Discussion on Evaluation Metrics

Light Gradient Boosted Machine Regressor (LGBM Regressor) and Extreme Gradient Boosting Regressor (XGBoost Regressor) are the 2 models that performed better than the other regression models (Linear Regression, Support Vector Regression, Decision Tree Regression, Random Forest Regression, K Neighbors Regression) for the prediction of Electrical Energy Output given the 4 features Temperature, Ambient Pressure, Relative Humidity and Exhaust Vacuum.

Both XGBoost and LGBM belong to a family of boosting algorithms. Boosting is a sequential technique that works on principle of ensemble. Boosting combines a set of weak learners and delivers improved prediction accuracy. Default base learners of XGBoost and LGBM are tree ensembles. However, the main difference is that XGBoost grows tree level-wise while LGBM grows tree leaf-wise.

The Evaluation metrics used for this regression problem are Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), R Squared and Adjusted R Squared.

	Hyper tuned Parameters	MAE	MSE	RMSE	R Squared	Adjusted R Squared
XGBoost Regressor	max_depth = 7 gamma = 1 n_estimators = 1000	2.1314	8.6068	2.9337	0.9695	0.9680
LGBM Regressor	max_depth = 75 learning_rate = 0.1 num_leaves = 150	2.2473	9.0666	3.0111	0.9681	0.9697

MAE measures the average magnitude of the errors in a set of predictions, without considering their direction. It is a linear score as all the individual differences are weighted equally in the average. MSE is the average of squared differences between prediction and actual observation. RMSE is a quadratic scoring rule, which is the square root of MSE. However, RMSE gives a relatively high weight to large errors, since errors are squared before taking the mean. MAE, MSE and RMSE are negatively oriented scores. R Squared metric represents the goodness of fit of a model. But it tends to increase with the number of independent variables, which is why the Adjusted R Squared was considered too. R Squared and Adjusted R Squared are positively oriented scores.

Thus, it is evident that XGBoost has performed better than LGBM in the metrics MAE, MSE, RMSE and R Squared.

If the RMSE=MAE, then all the errors are of the same magnitude. Here, since RMSE is slightly greater than MAE for both algorithms, there is a slight variance in the individual errors in the sample. Both models suggest that about 97% of the observed variation can be observed by the inputs (the 4 features Temperature, Ambient Pressure, Relative Humidity and Exhaust Vacuum), since R Squared scores are 0.9695 and 0.9681 for both models. Though Adjusted R Squared is slightly lower for XGBoost Regressor than the LGBM Regressor, both values are sufficiently high.

Thus, from the evaluation metrics, it is evident that the XGBoost Regressor model is better suited for electrical energy output prediction that the LGBM Regressor model.