Probability and Baye's theorem.

Probability → Share of Success | Total No of Possible outcomes.

ex. if you toss a coin, what is the probability that you will get a head?

→ $P(H) = \frac{1}{2} = 0.5$

ex. dice is rolled. What is 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 outcomes is 1.

Rule of Subtraction.

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

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

$\underline{\underline{P(T) = 1 - P(H)}}$

③ Complement rule

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

④ General addition rule

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

⑤ The multiplication rule

Events

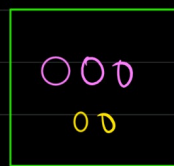Independent events → Dependent events

* Independent events

→ Tossing a coin

→ Throwing a dice

✓ $Pr(1) = 1/6$

* Dependent Event

Scen-1

$\boxed{\begin{matrix} OOO \\ OO \end{matrix}}$ → $P(Y) = \dfrac{2}{5}$ $\xrightarrow{\text{One yellow ball is taken out}}$ $P(Y) = \dfrac{1}{4}$

Scen-2 $P(R) = \dfrac{3}{5}$ $\xrightarrow{\text{One yellow ball is taken out}}$ $P(R) = 3/4$

$P(R \text{ and } Y) = P(R) * P(Y/R)$
$\qquad\qquad\qquad 3/5 \times 3/4$

$\rightarrow P(A \text{ and } B) = P(A) \times P\left(\dfrac{B}{A}\right)$

✓ $P(B/A) =$ Probability of event B when A has already occurred
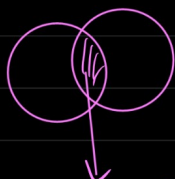
A and B
or
B and A $\Big\}$ same

$P(A \text{ and } B) = P(A) * P(B/A) \quad —— a$
$\qquad \| $
$P(B \text{ and } A) = P(B) * P(A/B) \quad —— b$

equating eqn ⓐ & ⓑ

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

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

Baye's theorem.

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

$P(A/B) \longrightarrow$ 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 probability
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 alcoholics.

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

→

$$P(A) = \text{Prob of having liver disease} = 0.10$$

$$P(B) = \text{Prob of alcoholism} = 0.05.$$

$$P(B|A) = 0.07$$

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

$$= 14\%.$$

Use of Baye's theorem

(Bayesian statistics)
↓
data analysis
&
Parameter estimation
based on baye's theorem

→ Naive Bayes ML model.

x_1 #room	x_2 Area	x_3 locit	y Price of House
—	→	—	—
=	=	=	-
∽	=	∽	(?)

$$P(y \mid x_1, x_2 x_3) = \frac{\overset{P(A)}{\overbrace{P(y)}} \cdot \overset{P(B|A)}{\overbrace{p(x_1 x_2 x_3/y)}}}{\underset{P(B)}{P \cdot (x_1 x_2 x_3)}}$$

↳ Baye's theorem.