

Sentiment Analysis in Financial News

- Apple Stocks: Sentiment-Driven Recommendations

TEAM - 2

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Overview

Our project investigates the relationship between financial news sentiment and Apple’s stock performance. By analyzing news articles and stock price data, we aim to identify patterns and correlations that can inform better stock forecasting. The project leverages advanced NLP techniques, including sentiment analysis from rule-based and large language models (LLMs), and historical stock price trends for predictive insights.

DataSource

We sourced Apple Inc. (AAPL) stock data from **Yahoo Finance** using the **yfinance** Python library, covering January 1, 2014, to October 8, 2024. The dataset includes Open, High, Low, Close, Volume, and Adjusted Close prices. Additionally, news articles from **The New York Times** were analyzed for sentiment insights, combining stock trends with market sentiment for better investment recommendations.

Workflow

This workflow combines data retrieval, text analysis, and time series forecasting to predict stock prices and provide actionable recommendations. Text data from the New York Times is summarized and analyzed for sentiment, while stock price data from Yahoo Finance is used for forecasting with the Prophet model. The sentiment analysis provides insights into market sentiment, which generates informed recommendations for decision-making when combined with the time series predictions.

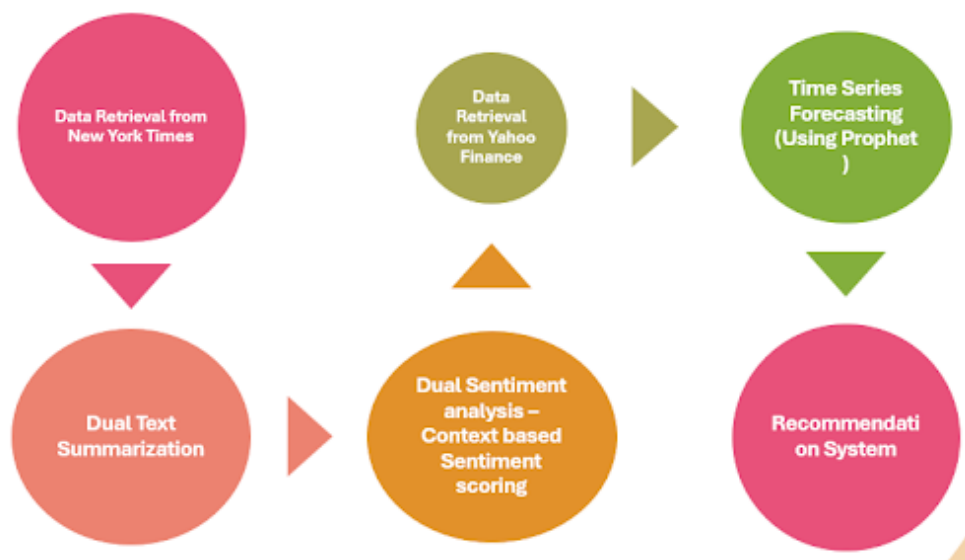


Figure - 1: Workflow for Apple Stock Price Prediction

Key Findings

This graph shows the monthly average closing price of Apple stock from 2014 to 2024. It highlights a consistent upward trend in stock prices over the years, reflecting Apple's growth and strong market performance. Periodic dips and peaks indicate moments of market volatility or responses to major events, with accelerated growth starting around 2019.

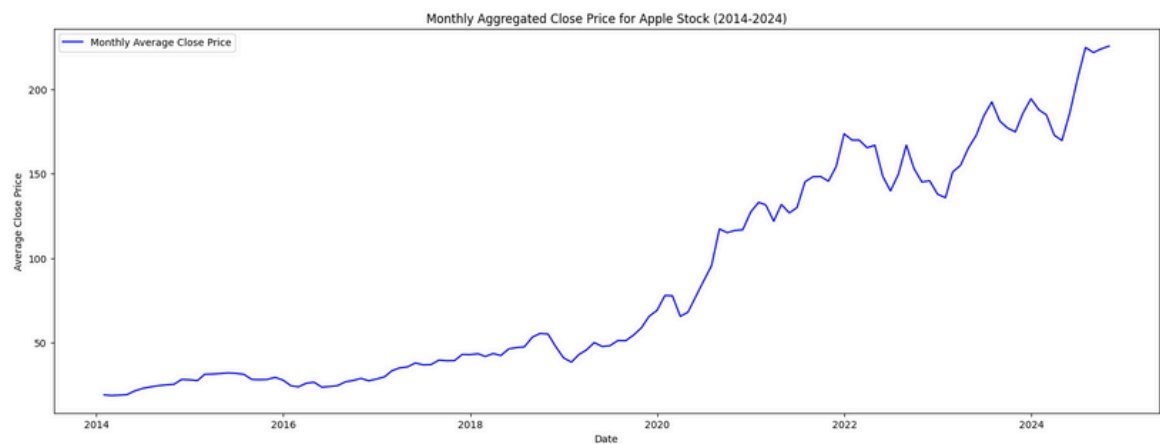


Figure - 2: Monthly Average Close Price Trend of Apple Stock (2014-2024)

This seasonality plot illustrates the monthly closing prices of Apple stock across multiple years, highlighting both recurring patterns and yearly variations. The data shows a general upward trend from June to December in several years, potentially linked to product launches and holiday sales. In contrast, the months from January to March often display stable or declining prices. Overall, the plot demonstrates Apple's consistent market growth and the influence of external factors on stock performance.

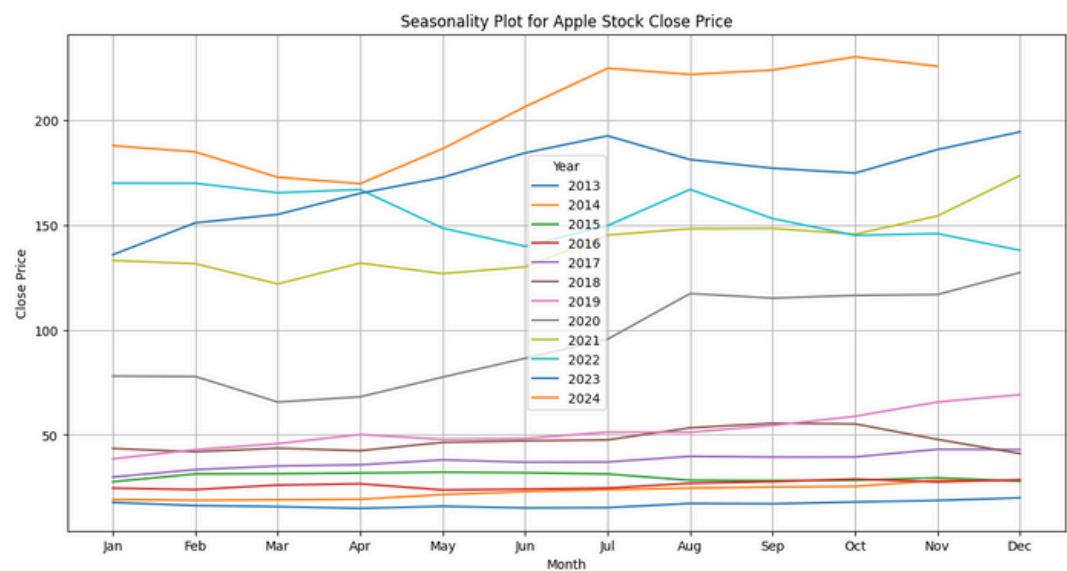
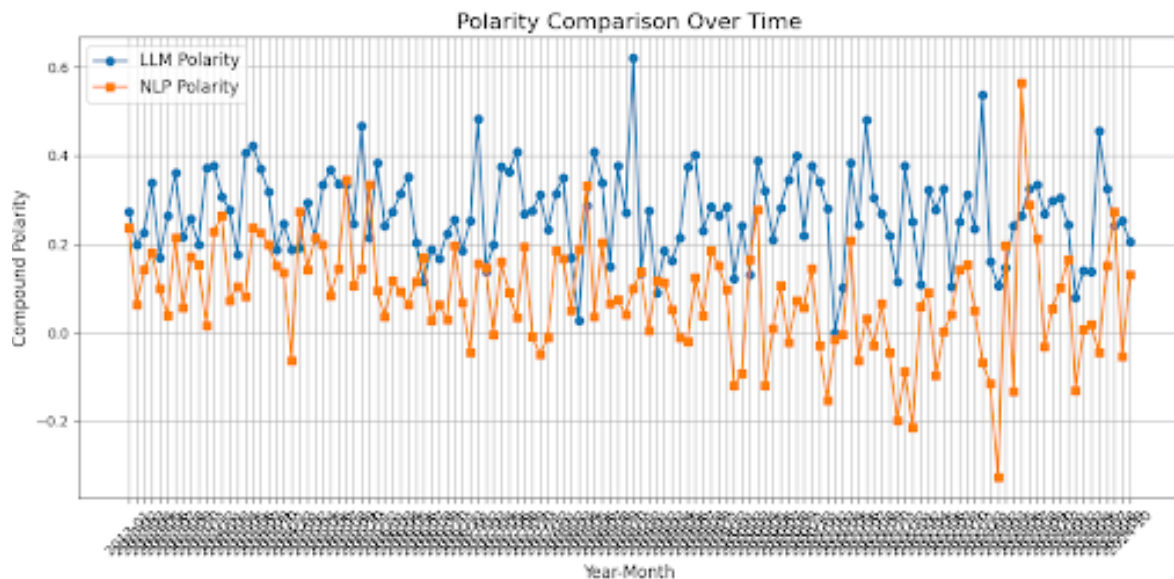


Figure - 3: Seasonality Trends in Apple Stock Closing Prices (2014-2024)



**Figure - 4: Comparison of Sentiment Polarity
Using LLM and NLP Methods**

This graph compares sentiment polarity over time between two methods: **LLM Polarity** (blue) and **NLP Polarity** (orange). The polarity scores fluctuate across the timeline, reflecting sentiment shifts influenced by external events or news. LLM Polarity generally shows higher positive scores, indicating a more optimistic sentiment interpretation, while NLP Polarity trends closer to neutral or negative, suggesting stricter sentiment assessment. Although both methods align in some periods, notable divergences highlight differences in sentiment evaluation approaches. This comparison provides valuable insights into the dynamic nature of sentiment and the varying interpretations offered by each method.

Apple Stock Forecasting: Prophet

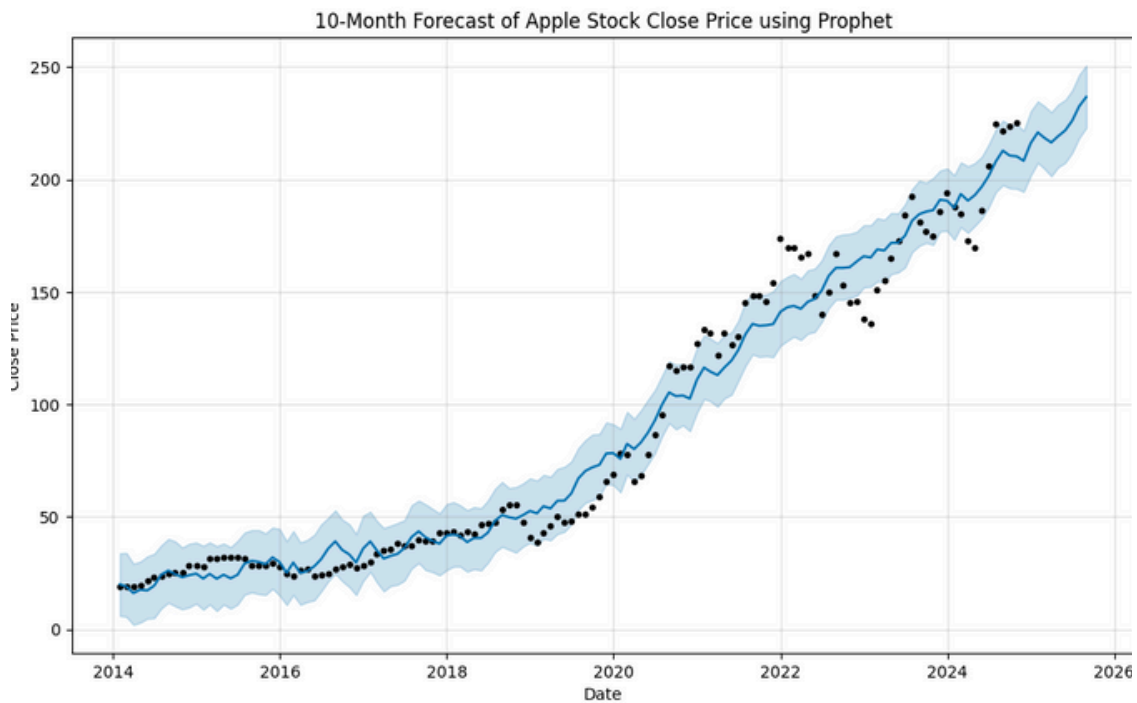


Figure - 5: Prophet Model Forecast for Apple Stock Prices

The graph represents a 10-month forecast of Apple stock closing prices using the Prophet model. Historical prices (black dots) from 2014 to 2024 are plotted alongside the model's forecast (blue line). The shaded blue area shows the 95% confidence interval, reflecting the uncertainty of predictions, which increases over time. The model captures a consistent upward trend in Apple's stock price, indicating long-term growth. The close alignment of actual and predicted values demonstrates the model's accuracy in forecasting trends. This analysis provides valuable insights for investors, suggesting a bullish outlook for Apple stock in the near future. The model's ability to handle seasonality and trends makes it well-suited for stock price forecasting. Such predictive analysis is crucial for strategic investment planning and risk management.



Sentiment Polarity Distribution

This chart illustrates the sentiment polarity of Apple-related news articles. The majority of articles fall under the Neutral category, indicating a largely objective tone in the coverage. Positive polarity makes up the second-largest portion, reflecting optimism in certain news stories, such as product launches or financial growth. Negative polarity is the smallest category, indicating a relatively low presence of critical or unfavorable sentiments in the analyzed articles. This distribution highlights the overall balanced sentiment in Apple news coverage.

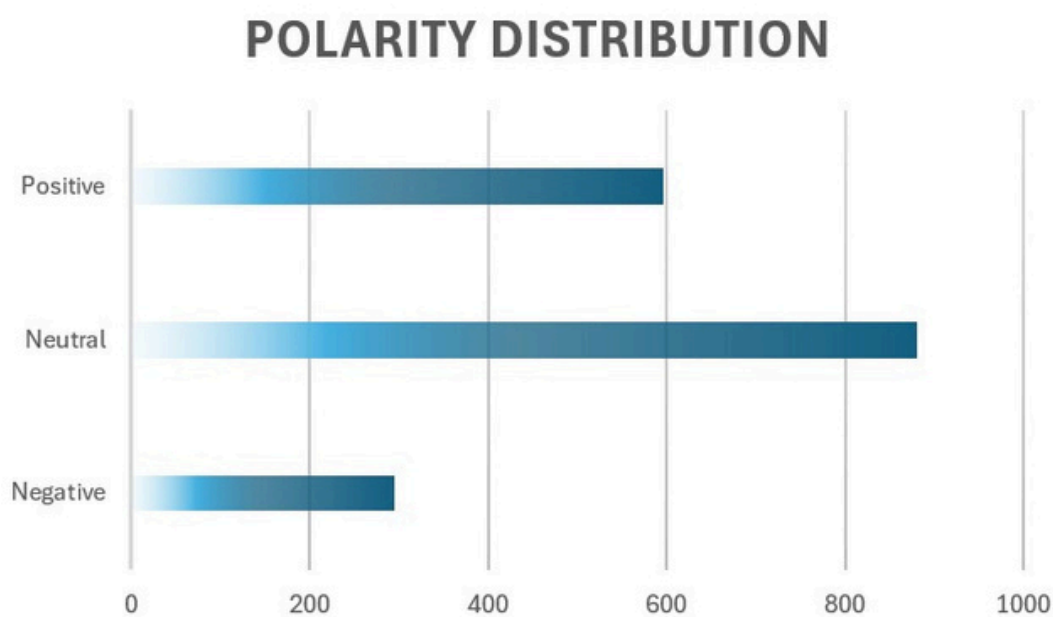


Figure - 6: Sentiment Polarity Distribution of Apple News Articles

Investment Recommendation System

The two plots demonstrate the functionality of our recommendation system, which guides whether to invest or not based on a targeted profit threshold. The system dynamically evaluates stock data and marks periods as **recommended** (green zones) or **not recommended** (red zones).

- **Red Zones:** Indicate periods where the forecasted stock value does not meet the profit threshold. During these periods, traders can choose to **sell their stock** or **wait** for the market to improve.



Figure - 7(a): Initial Version of the Recommendation System

- **Green Zones:** Represent favorable periods for investment, where the stock is expected to meet or exceed the targeted profit. Traders can use this information to **buy stocks** during these times.

The system also leverages forecasts for future dates, enabling traders to schedule market orders using time-based execution or automated triggers, ensuring timely and informed investment decisions. This visualization highlights how the recommendation system simplifies trading strategies while aiming for consistent profitability.



Figure - 7(b): Optimized Version of the Recommendation System

Weightage Distribution in the Recommendation System

This pie chart illustrates the weight distribution among the five key metrics used to design the investment recommendation system. Each metric is assigned a specific weight based on its importance in influencing investment decisions:

1. **Sentiment Weight (50%):** The largest weight is assigned to sentiment analysis, emphasizing the critical role of market sentiment in predicting stock movements.
2. **Trend Weight (20%):** Identifies upward or downward trends in stock performance, making it the second most influential metric.
3. **Past 10-Day Average Weight (15%):** Smoothing out fluctuations, this metric helps capture stable short-term patterns.
4. **Recommendation Target Weight (10%):** Focuses on achieving the predefined profit threshold, ensuring recommendations align with financial goals.
5. **Simple Recommendation Weight (5%):** Provides baseline suggestions, contributing a minor but complementary role.

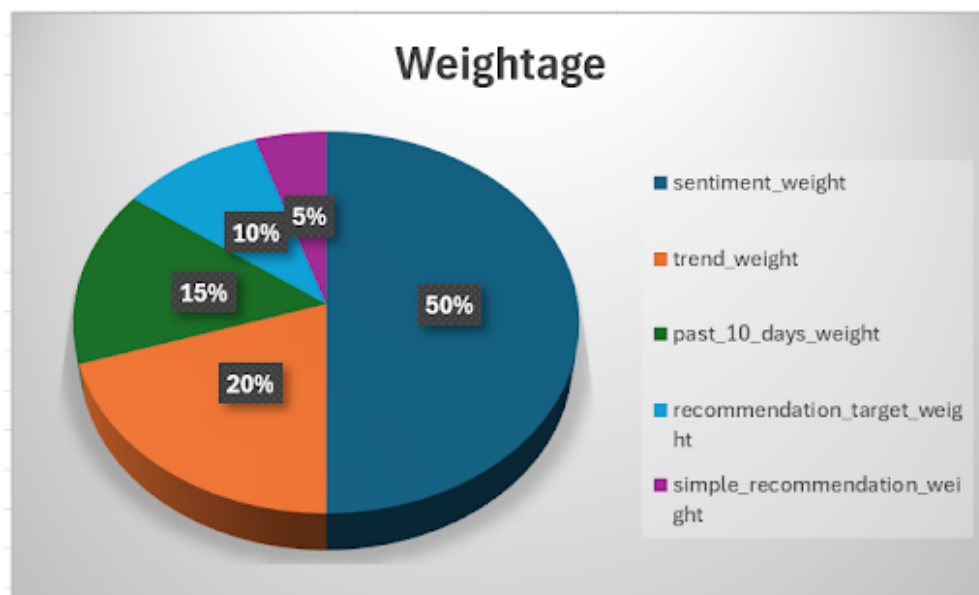


Figure - 8: Prophet Model Forecast for Apple Stock Prices



Recommendations

- **Positive Market Outlook:** Apple's market looks very favorable for investment due to the combination of a strong upward trend, consistent seasonal performance, and dominantly positive sentiment.
- **Short-Term Caution:** Investors should monitor periods of high volatility and occasional downward trends to optimize entry points.
- **Actionable Insight:** This is a good period for long-term investments in Apple, but careful monitoring is advised during negative sentiment spikes or high volatility periods.

Key References

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