Time Series Analysis

Daily Close Price Analysis of NVIDIA Stock (NVDA)

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Motivation

- NVIDIA is a market leader in graphics processing units (GPUs), AI, and high-performance computing.
- Plays a critical role in emerging technologies like deep learning, autonomous driving, and data centers.
- Frequently influenced by technological breakthroughs, product launches, and macroeconomic factors.
- NVIDIA’s stock exhibits rapid and frequent fluctuations due to constant innovation, new GPU launches, AI breakthroughs, and market sentiment.

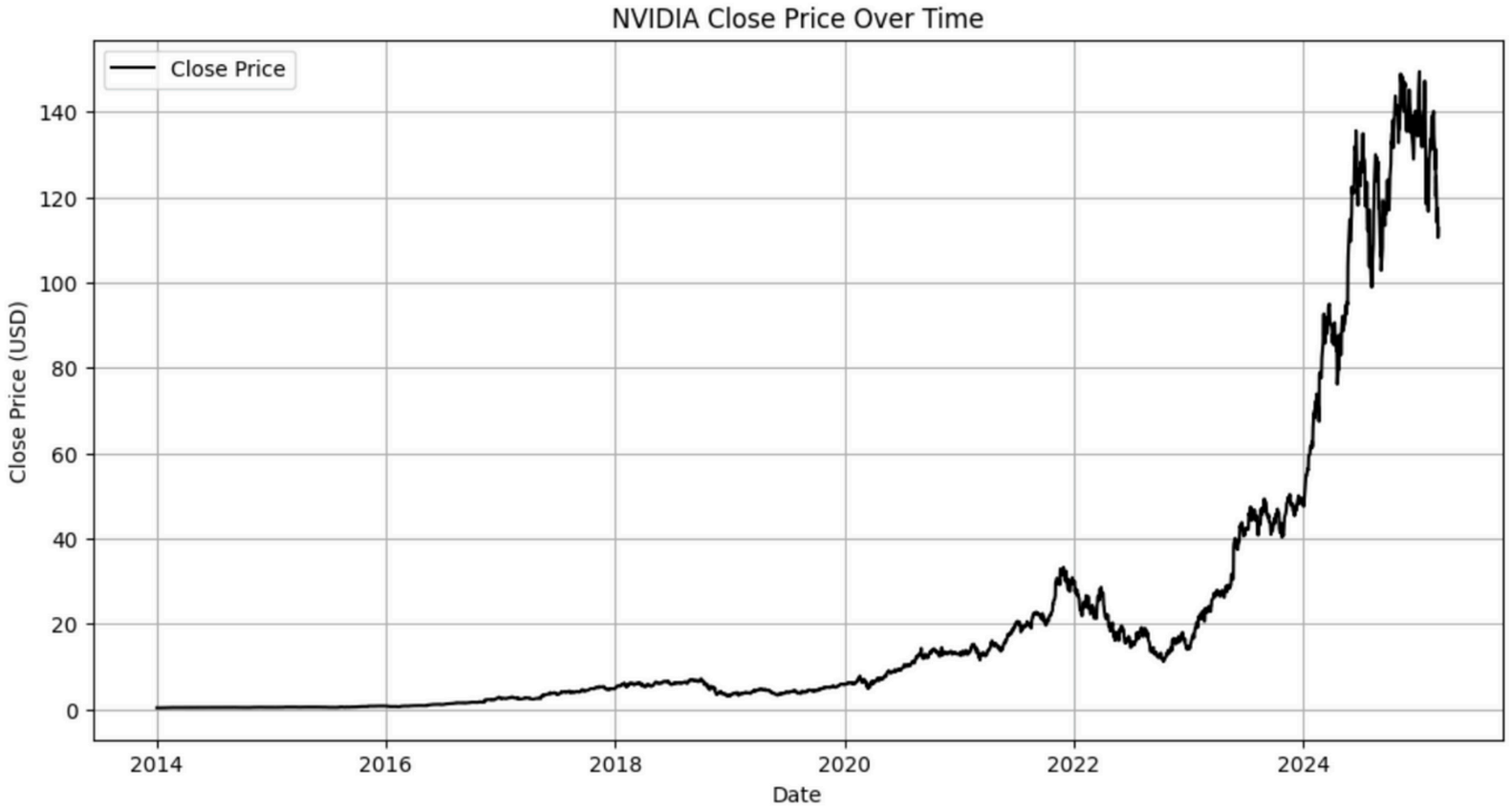
Dataset Used

Source: Yahoo Finance
Period: January 1, 2014 – Jan 1, 2025
Frequency: Daily
Variable Used: Closing price only

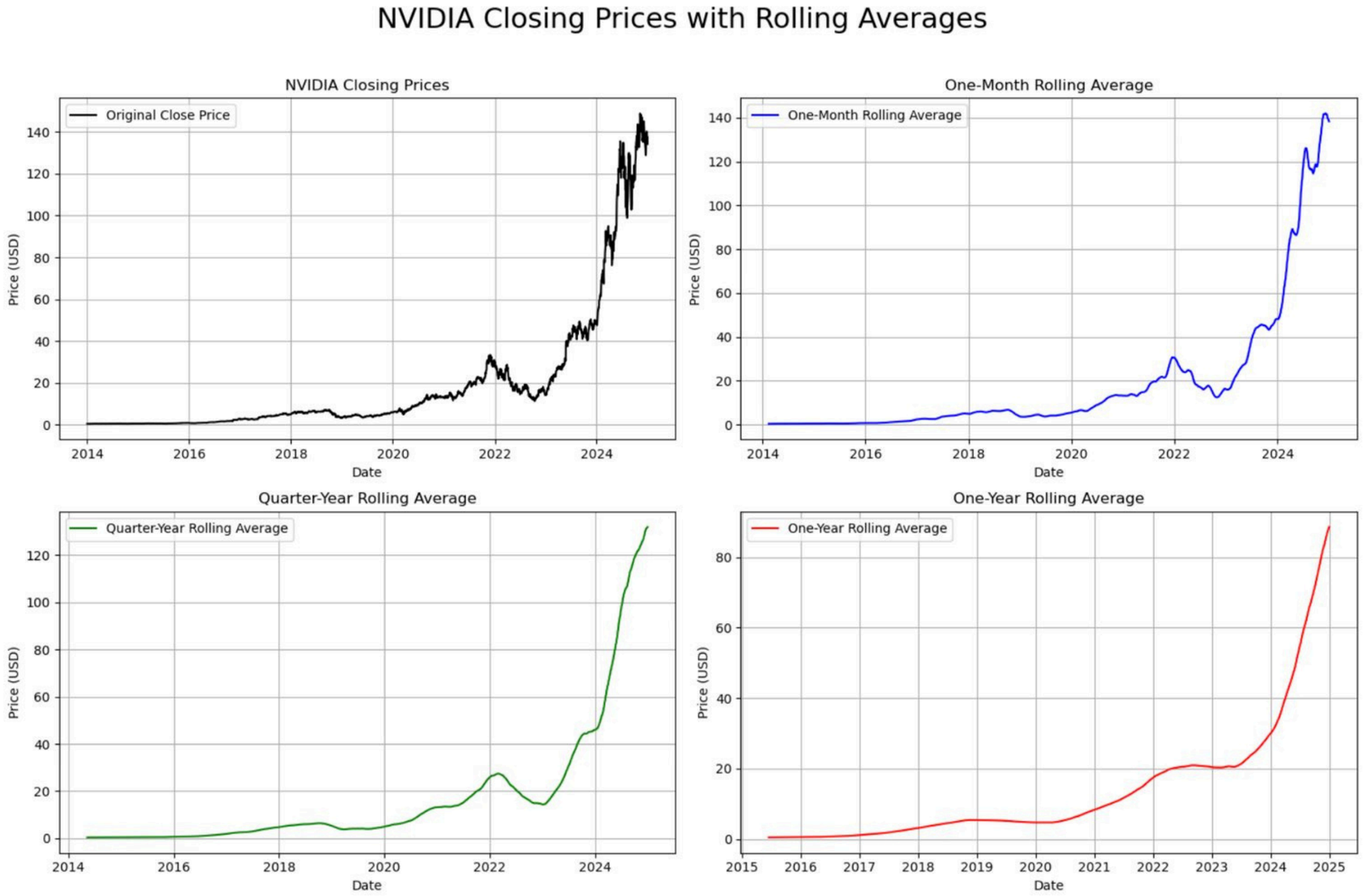
Date	Open	High	Low	Close	Volume
2014-01-02	0.375346	0.376761	0.370631	0.373932	260092000
2014-01-03	0.374639	0.375346	0.368273	0.369452	259332000
2014-01-06	0.373225	0.377233	0.369688	0.374403	409492000
2014-01-07	0.378176	0.381948	0.375582	0.380533	333288000
2014-01-08	0.381948	0.387607	0.380533	0.385720	308192000

Plotting the raw data

A clear upward trend can be visually observed, but the data is too volatile to get any good estimate about either trend or seasonality.



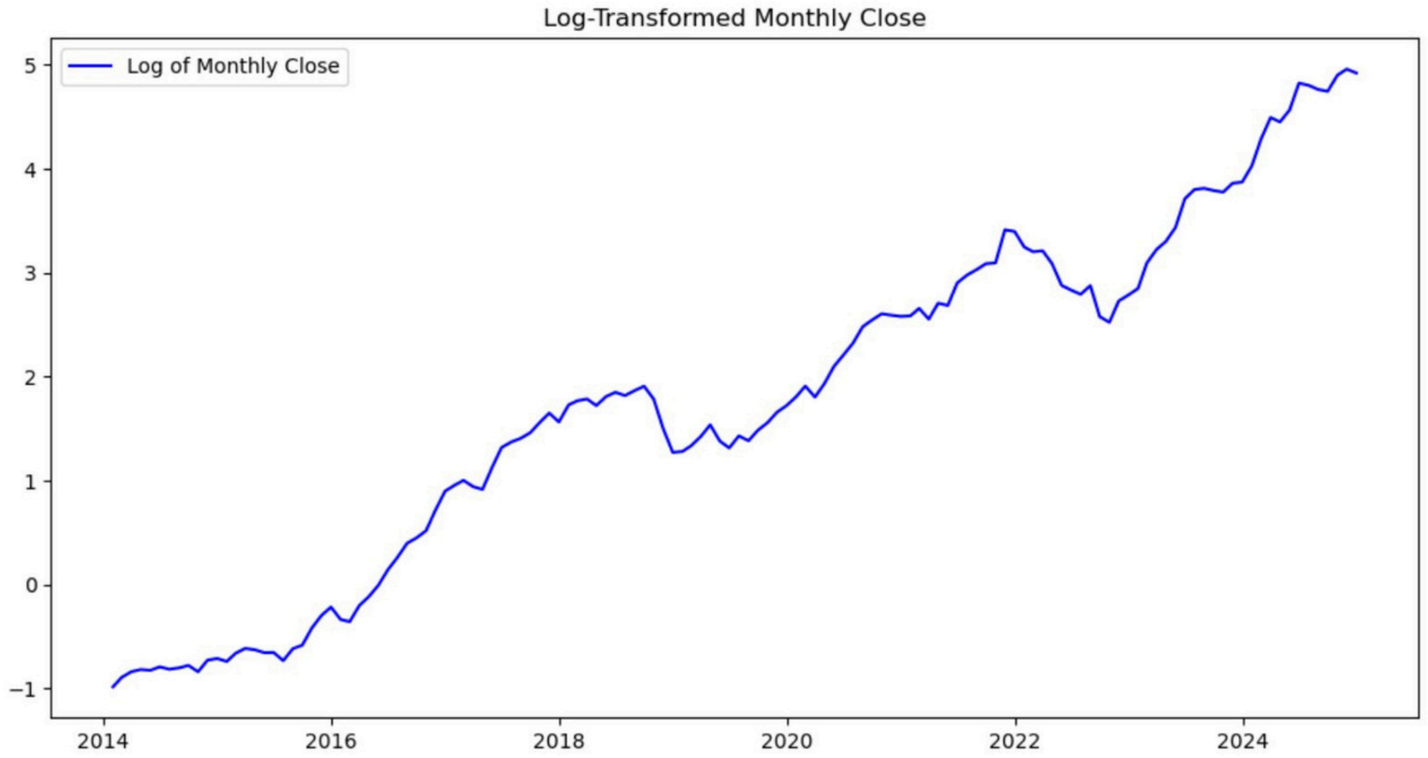
Rolling Averge of Log-Transformed Daily Closing Prices



Applying Log Transformation

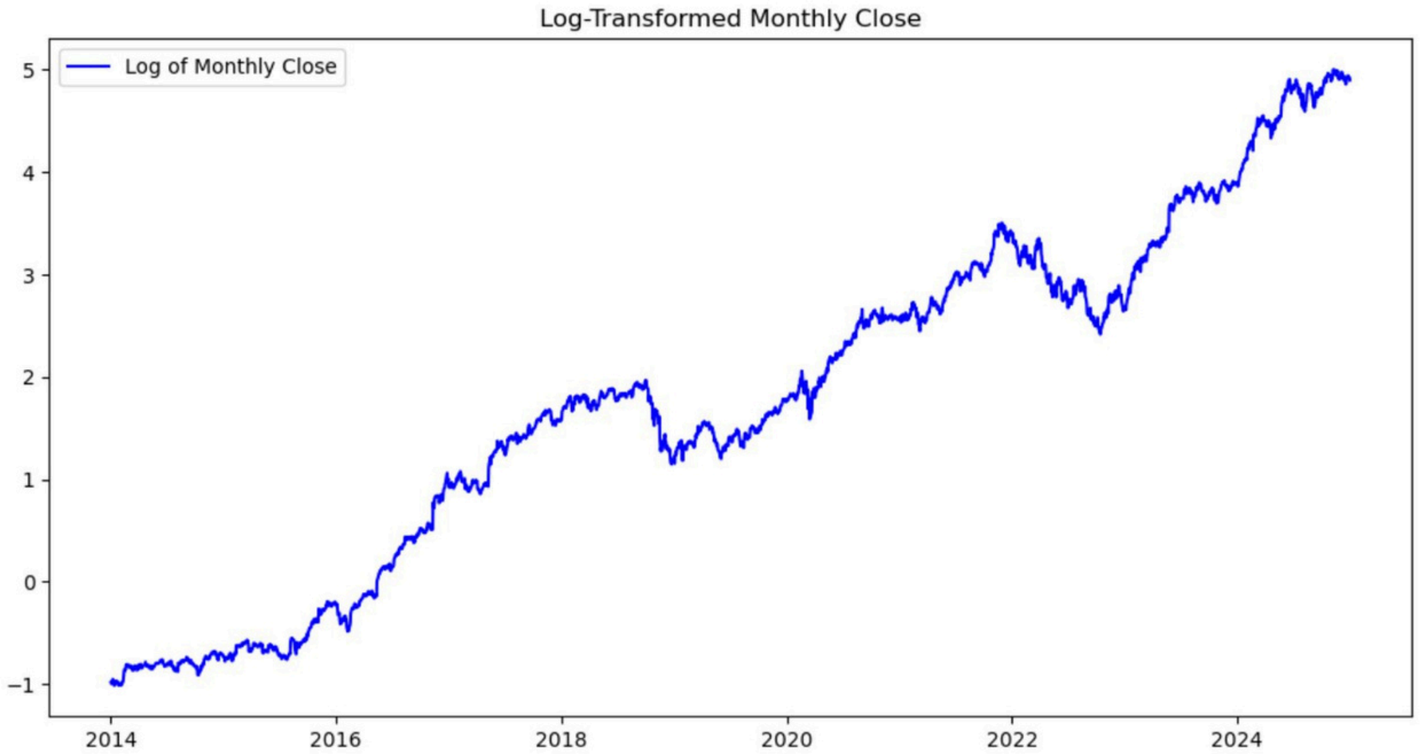
The logarithmic transformation compresses the fluctutions at higher prices allowing to better visually observe the linear trend in the logtransformed closing prices.

$$Yt=\log(Xt)$$



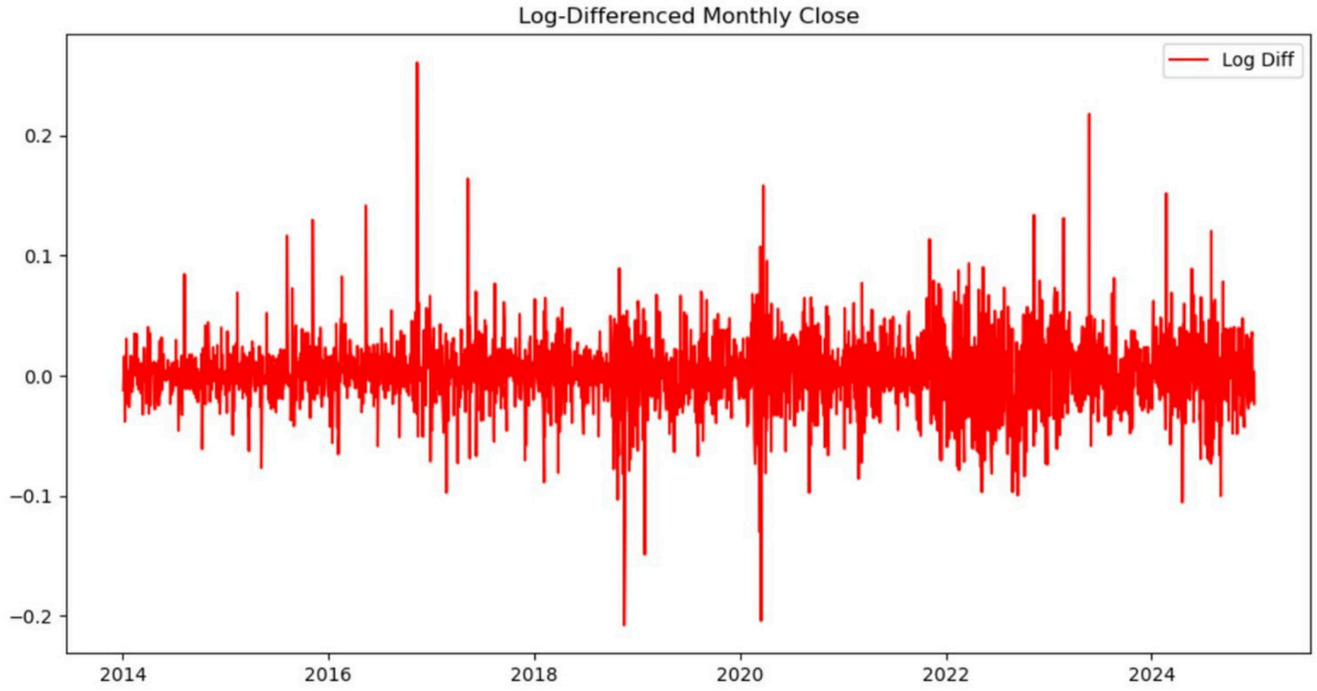
Stationarity testing

- The log-transformed monthly closing prices show a consistent long-term upward trend with reduced volatility at higher values, helping to stabilize variance and reveal the underlying linear growth pattern in NVIDIA’s stock performance over the past decade.
- Initially the ADF test and KPSS tests gave that the data is not stationary



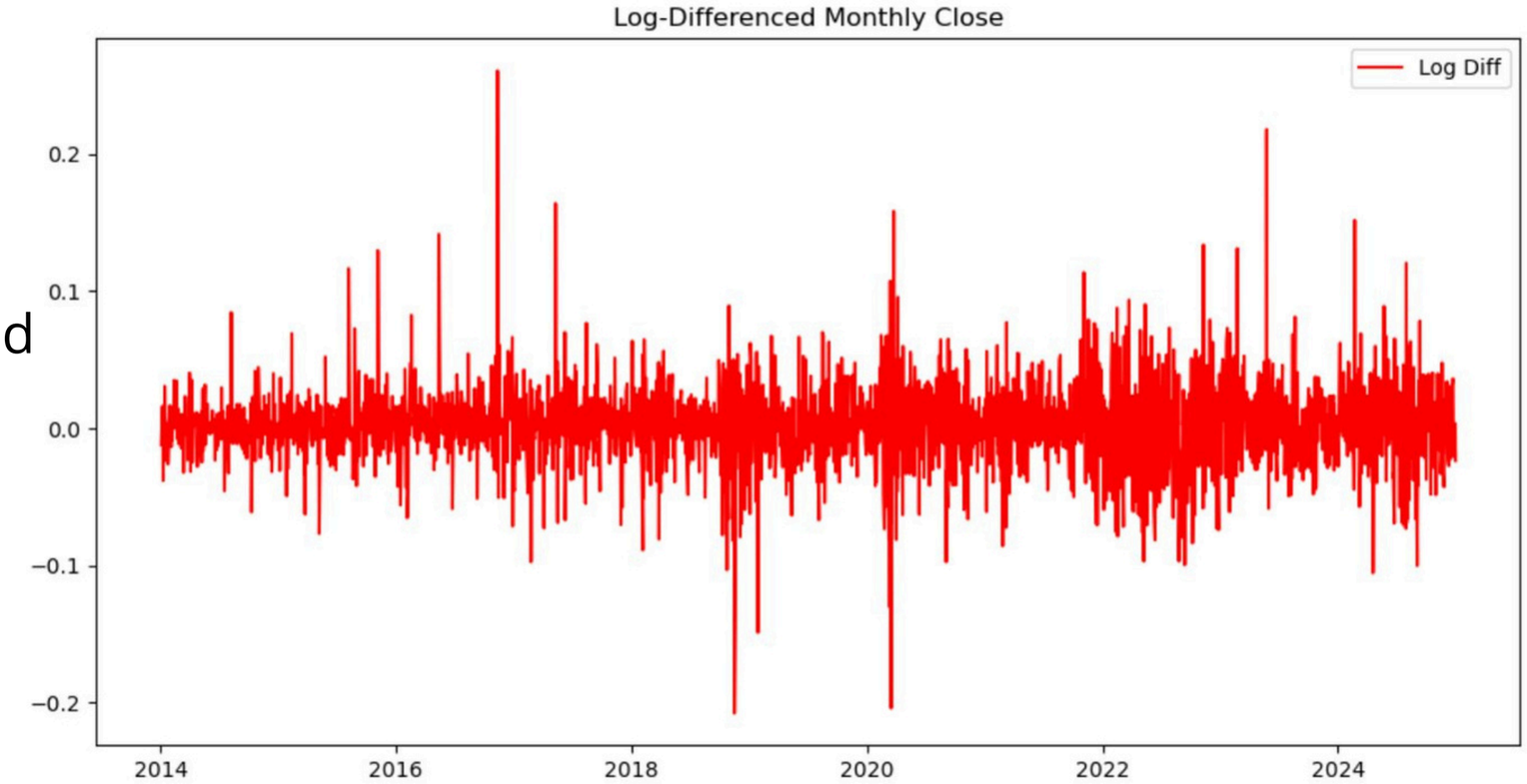
Linear Differencing

After observing a linear trend in the Log-Transformed closing prices, we perform Linear Differencing to eliminate the trend. The log-differenced series removes the upward trend and reveals high-frequency fluctuations around a stable mean, indicating stationarity and making the data suitable for time series modeling like ARIMA by isolating short-term changes in NVIDIA's monthly returns.



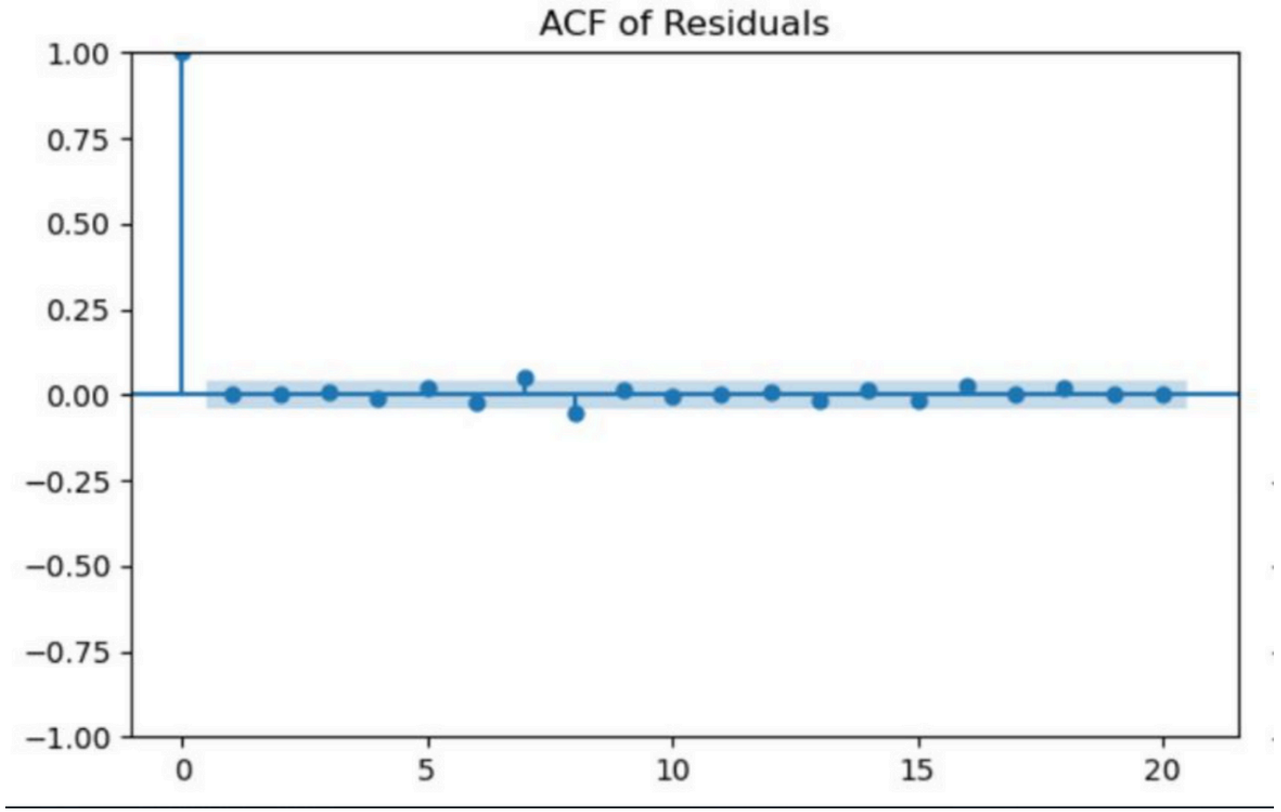
Stationarity Testing

- ADF and KPSS test give that now the data has become stationary after removing the trend



ACF Of Detrended Data

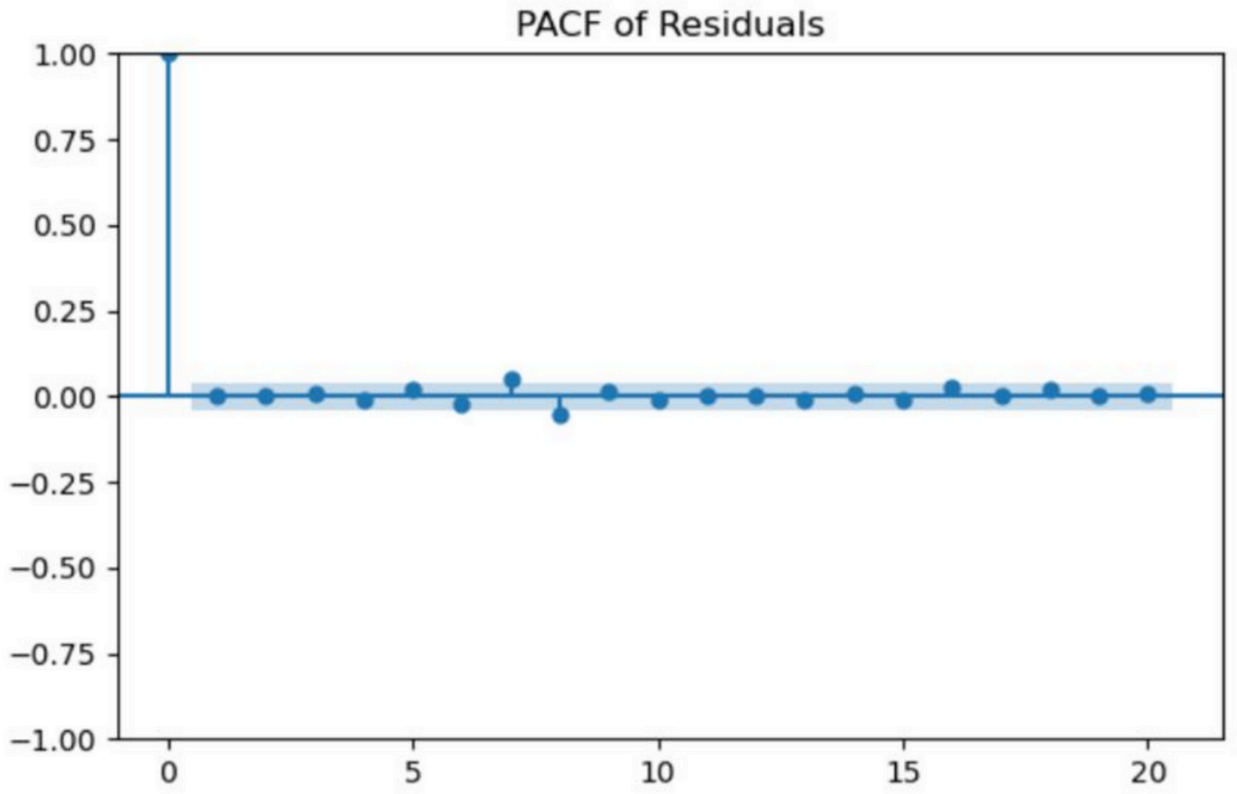
- The ACF plot shows that all autocorrelation values, except at lag 0, lie within the 95% confidence bounds, indicating no significant autocorrelation and confirming that the residuals resemble white noise after model fitting.



ACF of Residuals

PACF Of Detrended Data

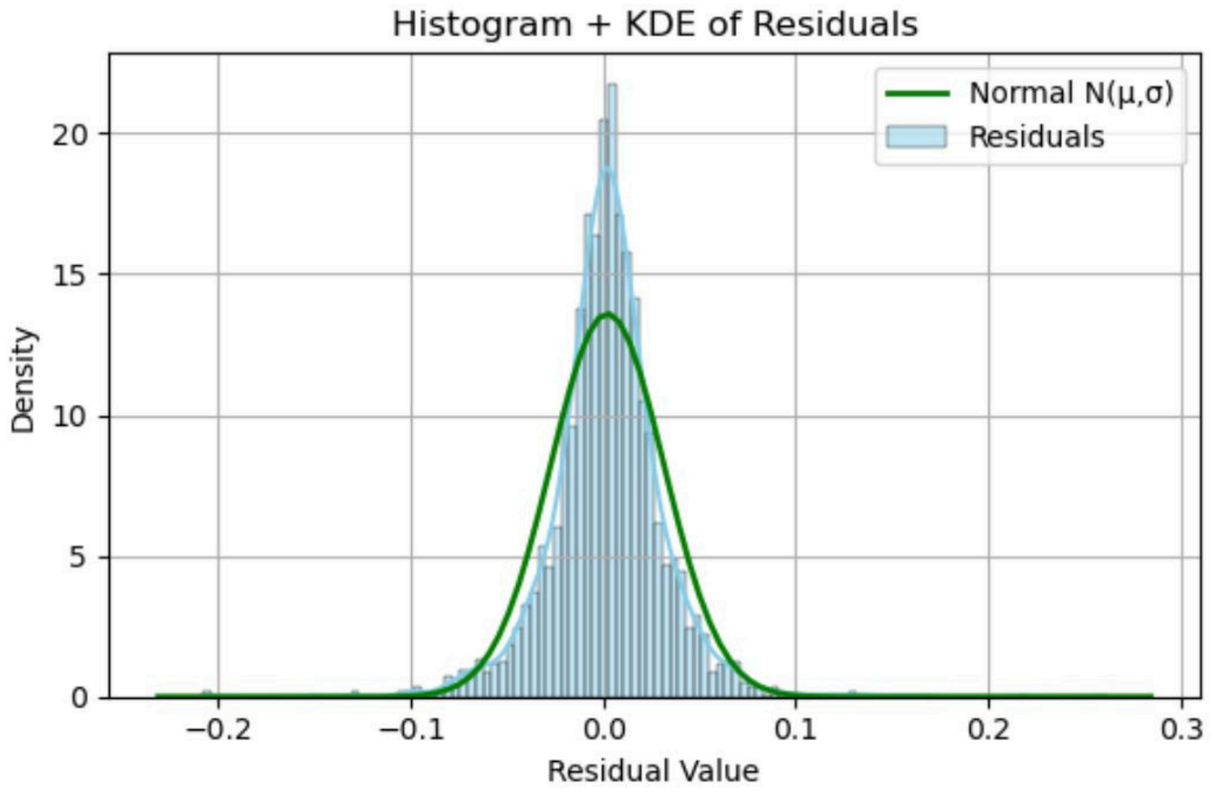
- The PACF plot reveals no significant partial autocorrelations beyond lag 0, suggesting that the residuals do not retain memory from past values, validating the model's effectiveness in eliminating any remaining linear structure or dependence.



PACF of Residuals

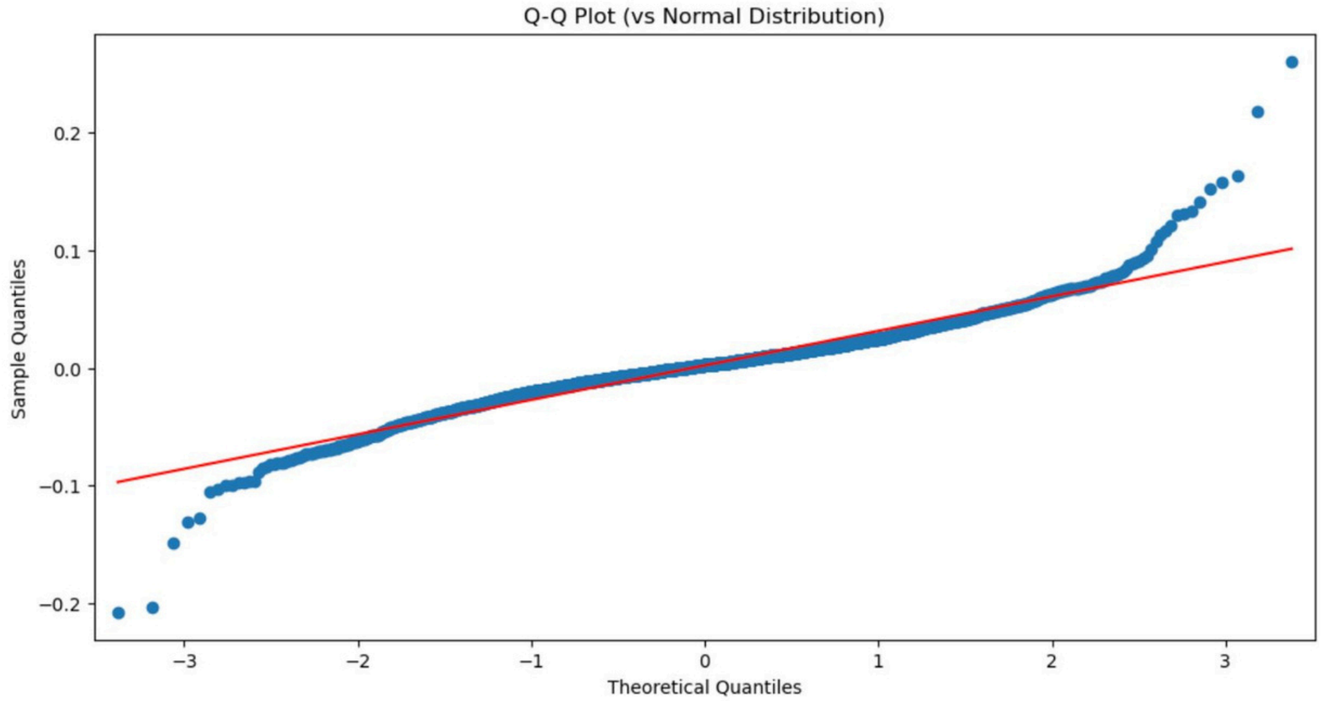
Histogram and KDE of Residuals

The residuals form a symmetric, bell-shaped distribution centered at zero, closely matching the normal curve, indicating the model's errors are unbiased, nearly normally distributed, and free of major outliers, validating the model's appropriateness for time series forecasting.



Q-Q Plot of Residuals

The Q-Q plot shows residuals closely follow a normal distribution with slight deviations at the tails, suggesting the model errors are mostly normal with minimal outliers, thus affirming the reliability of model assumptions for financial time series analysis.



THANK YOU