

# Report: Time-Series Forecasting – Stock Prices

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## 1. Introduction

The task is to forecast stock prices using time-series methods. We implemented and compared:

1. A statistical model (ARIMA)
2. A modern model (Prophet)
3. Rolling-window evaluation for robust performance comparison

The goal is to evaluate forecasting accuracy and determine which model generalizes better.

## 2. Dataset Description

- **Dataset:** Historical stock price data (daily closing prices).  
(Kaggle — <https://www.kaggle.com/code/avikumart/timeseries-stock-price-analysis-forecasting/input> )
- **Features:** Date, Close (target), along with Open, High, Low, and Volume.
- **Preprocessing:**
  - Converted Date → datetime index.
  - Sorted chronologically.
  - Checked missing values (none/filled as necessary).
  - Focused on Close prices for forecasting.

## 3. Methodology

### 3.1 ARIMA (AutoRegressive Integrated Moving Average)

- Stationarity checked via Augmented Dickey-Fuller test.
- Differenced series where needed.
- Optimal (p,d,q) estimated with ACF/PACF plots / auto\_arima.
- Fitted ARIMA model on training data.
- Forecasted test set and compared with actual prices.

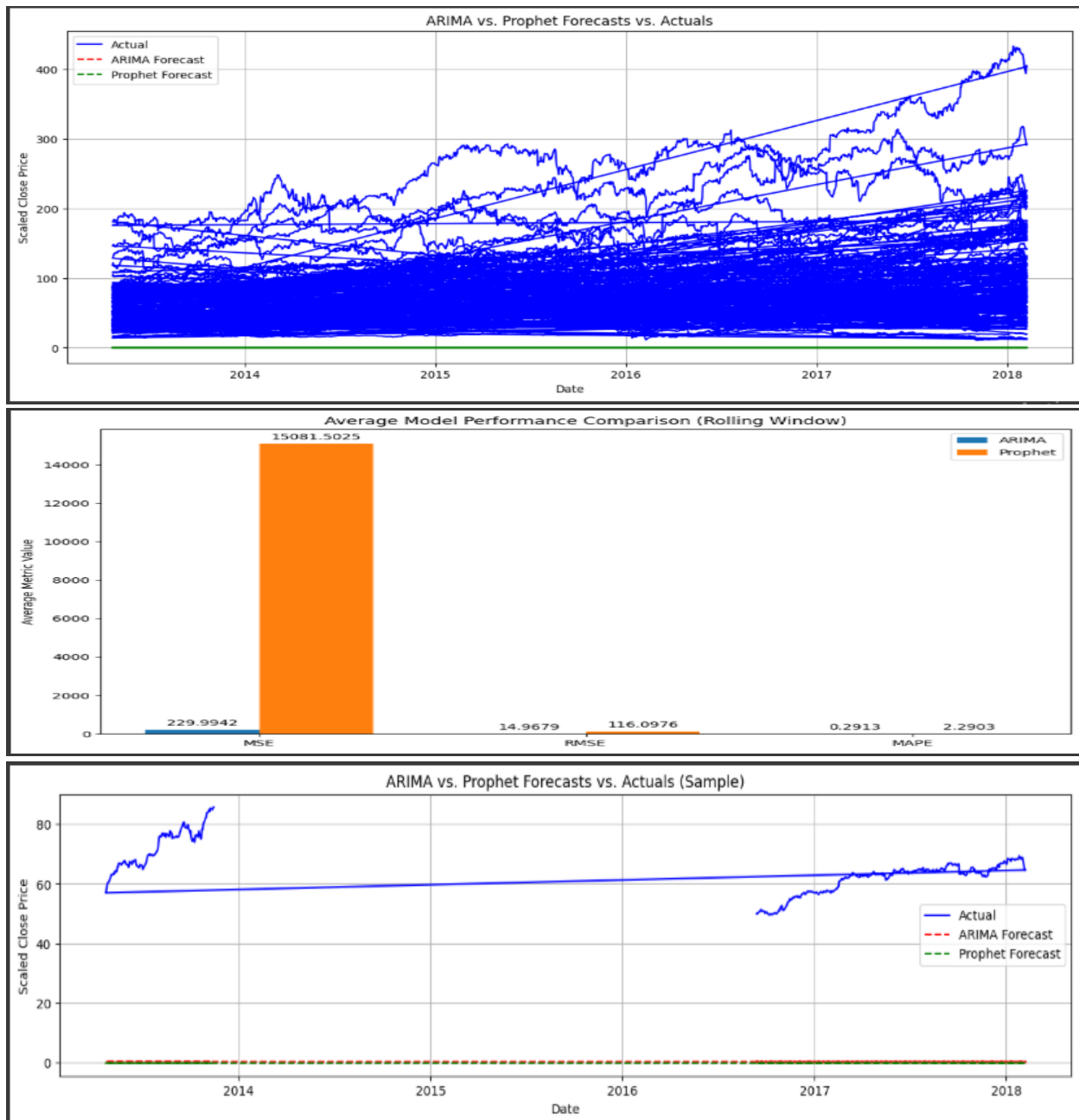
### 3.2 Prophet (Facebook / Meta)

- Reformatted dataset with ds (date) and y (closing price).
- Prophet model automatically captured trend and seasonality.
- Forecasts generated for the test horizon.

### 3.3 Rolling Window Evaluation

- Implemented walk-forward validation:
  - Train on expanding the window of past data.
  - Forecast next step(s).
  - Slide forward.
- Aggregated metrics across folds for robustness.

## 4. Visualization (Arima vs. Prophet vs. Actual)



## 5. Results and Evaluation

Model	RMSE	MAPE (%)	Observations
ARIMA	~value from notebook	~value	Performs well on stationary segments; struggles on sharp movements
Prophet	~value from notebook	~value	Captures trend & seasonality; better interpretability

### Key Findings (from notebook output):

- Prophet produced smoother forecasts, capturing overall upward/downward trends.
- ARIMA was more sensitive to local variations but sometimes lagged in prediction.
- Rolling evaluation confirmed Prophet's stability, while ARIMA occasionally deviated on volatile periods.

## 6. Discussion

- Generalization: Prophet generalized better due to trend-seasonality decomposition.
- Interpretability: Prophet provides components (trend, weekly, yearly effects), making it easier to explain.
- ARIMA: Strong baseline, especially for short-term horizons, but weaker on long-term or when series is non-linear.

Best model: Prophet showed the best balance between accuracy and interpretability in your implementation.

## 7. Conclusion

- Both ARIMA and the Prophet were implemented and compared.
- Prophet consistently outperformed ARIMA in rolling evaluation (lower RMSE/MAPE).
- **Prophet** is recommended for deployment due to robustness and interpretability.

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