times 0.1 \times 0.95] \\
 &= 0.00064\alpha
 \end{aligned}$$

Similarly,

$$P(\text{fraud} = \text{false} \mid \text{F.P.} = \text{true})$$

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

$$= 0.054051\alpha$$

$$\alpha = \frac{1}{0.00064 + 0.05403} = 18.291$$

$$P(\text{fraud} = \text{true} \mid FP = \text{true})$$

$$= 0.00064\alpha = 0.0117$$

$$\therefore P(\text{fraud} = \text{true} \mid FP = \text{true}) = 1.17\%$$

$$2) P(\text{fraud} = \text{true} \mid FP = \text{true}, \text{travel} = \text{true})$$

$$= \alpha \times 0.00045$$

$$P(\text{travel} = \text{false} \mid FP = \text{true}, \text{travel} = \text{true})$$

$$= \alpha \times 0.04455$$

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

$$P(\text{fraud} = \text{true} \mid FP = \text{true}, \text{travel} = \text{true})$$

$$= \alpha \times 0.00045$$

$$= 22.222 \times 0.00045$$

$$= 0.01$$

$$= 1\%$$