D214 Data Analytics Graduate Capstone

Task 3: Executive Summary

Jonathon “Jon” Fryman

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Student ID 00974544

Program Mentor: Lea Yoakem

C: 419-206-6989

Table of Contents

[Part I: Overview 2](#_Toc130220891)

[Part II: Problem Statement and Hypothesis 2](#_Toc130220892)

[Part III: Data Analysis Process 3](#_Toc130220893)

[Part IV: Findings 4](#_Toc130220894)

[Part V: Limitations 4](#_Toc130220895)

[Part VI: Proposed Actions 4](#_Toc130220896)

[Part VII: Expected Benefits 5](#_Toc130220897)

[Part VIII: Sources 5](#_Toc130220898)

# Part I: Overview

According to the New York Stock Exchanges available data, an average of $18.9 billion is traded on the stock market each day. With such a tremendous amount of money being invested, perspective investors stand to lose a substantial amount of funding if poor investments are made due to lack of research into the available data for a given stock.

# Part II: Problem Statement and Hypothesis

The stock market can often be riddled with uncertainty and filled with great fluctuation. To facilitate educated investing, it is essential to ascertain trends and seasonality that may exist within a given stocks performance prior to making a large investment.

Utilizing available historical stock information for the companies being analyzed, the objective is to develop a model capable of forecasting future stock performance with an accuracy that can provide a greater level of confidence for investors prior to committing large amounts of funding.

**Research Question**: To what extent can a company’s future daily per-share closing stock dollar value be accurately predicted?

**Hypothesis**: The hypothesis of the current data analysis is that the Mean Absolute Percentage Error(MAPE) score associated with each predicted stock closing price will be below 20%. A MAPE score below 20% indicates the difference between the dollar value for the predicted and actual stock closing price is smaller than 20% which is a generally considered good MAPE score.

**Null hypothesis**: The null hypothesis is that the MAPE score is 20% or greater. This would indicate less than 80% similarity on the predicted dollar value when compared to the actual stock closing price.  
  
**Alternate Hypothesis**: The alternate hypothesis is the predictions associated MAPE scores are less than 20%. A MAPE score in this range would indicate a greater than 80% similarity on the predicted dollar value in comparison to the actual stock closing price.

# Part III: Data Analysis Process

**Data Collection**: The data utilized was collected from <https://www.kaggle.com/datasets/evangower/big-tech-stock-prices>. This dataset contains historical market performance data for 14 American tech companies dating from January 2010 through December 2022. The data contained information related to date, opening price, closing price, daily low price, daily high price, adjusted closing price, and volume. The data set was downloaded as 14 unique .csv files with each file pertaining to a specific company’s data. A dataset consisting of the full range of dates beginning in January 2010 contained 3,271 historical trading days’ worth of data.

**Data Preparation**: Jupyter Notebooks was the primary tool used for this project in partnership with Python 3.8. Prior to the .csv files being imported from the downloaded dataset, importing the necessary Python libraries was required. For this analysis project, the pandas, matplotlib, seaborn, sklearn, statsmodel, and pmdarima packages were all utilized.

The 14 .csv files were then imported using pandas .read\_csv() function. A review was performed to ensure there were no missing or null values contained within the original 14 datasets. It was determined the files associated with Meta and Tesla did not contain a consistent number of historical datapoints in comparison to the remaining 12 files. As a result, these two companies had their data excluded from the analysis.

The remaining 12 files were used to populate a newly created empty DataFrame that used the trading date as an index formatted into datetime format. This index was set to begin on January 4, 2010, to be consistent with the earliest date found within the original data. The new DataFrame had a column created for each of the 12 companie, which were labeled using the company’s stock trading abbreviation. Each of these columns were then populated with the closing price associated with the specific trading date found in the row’s index for each of the 12 companies.

Additional Exploratory Data Analysis was performed to gain a better understanding of what was contained within the data. This included:

* Generating histograms for each company’s historical stock prices
* Generating a line chart for each company depicting their stock price over the entirety historical period.
* Performing an Augmented Dickey-Fuller test for each company’s data to determine if seasonality existed. In this case, no seasonality was found for any of the datasets.
* Additionally, the seasonal\_decompose() function was also used to review for seasonality.

A train/test split was performed to facilitate training the prediction model on a subset of data that was to be kept separate from the data to be used for validating the accuracy of the model.

Finally, the auto\_arima function was used to determine the optimal p,q, and d values to be used for each company’s data prior to fitting the training data to the respective model and generating predictions.

# Part IV: Findings

**Time Series Analysis**: It was determined that the closing price for all companies included for analysis could be forecast with an accuracy greater than 80% when compared to the actual price contained within the test validation data set. For many of the companies, the prediction accuracy was well above 90% when compared to the validation test data.

When the predictions were validated against the actual historical closing price associated with the predicted days:

* 99.3% of the 432 predictions had an accuracy >= 80% of the actual historical close price.
* 77% had >= 90% accuracy of the actual historical close price.
* 47% had >= 95% accuracy of the actual historical close price.
* The three predictions with < 80% accuracy had 79.2-79.9% accuracy in comparison to the actual historical close price.
* All three with accuracy below 80% were associated with Nvidia within a four-day span.

Additionally, the MAPE score associated with each predicted day for all 12 companies was below the 20% threshold required to accept the null hypothesis.

# Part V: Limitations

## The limitations of the performed analysis were that the predicted closing prices were consistently below the stocks actual closing price for a given day contained in the validation dataset. After careful consideration, it was determined to be beneficial to error on the side of caution and allow the prediction to be below an actual price. This was determined when comparing to the alternate scenario if predictions regularly exceeded the daily closing price which could cause a company to fall short of financial expectations.

## Overall, the model would benefit from additional testing in the future to determine if performance can be improved for the 23% of predictions that did not reach the 90% accuracy threshold.

# Part VI: Proposed Actions

**Recommendation**: Based upon the completed analysis, the recommended course of action is to that utilizing the developed model can assist with investment decisions if a company is seeking insight into an expected company's future market performance.

However, as stated in the previous section, it would be prudent to continue researching if improvement of the model is possible. Due to the current condition of predicting below the actual closing price included within the historical data, the accuracy of the model could falter if a company’s market value significantly changes for a given period.

In this scenario, the prediction model could lag behind in reflecting accurate predictions by failing to consider the drastically changed market value. This could cause an investor to be provided less than anticipated accuracy prior to committing large amounts of funding to a specific stock.

**Approach for future research**: Regarding future data study, there are two key points that would be essential to maintaining the accuracy of the current prediction model and improving it for additional use.

As stated previously, It would be prudent to facilitate regular updates to the model’s available historical data. This would allow predictions to continue into the future based upon historical data that is not yet currently available at the time of this analysis.

A second focus for future research would be to determine the need for generating predictions of other stocks. Based upon how the current model has been designed, it would not be overly complicated to implement additional companies to have predictions generated. Implementing this change would require that additional companies to be added are clearly defined and have publicly available historical data for collection. Implementing this change would facilitate predictions being generated for any company trading on the stock market with publicly available historical data.

# Part VII: Expected Benefits

Utilizing the developed prediction models, an investor can confidently review a company’s predicted closing price for a given trading day and have a greater level of confidence with how well that stock is expected to perform. This would facilitate an investor having the ability to roughly calculate an expected loss/gain for a given trading day and have an expectation how the funding they’ve invested will fluctuate.

Overall, the developed prediction models will provide the ability to make more educated investment decisions in terms of the best time to buy or sell a specific stock. This can directly impact an investor’s ability to minimize loss or maximize gains depending on the situation.

# Part VIII: Sources

1. Gower, E. (2023, January 30). Big Tech Stock prices. Kaggle. Retrieved February 23, 2023, fromhttps://www.kaggle.com/datasets/evangower/big-tech-stock-prices
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