Energy Consumption Forecasting & Anomaly Detection

Author: Prasad Vijaykumar Pandit

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Executive Summary

This project analyzed historical household energy consumption to identify trends, detect seasonality, forecast future usage, and flag anomalous days. Multiple models were compared, and an interactive Tableau dashboard was developed for visualization and business insights.

Project Overview

- Understanding consumption patterns
- Forecasting future demand
- Detecting anomalies
- Assisting operational planning through data-driven insights

Data Description

- **Source:** UCI Machine Learning Repository - Household Power Consumption Dataset
- **Granularity:** Minute-level readings aggregated to daily
- **Key Variables:** Date, Global Active Power (kW), Voltage, Sub-metering values

Key Insights

- Peak usage trends indicate higher demand in winter, lower in summer.
- Seasonal dependencies confirm yearly and monthly cyclic patterns.
- Anomaly detection flagged unusual consumption days.

Forecasting Models

- **SARIMAX:** Captured seasonality effectively.
- **Prophet:** Automatically detected seasonality, required minimal tuning, and consistently outperformed SARIMAX.

Recommendations

- Adjust energy planning for high-demand months.
- Investigate flagged anomalous days.
- Adopt Prophet for operational forecasting.
- Regularly review anomaly patterns for waste/fault detection.

Conclusion

Forecasting and anomaly detection improve operational efficiency, energy-saving strategies, and capacity planning. The Prophet model proved ideal for this problem.