

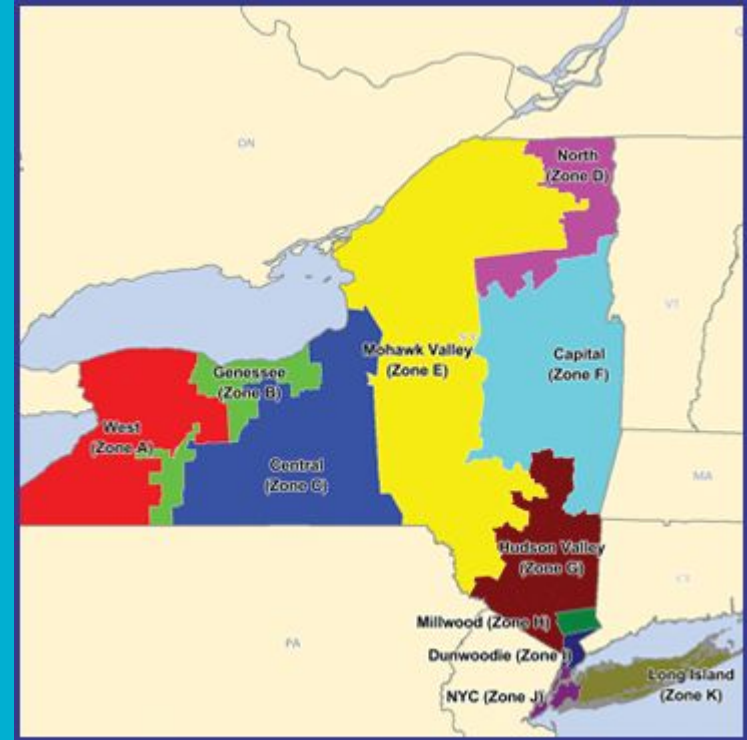
NYISO Power Analysis

A forecast of New York's power use to increase efficiency and pricing

Daniel Martinez

Summary

- Time Series
- ISO and energy pricing
- NYISO Data
- Facebook Prophet
- XGBoost
- Comparison
- Conclusions
- Future improvements

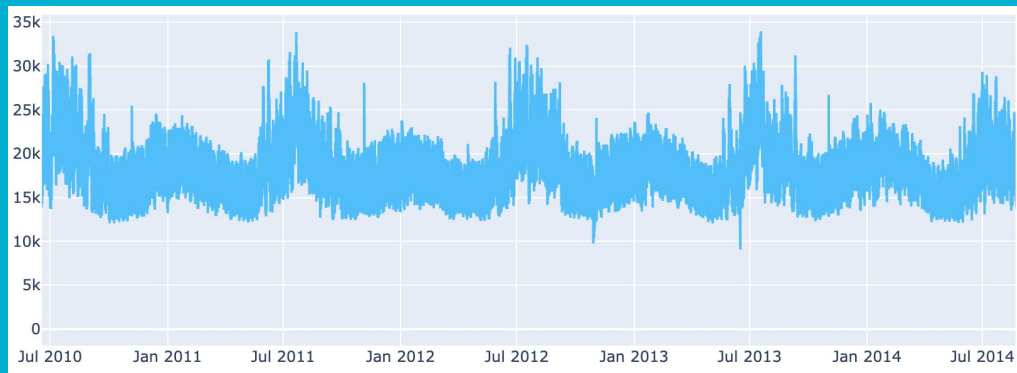


Time Series

Used for data with a natural temporal order

Forecasting by using previously observed values to predict future values

Useful for data with autocorrelation, seasonality and stationarity



ISO and energy pricing



An independent system operator (ISO) - operates a region's electricity grid, administers the region's wholesale electricity markets, and provides reliability planning for the region's bulk electricity system

New York Independent System Operator (NYISO) — the organization responsible for managing New York's electric grid and its competitive wholesale electric marketplace

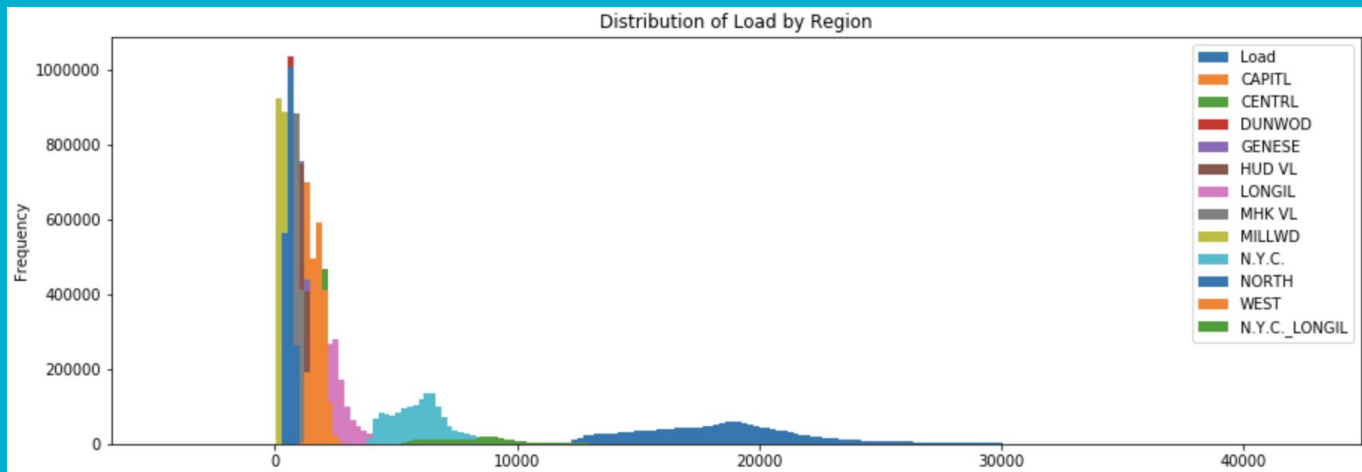
NYISO facilitates and coordinates purchases and sales of electricity in New York and across neighboring regions to meet consumer demands at the lowest possible cost

NYISO

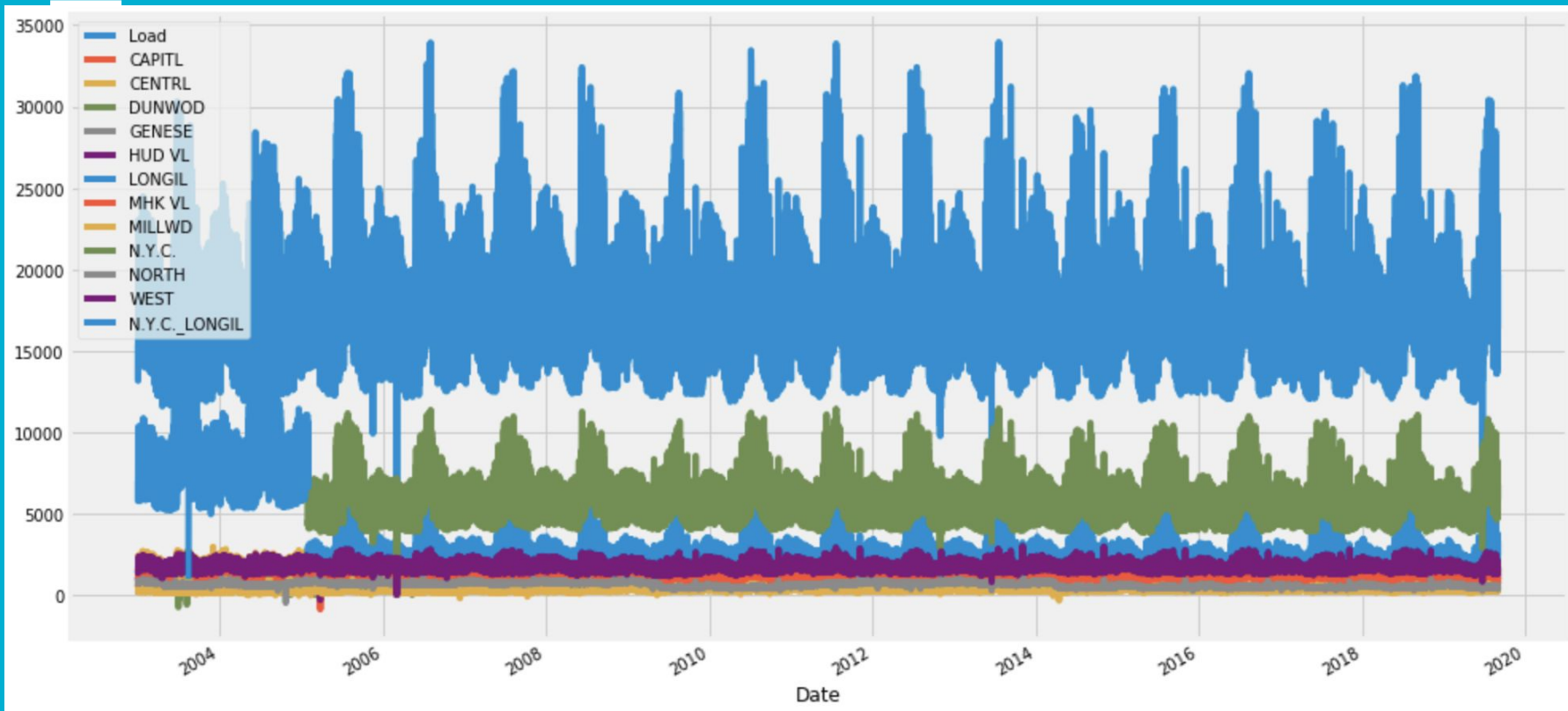
Used Load data collected every 5 minutes over 16 years

Downsampled 19.8 million data points to 150 thousand

11 different markets in New York State



NYISO Load 2002-2019



Prophet

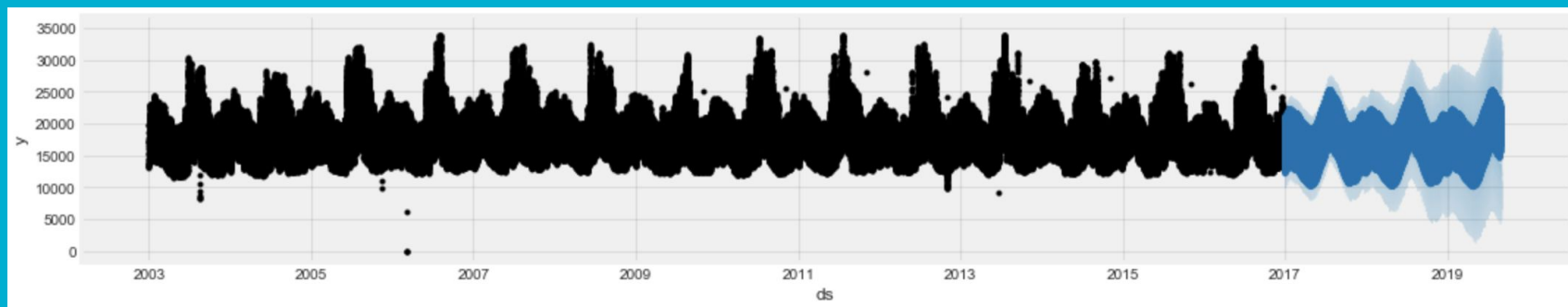
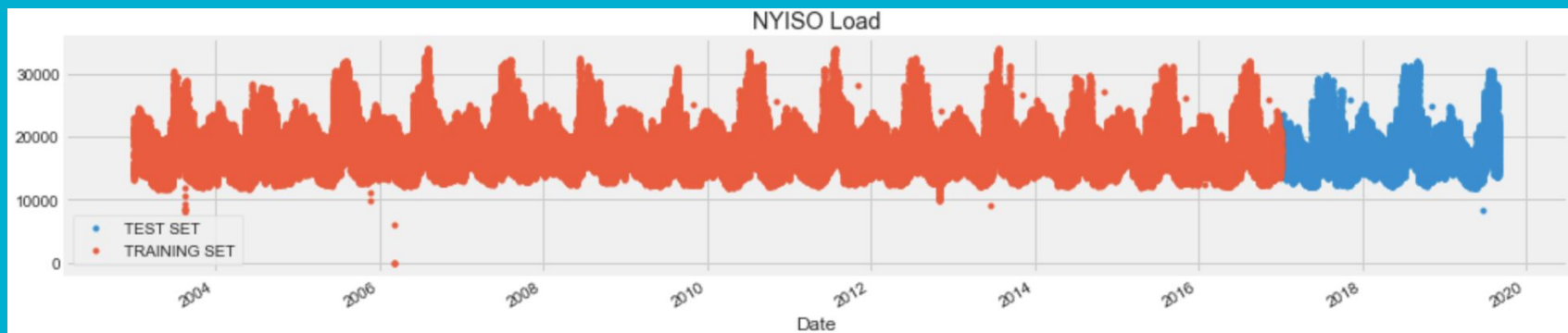


Open source software released by Facebook's Core Data Science team in 2017

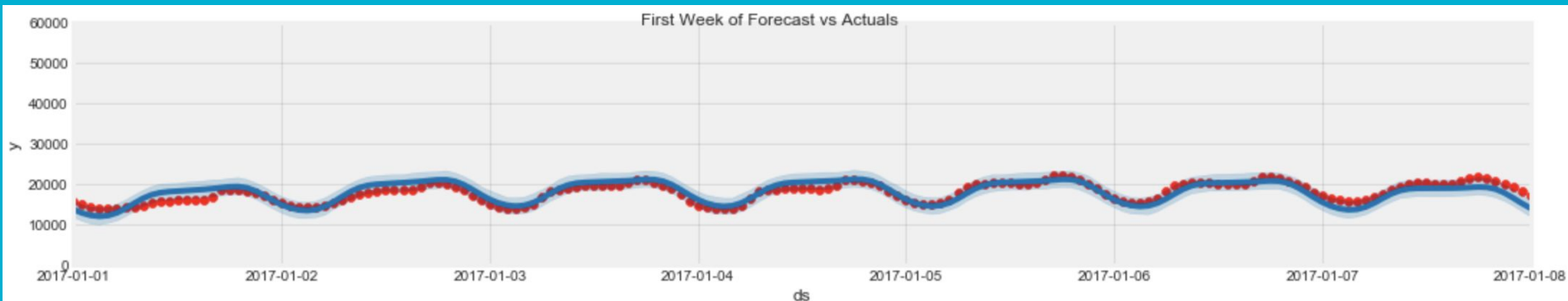
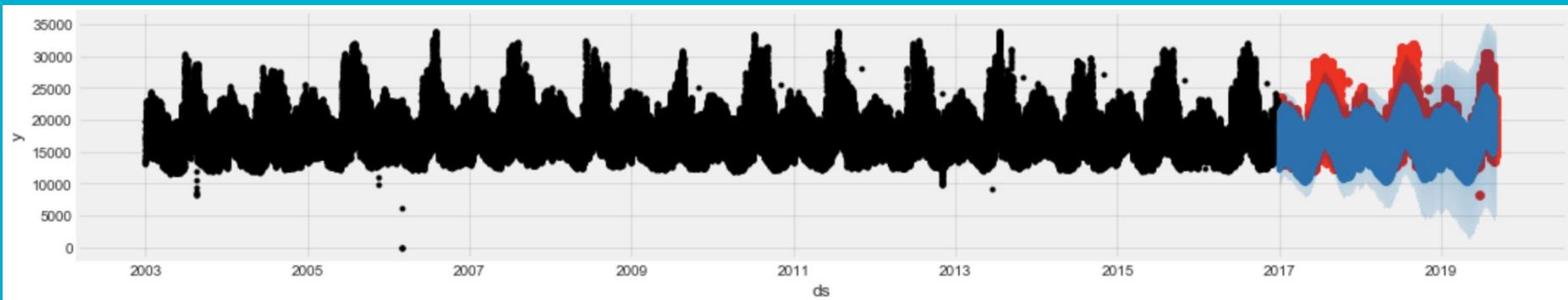
Forecasts time series data based on an additive model that works best with time series that have strong seasonal effects

An additive regression model with four main components:

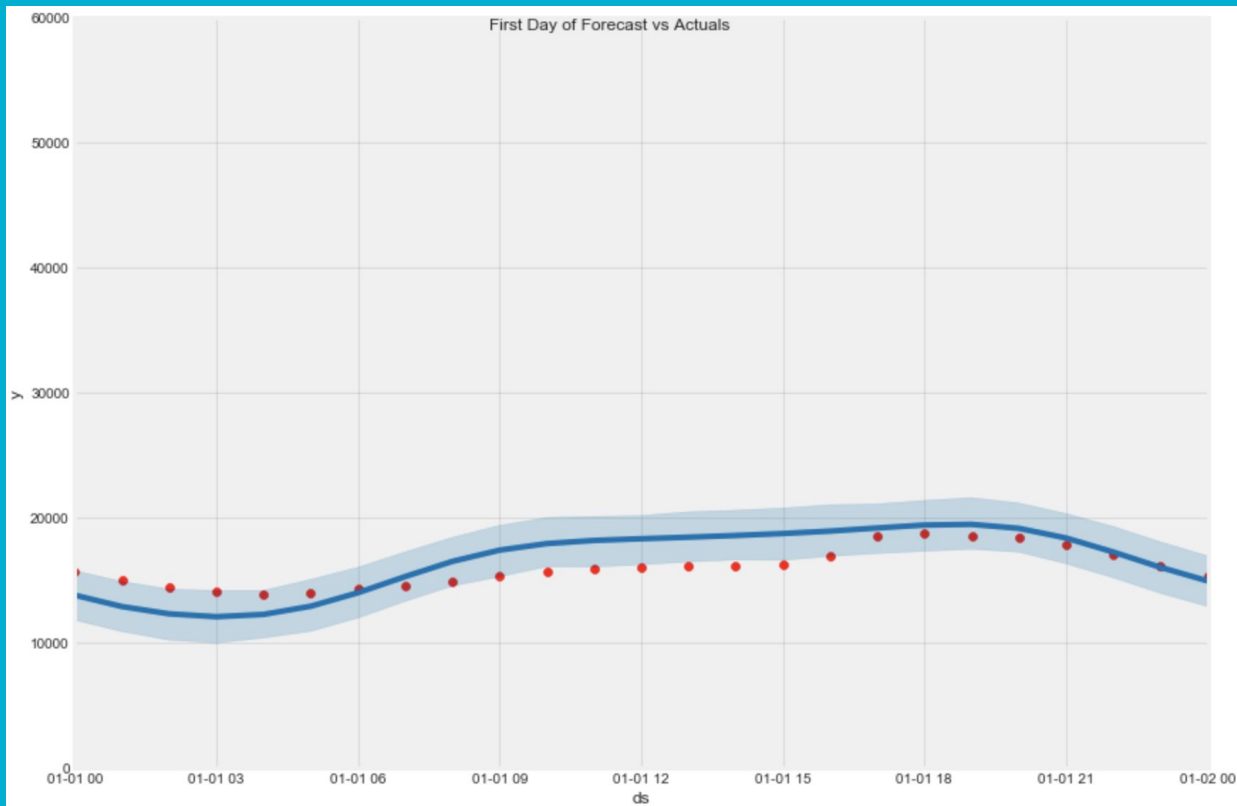
- A piecewise linear or logistic growth curve trend. Prophet automatically detects changes in trends by selecting changepoints from the data.
- A yearly seasonal component modeled using Fourier series.
- A weekly seasonal component using dummy variables.
- A user-provided list of important holidays.



PROPHET



1-Day Forecast



XGBoost

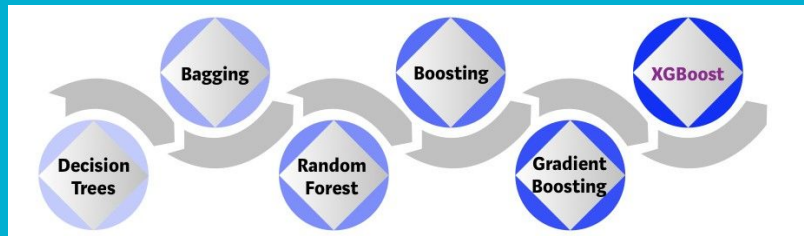
XGBoost

Decision-tree-based ensemble Machine Learning algorithm that uses gradient boosting

Scalable gradient boosting build for performance and speed

Since its introduction, this algorithm has been credited with winning numerous Kaggle competitions

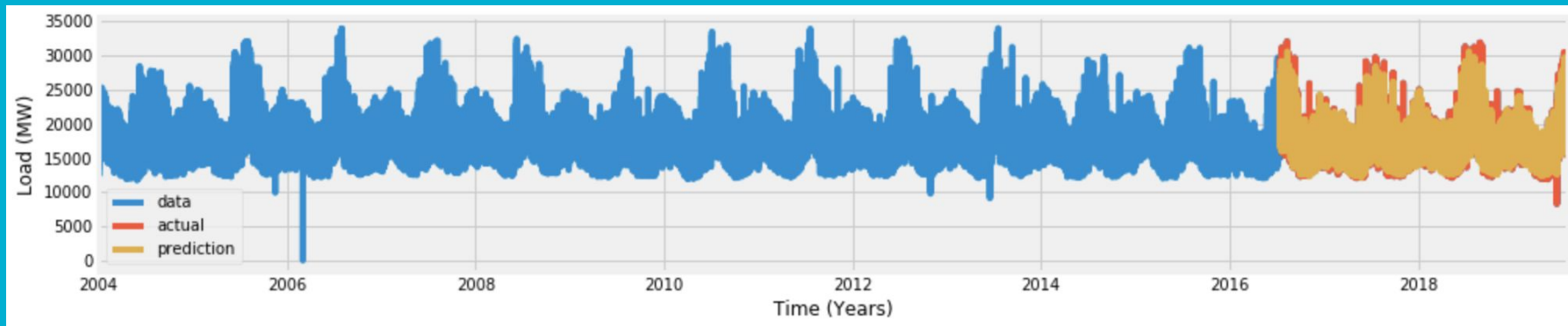
Can be used to solve regression, classification, ranking, and user-defined prediction problems



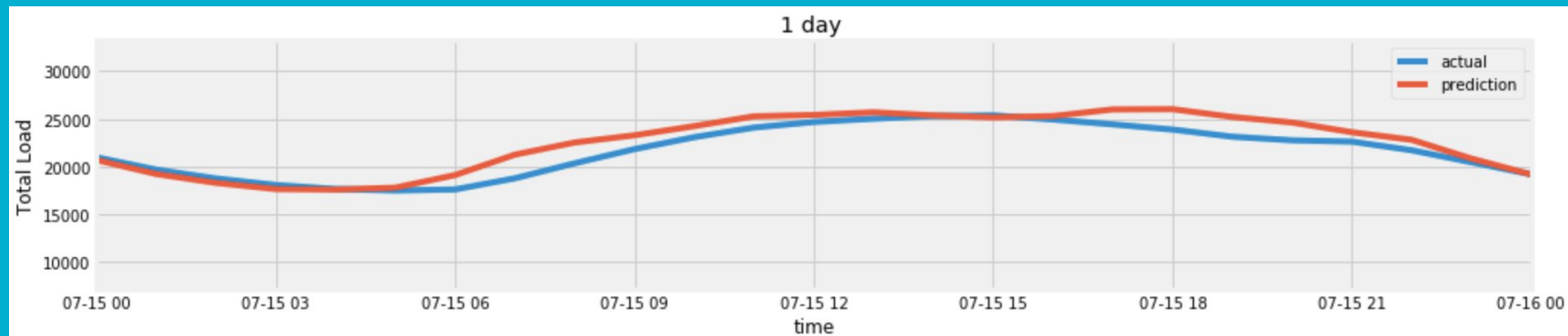
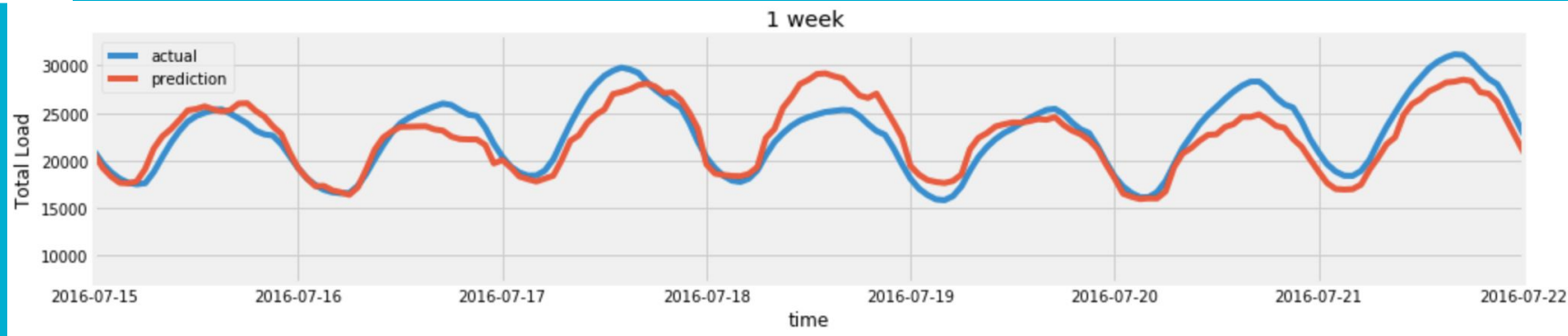
XGBoost Model

Engineered Features to forecast the next day Load

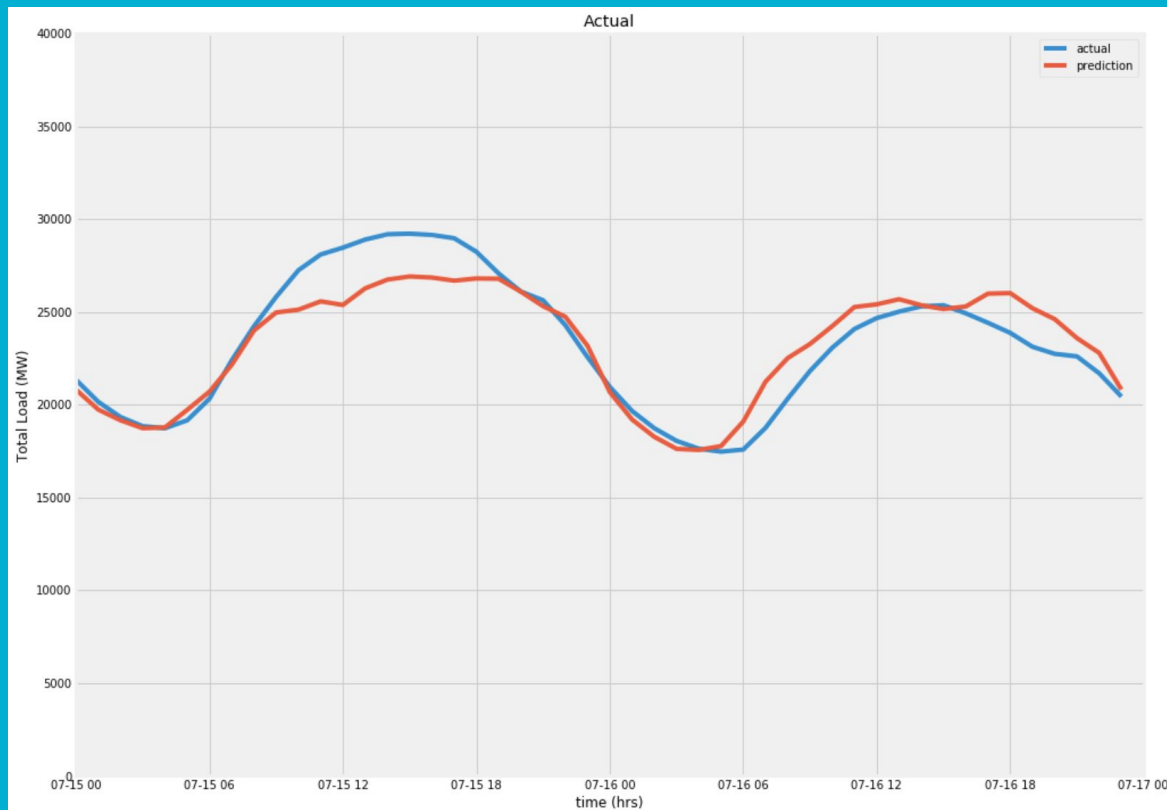
10 fold Cross Validation



XGBoost



Next Day Forecast



Comparison of Metrics

$$\text{SMAPE} = \frac{100\%}{n} \sum_{t=1}^n \frac{|F_t - A_t|}{(|A_t| + |F_t|)/2}$$

$$\text{M} = \frac{100\%}{n} \sum_{t=1}^n \left| \frac{A_t - F_t}{A_t} \right|$$

Prophet Model

SMAPE : 7.51%

MAPE : 7.56%

SMAPE (1-Day) : 9.28%

MAPE (1-Day): 9.42%

XGBoost Model

SMAPE : 4.49%

MAPE : 4.51%

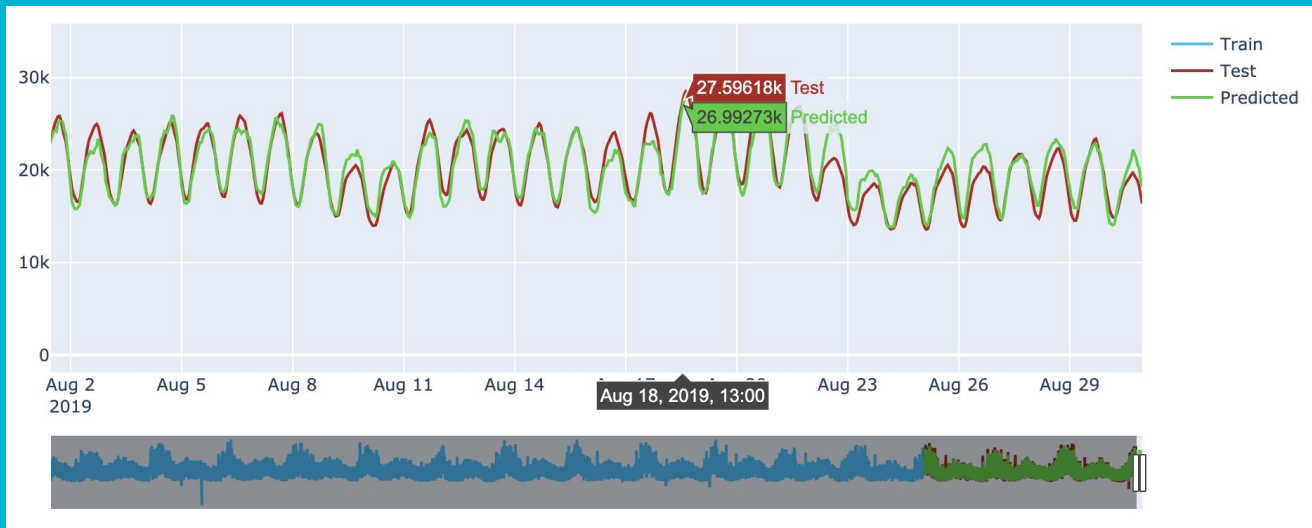
SMAPE (1-Day) : 4.45%

MAPE (1-Day): 4.30%

Conclusions

XGBoost is a powerful tool for predicting energy usage which can help make energy more efficient

Feature engineering can add performance to Prophet's predictions for 1 day forecasts



Future Improvements

- Add Pricing Data
- Improve Feature Engineering by including external factors such as weather, temperature, etc..
- Improve model increase forecast to weeks, months
- Improve Hyper-parameter tuning
- Use LightGBM for improved performance

Contact

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