

Performance Metrics

Author - Kanav Bansal

You can find me on **LinkedIn** -
www.linkedin.com/in/kanavbansal
Or <http://www.thataiguy.com>

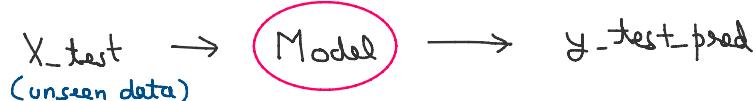
Training



- * After building the model, we will evaluate the models. For that, first predict on the unseen datapoints and then compare actual values with predicted values.

Testing

a. Prediction



b. Evaluation



- * Classification & Regression will have separate Evaluation Metrics.

CLASSIFICATION

1. Accuracy
2. Confusion Matrix
3. Precision & Recall
4. F1 - Score
5. ROC - AUC
Receiver Operating Characteristic Curve
(Area under curve)
6. Log Loss

REGRESSION

1. Mean Absolute Error
2. Mean Squared Error
3. Root Mean Sq. Error
4. R - Squared
5. Adjusted R - Squared

FOR REGRESSION PROBLEM

1. MEAN ABSOLUTE ERROR (MAE)

$$\text{MAE} = \frac{\sum_{i=1}^n \left| \text{abs} \left(\text{fact}_i - \text{y}_{\text{pred},i} \right) \right|}{n}$$

Mean abs Error

2. MEAN SQUARED ERROR (MSE)

$$MSE = \underbrace{\frac{1}{n} \sum_{i=1}^n}_{\text{Mean}} \left\{ \underbrace{(y_{acti} - \hat{y}_{predi})^2}_{\text{Error}} \right\}$$

↑ Squared

3. ROOT MEAN SQUARED ERROR (RMSE)

$$RMSE = \sqrt{MSE}$$

- * Important pointers on MAE, MSE & RMSE ↴
 - a. MSE is a differentiable function. Hence it is a goto choice of Loss Function when compared to MAE.
 - b. MSE is more sensitive to Outliers.
 - c. MAE, MSE & RMSE are the measures of average deviation of predictions from the actual values.
 - d. MAE, MSE & RMSE are used to compare 2 or more models.

4. R-squared OR COEFFICIENT OF DETERMINATION

$$R^2 = 1 - \frac{RSS}{TSS}$$

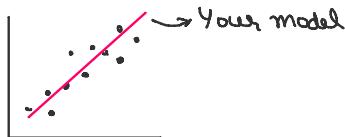
OR

$$R^2 = 1 - \frac{SS_{res}}{SS_{Tot}}$$

- RSS OR SS_{res}
(Sum of Squared residuals)

$$RSS = \sum_{i=1}^n (y_{acti} - \hat{y}_{predi})^2$$

y_{acti} → Actual value
 \hat{y}_{predi} → Predicted Value



i.e. RSS is the measure of error done by your model

- TSS OR SS_{Tot}
(Total Sum of squares)

$$TSS = \sum_{i=1}^n (y_{acti} - \bar{y}_{acti})^2$$

y_{acti} → Actual Value
 \bar{y}_{acti} → Mean of y_{acti} 's



i.e. TSS is the measure of error done by a simple mean model

CASE-1:

Your model behaves exactly like a simple mean model
 $RSS = TSS$ i.e. Your model's error is equal to the error's done by simple mean model?

$$\Rightarrow R^2 = 1 - \frac{RSS}{TSS}$$

$$\Rightarrow R^2 = 1 - 1$$

$$\Rightarrow R^2 = 0$$

CASE-2:

Your model behaves better than a simple mean model
 $RSS < TSS$ i.e. Your model's error is less than the error's done by simple mean model?

$$\Rightarrow R^2 = 1 - \frac{RSS}{TSS}$$

$$\Rightarrow R^2 = 1 - x$$

here, $0 < x < 1$

$$\Rightarrow 0 < R^2 < 1$$

CASE-3:

Your model behaves worse than a simple mean model
 $RSS > TSS$ i.e. Your model's error is greater than the error's done by simple mean model?

$$\Rightarrow R^2 = 1 - \frac{RSS}{TSS}$$

$$\Rightarrow R^2 = 1 - x$$

here, $1 < x < +\infty$

$$\Rightarrow -\infty < R^2 < 0$$

5. Adjusted R-squared

$$\bar{R}^2 = 1 - \left[\frac{(1-R^2)(n-1)}{(n-p-1)} \right]$$

$n \rightarrow$ No. of samples/rows in data

$p \rightarrow$ No. of predictors/independent features

Important Note:

- R^2 & \bar{R}^2 are used for explaining how well the independent variables explains the variability in the dependent variable.
- R^2 always increases with the addition of the independent variable which might lead to the existence of redundant variables in our model.
- Adjusted R^2 solves the above problem. The value of adjusted R^2 decreases if the increase in the R^2 by the additional variable is not significant enough.
- For comparing different regression models, RMSE is a better choice than R^2 or adj. R^2 .