# Final Project Report

Quantitative Analysis and Correlation Study of Stock Movements

## 1. Executive Summary

This report presents a comprehensive analysis of stock price movements for Apple Inc. (AAPL), utilizing quantitative methods and technical indicators to extract actionable insights. In addition, the project explores the correlation between news sentiment and stock price fluctuations, aiming to uncover patterns that can inform investment strategies.

The analysis employs Python libraries such as TA-Lib for technical analysis and PyNance for financial metrics. Sentiment analysis was conducted using natural language processing tools to evaluate the impact of market sentiment on stock returns. The findings indicate a nuanced relationship between sentiment and stock performance, providing valuable perspectives for both investors and financial analysts.

## 2. Project Objectives

The primary objectives of this project are:

**Data Preparation:** To clean and prepare stock and news data for analysis.

**Technical Analysis:** To apply technical indicators using TA-Lib for a detailed examination of stock performance.

**Sentiment Analysis:** To perform sentiment analysis on news articles and assess its impact on stock prices.

**Correlation Study:** To investigate the relationship between news sentiment and stock returns.

**Visualization:** To create clear and informative visualizations that aid in understanding the analysis results.

## 3. Methodology

### 3.1 Data Preparation

**Stock Data:** The historical stock price data for Apple Inc. was loaded into a pandas DataFrame. The data included key financial metrics such as Open, High, Low, Close, and Volume. Preprocessing steps involved handling missing values, converting date formats, and ensuring data consistency.

**News Data:** Sentiment analysis was performed on news headlines using TextBlob and NLTK. The sentiment scores were calculated and aggregated to represent daily sentiment. Dates were normalized to align with the stock data for accurate correlation analysis.

## 3.2 Technical Analysis

Indicators Used: The following technical indicators were calculated using TA-Lib:

**Moving Averages (MA):** Simple and Exponential Moving Averages were computed to smooth out price data and identify trends.

**Relative Strength Index (RSI):** RSI was used to measure the speed and change of price movements, identifying overbought or oversold conditions.

**Moving Average Convergence Divergence (MACD):** MACD was employed to reveal changes in the strength, direction, momentum, and duration of a trend in the stock's price.

## 3.3 Sentiment Analysis

**Tools Used:** Python libraries NLTK and TextBlob were utilized for sentiment analysis, assigning sentiment scores (positive, negative, neutral) to each news headline.

Daily Sentiment Scores: Sentiment scores were averaged for each day, creating a daily sentiment metric that could be correlated with stock returns.

## 3.4 Correlation Analysis

**Correlation Method:** The Pearson correlation coefficient was calculated between daily sentiment scores and stock price returns to quantify the relationship between market sentiment and stock performance.

**Analysis Period:** The analysis was conducted over a specific timeframe to ensure relevance and accuracy in the correlation study.

## 3.5 Visualization

**Visual Tools:** Matplotlib and Seaborn were used to create visualizations, including:

Time-series plots of stock prices with overlaid technical indicators.

Correlation heatmaps to visually represent the relationship between sentiment and stock returns.

Line graphs showcasing the impact of sentiment scores on daily stock performance.

# 4. Key Findings

## Technical Indicators:

**Moving Averages:** The stock's trend was well captured by the moving averages, providing clear signals for potential buy or sell actions.

**RSI:** The RSI indicated periods of overbought or oversold conditions, aligning with price corrections.

**MACD:** The MACD provided insights into momentum shifts, often preceding significant price movements.

### Sentiment Correlation:

The correlation analysis revealed a negative relationship between news sentiment and stock returns, indicating that sentiment plays an inversely proportional role but almost none it is around -0.002 in influencing stock price movements. So we can say it neutral.

## 5. Challenges and Lessons Learned

- **Data Alignment:** One of the main challenges was synchronizing the timestamps between the news and stock data. This required careful normalization and adjustment to ensure accurate correlation analysis.
- **Sentiment Analysis Accuracy**
- **Installing the TA-Lib**
- **Visualization Clarity**: Creating visualizations that clearly conveyed the results while avoiding clutter was challenging but crucial for effective communication of findings.

## 6. Conclusion

This project successfully met its objectives by applying technical analysis to stock data, performing sentiment analysis on news articles, and exploring the correlation between the two. The findings suggest that while technical indicators provide solid signals for stock performance, market sentiment also plays a role in influencing stock price movements.

The insights gained from this analysis are valuable for investors seeking to understand the multifaceted factors that drive stock prices. By combining technical analysis with sentiment data, a more comprehensive view of the market can be achieved.

## 7. Future Improvement

Advanced Sentiment Models and use other technical indicators. And also study further for other types of models.