Matthew Chin

Analysis of Top Five Tech Stocks:

Apple, Amazon, Facebook, Google, Microsoft

MSBA 320

Advanced Statistical Analysis with R & Python

Dr. Siamak Zadeh, Professor

Golden Gate University

Final Project

April 20, 2022

# Table of Contents

# Introduction

This analysis will cover the stocks of different industries and their performances in the last ten years. It is under the implication that any company or companies mentioned have been filed to publicly trade after having past submitted an initial public offering (IPO) at some point in their active operations. A publicly traded stock is one that is available on a market which allows people with money from anywhere in the world (i.e., available to the public) to invest in shares for a company they like because of what they stand for or have bought their products. In some cases, traders or investors can even make an income off stock prices if that company's stock price is positive for some period.

Over the years, tech companies like Amazon, Apple, Facebook, Google, and Microsoft, among others have made risky, innovative decisions to better promote their business visions and navigate the opportunities that technology has opened for society. These will be the five companies' stocks used for this analysis. The top executives of each of these companies allow shareholders to invest in their companies because as owners or even the founders of their companies, stock trading is income that they can live off of where it creates a "broken" IPO system leading to intense competition (Fox, 2011). People invest in such companies because they wanted to put their own money behind what these organizations are committed to and with what they want to do to improve the life of current and future generations. There have been concerns about how shareholders can buy low-value stocks and sell when they reached their highest value, but this goes to show how stock prices per share have mostly grown after the dot-com bubble of the late 1990s and early 2000s.

This analysis will not only forecast where stock prices for Google or Amazon would be in the next five or ten years, but also can help determine these companies' performances. If a

company decides to make more stocks available to people to get into the personal investment trend and open opportunities for those who want some form of ownership in companies they like, they could consider making share prices more affordable for more people to buy into. It will go into why since the early 2010s, tech stocks have, for the most part, been successful in gaining more shareholders and thus creating an additional opportunity for profit besides the products and applications they sell. Shares also provide equity or even a minority ownership stake in a company based on how much holders are willing to invest.

## Data Collection & Descriptive Analysis

I will look at stocks for the following major technological companies, five of which originated from a Kaggle dataset with daily updates of stock prices with respect to their stock symbol, all of which are publicly traded (Footballjoe789, 2022). The five well-known technology companies are known as Big Tech or FAAAM: Facebook, currently doing business as Meta Inc., Amazon, Apple, Google, which does business as Alphabet Inc., and Microsoft. Their stock symbols are FB, AMZN, AAPL, GOOGL, and MSFT, respectively. Data was pulled from the stock value history of the five listed companies as they are publicly traded on the Nasdaq, a market index relied on here in the United States.

The following approaches to data analysis will be as followed: time series analysis in a ten-year span and the amount of growth or decline each of the five stocks experienced, and ANOVA and linear regression analysis will also be used. In addition to the two analyses forms, statistical analysis and descriptive statistics will also be included in this dataset. Visualizations will also be provided wherever applicable, and there will be integration of this data as each of the five stock symbols have separate CSV files. These files come from a larger folder of files of other stocks, but these the five that were picked from the entire dataset from Kaggle. There will also be an analysis on how, when, or if any of these five companies saw their per-share price of stocks perform well enough such that they had enough money to split stocks, and encourage more of the public to invest in their company because of how well their financial performance was reported every quarter or every new year.

Each of the five stock symbols' data had the following information: day of trading, opening price, closing price, highest price reached, lowest price reached, volume, dividends, and stock splits. Any quantity of stock splits can be made possible by a company if they feel that by

making the share values a fraction of what they were before, that over time, all shareholders who owned more shares after a split made a profit off of what they originally invested (Gobler, 2022). Any one stock can reach a high value; however, any one stock can also experience a low where it drops below its opening price per share. For companies that had a successful three-month period and had excess profits, a company's executives or board of directors can choose to offer dividends to its shareholders. Dividends are usually of cash value that can be held onto simply because someone held shares in that company.

A ten-year time series analysis was chosen because each of the five listed companies have been traded on the market for at least or nearly ten years. Meta, which was known as Facebook Inc. until 2021, saw its first day of public trading on May 18, 2012, when CEO Mark Zuckerberg rang the opening bell for the Nasdaq, which is the stock exchange that Meta's stock symbol ($FB) has remained nearly ten years later to the day. Because this was the most recent of the five selected companies to have publicly traded stock, a ten-year analysis could only be possible because no information is available on Facebook's stock or its shareholders prior to May 2012. Since each of the five companies went public at different points of time, we will use an overall analysis of how technology stocks have been profitable since 2012, which marks ten years of the five listed stocks as allowed to be publicly traded.

The Python programming language will be used to do descriptive, predictive, and prescriptive statistics and analysis of the stock price data for these five companies. There are additional Python libraries and packages that will be used for data visualization, mining, prediction models, and any other information to better understand what data on stock prices per share are and how they have affected the modern technologies used in today's global economy.

A Jupyter interactive notebook which runs Python and Markdown languages was used in this analysis to run the regression and time series analysis models.

```
In [4]:    1 aapl.describe()
Out[4]:
```

|  | Open | High | Low | Close | Volume | Dividends | Stock Splits |
|---|---|---|---|---|---|---|---|
| count | 10420.000000 | 10420.000000 | 10420.000000 | 10420.000000 | 1.042000e+04 | 10420.000000 | 10420.000000 |
| mean | 13.513628 | 13.660789 | 13.368160 | 13.520843 | 3.319173e+08 | 0.000590 | 0.001631 |
| std | 30.328377 | 30.674950 | 29.992982 | 30.352131 | 3.392501e+08 | 0.009881 | 0.085952 |
| min | 0.038820 | 0.038820 | 0.038380 | 0.038380 | 0.000000e+00 | 0.000000 | 0.000000 |
| 25% | 0.234970 | 0.240060 | 0.229442 | 0.234800 | 1.244682e+08 | 0.000000 | 0.000000 |
| 50% | 0.386165 | 0.394490 | 0.380135 | 0.387735 | 2.196096e+08 | 0.000000 | 0.000000 |
| 75% | 12.238988 | 12.410095 | 12.134210 | 12.290980 | 4.123518e+08 | 0.000000 | 0.000000 |
| max | 182.397620 | 182.707230 | 178.892080 | 181.778400 | 7.421641e+09 | 0.220000 | 7.000000 |

**Figure 1.** Descriptive statistics of Apple Inc. in its history.
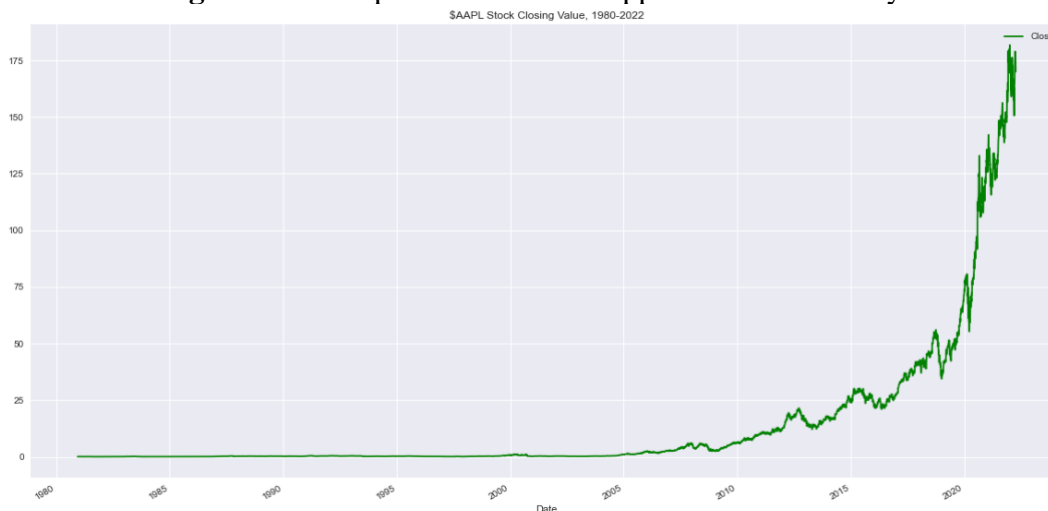


**Figure 2.** Apple Inc. ($AAPL) stock data based on closing bell value, Dec 1980–Apr 2022.

Apple Inc. was founded in 1976, with its current headquarters being in Cupertino, California. Its stock officially went public on December 12, 1980, where shares were sold for as little as $0.10 at the start of trading that day. Figure 2 shows Apple's stock throughout its 40-plus-years history, seeing an exponential rise in its price per share since the 2000s, when the company changed the landscape for technology. The company's strategy has revolved around

business fundamentals and supporting users' needs wherever possible, and keeping customers satisfied with their products to remain investing in the company's goals (Manessis, 2020). Portable devices such as the MacBook, iPod, iPhone, and iPad were manufactured and sold often to its customers, which has encouraged more shareholders to invest in their company because they enjoyed using Apple products. Eventually, newer models of said products, announcements of new products, and getting into the television and premium streaming services have only led its stock to increase over time as more consumers are willing to invest in the different outlets that Apple has been taking. Below shows the overall performance of each of the five publicly traded tech company stocks over the years. Note that Amazon and Google (now Alphabet) have seen the first and second highest per-share price, respectively, starting in the late 2010s and past 2020, with Amazon seeing the highest value of one share.
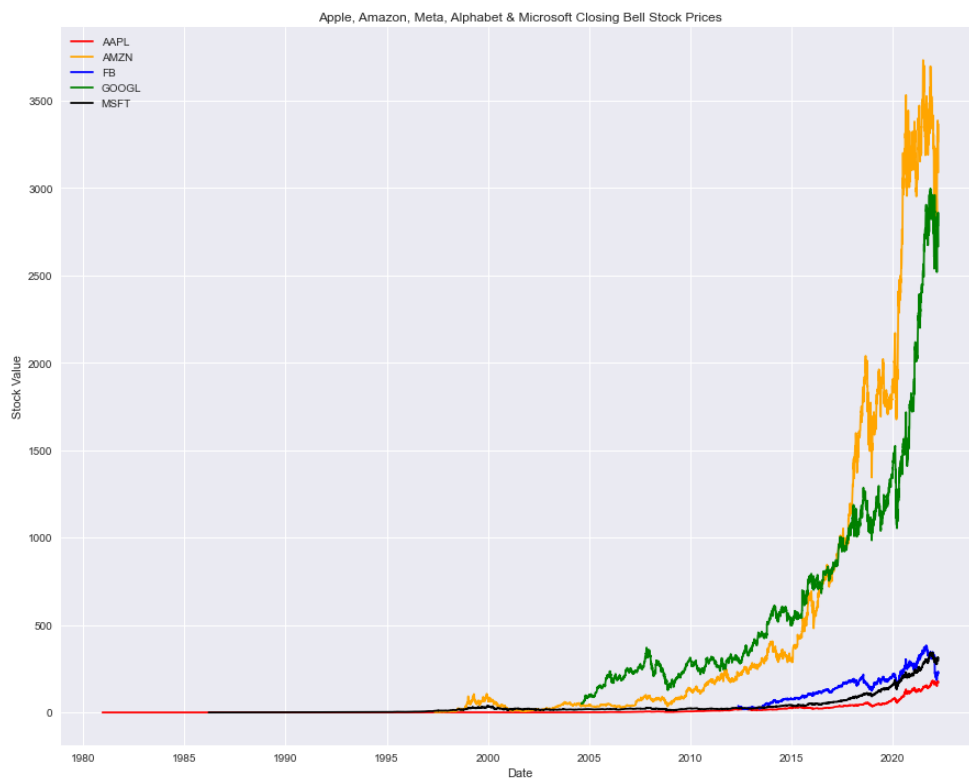


**Figure 3.** Apple, Amazon, Meta, Alphabet, Microsoft Closing Bell Stock Prices.

## Data Testing & Results: Time Series

Time series analysis was done on each of the five stocks' performance over the years which they were publicly traded. The stock value can change dramatically from time to time at any point in the short or long term and can be negatively affected due to an economic recession, a public health or housing crisis, or even tensions between competing companies and countries.
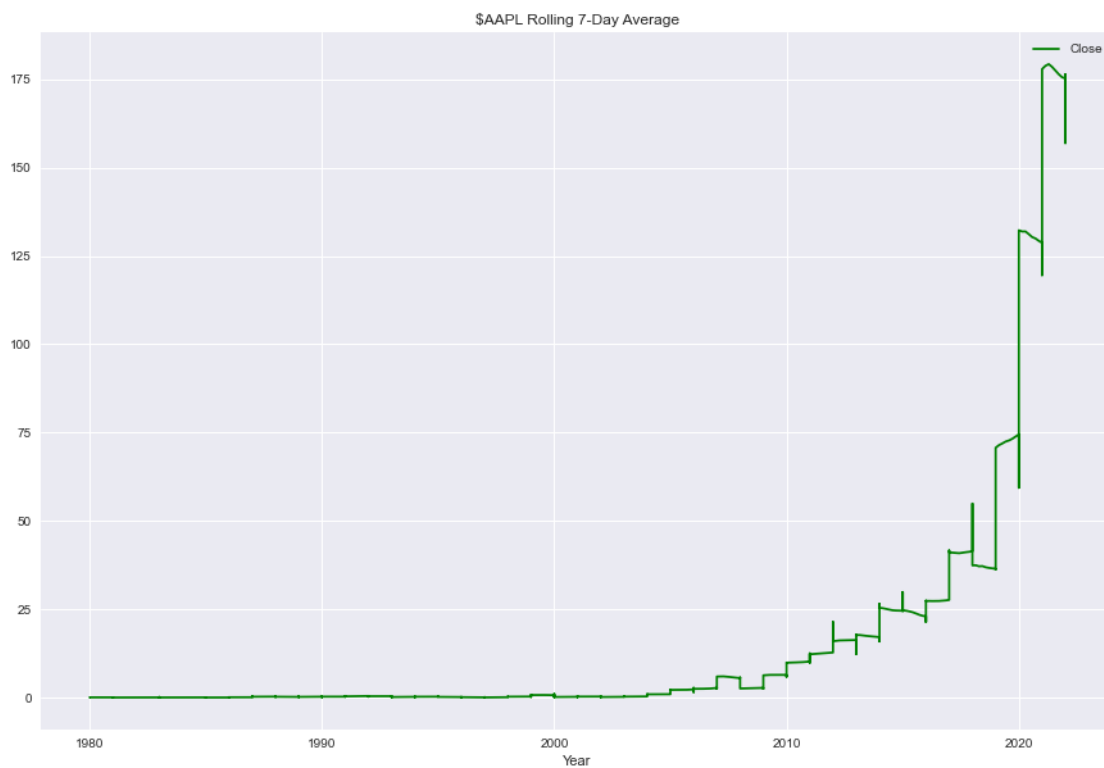


**Figure 4.** Apple stock performance on 7-day rolling average value of closing bell share price.

Figure 4 shows Apple's seven-day rolling average value of its share price. This was a rolling average calculated every seven trading days, which excludes weekends and weekdays where there are holidays. From this visualization, it can be seen that even during long-term periods of stock growth, there were periods where its share price suffered losses and ended lower

than when it started. Despite such occurrences, it has risen over short periods where its stock value would be at least more than double of what it was before. As a company that has done stock splits more than once after going public, it has encouraged more shareholders to invest in Apple stock because of their innovation, design, and trust they have with consumers around the world that they would continue to deliver with the strategies and products they have released.
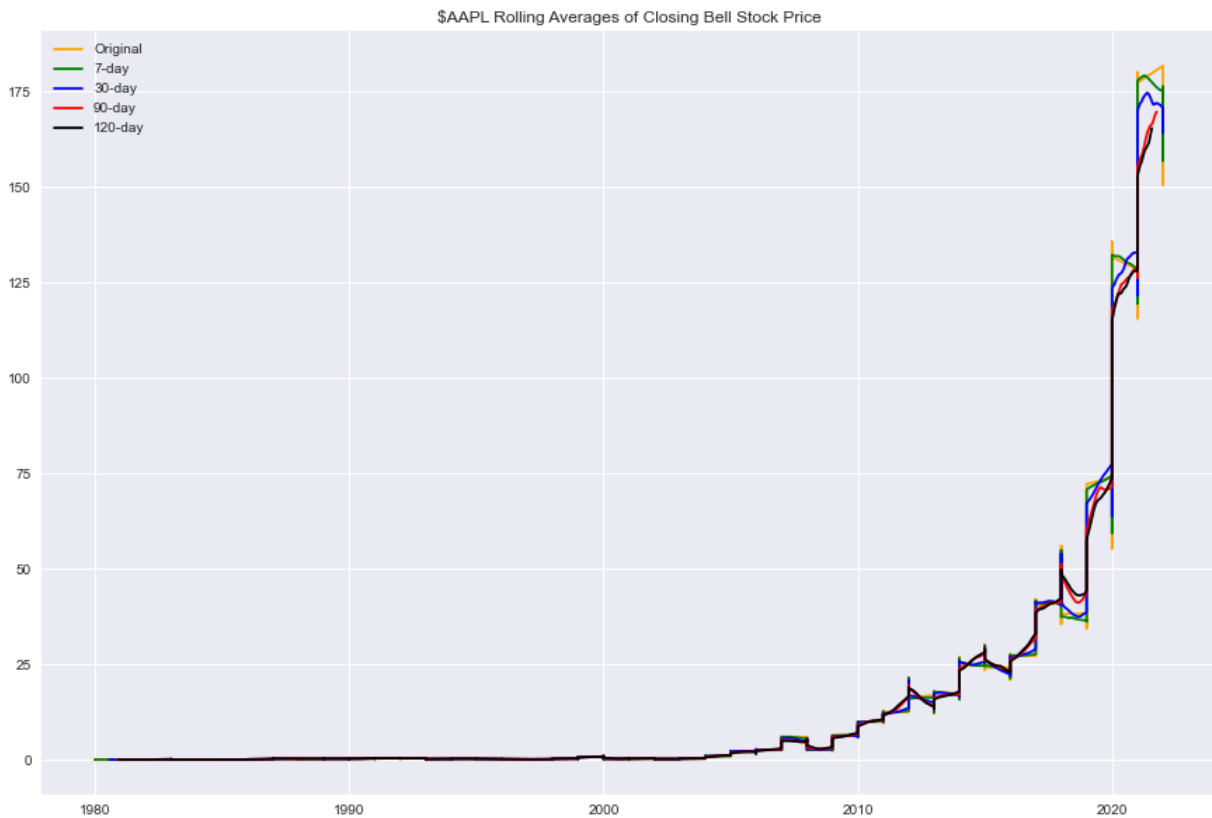


**Figure 5**. Overlapping of rolling average of Apple closing stock price against original day price.

Overall, regardless of the time-series analysis based on x-number of days, it is safe to say that Apple's stock has been fairly successful since the mid-2010s. Based on the rolling average of its stock value every 7, 30, 60, 90, and 120 trading days, it can most closely represent an exponential curve. In Figure 5, such features and characteristics can be seen on the graph where

the rate of the stock value would be high where the derivative of any "vertical" lines on the graph would be close to infinity if taking the derivative of any point on those trends. All of these x-day trends were compared to the original stock share price's fluctuation on a day-to-day basis. Any losses that were experienced appear to be temporary but more rewarding long-term, as evident with years from 2017 to 2019, but also the spike in value from 2020 to 2021.

Apple stock's values decreased early during the COVID-19 pandemic due to in-store retail sales being minimized or cut off due to restrictions and lockdowns. Because of this, their strategy turned to demand for virtual technical support and online purchases of new devices, which caused Apple's per-share value to increase to the extent where the company split stocks four-to-one in August 2020 (Manessis, 2020). Here, if Apple's share price was worth $500, after the 4-to-1 split, one share of Apple would only be worth $125 where 1 share was broken into 4 for any investor. The fifth stock split in the company's history, it became an opportunity for minor investors to buy Apple stock at a more affordable price. It would also even allow some users have full or partial shares for day trading and allow more unique consumers to invest in a higher volume of shares.

Of this sample of the big five tech company stocks, Apple has been publicly traded longer than Microsoft, Google, Facebook, and Amazon. Therefore, there is more data on Apple's opening and closing stock data, and exactly where it started in December 1980, well before the rise of technology startups and the subsequent development and innovation that has since become Silicon Valley. The next company's analysis focuses not on Silicon Valley in California, but how technology through retail found success in the Pacific Northwest.
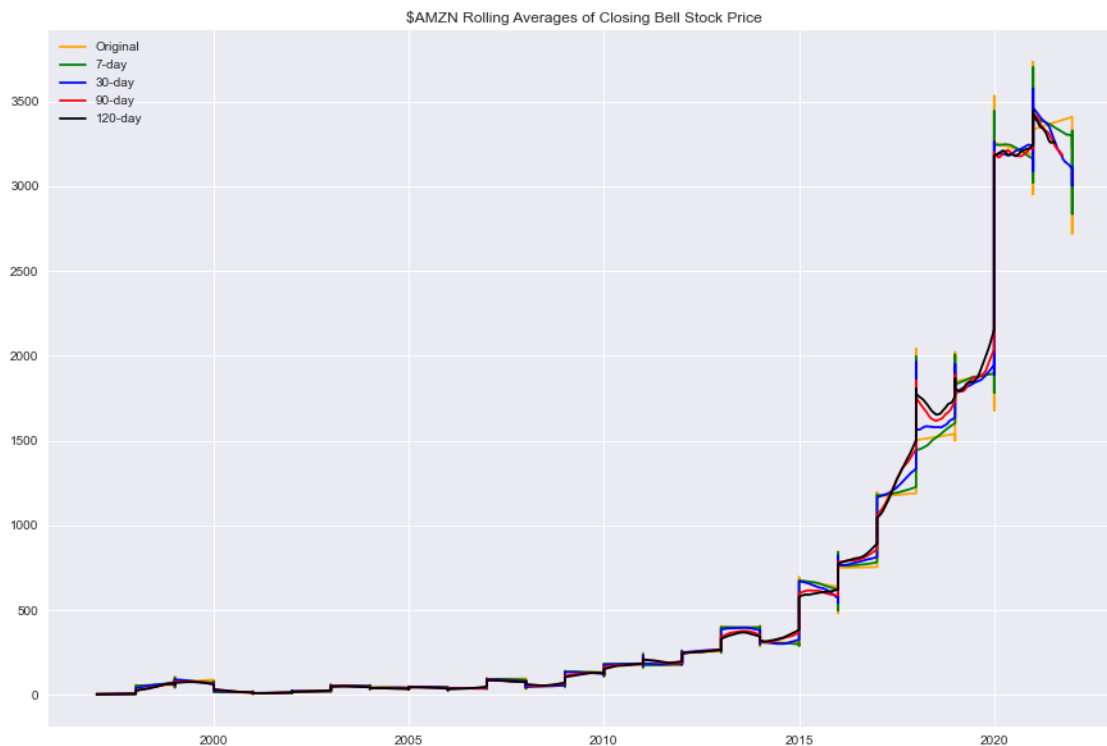
**Figure 6.** Amazon closing bell stock prices and respective rolling averages.

Amazon is a company that survived the dotcom bubble of 1999–2000, only going public in 1997. It jumped to even more success as it rose in revenue since the COVID-19 pandemic began in March 2020, and its stock value also rose exponentially because customers have wanted their products delivered to them based on the prompt services and delivery times it has promised over the years. As the pandemic continued, more success from the Amazon Prime subscriptions resulted in its share price rising past $3,500 at one point, which can be seen in Figure 6. Because of its financial successes during the pandemic, Amazon took advantage of closures of most in-store retail and essentials, having made $386 billion in 2020 by making items that are usually purchased in a store available online for the same or cheaper price (Kohan, 2021). By the end of 2020, shareholders saw a 73 percent return on investment (Rothman, 2020). All of this has propelled Amazon's sales past other retail competitors like Walmart and prompted then-CEO

Jeff Bezos to be the wealthiest person in the world, where at one point his net worth was reportedly at least $400 billion (Sandler, 2021). Their strategy of prioritizing customers and maximizing their supply chain potential resulted in more customers relying on Amazon to get what they need online. Amazon has been successful for supporting their customers' needs and encouraging younger audiences to subscribe to Amazon Prime for the best offers on products or its recommendations for shows to watch on Prime Video.
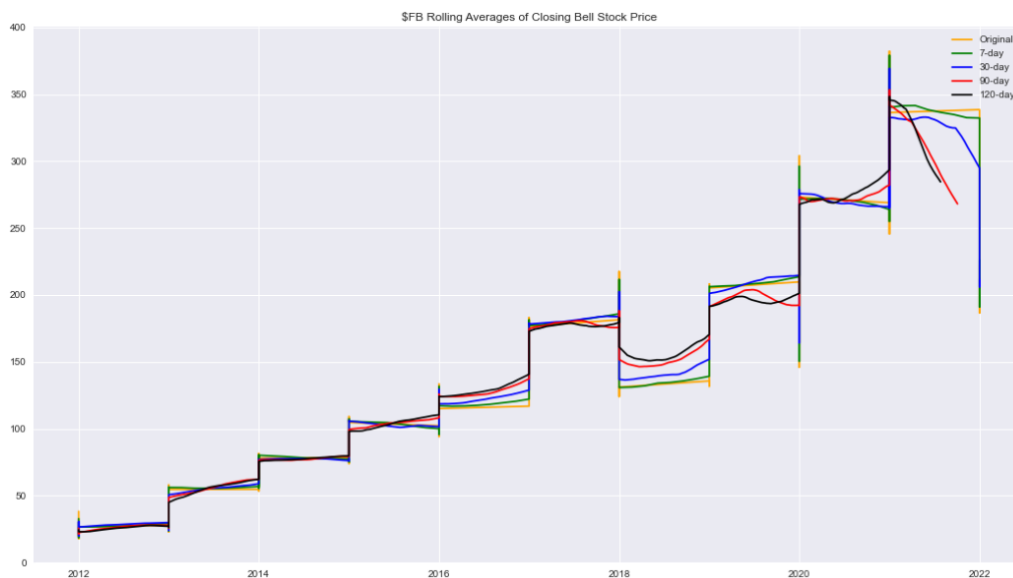


**Figure 7.** Facebook/Meta rolling average of closing bell stock performance.

Furthermore, as previously mentioned in this analysis, Facebook was the most recent of this group of the big five tech companies to have publicly traded stock available for consumers to invest in. Figure 7 has shown that as early as 2017, the company saw drops in its stock share values and thus lost money. Facebook, now known as Meta Inc., not only saw a drop in daily mean users on the Facebook App in the fourth quarter of 2021, but also experienced tense competition with TikTok and took a risk on the future of the Internet via the metaverse which lost more than $3 billion on its Oculus virtual reality headsets (Milmo, 2021). These

disadvantages to Meta as part of a number of security issues, ad revenue, and costly business

decisions against the company, caused its share price to depreciate in such a quick period. Thus,

the rolling average of stock price starting in 2020 saw big drops in its value despite it rebounding
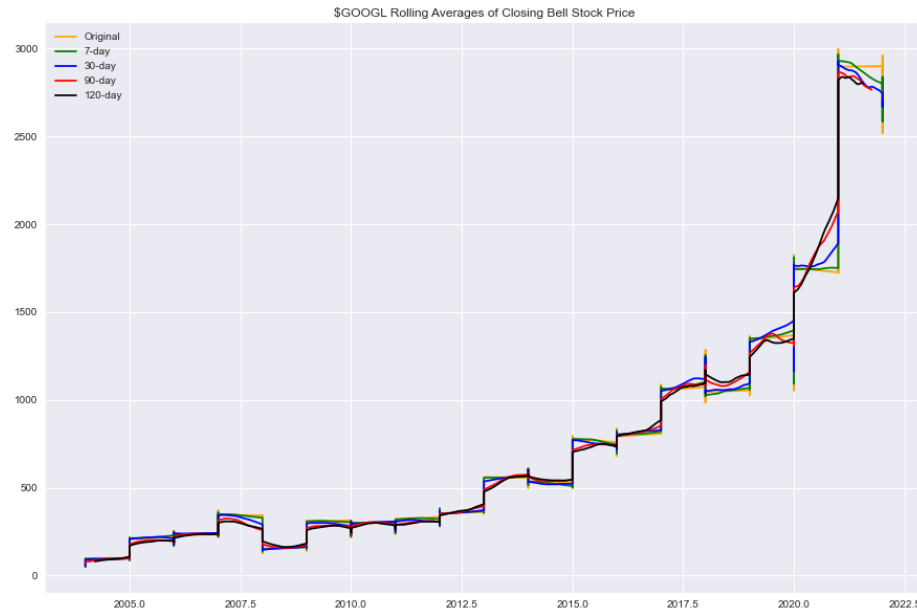
month after month of trading.



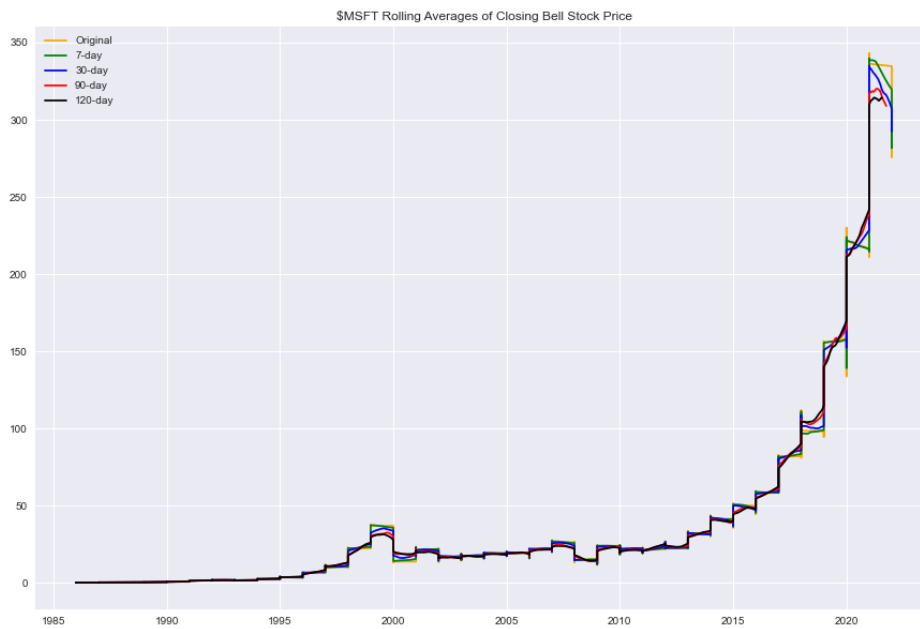**Figure 8.** Google/Alphabet rolling average of closing bell stock performance.



**Figure 9.** Microsoft rolling average of closing bell stock performance.

Google began publicly trading stock on April 29, 2004. (Wilhelm, 2017). Figure 8 shows the rolling day averages of Google's stock compared to the daily changes of the stock's performance. Microsoft is another company that has experienced exponential long-term success with its stock share price since going public on March 13, 1986 (Katje, 2021). Figure 9 shows its stock price's performance with rolling averages since its start date of trading. Based on the rolling averages, both of these companies' stock values saw exponential growth despite having experienced the rise in different decades, especially with Microsoft's shares having been on the market nearly two decades before Google first began trading.

For each of these five stocks, it appears that despite stock values occasionally dropping, on average, its gains will be higher. The peak value, as a result, will also be higher after each drop in price per share over time. Any decisions that each of the businesses make will be consequential or rewarding but experience long-term results that ultimately are positive if users and investors are interested in or willing to commit some or all of their time to their interests.

# Data Testing & Results: ANOVA

A second analysis was done to better understand the relationships between these five tech company stocks. An analysis of variance (ANOVA) was needed to determine how much change, positive or negative, has any one of the five tech company stocks experienced over the time that it has been publicly traded. Correlation was also used to determine any relationship between the stock values and other subsequent characteristics. For this analysis, we will be looking at Apple for correlation purposes provided that in previous analyses, there existed exponentially positive trends in the per-share price performance of Apple, Amazon, Meta, Alphabet, and Google stocks.

```
1  # Correlation on Apple data
2  aapl.corr()
```

|  | Open | High | Low | Close | Volume | Dividends | Stock Splits | Year | Month | Day |
|---|---|---|---|---|---|---|---|---|---|---|
| Open | 1.000000 | 0.999946 | 0.999930 | 0.999864 | -0.194234 | 0.094513 | 0.015690 | 0.628176 | 0.002895 | -0.002998 |
| High | 0.999946 | 1.000000 | 0.999914 | 0.999933 | -0.193684 | 0.093867 | 0.015990 | 0.627841 | 0.002721 | -0.002938 |
| Low | 0.999930 | 0.999914 | 1.000000 | 0.999931 | -0.195107 | 0.094466 | 0.015665 | 0.628468 | 0.003077 | -0.002864 |
| Close | 0.999864 | 0.999933 | 0.999931 | 1.000000 | -0.194404 | 0.094167 | 0.015950 | 0.628097 | 0.002904 | -0.002932 |
| Volume | -0.194234 | -0.193684 | -0.195107 | -0.194404 | 1.000000 | -0.030388 | 0.001121 | 0.174383 | -0.053327 | -0.011085 |
| Dividends | 0.094513 | 0.093867 | 0.094466 | 0.094167 | -0.030388 | 1.000000 | -0.001133 | 0.081792 | 0.000126 | -0.058040 |
| Stock Splits | 0.015690 | 0.015990 | 0.015665 | 0.015950 | 0.001121 | -0.001133 | 1.000000 | 0.013423 | -0.002850 | 0.006315 |
| Year | 0.628176 | 0.627841 | 0.628468 | 0.628097 | 0.174383 | 0.081792 | 0.013423 | 1.000000 | -0.015708 | -0.003211 |
| Month | 0.002895 | 0.002721 | 0.003077 | 0.002904 | -0.053327 | 0.000126 | -0.002850 | -0.015708 | 1.000000 | 0.001188 |
| Day | -0.002998 | -0.002938 | -0.002864 | -0.002932 | -0.011085 | -0.058040 | 0.006315 | -0.003211 | 0.001188 | 1.000000 |

```
1  # ANOVA model - Compare closing share price to stock trade volume
2
3  # AAPL
4  formula = "Close ~ Volume"
5  model1 = ols(formula, aapl).fit()
6  aov_aapl = sm.stats.anova_lm(model1, typ=2)
7  print(aov_aapl)
```

```
              sum_sq        df          F        PR(>F)
Volume   3.627544e+05       1.0  409.189014  2.815764e-89
Residual 9.235769e+06   10418.0        NaN          NaN
```

**Figures 10 & 11.** Correlation and analysis of variance of Apple.

Based on Figure 10, there existed positive correlation in Apple's stock's characteristics. The only negative correlations experienced were between its low point reached and the volume

traded, where some but not all shareholders likely sold their stocks in Apple whenever their per-share value dropped below opening price at some point in a day. In terms of the analysis of variance between stock trade volume and its closing day price, the change in terms of volume is inconsistent given there are periods of volatility, total gain, or total loss over a certain timespan, which was determined by the F ratio value. There was high variation in Apple's stock because of the exponential growth it experienced over its forty-two years its stock was available to trade.

The similarities found in this analysis of Apple can be applied for the other four companies, Amazon, Facebook, Google, and Microsoft. In the other four companies, there do exist periods of high variation and change in terms of volume of stock being traded as well as the closing price. They each will have reached different high or low share prices, thus also proving the variability of the price based off of a number of factors within the companies and against each other in competition.

## Conclusion

The stock market can be unpredictable at any time. Technology is part of our daily life, where we rely on social media or search engines to learn new things, or be informed about certain issues or headlines. It has influenced many to even make life decisions for some who want to live off of creating content for YouTube or for promoting a business on one's Instagram or Facebook page. Those that are committed to making income will have to make decisions on what, where, and when they should invest in stock that will make them the most money.

There are and will continue to be efforts made by tech companies to bring new ideas to light and reimagine what we know the Internet as it was, as it is now, and as it might be in the very near future. Innovation has only prompted further growth and discourse on new ideas, risks, and decisions that companies are to make on supporting users around the world and improving their lives in different ways. Using stocks to analyze a company's performance and understand a company's next moves in standing out against its competitors is one way of making this possible.

There is high risk for shareholders investing in stock, but further opening up the opportunity to invest in a company or in companies they like allows wealth to be not only shared but given back to those who share the same mission or values. It also provides some income despite the moderate to high risk levels that come with businesses making decisions and, in the occasions, when they face competition against each other. There is a better analysis and understanding of trends, but usually, stocks are often seen as investments that have flexibility either in the short term or the long term to show how many people enjoy what companies have done for society.

# References

Footballjoe789 (2022). US stock dataset, Version 1 [Data set]. Retrieved March 30, 2022, from

   https://www.kaggle.com/datasets/footballjoe789/us-stock-dataset

Fox, J. (2011, January 11). *Why Facebook (and others) don't want to go public*. Harvard

   Business Review. Retrieved April 4, 2022, from https://hbr.org/2011/01/why-facebook-

   doesnt-want-to-go-public

Gobler, E. (2022, March 31). *Here is what a stock split means for the average investor*. Time.

   Retrieved April 4, 2022, from https://time.com/nextadvisor/investing/what-is-stock-split/

Katje, C. (2021, June 30). *If you invested $1,000 in Microsoft at its IPO, here's how much you'd*

   *have now*. Benzinga. Retrieved April 1, 2022, from

   https://www.benzinga.com/general/education/21/06/21756652/if-you-invested-1-000-in-

   microsoft-at-its-ipo-heres-how-much-youd-have-now

Kohan, S. E. (2021, December 10). *Amazon's net profit soars 84% with sales hitting $386*

   *billion*. Forbes. Retrieved March 20, 2022, from

   https://www.forbes.com/sites/shelleykohan/2021/02/02/amazons-net-profit-soars-84-

   with-sales-hitting-386-billion/

Manessis, G. (2020, August 31). *History of Apple stock splits says investors shouldn't rush in to*

   *buy lower-priced shares*. CNBC. Retrieved March 25, 2022, from

   https://www.cnbc.com/2020/08/31/history-of-apple-stock-splits-says-dont-rush-in-to-

   buy-cheaper-

   shares.html#:~:text=The%20tech%20giant%20recently%20became,pre%2Dsplit%20shar

   es%20reaching%20%24500.

Milmo, D. (2022, February 3). *Why the facebook owner's shares are in Freefall*. The Guardian.

Retrieved March 31, 2022, from

https://www.theguardian.com/technology/2022/feb/03/why-facebook-shares-are-in-

freefall-meta-zuckerberg

Onyshchak, O. (2020). Stock market dataset, Version 1 [Data set]. Retrieved March 30, 2022,

from https://www.kaggle.com/datasets/jacksoncrow/stock-market-dataset

Rothman, L. (2020, December 23). *How has Amazon stock done since the beginning of 2020?*

The Motley Fool. Retrieved March 20, 2022, from

https://www.fool.com/investing/2020/12/23/how-has-amazon-stock-done-since-

beginning-2020/

Sandler, R. (2021, July 4). *Here's how rich Jeff Bezos got as Amazon's CEO*. Forbes. Retrieved

March 31, 2022, from https://www.forbes.com/sites/rachelsandler/2021/07/04/heres-how-

rich-jeff-bezos-got-as-amazons-

ceo/#:~:text=Bezos%20became%20the%20wealthiest%20person,to%20Amazon's%20so

aring%20stock%20price.

Wilhelm, A. (2017, September 14). *A look back in IPO: Google, the profit machine*.

TechCrunch. Retrieved March 30, 2022, from https://techcrunch.com/2017/07/31/a-look-

back-in-ipo-google-the-profit-machine/

# Appendix: Python Code

Moving Averages for the Five Stocks

Break down each of the closing values of the five stocks into separate intervals by doing running averages of 7, 30, 90, and 120 trading days.

In [33]:
```python
# Rolling average every 7, 30, 90, 120 trading days days for Apple
aapl_wksample = aapl.rolling(7).mean()
aapl_wksample2 = aapl.rolling(30).mean()
aapl_wksample3 = aapl.rolling(90).mean()
aapl_wksample4 = aapl.rolling(120).mean()
aapl_wksample5 = aapl.rolling(1000).mean()
```

In [34]:
```python
# Rolling average every 7, 30, 90, 120 trading days days for Amazon
amzn_wksample = amzn.rolling(7).mean()
amzn_wksample2 = amzn.rolling(30).mean()
amzn_wksample3 = amzn.rolling(90).mean()
amzn_wksample4 = amzn.rolling(120).mean()
```

In [35]:
```python
# Rolling average every 7, 30, 90, 120 trading days days for Meta
fb_wksample = fb.rolling(7).mean()
fb_wksample2 = fb.rolling(30).mean()
fb_wksample3 = fb.rolling(90).mean()
fb_wksample4 = fb.rolling(120).mean()
```

In [36]:
```python
# Rolling average every 7, 30, 90, 120 trading days days for Google
googl_wksample = googl.rolling(7).mean()
googl_wksample2 = googl.rolling(30).mean()
googl_wksample3 = googl.rolling(90).mean()
googl_wksample4 = googl.rolling(120).mean()
```

In [37]:
```python
# Rolling average every 7, 30, 90, 120 trading days days for Microsoft
msft_wksample = msft.rolling(7).mean()
msft_wksample2 = msft.rolling(30).mean()
msft_wksample3 = msft.rolling(90).mean()
msft_wksample4 = msft.rolling(120).mean()
```

In [43]:
```python
# All Apple rolling averages against original
plt.figure(figsize=(15,10))
plt.plot(aapl["Year"], aapl["Close"], color="orange")
plt.plot(aapl_wksample["Year"], aapl_wksample["Close"], color="green")
plt.plot(aapl_wksample2["Year"], aapl_wksample2["Close"], color="blue")
plt.plot(aapl_wksample3["Year"], aapl_wksample3["Close"], color="red")
plt.plot(aapl_wksample4["Year"], aapl_wksample4["Close"], color="black")
plt.legend(["Original", "7-day", "30-day", "90-day", "120-day"])
plt.title("$AAPL Rolling Averages of Closing Bell Stock Price")
plt.show()
```
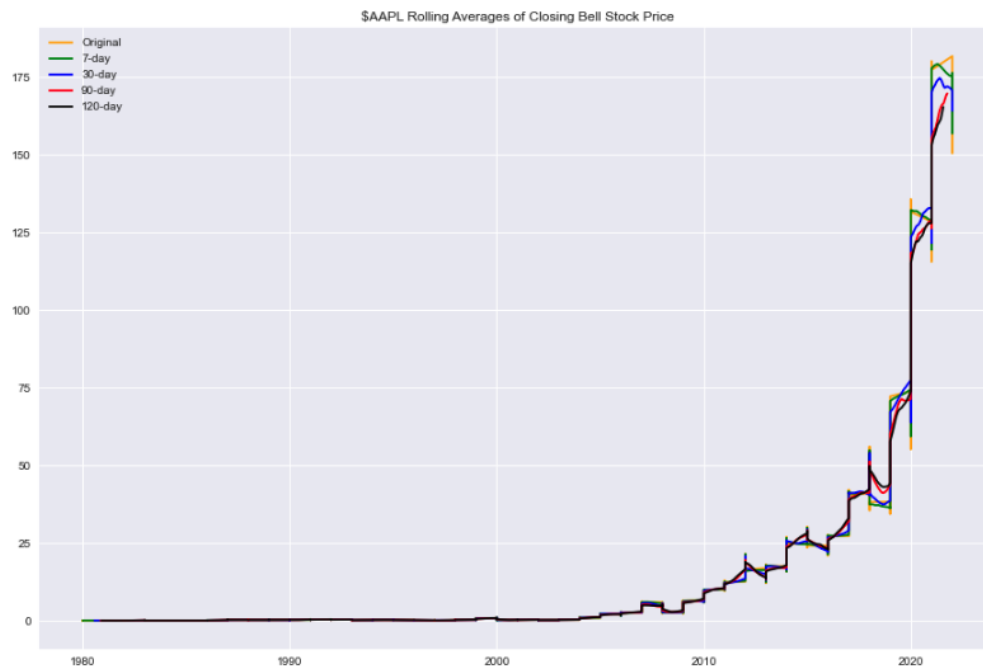
```python
1  # All Amazon rolling averages against original
2  plt.figure(figsize=(15,10))
3  plt.plot(amzn["Year"], amzn["Close"], color="orange")
4  plt.plot(amzn_wksample["Year"], amzn_wksample["Close"], color="green")
5  plt.plot(amzn_wksample2["Year"], amzn_wksample2["Close"], color="blue")
6  plt.plot(amzn_wksample3["Year"], amzn_wksample3["Close"], color="red")
7  plt.plot(amzn_wksample4["Year"], amzn_wksample4["Close"], color="black")
8  plt.legend(["Original", "7-day", "30-day", "90-day", "120-day"])
9  plt.title("$AMZN Rolling Averages of Closing Bell Stock Price")
10 plt.show()
```
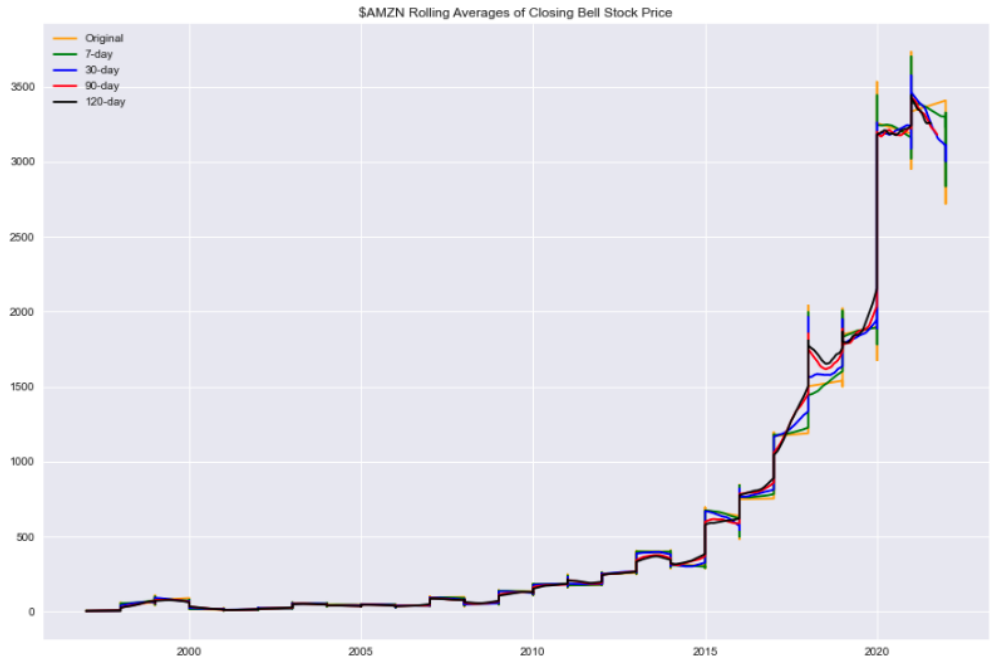


```python
1  # All Facebook/Meta rolling averages against original
2  plt.figure(figsize=(15,8))
3  plt.plot(fb["Year"], fb["Close"], color="orange")
4  plt.plot(fb_wksample["Year"], fb_wksample["Close"], color="green")
5  plt.plot(fb_wksample2["Year"], fb_wksample2["Close"], color="blue")
6  plt.plot(fb_wksample3["Year"], fb_wksample3["Close"], color="red")
7  plt.plot(fb_wksample4["Year"], fb_wksample4["Close"], color="black")
8  plt.legend(["Original", "7-day", "30-day", "90-day", "120-day"])
9  plt.title("$FB Rolling Averages of Closing Bell Stock Price")
10 plt.show()
```
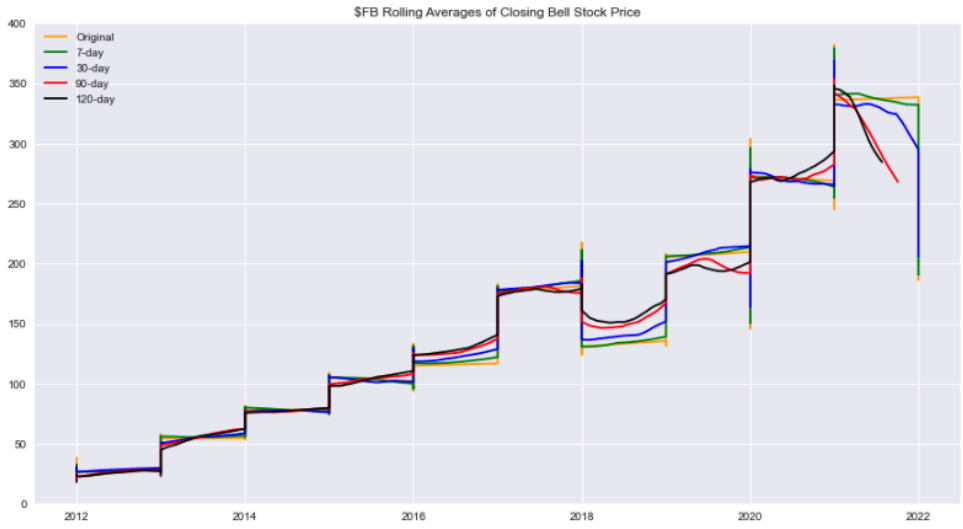
```
1   # All Google/Alphabet rolling averages against original
2   plt.figure(figsize=(15,10))
3   plt.plot(googl["Year"], googl["Close"], color="orange")
4   plt.plot(googl_wksample["Year"], googl_wksample["Close"], color="green")
5   plt.plot(googl_wksample2["Year"], googl_wksample2["Close"], color="blue")
6   plt.plot(googl_wksample3["Year"], googl_wksample3["Close"], color="red")
7   plt.plot(googl_wksample4["Year"], googl_wksample4["Close"], color="black")
8   plt.legend(["Original", "7-day", "30-day", "90-day", "120-day"])
9   plt.title("$GOOGL Rolling Averages of Closing Bell Stock Price")
10  plt.show()
```



$GOOGL Rolling Averages of Closing Bell Stock Price
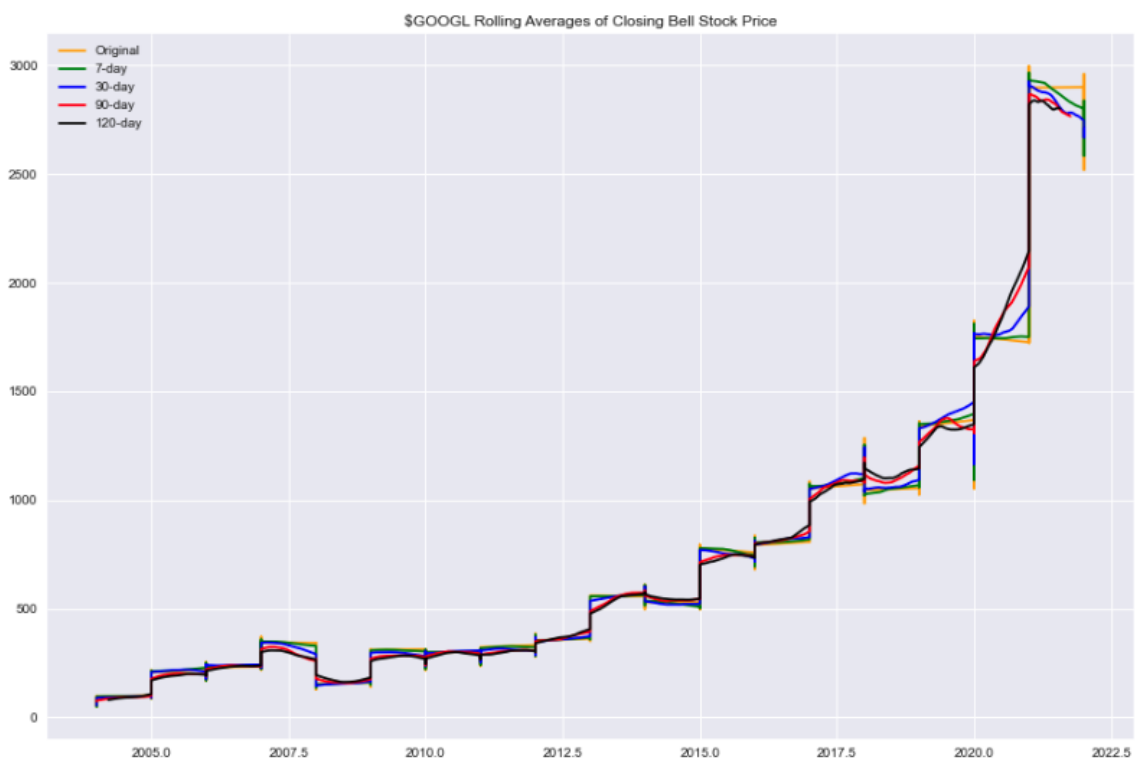
```python
# All Microsoft rolling averages
plt.figure(figsize=(15,10))
plt.plot(msft["Year"], msft["Close"], color="orange")
plt.plot(msft_wksample["Year"], msft_wksample["Close"], color="green")
plt.plot(msft_wksample2["Year"], msft_wksample2["Close"], color="blue")
plt.plot(msft_wksample3["Year"], msft_wksample3["Close"], color="red")
plt.plot(msft_wksample4["Year"], msft_wksample4["Close"], color="black")
plt.legend(["Original", "7-day", "30-day", "90-day", "120-day"])
plt.title("$MSFT Rolling Averages of Closing Bell Stock Price")
plt.show()
```



$MSFT Rolling Averages of Closing Bell Stock Price