* Accuracy and error measures. *

→ In data mining, classification involves the problem of predicting which category or class a new observation belongs to.

→ The classifier (derived model) is based on the analysis of a set of training data where each data is given a class label.

→ The trained model (classifier) is then used to predict the class label for new, unseen data.

→ To understand classification metrices, one of the most important concepts is the confusion matrix.

→ The different classifier evaluation measures are discussed below:

1. Confusion Matrix :-

It is a useful tool for analyzing how well your classifier can recognize tuples of different classes.

→ It is also called as contingency matrix.

→ Each row in the confusion matrix represents an actual class, while each column represents a predicted class.

The confusion matrix as follows,

		Predicted Class		
		1 (Yes)	0 (No)	Total
Actual class	1	TP	FN	P
	0	FP	TN	N

P + N = Total.

→ • TP :- It represents the values which are predicted to be true and are actually true.

→ • TN :- It represents the values which are predicted to be false and are actually false.

→ • FP :- It represents the values which are predicted to be true, but are false. Also called Type I error.

→ • FN :- It represents the values which are predicted to be false, but are true. Also called as Type II error.

2. Sensitivity :- Also called the true positive recognition rate. It is proportion of positive tuples that are correctly identified.

$$\text{Sensitivity} = \frac{TP}{TP + FN}.$$

3. Specificity :- Also called the true positive rate. It is proportion of negative tuples that are correctly identified.

$$\text{Specificity} = \frac{TN}{TN + FP}.$$

4. Accuracy :- The accuracy of the classifies on a given test set is the percentage of test set tuples that are correctly classified by the classifier. It is also ~~called~~ refered to as the overall recognition rate of the classifies.

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

5. Precision :- It is the measure of exactness. It determines what percentage of tuples labelled as positive are actually positive.

$$\text{Precision} = \frac{TP}{TP + FP} \quad \text{also OR}$$

$$\text{Precision} = \frac{TP}{\text{Predicted Yes}}$$

6. **Recall** :- It is the measure of completeness. It determine what percentage of positive tuples are labelled as positive.

$$\text{Recall} = \frac{TP}{TP + FN}$$

OR

$$\text{Recall} = \frac{TP}{\text{Actual Yes}}$$

7. **F-Score** :- It is the harmonic mean of precision and recall. Also called as overall performance. It gives equal weight to precision and recall. It is also called as F1 score.

$$F = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}.$$

8. **Error Rate** :- It is also called as misclassification rate of a classifier.

→ It is simply (1 − Accuracy)

OR

$$\text{Error Rate} = \frac{FP + FN}{\text{Total}}.$$