Performance Metrics, Accuracy, Precision, Recall And F-Beta.

y

x x x → CLASS A
x ✓ x x
x x x x
x x x ✓ ✓ x → CLASS B
x ✓ x ✓ ✓
x ✓ x ✓ ✓ ✓
x ✓ x ✓ ✓

X
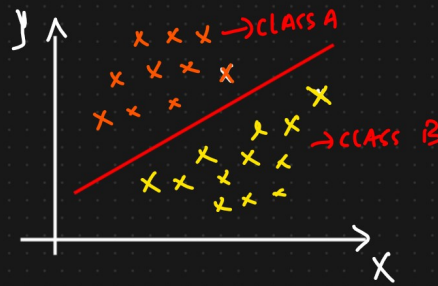
① Confusion Matrix

Actual value (y)

	1	0
1	3	2
0	1	1

Predicted value $\hat{y}$

DATASET

Actual value → y Model predicted Value → $\hat{y}$

x_1	x_2	y	$\hat{y}$	
—	—	0	1	→ Wrong prediction
—	—	1	1	→ Correct prediction
—	—	0	0	→ Correct "
—	—	1	1	→ " "
—	—	1	1	→ ' "
—	—	0	1	→ Wrong Prediction
—	—	1	0	→ " "

	1	0	Actual
1	TP	FP	
0	FN	TN	

Predicted

Predicted value $\hat{y}$

TP = True Positive

TN = True Negative

FP = False Positive

FN = False Negative.

$$\text{Model Acc} = \frac{TP+TN}{TP+FP+FN+TN}$$

$$= \frac{3+1}{3+2+1+1} = \frac{4}{7} = 57.1\%$$

DATASET → Imbalance dataset

1000 datapoints
$\begin{array}{c} 900 \to 1 \\ 100 \to 0 \end{array}$ } Imbalanced dataset

Dumb Model → 1

	1	0	Actual
1	900	100	
0	0	0	

Predicted

Accuracy = 90%.

③ Precision $= \dfrac{TP}{TP + FP}$ } Out of all the actual values how many are correctly predicted.

	1	0	Actual
1	TP	FP	
0	FN	TN	

Predicted

↳ FP is Important

④ Recall $= \dfrac{TP}{TP + FN}$ } Out of all the predicted value how many are correctly predicted with actual values

	1	0	Actual
1	TP	FP	
0	FN	TN	

Predicted

FN ↓↓

Usecase 1 :   Spam Classification

Text ⟹ Model ⟹ Spam / Not Spam.

	1	0	Actual
1	TP	FP ✗	
0	FN	TN	⟹ Precision

Predicted

$$TP \Leftarrow \begin{array}{c} \overset{1}{Mail \rightarrow Spam} \\ \overset{1}{Model \rightarrow Spam} \end{array} \Big\} \text{ Accurate Scenario}$$

$$TN \Leftarrow \begin{array}{c} \overset{0}{Mail \rightarrow Not\ a\ Spam} \\ \overset{0}{Model \rightarrow Not\ a\ Spam} \end{array} \Big\} \text{ Accurate Scenario}$$

$$\text{Important} \Rightarrow FP \Leftarrow \begin{array}{c} Mail \rightarrow Not\ a\ Spam \\ Model \rightarrow Spam \end{array} \Big\} \begin{array}{c} Wrong\ Prediction \\ \{Blunder\} \end{array}$$

$$FN \Rightarrow \begin{array}{c} Mail \rightarrow Spam \\ Model \rightarrow Not\ a\ Spam \end{array} \Big\} \begin{array}{c} Wrong \\ Prediction \end{array}$$

Usecase ⇒ FN is Important

To predict whether a person has diabetes or not

	Diabetes	No Diabetes	Actual
Diabetes	TP	FP	
No Diabetes	FN	TN	

⇓

Recall

TP ∈ { Actual → Diabetes / Model → Diabetes } Correct

TN ∈ { Actual → No Diabetes / Model → " " } Correct

FP ∈ { Actual → No Diabetes / Model → Diabetes } Wrong Prediction

FN ⇒ { Actual → Diabetes / Model → No Diabetes } Blunder

Assignment : Tomorrow the stock market will crash or not

Reduce FP↓↓ or FN↓↓

⑤ F-Beta Score $= \left(1+\beta^2\right) \dfrac{Precison * Recall}{Precision + Recall}$

① If FP and FN are both Important

$\beta = 1$

F1 Score $= 2 * \dfrac{P*R}{P+R}$ ⇒ Harmonic Mean

② If FP is more important than FN

$$\beta = 0.5$$

$$F_{0.5} \text{ Score} = (1 + 0.25) \frac{P * R}{P + R}$$

③ If FN is more important than FP

$$\beta = 2$$

$$F_2 \text{ Score} = (1 + 4) \frac{P * R}{P + R}$$