S&P500 - Forecast

Comprehensive Analysis

Sheet 1 SP500 S&P 500 Index DATE 2015-06-19 2109.99 2015-06-22 2122.85 2015-06-23 2124.2 2015-06-24 2108.58 2015-06-25 2102.31 2015-06-26 2101.49 2015-06-29 2057.64 **2015-06-30** 2063 11

Dataset



80% of the US market capitalization

500 US biggest companies per mkt cap

10 years - daily

2010 00 00 2000.11

Data cleaning

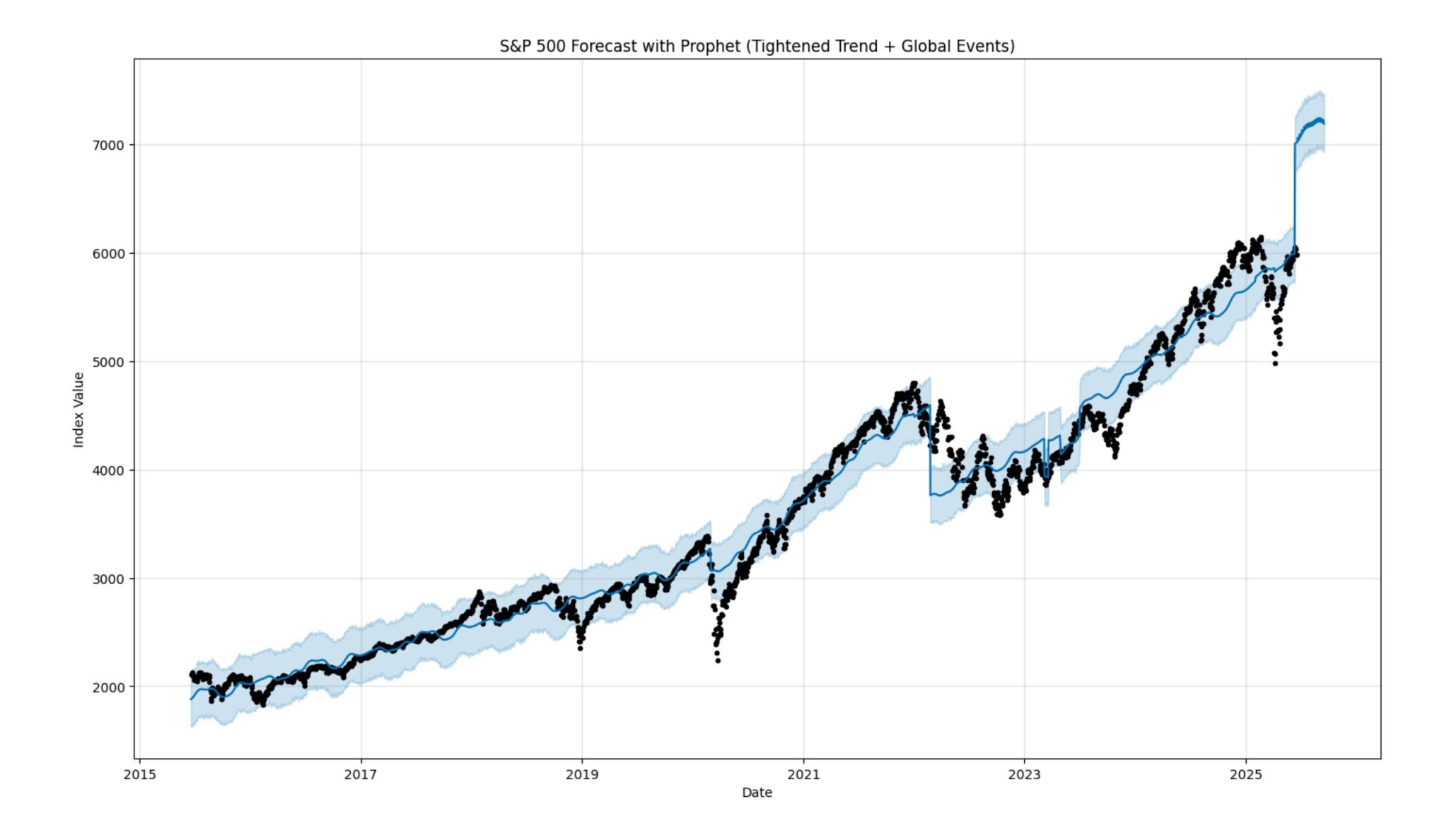
NaN values filled with median between prior and next number

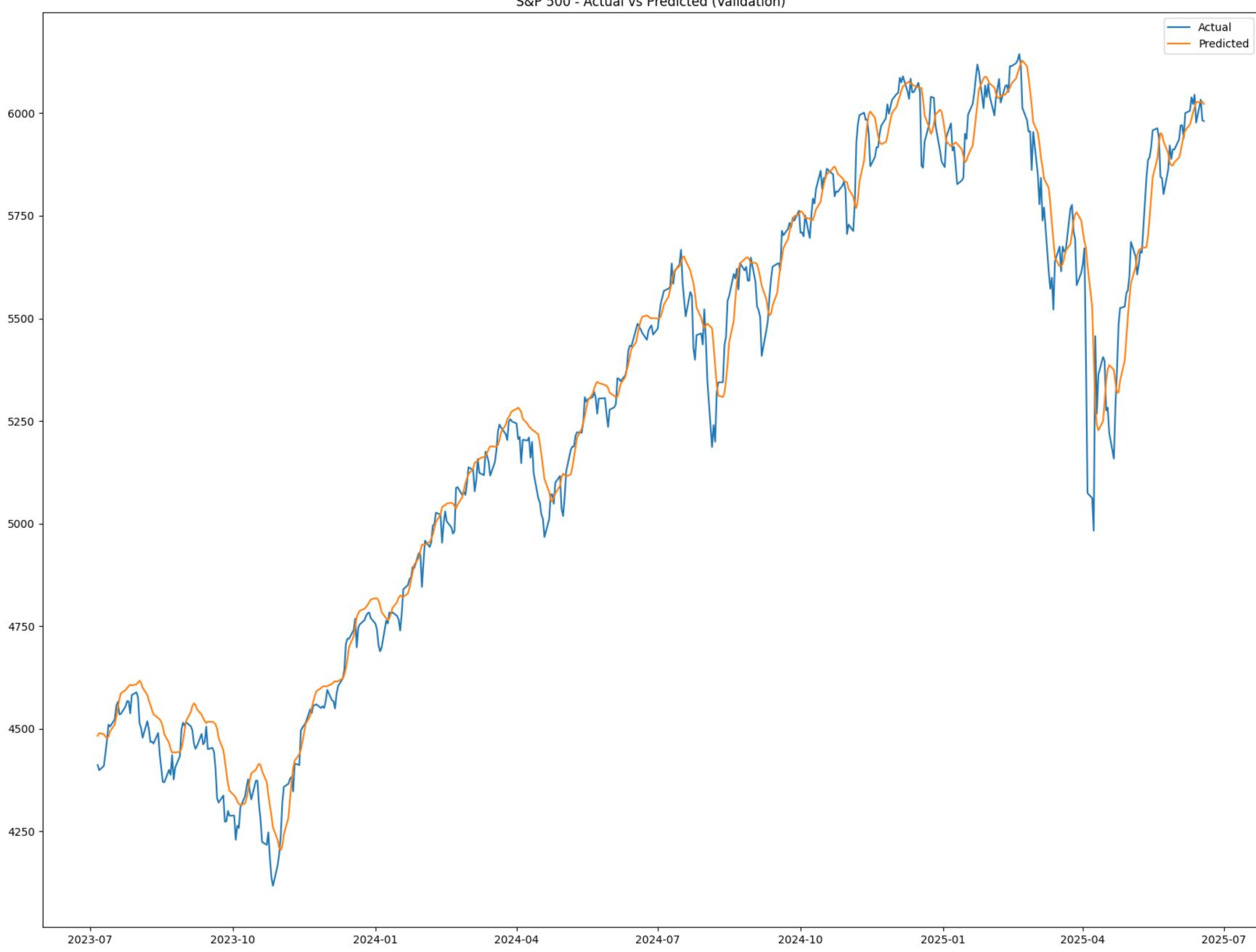
Data description → Number of entries: 2,618

Minimum: 1,829.08

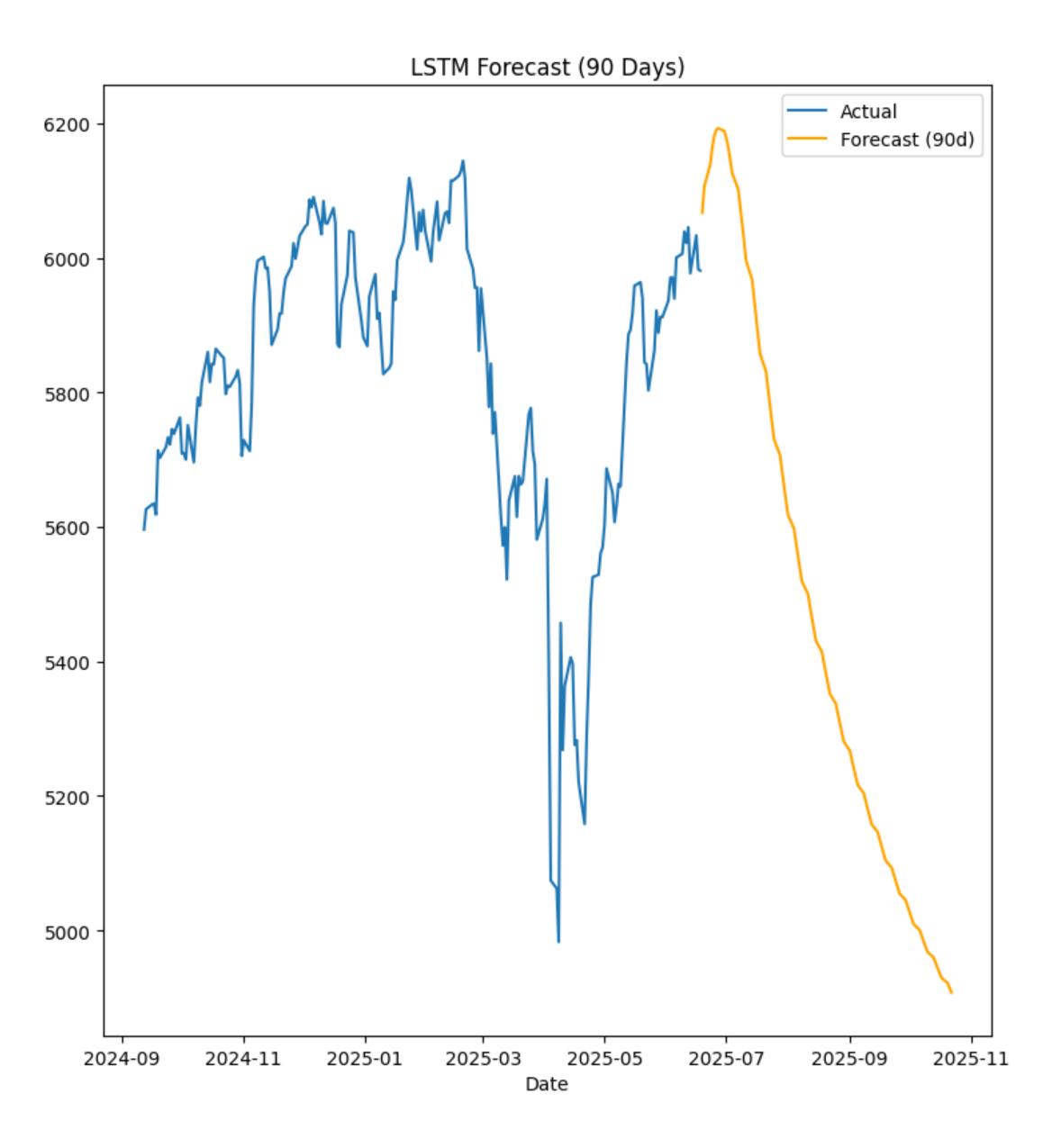
Maximum: 6,204.95

Major Events → COVID, FEDFUND increase, Tarrifs, different wars, etc.

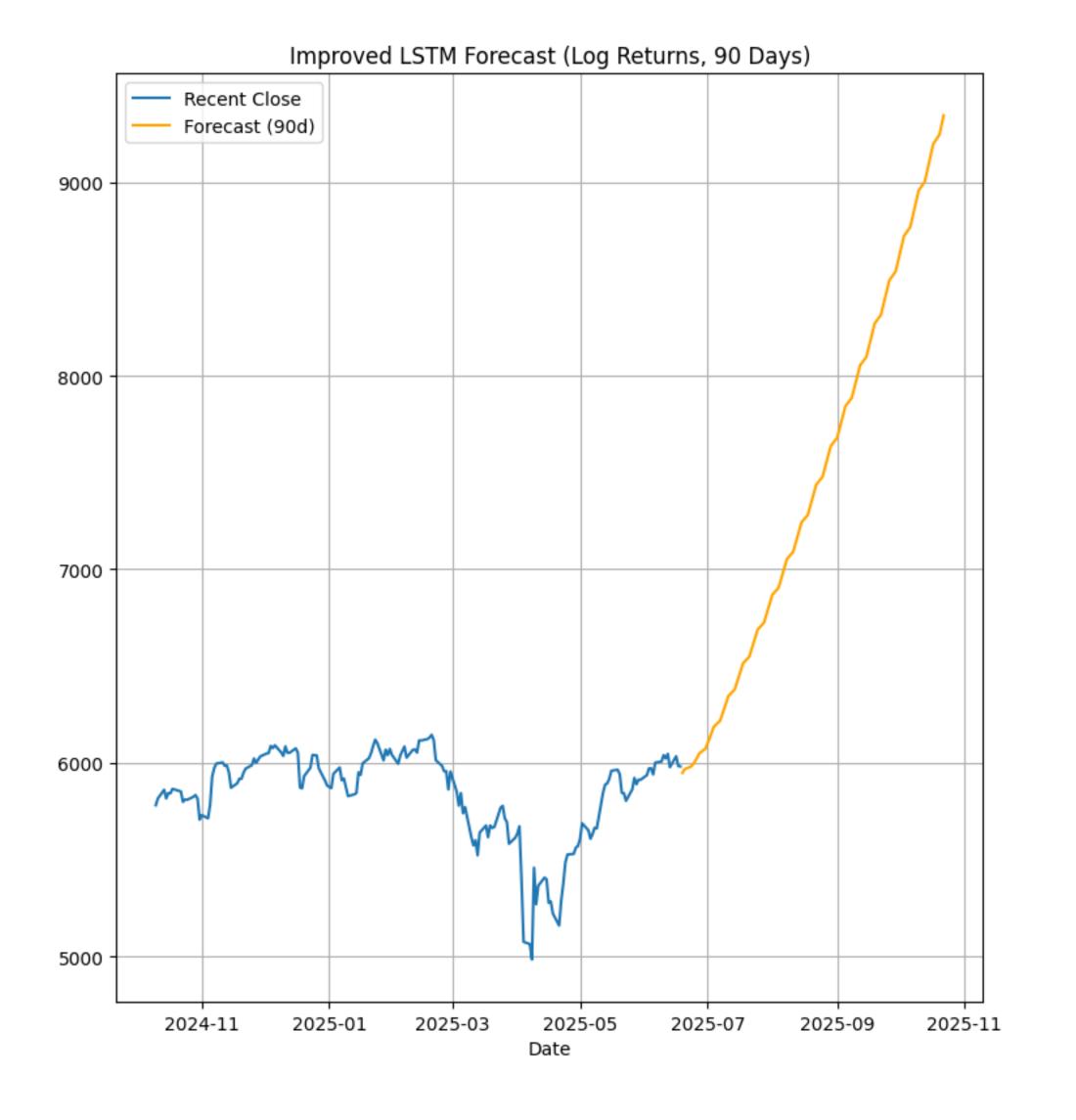


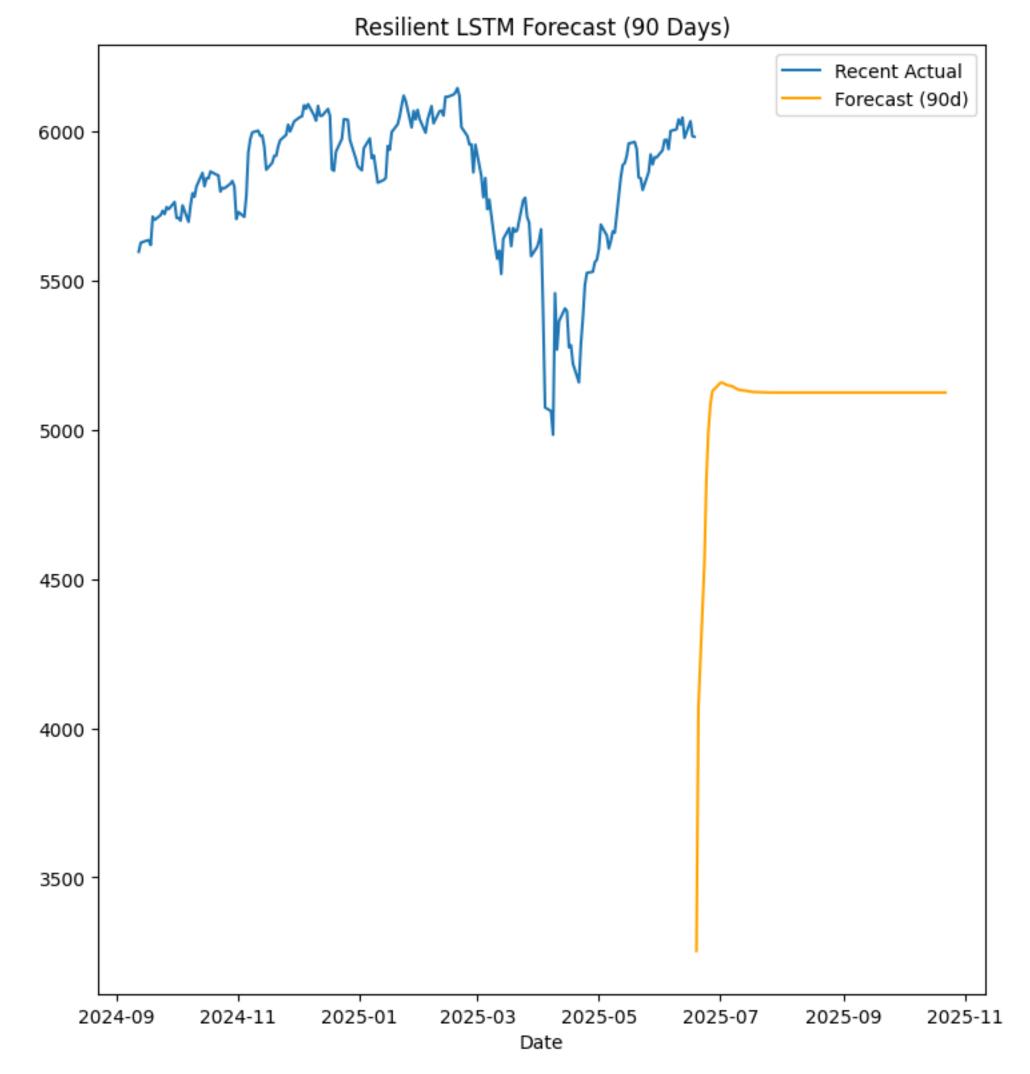


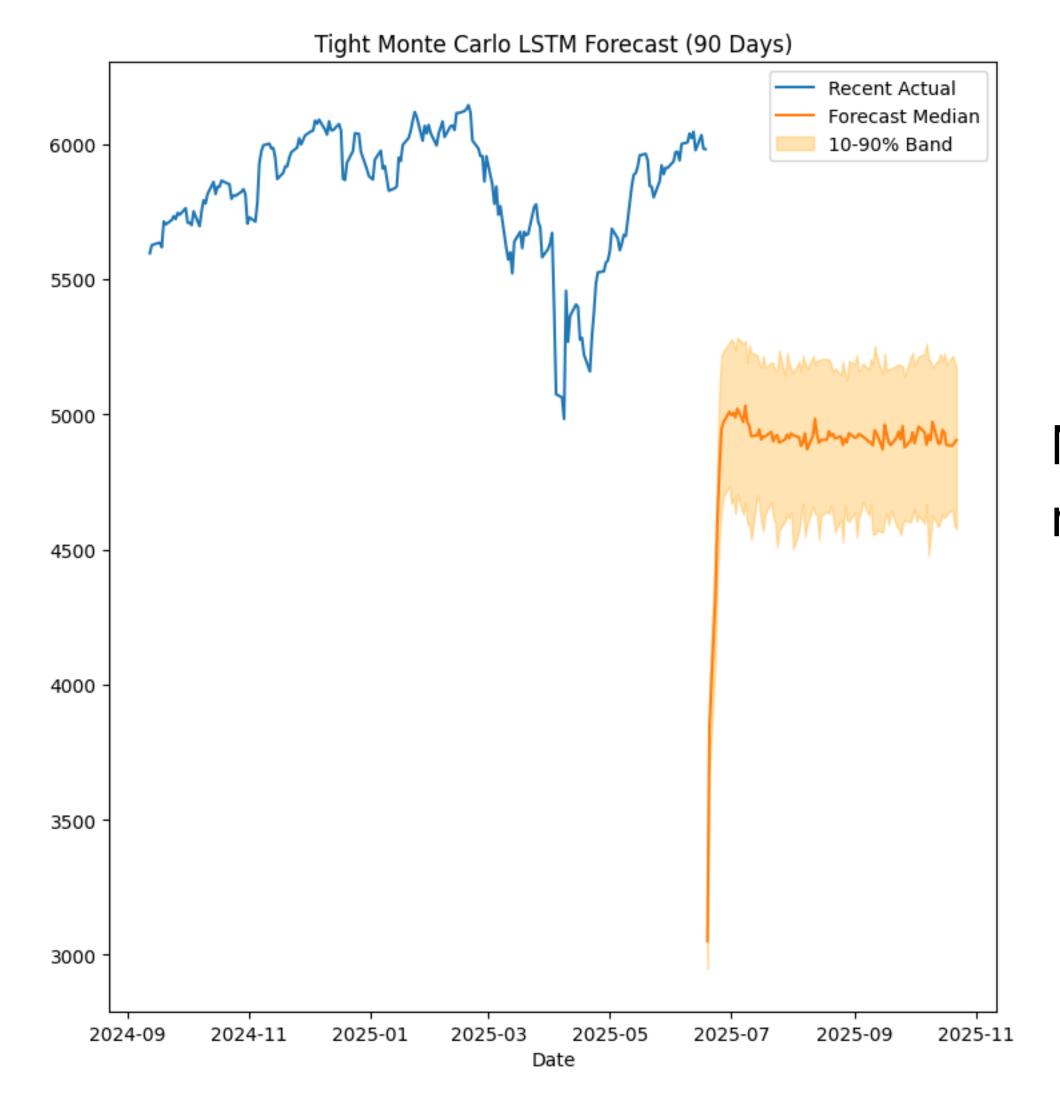
Overfitting



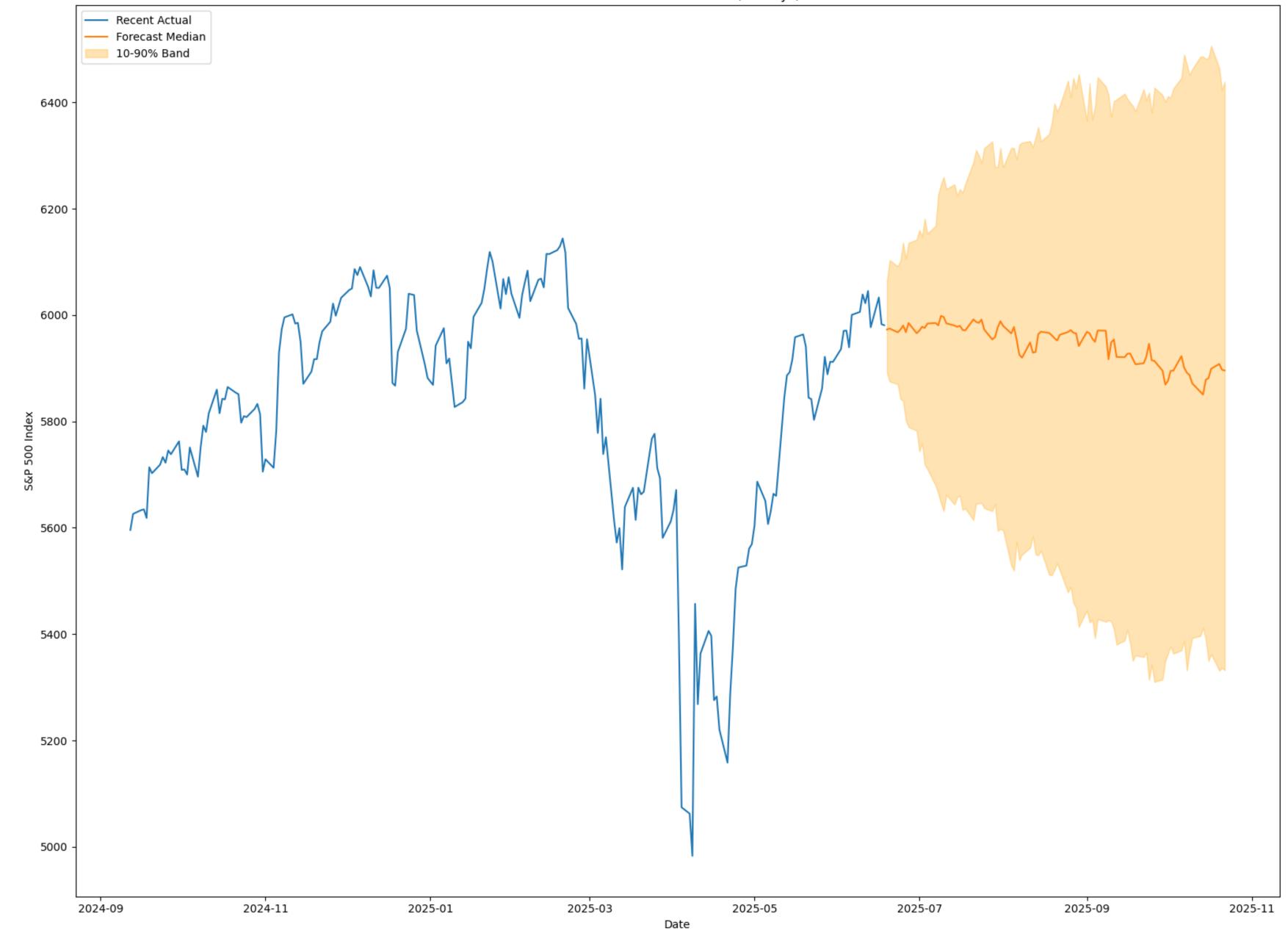
Overfitting

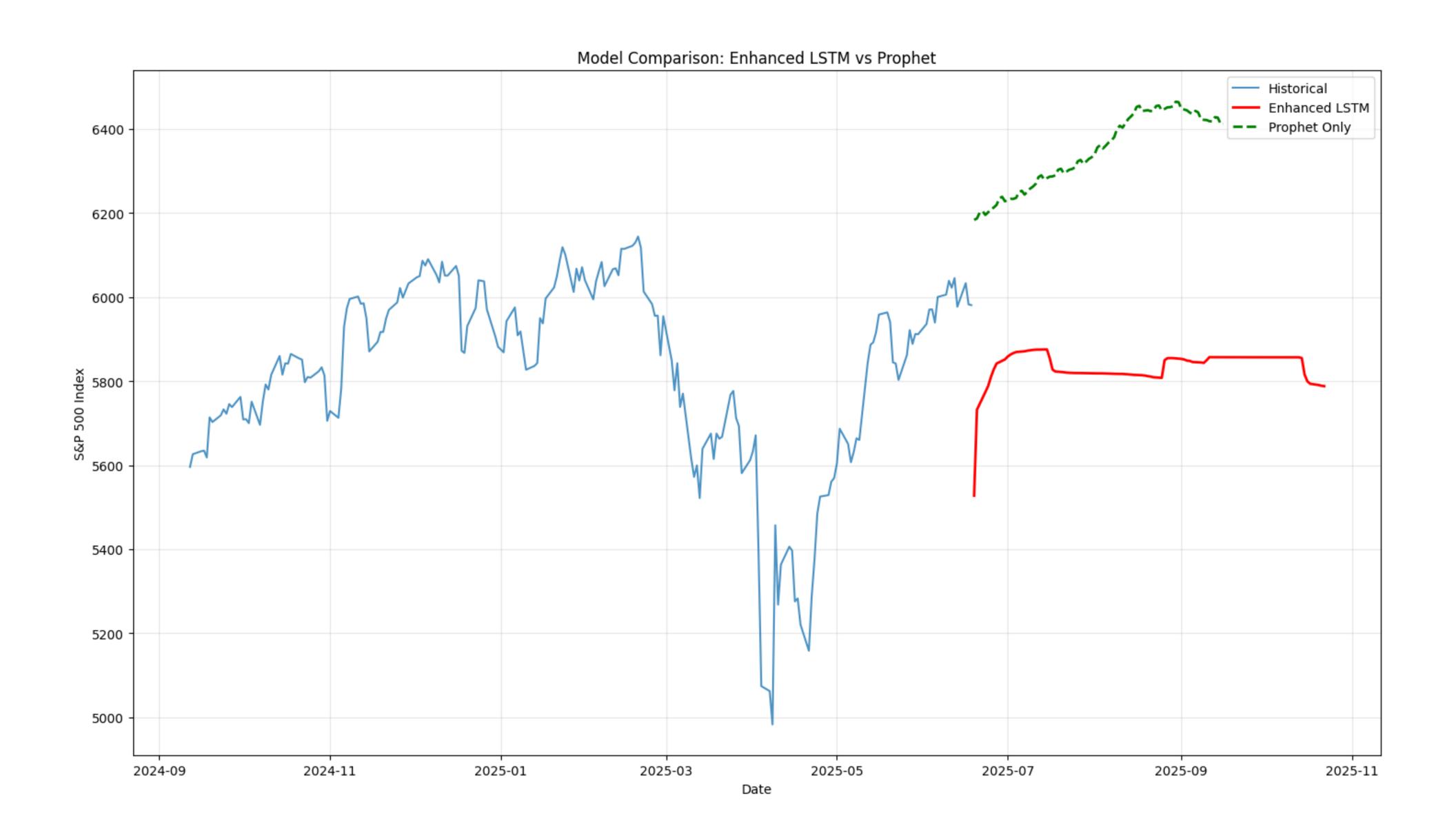


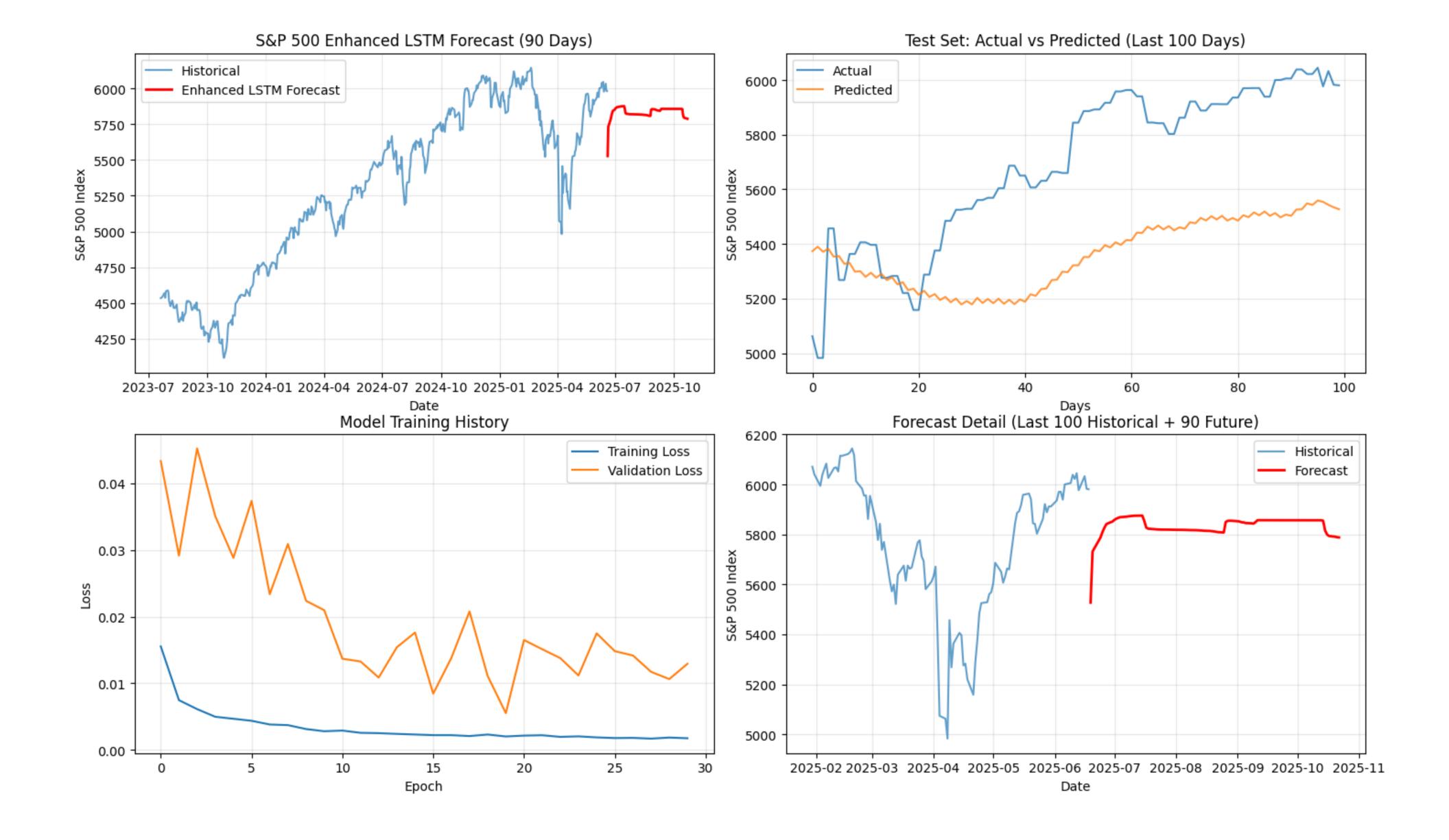




Monte Carlo model introduced







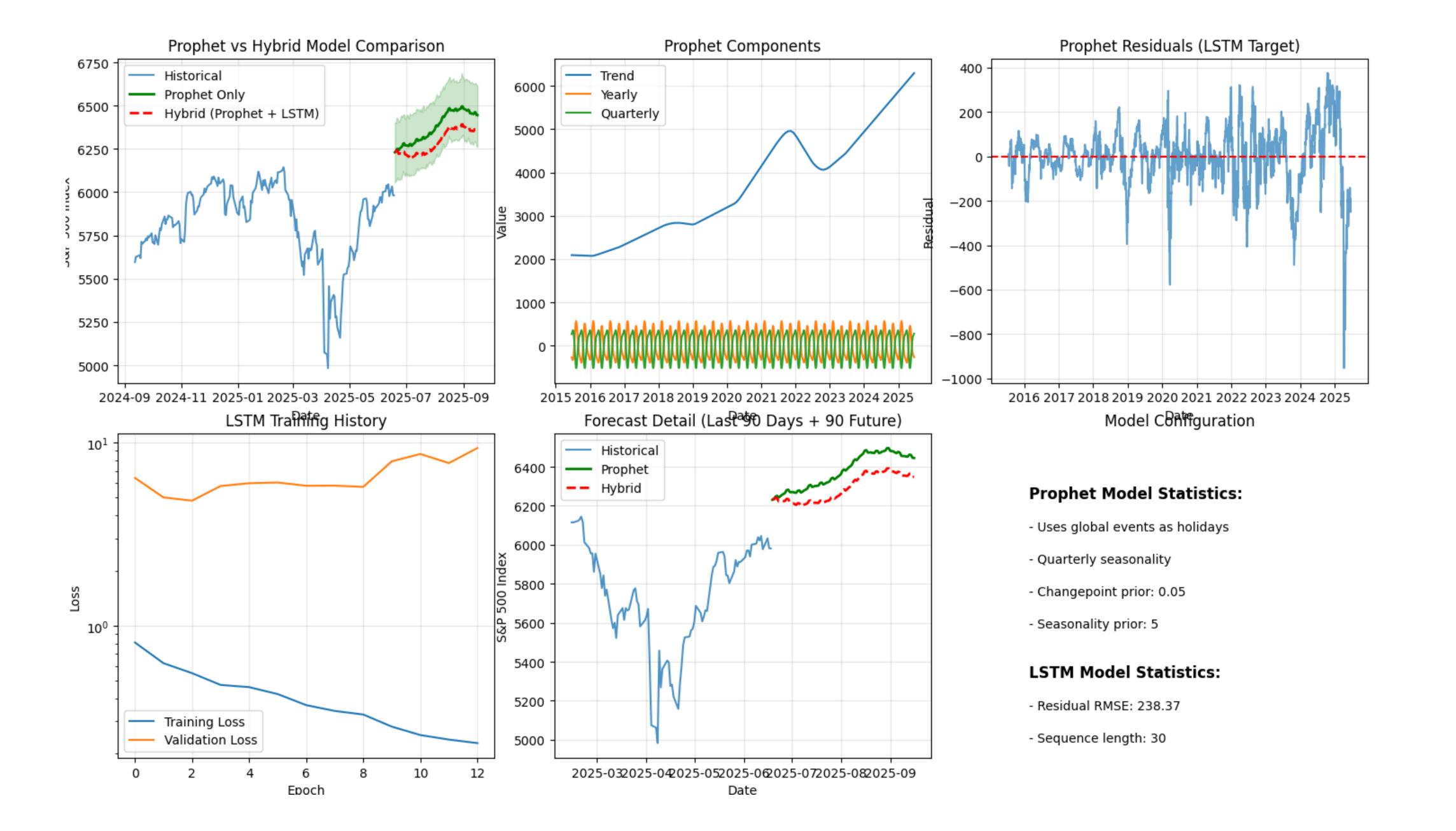
Prophet+LSTM

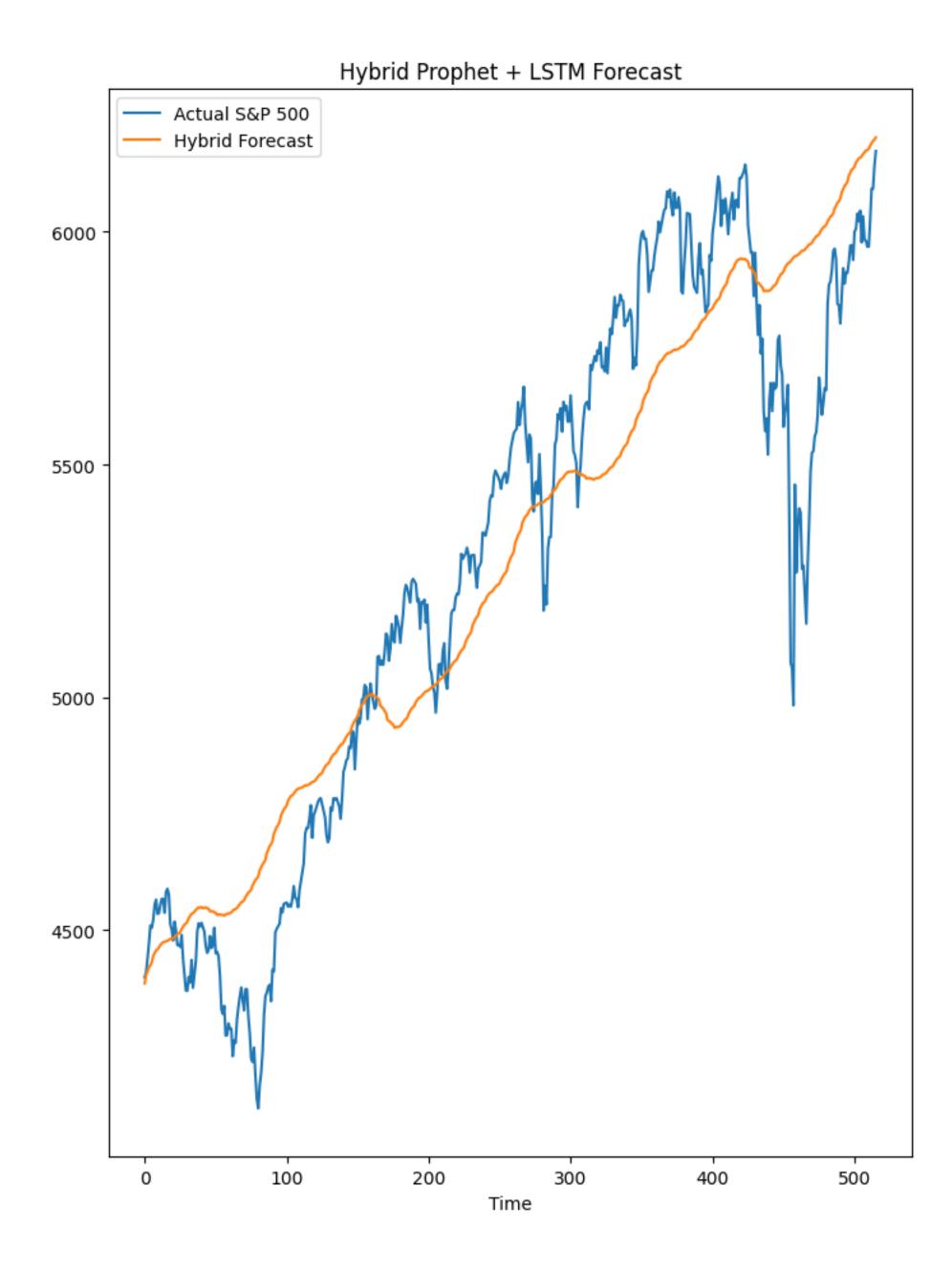
Decided to create a LSTM model based on Prophet trends

LSTM model to learn from validation errors from Prophet

Prophet: strong for trends, seasonability, and holiday effects

LSTM: designed to learn and remember patterns in sequential data → uses "memory cells" to model complex relationships



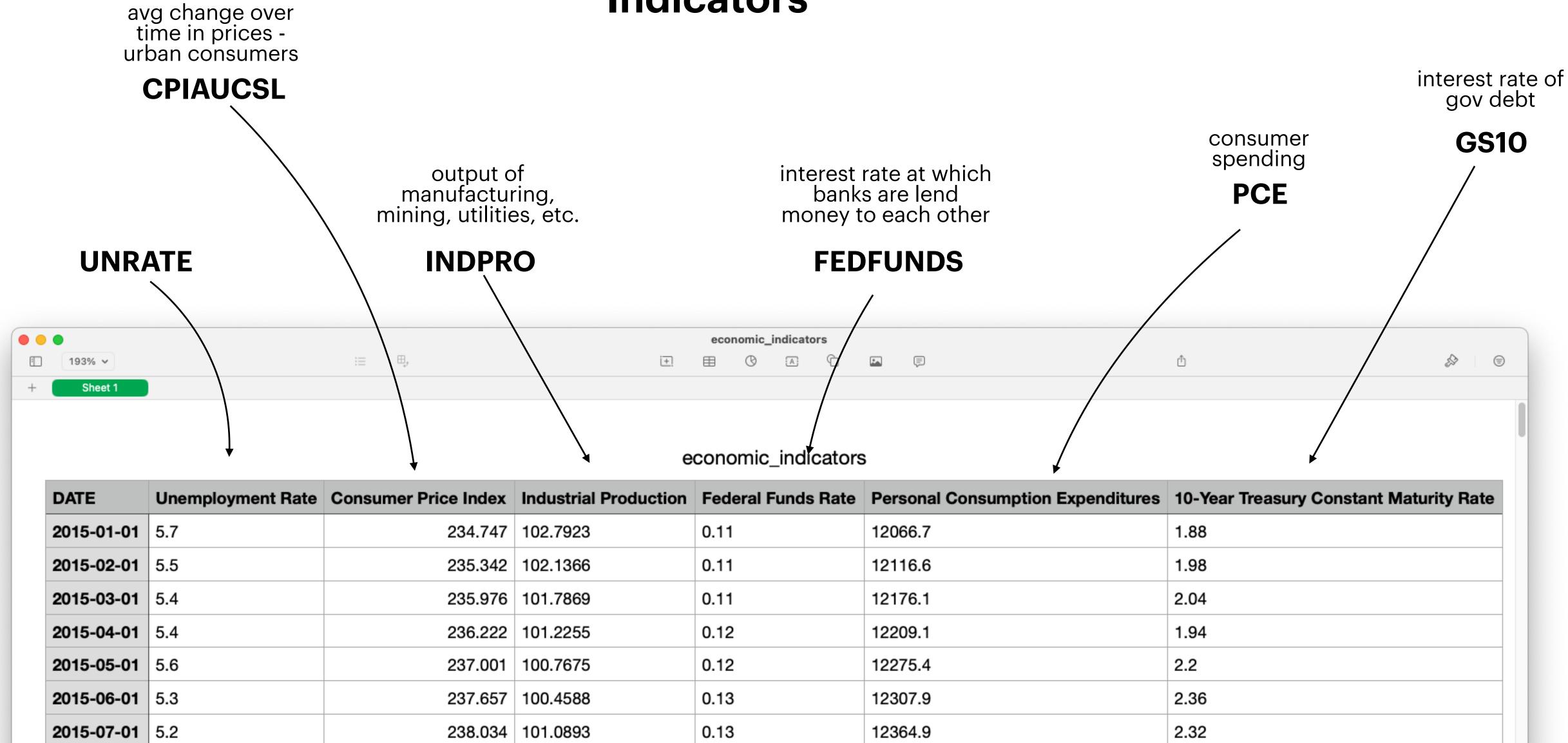


Combined Prophet trends with the power of LSTM

Recent changes to S&P 500 shifts the accuracy

→ daily → forward fill to next value

Economic Indicators



LSTM Forecast: S&P 500 with Forward-Filled Macroeconomic Indicators — Actual Predicted -0.42084-0.42086-0.42088-0.42090 -0.42092 -0.42094100 200 400 500 300

Time

mainly scale issues from econ indicators

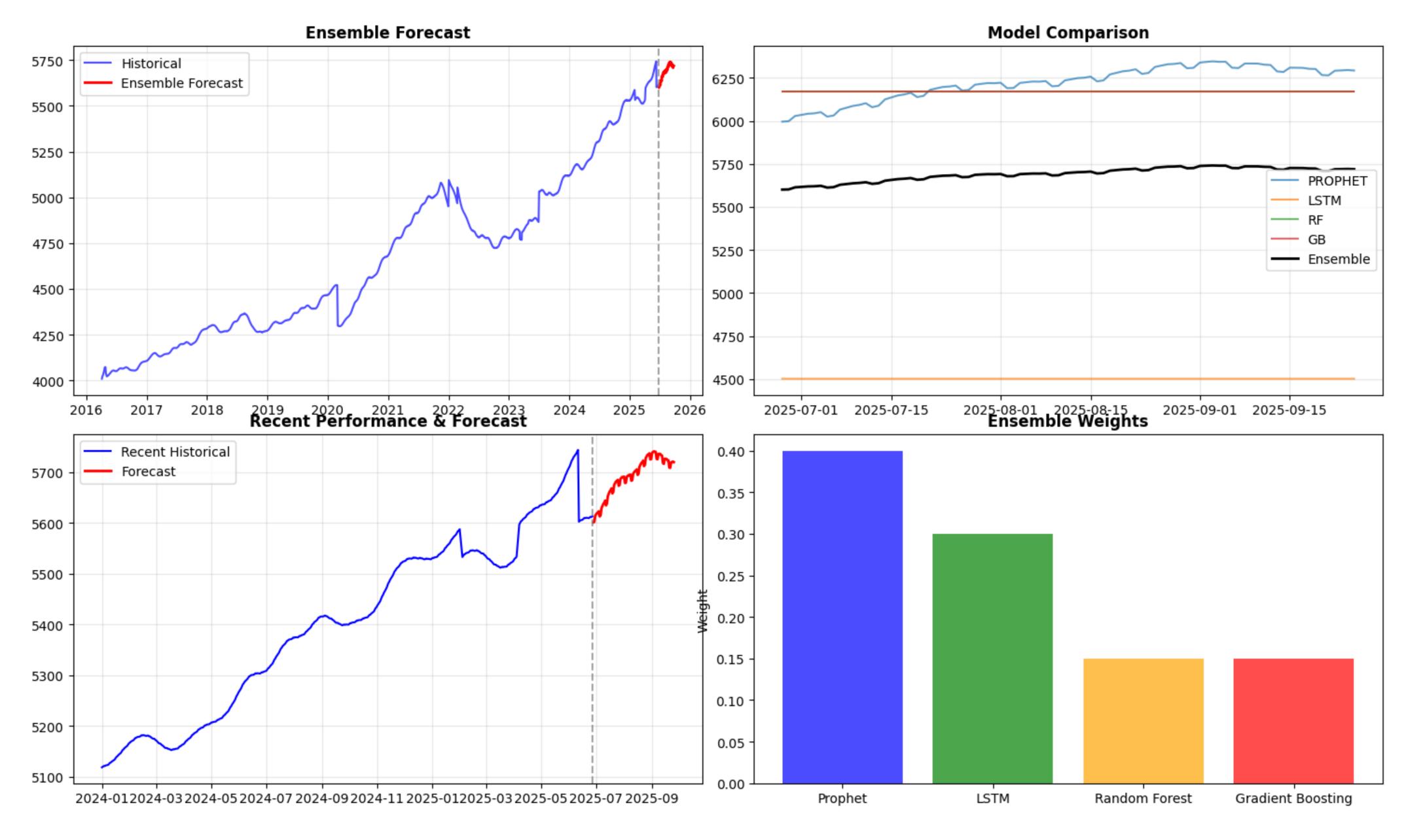
Ensemble Model

Combines **Prophet**, **LSTM** (deep learning), **tree-based models** (Random Forest, Gradient Boosting)

Prophet(40%), LSTM(30%), RF(15%), GB(15%)

MinMax Scaler to solve scale issues

Combines historical S&P500 data with economic indicators and takes into account the major global events



price momentum, volatility, lag, time-based features → TA-Lib

Ensemble Model

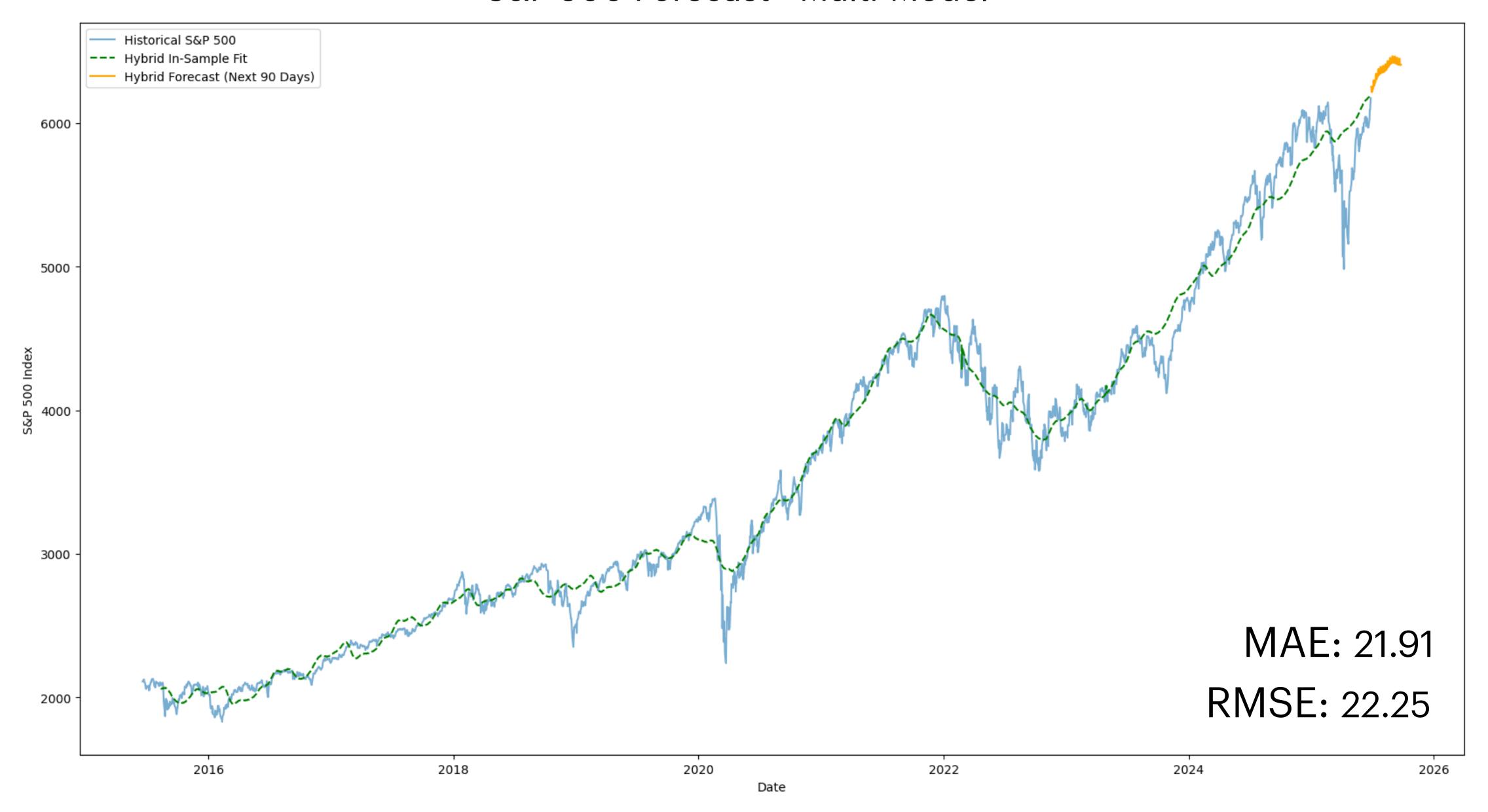
TA-Lib → used to calculate common financial metrics

Reflects price trends, momentum and volatility

Key indicators:

- SMA & EMA: moving averages → detects trend direction
- Bollinger Bands: measures price volatility relative to mvg avgs
- Other indicators: RSI, MACD, ATR

S&P 500 Forecast - Multi-Model



Future Enhancements

News/sentiment integration

More economic indicators

Add more S&P value data → to better volatility