Probability and Baye's theorem

Probability → Share of success | Total no of possible outcomes.

eg: if you toss a coin, what is the probability that you will get a head?

→ $P(X=H) = 1/2 = 0.5$

eg: dice is rolled. What is the probability that the outcome is an even no?

→ 1, 2, 3, 4, 5, 6

↑ ↑ ↑

$P(\text{Even no}) = \frac{3}{6}$

* **Probability rules:-**

① For any event A → $0 \leq P(A) \leq 1$

② The sum of all probabilities of all possible outcome is 1.

$P(H)$ or $P(T)$

$P(H) + P(T) = 1$

$P(T) = 1 - P(H)$ ← rule of substraction.

③ **Complement rule**

$P(\text{not } A) = 1 - P(A)$

→ $P(H) = 1/2$

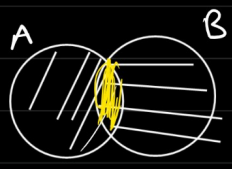
$P(\text{not } H) = 1 - \frac{1}{2} = \frac{1}{2}$

→ $P(3) = 1/6$

$P(\text{not } 3) = 1 - \frac{1}{6} = \frac{5}{6}$.

④ General addition rule

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$



$P(A) + P(B) - P(A \text{ and } B)$

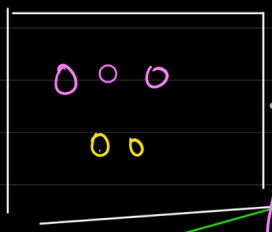
↓

$A \cap B$, $B \cap A$

⑤ Multiplication rule

Events

- Independent events
  - → Tossing a coin
  - → Throwing a dice
- Dependent event



$P(Y) = \frac{2}{5}$ → one yellow ball is taken out → $P(Y) = \frac{1}{4}$

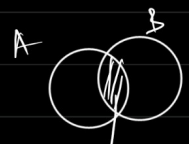
$P(R) = \frac{3}{5}$ → one yellow ball is taken out → $P(R) = \frac{3}{4}$

$P(R \text{ and } Y) = P(R) \times P(Y/R)$

$= \frac{3}{5} \times \frac{3}{4}$

→ The probability is changing based on the last event.

These are called dependent events.



A and B or B and A } same

And if events are dependent

$$P(A \text{ and } B) = \underbrace{P(A)}_{\text{Prob of A}} \times P(B/A)$$

↓ Probability of event B when A has already occurred.

$$P(A \text{ and } B) = P(A) * P(B/A) \quad \text{—①}$$

$$P(B \text{ and } A) = P(B) * P(A/B) \quad \text{—②}$$

equating eqn ① & ②

$$P(A) * P(B/A) = P(B) * P(A/B)$$

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

← Bayes theorem

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

$P(A/B)$ = Prob of event A given B has already occurred

$P(B/A)$ = Prob of event B, given A has already occurred.

$P(A), P(B)$ → Independent Prob of A and B

Q 10% of patients in a clinic have liver disease. Five percent of the clinical patients are alcoholics. Among these patients diagnosed with liver disease 7% are alcoholic.

What is prob of patients having liver disease given that he is an alcoholic?

→ $P(A)$ = Prob of having liver disease = 0.10

$P(B)$ = Prob of alcoholism = 0.05

$P(B/A) = 0.07$

$P(A/B) = ?$

$$= P(A/B) = \frac{P(B/A) \cdot P(A)}{P(B)} = \frac{0.07 \times 0.10}{0.05} = 0.14$$

$\Rightarrow 14\%$.

* Use of Bayes theorem

↳ Naive Bayes classifier ML model.

Bayesian Statistics

↓

data analysis and parameter estimation based on bayes theorem

x_1 # of rooms	x_2 Area	x_3 locality	y Price
—	—	—	=
—	—	—	—

$$P(y/x_1 x_2 x_3) = \frac{P(y) \cdot P(x_1 x_2 x_3/y)}{P(x_1 x_2 x_3)}$$

A, B, A, P(B/A), P(B)

Bayes theorem.