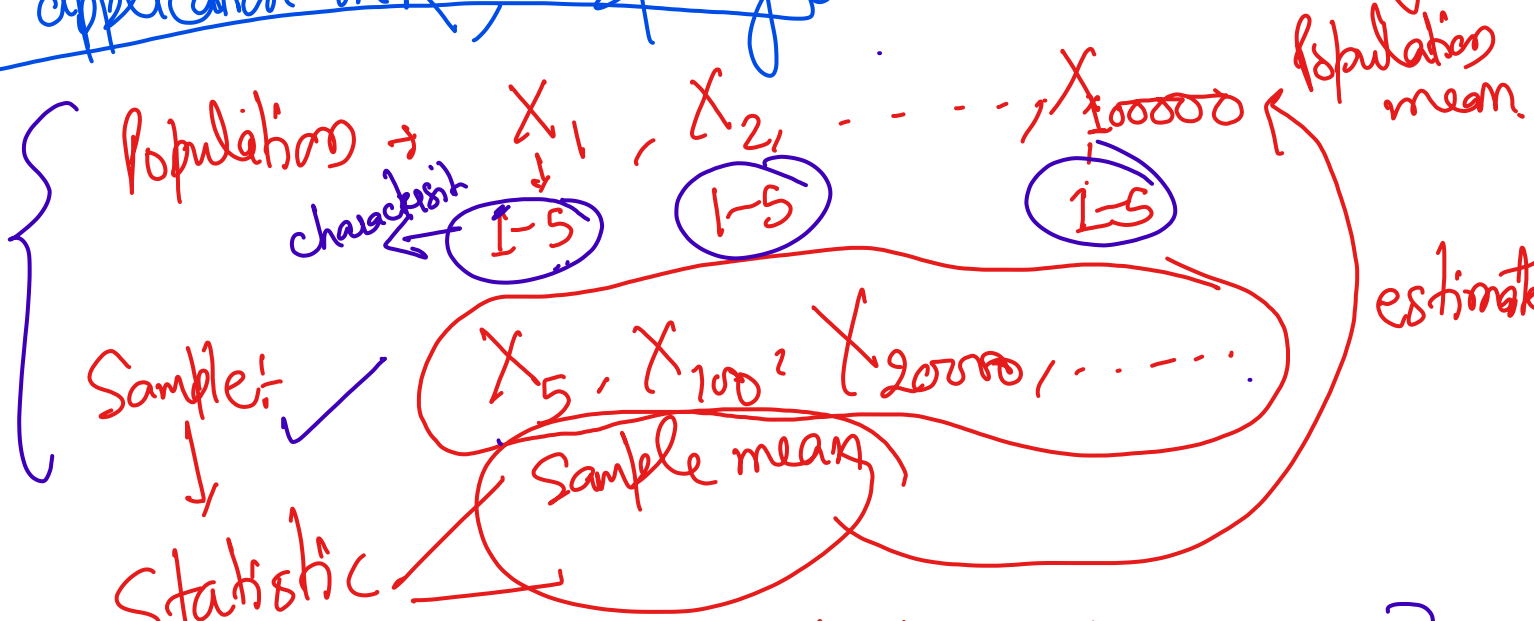
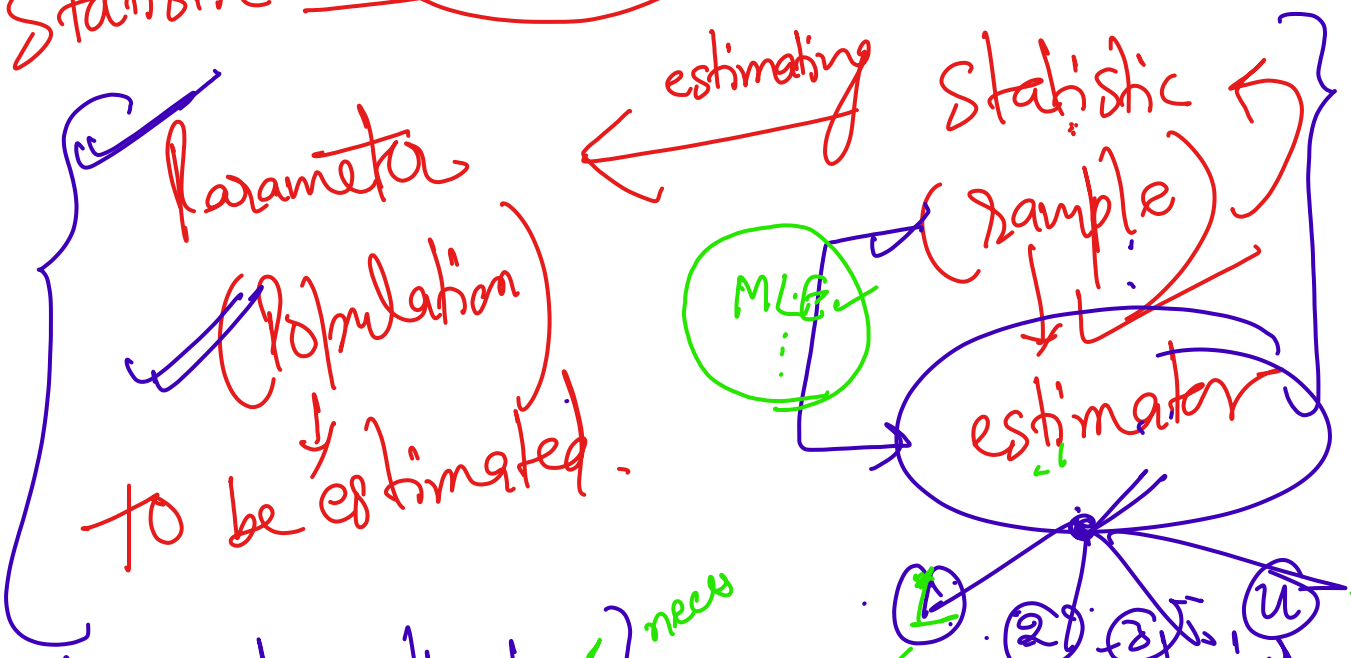
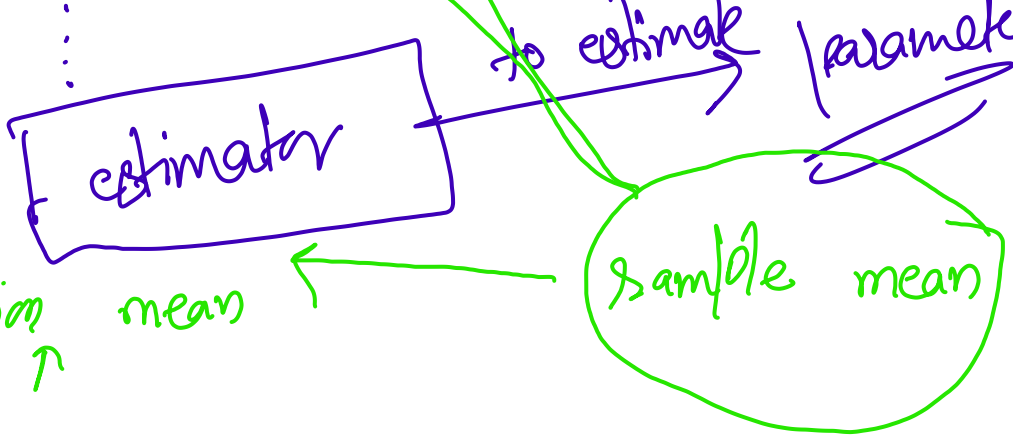
Book:- G. James, D. Witten, T. Hastie & R. Tibshirani
An introduction to statistical learning with application in R, Springer.





1. Unbiased estimator
2. Consistent estimator
   ⋮

needs



Linear Algebra

Mathematics

Linear Algebra | Prob. Statistic | Optimization

Eigenvalue | Eigenvectors

$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ — matrix — 2×2

- Determinant of matrix
- Inverse of matrix
- eigenvalue of matrix

$\det(A)$

A^{-1}

one single no.

eigenvalues — no. of rows = no. of columns.

Principal Component Analysis.

$A_{m \times n}$ square matrix → n eigenvalues.

Eigenvalue Decomposition:-

$A = U \cdot P \cdot U^{-1}$

A — any matrix

Data set.

$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = [U] \begin{bmatrix} 200 & 0 \\ 0 & 100 \end{bmatrix} [U^{-1}]$

1st eigenvalue of A

2nd eigenvalue

Image:

256×256

≈ 65000

Tackle this data.

A is not square matrix

Inverse of matrix not necessarily exist

Singular Value Decomposition

$$A = U \times S \times V^T$$

U → matrix, S → matrix (store), V^T → matrix

S: matrix of singular values

A = [ ] svd(A)

Principal component

Data → store

Tool

Image compression ... trade off ... reconstruct our image completely

Name, Age, height, Last ... 10 features

Stu(1)
Stu(2)
...
Stu(100)

only relevant ?? to solve problem!

100×100

$A = [\ ]$ 10×10 → 100

S → only 10

SVD of A

1. Finds AA^T
2. Finds eigenvectors of AA^T → U
3. Find A^TA
4. Find eigenvectors of A^TA → V
5. Eigenvalues of AA^T → S

AA^T → singular values of A

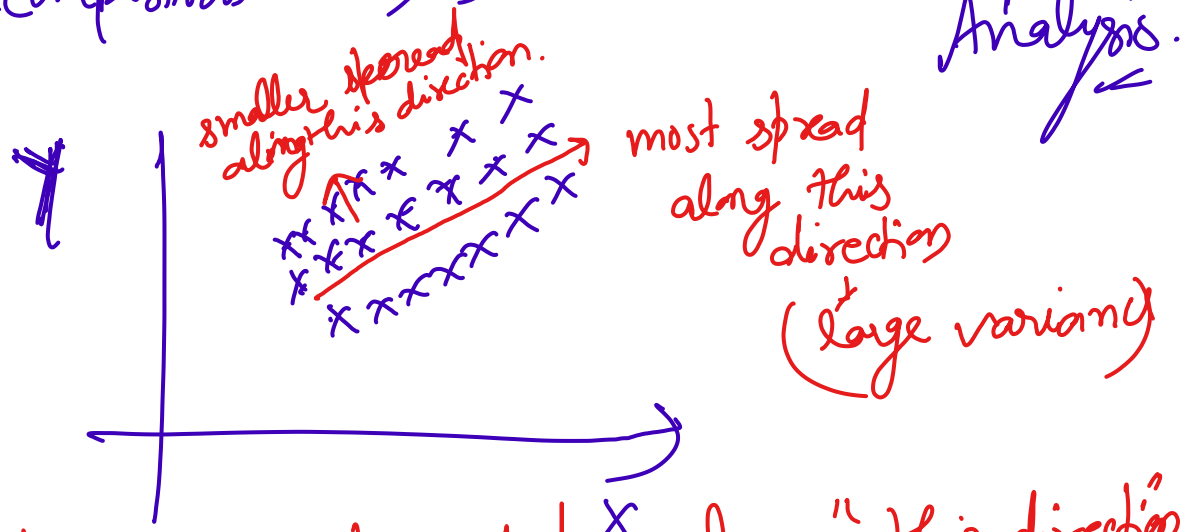
data set

$A \longrightarrow U, S, V^T$

SVD for PCA

dataset

$A \xrightarrow{\text{Singular value decomposition}} U, S, V \longrightarrow$ in finding Principal Component Analysis.



Key idea: Data can be projected along "this direction" (while capturing the important information)

Ques:- How to determine the direction with largest variance?

Ans:- PCA (Principal Component Analysis)

Aim:- we have data using SVD

(1) Principal direction
(2) Principal component

U, S, V matrix.

$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}_{2\times 3}$ NOT → ~~Eigenvalue~~

$A^T = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix}_{3\times 2}$

AA^T $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}_{2\times 3} \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix}_{3\times 2}$

$= [\text{Square}]_{2\times 2}$

Singular value ⟸ eigen values

NPTEL :

download :

① R - Software. → IIT Kanpur

② Statistics with R → IIT Kanpur