Week 1 analysis report on the Stock Market (2000 – 2023)

1. ***Introduction***

This research project aims to explore long-term trends and risk behaviors in the stock market by analyzing the historical closing prices of four major technology companies: Apple, Microsoft, Nvidia, and Google (Alphabet). Using data from 2002 to 2024, the study investigates how each company's stock has evolved by identifying key metrics such as maximum and minimum closing prices, volatility (standard deviation), and beta values in comparison to the market. By leveraging R programming for statistical analysis and Tableau for visualization, the project provides insights into both the performance and risk dynamics of each stock. This analysis serves as a practical application of financial data science and helps illustrate the broader growth patterns within the tech sector over the past two decades.

For this particular project, I used 4 of the big Technology Companies' datasets about their stock market price. The four of them are:

1) Apple
2) Alphabet (Google)
3) Microsoft
4) Nvidia

For this project, I decided to make use of GitHub to create a repository and upload all the relevant files regarding this research project that I'm writing. Here is the link to my personal GitHub repository:

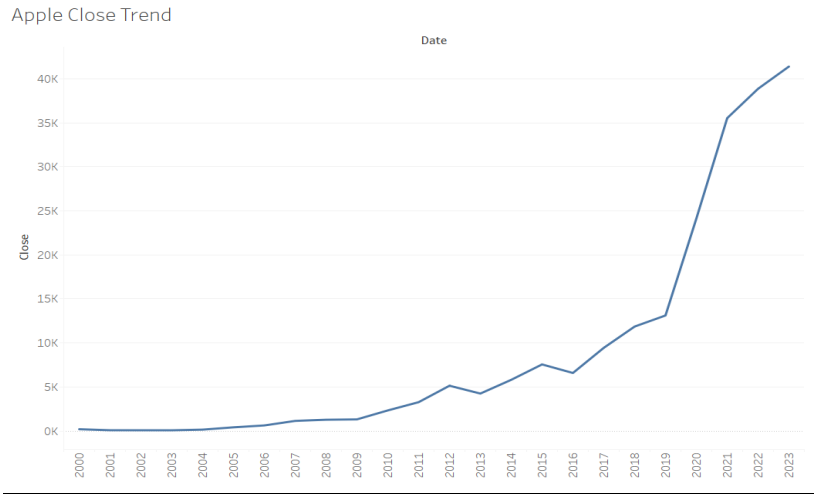
https://github.com/muhdhsyukri/Research-Stock-Market-Analyzation

2. ***Datasets Visualization, Insights, and Analysis.***

The close trend in the stock market refers to the pattern of changes in a stock's closing price—the final price at which it trades each day—over a given period. It helps indicate whether a stock is generally trending upward, downward, or showing high volatility. By observing the close trend, investors can understand how a stock's value has moved over time and identify long-term growth, declines, or major turning points triggered by market events or company performance.

Understanding the close trend is important because it offers insight into a stock's historical behavior and helps investors assess potential risks and opportunities. It is a key part of technical analysis and is often used to inform trading decisions, identify entry or exit points, and evaluate the overall sentiment of the market toward a particular stock or sector.

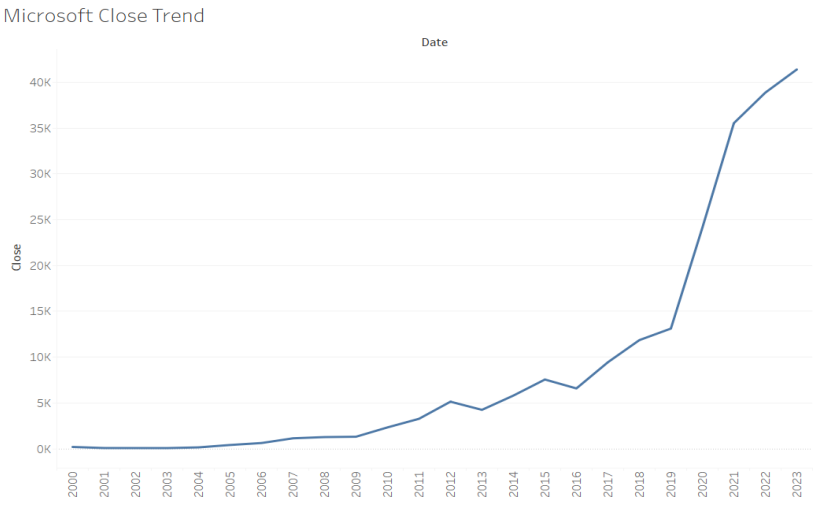
1) **Apple Close Trends.**



Graph 1 shows a line chart of the closing trends in the Apple company.

Apple's closing price trend shows a remarkable long-term upward trajectory. From a modest low of $0.23 in April 2003, the stock steadily grew, reaching an all-time high of $198.11 on December 14, 2023. This reflects Apple's transformation from a niche tech company to a global technology leader driven by the iPhone, Mac, and services ecosystem. The growth trend especially accelerated after 2010 and was further boosted by pandemic-era demand for consumer electronics and digital services.

2) **Microsoft Close Trend.**

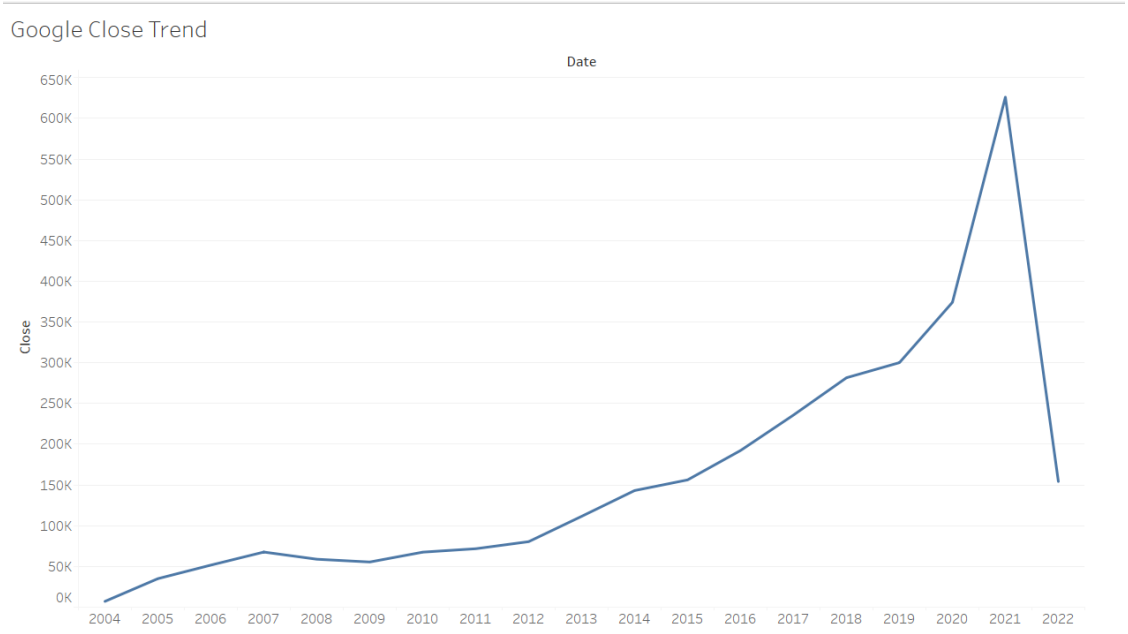


Graph 2 shows a line chart of the closing trend in the Microsoft company.

Microsoft's closing prices reveal consistent growth, with the lowest price recorded at $15.15 on March 9, 2009, during the global financial crisis. Since then, the stock rebounded significantly, hitting its peak at $377.85 on November 22, 2023. This long-term upward movement aligns with Microsoft's strategic expansion into cloud computing (Azure),

productivity software (Office 365), and AI. The trend also reflects investor confidence during its transition into a cloud-first and AI-integrated enterprise.

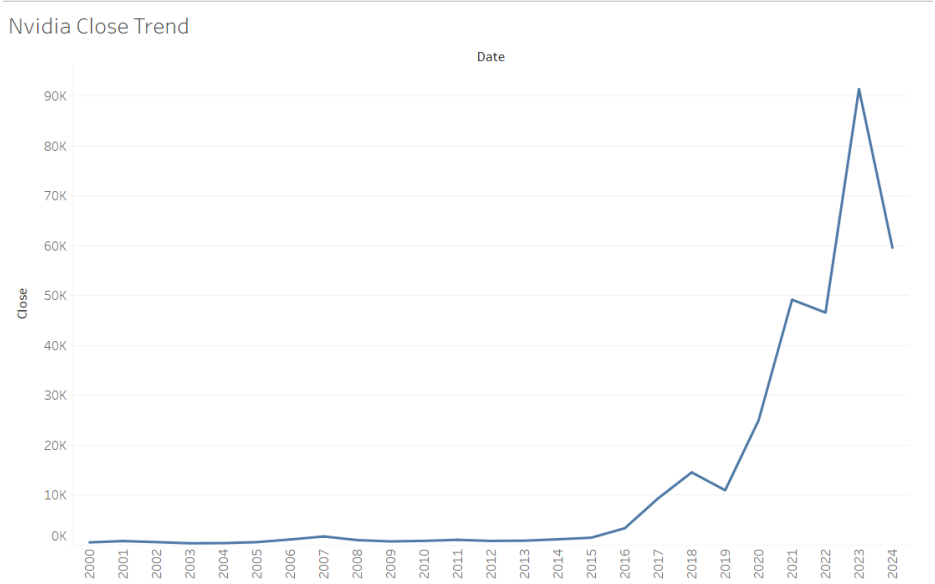
3. Alphabet (Google) close trend.



Graph 3 shows a line chart of the closing trend in the Alphabet (Google) company.

Google's closing price trends display substantial growth, starting at $50.06 on September 3, 2004, shortly after its IPO. The stock reached a peak of $2,996.77 on November 18, 2021, reflecting years of innovation and dominance in search, advertising, Android, and cloud services. The price surged sharply during the pandemic due to increased digital ad revenue and online services, peaking before a tech-sector correction in 2022.

4. Nvidia close trend.



Graph 4 shows a line chart of the closing trend for the Nvidia company.

Nvidia shows the steepest growth curve among the four stocks, beginning with a low of $0.61 on October 9, 2002, and skyrocketing to a record $950.02 on March 25, 2024. This dramatic rise illustrates Nvidia's evolution from a graphics card manufacturer to a dominant player in AI, machine learning, and data center computing. The surge in 2023–2024 especially mirrors the global AI boom and demand for high-performance GPUs powering LLMs and neural networks.

Visualization summary

Over the past two decades, Apple, Microsoft, Nvidia, and Google (Alphabet) have all demonstrated strong long-term upward trends in their closing prices, reflecting their growth into global tech leaders. Apple rose from $0.23 in 2003 to $198.11 in 2023, driven by its product innovation and digital ecosystem. Microsoft showed steady growth from its 2009 low of $15.15 to $377.85 in 2023, fueled by its transition into cloud computing and AI. Nvidia experienced the most dramatic rise, from just $0.61 in 2002 to $950.02 in 2024, highlighting its central role in the AI and GPU market.

Google (Alphabet) also saw substantial appreciation, climbing from $50.06 shortly after its 2004 IPO to a peak of $2,996.77 in 2021. This growth was driven by its dominance in digital advertising, search, and cloud technologies, with a strong boost during the pandemic. Each company's closing price trend reflects not only its success but also broader market trends such as the rise of consumer tech, cloud infrastructure, and artificial intelligence.

3. Datasets Standard Deviation and correlation matrix.

In a stock market dataset, **standard deviation** measures how much a stock's prices vary from its average (mean) over a certain period. Here's what it means practically:

- A **high standard deviation** means the stock price is **very volatile**, swinging up and down a lot.
- A **low standard deviation** means the stock price is **more stable**, staying close to the average.

I used RStudio and the R language to create the table and calculate the standard deviation. Here are the pictures of the code that I've written:

```r
# Calculate daily returns
apple <- apple %>% arrange(Date) %>% mutate(Return = Close / lag(Close) - 1)
microsoft <- microsoft %>% arrange(Date) %>% mutate(Return = Close / lag(Close) - 1)
nvidia <- nvidia %>% arrange(Date) %>% mutate(Return = Close / lag(Close) - 1)
google <- google %>% arrange(Date) %>% mutate(Return = Close / lag(Close) - 1)

apple <- apple %>%
  arrange(Date) %>%
  mutate(Return = .data[["Close"]] / lag(.data[["Close"]]) - 1)

microsoft <- microsoft %>%
  arrange(Date) %>%
  mutate(Return = .data[["Close"]] / lag(.data[["Close"]]) - 1)

nvidia <- nvidia %>%
  arrange(Date) %>%
  mutate(Return = .data[["Close"]] / lag(.data[["Close"]]) - 1)

google <- google %>%
  arrange(Date) %>%
  mutate(Return = .data[["Close"]] / lag(.data[["Close"]]) - 1)
```

```r
# Calculate standard deviation of daily returns
apple_sd <- sd(apple$Return, na.rm = TRUE)
microsoft_sd <- sd(microsoft$Return, na.rm = TRUE)
nvidia_sd <- sd(nvidia$Return, na.rm = TRUE)
google_sd <- sd(google$Return, na.rm = TRUE)

apple_sd
microsoft_sd
nvidia_sd
google_sd

# Create a table for the standard deviation
tibble(
  Stock = c("Apple", "Microsoft", "Nvidia", "Google"),
  `Standard Deviation` = c(apple_sd, microsoft_sd, nvidia_sd, google_sd)
)
```

```
[1] 0.01908313
>
> # Create a table for the standard deviation
> tibble(
+   Stock = c("Apple", "Microsoft", "Nvidia", "Google"),
+   `Standard Deviation` = c(apple_sd, microsoft_sd, nvidia_sd, google_sd)
+ )
# A tibble: 4 × 2
  Stock     `Standard Deviation`
  <chr>                    <dbl>
1 Apple                   0.0208
2 Microsoft               0.0171
3 Nvidia                  0.0308
4 Google                  0.0191
>
```

Among the four companies analyzed, **Nvidia** exhibits the highest stock price volatility with a standard deviation of **0.0308**, indicating that its price fluctuates the most. **Apple** and **Google** have moderate volatility levels at **0.0208** and **0.0191**, respectively. **Microsoft** shows the lowest volatility with a standard deviation of **0.0171**, suggesting it has the most stable price movements over the observed period.

A correlation matrix in the stock market helps identify how closely the price movements of different stocks are related. It shows values ranging from -1 to 1, where +1 means the stocks move perfectly together, 0 indicates no relationship, and -1 means they move in opposite directions. This tool is useful for understanding market behavior and improving portfolio diversification—investors can reduce risk by combining stocks with low or negative correlations. For example, if Apple and Microsoft have a high correlation of 0.95, their prices tend to rise and fall together, while a lower correlation between Nvidia and Google (e.g., 0.2) suggests they behave more independently.

I have also written the R code for the correlation matrix and created the table for it. Here is the code:

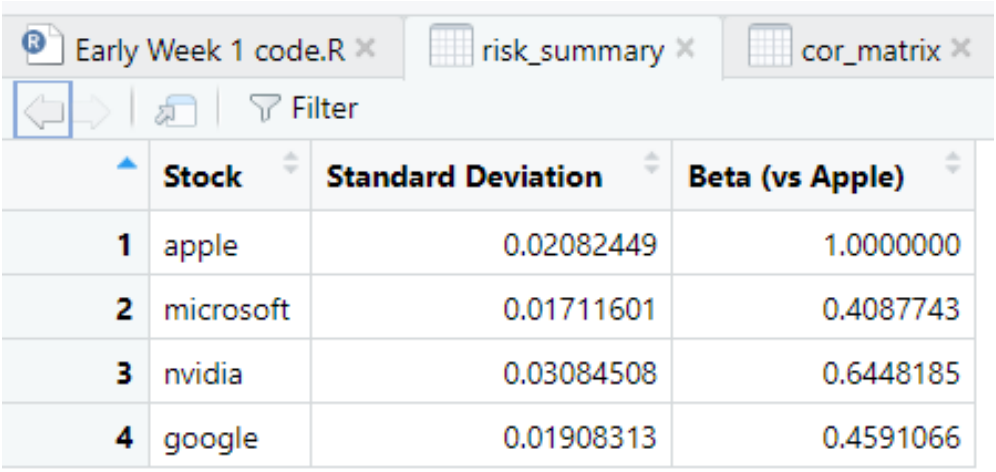
```r
# Correlation matrix
apple_ret <- apple %>% select(Date, Apple = Return)
microsoft_ret <- microsoft %>% select(Date, Microsoft = Return)
nvidia_ret <- nvidia %>% select(Date, Nvidia = Return)
google_ret <- google %>% select(Date, Google = Return)

# Join all four by Date
returns_df <- reduce(
  list(apple_ret, microsoft_ret, nvidia_ret, google_ret),
  full_join,
  by = "Date"
) %>% drop_na()

# Correlation matrix
cor_matrix <- cor(returns_df %>% select(-Date))
print(cor_matrix)
```

```
> 
> # Correlation matrix
> cor_matrix <- cor(returns_df %>% select(-Date))
> print(cor_matrix)
              Apple Microsoft    Nvidia    Google
Apple     1.0000000 0.5018113 0.4482072 0.5027794
Microsoft 0.5018113 1.0000000 0.4970097 0.5397538
Nvidia    0.4482072 0.4970097 1.0000000 0.4328178
Google    0.5027794 0.5397538 0.4328178 1.0000000
> 
```

All four companies show moderate positive correlations with one another, indicating that their stock returns tend to move in the same direction, but not perfectly. The strongest correlation is between Microsoft and Google (0.54), suggesting they have the most similar return patterns among the group. Apple is moderately correlated with both Microsoft (0.50) and Google (0.50), while its correlation with Nvidia (0.45) is slightly lower. Nvidia has the weakest correlations overall, especially with Google (0.43) and Apple (0.45), implying it behaves a bit more independently compared to the others. This mix of correlations offers opportunities for portfolio diversification, especially with Nvidia in the mix.

4. ***Risk Measurement***

Apple serves as a strong market benchmark in this analysis due to its dominant position in the global tech industry, large market capitalization, and consistent long-term growth. As one of the most influential companies in the world, Apple reflects both sector-specific trends and broader market movements, making it a relevant reference point when evaluating other major tech stocks like Microsoft, Nvidia, and Google. Its leadership in consumer technology, widespread investor following, and reliable historical data further support its use as a proxy for market behavior, especially in tech-focused financial analysis.



	Stock	Standard Deviation	Beta (vs Apple)
1	apple	0.02082449	1.0000000
2	microsoft	0.01711601	0.4087743
3	nvidia	0.03084508	0.6448185
4	google	0.01908313	0.4591066

This table summarizes the risk characteristics of four major tech stocks—Apple, Microsoft, Nvidia, and Google—using two key metrics: standard deviation and beta (vs Apple). The standard deviation reflects each stock's price volatility, while beta measures sensitivity to Apple's price movements, which is used here as a market proxy.

Among the four, Nvidia has the highest standard deviation (0.0308), indicating it is the most volatile and therefore carries the highest risk. In contrast, Microsoft is the least volatile (0.0171), suggesting more price stability. In terms of beta, Nvidia again stands out with the highest value (0.6448), showing it reacts more strongly to Apple's price movements, while Microsoft has the lowest beta (0.4088), indicating less sensitivity to Apple's market behavior. Overall, Nvidia is both the most volatile and the most responsive to market shifts, while Microsoft is the most stable and less influenced by broader tech trends. These insights help investors understand the trade-off between potential return and risk across these tech giants.

5. ***Improvement Plans.***

There are several key areas where improvements can be made to deepen insights and enhance the quality of the research. First, you could expand your dataset to include more companies (e.g., Amazon, Meta, Tesla) or index benchmarks like the S&P 500 to provide broader market context. This would allow you to compare tech stocks to the overall market and assess whether their growth is sector-specific or market-wide.

Second, incorporating more advanced statistical analysis, such as moving average crossovers, Bollinger Bands, or regression models, can offer more detailed insights into price behavior and potential forecasting. Third, you could enhance interactivity by developing a dynamic Tableau dashboard with filters for time ranges, stock comparison, and key financial indicators. Lastly, consider adding a qualitative layer to your findings by briefly exploring news events or company milestones that coincide with major price shifts. This will not only strengthen your interpretations but also bring real-world context into your data-driven storytelling.

6. ***Conclusion***

The analysis of four major tech stocks—Apple, Microsoft, Nvidia, and Google—reveals that while all exhibit moderate positive correlations, they do not move in perfect sync, allowing room for diversification. Microsoft and Google show the strongest correlation, indicating similar return behavior, whereas Nvidia is the least correlated with the rest, suggesting a more independent performance. In terms of volatility, Nvidia stands out with the highest standard deviation, reflecting greater price swings and risk, while Microsoft shows the lowest volatility, offering more price stability. Overall, the combination of correlation and volatility insights can guide more informed investment decisions, balancing risk and diversification across the portfolio.