Matrics in Classification.

Performance metrics. in classification.

① Confussion matrices

② FP (Type I Error)

③ FN (Type II Error)

④ Recall [True positive rate]

⑤ Precission [Positive Prediction value.] →Tore

⑥ Accuracy

⑦ F Beta.

⑧ Cohen Kappa

⑨ ROC Curve, AUC Curve

⑩ PR Curve

(Precission- Recall)

"How much Good Your model is?"

Classification

Problem Statement

Probabilities | Class labels

→ ROC Curve.

→ AVC Curve.

→ PR Curve.

Suppose Binary Pr.
and it has only 2
outcome.

A, B

1500 records.

500 / 500 } balance dataset
⇒ Default threshold
Value = 0.05

600 / 400 } same level
model or algo.
can understand.

Here ML algorithm
not biasf.

200 / 300

output < 0.5,

800 / 200

class A or
class B

Dataset
Imbalanced → Provide in ML Algorithm.

Some of the Algorithm get biasf.

Balance dataset (used) → Accuracy

Imbalance dataset → Precision, Recall, f1 Measure or
f Beta....

Lets on classification problem.

Confusion Matrix.

Actually ⇐

Predicted	Has Heart Disease	Does not have heart disease	
Has heart Disease	True Positive	False Positive	→ Type I Error
Does not have heart disease	False Negative	True Negative	

↓ Type II Error

Always focus on <u>Reduce</u> FP ↓ and FN ↓

Type I Error

③ FPR = False Positive Rate = $\dfrac{FP}{FP + TN}$

④ FNR = False Negative Rate = $\dfrac{FN}{FN + TP}$

① Sennitivity = $\dfrac{\text{True Positive}}{\text{True Positive + False Negative.}}$ [Recall]

② Specificity = $\dfrac{\text{True Negatives}}{\text{True Negative + False Positive.}}$ [Precision]

Considering it's a balance dataset.

$$\therefore \text{Accuracy} = \dfrac{\text{Right Result}}{\text{Total Result}}$$

$$q7 \quad q\Xi \quad = \dfrac{TP + TN}{TP + TN + FN + FP}$$

Imbalance dataset.

Test
| 900, 100 |
| 800, 200 |

A ⟶ →B

→ may may model Predicted all are
class A

$$\therefore \text{Accuracy} = \dfrac{90+0}{100}$$
$$= 90\%$$

So there is a Problem.

→ we can't use Accuracy for imbalance dataset.

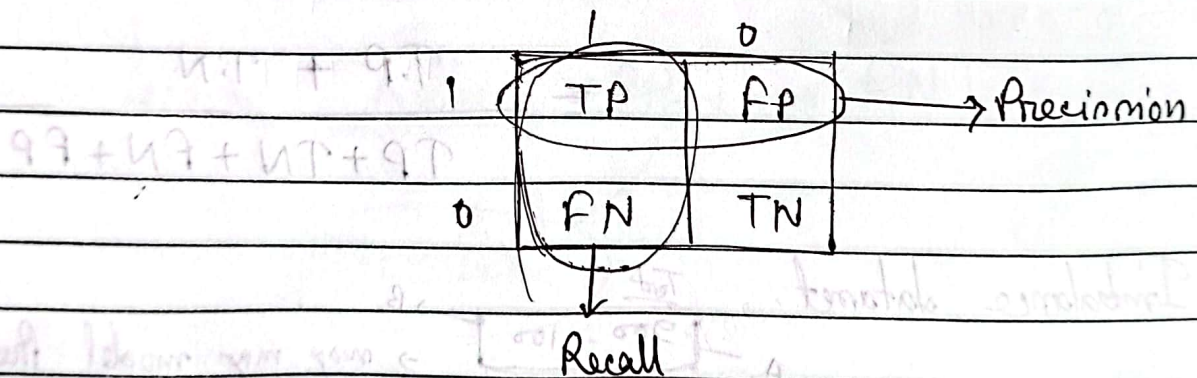⎡→Recall
⎢→Precision
⎣→ F- Beta.

$$\therefore \text{Recall} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}} \qquad [\text{Sensitivity}]$$

$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

$$[\text{use Spam detection}]$$

→ If FP Greater impact on role, go to → Precision.

   FN Greater impact on role ⋯→ use Recall

→ When FP and FN That means Type I and Type II

   Error both are Important or greater

   impact, we use "f_1 Measure" or

   F-Beta.

→ Both are Equally Important ← $\beta = 1$

$$\Rightarrow \quad f_{Beta} = \left(1 + \beta^2\right) \frac{Precision * Recall}{\beta^2 * Precision + Recall}$$

$\beta = 1 \qquad f_1 \cdot score$

$$F_1 = 2 * \frac{Precision * Recall}{Precision + Recall}$$

$\beta = 0.5 \qquad f_{0.5} \ score$

$\beta = 2 \qquad f_2 \ score$

$$= \quad Harmonic \ Mean \quad \frac{2 \times Y}{n + Y}$$

$\beta = 1$, when FN and FP both are equally important.

$\beta = 0.5$, when FP $>$ FN more important

$\beta = 2$, when FN $>$ FP more important.

β value $(1 - 10)$

ROC and AUC

Consider a binary Problem.

$$0.5 > \quad = 0$$
$$0.5 < \quad = 1$$

Y	$\hat{Y}$ (Predict)	$\hat{Y}_{(0)}$	$\hat{Y}_{(0.2)}$	$\hat{Y}_{(0.4)}$
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	

Threshold value

Consider.

0, 0.2, 0.4, 0.6, 0.8

$$TPR = \frac{TP}{TP+FN} = \frac{4}{4+0} = 1 \qquad \qquad \frac{0.2}{\quad} \quad 1$$

$$FPR = \frac{FP}{FP+TN} = \frac{2}{2+0} = 1 \qquad \qquad 0.5$$
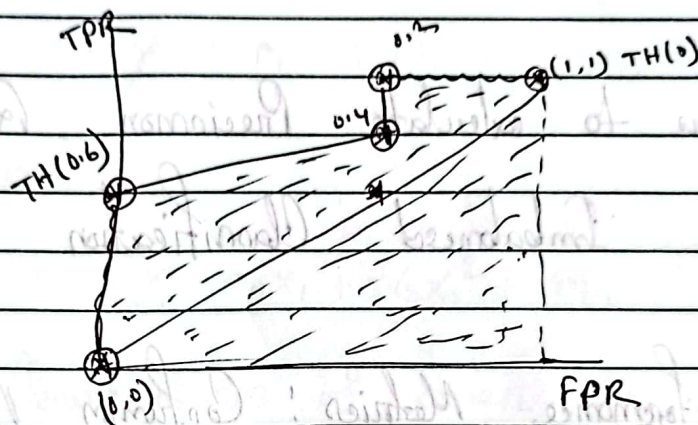

TPR

(0,0)

FPR

, ROC
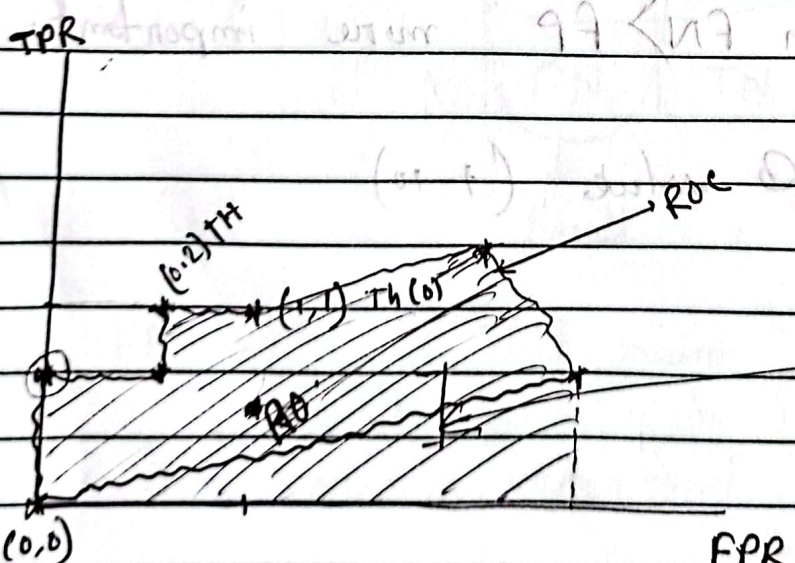
→ AUG Area Under Curve

The more the area under the curve the better model

Depend on Domain Expert Person,
what threshold value
will Select.

→ Hei monu i need higher TPR so i selected

TH (0.6)

Based on Considerd Threshold value, we will get

TPR and FPR value, and we

(১) value দিয়ে আমরা একটা গ্রাফ এ Point গুলো Place
এবং একটা curve পাব (ROC)। Point গুলো জোড় করে.

(২) curve এর under এ যা থাকবে, তা AUC।

কীভাবে TH value Select করব। Domain expert যেভাবে বলে।

1. Matrics to Evaluate your Machine learning Algorithm.

(towards datascience)

2. Confusion Matrix, Accuracy, Precision, Recall, F1 Score.

(medium.)

3. How to calculate Precision, Recall, and f Measure for Imbalanced Classification (machin learning mastery)

4. Performance Metrics: Confusion Matrix, Precision, Recall, F1 Score. (Towards datascience)

You should Read some in those article from we site.

The answer you get depend upon the Question you ask.

Thomas Kuhn.