Probability theory:

It is a tool that explains the uncertainity of any given event.

(x, X)

$$\boxed{\text{Prob.}(\text{event}) = \frac{\text{fav. outcome}}{\text{total outcomes.}}}$$

$\{H, T\}$

H

$\{1,2,3,4,5,6\}$

$\{5\}$

independent event:

A, B

$$\boxed{\underbrace{P(A,B)}_{\text{joint prob}} = P(A)P(B)}$$

$\cancel{P(A)}$

$\cancel{P(A,}$

$\cancel{P(A}$

$$P(X) = \sum_{i=0}^{N} P(X=x_i, Y=y_i)$$

or $P(Y)$

$$P(X) = \sum_{y} P(X|Y)\,P(Y)$$

Sum rule

$$P(X,Y) = P(X|Y)\,P(Y)$$

Bayes Theorem:

$$\boxed{\underset{\text{Posterior}}{P(Y|X)} = \frac{\overset{\text{likelihood}}{P(X|Y)}\;\overset{\text{Prior}}{P(Y)}}{\underset{\text{marginalised}}{P(X)}}}$$

Q) P(covid | +ve) ?

$P(+ve \mid covid) = 0.98$

$P(-ve \mid no\ covid) = 0.97$

B)

|B)

$$P(X) = \sum_{i=1}^{N} P(X|Y=y_i)P(Y=y_i)$$

$$P(X) = P(x|y_0)P(y_0) + P(x|y_1)P(y_1)$$

$$P(C|+ve) = \frac{P(+|C)\,P(C)}{P(+ve)}$$

$$X = \{+ve, -ve\}$$

$$Y = \{C, NC\}$$

$$= \frac{0.98 \times 0.008}{P(+|C)P(C) + P(+|NC)P(NC)}$$

$$= \frac{0.98 \times 0.008}{\quad} = \frac{0.00784}{0.00784 + 0.02976}$$

$P(\text{covid}) = 0.008$

Variables type:

→ 1. Discrete

→ 2. Continuou

E

Con

$$= \frac{0.98 \times 0.008}{0.98 \times 0.008 + 0.03 \times 0.992} = \frac{0.00784}{0.00784 + 0.02976}$$

$$= \frac{0.00784}{0.0376}$$

$$\approx 0.2085$$

$$\approx 21\%$$

(fixed $\{1,0,3,2\}$)

s (range continuous)

xpectation & Covariance:

$\{1,2,3,4,5,6,7\} = \frac{\sum_{i=1}^{N} x_i}{N} = 4$

0 - 100 $y = x$ $\mu = \frac{\infty}{\infty}$ = not defined

tinuous var. → expectation of variable

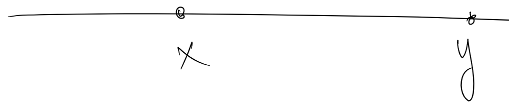
$$\mathbb{E}[f] = \int p(x)\, f(x)\, dx$$

$$\mathbb{E}[f] = \sum p(x) f(x)$$

$$var[f] = \mathbb{E}[f(x)^2] - \mathbb{E}[f(x)]^2$$

Q) Rod $\underline{1}$ unit length

2 break



P(Δ forming)

Bay

wei

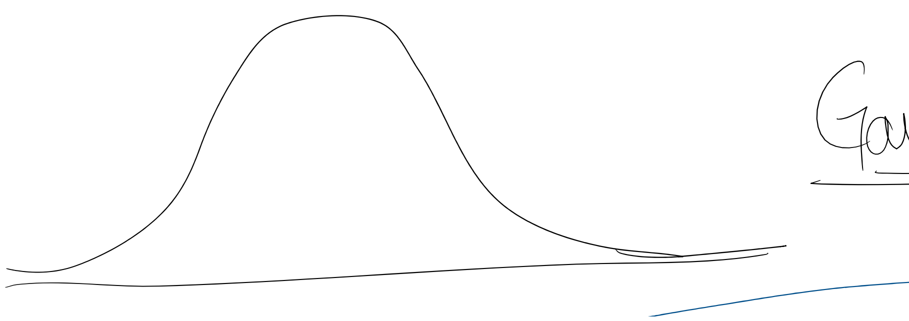
$p(Y|X) = \frac{P(X}{P}$

posterior

$P(W|D) =$

maximiz

Gau



$$\mathrm{var}[f] = \mathbb{E}[f(x)^2] - \mathbb{E}[f(x)]$$

$$\mathrm{var}[x] = \mathbb{E}[x^2] - \mathbb{E}[x]^2$$

esian Prob. :

ghts (W)

$$\frac{(X|Y)\,P(Y)}{P(X)}$$

$$\frac{\overset{\text{liklihood}}{P(D|W)}\;P(W)}{P(D)}$$

e likelihood prob.

ussian Dist:

$\mathcal{N}(x|$

$E[$

$E[$

F

$\mathcal{N}(x$

$$\mathcal{N}(x \mid \mu, \sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

μ: mean
σ^2: variance

$$\int_{-\infty}^{\infty} \mathcal{N}(x \mid \mu, \sigma^2)\, dx = 1$$

$$E[x] = \int_{-\infty}^{\infty} \mathcal{N}(x \mid \mu, \sigma^2)\, x\, dx = \mu$$

$$E[x^2] = \int_{-\infty}^{\infty} \mathcal{N}(x \mid \mu, \sigma^2)\, x^2\, dx = \mu^2 + \sigma^2$$

$A^2 =$

or D dimensions:

$$\mathcal{N}(x \mid \mu, \Sigma) = \frac{1}{(2\pi)^{D/2}} \cdot \frac{1}{(\Sigma)^{1/2}} \exp\left(\frac{-1}{2}(x-\mu)\Sigma^{-1}(x$$

$$X = \{x_1, x_2, x_3, \ldots x_n\}$$

...lihood

: standard dev.

β : precision $\left(\frac{1}{\sigma^2}\right)$

$A \cdot A^T$

$-\mu)^T$)

likelihood

$$P(X|\mu,\sigma^2) = \prod_{i=1}^{N} \mathcal{N}(x_i|\mu,\sigma^2)$$

maximize my likelihood.