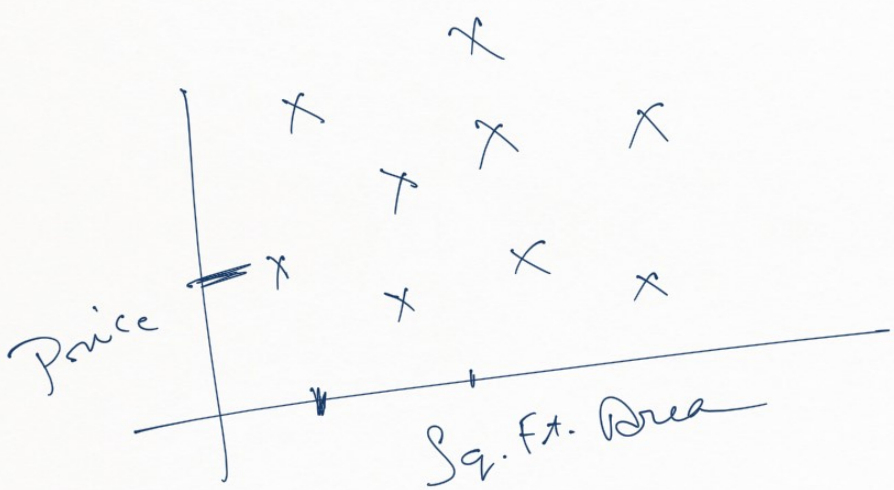
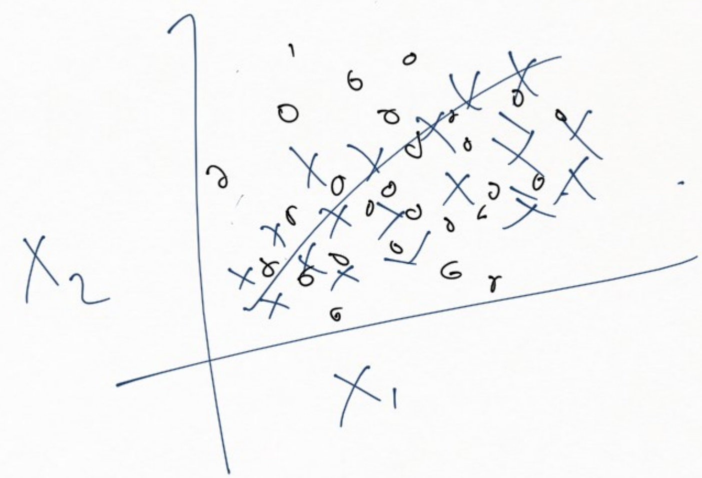
Higher Dimensional Problems :)

$x_1, x_2, x_3 \ldots, x_n \Rightarrow$ n-dimensional

{No. of Rooms {Sq. Ft Area, Price





Dimensionality Reductions

Combine Features into Smaller set.

$\Downarrow$

CFA

$\rightarrow$ Common Factor Analysis

Eliminate Features & keep a representative

$\Downarrow$

PCA

Principal Component Analysis.

No. of Rooms	Sq. Ft Area
3	900
4	1000
5	1300
7	2000
100	5000

Standard Scaler =>

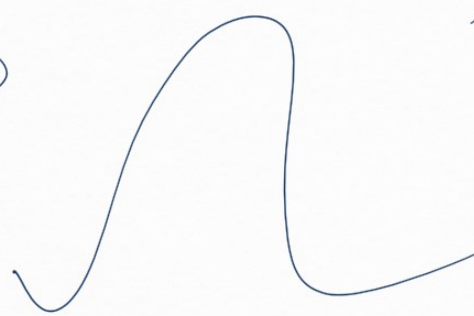
$$z \Rightarrow \frac{x - \mu}{\sigma}$$

Min max Scaler.

$$\frac{x - \min(x)}{\max(x) - \min(x)}$$

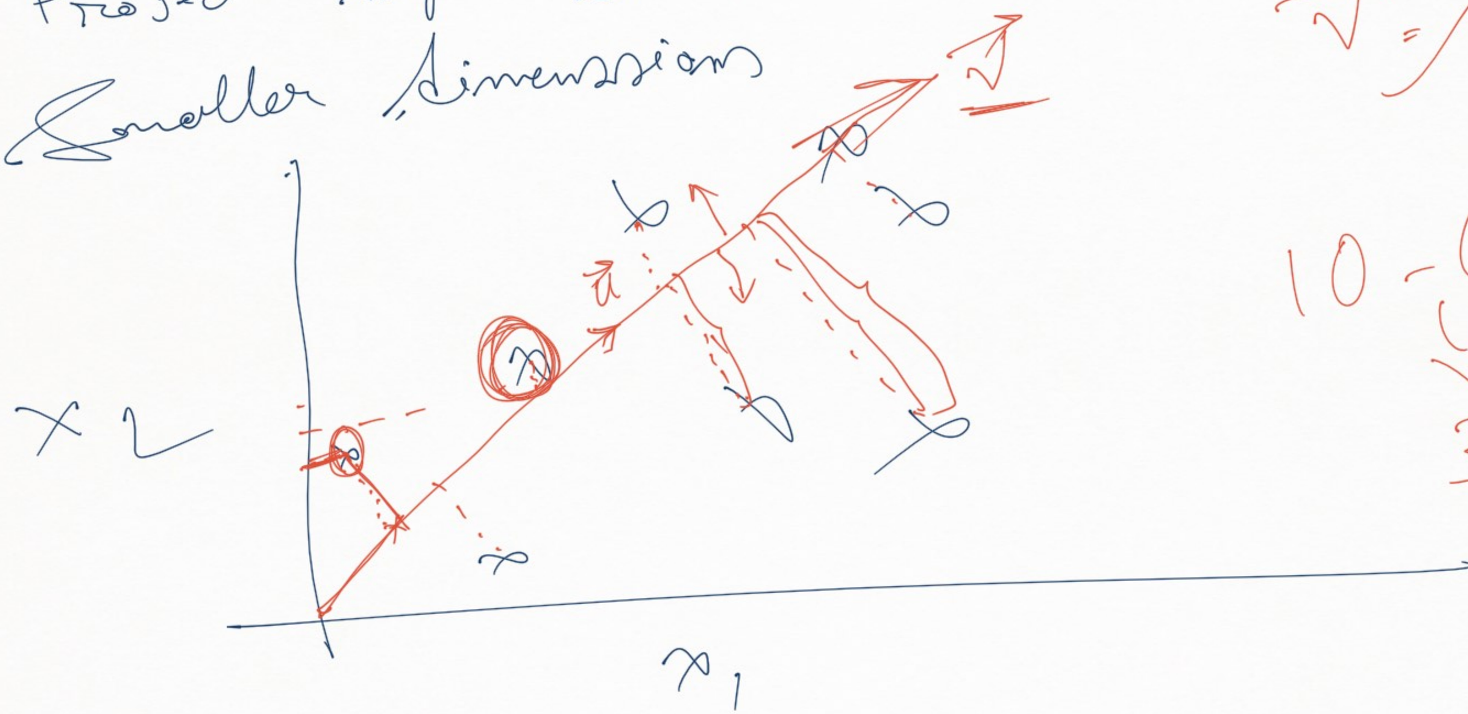
$$\frac{x - \mu}{\sigma} \Rightarrow \mu = 0$$

$z \Rightarrow$



Principal Component Analysis. =)

Project higher dimensional data to smaller dimension



$\vec{v} \Rightarrow \vec{u}$

10 - Columns.

$\Downarrow$

3 Prin

Eigen Values & Vectors :)

$Xv = \lambda v$ → Eigen Value

→ Eigen Vectors

$\det|X| \neq 0$

$$I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad I = I^T$$

$$I \cdot I^T = I^T I = I$$

$X \Rightarrow n \times m$

Singular Value Decomposition :)

House price prediction → X

$$X = \begin{bmatrix} x_1 & x_2 & \cdots & x_m \end{bmatrix}$$

$$X = U \Sigma V^T$$

V^T: $m \times m$

Σ: $n \times m$

U: Left singular matrix, $n \times n$

$$U = \begin{bmatrix} | & | & & | \\ u_1 & u_2 & \cdots & u_m \\ | & | & & | \end{bmatrix} \qquad V^T = \begin{bmatrix} | & | & & | \\ v_1 & v_2 & \cdots & v_m \\ | & | & & | \end{bmatrix}$$

$$\Sigma = \begin{bmatrix} \sigma_1 & & & 0 \\ & \sigma_2 & & \\ & & \ddots & \\ 0 & & & \sigma_m \end{bmatrix} \Rightarrow \sigma_1 > \sigma_2 > \sigma_3 \cdots > \sigma_m \geq 0$$

$$UU^T = U^TU = I$$

$$VV^T = V^TV = I$$

$U\Sigma V^T = \vec{U}_1\sigma_1\vec{V}_1 + \dots + \vec{U}_m\sigma_m\vec{V}_m$

$\begin{array}{c} \vec{a}_1 \\ \vec{a}_2 \end{array} \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{array}{cc} \vec{b}_1 & \vec{b}_2 \\ \multicolumn{2}{c}{\begin{bmatrix} 1 & \\ 3 & 4 \end{bmatrix}} \end{array} = \begin{bmatrix} a_1b_1 & a_1b_2 \\ a_2b_1 & a_2b_2 \end{bmatrix}$

$\vec{U}_1\sigma_1\vec{V}_1 + \vec{U}_2\sigma_2\vec{V}_2$

$\vec{U}_1\sigma_1 \quad \vec{U}_2\sigma_2 \quad \vec{U}_3\sigma_3$

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$

$V \Rightarrow$ Orange in Algemlin

$\Sigma = \begin{bmatrix} \sigma_1 & 0 & 0 \\ 0 & \sigma_2 & 0 \\ 0 & 0 & \sigma_3 \end{bmatrix}$

$\begin{bmatrix} U_{11} & U_{21} & U_{31} \\ U_{12} & U_{22} & U_{32} \\ U_{13} & U_{23} & U_{33} \end{bmatrix}$

$$X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ m \end{bmatrix}$$

$B = X - \bar{X}$

$\Downarrow$

$\mu_x = 0$

$x - \mu$

$C = U \Sigma V^T$

$T = BV = U\Sigma$

$U_B \Sigma_B V$

$\Downarrow$

Principal Components

$U\Sigma \Rightarrow B \Rightarrow$ Mean centered

1st row > 2nd row > 3 ...

$\Rightarrow$ 93%.

Variance $\Rightarrow \sigma^2 = \frac{(x-\mu)^2}{n} = \frac{x^2}{n}$

$B^T B = C \Rightarrow$ Covariance Matrix