FUDAN UNIVERSITY 1905 復旦大學

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Pg 4.

Car.

1a. $P(C_2=1|D_2=0) = \sum_{C_1} P(C_1) P(C_2=1|C_1) P(D_2=0|C_2=1).$

$= P(C_1=0) P(C_2=1|C_1=0) P(D_2=0|C_2=1) + P(C_1=1) P(C_2=1|C_1=1) P(D_2=0|C_2=1)$

$= 0.5 \cdot \varepsilon \cdot \eta + 0.5 \times (1-\varepsilon) \cancel{\times (1-\eta)}\, \eta$

$= 0.5\eta$

$P(C_2=0|D_2=0) = 0.5(1-\varepsilon)(1-\eta) + \cancel{0.5\varepsilon}\, 0.5\varepsilon(1-\eta) = 0.5(1-\eta).$

~~B~~ Normalize, then we get

$P(C_2=1|D_2=0) = \eta.$

~~broadcast. X one by one.~~

1b. $P(C_2=1|D_2=0, D_3=1)$

$= \sum_{C_1} P(C_1) P(C_2=1|C_1) P(D_2=1|C_2=1) * \sum_{C_3} P(C_3|C_2=1) P(D_3=1|C_3).$

$= [0.5\varepsilon\eta + 0.5(1-\varepsilon)\eta][\varepsilon\eta + (1-\varepsilon)(1-\eta)].$

$= 0.5\eta(\varepsilon\eta + (1-\varepsilon)(1-\eta))$ The same, ~~to~~ we have:

$P(C_2=0|D_2=0, D_3=1)$

$= 0.5(1-\eta)[(1-\varepsilon)\eta + \varepsilon(1-\eta)]$

normalize:

$$P(C_2=1|D_2=0, D_3=1) = \frac{①}{①+②} = \frac{\varepsilon\eta^2 + (1-\varepsilon)(1-\eta)\eta}{\varepsilon\eta^2 + 2(1-\varepsilon)(1-\eta)\eta + \varepsilon(1-\eta)^2}.$$

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1c.

i $P(C_2=1 \mid D_2=0) = y$ (from 1a). $= 0.2$.

$P(C_2=1 \mid D_2=0, D_3=1) = 0.4157$.

ii. From $D_3=1$ we can infer that C_3 ~~is~~ probably equals 1, and C_2 is probably the same as C_3, so it increase the belief of $C_2=1$.

iii. $$y = \frac{\varepsilon y^2 + (1-\varepsilon)(1-y)y}{\varepsilon y^2 + 2(1-\varepsilon)(1-y)y + \varepsilon(1-y)^2},$$

$$\varepsilon y^2 + 2(1-\varepsilon)(1-y)y + \varepsilon(1-y)^2 = \varepsilon y + (1-\varepsilon)(1-y).$$ set $y = 0.2$.

$\Rightarrow \varepsilon = 0.5$.

This shows $D_3=1$ doesn't gives us any ~~more~~ new information. So we can know that it should be C_3 have no link ~~by~~ to C_2. and ε should be 0.5.