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Comp 341 HW#3

1) $P(A,D,S,T) = P(A) \cdot P(D) \cdot P(S|A,D) \cdot P(T|S)$

2) $P(+s|+t) =$

Let's find $P(S|+t)$ first. Query variables: S
Evidence variables = +t
Hidden variables: A, D

factors: $P(A) \cdot P(D) \cdot P(S|A,D) \cdot P(T|S)$

Choose A:

$P(A) \quad P(S|A,D) \xrightarrow{\times} P(A,S|D) \xRightarrow{\Sigma} P(S|D)$

A	D	S	P(A,S|D)
+a	a	+s	0.12
+a	n	+s	0.3
+a	d	+s	0.42
-a	a	+s	0.16
-a	n	+s	0.28
-a	d	+s	0.36

D	S	P(S|D)
a	+s	0.28
n	+s	0.58
d	+s	0.78

factors: $P(D) \cdot P(T|S) \cdot P(S|D)$

Choose D:

$P(D) \quad P(S|D) \xrightarrow{\times} P(S,D) \xrightarrow{\Sigma} P(S)$

D	S	P(S,D)
a	+s	0.056
n	+s	0.29
d	+s	0.234

S	P(s)
+s	0.58
-s	0.42

factors: $P(T|S) P(S)$

Finish with S:

$P(S) \quad P(T|S) \xrightarrow{\times} P(T,S) \xrightarrow{\text{Normalize}} P(S|T)$

T	S	P(T,S)
+t	+s	0.551
+t	-s	0.0798

T	S	P(S|t)
+t	+s	0.87
+t	-s	0.13

factors: $P(S|T)$

$\rightarrow P(+s|+t) = 0.87.$ //

3) From the previous qustion, I obtained $P(S)$ as follows:

S	P(s)
+s	0.58
-s	0.42

Hence, $P(+s) = 0.58.$ //

4) $EU(buy) = \sum_s P(s) \cdot U(Buy, s)$

$= 0.58 \cdot 5000 + 0.42 \cdot (-6000)$

$= 2900 - 2520$

$= 380.$ //

5) $P(T|S) \quad P(S) \xrightarrow{\times} P(T,S) \xrightarrow{\Sigma} P(T)$

T	S	P(T,S)
-t	+s	0.029
-t	-s	0.34
+t	+s	0.551
+t	-s	0.0798

T	P(T)
+t	0.63
-t	0.37

Normalize

T	S	P(S|T)
-t	+s	0.08
-t	-s	0.92
+t	+s	0.87
+t	-s	0.13

$EU(buy|+t) = 0.87 \cdot 5000 + 0.13 \cdot (-6000) = 3570$

$EU(buy|-t) = 0.08 \cdot 5000 + 0.92 \cdot (-6000) = -5120$

$EU(\text{Not buy}|+t) = 0.87 \cdot 0 + 0.13 \cdot 0 = 0$

$EU(\text{Not buy}|-t) = 0.08 \cdot 0 + 0.92 \cdot 0 = 0$

$MEU(B|+t) = 3570 \quad MEU(B|-t) = 0$

$VPI(T) = \sum_t P(t) \cdot MEU(B|t) - MEU(buy)$

$= 0.63 \cdot 3570 \cdot 0.37 \cdot 0 - 380$

$= 1869.1$ is the max amount. //

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6)

A	D	S	T	Weight
+o	d	+s	+t	0.57
+o	d	-s	+t	0.114

$P(d \mid +o, +t)$

$\prod_e P(+o) \cdot P(+t \mid +s) = 0.6 \cdot 0.95 = 0.57$

$\prod_e P(+o) \cdot P(+t \mid -s) = 0.6 \cdot 0.19 = 0.114$

7) $P(S \mid A, D, T) = \dfrac{P(S, A, D, T)}{P(A, D, T)}$

$$P(S \mid A, D, T) = \frac{P(A) \cdot P(D) \cdot P(S \mid A, D) \cdot P(T \mid S)}{\sum_S P(A) \cdot P(D) \cdot P(S \mid A, D) \cdot P(T \mid S)}$$

$$= \frac{P(S \mid A, D) \cdot P(T \mid S)}{\sum_S P(S \mid A, D) \cdot P(T \mid S)}$$

$$P(S \mid -o, n, -t) = \frac{P(S \mid -o, n) \cdot P(-t \mid S)}{\sum_S P(S \mid -o, n) \cdot P(-t \mid S)}$$

$0.7 \cdot 0.05 + 0.3 \cdot 0.81 = 0.278$

S	$P(S \mid -o, n, -t)$
+s	$0.7 \cdot 0.05 / 0.278 = 0.126$
-s	$0.3 \cdot 0.81 / 0.278 = 0.874$. //