Stock Price Data Analysis Report

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Tools Used:

Python, pandas, scikit-learn, matplotlib, statsmodels, seaborn

Project:

Data Analysis using Python

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1. INTRODUCTION

The Stock Price dataset contains daily trading information for multiple companies, including opening, high, low, and closing prices along with trade volume.

Dataset Columns

- Symbol
- Date
- Open
- High
- Low
- Close
- Volume

Project Overview

This project demonstrates essential data analysis and machine learning techniques in Python, focusing on three main analytical tasks:

- **Regression Analysis:** Performing a simple linear regression analysis to predict one variable based on another.
- **Time Series Analysis:** Analyze a time-series dataset (e.g., stock prices, temperature data) to detect trends and seasonality.
- **Clustering Analysis:** Implement K-Means clustering to group similar data points together based on feature similarities.

2. OBJECTIVES

Level 2 – Task 1: Regression Analysis

- Split the dataset into training and testing sets.
- Fit a linear regression model using scikit-learn.
- Interpret the coefficients and evaluate the model using metrics such as R-squared and mean squared error.

Level 2 – Task 2: Time Series Analysis

- Plot time-series data and identify patterns.
- Decompose the series into trend, seasonality, and residuals using statsmodels.
- Perform moving average smoothing and plot the results.

Level 2 – Task 3: Clustering Analysis (K-Means)

- Standardize the dataset (e.g., using StandardScaler).
- Apply K-Means clustering and determine the optimal number of clusters using the elbow method.
- Visualize clusters using 2D scatter plots.

3. TOOLS AND TECHNOLOGIES

Tool	Purpose
Python	Programming language used for all analysis
pandas	Data cleaning, manipulation, and preprocessing
scikit-learn	Machine learning modeling (Regression, K-Means)
statsmodels	Time series decomposition
matplotlib and seaborn	Visualization and plotting
VS Code	Development environment

4. TASK 1: DATA CLEANING AND REGRESSION ANALYSIS

Description

The raw dataset *2) Stock Prices Data Set.csv* was cleaned before performing regression analysis.

Data Cleaning Steps

1. Loaded dataset using pandas.
2. Checked for missing values - found in *open*, *high*, and *low* columns and they were removed missing rows.
3. Checked for duplicates – not found.
4. Converted *date* column to datetime format.
5. Saved cleaned dataset.

Dataset Summary after Cleaning

Detail	Value
Total Rows	497,461
Total Columns	7
Missing Values	None
Duplicate Rows	None

Model Building

- Predict *closing price* based on *opening price* using Linear Regression.

Steps:

1. Defined variables:

   X = df[['open']]

   y = df['close']

2. Split dataset (80% training, 20% testing).

3. Trained Linear Regression model using scikit-learn.
4. Evaluated model with R^2, MSE, and RMSE metrics.

Model Evaluation Metrics

Metric	Value
R-squared (R^2)	0.9997
Mean Squared Error (MSE)	2.7261
Root Mean Squared Error (RMSE)	1.6511
Intercept (b_0)	0.0267
Coefficient (b_1)	0.9999

Results and Interpretation

- **R^2 = 0.9997**

  Excellent model fit, explaining 99.97% of variance in closing prices.

- **Coefficient (b_1 = 0.9999)**

  Strong one-to-one relationship between open and close.

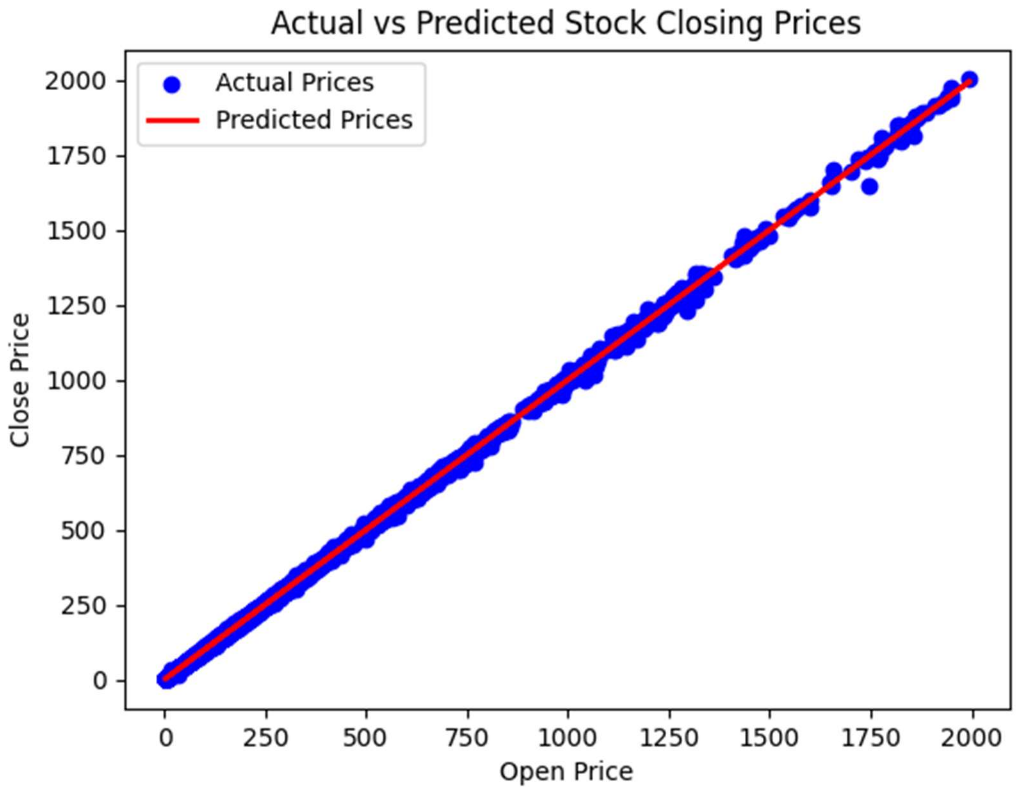
- **Intercept (0.0267)**

  Very small, indicating minimal difference between open and close prices.

- **Low MSE and RMSE**

  Model predicts accurately with minimal error.

Visualization



Above plot clearly shows predicted prices aligning closely with actual prices, proving the strong linear relationship.

5. TASK 2: TIME SERIES ANALYSIS

Objective

To analyze the *close* price trends over time, identify seasonal patterns, and visualize smoothed trends.

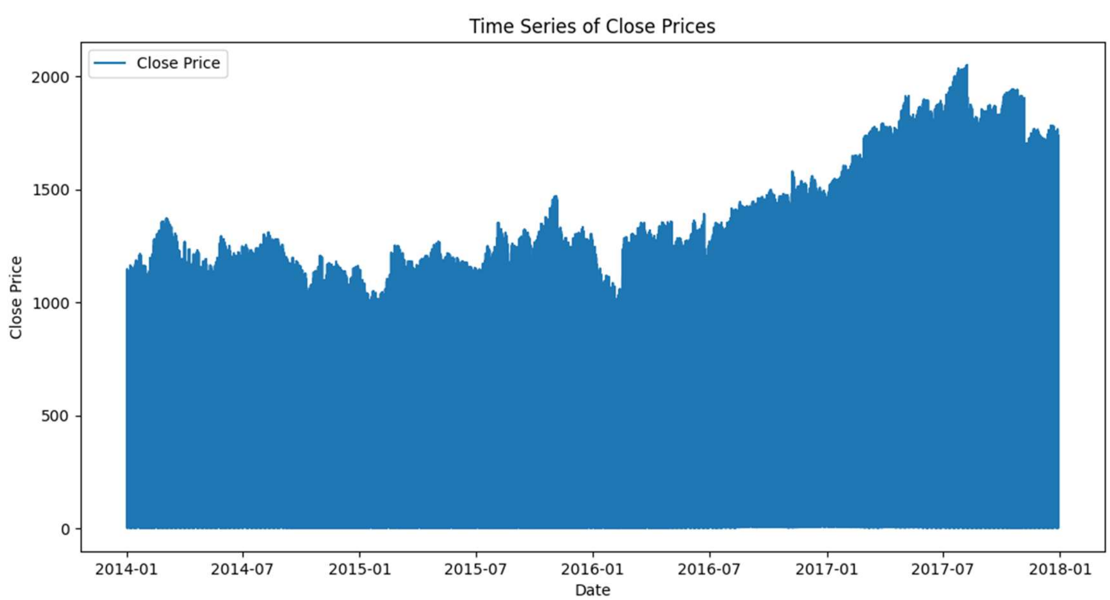
Methodology

1. **Data Preparation**

    - Loaded *Stock_Price_Cleaned.csv*.
    - Converted *date* column to datetime.
    - Sorted by date and set as index.

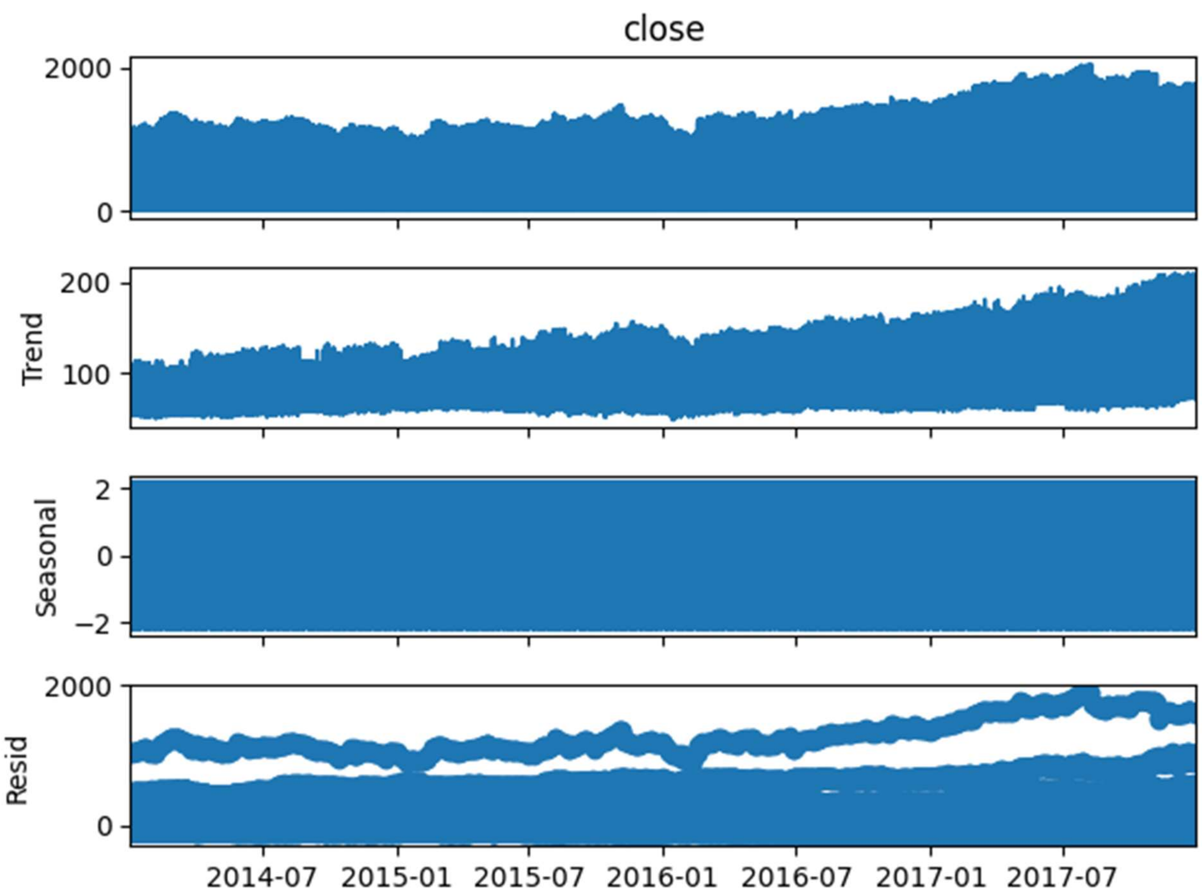
2. **Visualization**

    - Plotted *close* prices against date to show daily price fluctuations.



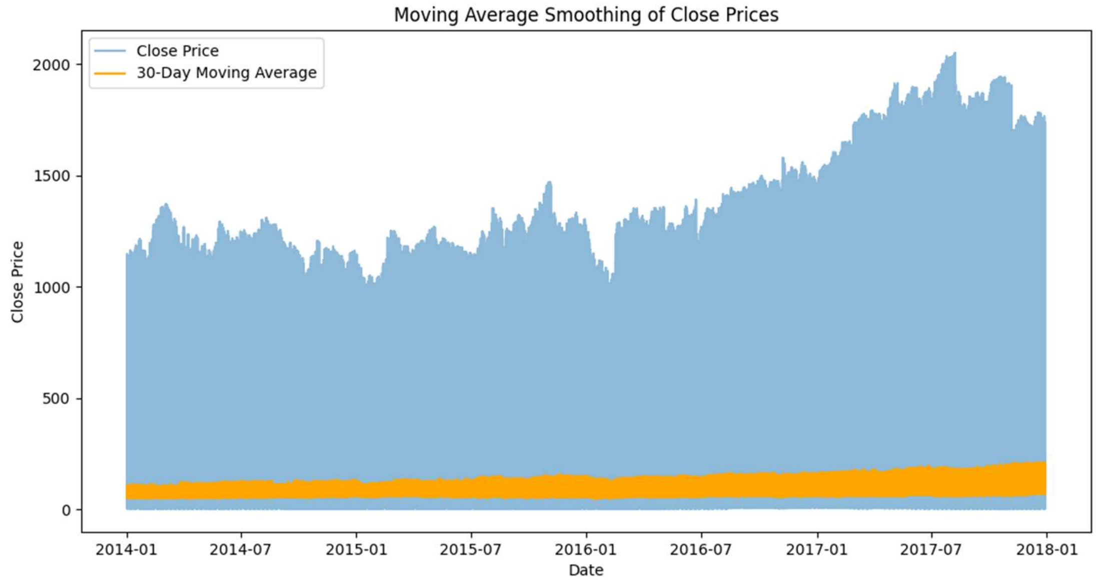
3. **Decomposition**

- Applied additive seasonal decomposition using seasonal_decompose().
- Extracted trend, seasonal, and residual components.



4. **Moving Average**

- Calculated 30-day moving average.
- Overlaid with actual prices to smooth short-term fluctuations.



5. **Saving Outputs**

Results and Interpretation

- Time series plot shows high frequency fluctuations over time.
- Decomposition highlights no seasonal component and reveals the underlying long-term movement.
- Moving average is barely visible at the bottom and suggesting it’s much flatter than the raw close price.

6. TASK 3: CLUSTERING ANALYSIS (K-MEANS)

Objective

To group stocks with similar price and volume characteristics into meaningful clusters.

Methodology

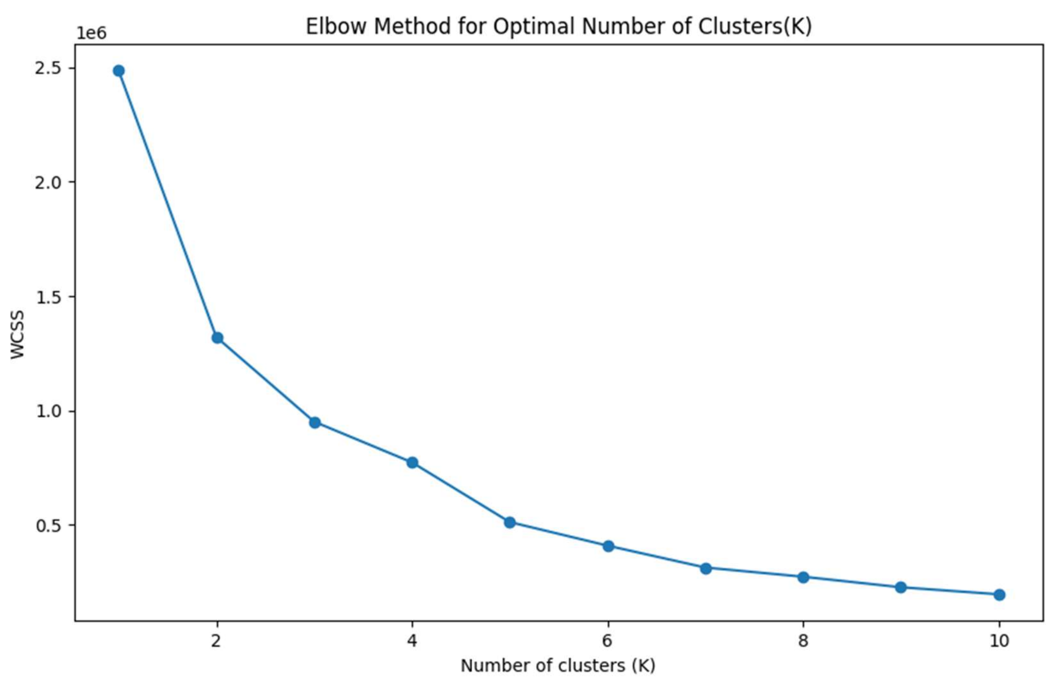
1. **Feature Selection**

    - Selected numerical features: *open, high, low, close, volume.*

2. **Feature Standardization**

    - Applied StandardScaler() to standardize the features.

3. **Finding Optimal K (Elbow Method)**
    - Computed Within-Cluster Sum of Squares (WCSS) for K = 1–10.



- Observed elbow point at **K = 3** (Optimal number of clusters)

- Saved plot.

4. **K-Means Clustering**

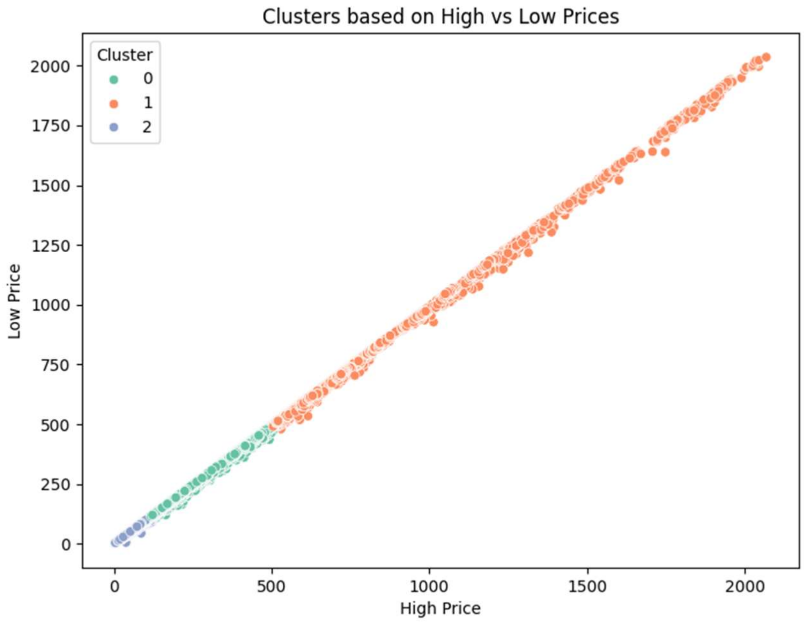
- Applied KMeans(n_clusters=3) and assigned cluster labels.
- Added a new column Cluster to the dataset.

5. **Cluster Visualization**

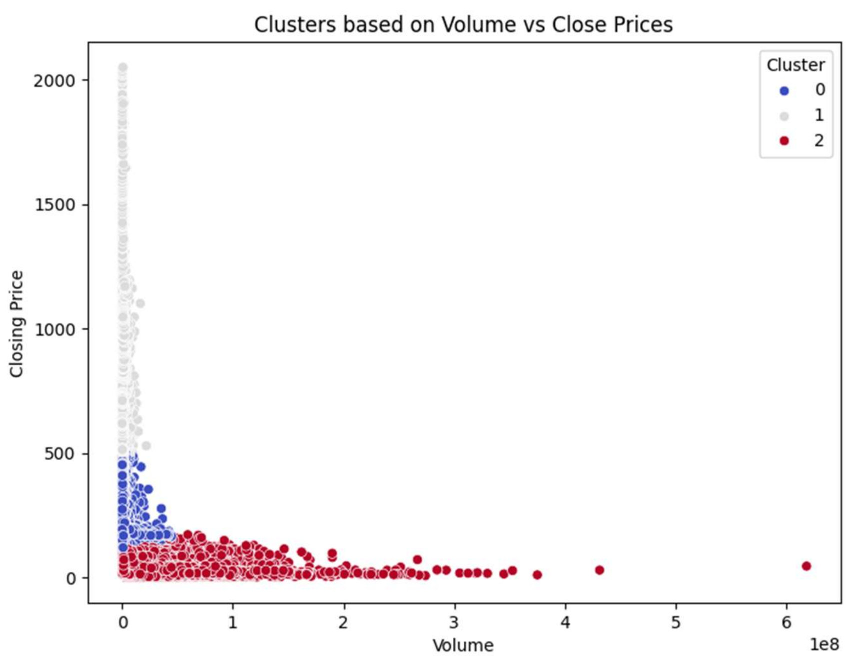
- Visualized clusters using multiple feature pairs:

    ✓ Open vs Close

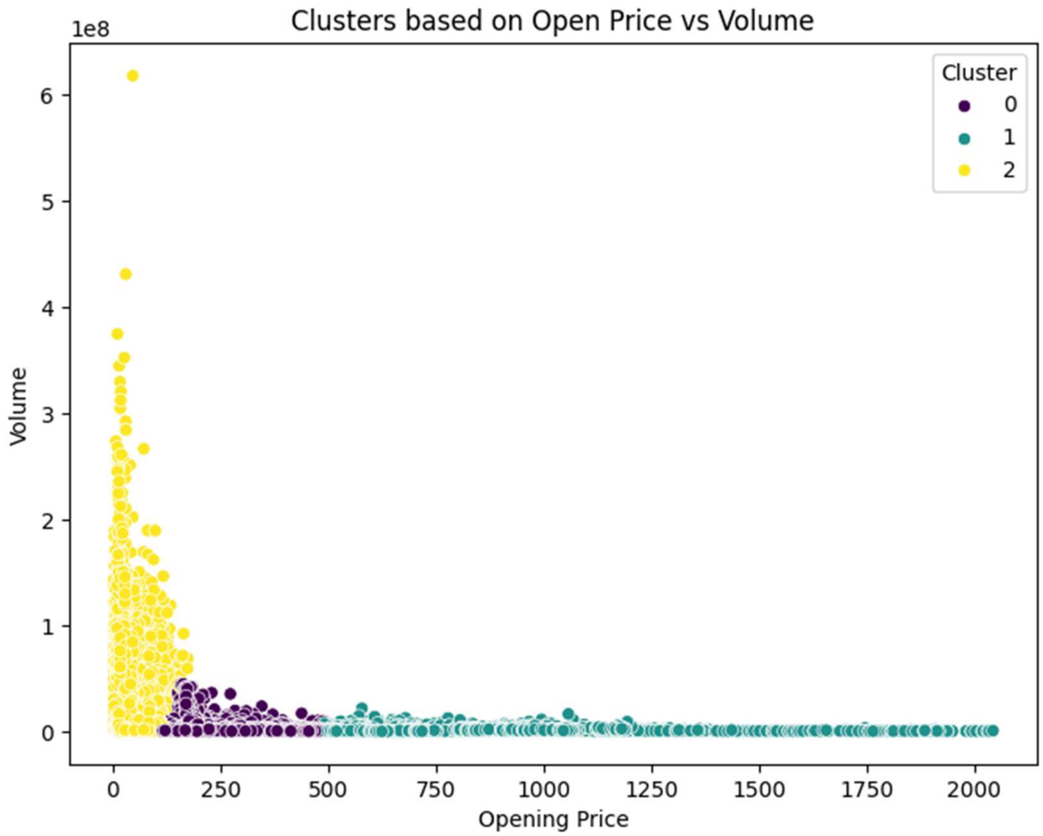
✓ High vs Low



✓ Volume vs Close



✓ Open vs Volume



- Saved clustered dataset
-

Results and Interpretation

- The Elbow Method confirmed 3 distinct stock clusters.
- Cluster visualizations revealed:
  - Distinct separations based on stock price ranges and trade volumes.
  - Clear grouping of similar-performing stocks.
- Clusters indicate behavioral patterns of the data set.

7. CONCLUSION

This project successfully explored stock price data through three analytical approaches:

- **Regression Analysis:**
  Accurately predicted closing prices with an R^2 of 0.9997, confirming a strong linear relationship.
- **Time Series Analysis:**
  Revealed seasonality, trends, and smoothed fluctuations through decomposition and moving average.
- **Clustering Analysis:**
  Grouped similar stocks into three clusters, highlighting it's patterns in trading behavior and price similarity.

8. LIST OF FIGURES

Figure	File Name
Regression Plot	regression_plot.png
Time Series Decomposition	time_series_decomposition.png
Moving Average Plot	moving_average_smoothing.png
Elbow Method Plot	elbow_method.png
Open vs Close Clusters	kmeans_clusters.png
High vs Low Clusters	kmeans_high_low_clusters.png
Volume vs Close Clusters	kmeans_volume_close_clusters.png
Open vs Volume Clusters	kmeans_open_volume_clusters.png

End of the Report