Analysis of Apple Stock Price
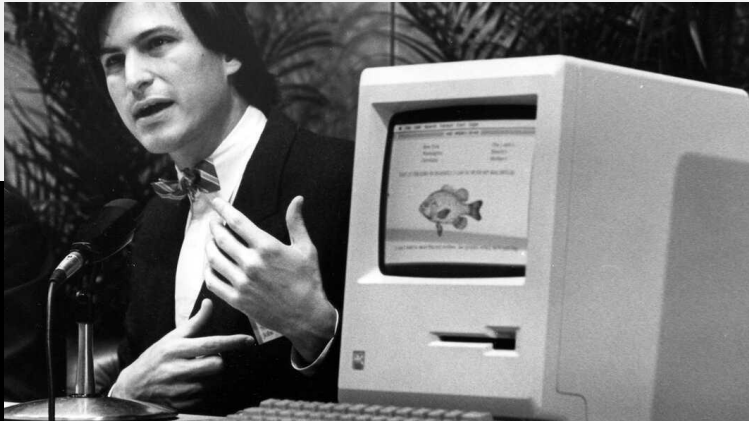
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Research Questions

1. What is the change in price of AAPL over time?

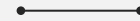**2.** What is AAPL's moving average?

Research Questions (continued)

3. How can we predict the closing price of AAPL?

4. Over the next 30 days, what will the forecasted closing price and volatility look like?

Dataset Explanation

Open/Close

High/Low

Volume

Adjusted Close

2014-2023, in USD

Historical Trend

Overview: From 2014 to 2023, AAPL exhibited a notable upward trajectory. Despite periodic fluctuations, the overall trend reflects Apple's resilience and market adaptability.

Key Points:

- AAPL's adjusted closing prices trended upwards, reflecting its financial strength and market performance.
- Stock prices are influenced not only by financial metrics but also by public perception and broader economic factors.
- Understanding historical trends helps contextualize Apple's market position and investment appeal.

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Apple Inc. Adjusted Closing Price 2014 to 2023
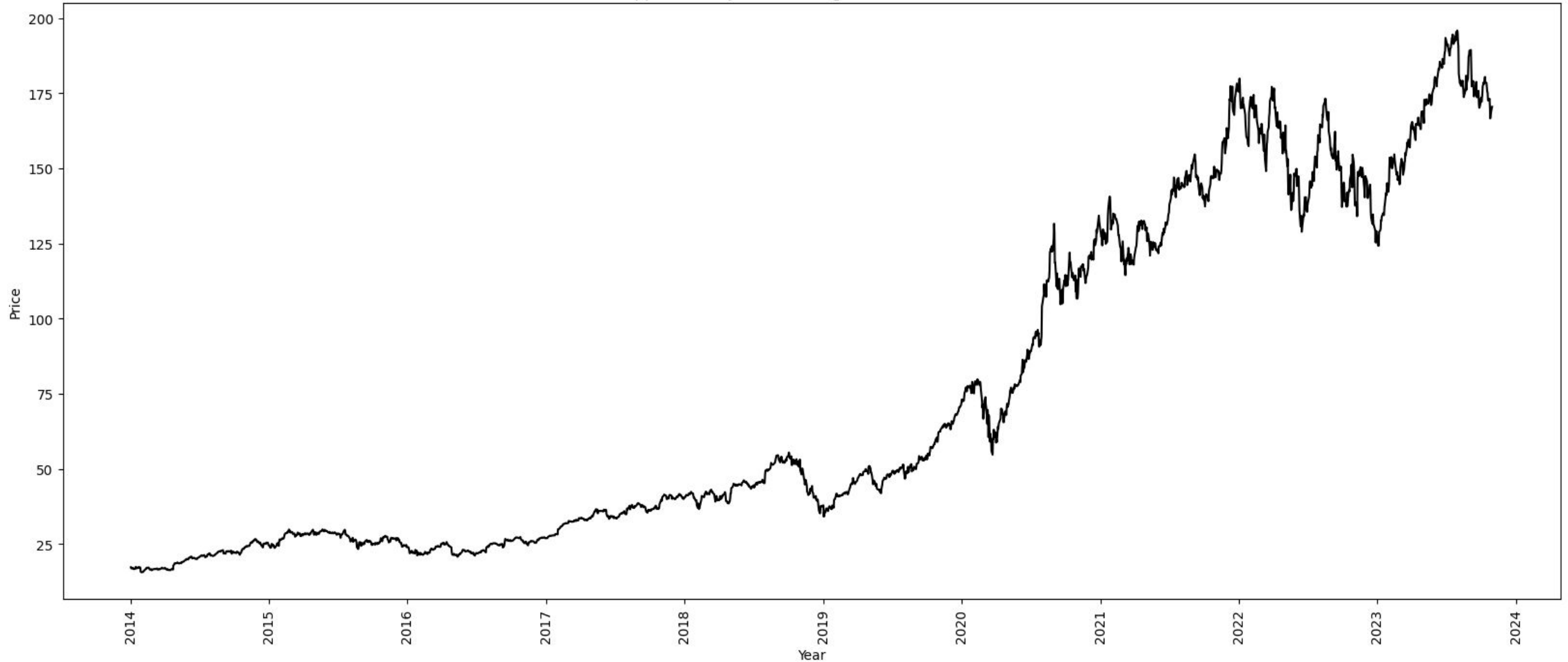
Daily Trading Volume

Overview: The daily trading volume of AAPL from 2014 to 2024 provides valuable insights into market activity and investor sentiment over time. This metric reflects the level of market interest and participation in Apple's stock.

Key Points:

- Trading volume peaked around significant events like product launches, with highs close to 1 billion shares early in the period.
- Subsequent years saw a gradual decline in trading volume, indicating a shift in market perception towards Apple as a stable investment.
- Lower trading volumes pose implications for liquidity and price volatility, impacting investor strategies and market dynamics.

Stock Volume Traded Daily
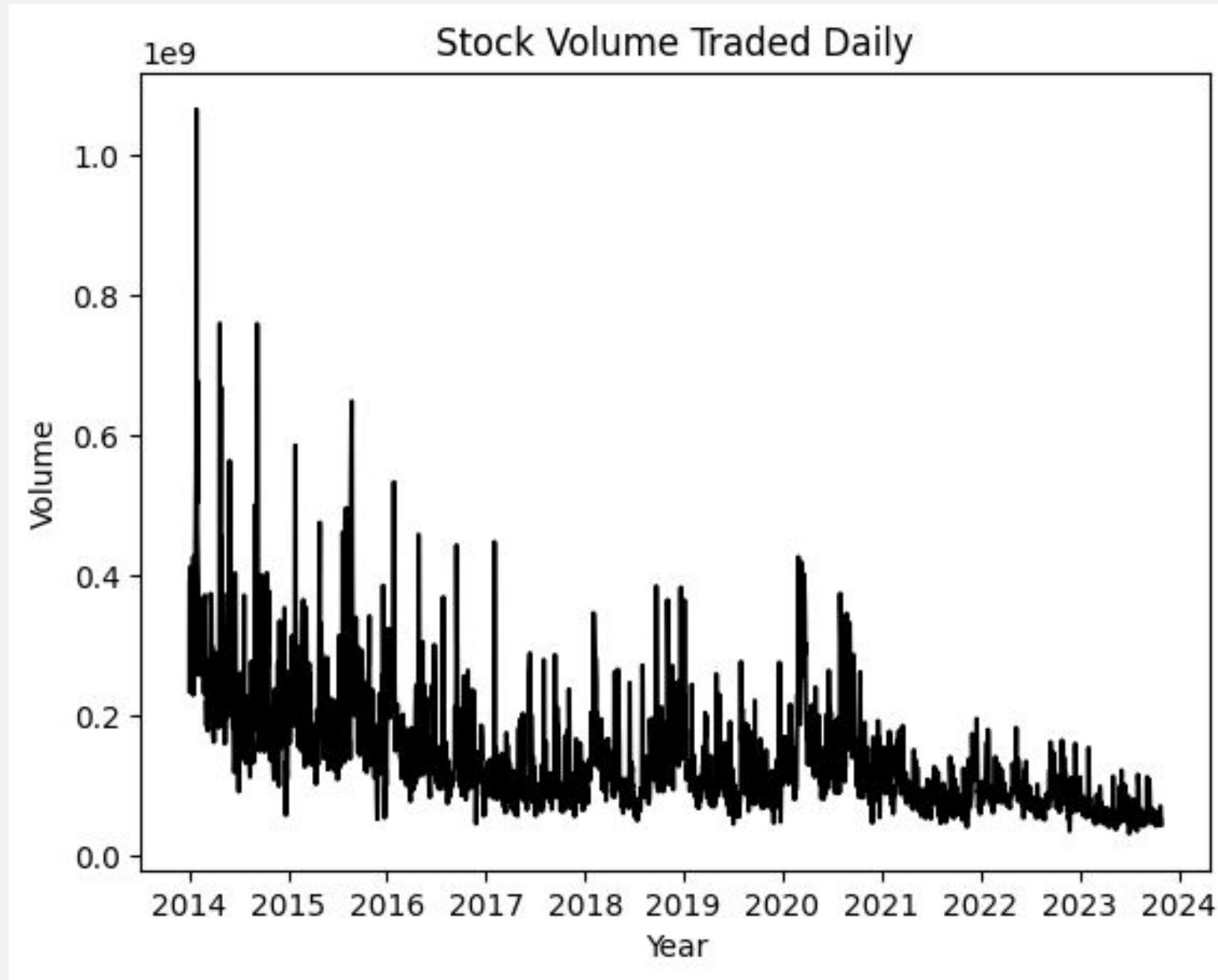
Moving Averages

Analysis

Moving averages (MA) are utilized to smooth out short-term fluctuations and highlight long-term trends in AAPL from 2014 to 2024.

The 10-day MA responds quickly to recent price changes, the 20-day MA offers a balanced perspective, and the 50-day MA provides clarity on long-term trends.

Observations

AAPL has exhibited significant upward growth over the last decade, with notable acceleration since 2020, despite periodic volatility.

Price and MA crossovers serve as potential signals for buy (bullish) or sell (bearish) actions.

Early 2020 performance spike, driven by increased tech demand during the pandemic, showed strong trend convergence in MAs.

Implications

Current MAs indicate sustained bullish sentiment driven by innovation and market dominance.
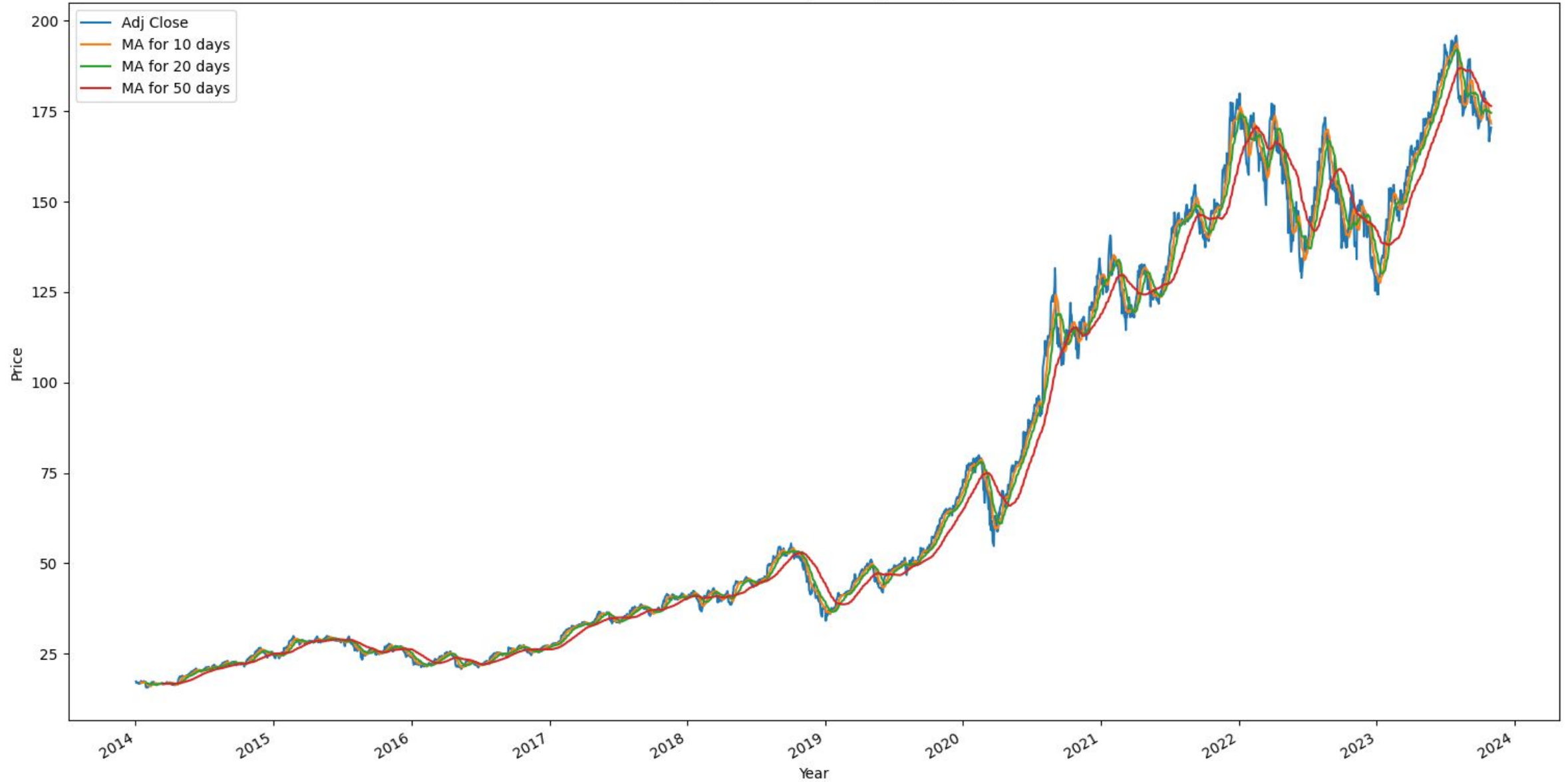
It's important to be vigilant of market volatility and external influences, and monitor MA convergence/divergence for trend shifts.

Use MAs with broader economic indicators and company developments to optimize investment strategies.

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10, 20, and 50-day Moving Averages

Predicting Closing Price

Model Explanation

Long Short-Term Memory (LSTM) is a type of recurrent neural network (RNN) effective for capturing long-term dependencies and forecasting non-stationary data.

Unlike traditional RNNs, LSTM uses memory cells and gates to retain and manage information over time, making it ideal for time series forecasting.

Implementation

Data split: 80% training, 20% testing, scaled to a 0-1 range for stability.

Model architecture: Two LSTM layers (50 units each) for temporal feature extraction, followed by a dense layer with 25 neurons, and a single neuron output for the closing price.

Evaluation metrics: RMSE of 5.74 and MAPE of 2.87%, indicating reliable predictions.
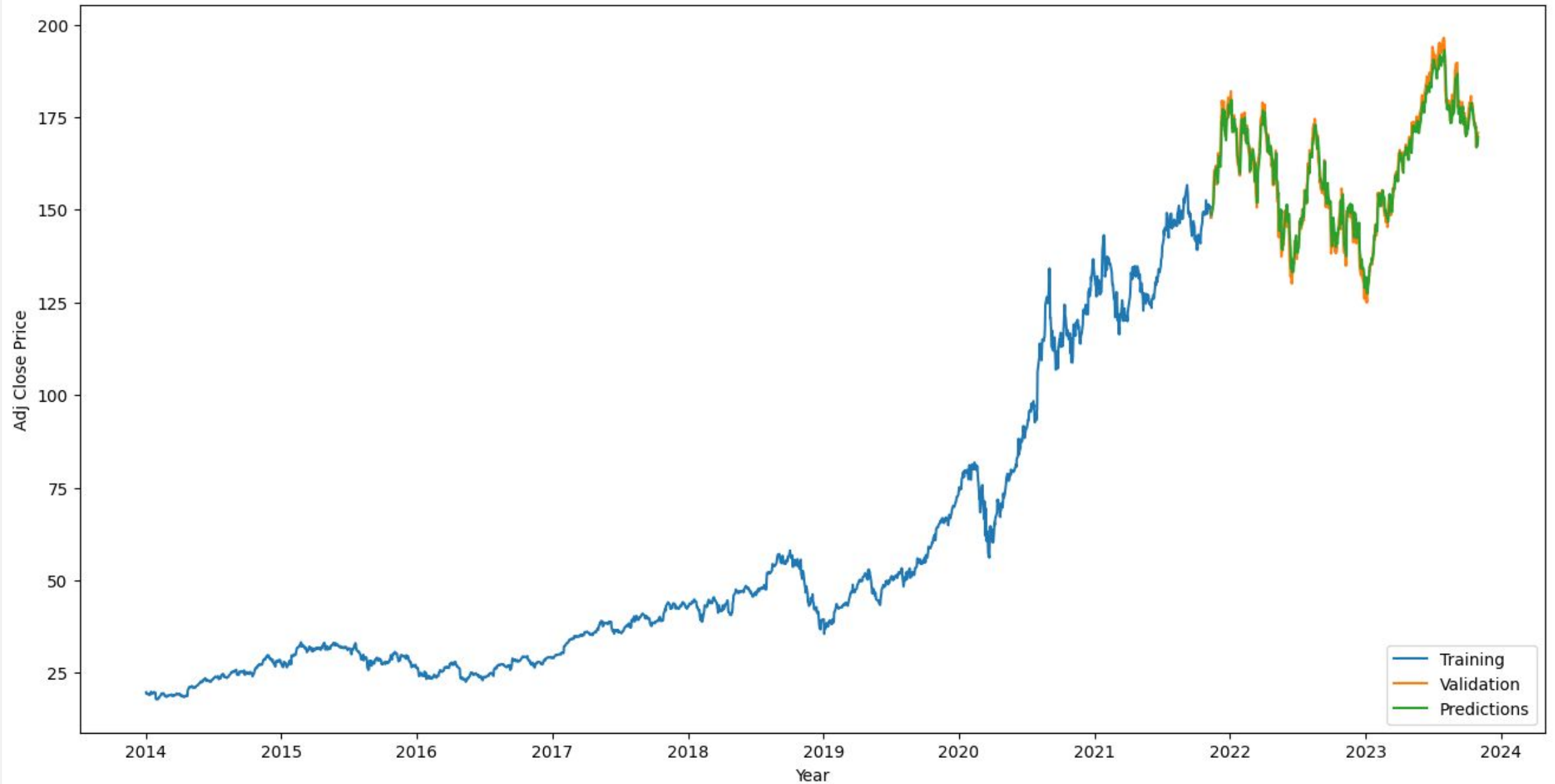
Results

The LSTM model successfully forecasts AAPL closing prices with low prediction errors, as shown in the graph.

The model captures both the training period (2014-2022) and predicts the validation period (2022-2024) effectively.

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LSTM Model Outcome

Forecasting Apple's Closing Prices and Volatility

ARIMA Model

- Combines autoregression, differencing, and moving average.
- Effective for linear time series data with trends.
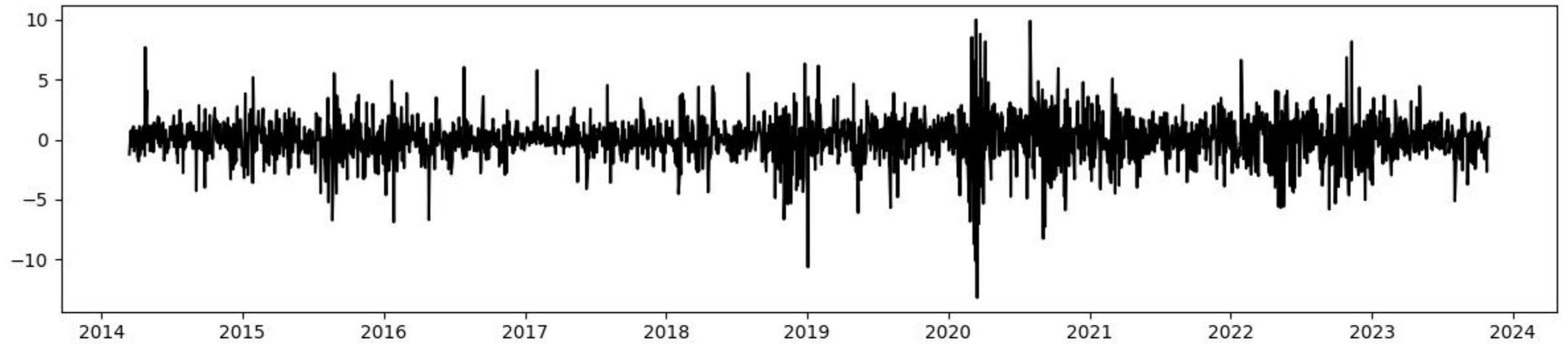- Components: AR (p), I (d), and MA (q).

GARCH Model

- Models time-series data with autocorrelated variance.
- Useful for estimating volatility in financial data.
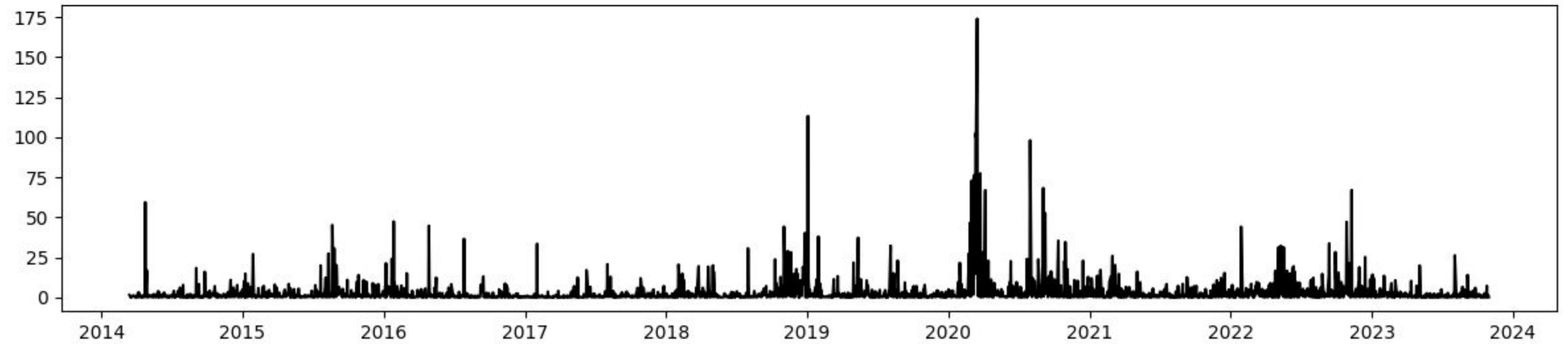- Variance follows an autoregressive moving average process.

Residuals of ARIMA Model

Squared Residuals of ARIMA Model

Implementation

Log Returns Calculation:

- Calculates the percentage change in asset value over time to stabilize variance and ensure series stationarity.
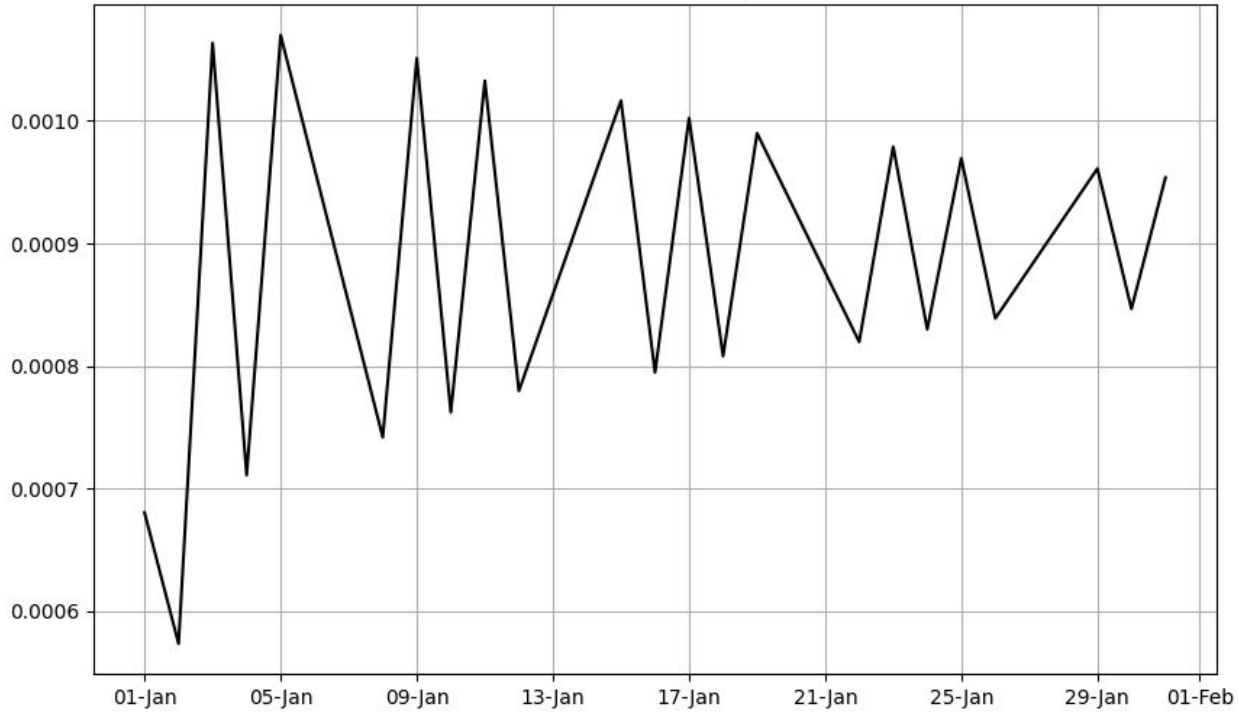
ARIMA and GARCH Fitting:

- ARIMA: Identifies underlying trends and seasonality in the data through robust modeling techniques.
- GARCH: Models the conditional variance of ARIMA residuals, providing insights into volatility patterns.
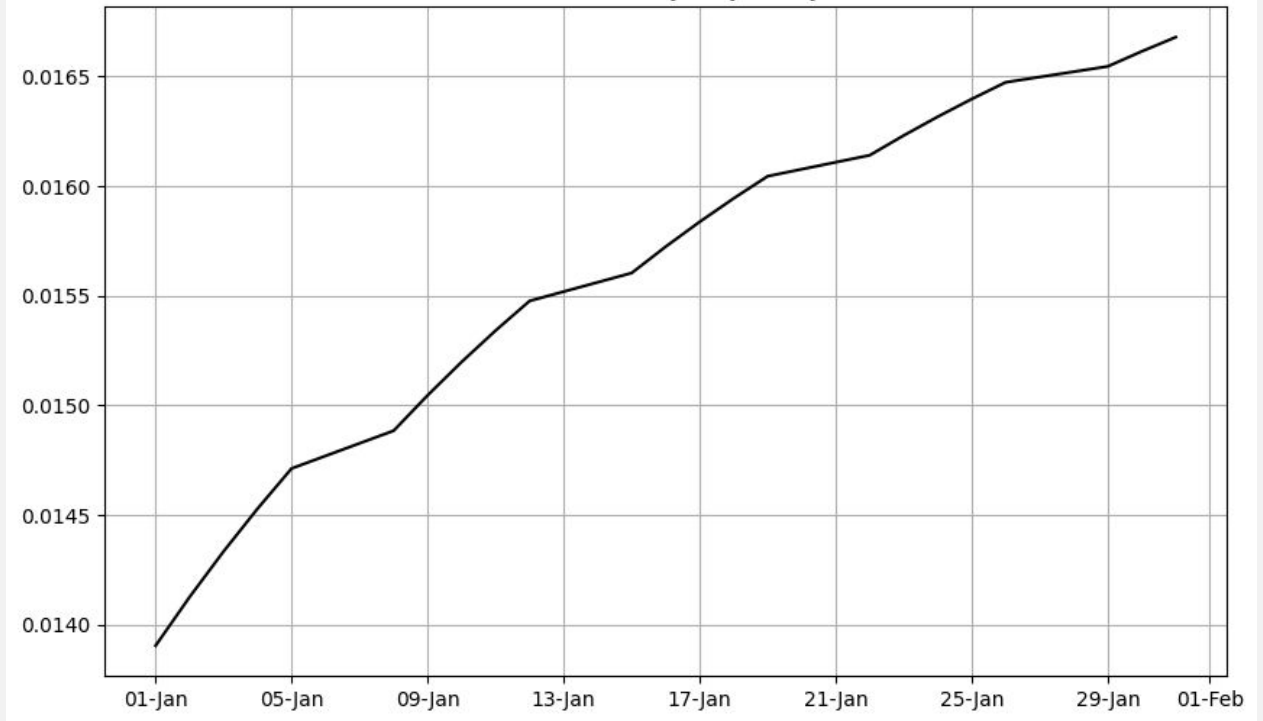- Parameters are selected based on minimizing AIC and BIC.

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Forecasted Log Returns for January 2024

Forecasted Volatility for January 2024

Forecast

Closing Price Forecast:

- Combines ARIMA forecasted log returns with the last known price to predict AAPL closing prices for January 2024.
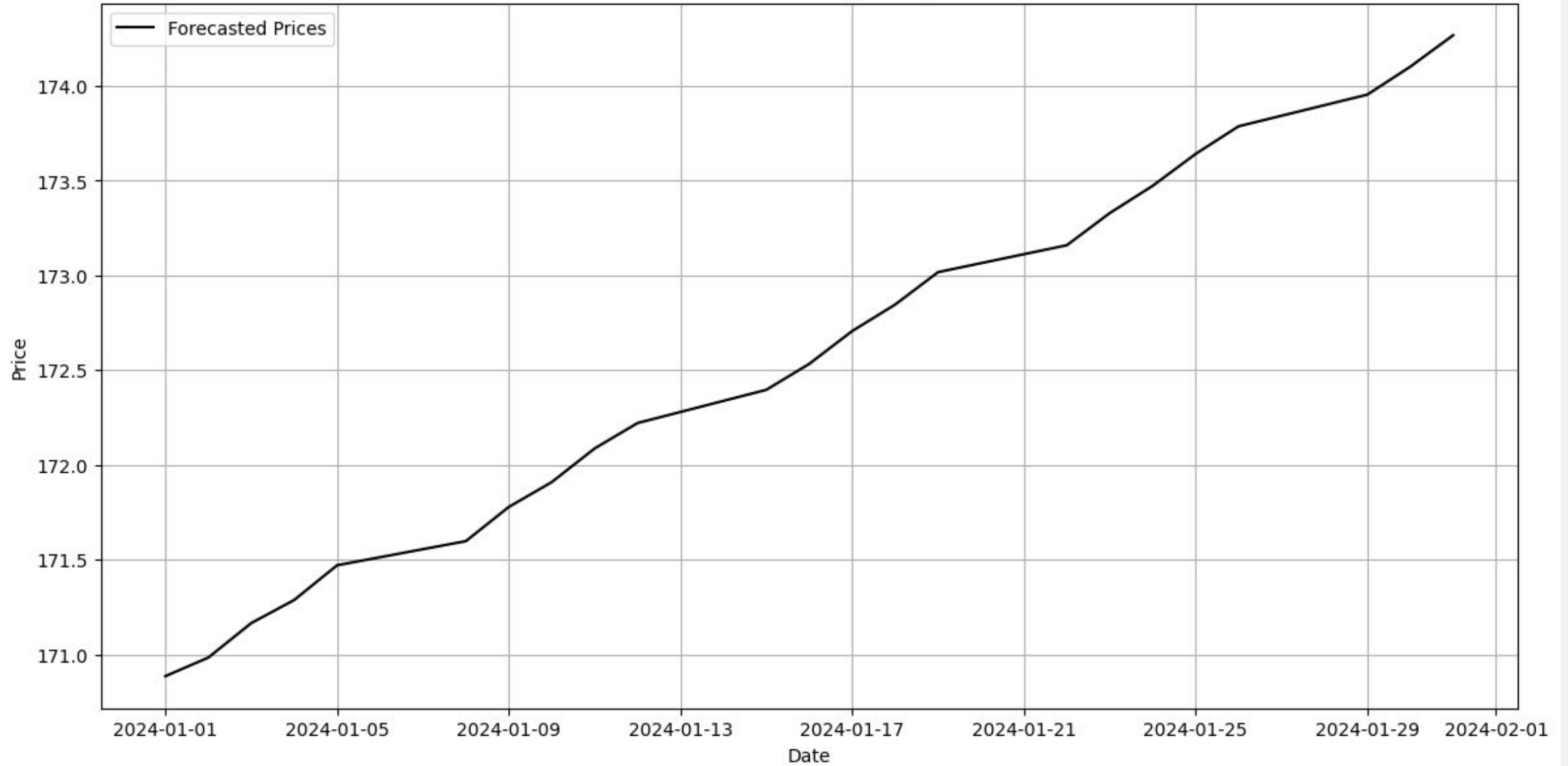
Volatility Forecast:

- Utilizes GARCH(1,2) model parameters to predict fluctuations in AAPL for January 2024.

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Forecasted Prices for January 2024

Insights

Combined Model Benefits:
- Provides a robust framework for analyzing trends and volatility in AAPL.
- Enhances financial decision-making and risk management by integrating ARIMA and GARCH models.

Practical Implications:
- Assists investors in anticipating potential returns and adjusting investment strategies based on forecasted closing prices and volatility.
- Offers valuable insights for optimizing portfolio management strategies in dynamic financial markets.

Conclusion

In our study of AAPL from 2014 to 2024, we employed ARIMA, GARCH, and LSTM models to forecast trends and volatility. Our analysis highlighted significant historical events influencing stock performance, while LSTM effectively captured long-term dependencies. Discrepancies between forecasted and actual closing prices for January 2024 underscored the impact of unforeseen events and model assumptions, emphasizing the need for continuous model refinement in dynamic financial markets.

Thank you!
Questions?

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