Stock Market and Layoff Trend Analysis

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Problem Definition

The onset of COVID-19 has been a defining moment for global economies, with FAANG companies (Facebook, Apple, Amazon, Netflix, Google) at the center of a significant market transformation. This project aims to dissect the repercussions of the pandemic on the stock performance of these tech giants, with a specific focus on how corporate layoff events within these companies correlate with their stock valuation from **2019 to the present**. Our analysis is structured around the following questions:

1. What patterns emerge in the stock performance of FAANG companies post COVID-19, especially during layoff announcements?
2. How do layoffs within these companies correlate with their stock prices in the context of the pandemic?
3. Can we model and predict the stock performance of FAANG companies with a focus on periods marked by layoffs(2019-present)?
4. What insights can we draw from the pandemic and layoff events that could guide future corporate and investor decisions?

Background Description

Our project investigates how pandemic-induced market conditions and corporate decisions like layoffs have influenced the stock performance of FAANG companies. Spanning from the beginning of **2019 to the present**, our analysis provides a deep dive into the resilience and vulnerabilities of these market-leading companies during unprecedented times. By examining layoff data alongside stock prices, we aim to find the extent to which these events have impacted investor sentiment and market valuation. Through this study, we're not only looking back to understand the effects of the pandemic and layoffs on these top companies but also using what we learn to help predict future trends.

Description of Dataset

1. The dimensions of the stock price dataset:
   The stock price dataset is collected from Yahoo Finance, a prominent financial information website [1]. The timeline spans from January 1, 2019, to April 1, 2024, encompassing a total of 64 monthly stock prices. We have selected attributes including open, high, low, adjusted closing, closing, and volume, totaling 6 attributes.

2. The dimension of layoff dataset:
   The layoff dataset is collected from Layoffs.fyi, a website that tracks US tech company layoffs since COVID-19 by sourcing the data from 3 prominent newspapers and media outlets: Bloomberg, The Wall Street Journal, and The New York Times [2]. The timeline covers the period from April 28, 2022, to April 17, 2024, comprising a total of 31 dates of data. It includes 4 selected attributes: company, number of laid off, date, and source.

Description of methods

In our final report, we employed various charts to visualize the results of both descriptive and predictive analyses. Descriptive analysis was represented through heat maps, line charts with bar overlays, and line charts of moving averages, enabling us to explore the correlations, tendencies, and relationships among the variables, elucidating the stock market sentiment and layoff trends. The predictive analysis was depicted using a machine learning linear regression model, allowing us to explore the relationships between time and stock price and further predict the future stock price.

In conducting our analysis, we utilized a range of Python libraries and tools. We employed the 'requests' library and the 'Beautiful Soup' package to parse and extract content from Yahoo Finance stock prices. For preprocessing and cleaning, as well as manipulating the data into suitable formats, we utilized the 'numpy' and 'pandas' libraries. To visualize our data and generate insightful graphs, we relied on the 'matplotlib' and 'seaborn' libraries. Finally, for data analysis, the 'yfinance' library enabled access to historical stock market data, while the

'scikit-learn' library facilitated the construction of a linear regression model to analyze stock prices over time.

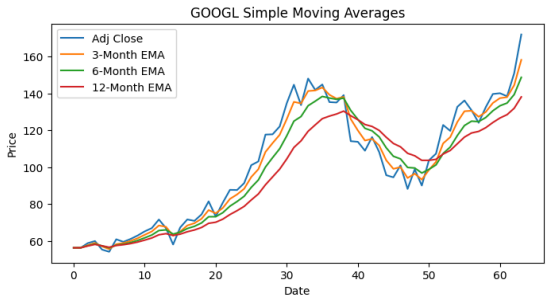
Experiment Setup and Analysis

Data Collection and Cleaning: The data collection and cleaning processes were methodically automated using Python scripts. Data Collection was handled by get_data.py, which automated the gathering of monthly stock data and financial statements from Yahoo Finance. This script utilized BeautifulSoup and the requests libraries for scraping historical stock metrics (Open, High, Low, Close, Adjusted Close, and Volume) and yfinance for financial statements. The collected data was saved as CSV files in a raw data folder.

Data Cleaning was conducted using the clean_data.py script, which standardized date formats and converted numeric fields from strings to floats. It removed any rows with missing or zero values indicative of non-trading days. The cleaned data was then stored separately in a processed data folder to prevent data leakage and maintain data integrity throughout the analysis

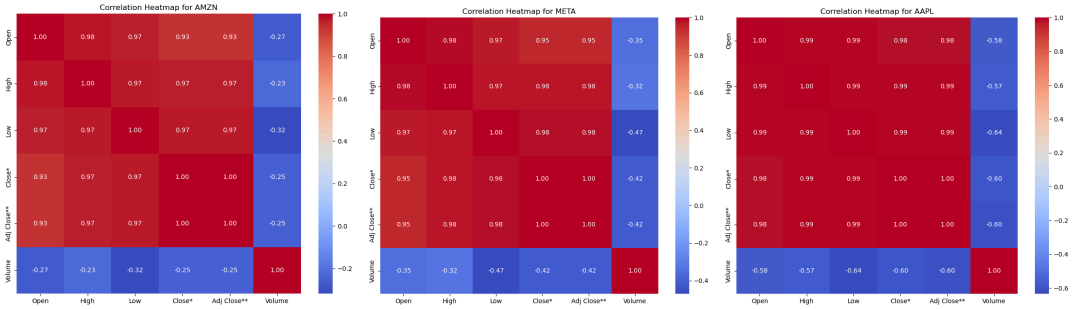
Data Analysis: The cleaned financial data was analyzed using the run_analysis.py script, which performed descriptive statistical analysis to summarize key financial metrics. The script calculated measures such as mean, median, standard deviation, and quartile distributions for various financial indicators, saving these statistics in an analysis directory for easy reference and further investigation.

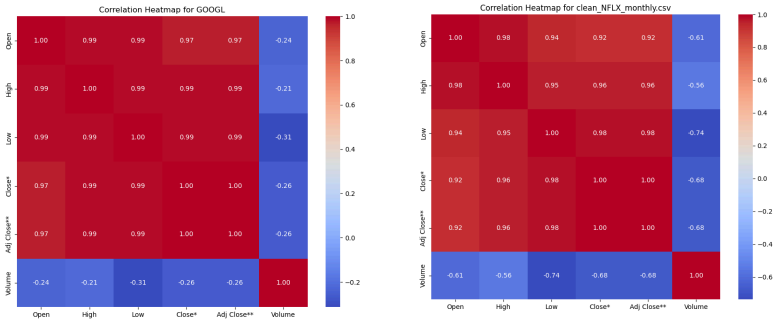
Moving Averages: Using simple moving averages, we traced stock price trends over 3, 6, and 12-month periods. The resulting plots revealed smooth trajectories that helped identify underlying patterns across different timescales. The comparative moving average plot for all companies elucidated the convergences and divergences, suggesting market sentiment and possible correlated behaviors among the stocks.



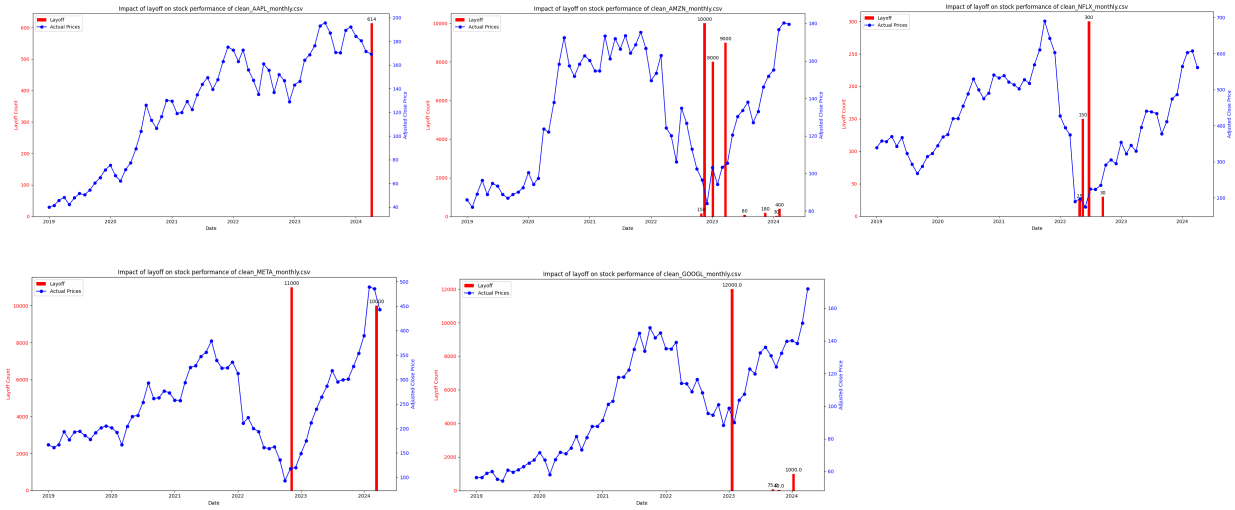
The stock performances of META and NFLX exhibited greater volatility, with notable divergences from their moving averages, suggesting a less stable investor sentiment and a more reactive market response. Conversely, AMZN displayed moderate stability with its stock price fluctuating below and then above its moving averages, indicative of periods of negative sentiment followed by recovery. In contrast, AAPL and GOOGL showed the most stability; their stock prices closely tracked their moving averages, suggesting lower volatility and a stronger, more consistent market confidence. Other Visualizations are in the Visualizations file.

Correlation Analysis: The heat maps for GOOGL, NFLX, AAPL, AMZN, and META indicate a high positive correlation among their daily trading prices, meaning these metrics typically move in tandem. Volume is negatively correlated with trading prices across all companies, suggesting that higher trading volumes often occur on days when stock prices are lower, potentially indicating sell-offs or negative market reactions.





Layoff Analysis: The integration of layoff data provided a unique viewpoint on how workforce reductions potentially impacted stock prices. Dual-axis plots effectively juxtaposed layoffs against stock valuations, offering a clearer view of their correlation.



GOOGL: A peak in the red layoff bars indicates a significant layoff event. Following this event, the stock noticeably upticks.

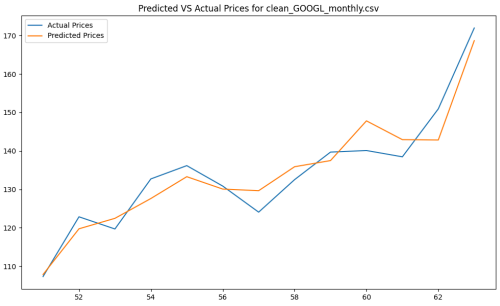
NFLX: Multiple layoff events are visible. The stock price shows volatility around the times of these layoffs, with a sharp drop in price following the largest layoff event before recovering.

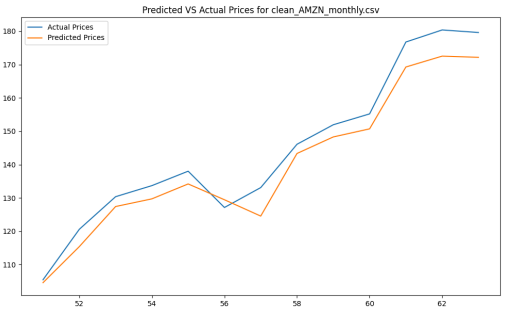
AAPL: The data shows a major layoff event, after which the stock price significantly increases. It suggests a potential positive investor response or a perceived

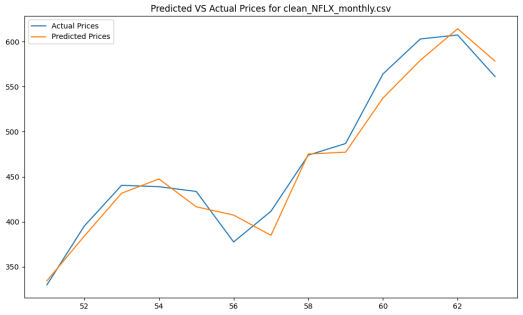
META: A pronounced layoff event is present, followed by a steep increase in stock price, similar to the pattern observed with AAPL.

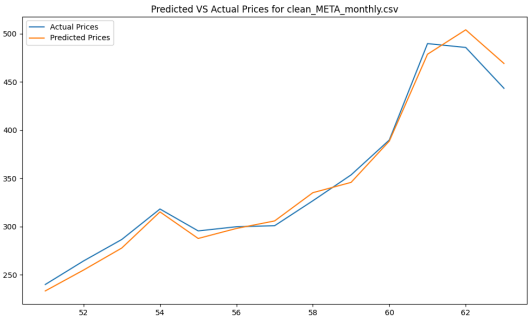
From this layoff analysis, it seems that layoffs may have a complex relationship with stock performance, with stock prices sometimes rising after layoffs, possibly due to anticipated cost savings or restructuring benefits as perceived by the market.

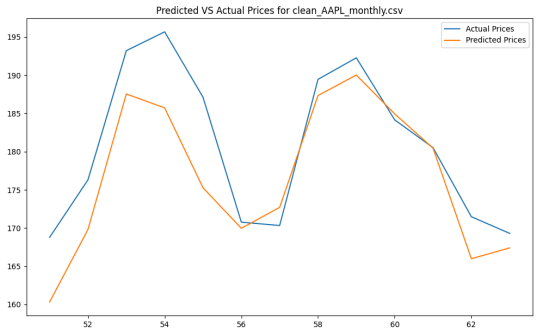
Predictive Modeling: Linear regression models forecasted stock prices with various degrees of accuracy, as indicated by the RMSE, MAE, and R-squared values. The models underscored the challenge of predicting stock market prices, with the predictive accuracy varying across different companies.











META: The stock price predictions follow the actual prices quite closely until the end, when the actual prices drop while the predictions continue to rise.

AMZN: There is a visible deviation between the actual and predicted prices, particularly towards the end of the period shown.

AAPL: The predictive model shows some discrepancies, especially around the middle of the graph, where a sharp dip in actual prices is not mirrored in the predictions. **NFLX**: The actual and predicted prices appear closely aligned for most of the period.

GOOGL: The predicted prices underestimate the actual prices towards the end of the timeline.

Performance metrics: The model performs best in predicting GOOGL's stock price, evidenced by the lowest RMSE, MAE, and a high R-squared, indicating a close correlation with actual

prices. AMZN also shows good model accuracy and fit. AAPL's predictions are moderately accurate with a strong correlation, while META, despite high errors, still captures a significant variance. NFLX, however, has the least accurate predictions with lower power to explain, as shown by its higher RMSE, MAE, and lower R-squared. Overall, the model is most effective with GOOGL and least with NFLX and META.

Ticker Symbol	RMSE	MAE	R-SQUARED
META	11.1122	8.91343	0.98011
AMZN	5.26078	4.72236	0.945671
AAPL	5.01443	3.81967	0.73818
NFLX	17.3241	14.7695	0.958622
GOOGL	4.43328	3.83642	0.913971

Observations

The observed impact of layoffs on stock prices presents a complex picture; while they often signal internal issues, causing immediate stock price drops, they can also be viewed as cost-cutting measures that potentially enhance efficiency, leading to price increases in some cases. This dual effect was reflected in varied stock price reactions post-layoff announcements. Company-specific trends further indicated that AAPL and GOOGL experienced more stability and less volatility post-layoffs, suggesting stronger market confidence in their financial management compared to META and NFLX, which faced more significant price swings. Additionally, the use of linear regression models to predict stock prices demonstrated mixed effectiveness. The models performed optimally with GOOGL but struggled with NFLX and META, underscoring the difficulty in accurately modeling the nuanced factors influencing stock prices.

Conclusions

Although FAANG companies have demonstrated stable stock performance In the post-pandemic era, these companies have experienced occasional fluctuations in response to layoffs. This suggests an eventual market recognition of cost-saving benefits. A correlation between layoffs and stock prices exists, in which initial drops are often followed by upward trends as the market adjusts to the potential for reduced expenses and increased efficiency. Predictive models like linear regression offer a foundational approach for forecasting stock prices in the context of layoffs but further research needs to be done to address the multifaceted

influences of market factors. Lastly, this study emphasizes the importance of strategic planning and transparent communication regarding layoffs in order for corporations to sustain or regain investor confidence.

References

Finance, Y. (n.d.). *Yahoo Finance - Stock Market Live, quotes, Business & Finance News*. Yahoo! Finance. https://finance.yahoo.com/

Lee, R. (2024, April 25). *Layoffs.fyi*. Layoffs.fyi - Tech Layoff Tracker and Startup Layoff Lists. Retrieved April 27, 2024, from https://layoffs.fyi/