Performance Prediction of Model

Accuracy = No.of correctly classified points/Total no.of points in Dtest

We should never use accuracy as a measure in Imbalance Dataset

Confusion Matrix

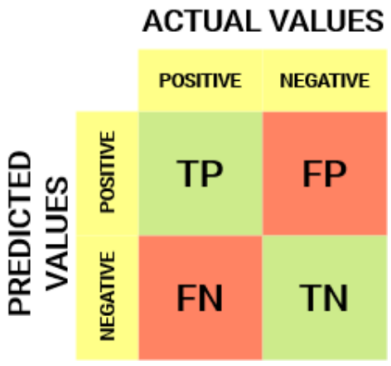
Confusion Matrix is an N x N matrix used for calculating the performance of a classification model, where N is the number of target classes.

It compares the actual target values with those predicted by the machine learning model. This gives us a holistic view of how well our classification model is performing and what kinds of errors it is making.

Confusion Matrix for binary classification shows the four different outcomes: true positive, false positive, true negative, and false negative. The actual values form the columns, and the predicted values (labels) form the rows

- Useful for measuring Recall, Precision, Specificity, Accuracy and most importantly AUC-ROC Curve
- **It helps us evaluate how our model performed, where it went wrong and offers us guidance to correct our path.**

4 combination are - TN, FN, FP, TP.



Let's decipher the matrix:

- The target variable has two values: Positive or Negative
- The columns represent the actual values of the target variable
- The rows represent the predicted values of the target variable

Memory Tips- In TN, T-are you correct, N-what is predicted label, First row N,2nd row P, IF actual and predicted is same then T else F

True Positive, True Negative, False Positive and False Negative in a Confusion Matrix -

True Positive (TP) -

- The predicted value matches the actual value
- The actual value was positive and the model predicted a positive value

True Negative (TN) -

- The predicted value matches the actual value
- The actual value was negative and the model predicted a negative value

False Positive (FP) – Type 1 error

- The predicted value was falsely predicted
- The actual value was negative but the model predicted a positive value
- Also known as the Type 1 error

False Negative (FN) – Type 2 error

- The predicted value was falsely predicted
- The actual value was positive but the model predicted a negative value
- Also known as the Type 2 error

Precision vs. Recall -

Precision tells us how many of the correctly predicted cases actually turned out to be positive.

- For all the points model declared/predicted to be +ve, what percentage of them are actually +ve.
- Out of all the positive classes we have predicted correctly, how many are actually positive.

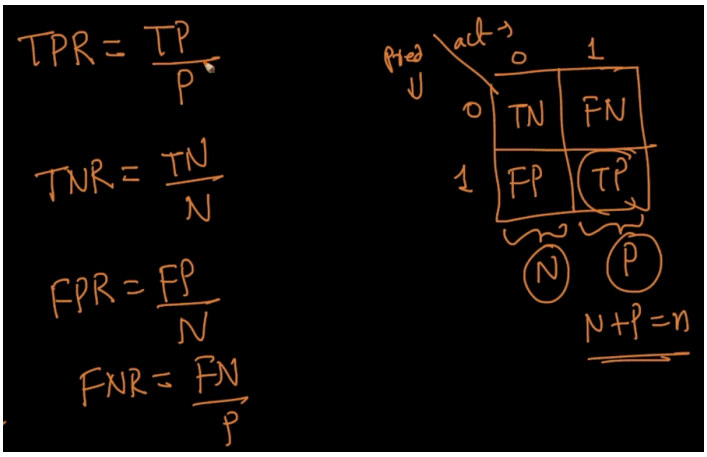
$$P = TP/(TP + FP)$$

- Eg. Let we predicted there will raining day of 10 days in a month. If raining day actually turn out to 10 days then its Precision.

Recall tells us how many of the actual positive cases we were able to predict correctly with our model.

- For all the actually +ve points, how many of them are predicted to be +ve.
- Out of all the positive classes, how much we predicted correctly

$$R = TP/(TP + FN)$$



- Eg. If I will give 10 chocolates packed toffies to a person, and that person will predicted no. of chocolate from 10 toffies.
- Eg. Jack had let's say ten such instances in reality, and he narrated twenty instances to finally spell out the ten correct instances, then his recall will be a 100%, but his precision will only be 50%.

F-measure -

F1-score is a harmonic mean of Precision and Recall, and so it gives a combined idea about these two metrics. It is maximum when Precision is equal to Recall.

$$F1 = (2 * Precision * Recall)/(Precision + Recall)$$

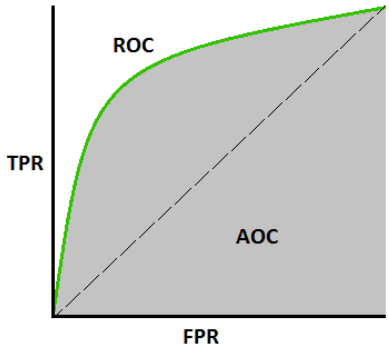
- It is difficult to compare two models with low precision and high recall or vice versa. So to make them comparable, we use F-Score.
- When we want both High Precision and High Recall then we use F1 score.
- F-score helps to measure Recall and Precision at the same time
- The interpretability of the F1-score is poor. This means that we don't know what our classifier is maximizing – precision or recall

AUC - ROC Curve

- AUC - ROC curve is a performance measurement for classification problem at various thresholds settings.

> **ROC** is a probability curve and **AUC** represents degree or measure of separability.

- It tells how much model is capable of distinguishing between classes.
- Higher the AUC, better the model is at predicting 0s as 0s and 1s as 1s.



How to speculate the performance of the model?

- An excellent model has AUC near to the 1 which means it has good measure of separability.
- A poor model has AUC near to the 0 which means it has worst measure of separability.
- In fact it means it is reciprocating the result. It is predicting 0s as 1s and 1s as 0s.
- When AUC is 0.5, it means model has no class separation capacity whatsoever.

Log Loss

Log Loss is the avg negative log(Prob.correct class label).

- Range from 0 to infinity, 0 is the best case.

Loss function- A function used to evaluate the performance of the algorithm used for solving a task.

R^2 or coefficient determination

R^2 defines the degree to which the variance in the dependent variable (or target) can be explained by the independent variable (features).

- Eg Let say the R-squared value for a particular model comes out to be 0.7. This means that 70% of the variation in the dependent variable is explained by the independent variables.
- Ideally, we would want that the independent variables are able to explain all the variation in the target variable. In that scenario, the r-squared value would be 1. Thus we can say that higher the r-squared value, better in the model.
- Higher the R squared, the more variation is explained by your input variables and hence better is your model. Also, the r-squared would range from 0 to 1.

$$r^2 = 1 - \frac{\text{SS Error}}{\text{SS Total}} = 1 - \frac{\sum(y_i - \hat{y}_i)^2}{\sum(y_i - \bar{y})^2}$$

Median Absolute Deviation ¶

MAD is defined as the median of the absolute deviations from the data's median.

- Eg. Consider the data (1, 1, 2, 2, 4, 6, 9). It has a median value of 2. The absolute deviations about 2 are (1, 1, 0, 0, 2, 4, 7) which in turn have a median value of 1 (because the sorted absolute deviations are (0, 0, 1, 1, 2, 4, 7)). So the median absolute deviation for this data is 1

Refer-

- Confusion Matrix- https://towardsdatascience.com/understanding-confusion-matrix-a9ad42dcfd62 (https://towardsdatascience.com/understanding-confusion-matrix-a9ad42dcfd62)
- Confusion Matrix - https://www.analyticsvidhya.com/blog/2020/04/confusion-matrix-machine-learning/ (https://www.analyticsvidhya.com/blog/2020/04/confusion-matrix-machine-learning/)
- R2 - https://medium.com/analytics-vidhya/r-squared-vs-adjusted-r-squared-a3ebc565677b (https://medium.com/analytics-vidhya/r-squared-vs-adjusted-r-squared-a3ebc565677b)