

Exercise Naive Bayes - Tennis

Tennis-Example: Shall we play Tennis?

Day	Outlook	Temp.	Humidity	Wind	Decision
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cool	Normal	Weak	Yes
6	Rain	Cool	Normal	Strong	No
7	Overcast	Cool	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cool	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

Learning Phase: probability tables

Outlook	Yes	No
Sunny	2/9	3/5
Overcast	4/9	0
Rain	3/9	2/5

Temp	Yes	No
Hot	2/9	2/5
Mild	4/9	2/5
Cool	3/9	1/5

Humidity	Yes	No
High	3/9	4/5
Normal	6/9	1/5

Wind	Yes	No
Strong	3/9	3/5
Weak	6/9	2/5

$$P(\text{Decision} = \text{Yes}) = 9/14 ; P(\text{Decision} = \text{No}) = 5/14$$

Given the following data, which decision should we make?

1. $X'_1 = (\text{Outlook} = \text{Sunny})$

$$P(\text{Yes} | x') \approx P(\text{Sunny} | \text{Yes}) P(\text{Play} = \text{Yes}) = 2/9 * 9/14 = 1/7$$

$$P(\text{No} | x') \approx P(\text{Sunny} | \text{No}) P(\text{Play} = \text{No}) = 3/5 * 5/14 = 3/14$$

→ Decision for NO

2. $X'_2 = (\text{Outlook} = \text{sunny}; \text{Wind} = \text{weak})$

→ Decision for YES

3. $X'_3 = (\text{Outlook} = \text{sunny}; \text{Temperature} = \text{Hot}; \text{Humidity} = \text{High}, \text{Wind} = \text{Weak})$

→ Decision for NO

4. $X'_4 = (\text{Outlook} = \text{Sunny}; \text{Temperature} = \text{Cool}; \text{Humidity} = \text{High}, \text{Wind} = \text{Strong})$. How high is the probability for this decision?

$$P(\text{Outlook}=\text{Sunny} | \text{Play}=\text{Yes}) = 2/9$$

$$P(\text{Temperature}=\text{Cool} | \text{Play}=\text{Yes}) = 3/9$$

$$P(\text{Humidity}=\text{High} | \text{Play}=\text{Yes}) = 3/9$$

$$P(\text{Wind}=\text{Strong} | \text{Play}=\text{Yes}) = 3/9$$

$$P(\text{Play}=\text{Yes}) = 9/14$$

$$P(\text{Outlook}=\text{Sunny} | \text{Play}=\text{No}) = 3/5$$

$$P(\text{Temperature}=\text{Cool} | \text{Play}=\text{No}) = 1/5$$

$$P(\text{Humidity}=\text{High} | \text{Play}=\text{No}) = 4/5$$

$$P(\text{Wind}=\text{Strong} | \text{Play}=\text{No}) = 3/5$$

$$P(\text{Play}=\text{No}) = 5/14$$

$$P(\text{Yes} | x') \approx [P(\text{Sunny} | \text{Yes})P(\text{Cool} | \text{Yes})P(\text{High} | \text{Yes})P(\text{Strong} | \text{Yes})]P(\text{Play}=\text{Yes}) = 0.0053$$

$$P(\text{No} | x') \approx [P(\text{Sunny} | \text{No})P(\text{Cool} | \text{No})P(\text{High} | \text{No})P(\text{Strong} | \text{No})]P(\text{Play}=\text{No}) = 0.0206$$

➔ Decision for NO

➔ How high is the probability for „NO”? $0.0206/(0.0206+0.0053) = 0.795$