EE6435 Assignment 2.

Saturday, March 9, 2019
1:43 PM

(a)

Q1: $P(A|+) = \frac{P(A \cap +)}{P(+)} = \frac{4}{10} \cdot 2 = \frac{4}{5}$

$P(B|+) = \frac{P(B \cap +)}{P(+)} = \frac{1}{10} \cdot 2 = \frac{1}{5}$

$P(C|+) = \frac{P(C \cap +)}{P(+)} = \frac{3}{10} \cdot 2 = \frac{3}{5}$

$P(A|-) = \frac{P(A \cap -)}{P(-)} = \frac{1}{2} / \frac{1}{2} = 1$

$P(B|-) = \frac{P(B \cap -)}{P(-)} = \frac{2}{10} \cdot 2 = \frac{2}{5}$.

$P(C|-) = \frac{P(C \cap -)}{P(-)} = \frac{1}{5} \cdot 2 = \frac{2}{5}$.

(b) $P(+|A=0, B=1, C=0) = \frac{P(+ \cap A=0, B=1, C=0)}{P(A=0, B=1, C=0)}$

$= \frac{P(A=0, B=1, C=0|+) P(+)}{P(A=0, B=1, C=0)}$

$= \frac{P(A=0|+) P(B=1|+) P(C=0|+) \cdot P(+)}{P(A=0, B=1, C=0)}$

$= \frac{\frac{1}{2} \cdot \frac{1}{5} \cdot \frac{2}{5} \cdot \frac{1}{5}}{P(A=0, B=1, C=0)}$

$P(-|A=0, B=1, C=0) = \frac{P(-, A=0, B=1, C=0)}{P(A=0, B=1, C=0)}$

$= \frac{P(A=0, B=1, C=0, -)}{P(A=0, B=1, C=0)} = \frac{P(A=0|-) P(B=1|-) P(C=0|-) P(-)}{P(A=0, B=1, C=0)}$

$= 0$

the prediction result is +.

(c) $m=4$ $p=\frac{1}{2}$ $mp=2$

$\Rightarrow P(A=1|+)=\frac{4/2}{5+4}=\frac{2}{9}$ $P(A=0|+)=\frac{3}{9}$

$P(B=1|+)=\frac{3}{9}$ $P(B=0|+)=\frac{6}{9}$

$P(C=1|+)=\frac{5}{9}$ $P(C=0|+)=\frac{4}{9}$

$P(A=0|-)=\frac{2}{9}$ $P(A=1|-)=\frac{7}{9}$.

$P(B=0|-)=\frac{5}{9}$ $P(B=1|-)=\frac{4}{9}$

$P(C=0|-)=\frac{5}{9}$ $P(C=1|-)=\frac{4}{9}$

(d) $P(+|A=0,B=1,C=0)=\frac{P(A=0|+)P(B=1|+)P(C=0|+)P(+)}{P(A=0,B=1,C=0)}=\frac{\frac{3}{9}\cdot\frac{3}{9}\cdot\frac{4}{9}\cdot\frac{1}{2}}{P(A=0,B=1,C=0)}$

$=\frac{2}{81}\frac{1}{P(A=0,B=1,C=0)}$

$P(-|A=0,B=1,C=0)=\frac{P(A=0|-)P(B=1|-)P(C=0|-)P(-)}{P(A=0,B=1,C=0)}$

$=\frac{20}{729}\frac{1}{P(A=0,B=1,C=0)}$

The prediction result is $-$

(e) The dataset size is small so it is very easy to get a 0 value when computing, and this will lead to the classification error, so the m-approach is better to avoid this.

Q2 (a) $P(A=1|+)=\frac{4}{5}$ $P(B=1|+)=\frac{2}{5}$ $P(C=1|+)=\frac{3}{5}$

$P(A=1|-)=\frac{1}{5}$ $P(B=1|-)=\frac{2}{5}$ $P(C=1|-)=\frac{2}{5}$.

(b) $P(+|A=1,B=1,C=1) = \frac{P(A=1|+)\,P(B=1|+)\,P(C=1|+)\cdot P(+)}{P(A=1,B=1,C=1)}$

$= \frac{2}{125}\left(\frac{}{P(A=1,B=1,C=1)}\right)$

$P(-|A=1,B=1,C=1) = \frac{P(A=1|-)\,P(B=1|-)\,P(C=1|-)\cdot P(-)}{P(A=1,B=1,C=1)}$

$= \frac{2}{125}\,\frac{}{P(A=1,B=1|C=1)}$

Prediction is +

~~(a) $P(B=1)=\frac{2}{5}$ $P(C=1)=\frac{1}{2}$ $P(B=1,C=1)=\frac{2}{10}=\frac{1}{5}$~~

~~$P(B,C)=P(B)\cdot P(C)$.~~

(c) $P(B=1)=\frac{2}{5}$ $P(C=1)=\frac{1}{2}$ $P(B=1,C=1)=\frac{2}{10}=\frac{1}{5}$

$P(B,C)=P(B)\cdot P(C)$.

(d) $P(A=1)=\frac{1}{2}$ $P(B=0)=\frac{3}{5}$ $P(A=1,B=0)=\frac{3}{10} \neq P(A=1)\cdot P(B=0)$

(e) $P(C=1,B=1|+) = \frac{P(C,B,+)}{P(+)} = \frac{1}{5}$

$P(C=1|+)=\frac{3}{5}$ $P(B=1|+)=\frac{2}{5}$

not independent for $P(C=1,B=1|+) \neq P(C=1|+)\cdot P(B=1|+)$.

Q3:

Mileage	
Hi	Lo
$\frac{23}{41}$	$\frac{18}{41}$

Air condition.	
working	Broken
$\frac{27}{41}$	$\frac{14}{41}$

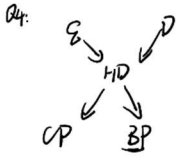
		Mileage: Hi	Mileage: Lo.
Engine	Good	$\frac{13}{23}$	$\frac{14}{18}$
Engine	Bad.	$\frac{10}{23}$	$\frac{4}{18}$

		E=G A=W	E=G A=B	E=B A=W	E=B A=B.
Car value	Hi	$\frac{13}{18}$	$\frac{5}{9}$	$\frac{2}{9}$	0
Car value	Lo	$\frac{5}{18}$	$4/9$	$7/9$	1

$P(E=B, A=B)$  $\Rightarrow$ E and A independent to each other.

$P(E=B, A=B) = P(E=B) \cdot P(A=B) = \frac{14}{41} \cdot \frac{14}{41} = 0.1165$

Q4:



$P(BP=low) = P(BP=low, HD=Y) + P(BP=low, HD=N)$.

$= P(BP=low|HD=Y)P(HD=Y) + P(BP=low|HD=N)P(HD=N)$

$P(HD=Y) = P(HD=Y, E=H, D=Y) + P(HD=Y, E=M, D=N) + P(HD=Y, E=M, D=Y) + P(HD=Y, E=M, D=N)$

$= P(HD=Y|E=H, D=Y) \cdot P(E=H)P(D=Y) + \cdots$

$= 0.25 \cdot 0.7 \times 0.25 + 0.45 \times 0.7 \times 0.75 + 0.55 \times 0.3 \times 0.25 + 0.75 \times 0.3 \times 0.75$

$= 0.4$.

$P(HD=N) = 0.51$.

$P(BP=low) = 0.4815$

(b) $P(HD=yes \mid BP=low) = \frac{P(BP=low \mid HD=yes) \cdot P(HD=yes)}{P(BP=low)} = \frac{0.15 \times 0.49}{0.4815} = 0.1526$

(c) $P(HD=yes \mid BP=H, D=H, E=NO) = \frac{P(HD, BP, D, \bar{E})}{P(BP, D, \bar{E})} = \frac{P(BP \mid HD) \cdot P(\bar{E}, D, HD)}{P(BP, D, \bar{E})}$.

$$= \frac{P(BP \mid HD)\, P(HD \mid E, D) \cdot P(E, D)}{P(BP, D, \bar{E})}$$

$P(BP, D, E) = P(BP \mid D, E) P(D, E) + P(BP \mid \bar{D}, E) P(\bar{D}, E) + P(BP \mid D\bar{E}) P(D, \bar{E}) + \ldots\ldots$

$\Rightarrow P(ED) = P(\bar{E}) \cdot P(D)$.

$\Rightarrow P(HD=Y \mid BP=High, D=healthy, E=NO)$

$= 0.8386$.