APS - probability & statistics - problem set 2 ①

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FR - forecast rain

AR - Actual rain

AR' - no rain

FR' - forecast no rain

1) $P(FR \cap AR) = 0.4$

$P(FR \cap AR') = 0.2$

$P(FR' \cap AR) = 0.15$

$P(FR' \cap AR') = 0.25$

a) $\underbrace{P(FR \cap AR)}_{0.4} + \underbrace{P(FR \cap AR')}_{0.2}$

b) $\underbrace{P(FR \cap AR')}_{0.2} + \underbrace{P(FR' \cap AR)}_{0.15}$

c) $P(A|B) = \dfrac{P(A \cap B)}{P(B)}$

$$P(AR \mid FR) = \frac{P(AR \cap FR)}{P(FR)}$$

$$= \frac{P(AR \cap FR) \leftarrow 0.4}{\underbrace{P(FR \cap AR)}_{0.4} + \underbrace{P(FR \cap AR')}_{0.2}}$$

d)

$$P(FR \mid AR) = \frac{P(FR \cap AR) \leftarrow 0.4}{\underbrace{P(FR \cap AR)}_{0.4} + \underbrace{P(FR' \cap AR)}_{0.15}}$$

2) a) P(ectopic pregnancy | smoker) = 2 P(ectopic pregnancy | not smoker)

b) since only info of women @ child bearing age given. (no info about women of other age groups in question)

~~P(~~ ~~women~~ P(smoker) = 0.32

c) ~~1 - 0.32~~

P(non - smoker) = 1 - 0.32 = 0.68

d) $$P(\text{smoker} \mid EP) = \frac{P(EP \mid \text{smoker})\, P(\text{smoker})}{P(EP)}$$

$$= \frac{P(EP \mid \text{smoker})\, P(\text{smoker})}{P(EP \mid S)\, P(S) + P(EP \mid \text{not smoker}) \times P(\text{not smoker})}$$

$$= \frac{\cancel{P(E|S)}\, P(S)}{\cancel{P(E|S)}\, P(S) + \frac{\cancel{P(E|S)}}{2} \times P(\text{not smoker})}$$

$$= \frac{P(S)^{\leftarrow 0.32}}{\underset{\uparrow\, 0.32}{P(S)} + \frac{P(\text{not smoker})}{2}^{\leftarrow 0.68}}$$

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problem set 2

6(a)

P (transfusion success) = P (Receiver O^- & Donor O^-) +

P (Re O+ & Do O-) + P (Re O+ & Do O+)

+ P (Re A- & Do O-) + P (Re A- & Do A-)

+ P (Re A_+ & Do O-) + ... so on

6(b) population - fraction of people with O^- & A^- is less, hospitals should make sure to stock these up when they get chance - for emergency cases.

6(c) A^+ only

$$P\left(\begin{matrix}\text{wonded soldier} \\ \text{is } A^+ \text{ or } AB^+\end{matrix}\right) = \frac{357+34}{1000} \times 100 = 39.1\%$$

$$P\left(\begin{matrix}\text{one of 2} \\ \text{soldiers belong} \\ \text{to } O^-\end{matrix}\right) = 6.6\%$$

So testing should be done on wounded soldieers as more probability

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520 - women

3 ~~B~~) 1000 students

50 → CS students

women in CS → 20

a) $P(\text{female student} \mid CS) = 2/5$

b) $P(CS \mid \text{female}) = 2/52$

4) $P(S) = 0.002$ $P(PC \mid S) = 0.25$

$P(E) = 0.002$ $P(PC \mid E) = 0.3$

$P(CS) = 0.01$ $P(PC \mid CS) = 0.9$

$P(HE) = 0.001$ $P(PC \mid HE) = 0.1$

$$P(CS \mid PC) = \frac{P(PC \mid CS)\, P(CS)}{P(PC)}$$

$$= \frac{P(PC \mid CS)\, P(CS)}{P(PC \mid S)\, P(S) + P(PC \mid E)\, P(E) + P(PC \mid CS)\, P(CS) + P(PC \mid HE)\, P(HE)}$$

$$= \frac{(0.9)(0.01)}{\cancel{(0.9)(0.25)+}\ (0.9)(0.01) + (0.3)(0.002) + (0.9)(0.01) + (0.1)(0.001)}$$

5)

Locations : L_1 and L_2 $\rightarrow$

$P(L_1) = 0.80$

$P(L_2) = 0.20 \rightarrow$ has window

$P(\text{obs } w \mid w^c) = 0.2 \rightarrow L_1$

$P(\text{obs } w \mid w) = 0.9 \rightarrow L_2$

$P(L_1 \mid \text{obs } w) = ?$

$P(L_2 \mid \text{obs } w) = ?$

$$P(L_1 \mid \text{obs } w) = \frac{\overset{0.9}{P(\text{obs } w \mid L_1)}\ \overset{0.8}{P(L_1)}}{\left(P(\text{obs } w \mid w^c)\, P(\cancel{\text{obs}}\ w^c) + P(\text{obs } w \mid w)\, P(w)\right)}$$

$$= \cancel{(0.9)}\ \frac{(0.2)(0.8)}{(0.2)(0.8) + (0.9)(0.8)}$$

$$P(L_2 \mid \text{obs } w) = \frac{P(\text{obs } w \mid \overset{w}{L_2})\, P(L_2)}{P(\text{obs } w \mid w^c)\, P(w^c) + P(\text{obs } w \mid w)\, P(w)}$$

$$= \frac{(0.9)(0.2)}{(0.2)(0.8) + (0.9)(0.8)}$$