

Energy Consumption Forecasting - Model Evaluation Report

1. Project Overview

You're working on energy consumption forecasting using temporal, electrical, and engineered features. Your target is `Global_active_power`, evaluated via Linear Regression, Random Forest, and XGBoost models.

2. Model Performance Comparison

Model	RMSE	MAE	R ² Score
Linear Reg.	0.0401	0.0255	0.9986
Random Forest	0.0242	0.0109	0.9995
XGBoost	0.0284	0.0168	0.9993
Tuned RF	0.0300	0.0139	0.9992

All models perform exceptionally well. Random Forest slightly outperforms others. Linear Regression also does surprisingly well, suggesting strong linearity in data.

3. Visual Analysis Summary

- Actual vs Predicted: Near-perfect fit.
- Residuals: Random Forest and XGBoost show better error distribution than Linear Regression.
- Time Series Plots: Predicted closely tracks actual values with minor deviation at peaks.
- Correlation: `Sub_metering` and `Intensity` features highly correlate with `Global_active_power`.

4. Feature Engineering Insights

Rolling averages and peak indicators help with performance. Voltage had weak impact. Consider adding lag features and interaction terms for more depth.

5. Recommendations

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- Use Random Forest for deployment (balance of accuracy and performance).
- Use XGBoost if aiming for top accuracy and can afford computational cost.
- Perform feature importance, cross-validation, and drift detection.
- Consider SHAP for explainability and prepare for deployment via Flask/FastAPI.

6. Next Steps

1. Add SHAP value analysis
2. Deploy model in real-time environment
3. Monitor performance over time
4. Document model pipeline and assumptions