Time Series Analysis Report: Historical Stock Prices (May 2013 - May 2019)

INTRODUCTION:

This report outlines the analysis of historical stock prices for Amazon (AMZN), Domino's Pizza (DPZ), Bitcoin (BTC), and Netflix (NFLX) over the period from May 2013 to May 2019. The objective is to uncover patterns, trends, and insights from the temporal data to better understand stock price movements over time.
The dataset provided to us, can be seen here: Kaggle Dataset
Let's get into a short briefing into the code.

Next up, I imported some very basic libraries, which are necessary to handle tabular data and perform analysis.

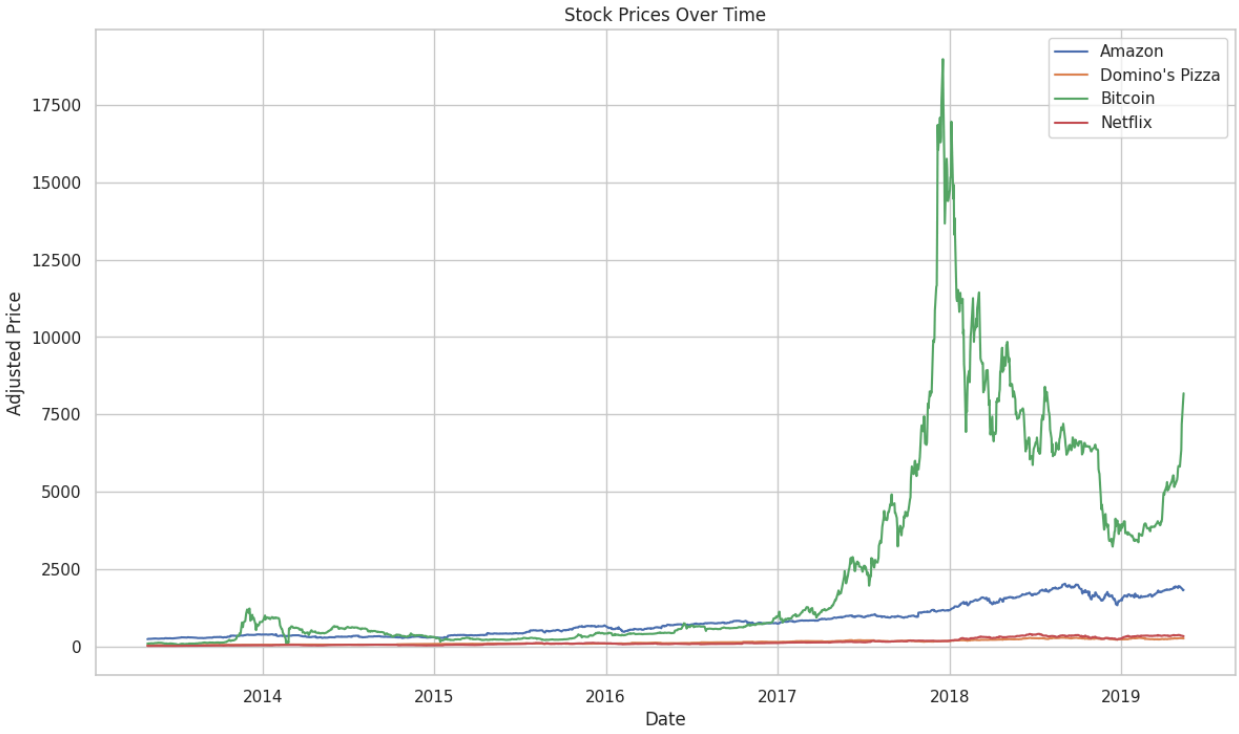
```
# Importing the required libraries
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
sns.set(style="whitegrid")
```

Data Preprocessing:

The 'Date' column was converted to datetime format and set as the index.

Visualization of Time Series Data:

Plotting Stock Prices



This plot shows the stock prices with time of 4 stocks - Amazon, Domino's Pizza, Bitcoin(Crypto) and Netflix.

From the plotted graphs, we can draw several inferences about the stock prices of Amazon, Domino's Pizza, Bitcoin, and Netflix over time from May 2013 to May 2019:

1. **Amazon (AMZN)**: Shows a consistent upward trend with some volatility, reflecting strong growth in stock price over the period.
2. **Domino's Pizza (DPZ)**: Also exhibits a generally upward trend with less volatility compared to Amazon, indicating steady growth.
3. **Bitcoin (BTC)**: Highly volatile with dramatic price spikes, particularly noticeable in early 2018, showing the speculative nature of cryptocurrency.
4. **Netflix (NFLX)**: Displays a steady increase similar to Amazon, indicating robust growth in the streaming industry.

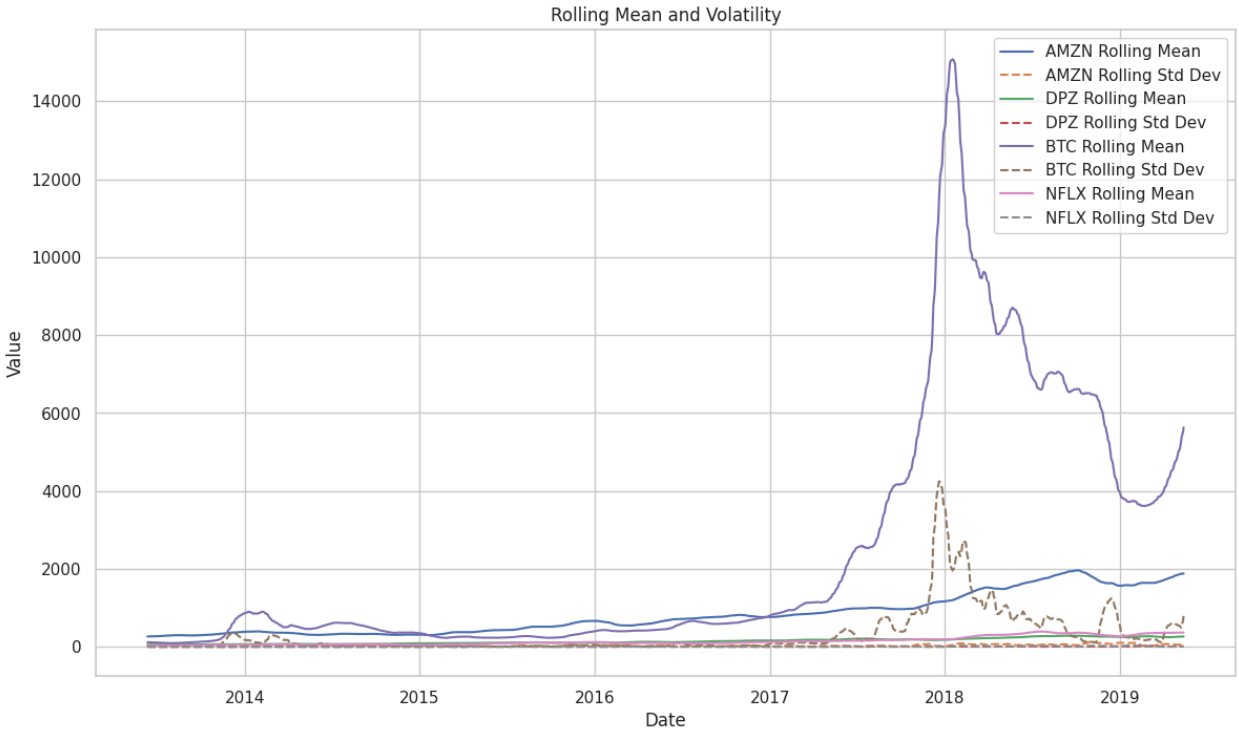
These trends suggest significant growth for AMZN, DPZ, and NFLX, while BTC exhibits high volatility typical of cryptocurrencies.

Advanced Analysis:

Rolling Mean and Volatility Analysis

Rolling mean is a technique used to smooth out time series data by calculating the average of data points within a specified window that moves with time in the data series. This helps in identifying trends by reducing the noise from short-term fluctuations, thus smoothing the time series curves.

The rolling standard deviation measures the stretch of data points within the same moving window. It helps us in understanding the volatility of the data over time. Generally, the window size is taken for a month for a good generalization.



As you can see, unlike the above graphs, this graph has smoothed out distortions, because the rolling mean has no effect from short term fluctuations. By comparing the rolling mean of different stocks, we can observe relative performance over time. Points where the rolling mean changes direction indicate potential shifts in trend. On the other hand, the rolling standard deviation curve shows periods of high and low volatility. Higher rolling standard deviation indicates greater variability and risk. Periods with lower rolling standard deviation indicate more stable stock prices.

For the stocks in the dataset:

1. **Amazon (AMZN)**:

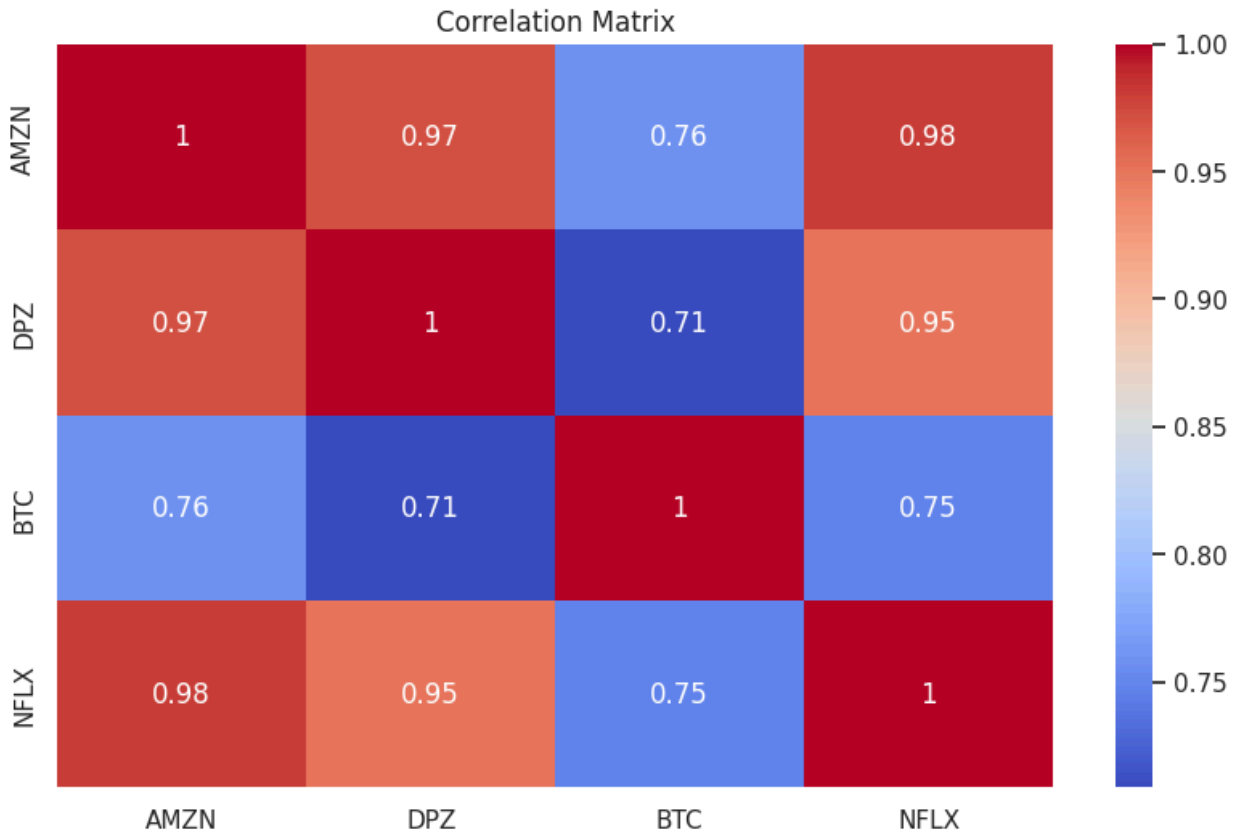
    - **Rolling Mean**: Shows consistent upward movement, indicating a strong long-term growth trend.
    - **Rolling Std Dev**: Periods of increased volatility around market events.
2. **Domino's Pizza (DPZ)**:
    - **Rolling Mean**: Steady growth, less pronounced than Amazon.
    - **Rolling Std Dev**: Moderate volatility, indicating stable growth with fewer fluctuations.
3. **Bitcoin (BTC)**:
    - **Rolling Mean**: Dramatic fluctuations, especially noticeable during the 2018 cryptocurrency boom.
    - **Rolling Std Dev**: High volatility, reflecting the speculative nature of cryptocurrencies.
4. **Netflix (NFLX)**:
    - **Rolling Mean**: Steady growth similar to Amazon.
    - **Rolling Std Dev**: Periods of increased volatility, often around earnings reports or market changes.

Correlation heatmap

The correlation heatmap for different stocks is as shown below.

Key Insights from the Correlation Heatmap:

1. **Positive Correlation**: Values close to 1 indicate a strong positive relationship. For example, if Amazon (AMZN) and Netflix (NFLX) show a high correlation, their stock prices tend to move in the same direction.
2. **Negative Correlation**: Values close to -1 indicate a strong negative relationship. If Bitcoin (BTC) shows a negative correlation with traditional stocks, it may act as a hedge.
3. **No Correlation**: Values around 0 suggest no linear relationship. For instance, if DPZ and BTC have a correlation near zero, their price movements are largely independent.

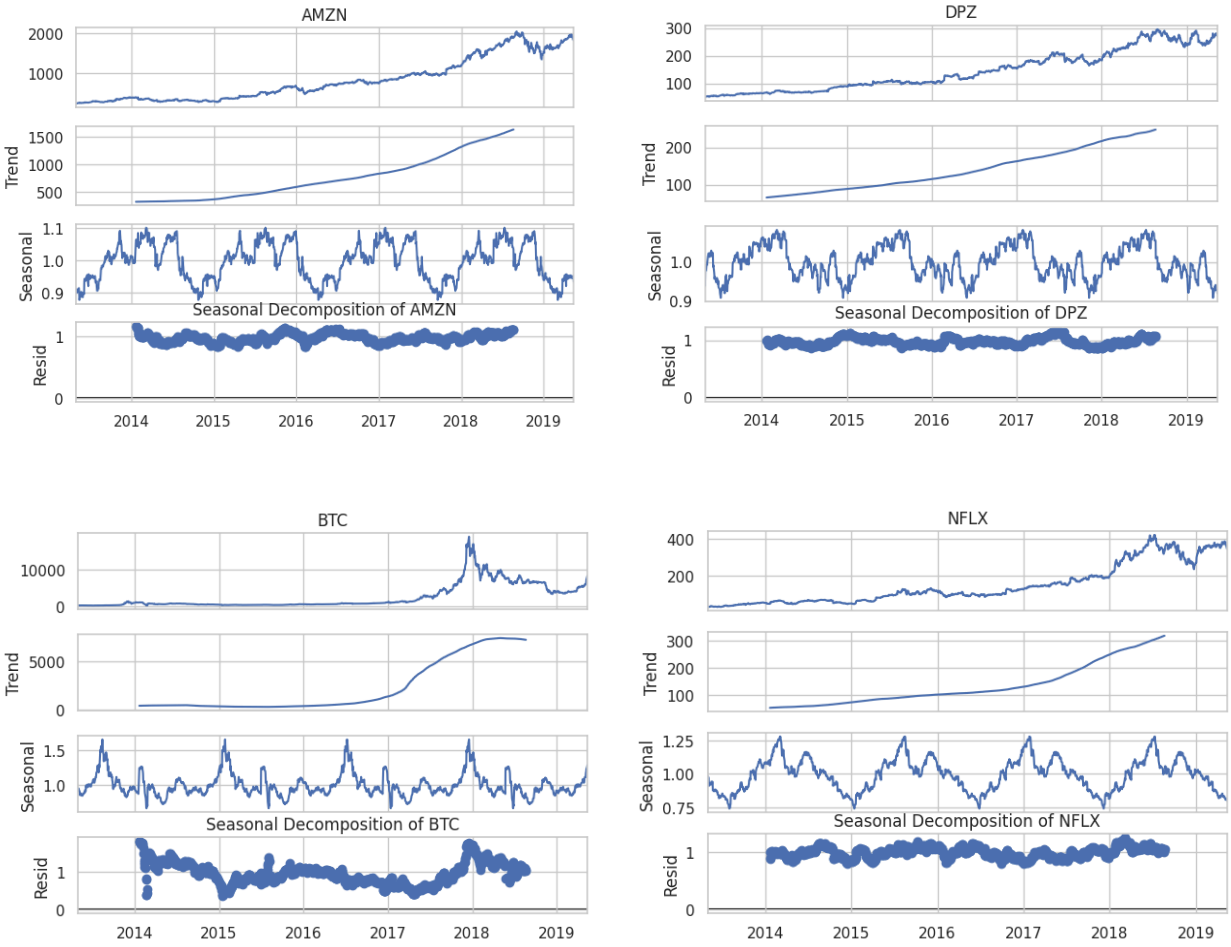


- **High Positive Correlation (e.g., AMZN and NFLX)**: Indicates that these stocks often move together, possibly due to shared market factors or investor sentiment.
- **High Negative Correlation (if any)**: Suggests that when one stock rises, the other tends to fall, useful for diversification strategies.
- **Low or No Correlation (e.g: DPZ and BTC)**: Implies independent price movements, offering diversification benefits.

Seasonal Trend Decomposition

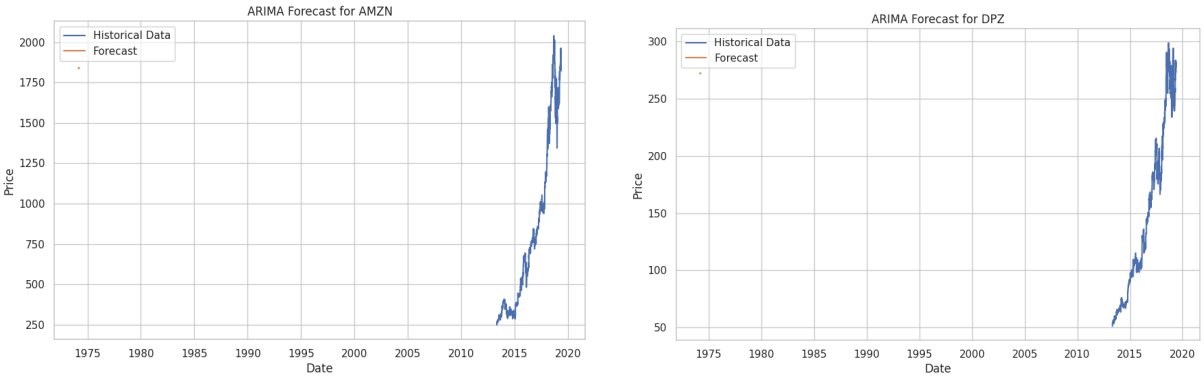
Seasonal decomposition is a technique used to break down a time series into its individual components: trend, seasonal, and residual.

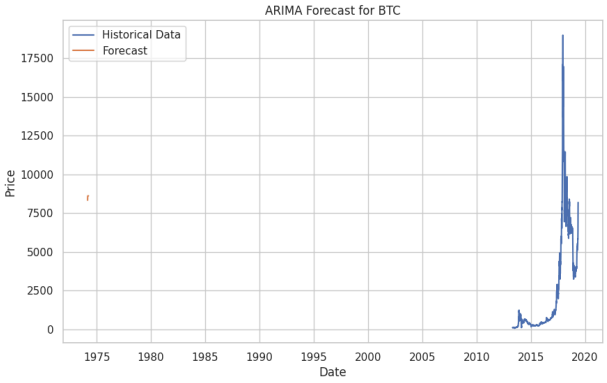
1. **Trend**: The long-term movement or direction of the time series. It represents the underlying pattern or tendency in the data.
2. **Seasonal**: The repetitive, periodic fluctuations or patterns in the data that occur at fixed intervals (e.g., daily, weekly, monthly, yearly).
3. **Residual**: The random, irregular, or unexplained variation left after removing the trend and seasonal components from the original time series.

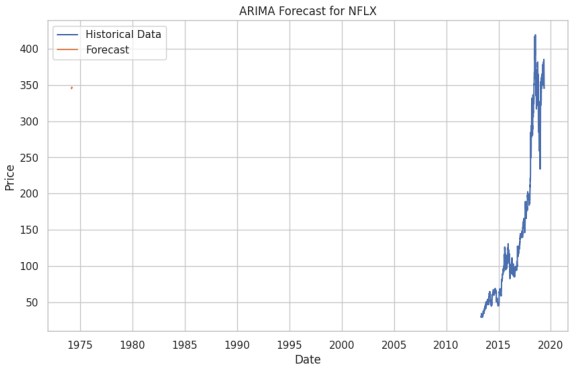


Forecasting with ARIMA

ARIMA is Autoregressive Integrated Moving Average. It's a widely used statistical method for time series forecasting. The parameters (p, d, q) of the ARIMA model represent the number of autoregressive terms, differences, and moving average terms, respectively.







ARIMA'S prediction for these 4 stocks are as follows:

Growth patterns for Amazon, Domino's Pizza, and Netflix will be steady, but there will be short fluctuations in between. However for Bitcoin, a sharp drop was seen, then some regular growth again.

Conclusion

The analysis provided insights into the stock price trends, volatility, and correlations among Amazon, Domino's Pizza, Bitcoin, and Netflix. Rolling mean and volatility analysis revealed variability in stock prices. Correlation analysis highlighted relationships between stocks, while seasonal decomposition helped in understanding underlying patterns. ARIMA models were used for forecasting future prices.