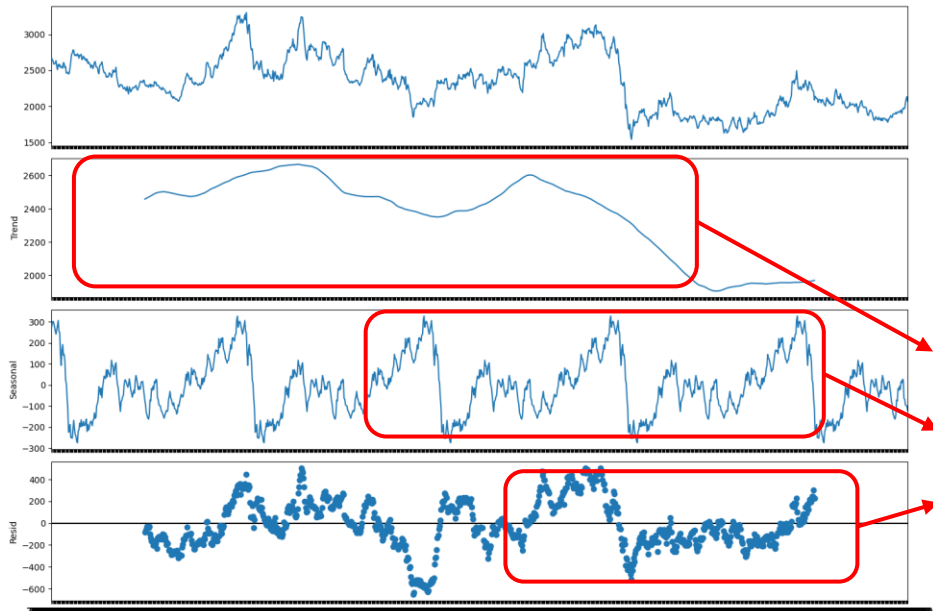


Tokyo Exchange Stock Price Prediction

Adam Foster
Maciek Staniszewski



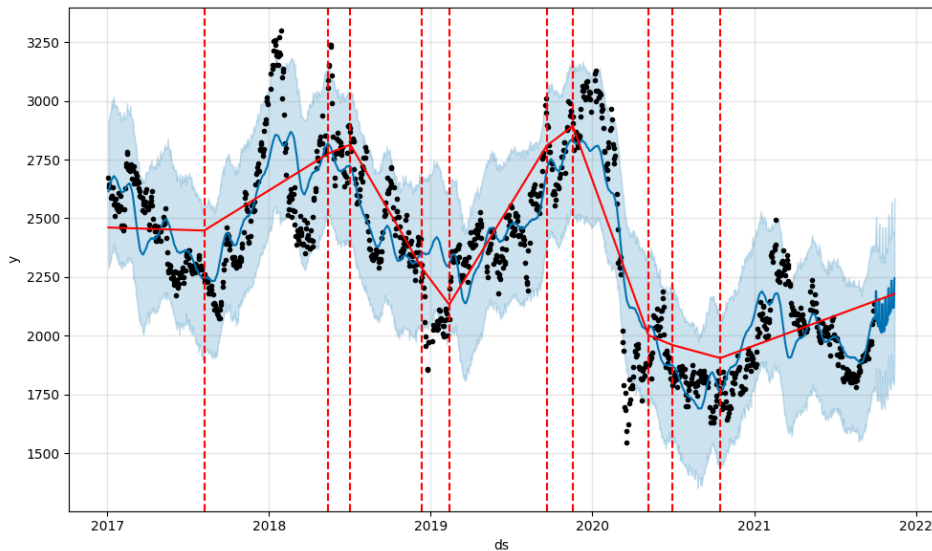
Tokyo Stock Exchange Data



- Data from 2017 to 2022
- Huge 1.3 GB dataset, restricted to one time series of “*Japan Petroleum Exploration*” – well established oil & gas company with data spanning the full period
- Ensured continuous and no missing values
- 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



- Univariate additive model that identifies non-linear trends and seasonal effects
- 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

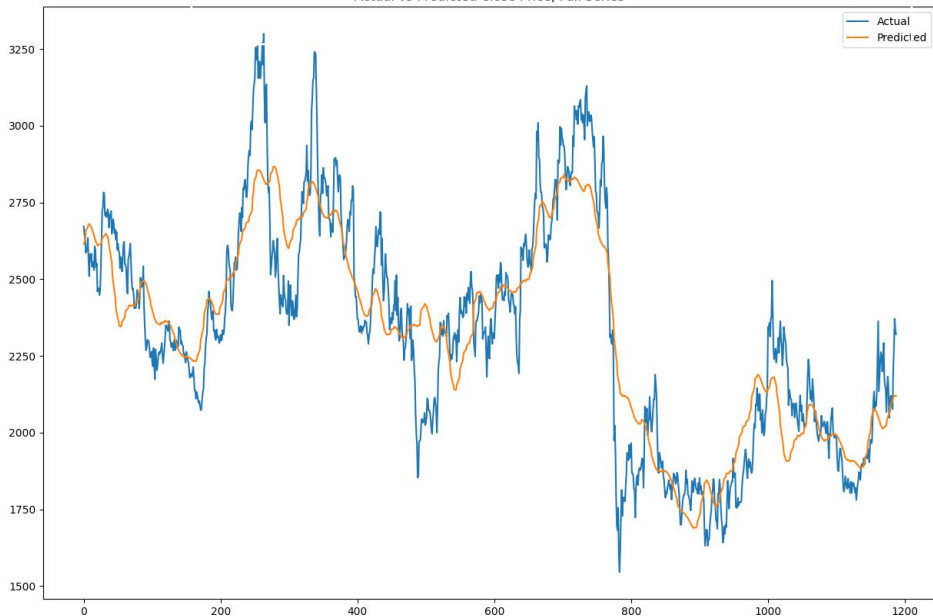


Prophet - Fitting and Predictions

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

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

Actual vs Predicted Close Price, Full Series

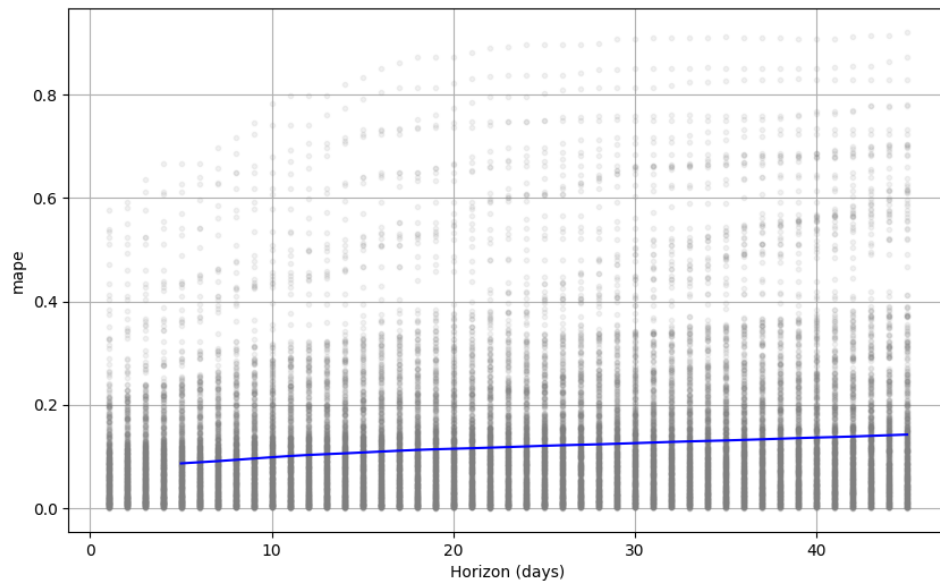


Actual vs Predicted Close Price, Out-of-Sample Performance





Prophet - Cross Validation



- 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



Orbit

Probabilistic Bayesian time series modelling framework.

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.

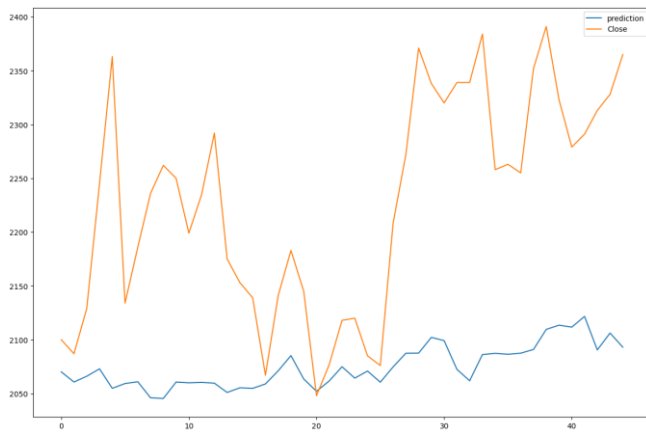


Orbit

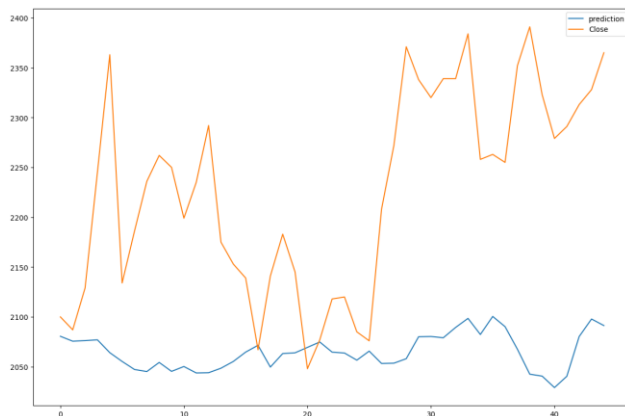


Orbit - Model Evaluation

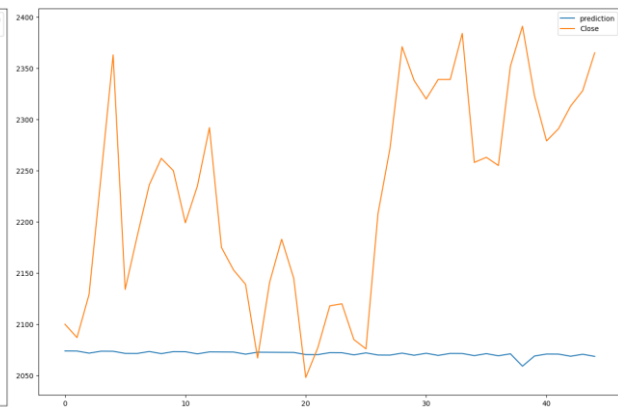
Exponential Smoothing



Local Global Trend



Damped Local Trend



Orbit



Conclusion

Prophet is a great tool for equity time series forecasting, requiring minimal setup and generating an exceptionally accurate forecast:

- Prophet: MAPE = **4.6%**

Orbit is a good alternative, ignoring some of the more pronounced spikes in data (less overfitting):

- Exponential Smoothing (ETS): MAPE = **6.7%**
- Local Global Trend (LGT): MAPE = **7.2%**
- Damped Local Trend (DLT): MAPE = **6.9%**