Lec 04

Wednesday, January 11, 2023 1:25 PM

$\mathcal{N}(\mu, \sigma)$

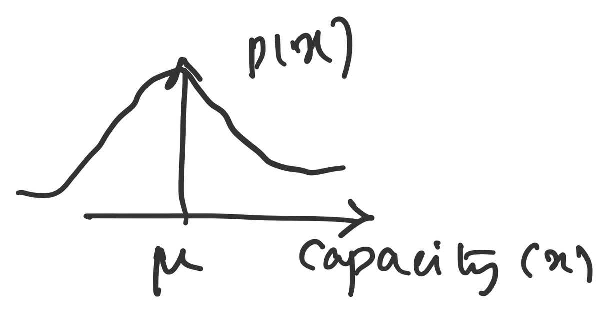
caliograhical \mathcal{N}

Recap

Normal distribution ← central limit effect

- single variable → μ, σ
- multi variable → $\mu, \Sigma_{K \times K}$
  - diagonal ~ marginal distr.
  - off diagonal ~ spread over the space

Statistical (in)dependence, randomize an experiment, estimating parameters from samples.

–  → $[x_1, x_2, \ldots x_n]$ random sample

random variable ← capacity value

$Pr(C)$ = probability of my random variable under the assumed distribution

variables : C → capacity of the battery

T → lifetime of "

$P(C,T) \sim N(\mu, \Sigma)$ $\quad \Sigma = \begin{bmatrix} \sigma_{C,C} & \sigma_{C,T} \\ \sigma_{T,C} & \sigma_{T,T} \end{bmatrix}$

$C = 100\%$ 24hrs

$= 80\%$ 12hrs

$p(T \mid C = C_0)$ ← conditional distribution

$P(C = 100\%, T = 12hrs) > 0$

$= P(C)\, P(T \mid C = 100\%)$

$= P(T)\, P(C \mid T = 12hrs)$ } Baye's theorem

$= P(C)\, P(T)$

↑

statistical independence

→ independently drawn identical data

(independt identical distributed) iid

Randomizing an experiment

→ assign each one of our measurable unit randomly

→ confounding in your data

$P(C,T) \sim N(\mu, \Sigma)$

$(c_1, c_2, c_3, \ldots, c_n) \sim N(\mu, \sigma)$

likelihood of sampling from my distribution

$L(\mu, \sigma) = \prod_{i=1}^{n} P(C_i)$

$= P(C_1)\, P(C_2, C_3, \ldots, C_n \mid C_1)$

$P(C_1, C_2, \ldots C_n) = P(C_1)\, P(C_2) \cdots P(C_n) = \prod_{i=1}^{n} P(C_i)$

$C \sim N(\mu, \sigma)$

$L(\mu, \sigma) = \prod_{i=1}^{n} N(\mu, \sigma)$

$= \prod_{i=1}^{n} \frac{1}{\sigma\sqrt{2\pi}} \exp\left(\frac{(c_i - \mu)^2}{2\sigma^2}\right)$

$= \sigma^{-n/2} (2\pi)^{-n/2} \exp\left(-\frac{1}{2\sigma^2} \sum (c_i - \mu)^2\right)$

Values that maximize this expression, $\hat{\mu}, \hat{\sigma}$

Maximum likelihood estimation $(\hat{\mu}, \hat{\sigma})$ ← maximizing an analytical function

(MLE)