

Naïve Bayes

Outline

- Probability Review
 - Conditional Probability
 - Bayes Theorem
 - Conditional Independence
- Naïve Bayes Classifier

Example of Bayes Rule

- Givens
 - A doctor knows that meningitis causes stiff neck 50% of the time
 - Prior probability of any patient having meningitis is 1/50,000
 - Prior probability of any patient having stiff neck is 1/20
- If a patient has stiff neck, what's the probability he/she has meningitis?

$$P(M | S) = \frac{P(S | M)P(M)}{P(S)} = \frac{0.5 \times 1/50000}{1/20} = 0.0002$$

Example of Naïve Bayes Classifier

Test Record: $X = (\text{Sex} = \text{Male}, \text{Age} = 32, \text{Pclass} = 2)$

$$P(\text{Sex}=\text{Male}|\text{No}) = 6/7$$

$$P(\text{Sex}=\text{Female}|\text{No}) = 0$$

$$P(\text{Sex}=\text{Male}|\text{Yes}) = 1/7$$

$$P(\text{Sex}=\text{Female}|\text{Yes}) = 1$$

$$P(\text{Pclass}=1|\text{No}) = 2/4$$

$$P(\text{Pclass}=2|\text{No}) = 1/2$$

$$P(\text{Pclass}=3|\text{No}) = 1/4$$

$$P(\text{Pclass}=1|\text{Yes}) = 2/4$$

$$P(\text{Pclass}=2|\text{Yes}) = 1/2$$

$$P(\text{Pclass}=3|\text{Yes}) = 3/4$$

$$\text{Mean}(\text{Age}|\text{No}) = 41.5$$

$$\text{Var}(\text{Age}|\text{No}) = 262$$

$$\text{Mean}(\text{Age}|\text{Yes}) = 28$$

$$\text{Var}(\text{Age}|\text{Yes}) = 1.6$$

- $$\begin{aligned} P(X|\text{Class}=\text{No}) &= P(\text{Sex}=\text{Male}|\text{No}) \\ &\quad \times P(\text{Pclass}=2|\text{No}) \\ &\quad \times P(\text{Age}=32|\text{No}) \\ &= 6/7 \times 1/2 \times 0.0204 = 0.0128 \end{aligned}$$

$$P(X|\text{No})P(\text{No}) = 0.0128 \times 6/10 = 0.00768$$

- $$\begin{aligned} P(X|\text{Class}=\text{Yes}) &= P(\text{Sex}=\text{Male}|\text{Yes}) \\ &\quad \times P(\text{Pclass}=2|\text{Yes}) \\ &\quad \times P(\text{Age}=32|\text{Yes}) \\ &= 1/7 \times 1/2 \times 0.0021 = 0.00015 \end{aligned}$$

$$P(X|\text{Yes})P(\text{Yes}) = 0.00015 \times 4/10 = 6 \times 10^{-5}$$

$$P(X|\text{No})P(\text{No}) > P(X|\text{Yes})P(\text{Yes})$$

Therefore $P(\text{No}|X) > P(\text{Yes}|X)$

=> Class = No

End of Slide Sample

4 of 21 slides in presentation