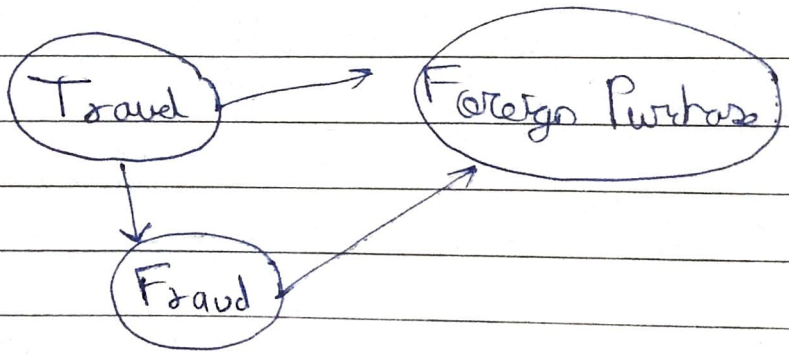
Tutorial 7

Exercise



→ Travel and fraud both can cause foreign purchase.

→ Foreign purchase is evidence for fraud.

→ Travel explains foreign purchase and hence is evidence against fraud.

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

$= \alpha * \sum_{travel} [P(fraud = true \mid travel) * P(foreign\text{-}pur = true \mid travel, fraud = true) * P(travel)]$

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$= \alpha * [P(\text{fraud} = \text{true} \mid \text{fraud} = \text{true})$
$* P(\text{foreign-purchase} = \text{true} \mid \text{travel} = \text{true}, \text{fraud} = \text{true})$
$* P(\text{travel} = \text{true}) + P(\text{fraud} = \text{true} \mid \text{travel} = \text{false})$
$* P(\text{foreign-purchase} = \text{true} \mid \text{travel} = \text{false}, \text{fraud} = \text{true})$
$* P(\text{travel} = \text{false})]$

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

$= \alpha [0.00045 + 0.00019] = 0.00064\alpha$

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

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

$= \alpha [0.99 \times 0.9 \times 0.05 + 0.998 \times 0.01 \times 0.95]$
$= \alpha [0.04455 + 0.009481]$
$= 0.0540312$

$\alpha = \frac{1}{(0.00064 + 0.054031)} = 18.29$

Ans $\therefore P(\text{fraud} = \text{true} \mid \text{foreign-purchase} = \text{true})$
$= \alpha \times 0.00064 = 18.29 \times 0.00064$
$= 0.011$
$= 1.1\%$

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2) $P(\text{fraud} = \text{true} \mid \text{foreign-purchase} = \text{true}, \text{travel} = \text{true})$
$= \alpha \times 0.00045$

$P(\text{fraud} = \text{false} \mid \text{foreign-purchase} = \text{true}, \text{travel} = \text{true})$
$= \alpha \times 0.04455$

$\therefore \alpha = 1/(0.00045 + 0.04455)$
$\alpha = 22.22$
$\therefore P(\text{fraud} = \text{true} \mid \text{foreign-purchase} = \text{true} \mid \text{travel} = \text{true}) = 0.01$

Ans $\therefore P(\text{fraud} = \text{true} \mid \text{foreign-purchase} = \text{true} \mid \text{travel} = \text{true})$
$= 1.0\%$