Predicting Stock Market Volatility

Raymond Liu & Janav Sama

Agenda

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Problem Statement

Objectives

Problem

Accurately predicting stock market volatility remains a significant challenge. Our project addresses this issue by exploring the impact of various economic factors, such as unemployment and interest rates, on stock price fluctuations

Goal

Develop and compare sophisticated models, specifically focusing on the standard deviation method and the GARCH model, to predict stock price volatility with greater precision.

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Data Collection

Sources

Federal Reserve Economic Data (FRED)

FRED is a US online database consisting of hundreds of thousands of economic data time series. It was used to extract economic indicators like unemployment rate and interest rate.

Yfinance

Yfinance is an open source API that uses Yahoo! Finance's data for educational and research purposes. We used this API and its start, end and stock symbol to derive closing stock price.

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Models

Data Science Approaches

Approach 1

- Use the merged Data Frame that has the stock price, interest rate and unemployment data to find the Linear Regression.
- Use train_test_split to get predictions.
- Run the prediction values through Numpy's std function to get the standard deviation of the Data Frame.
- This is now the predicted volatility as of October 2023 for the given stock.

Approach 2

- Use the merged Data Frame to calculate volatility using GARCH model.
- Set the training values as the closing price.
- Extend the use of the ARCH model by using GARCH
- Run the stock price change (volatility values) through the GARCH model to predict the future estimate change.
- This model utilizes the previous data as a base to predict the future values. The model constantly improves using updated values.
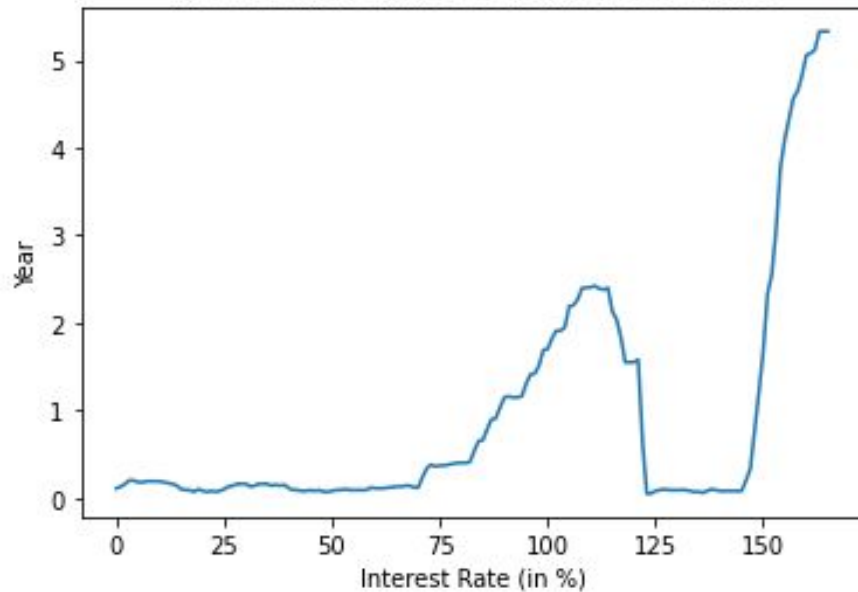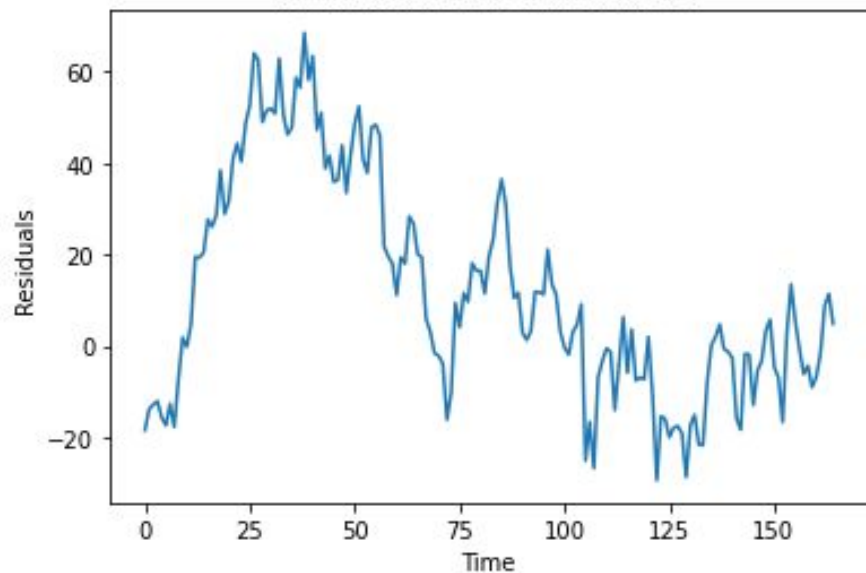
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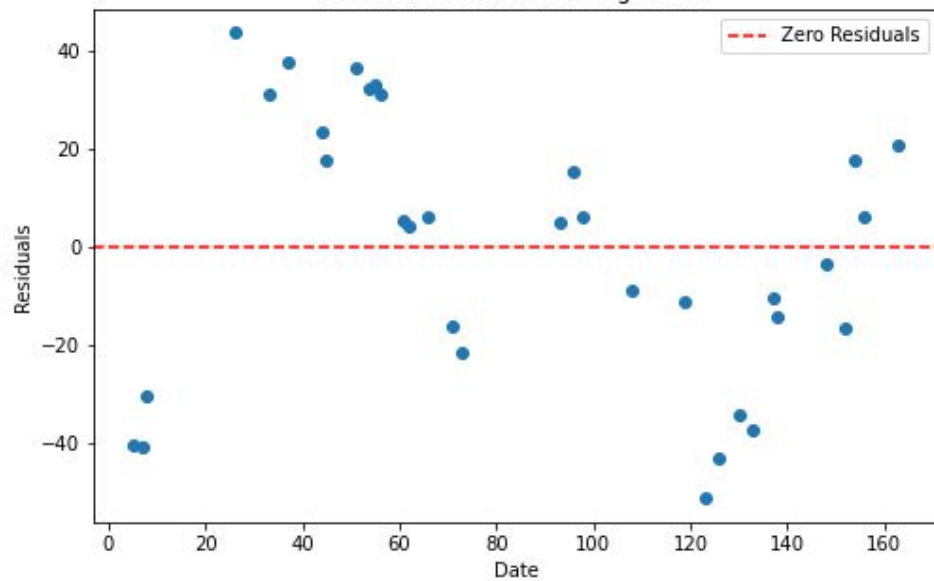## Visualizing Data

Unemployment Rates in the US from 2010 to 2023
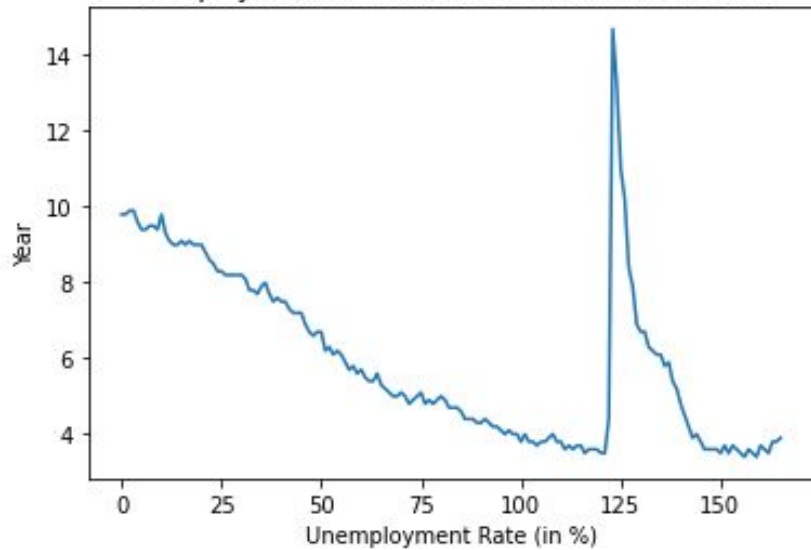
Interest Rates in the US from 2010 to 2023

Residual Plot for GARCH Model

Residual Plot for Linear Regression

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# Results

Key Findings of Our Analysis

Model Performance Comparison

- The standard deviation method demonstrated superior predictive accuracy over the GARCH model in forecasting stock volatility.
- Enhanced responsiveness to economic changes was observed in the GARCH model, particularly during periods of significant market shifts.

Impact of Economic Indicators

- A strong correlation was identified between stock volatility and unemployment rates, indicating heightened market sensitivity to labor market conditions.
- Interest rate fluctuations showed a notable influence on stock price volatility, with higher rates often correlating with increased market unpredictability.

Stock Price and Unemployment Rate Over Time
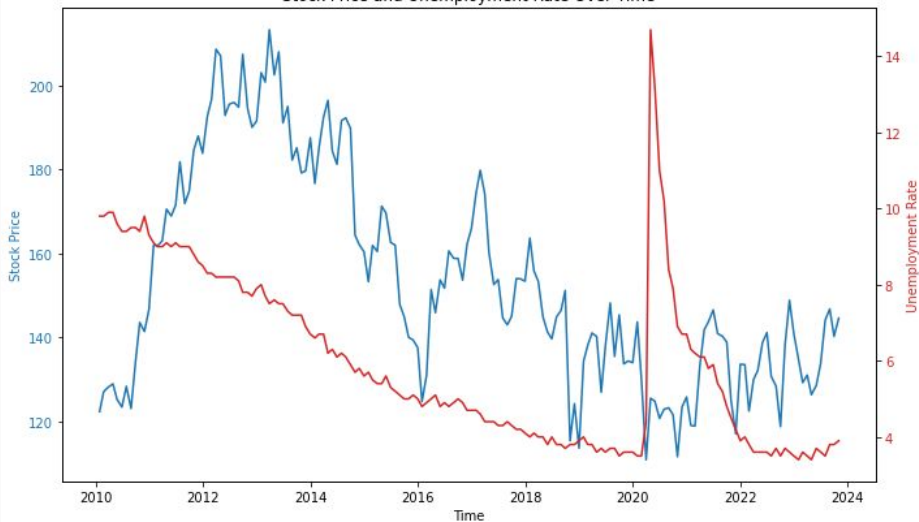
Stock Price and Inflation Rate Over Time
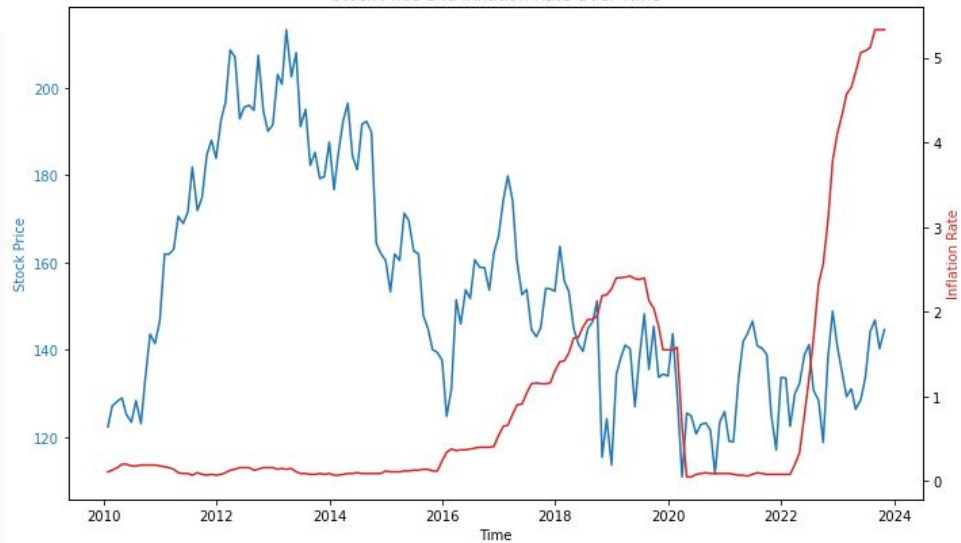
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Conclusion

Concluding Insights

Summarizing Findings

- Our analysis reveals that the standard deviation approach significantly outperforms the GARCH model approach in predicting stock market volatility

- Economic factors, notably unemployment and interest rates, play a crucial role in influencing stock market fluctuations

Future Outlook

- Further research can expand on these findings by including a wider range of economic indicators and exploring global market dynamics

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Thank you