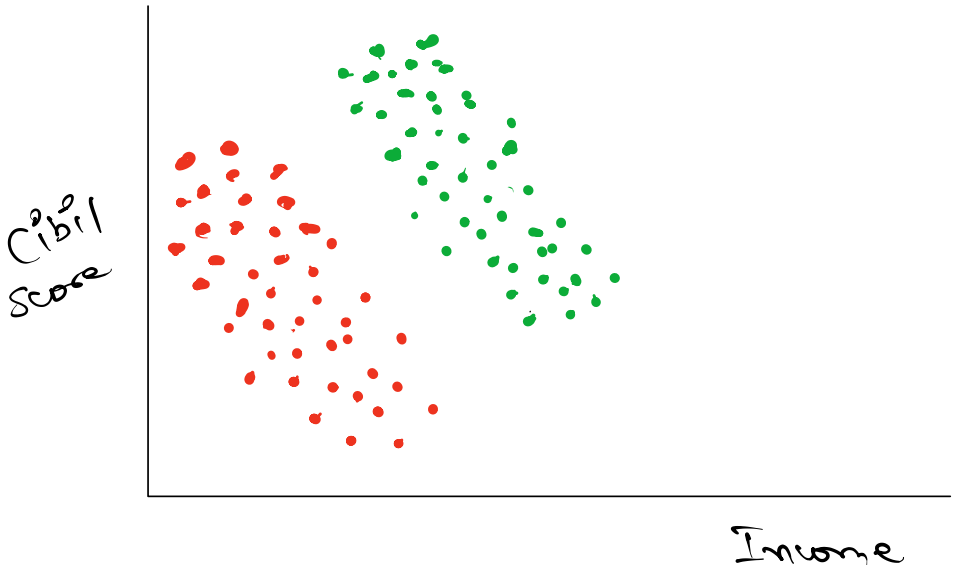
Linear Discriminant Analysis (LDA) 26 July

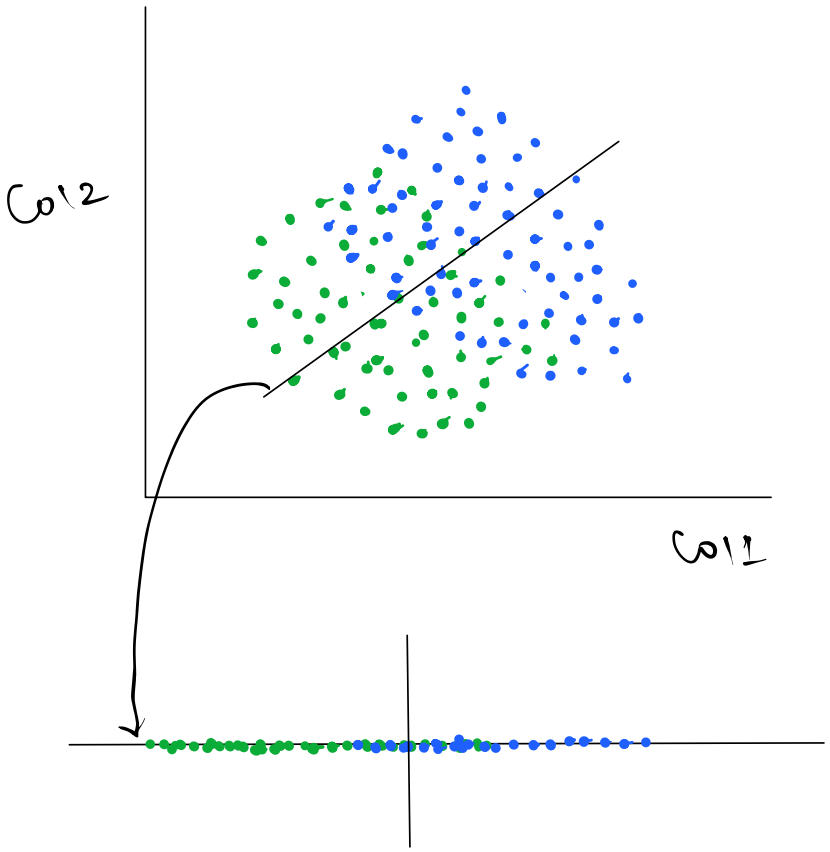
Thursday, 29 May 2025 20:47

→ It is also used for dimensionality reduction like PCA:

→ But it is used only for classification data unlike PCA (which can be used on all types of data).

	Income	Cibil_Score	Loan Approved or Not?
0	28K	680	No
1	75K	790	Yes
	-	-	-





To solve the problem of inseparable classification data, we have to use "LDA".

LDA will project the data onto a new axis to make the data easily separable and while doing so it will be automatically reduce the dimension of the data.

Note: Unlike PCA, LDA's main focus is not on dimensionality reduction but on separating the data by maximizing the separation b/w the classes

LDA will also make a new axis and project the datapoints on that new axis.

The new axis that LDA will create should follow these two criterias (both considered simultaneously):

① Maximize the distance b/w the means of two classes / categories.

② Minimize the variation (spread) within each class.

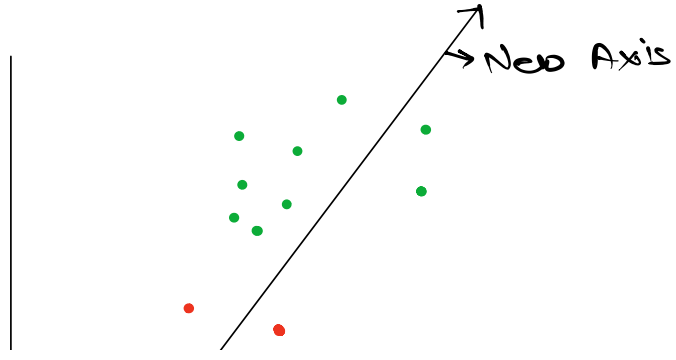
$$\frac{(\mu_R - \mu_G)^2}{s_R^2 + s_G^2} \longrightarrow \frac{\text{Maximize}}{\text{Minimize}} \longrightarrow \text{Maximize}$$

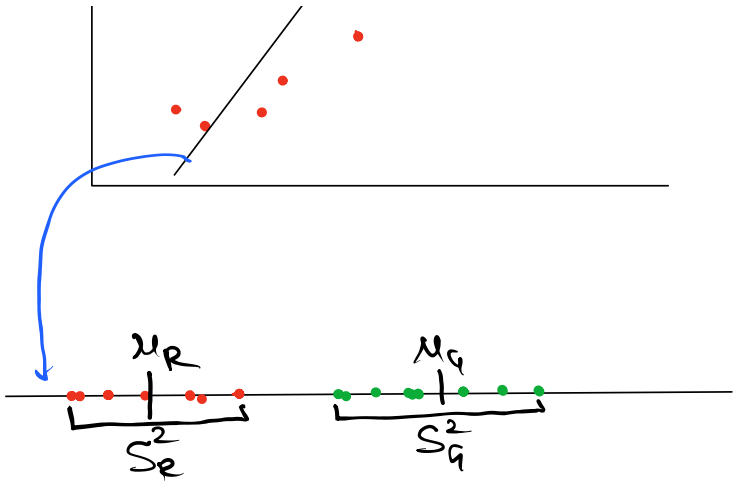
μ_R : Mean of Red datapoints

μ_G : Mean of Green Datapoints

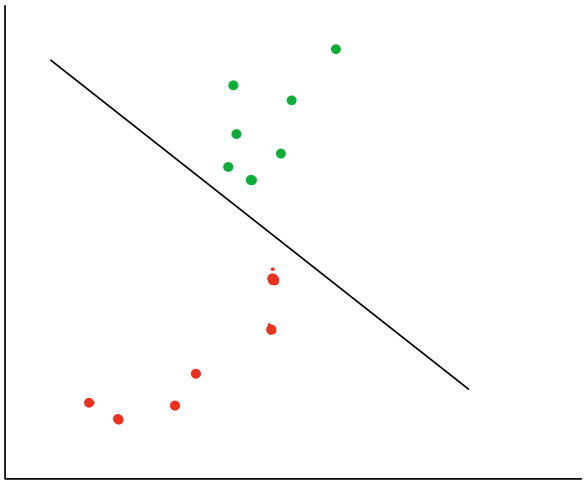
s_R^2 : Variance of Red datapoints

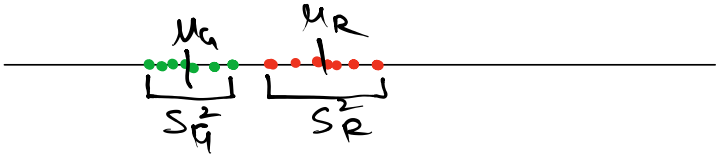
s_G^2 : variance of Green datapoints





$$\frac{(\mu_R - \mu_G)^2}{S_R^2 + S_G^2} = \frac{580}{380 + 417} =$$





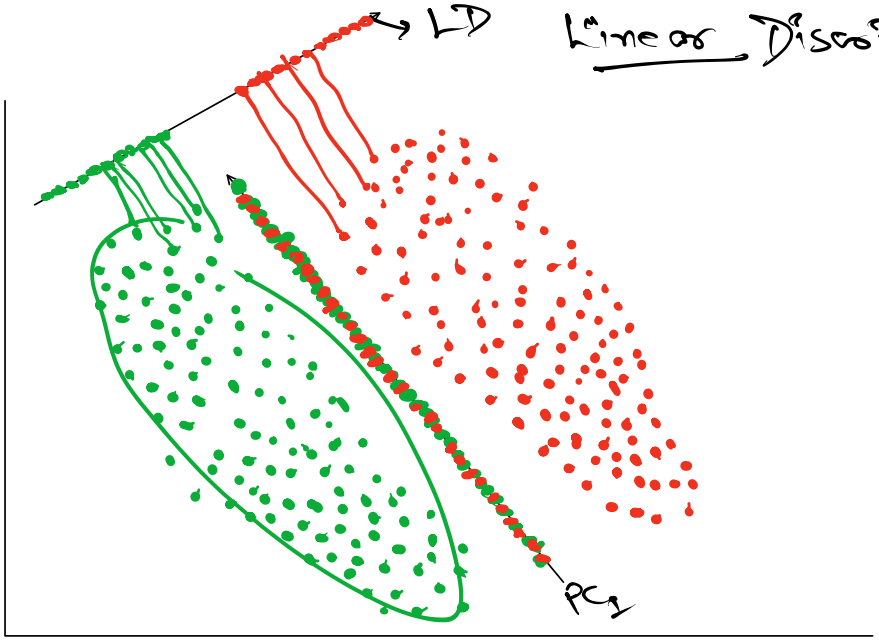
$$\frac{(\mu_G - \mu_R)^2}{S_G^2 + S_R^2} = \frac{130}{110 + 160}$$

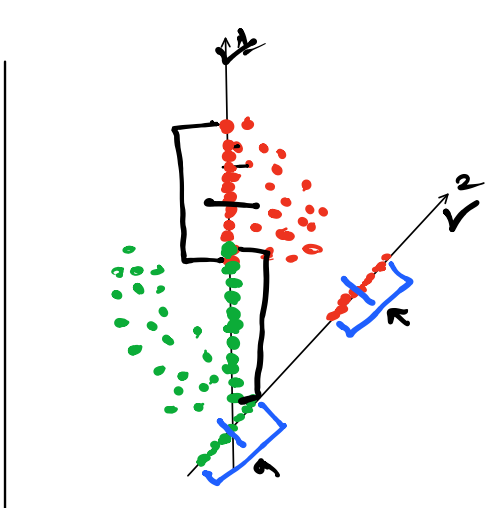
PCA vs LDA →

PCA → main focus is to reduce the dim of the data.

LDA → main focus of LDA is to transform a classification data in such a way that the data is separated properly.

LDA

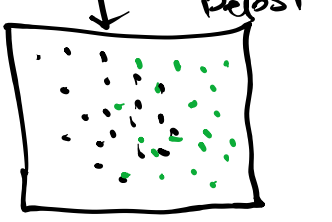




NO

Mean

Variance



Fisher Discriminant Ratio →

Numerator

$$FDR = \frac{(\tilde{\mu}_1 - \tilde{\mu}_2)^2}{\tilde{s}_1^2 + \tilde{s}_2^2}$$

Maximize

Minimize

$\tilde{\mu}_1$ = Mean of Red points (AP)

$\tilde{\mu}_2$ = Mean of Green points (AP)

$\tilde{s}_1^2$ = Variance of red points (AP)

$\tilde{s}_2^2$ = variance of green points (AP)

① $\frac{282}{437}$ ② $\frac{450}{130}$ ③ 1537 / 260 ④ $\frac{780}{630}$