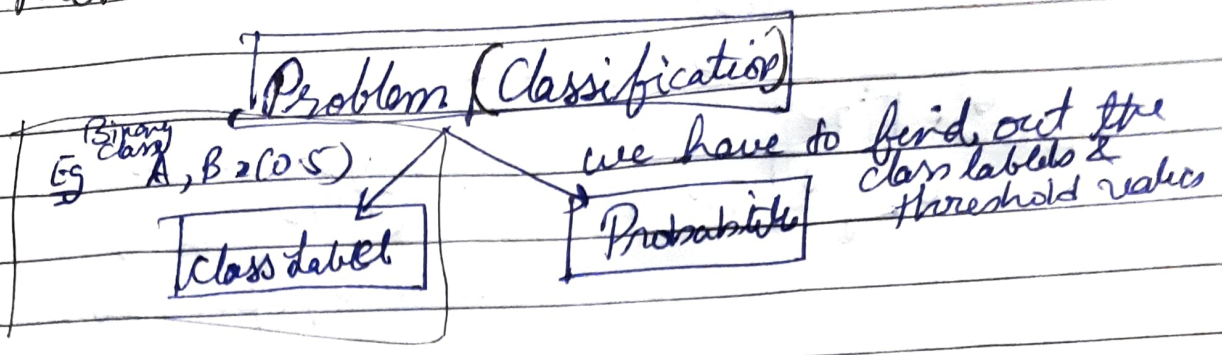
Metrics In Classification



Eg A person has cancer or not, threshold may or may not be 0.5.

10000 records

- 500 Y, 500 N
- 600 Y, 400 N
- 400 Y, 600 N

} Balanced

⇓ Use: Accuracy

Imbalanced

- 950 Y, 50 N
- 900 Y, 50 N

Use: Precision, Recall, F-β

Don't use: Accuracy

If these data points are given to ML algo, then ML algo won't get biased on max no of output

Predicted Values \ Actual Values	1	0
1	TP	FP
0	FN	TN

Type 1 Errors → FPR

$$FPR = \frac{FP}{FP+TN}$$

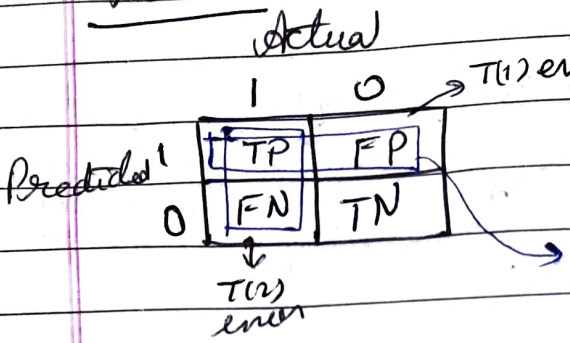
Type 2 Error → FNR

$$FNR = \frac{FP}{FP+TN}$$

$$Accuracy = \frac{TP+TN}{TP+FP+FN+TN}$$

Any classification problem, try reducing Type 1, Type 2 errors.

Recall



$$\text{Recall / Sensitivity (TPR)} = \frac{TP}{TP + FN}$$

$$\text{Precision / Specificity} = \frac{TP}{TP + FP}$$

Recall: Out of total actual +ve values (1) / True) how many (+ve) did we predict correctly

Precision: Out of total predicted +ve results, how many results were actually +ve.

When to use what?

① Spam Detection: Precision. (FP↓↓)

If a mail is not a spam but the model predicted that it is a spam, try to reduce false positive value because if a mail is not a spam & it is predicted as spam, customer is gonna miss that mail, which may be very impt to him/her. (FP↓↓)

② Cancer Detection: Recall (FN↓↓)

If a person is having a cancer but he is predicted as not having a cancer, it will be disaster.

If FP is much more impt ⇒ Precision
" FN " " " ⇒ Recall

If FP, FN both are impt ⇒ F-β score.

F-β score

$$F_\beta = (1+\beta^2)\frac{P \times R}{\beta^2(P+R)}$$

β = 1 — F-1 score
β = 0.5 — F 0.5 score
β = 2 — F 2 score.

$\beta = 1 \quad F_1 = 2\frac{P \cdot R}{P+R}$ Harmonic mean $= \left(\frac{2xy}{x+y}\right)$

If FP is having more impact than FN (T-2 error) reduce your β value. (<1)

If FN is having more impact → (T-1 error) increase your β value (>1)

~~ROC~~ AUC (Binary Classification) — generally used

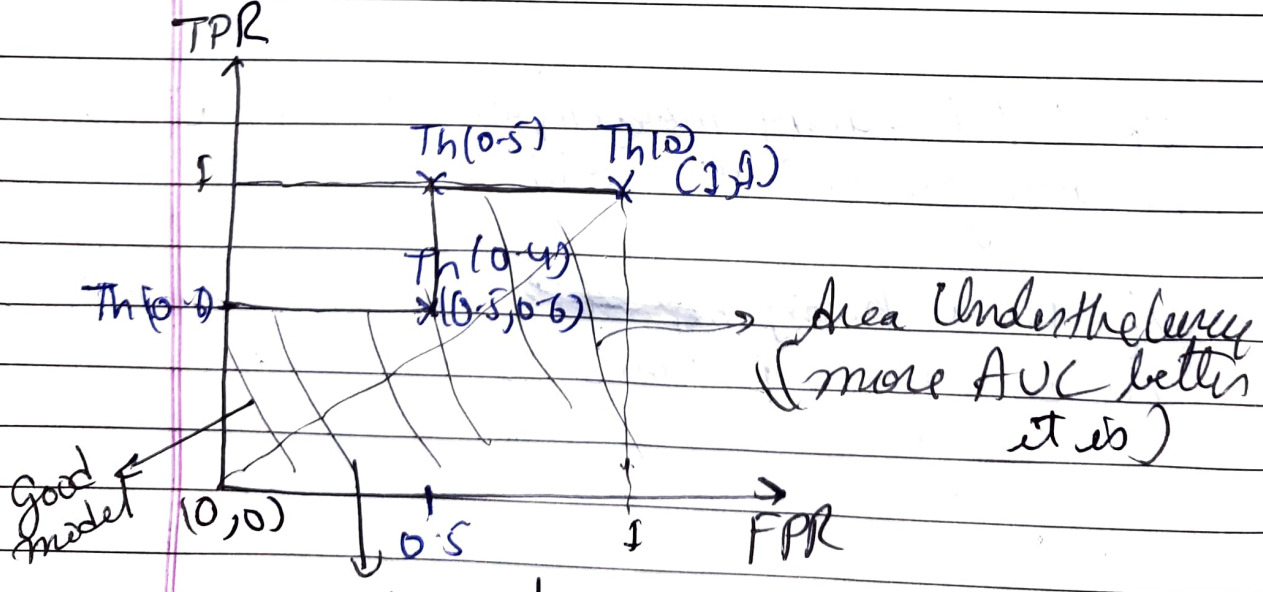
$$TPR = \frac{TP}{TP + FN}$$

$$FPR = \frac{FP}{FP + TN}$$

$y \rightarrow \hat{y}$

Threshold [0, 0.2, 0.4, 0.6, 0.8, 1)

y	$\hat{y}$	$\hat{y}(0)$	$\hat{y}(0.2)$
1	0.8	1	1
0	0.9	1	1
1	0.4	1	1
1	0.3	1	1
0	0.2	1	0
1	0.7	1	1
		↓	
		$TPR = \frac{4}{4+0} = 1$	1
		$FPR = \frac{2}{2+0} = 1$	0.5



→ Area Under the curve (more AUC better it is)

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Higher TP

	TPR	FPR
ⓐ Th (0·6)	0·6	0
ⓑ Th (0·2)	1·0	0·5
ⓒ Th (0·4)	0·5	0·6

ⓐ Only focus on FPR
ⓑ FPR doesn't matter as long as TPR is high
ⓒ trade off b/w the two