

Assignment 6

1. $P(HBP) = \sum_{Sm} \sum_{ME} P(HBP, Sm, ME)$
 $P(HBP) = \sum_{Sm} \sum_{ME} P(HBP|Sm, ME) * P(Sm) * P(ME)$
 $P(HBP) = 0.6*0.2*0.5 + 0.72*0.2*0.5 + 0.33*0.8*0.5 + 0.51*0.8*0.5$
 $P(HBP) = 0.47$

2. $P(HD) = \sum_{Ath} \sum_{HBP} \sum_{FH} P(HD, Ath, HBP, FH)$
 $P(HD) = \sum_{Ath} \sum_{HBP} \sum_{FH} P(HD|Ath, HBP, FH) * P(Ath) * P(HBP) * P(FH)$
 Here's a table for each component and then summed at the bottom

Ath	HBP	FH	P(HD)	P(Ath)	P(HBP)	P(FH)	P(HD,Ath,HBP,FH)
y	y	y	0.92	0.53	0.47	0.15	0.03
y	y	n	0.91	0.53	0.47	0.85	0.19
y	n	y	0.81	0.53	0.53	0.15	0.03
y	n	n	0.77	0.53	0.53	0.85	0.19
n	y	y	0.75	0.47	0.47	0.15	0.02
n	y	n	0.69	0.47	0.47	0.85	0.13
n	n	y	0.38	0.47	0.53	0.15	0.01
n	n	n	0.23	0.47	0.53	0.85	0.05
Total							0.66

$$P(HD) = 0.66$$

$$3. P(HD | \text{Rapid}) = \frac{P(\text{Rapid} | HD) * P(HD)}{P(\text{Rapid})}$$

$$P(HD | \text{Rapid}) = \frac{P(\text{Rapid} | HD) * P(HD)}{\sum_{HD} P(HD, \text{Rapid})}$$

$$P(HD | \text{Rapid}) = \frac{0.99 * 0.66}{0.99*0.66+0.35*0.3}$$

$$P(HD | \text{Rapid}) = 0.86$$

$$4. P(HBP | HD, FH) = \frac{P(HD, FH, HBP)}{P(HD, FH)}$$

First I need to figure out the P(HD, FH) which is shown by the following table:

Ath	HBP	FH	P(HD)	P(Ath)	P(HBP)	P(FH)	P(HD,Ath,HBP,FH)
y	y	y	0.92	0.53	0.46	0.15	0.03
y	n	y	0.81	0.53	0.54	0.15	0.03
n	y	y	0.75	0.47	0.46	0.15	0.02
n	n	y	0.38	0.47	0.54	0.15	0.01
Total							0.11

Now, I can use this data to find the P(HD,FH, HBP) with the following data points:

Ath	HBP	FH	P(HD)	P(Ath)	P(HBP)	P(FH)	P(HD,Ath,HBP,FH)
y	y	y	0.92	0.53	0.46	0.15	0.03
n	y	y	0.75	0.47	0.46	0.15	0.02
Total							0.06

Now I just put everything into the equation to solve:

$$P(\text{HBP} \mid \text{HD}, \text{FH}) = \frac{0.06}{0.11}$$

$$P(\text{HBP} \mid \text{HD}, \text{FH}) = 0.55$$

$$5. P(\text{Sm} \mid \text{HD}) = \frac{P(\text{HD}|\text{Sm}) * P(\text{Sm})}{P(\text{HD})}$$

$$P(\text{Sm} \mid \text{HD}) = \frac{P(\text{HD,HBP}) * P(\text{HBP}) * P(\text{HBP,Sm}) * P(\text{Sm})}{P(\text{HD})}$$

Now, I can find the probability of Heart Disease given High Blood Pressure by adding the different probabilities

Ath	HBP	FH	P(HD)	P(Ath)	P(HBP)	P(FH)	P(HD,Ath,HBP,FH)
y	y	y	0.92	0.53	1	0.15	0.07
y	y	n	0.91	0.53	1	0.85	0.41
n	y	y	0.75	0.47	1	0.15	0.05
n	y	n	0.69	0.47	1	0.85	0.28
Total							0.81

$$\text{The } P(\text{HBP,Sm}) = \sum_{\text{Sm}} P(\text{HBP}, \text{Sm}, \text{ME})$$

$$P(\text{HBP,Sm}) = 0.6 * 0.5 * 1 + 0.72 * 0.5 * 1$$

$$P(\text{HBP,Sm}) = 0.66$$

Now, I just substitute everything into the equation and solve.

$$P(\text{Sm} \mid \text{HD}) = \frac{P(\text{HD}, \text{HBP}) * P(\text{HBP}) * P(\text{HBP}, \text{Sm}) * P(\text{Sm})}{P(\text{HD})}$$

$$P(\text{Sm} \mid \text{HD}) = \frac{0.81 * 0.47 * 0.66 * 0.2}{0.65}$$

$$P(\text{Sm} \mid \text{HD}) = 0.07$$

6. The probability in question 5 would increase because now you know that the person has high blood pressure which can be caused by smoking. Because of this, you don't need to multiply by $P(\text{HBP})$ in the above equation. As such, the numerator is larger increasing the probability to 0.16.

$$7. P(\text{Me} \mid \text{Ang}) = \frac{P(\text{Ang}, \text{HD}) * P(\text{HD}) * P(\text{HD}, \text{HBP}) * P(\text{HBP}) * P(\text{HBP}, \text{ME}) * P(\text{ME})}{P(\text{Ang})}$$

First we solve for $P(\text{HBP}, \text{ME})$ which is:

$$\text{The } P(\text{HBP}, \text{ME}) = \sum_{\text{ME}} P(\text{HBP}, \text{Sm}, \text{ME})$$

$$P(\text{HBP}, \text{ME}) = 0.6 * 1 * 0.2 + 0.33 * 1 * 0.8$$

$$P(\text{HBP}, \text{ME}) = 0.38$$

We can calculate the $P(\text{Ang})$ as well:

$$P(\text{Ang}) = \sum_{\text{HD}} P(\text{Ang}, \text{HD})$$

$$P(\text{Ang}) = 0.85 * 0.66 + 0.4 * 0.34$$

$$P(\text{Ang}) = 0.70$$

As we've solved for the other probabilities above, we can just substitute everything into the equation in order to solve:

$$P(\text{Me} \mid \text{Ang}) = \frac{0.85 * 0.66 * 0.81 * 0.47 * 0.38 * 0.5}{0.7}$$

$$P(\text{Me} \mid \text{Ang}) = 0.058$$