

Naive Bayes → Part 2

Bayes Theorem

$$P(B/A) = \frac{P(B) * P(A/B)}{P(A)}$$

→ **BAYES THEOREM**

Supervised ML

↓ CLASSIFICATION

X_1	X_2	X_3	X_4
—	—	—	—
—	—	—	—

Y
0/1

No

Yes ✓

$$P(\overset{\downarrow}{Y} / \overset{A}{\underbrace{X_1, X_2, X_3, X_4 \dots X_n}}) = \frac{P(Y) * P(X_1, X_2, X_3, X_4 \dots X_n / Y)}{P(X_1, X_2, X_3 \dots X_n)}$$

$$= \frac{P(Y) * P(X_1/Y) * P(X_2/Y) * P(X_3/Y) \dots P(X_n/Y)}{}$$

Constant → ~~$P(X_1) P(X_2) P(X_3) \dots P(X_n)$~~

$$P(N / X_1, X_2, X_3 \dots X_n) = \frac{P(N) * P(X_1/Y) * P(X_2/Y) * \dots * P(X_n/Y)}{}$$

Constant → ~~$P(X_1) * P(X_2) * P(X_3) \dots P(X_n)$~~

Day	Outlook	Temperature	Humidity	Wind	Play Tennis
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D7	Overcast	Cool	Normal	Strong	Yes
D8	Sunny	Mild	High	Weak	No
D9	Sunny	Cool	Normal	Weak	Yes
D10	Rain	Mild	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No

Outlook

$P(\text{Sunny}|\text{Yes})$

Sunny

Overcast

Rain

Yes

No

$P(Y)$

$P(N)$

2

3

$\frac{2}{9}$

$\frac{3}{5}$ ✓

4

0

$\frac{4}{9}$

$\frac{0}{5}$

3

2

$\frac{3}{9}$

$\frac{4}{5}$

9

5

= 14

Temperature

Yes

No

$P(Y)$

$P(N)$

Hot

2

2

$\frac{2}{9}$

$\frac{2}{5}$

Mild

4

2

$\frac{4}{9}$

$\frac{2}{5}$

Cold

3

1

$\frac{3}{9}$

$\frac{1}{5}$

9

5

PLAY

Yes

9

$P(Y)$

$P(N)$

$\frac{9}{14}$

$\frac{5}{14}$

No

5

14

New Data

→ Test (Sunny, Hot) → ??

$$P(\text{Yes} | \text{Sunny}, \text{Hot}) = P(\text{Yes}) * P(\text{Sunny} | \text{Yes}) * P(\text{Hot} | \text{Yes})$$

$$P(\text{No} | \text{Sunny}, \text{Hot}) = P(\text{No}) * P(\text{Sunny} | \text{No}) * P(\text{Hot} | \text{No})$$

$$P(\text{Yes} | \text{Sunny}, \text{Hot}) = \frac{9}{14} * \frac{2}{9} * \frac{2}{9}$$

$$= \frac{2}{63} = 0.031$$

$$\begin{aligned}
 P(\text{No} / \text{Sunny}, \text{Hot}) &= P(\text{No}) * P(\text{Sunny} / \text{No}) * P(\text{Hot} / \text{No}) \\
 &= \cancel{5/14} * 3/5 * \cancel{2/5} \\
 &= \frac{3}{35} = \underline{\underline{0.085}}
 \end{aligned}$$

$$P(\text{Yes} / \text{Sunny}, \text{Hot}) = \frac{0.031}{0.031 + 0.085} = 27\%$$

$$P(\text{No} / \text{Sunny}, \text{Hot}) = \frac{0.085}{0.031 + 0.085} = 73\%$$

Naive Bayes
Theorem

→ Sunny, Hot → O/p → No = 0.73

Assignment → (overcast, Mild) → O/p??