srinivasan530_termproject

March 1, 2025

[33]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stats
from statsmodels.formula.api import ols
from scipy.stats import pearsonr
from sklearn.linear_model import LinearRegression
import seaborn as sns

class StockDataAnalysisDataset:
    def __init__(self, file_name):
        self.file_path = file_name
        self.df = None
        self.selected_variables = ["Open", "Close", "High", "Low", "Volume"]

    #describe variable for dataset
    def describe_variables_for_dataset(self):
        descriptions_val = self.df[self.selected_variables].describe()
        print("Variable Descriptions from dataset used:")
        print(descriptions_val)

    #Load dataset
    def load_dataset(self):
        self.df = pd.read_csv(self.file_path)
        # renaming columns
        self.df.rename(columns={
            "date": "Date", "open": "Open", "high": "High",
            "low": "Low", "close": "Close", "volume": "Volume", "Name": "Ticker"
        }, inplace=True)
        self.df["Date"] = pd.to_datetime(self.df["Date"])
        self.df.dropna(inplace=True)
        print("Data Loaded Successfully!")

    #Plot histogram
    def plot_histograms_for_dataset(self):
        for var in self.selected_variables:
```

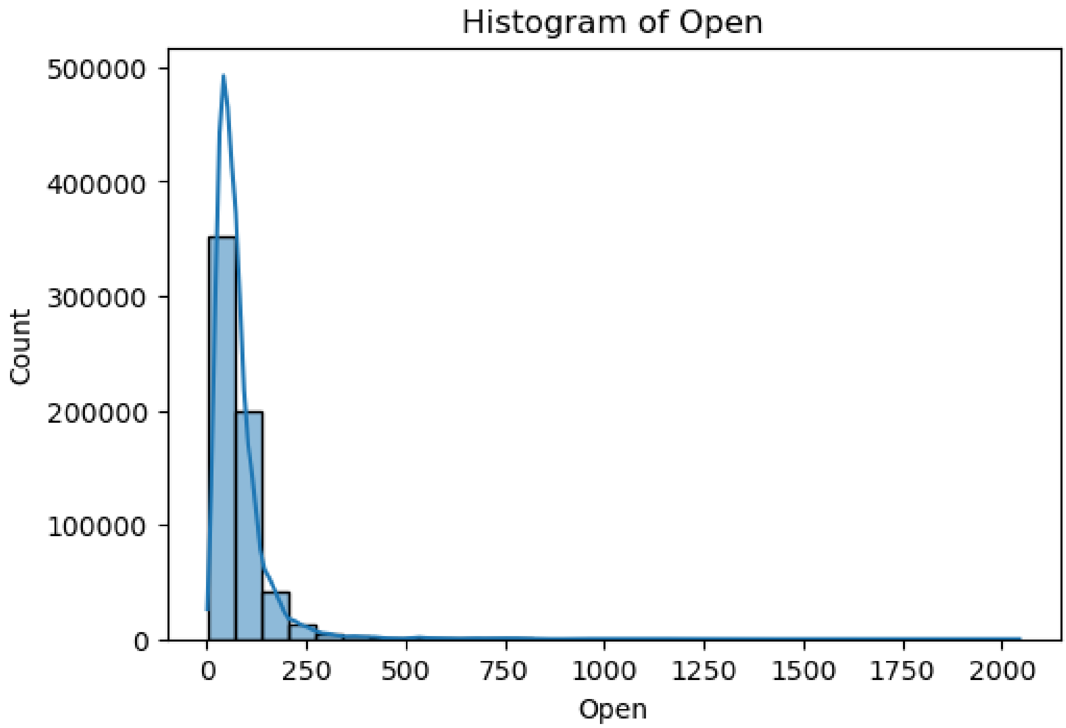
```python
            plt.figure(figsize=(6,4))
            sns.histplot(self.df[var], bins=30, kde=True)
            plt.title(f'Histogram of {var}')
            plt.show()

    # Identify outliers for the variables
    def identify_outliers_for_dataset(self):
        for var in self.selected_variables:
            q1 = self.df[var].quantile(0.25)
            q3 = self.df[var].quantile(0.75)
            iqr = q3 - q1
            lower_bound = q1 - 1.5 * iqr
            upper_bound = q3 + 1.5 * iqr
            outliers = self.df[(self.df[var] < lower_bound) | (self.df[var] >
↪upper_bound)]
            print(f"Outliers in {var}: {len(outliers)}")

    # compute PMF for AAPL and GOOGLe
    def compute_pmf_for_dataset(self):
        scenarios = [
            self.df[self.df['Ticker'] == 'AAPL']['Close'],
            self.df[self.df['Ticker'] == 'GOOG']['Close'],
            self.df[self.df['Ticker'] == 'CMS']['Close'],
            self.df[self.df['Ticker'] == 'CSCO']['Close'],
            self.df[self.df['Ticker'] == 'ILMN']['Close'],
            self.df[self.df['Ticker'] == 'NVDA']['Close'],

        ]
        labels = ["AAPL", "GOOG","CMS","CSCO","ILMN","NVDA"]
        for i, scenario in enumerate(scenarios):
            pmf = scenario.value_counts(normalize=True)
            plt.figure(figsize=(6,4))
            pmf.plot(kind='bar')
            plt.title(f'PMF of Closing Prices - {labels[i]}')
            plt.show()

    # computation of Cumulative Distribution function
    def compute_cdf_for_dataset(self):
        sorted_data = np.sort(self.df['Close'])
        cdf = np.arange(len(sorted_data)) / float(len(sorted_data))
        plt.figure(figsize=(6,4))
        plt.plot(sorted_data, cdf, marker='.', linestyle='none')
        plt.title("Cumulative Distribution Function (CDF) of Closing Prices")
        plt.show()

    def analyze_distribution_for_dataset(self):
        stats.probplot(self.df['Close'], dist="norm", plot=plt)
```

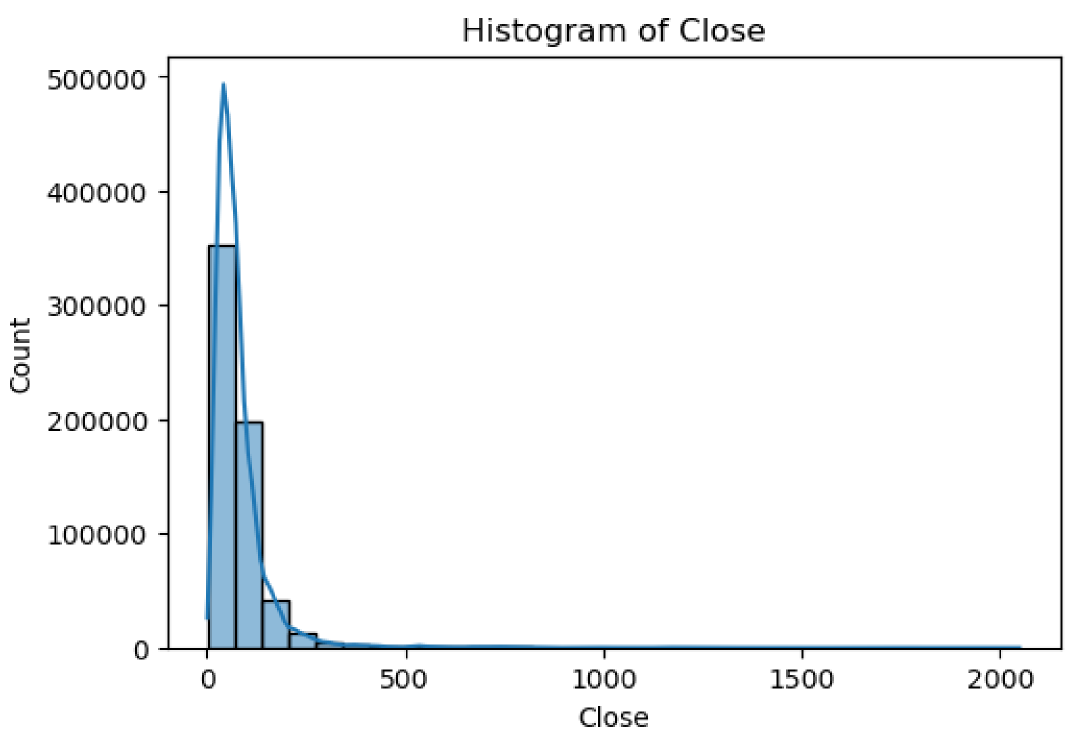
```
        plt.title("Normal Q-Q Plot for Closing Prices")
        plt.show()

    def scatter_plots_for_dataset(self):
        plt.figure(figsize=(6,4))
        sns.scatterplot(x=self.df['Open'], y=self.df['Close'])
        plt.title("Scatter Plot of Open vs Close Prices")
        plt.show()

        plt.figure(figsize=(6,4))
        sns.scatterplot(x=self.df['High'], y=self.df['Low'])
        plt.title("Scatter Plot of High vs Low Prices")
        plt.show()

    def compute_correlation_for_dataset(self):
        correlation, _ = pearsonr(self.df['Open'], self.df['Close'])
        print(f"Pearson Correlation between Open and Close: {correlation}")

    def regression_analysis_for_dataset(self):
        model = ols("Close ~ Open + High + Low + Volume", data=self.df).fit()
        print(model.summary())

    def correlation_analysis_for_dataset(self):
        """Computes Pearson correlation coefficients."""
        correlation_matrix = self.df[self.selected_variables].corr()
        print("Correlation Matrix:\n", correlation_matrix)
        plt.figure(figsize=(8, 6))
        sns.heatmap(correlation_matrix, annot=True, cmap="coolwarm", fmt=".2f")
        plt.title("Correlation Matrix Heatmap")
        plt.show()

    def linear_regression_analysis(self):
        """Performs regression analysis using Linear Regression."""
        X = self.df[["Open", "High", "Low", "Volume"]]
        y = self.df["Close"]

        self.model = LinearRegression()
        self.model.fit(X, y)
        r_squared = self.model.score(X, y)

        regression_results = {
            "Coefficients": self.model.coef_,
            "Intercept": self.model.intercept_,
            "R-Squared": r_squared
        }
```

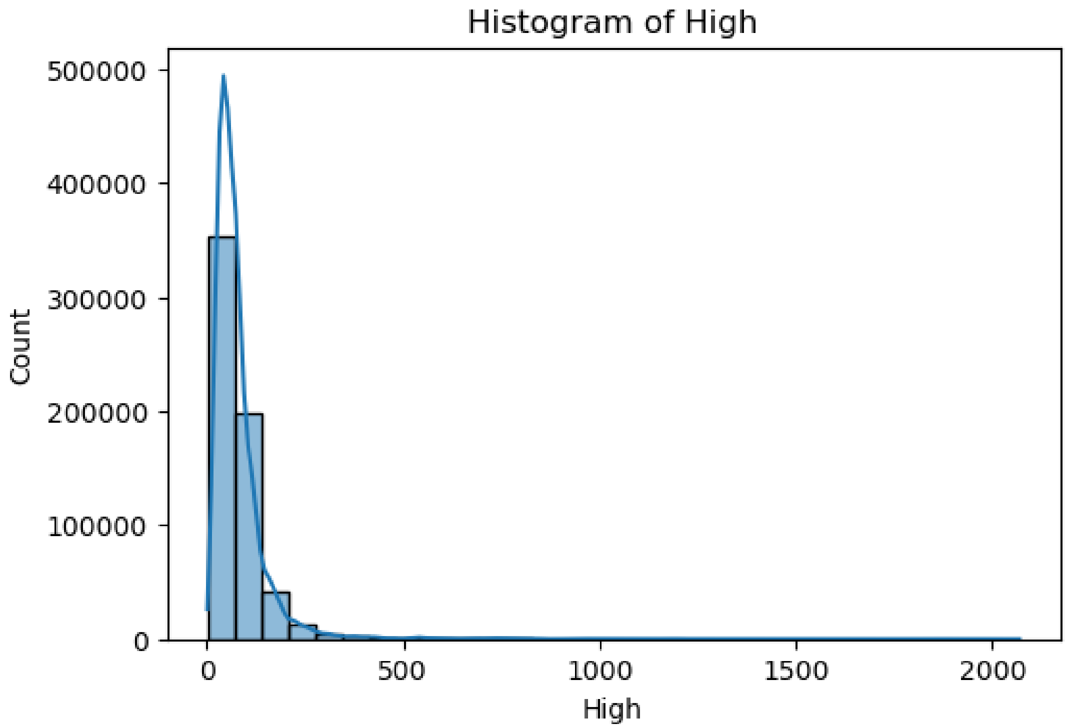
```python
        regression_df = pd.DataFrame(regression_results, index=["Open", "High", "Low", "Volume"])
        print("Regression Analysis Result:\n", regression_df)
        plt.figure(figsize=(8, 6))
        sns.heatmap(regression_df, annot=True, cmap="coolwarm", fmt=".2f")
        plt.title("Regression Analysis Results Heatmap")
        plt.show()

    def hypothesis_testing_for_dataset(self):
        """Performing hypothesis testing  compare mean Close and Open prices."""
        t_stat, p_value = stats.ttest_rel(self.df["Close"], self.df["Open"])

        hypothesis_results = pd.DataFrame({
            "T-Statistic": [t_stat],
            "P-Value": [p_value],
            "Conclusion": ["Reject H0" if p_value < 0.05 else "Fail to Reject H0"]
        })
        print("Hypothesis Analysis Result:\n", hypothesis_results)

    def plot_analytical_distribution_for_dataset(self):
        """Fits and plots an analytical normal distribution."""
        mu, sigma = stats.norm.fit(self.df["Close"])

        x = np.linspace(self.df["Close"].min(), self.df["Close"].max(), 100)
        pdf = stats.norm.pdf(x, mu, sigma)

        plt.figure(figsize=(10, 5))
        sns.histplot(self.df["Close"], bins=50, kde=True, stat="density", label="Actual Data", color="blue")
        plt.plot(x, pdf, 'r-', label="Fitted Normal Distribution")
        plt.xlabel("Closing Price")
        plt.ylabel("Density")
        plt.title("Analytical Distribution of Closing Prices")
        plt.legend()
        plt.show()

    def run_all_analysis(self):
        self.load_dataset()
        self.describe_variables_for_dataset()
        self.plot_histograms_for_dataset()
        self.identify_outliers_for_dataset()
        self.compute_pmf_for_dataset()
        self.compute_cdf_for_dataset()
        self.analyze_distribution_for_dataset()
        self.scatter_plots_for_dataset()
        self.compute_correlation_for_dataset()
```

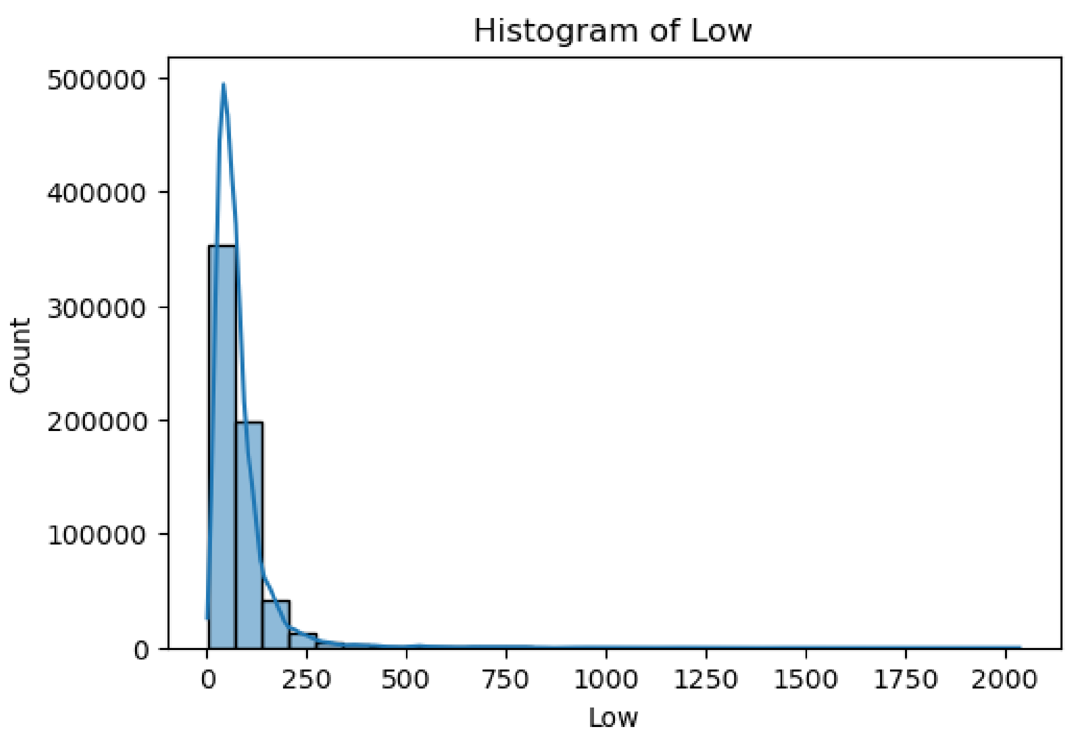
```python
        self.regression_analysis_for_dataset()
        self.correlation_analysis_for_dataset()
        self.linear_regression_analysis()
        self.hypothesis_testing_for_dataset()
        self.plot_analytical_distribution_for_dataset()

        print("Analysis Completed successfully for Stock dataset!")

# Class initialization with the dataset
analysis_data = StockDataAnalysisDataset("all_stocks_5yr.csv")
analysis_data.run_all_analysis()
```

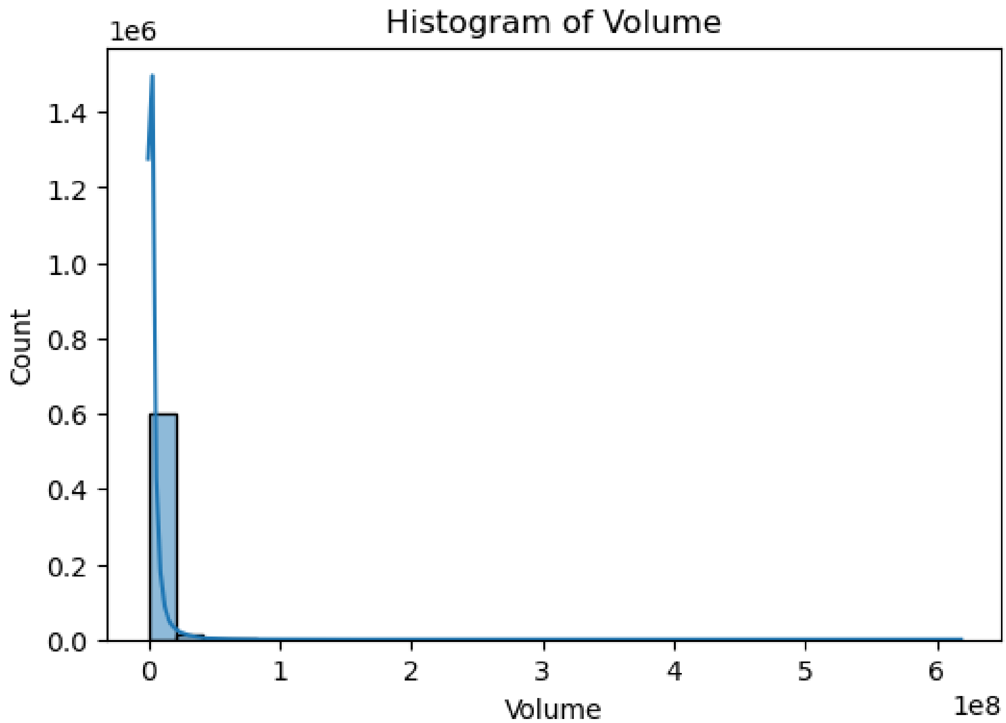
```
Data Loaded Successfully!
Variable Descriptions from dataset used:
                Open          Close           High            Low  \
count  619029.000000  619029.000000  619029.000000  619029.000000
mean       83.023334      83.043305      83.778419      82.256200
std        97.378769      97.388913      98.207735      96.507634
min         1.620000       1.590000       1.690000       1.500000
25%        40.220000      40.240800      40.620000      39.830000
50%        62.590000      62.620000      63.150000      62.020000
75%        94.370000      94.410000      95.180000      93.540000
max      2044.000000    2049.000000    2067.990000    2035.110000

             Volume
count  6.190290e+05
mean   4.321892e+06
std    8.693671e+06
min    1.010000e+02
25%    1.070351e+06
50%    2.082165e+06
75%    4.284550e+06
max    6.182376e+08
```


Histogram of Open
Count
500000
400000
300000
200000
100000
0
0
250
500
750
1000
1250
1500
1750
2000
Open

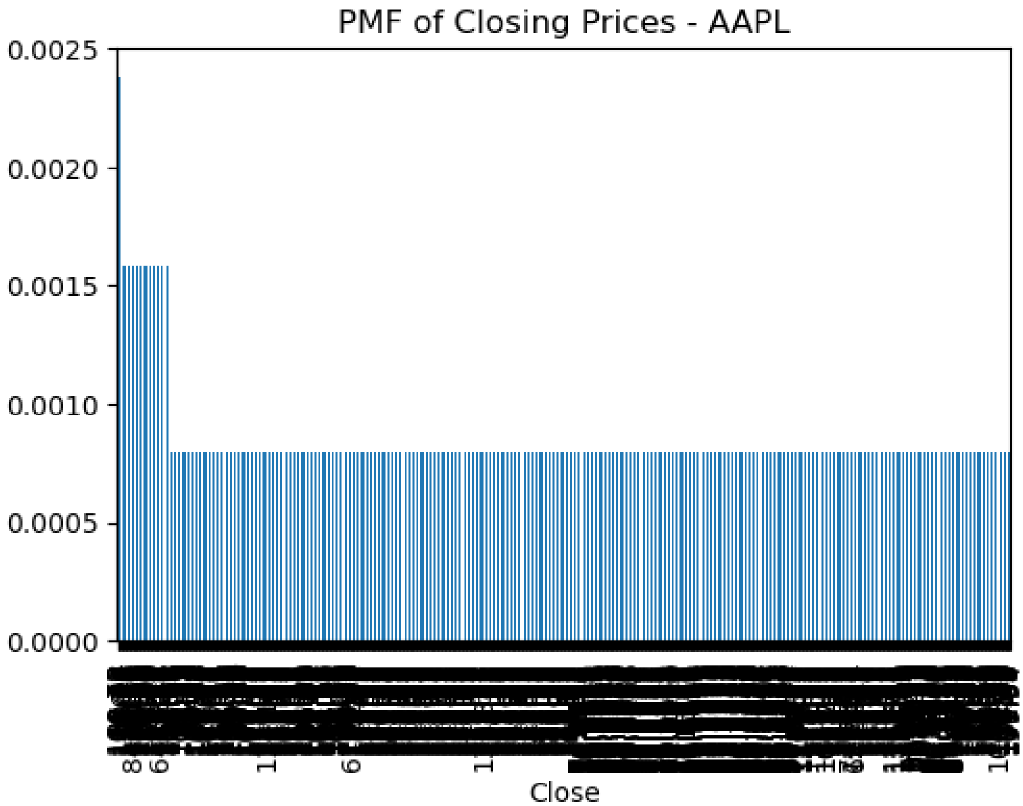

Histogram of Close
Count
500000
400000
300000
200000
100000
0
0
500
1000
1500
2000
Close

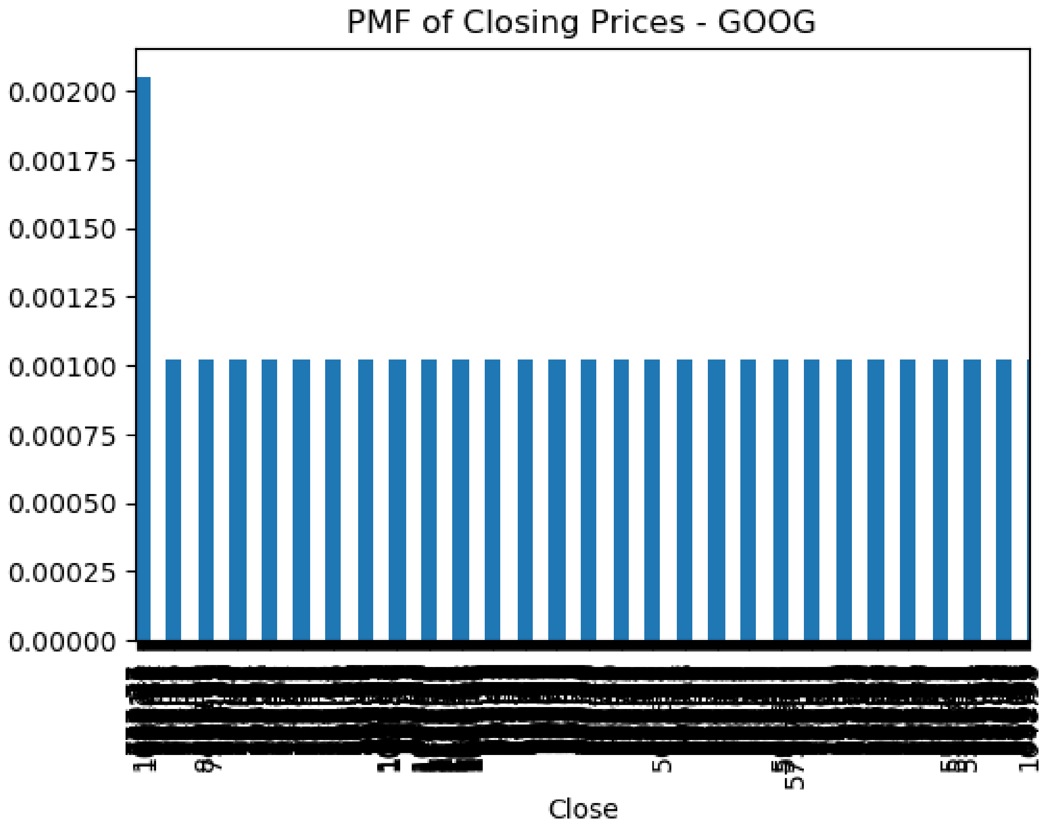

Histogram of High
Count
500000
400000
300000
200000
100000
0
0
500
1000
1500
2000
High

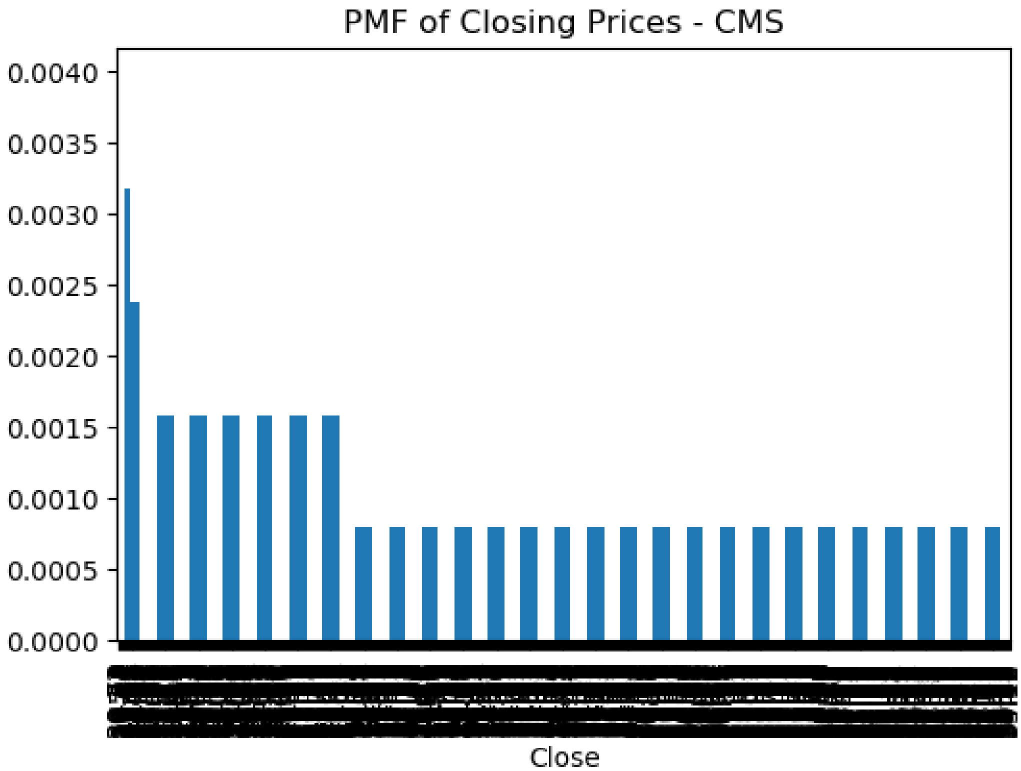

Histogram of Low
Count
500000
400000
300000
200000
100000
0
0
250
500
750
1000
1250
1500
1750
2000
Low

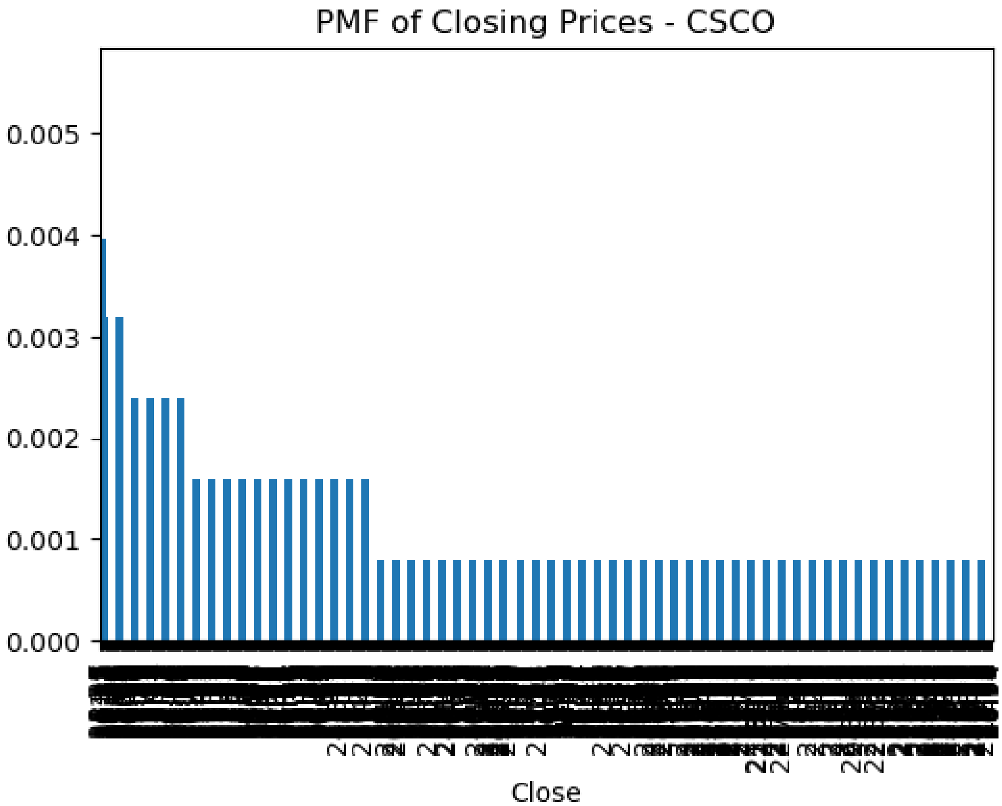


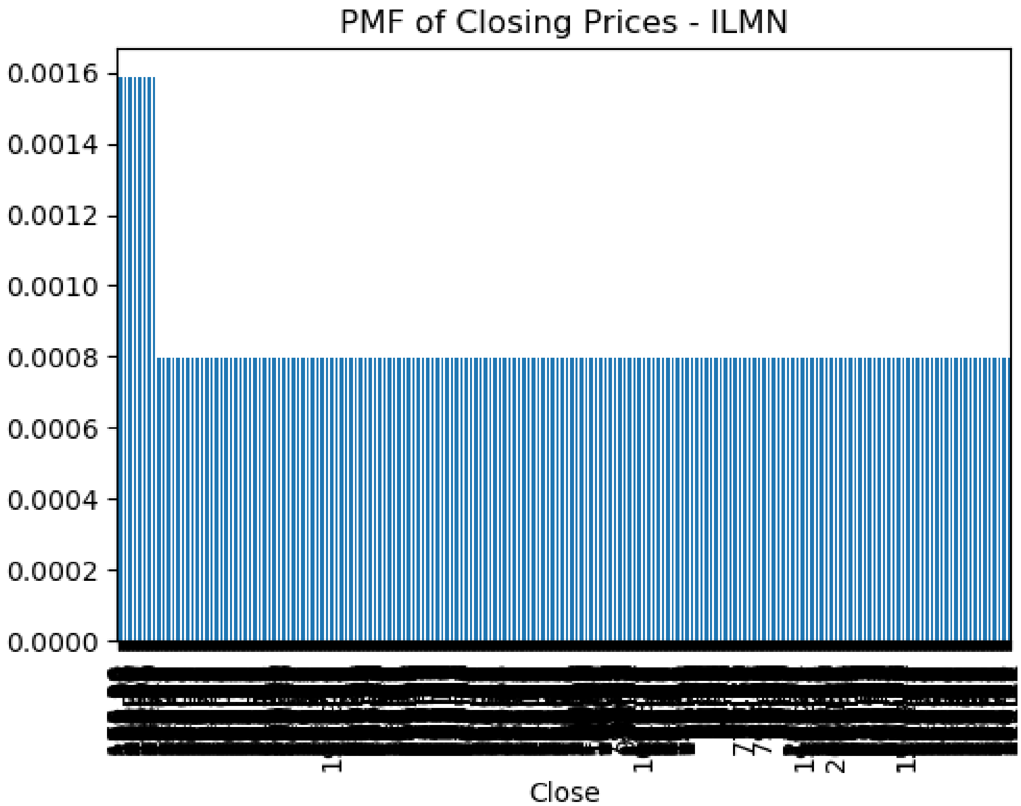

```
Outliers in Open: 38963
Outliers in Close: 38930
Outliers in High: 39020
Outliers in Low: 38891
Outliers in Volume: 59502
```

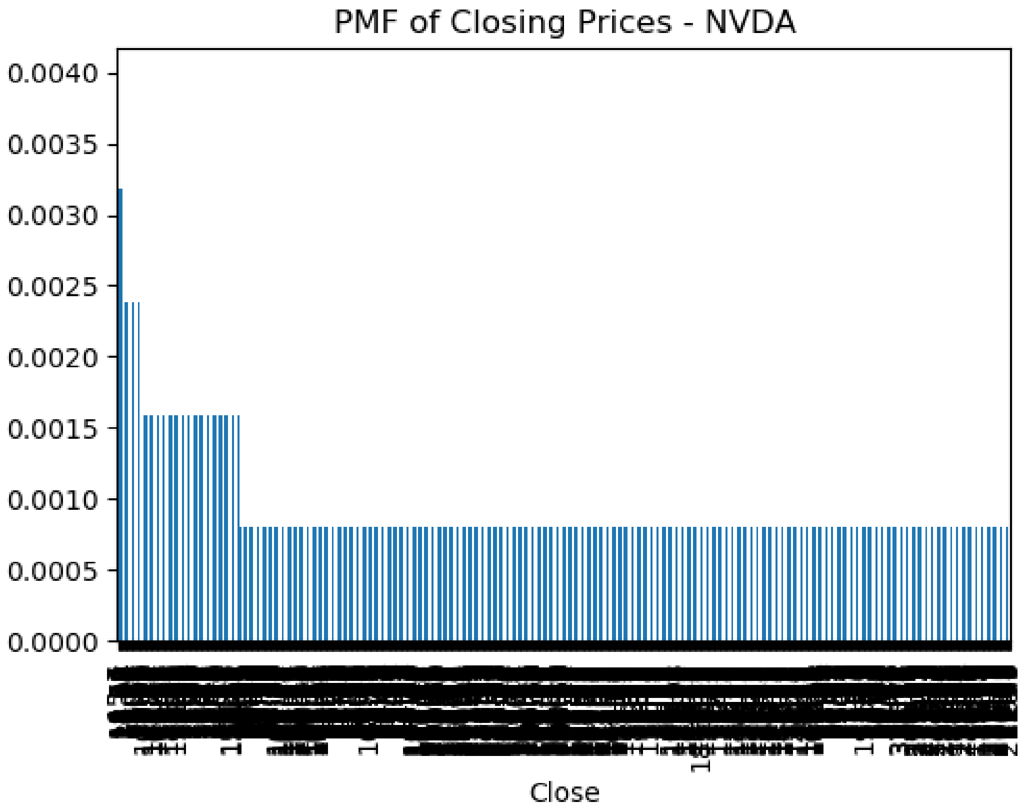

PMF of Closing Prices - AAPL
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Close

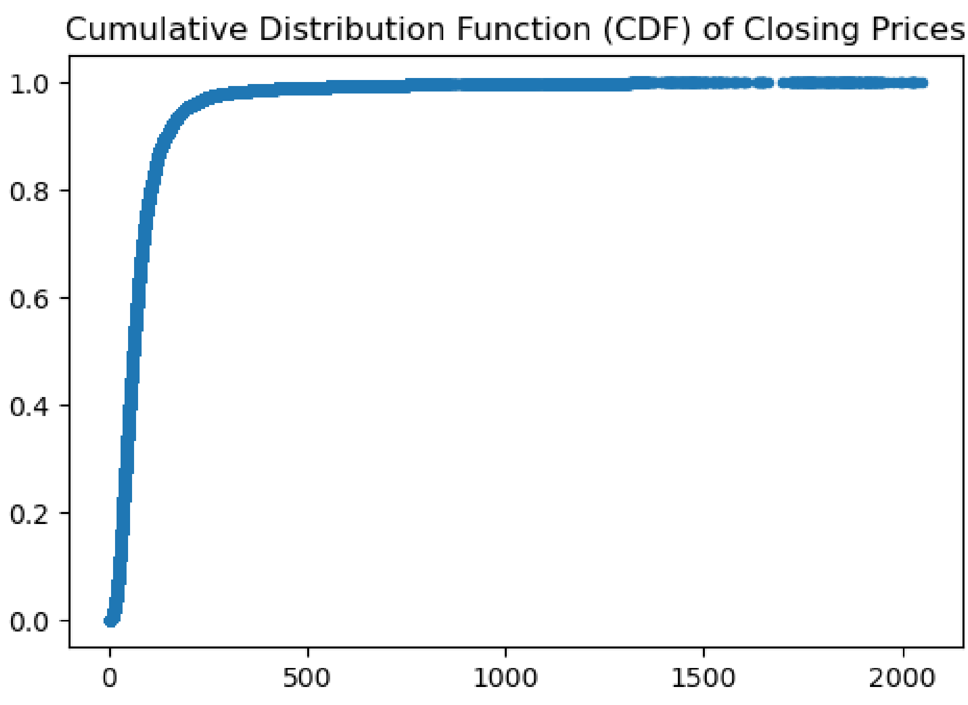

PMF of Closing Prices - GOOG
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
Close

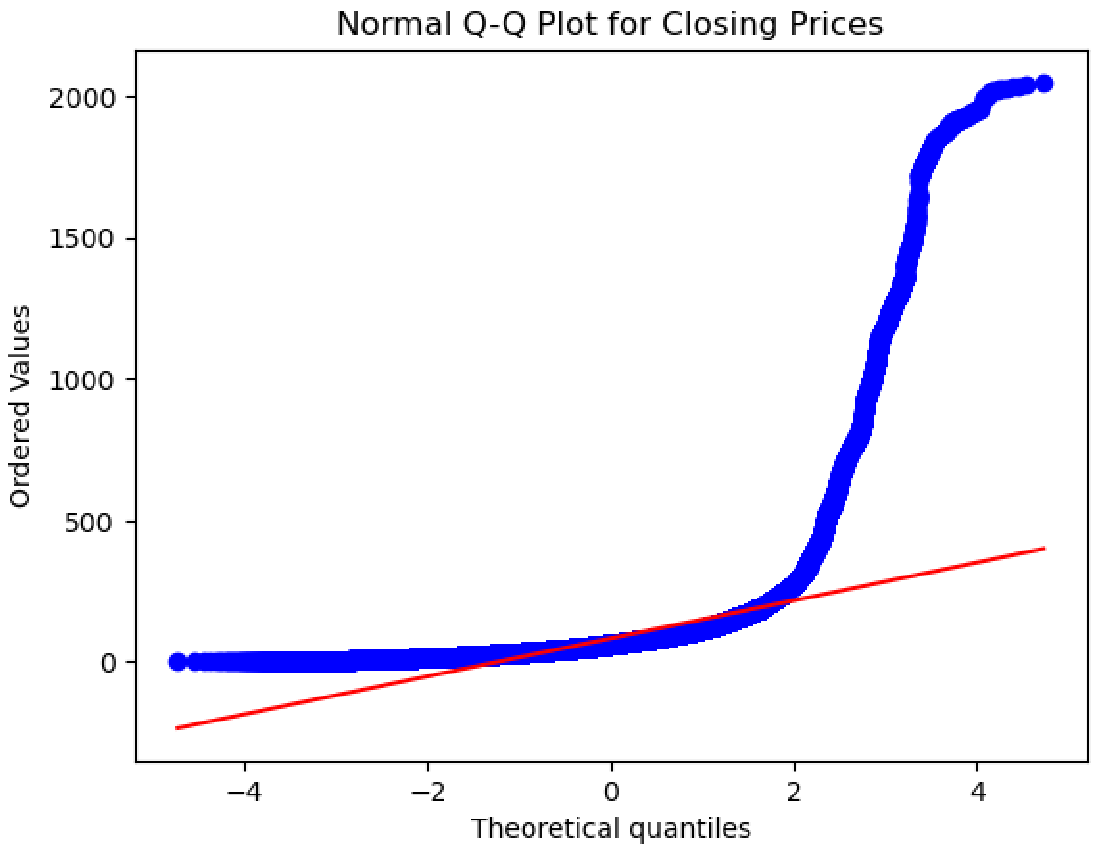

PMF of Closing Prices - CMS
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Close

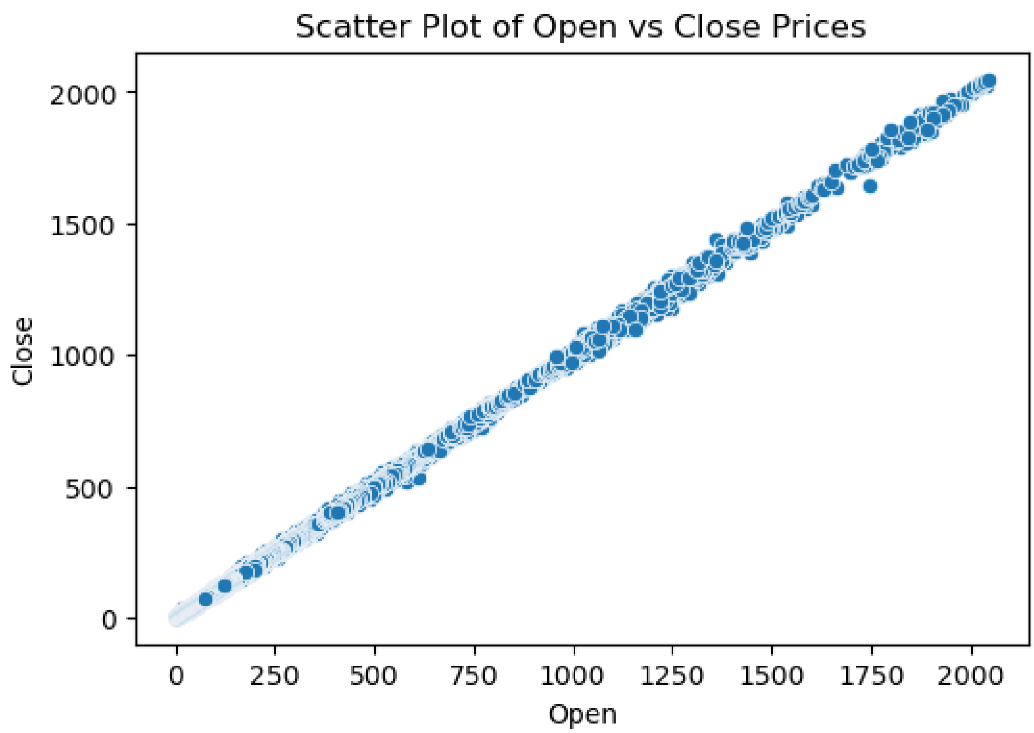

PMF of Closing Prices - CSCO
0.005
0.004
0.003
0.002
0.001
0.000
Close

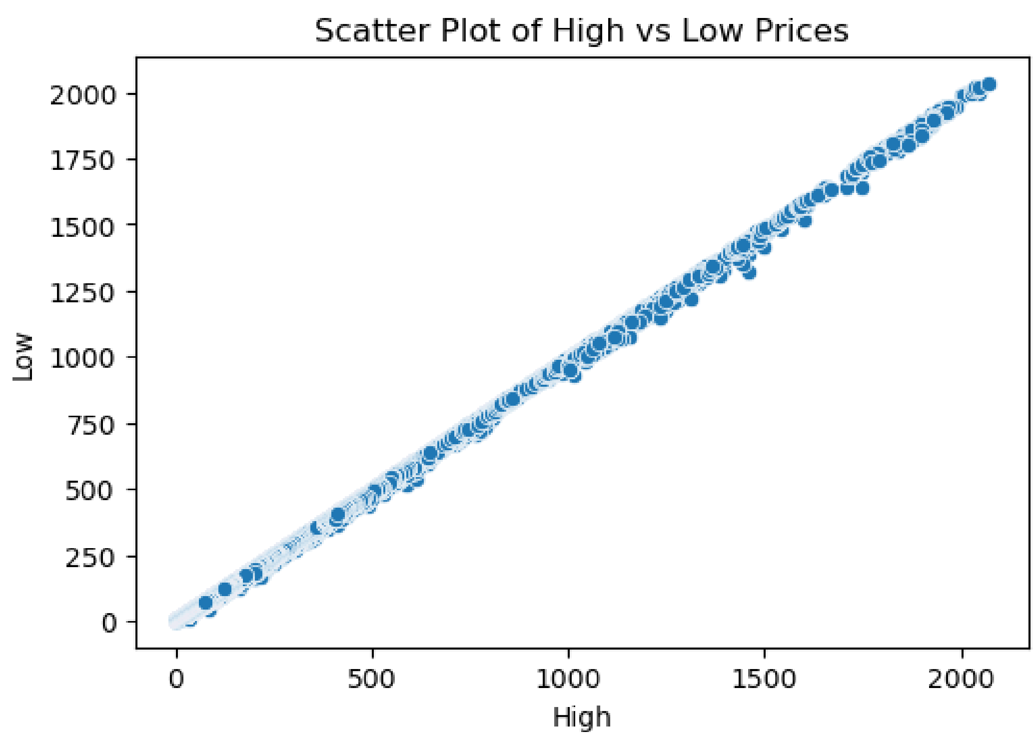

PMF of Closing Prices - ILMN
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
Close


PMF of Closing Prices - NVDA
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Close

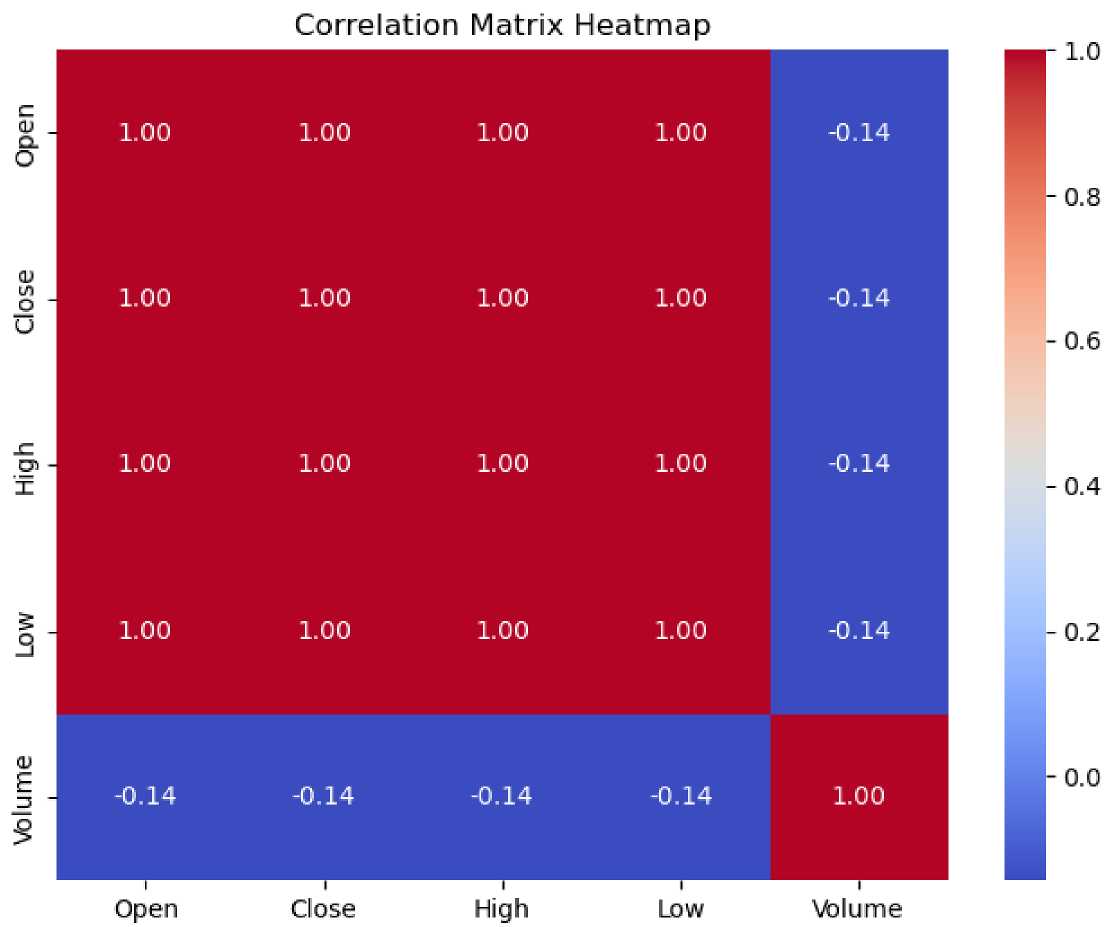

Cumulative Distribution Function (CDF) of Closing Prices
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
2000


Normal Q-Q Plot for Closing Prices
Ordered Values
2000
1500
1000
500
0
−4
−2
0
2
4
Theoretical quantiles

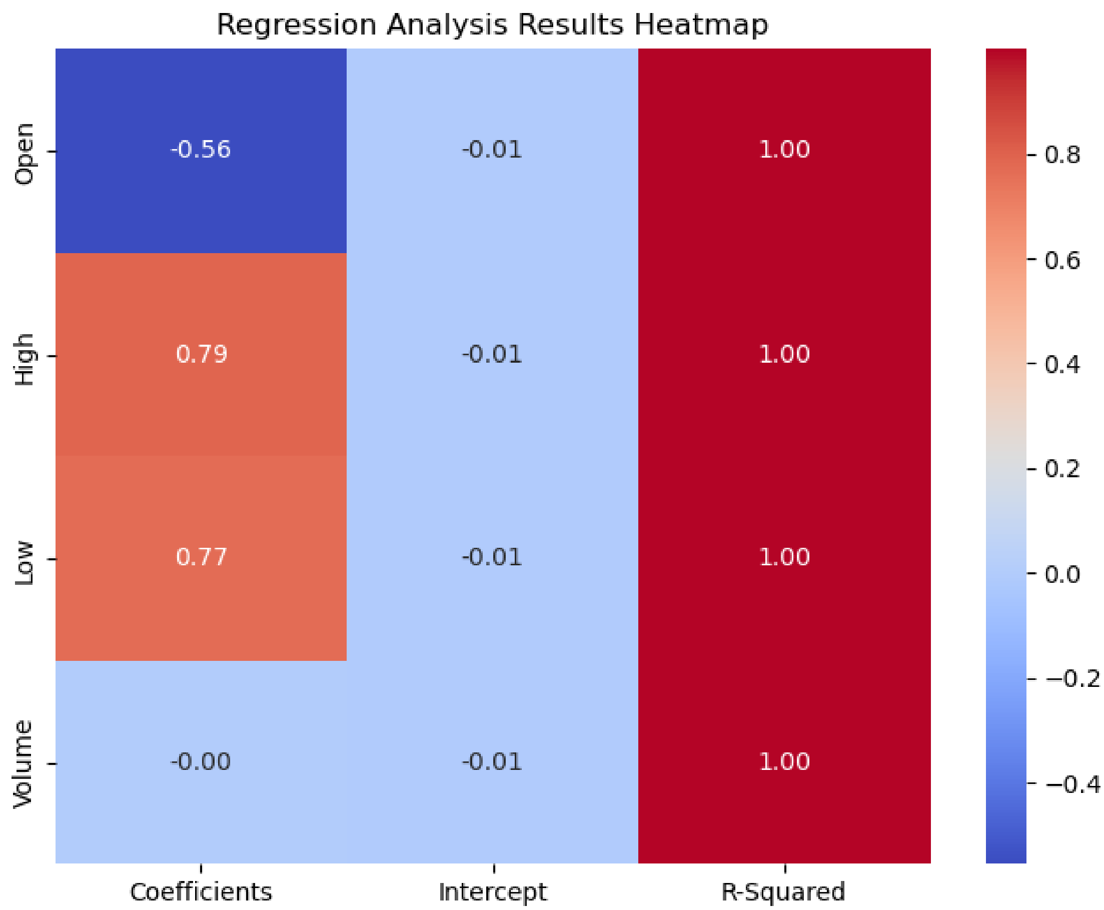

Scatter Plot of Open vs Close Prices
2000
1500
1000
500
0
Close
0
250
500
750
1000
1250
1500
1750
2000
Open


Scatter Plot of High vs Low Prices
2000
1750
1500
1250
1000
750
500
250
0
Low
0
500
1000
1500
2000
High

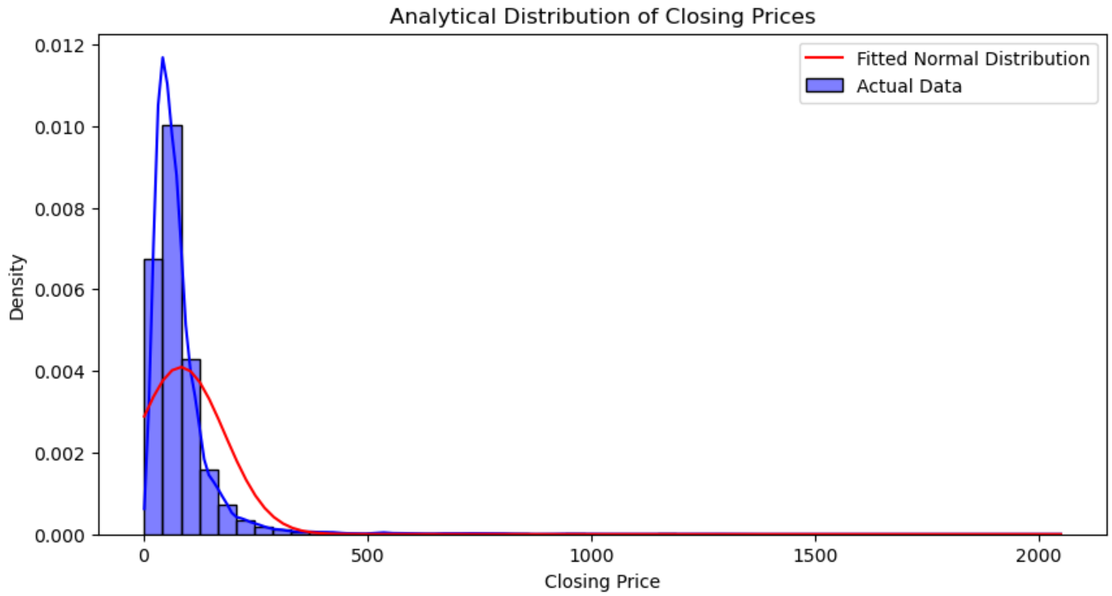
```
Pearson Correlation between Open and Close: 0.999871931742259
                            OLS Regression Results
==============================================================================
Dep. Variable:                  Close   R-squared:                       1.000
Model:                            OLS   Adj. R-squared:                  1.000
Method:                 Least Squares   F-statistic:                 3.097e+09
Date:                Sat, 01 Mar 2025   Prob (F-statistic):               0.00
Time:                        18:47:56   Log-Likelihood:            -6.4729e+05
No. Observations:              619029   AIC:                         1.295e+06
Df Residuals:                  619024   BIC:                         1.295e+06
Df Model:                           4
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept     -0.0058      0.001     -4.567      0.000      -0.008      -0.003
Open          -0.5555      0.001   -569.233      0.000      -0.557      -0.554
High           0.7890      0.001    939.721      0.000       0.787       0.791
Low            0.7668      0.001    976.186      0.000       0.765       0.768
Volume     -4.584e-11   1.02e-10     -0.450      0.653   -2.46e-10    1.54e-10
==============================================================================
Omnibus:                   257405.725   Durbin-Watson:                   2.057
Prob(Omnibus):                  0.000   Jarque-Bera (JB):        510301750.744
Skew:                           0.066   Prob(JB):                         0.00
Kurtosis:                     143.658   Cond. No.                     1.41e+07
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
[2] The condition number is large, 1.41e+07. This might indicate that there are
strong multicollinearity or other numerical problems.
Correlation Matrix:
            Open     Close      High       Low    Volume
Open    1.000000  0.999872  0.999939  0.999928 -0.142705
Close   0.999872  1.000000  0.999936  0.999939 -0.142802
High    0.999939  0.999936  1.000000  0.999903 -0.142316
Low     0.999928  0.999939  0.999903  1.000000 -0.143240
Volume -0.142705 -0.142802 -0.142316 -0.143240  1.000000
```




```
Regression Analysis Result:
         Coefficients  Intercept  R-Squared
Open   -5.555230e-01  -0.005817    0.99995
High    7.889903e-01  -0.005817    0.99995
Low     7.667548e-01  -0.005817    0.99995
Volume -4.584100e-11  -0.005817    0.99995
```




```
Hypothesis Analysis Result:
    T-Statistic       P-Value Conclusion
0     10.081291  6.712676e-24  Reject H0
```




```
Analysis Completed successfully for Stock dataset!
```

[ ]: