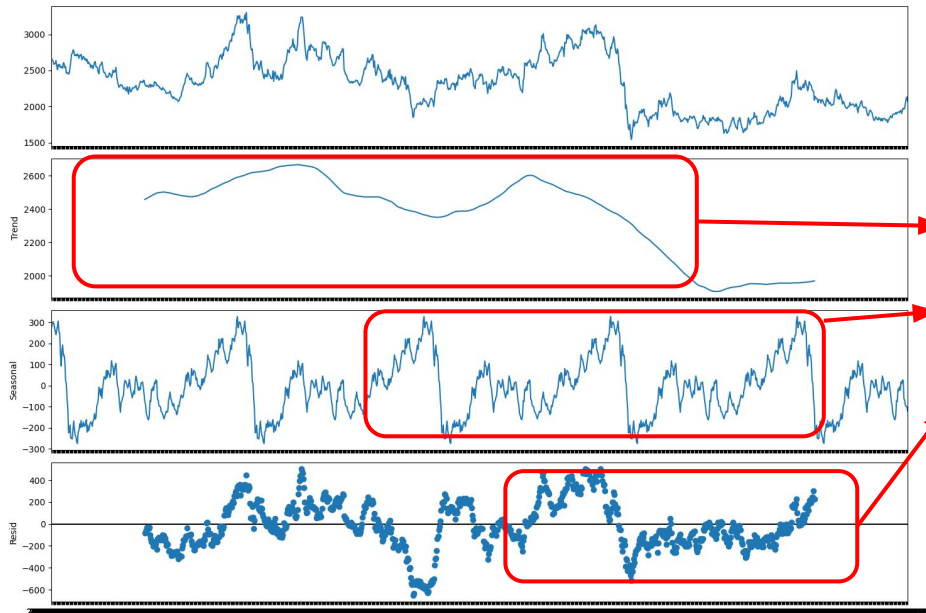# Tokyo Stock Prices

Adam Foster
Maciek Staniszewski
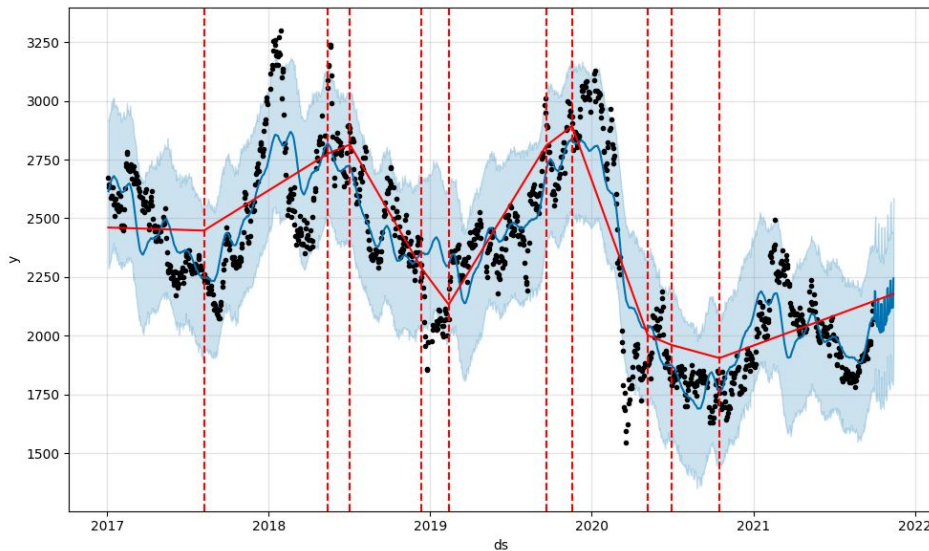
Tokyo Stock Exchange Data

- Data from 2017 to 2022

- Huge 1.3 GB dataset, restricted to one time series of *"Japan Petroleum Exploration"*

- Predicting Close instead of Returns
    - Eliminating negative observations

- No clear deterministic trend

- Strong yearly **linear** seasonal effects

- Residuals distributed around 0, expected for a linear model

Prophet

- Last 45 observations removed from the training dataset
- Prophet fits the in-sample data very well
  - Avoids overfitting and doesn't accurately model sudden spikes
  - Models stable progressions well
  - Identifies 10 trend changepoints
- Forecast is jumpy, but follows the general pattern.
- Accounting for holidays has no effect on prediction due to how the stock market operates
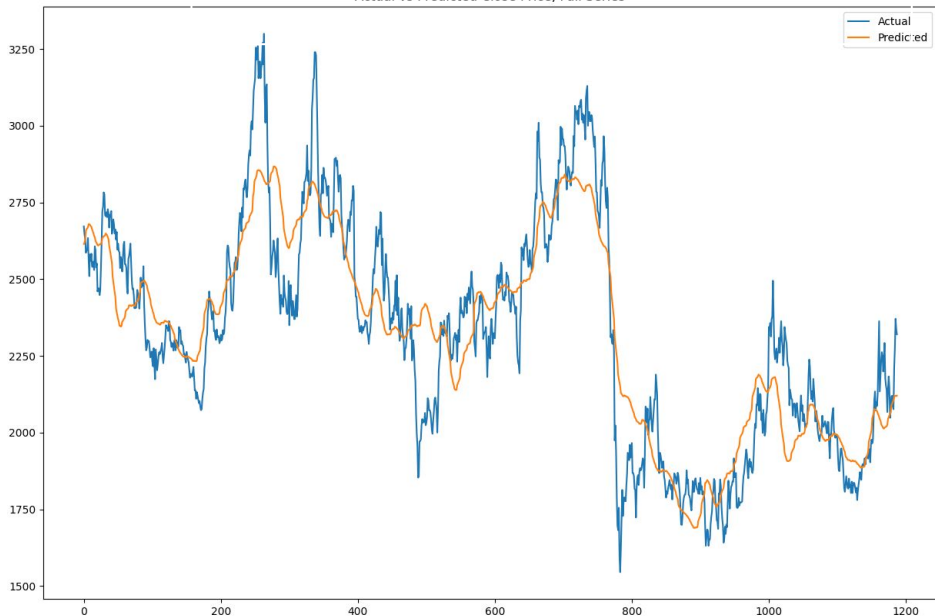
PROPHET

Prophet - Fitting and Predictions

- MAE = 124.8, MAPE = **5.4%**

- MAE = 100.6, MAPE = **4.6%**
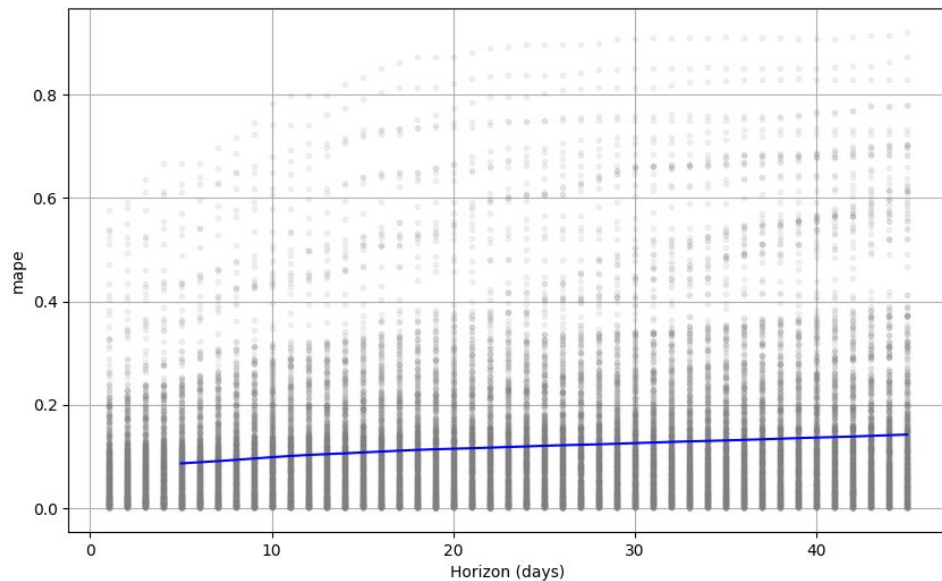

Actual vs Predicted Close Price, Full Series

Actual vs Predicted Close Price, Out-of-Sample Performance

PROPHET

Prophet - CV

- Our previous MAPE score smaller than 5% depended on favourable plateau in the Close price
- The MAPE resulting from cross validation averaged at **~18%**
- MAPE was steadily increasing proportionally to the increase of the horizon.
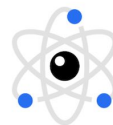
PROPHET

Orbit

We tested three State Space Models supported by Orbit:
- Exponential Smoothing (ETS):   MAPE = **6.7%**
- Local Global Trend (LGT):   MAPE = **7.2%**
- Damped Local Trend (DLT):   MAPE = **6.9%**

All three models performed similarly in the out-of-sample period. ETS was the best at picking up a sudden price jump, while DLT was steadily trending downwards.
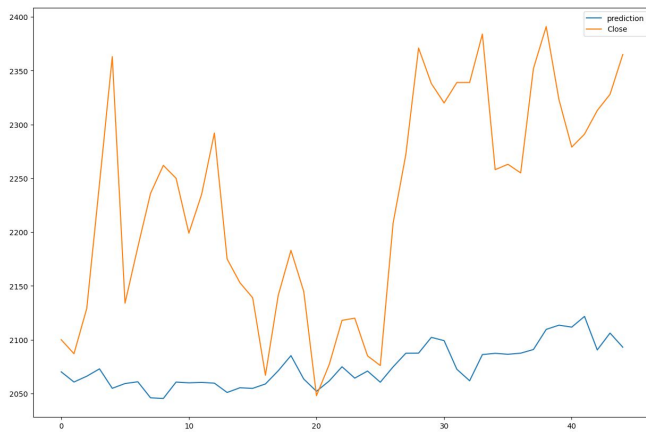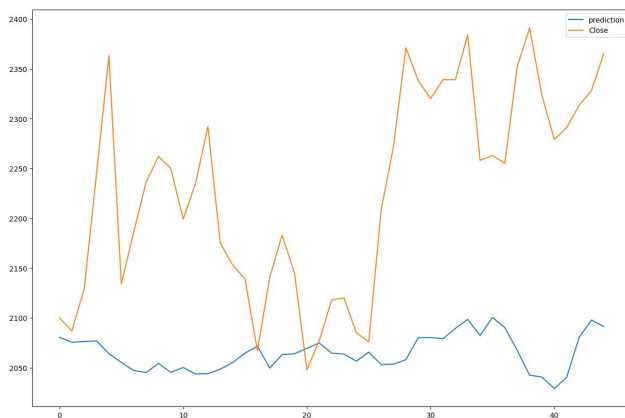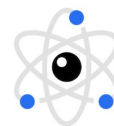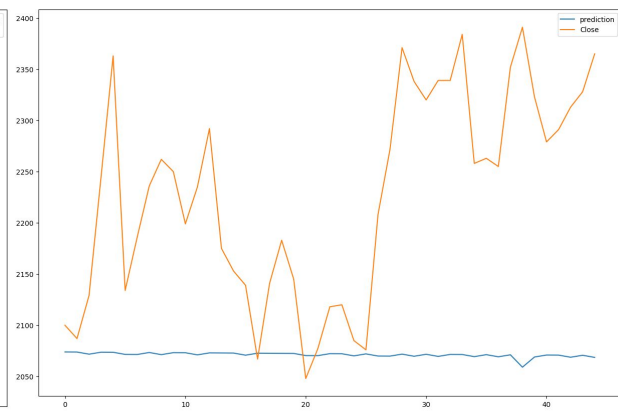
Orbit

Orbit - Model Evaluation

Exponential Smoothing

Local Global Trend

Damped Local Trend