Tutorial 7 : Machine Learning 2.

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→ Bayesian Network.

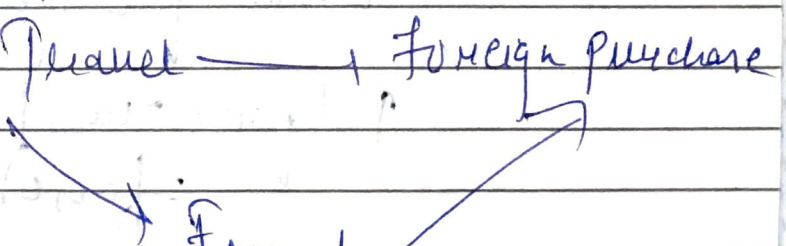
Possible Network structure :-

→ We know that travel and fraud can cause foreign purchases

→ Travel can be increased probability of foreign purchase makes fraud more likely, foreign purchase is evidence for fraud.

→ Travel and fraud can each cause foreign purchase. Travel explains foreign purchase and so is evidence against fraud.

True	False
0.05	0.95



Percentage fraud - will not change

Travel	Fraud	True	False
True	True	0.01	0.99
False	True	0.004	0.996

Travel	Fraud	True	False
True	True	0.90	0.10
False	True	0.10	0.90
True	False	0.05	0.10
False	False	0.01	0.99

→ 1) Classify the hidden variable

P[foreign purchase = true, fraud = ?, travel = ?]

P[fraud = true | foreign purchase = true]

= α * [P(fraud = true) travel = true)

* P[foreign purchase = true) travel = false, fraud = true) * P(fraud = true) +

P(fraud = true | travel = false) * P(foreign-purchase = true]

= α * [0.01 * 0.90 * 0.05 +

0.002 * 0.10 * 0.95]

$= \alpha * [0.00045 + 0.00019]$

$= 0.00064\alpha$

$P(\text{fraud} = \text{false} \mid \text{foreign purchase} = \text{true})$

$= \alpha * [P(\text{fraud} = \text{False} \mid \text{fraud} = \text{true}) *$

$P(\text{foreign purchase} = \text{true} \mid \text{travel} = \text{true}, \text{fraud} = \text{false}) *$

$P(\text{travel} = \text{true}) +$

$P(\text{fraud} = \text{false} \mid \text{travel} = \text{false}) *$

$P(\text{foreign purchase} = \text{true} \mid \text{travel} = \text{false}, \text{fraud} = \text{false}) *$

$P(\text{travel} = \text{False})]$

$= \alpha * [0.99 * 0.90 * 0.05 +$

$0.998 * 0.01 * 0.95]$

$= \alpha * [0.0455 + 0.00948]$

$= 0.054831\alpha$

$\alpha = \frac{1}{0.00064 + 0.054031} = 18.291$

$P(\text{fraud} = \text{true} \mid \text{foreign purchase} = \text{true}) = 0.00064\alpha$

$= 0.00064 \times 18.291$

$= 0.01170$

$\therefore P(\text{fraud} = \text{true} \mid \text{foreign-purchase} = \text{true}) = 1.14\%$

2) $P(\text{fraud} = \text{true} \mid \text{foreign-purchase} = \text{true}, \text{fraud} = \text{true})$

$= \alpha (0.00045)$

$P(\text{fraud} = \text{false} \mid \text{foreign-purchase} = \text{true}, \text{fraud} = \text{true})$

$= \alpha (0.0055)(0.04455)$

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

$P(\text{fraud} = \text{true}, \text{foreign purchase} = \text{true}, \text{fraud} = \text{true})$

$= \alpha \times 0.00045$

$= 22.222 \times 0.00045$

$= 0.01$

$P(\text{fraud} = \text{true}, \text{foreign purchase} = \text{true}, \text{fraud} = \text{true}) = 100\%$