MA 374 - Financial Engineering Lab06

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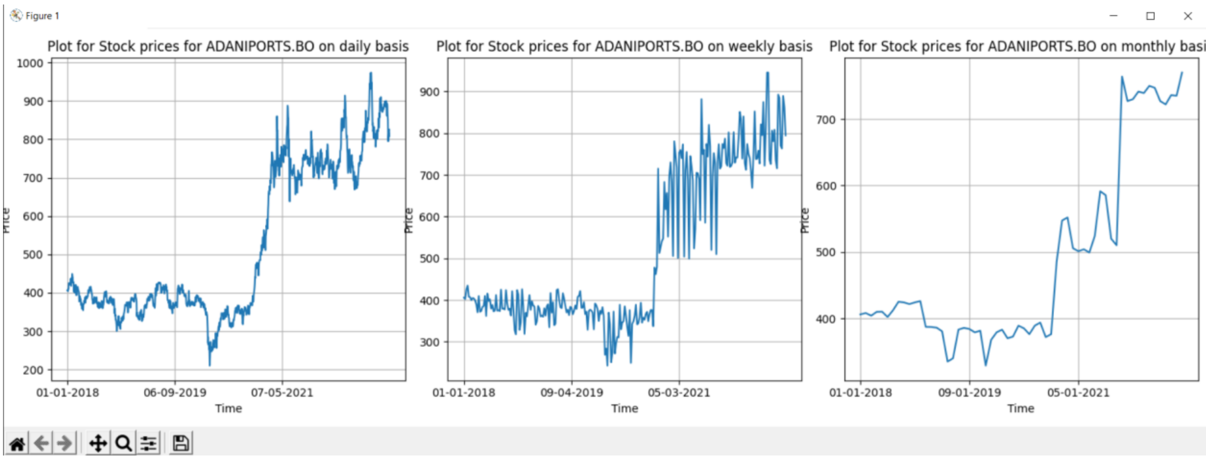
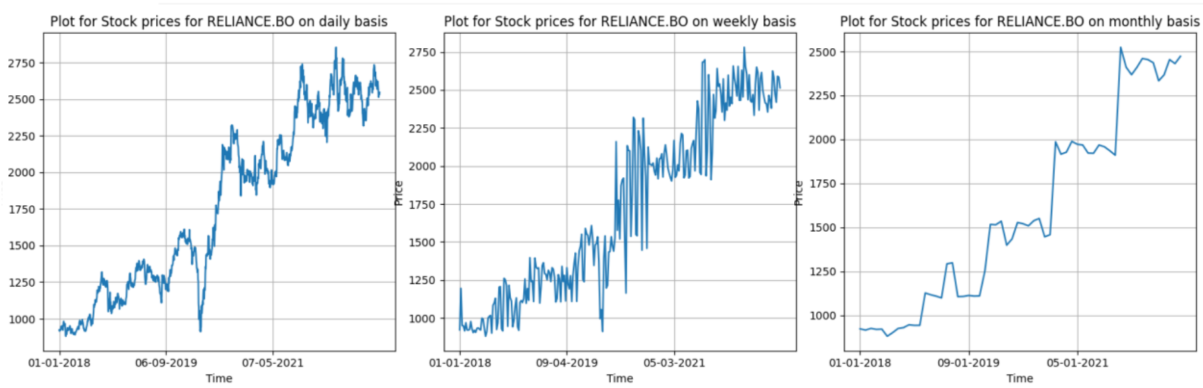
Note: As there are many plots in this lab assignment and it is instructed that we need not put all the plots, I have shown only some plots and relevant ones.

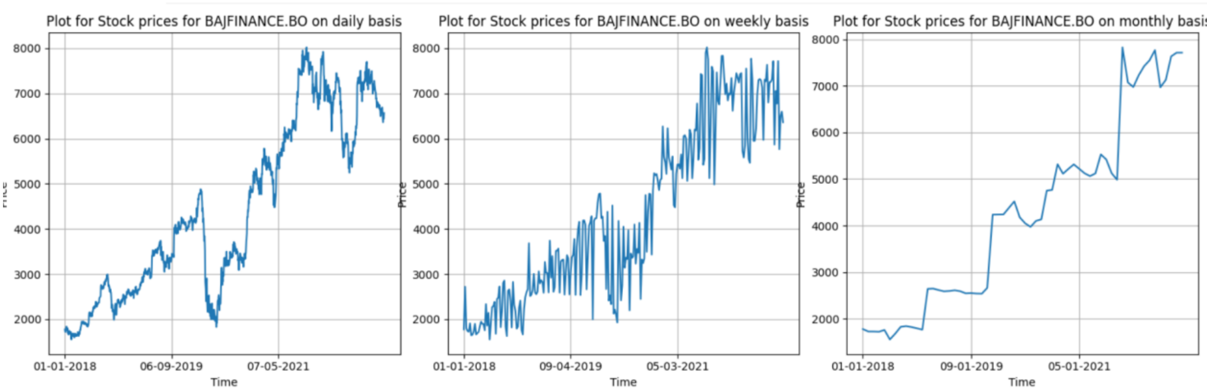
Q1

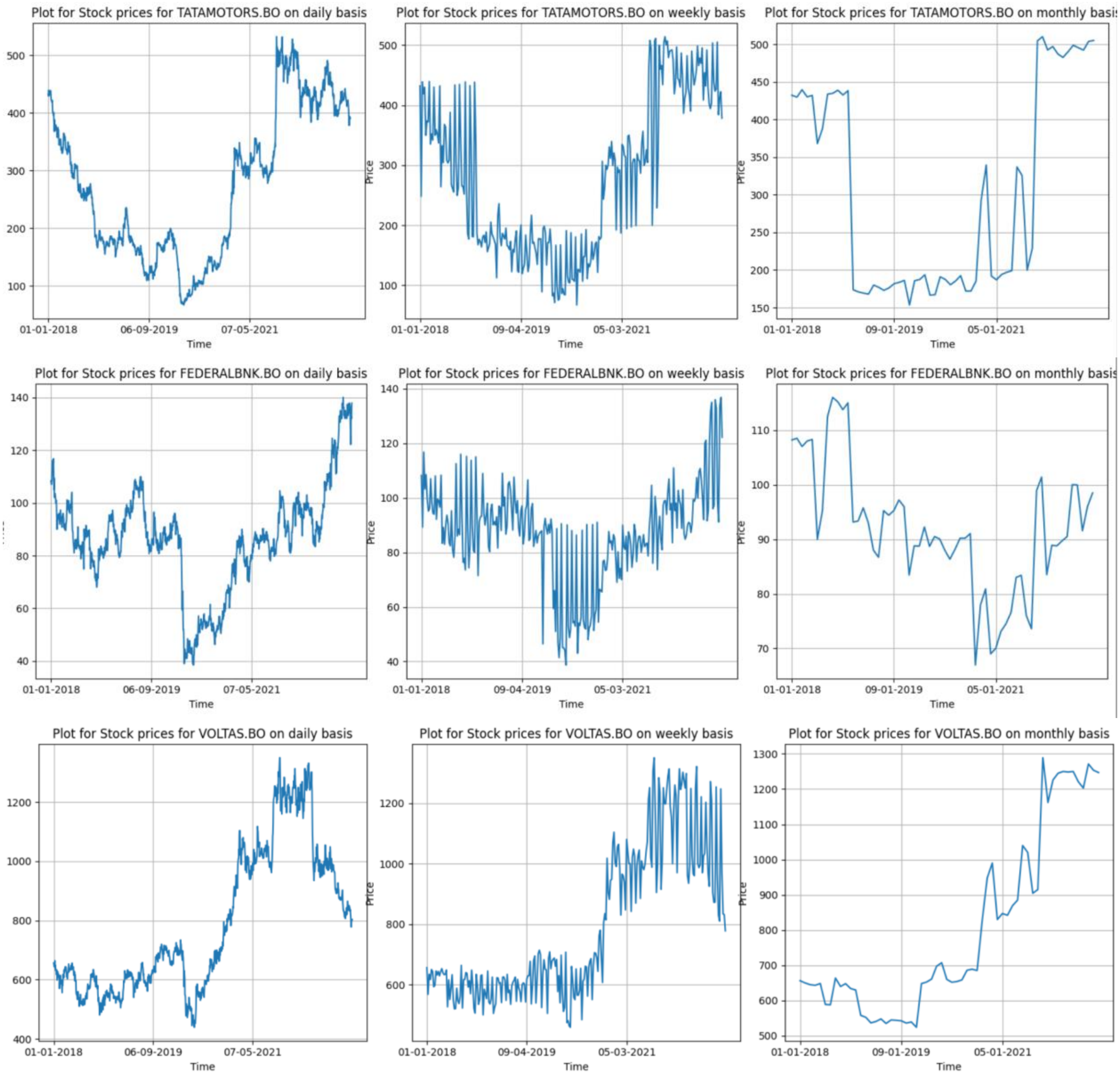
Plot of stock prices against time

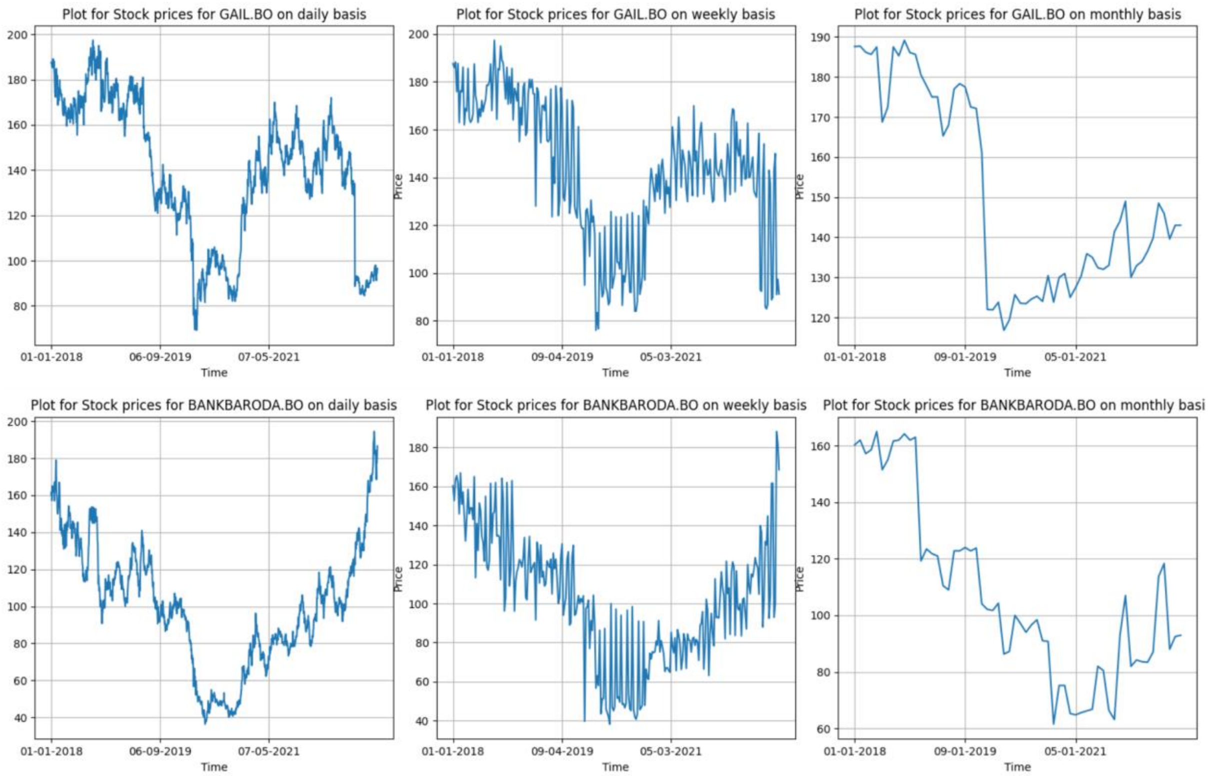
- **bsedata1** plots (price vs time)



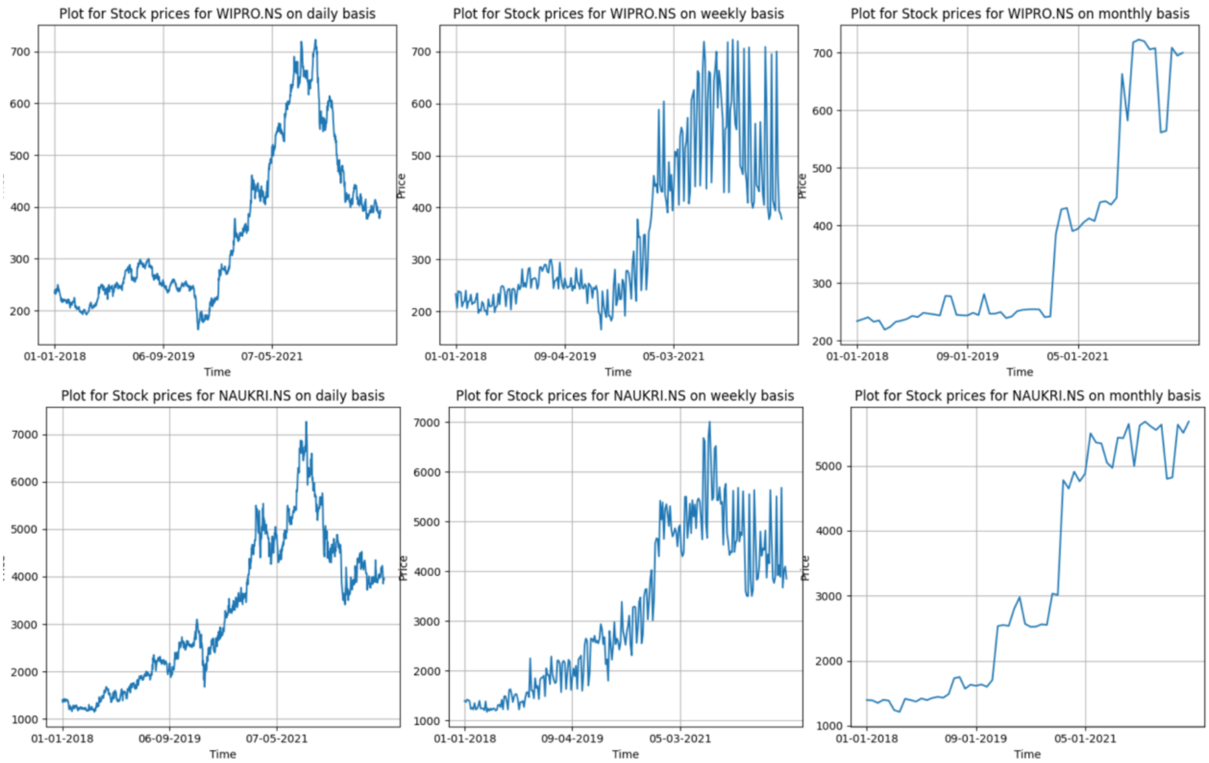


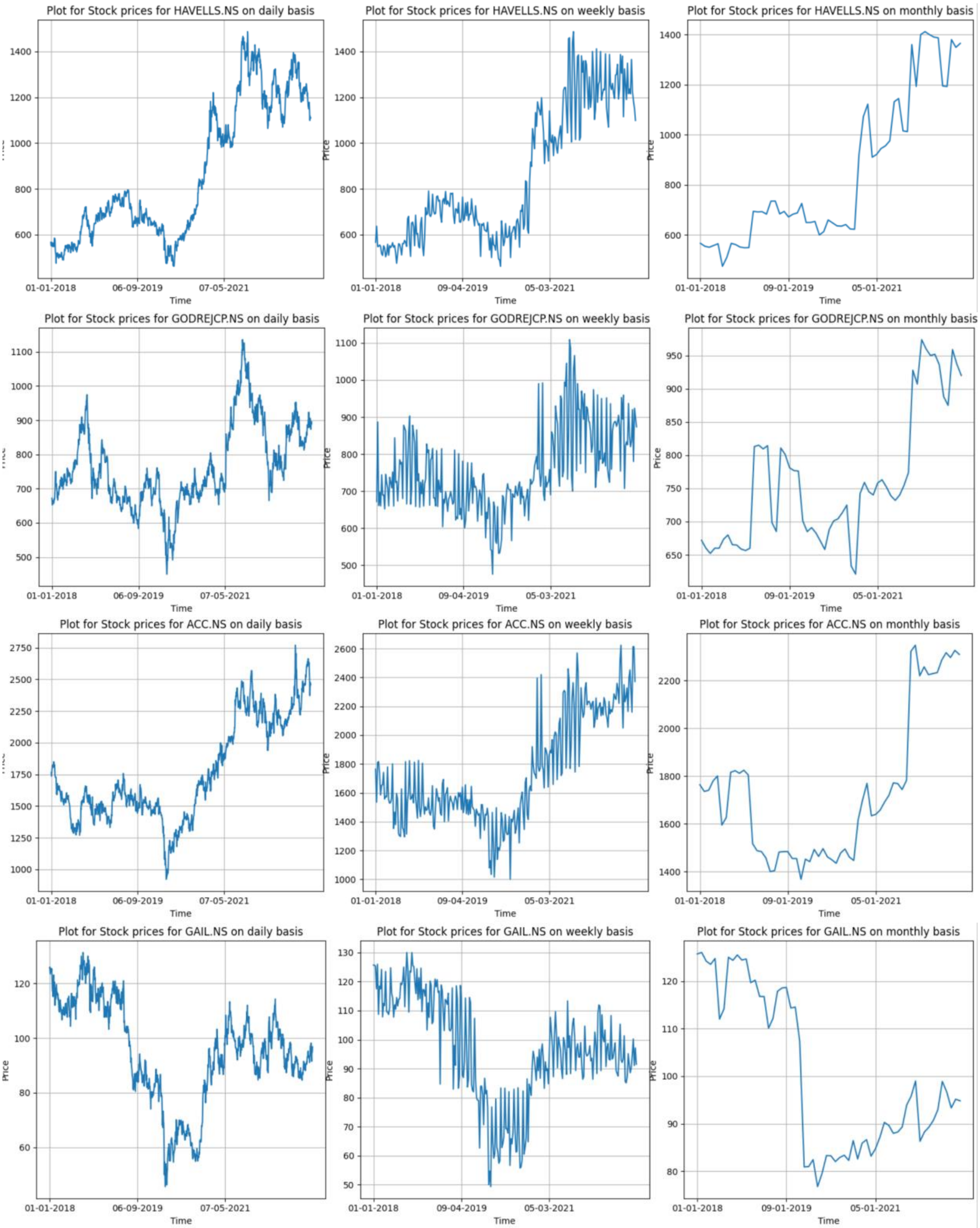



Plot for Stock prices for TATAMOTORS.BO on daily basis
Plot for Stock prices for TATAMOTORS.BO on weekly basis
Plot for Stock prices for TATAMOTORS.BO on monthly basis
Plot for Stock prices for FEDERALBNK.BO on daily basis
Plot for Stock prices for FEDERALBNK.BO on weekly basis
Plot for Stock prices for FEDERALBNK.BO on monthly basis
Plot for Stock prices for VOLTAS.BO on daily basis
Plot for Stock prices for VOLTAS.BO on weekly basis
Plot for Stock prices for VOLTAS.BO on monthly basis
Price
Time
01-01-2018
06-09-2019
07-05-2021
09-04-2019
05-03-2021
09-01-2019
05-01-2021



- **nsedata1** plots (price vs time)

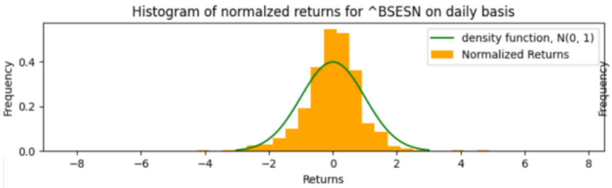


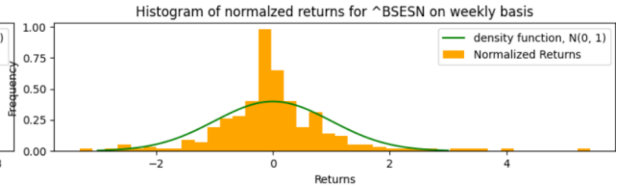


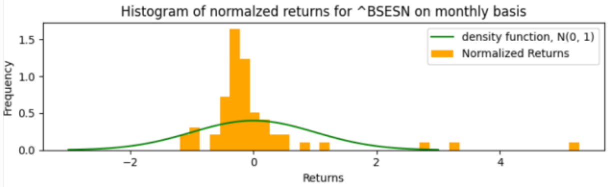
Q2

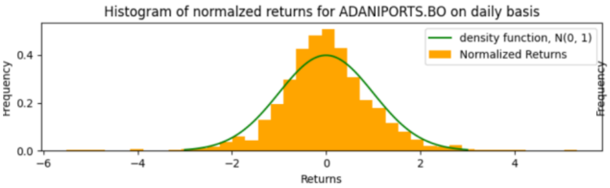
BSE DATA ANALYSIS

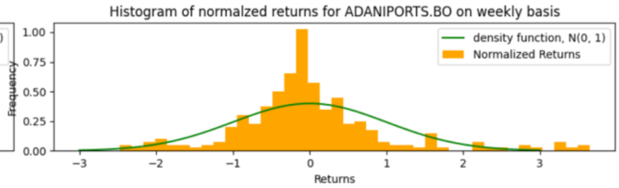
- Plots (not all) for returns (Ri) for **bsedata1** are:

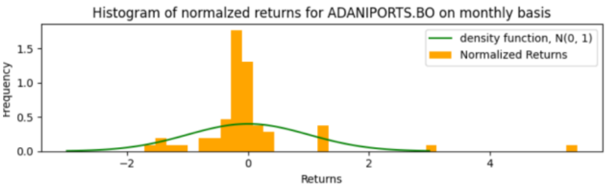


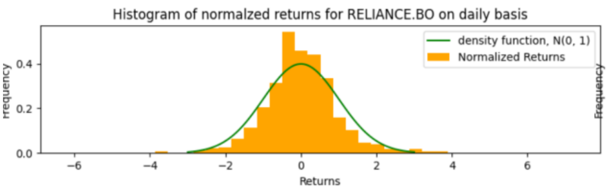


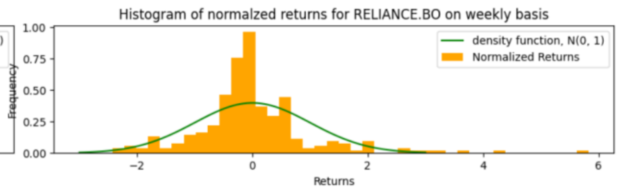


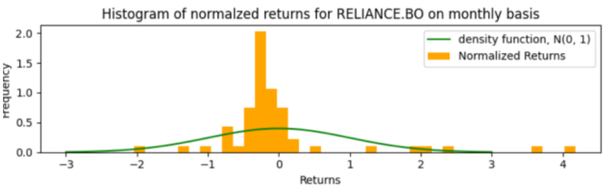


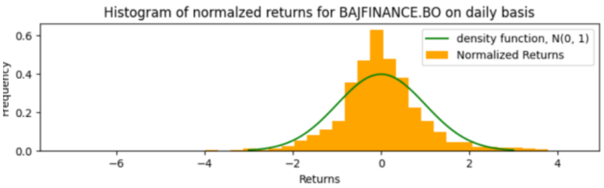


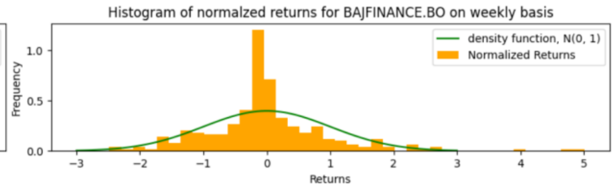


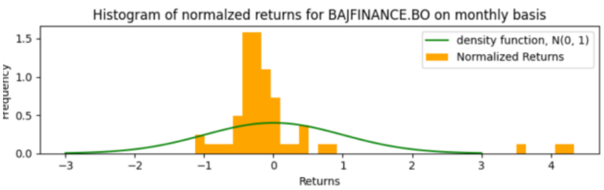


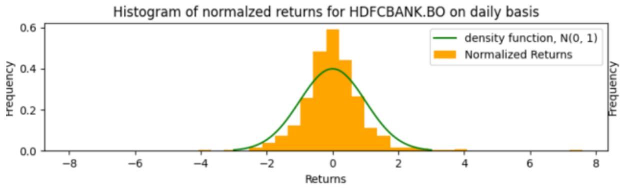


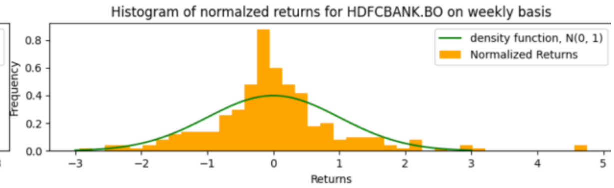


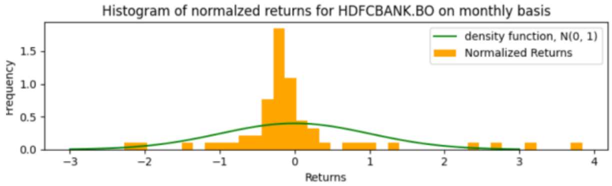


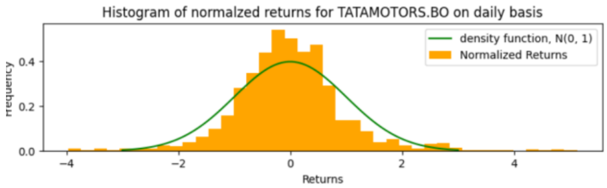


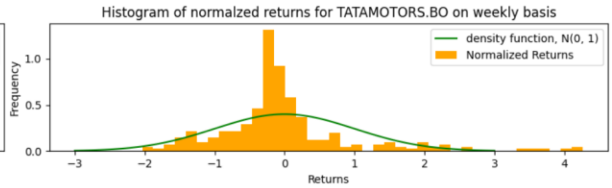


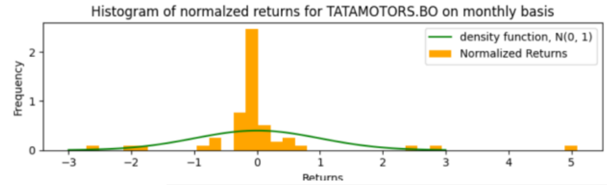

Histogram of normalzed returns for HDFCBANK.BO on daily basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

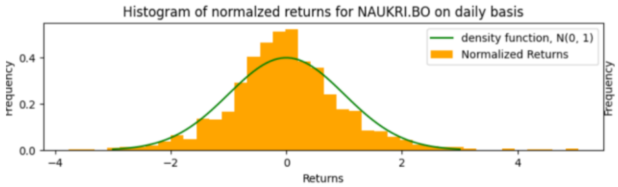

Histogram of normalzed returns for HDFCBANK.BO on weekly basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

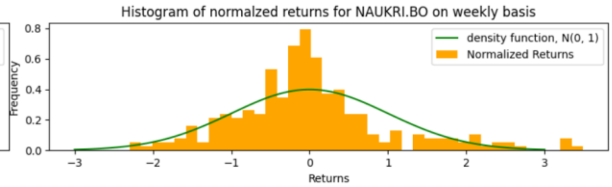

Histogram of normalzed returns for HDFCBANK.BO on monthly basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

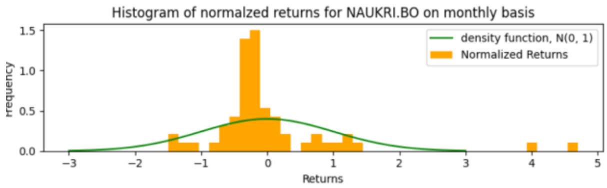

Histogram of normalzed returns for TATAMOTORS.BO on daily basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

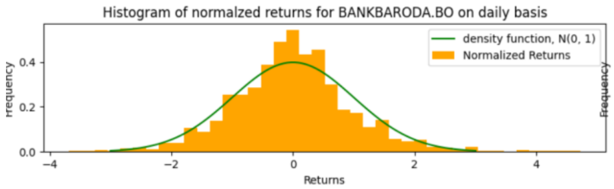

Histogram of normalzed returns for TATAMOTORS.BO on weekly basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

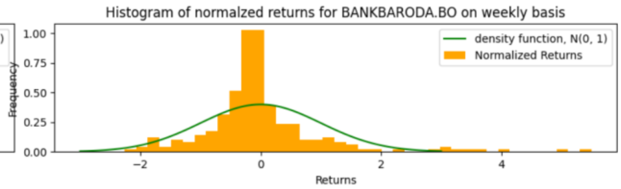

Histogram of normalzed returns for TATAMOTORS.BO on monthly basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

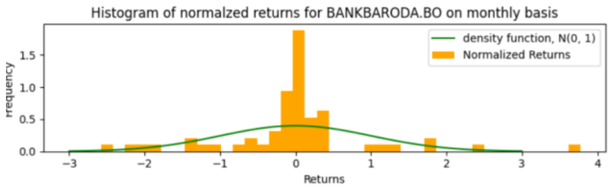

Histogram of normalzed returns for NAUKRI.BO on daily basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns


Histogram of normalzed returns for NAUKRI.BO on weekly basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

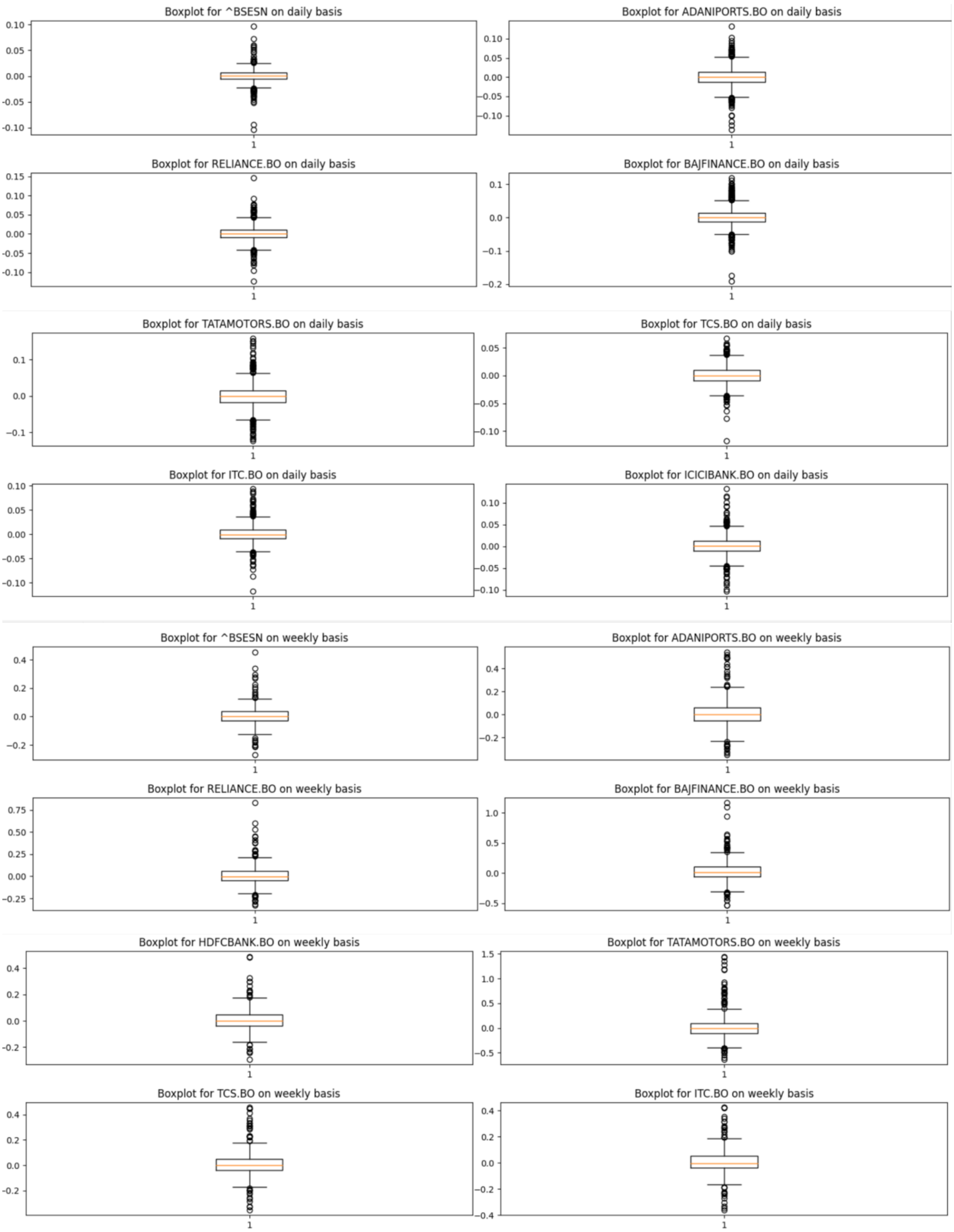

Histogram of normalzed returns for NAUKRI.BO on monthly basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

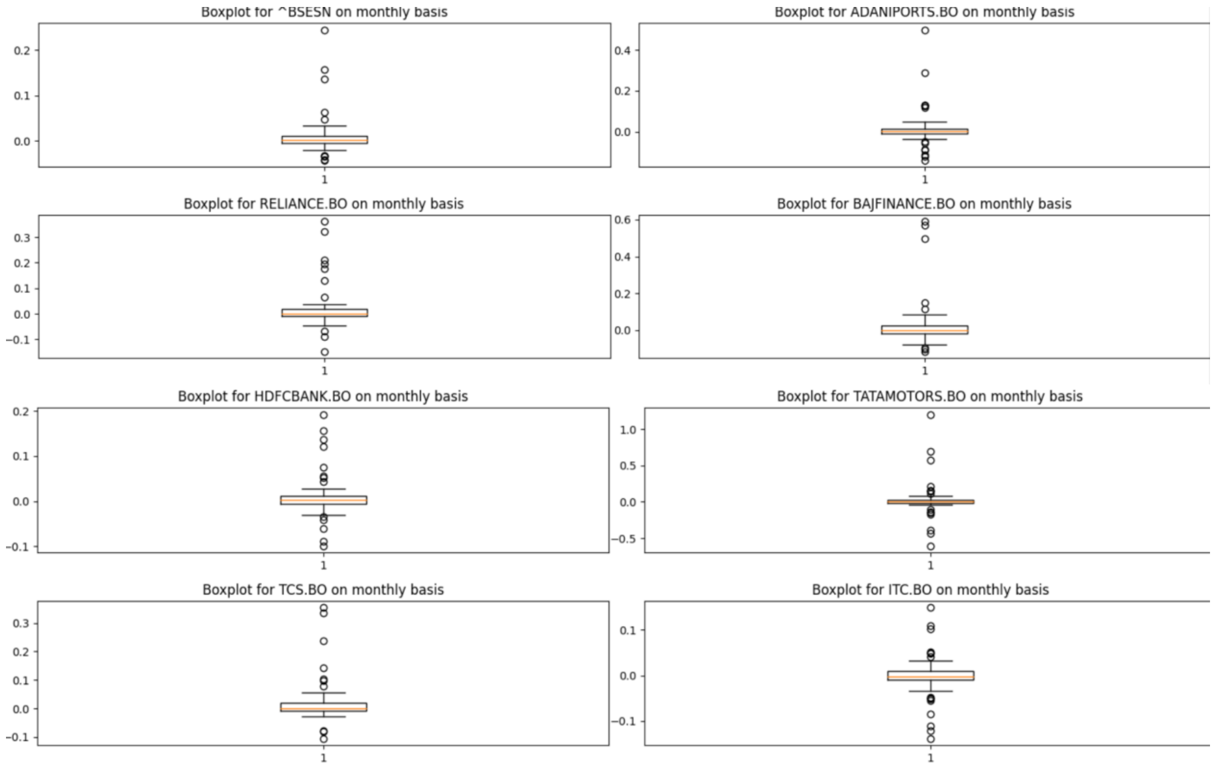

Histogram of normalzed returns for BANKBARODA.BO on daily basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns


Histogram of normalzed returns for BANKBARODA.BO on weekly basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

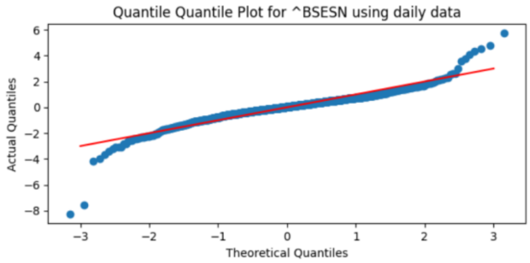

Histogram of normalzed returns for BANKBARODA.BO on monthly basis
density function, N(0, 1)
Normalized Returns
Frequency
Returns

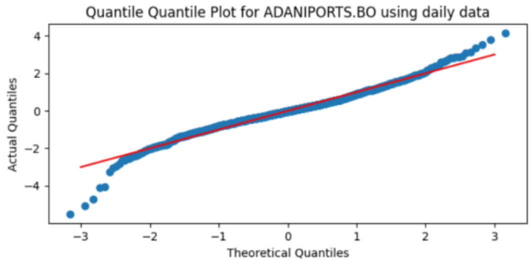
- **boxplots** for bsedata1 are as:

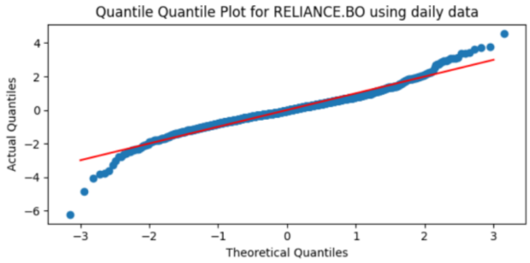


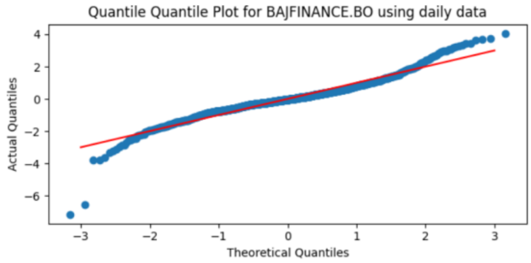

Boxplot for ^BSESN on monthly basis
0.2
0.1
0.0
1
Boxplot for ADANIPORTS.BO on monthly basis
0.4
0.2
0.0
1
Boxplot for RELIANCE.BO on monthly basis
0.3
0.2
0.1
0.0
−0.1
1
Boxplot for BAJFINANCE.BO on monthly basis
0.6
0.4
0.2
0.0
1
Boxplot for HDFCBANK.BO on monthly basis
0.2
0.1
0.0
−0.1
1
Boxplot for TATAMOTORS.BO on monthly basis
1.0
0.5
0.0
−0.5
1
Boxplot for TCS.BO on monthly basis
0.3
0.2
0.1
0.0
−0.1
1
Boxplot for ITC.BO on monthly basis
0.1
0.0
−0.1
1

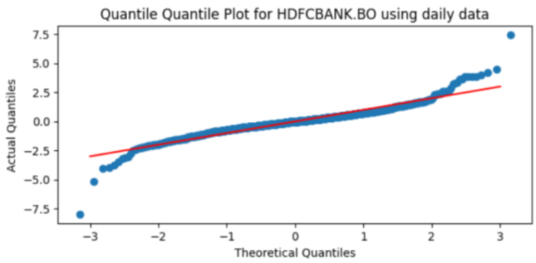
- **quantile-quantile** plots for bsedata1 are as:

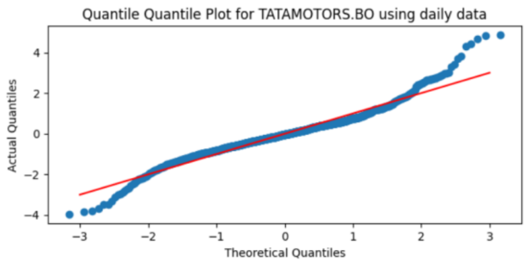


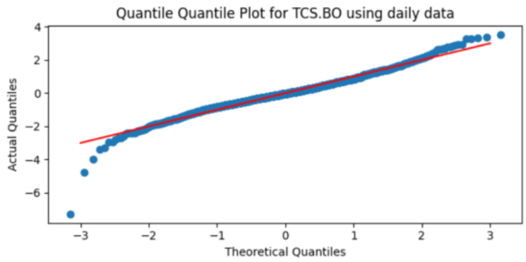


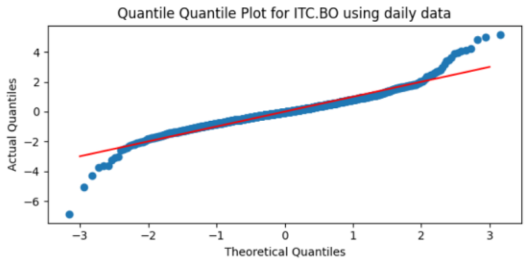


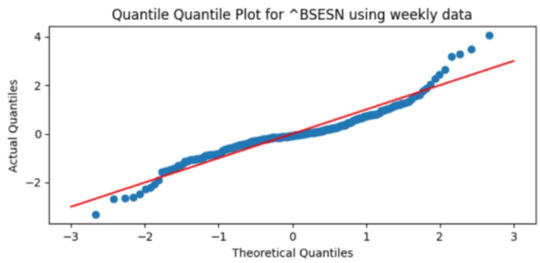


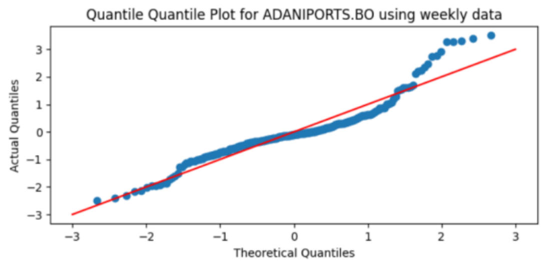


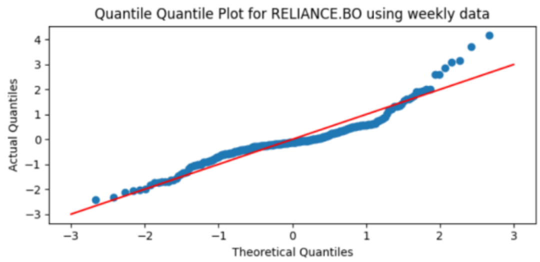


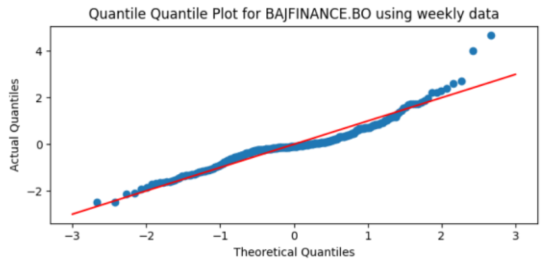


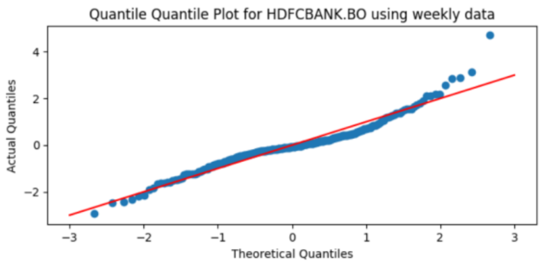


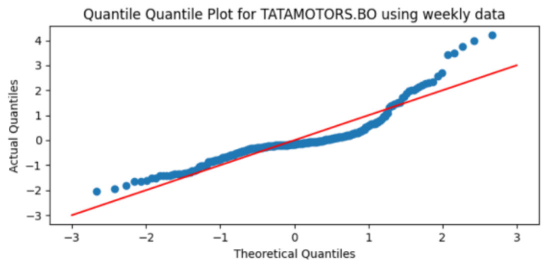


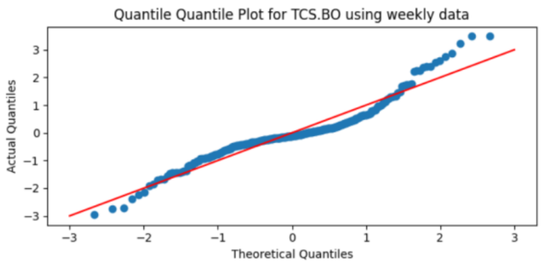


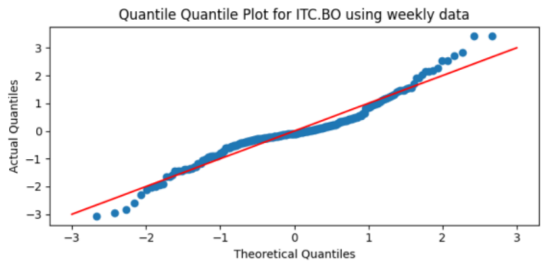


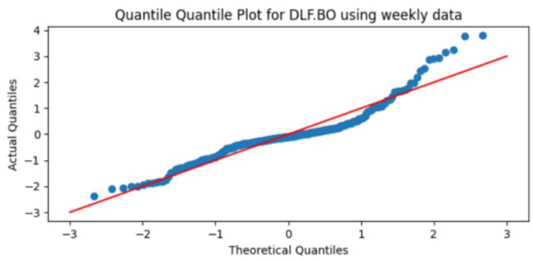


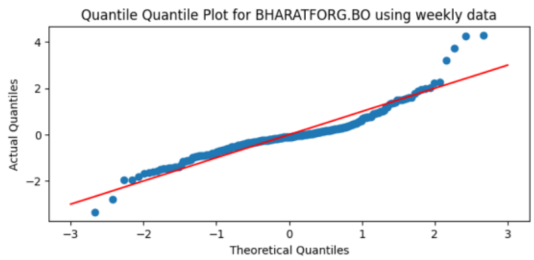

Quantile Quantile Plot for HDFCBANK.BO using weekly data
Actual Quantiles
Theoretical Quantiles

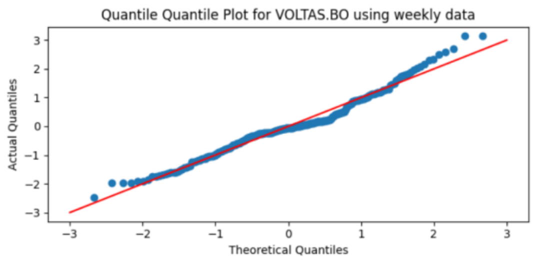

Quantile Quantile Plot for TATAMOTORS.BO using weekly data
Actual Quantiles
Theoretical Quantiles

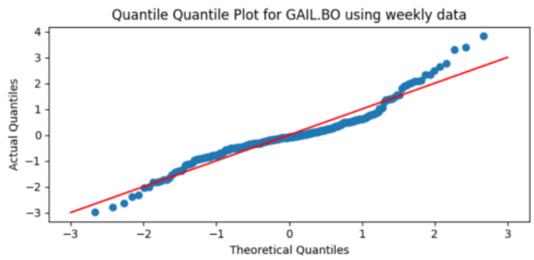

Quantile Quantile Plot for TCS.BO using weekly data
Actual Quantiles
Theoretical Quantiles

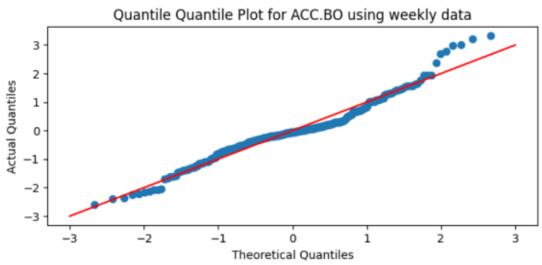

Quantile Quantile Plot for ITC.BO using weekly data
Actual Quantiles
Theoretical Quantiles

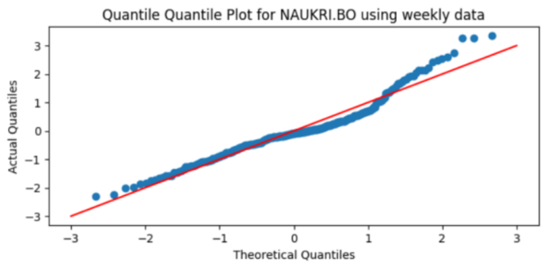

Quantile Quantile Plot for DLF.BO using weekly data
Actual Quantiles
Theoretical Quantiles

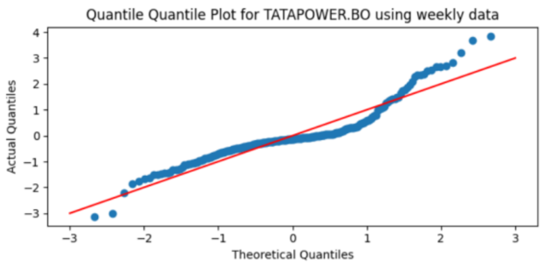

Quantile Quantile Plot for BHARATFORG.BO using weekly data
Actual Quantiles
Theoretical Quantiles

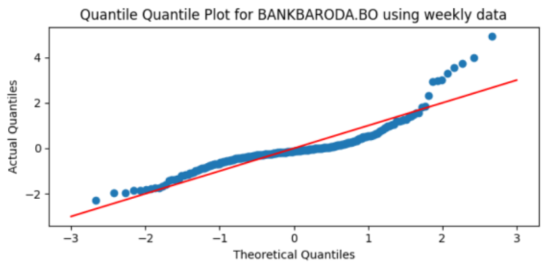

Quantile Quantile Plot for VOLTAS.BO using weekly data
Actual Quantiles
Theoretical Quantiles


Quantile Quantile Plot for GAIL.BO using weekly data
Actual Quantiles
Theoretical Quantiles


Quantile Quantile Plot for ACC.BO using weekly data
Actual Quantiles
Theoretical Quantiles

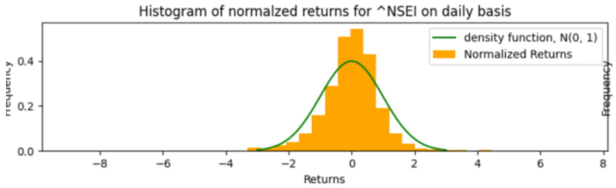

Quantile Quantile Plot for NAUKRI.BO using weekly data
Actual Quantiles
Theoretical Quantiles

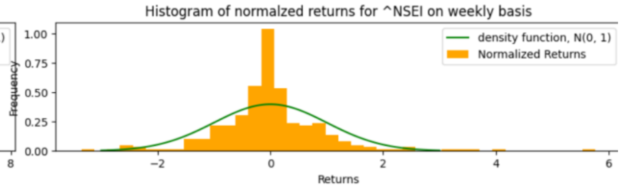

Quantile Quantile Plot for TATAPOWER.BO using weekly data
Actual Quantiles
Theoretical Quantiles

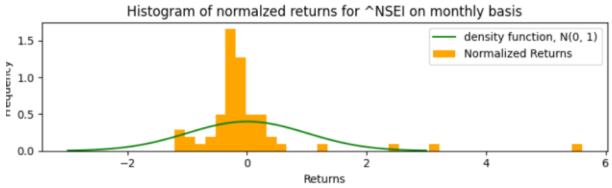

Quantile Quantile Plot for BANKBARODA.BO using weekly data
Actual Quantiles
Theoretical Quantiles

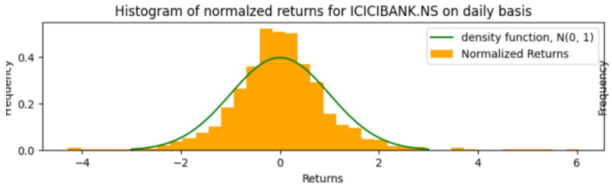
NSE DATA ANALYSIS

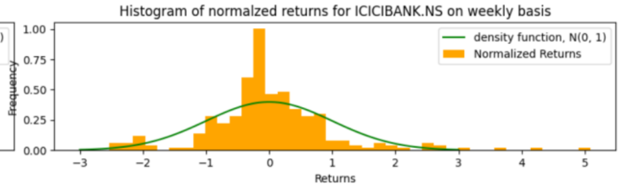
- Plots (not all) for returns (Ri) for **nsedata1** are:

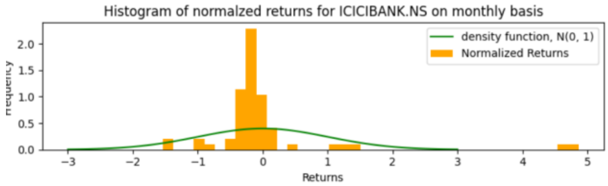


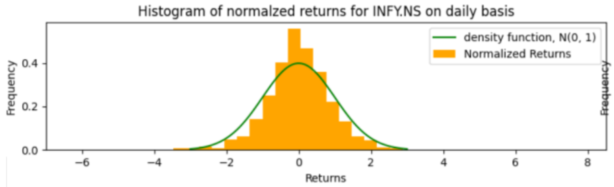


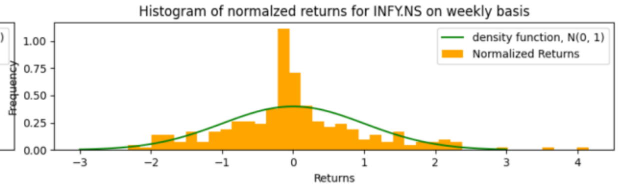


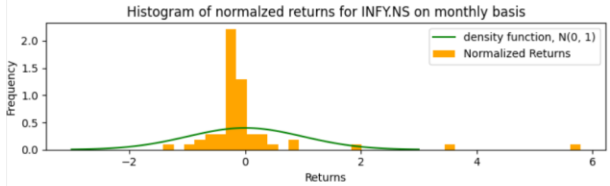


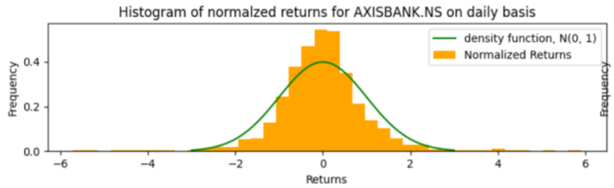


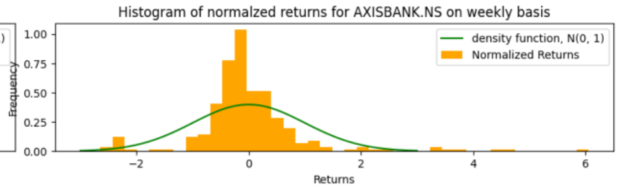


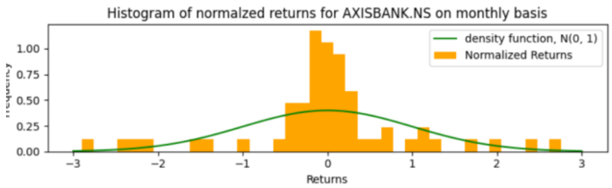


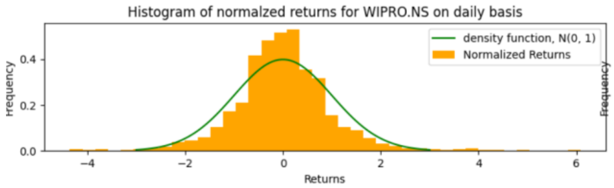


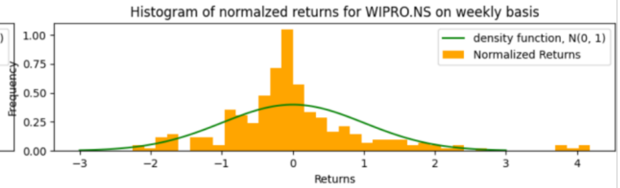


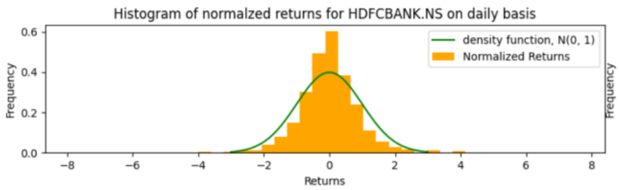


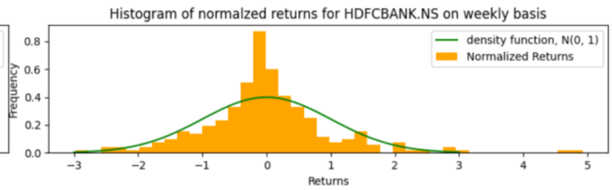


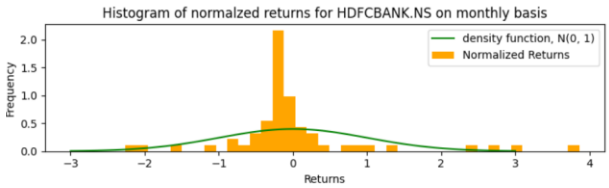


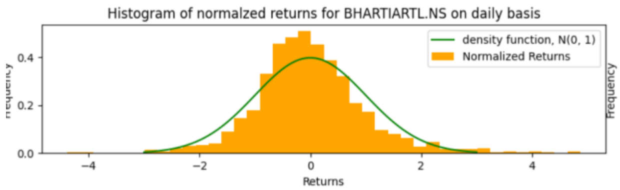


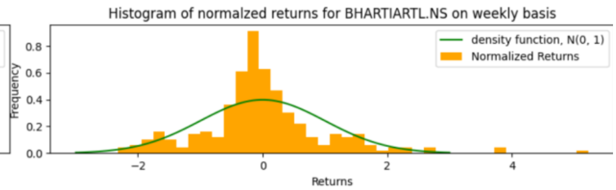


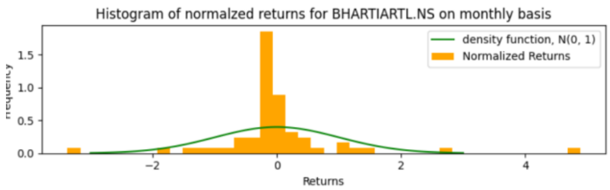


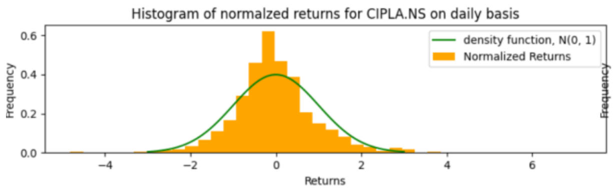


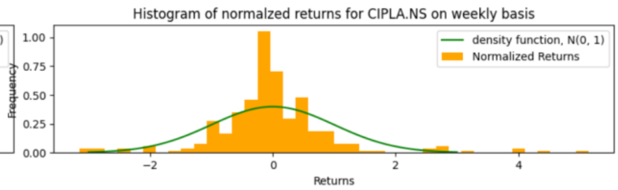


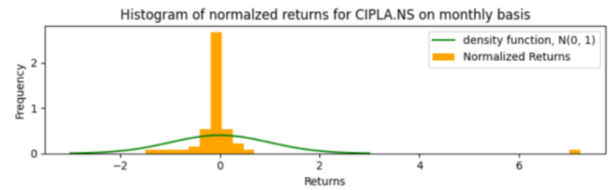




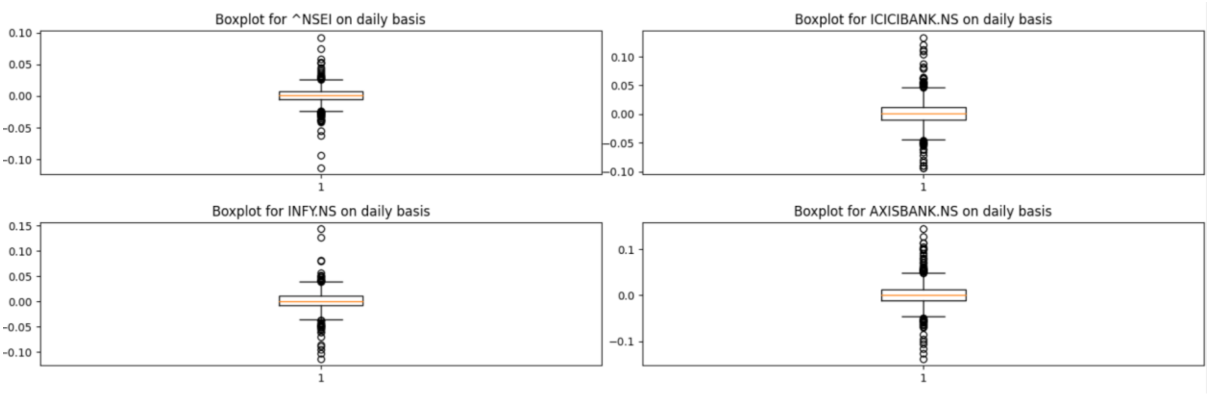




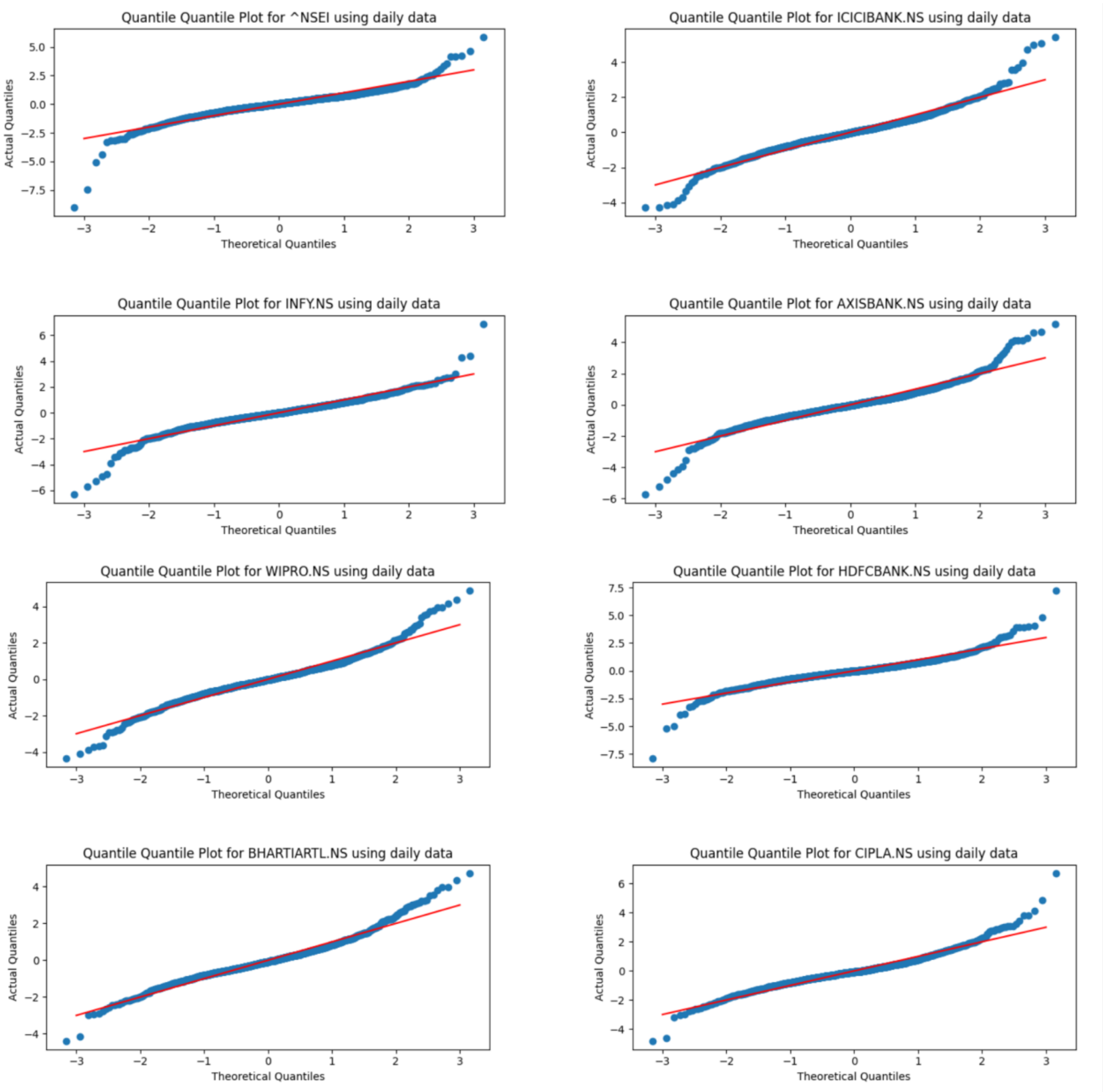


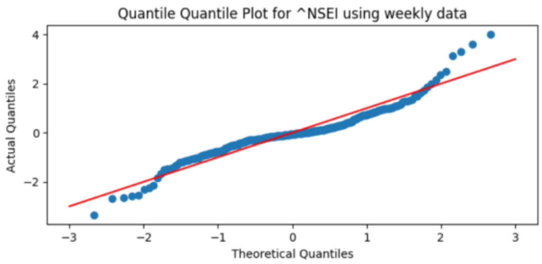


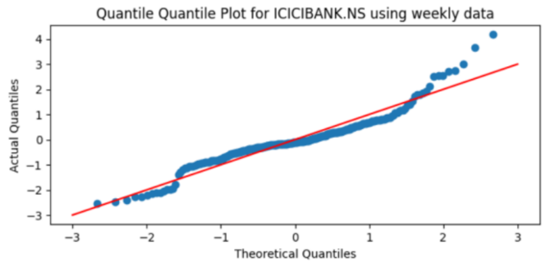
- **boxplots** for nsedata1 are as:

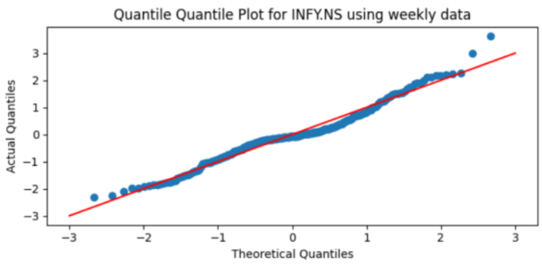


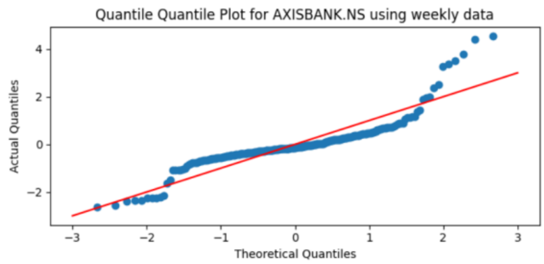
- **quantile-quantile** plots for nsedata1 are as:

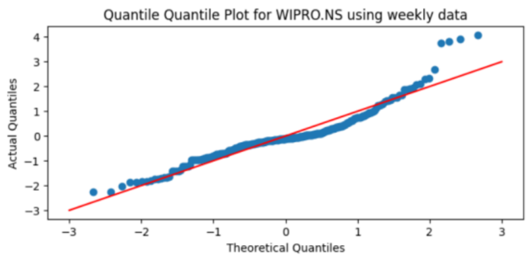


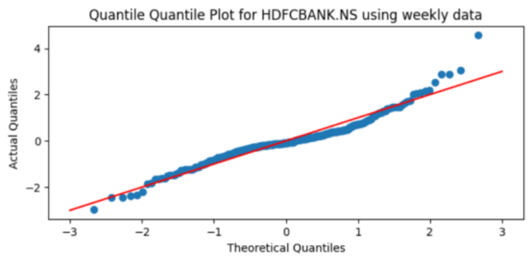

Quantile Quantile Plot for ^NSEI using weekly data
Actual Quantiles
Theoretical Quantiles

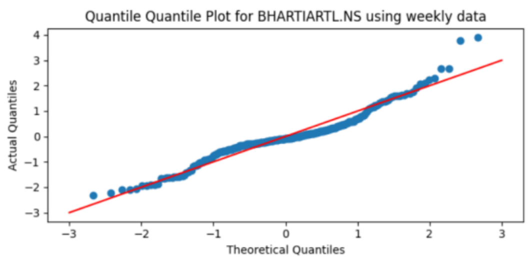

Quantile Quantile Plot for ICICIBANK.NS using weekly data
Actual Quantiles
Theoretical Quantiles

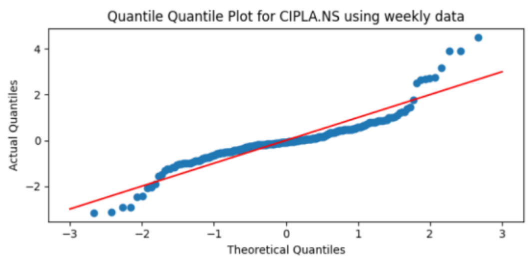

Quantile Quantile Plot for INFY.NS using weekly data
Actual Quantiles
Theoretical Quantiles

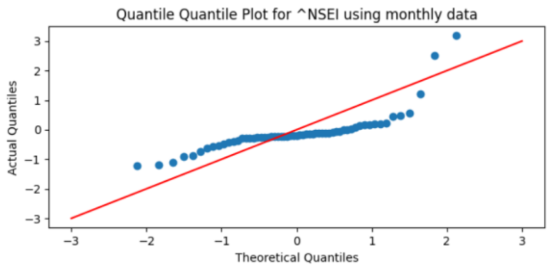

Quantile Quantile Plot for AXISBANK.NS using weekly data
Actual Quantiles
Theoretical Quantiles

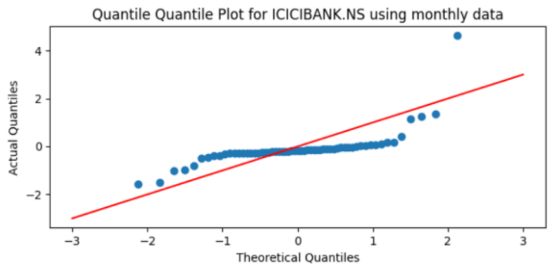

Quantile Quantile Plot for WIPRO.NS using weekly data
Actual Quantiles
Theoretical Quantiles

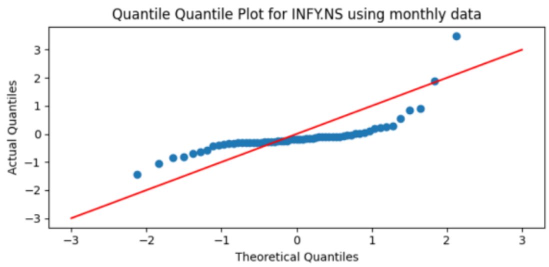

Quantile Quantile Plot for HDFCBANK.NS using weekly data
Actual Quantiles
Theoretical Quantiles

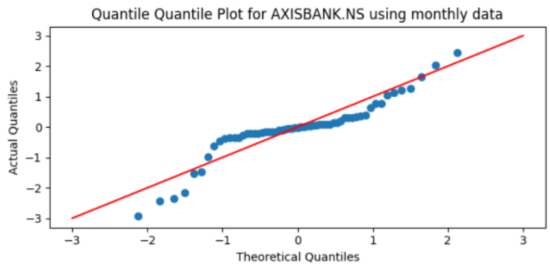

Quantile Quantile Plot for BHARTIARTL.NS using weekly data
Actual Quantiles
Theoretical Quantiles

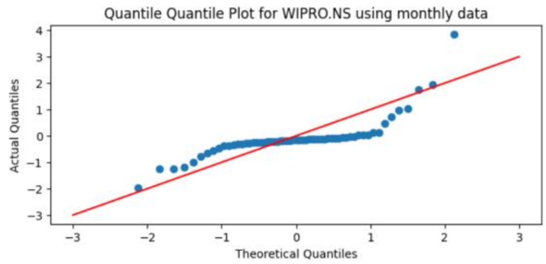

Quantile Quantile Plot for CIPLA.NS using weekly data
Actual Quantiles
Theoretical Quantiles

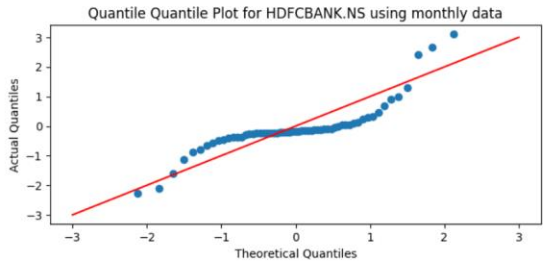


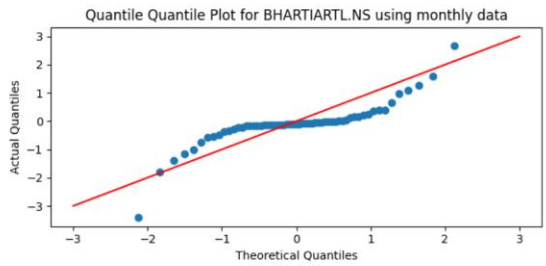


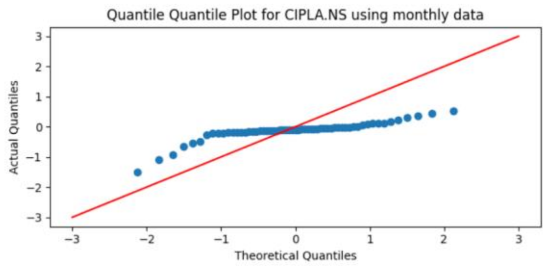












Observations

- The N(0,1) distribution provides a rough estimate of the normalized returns.
- Accuracy of estimation improves when returns are computed on a daily basis instead of weekly or monthly.
- Deviations between actual returns and N(0,1) occur due to random fluctuations in the real-world market.
- Naïve Gaussian distribution cannot completely model the market.
- Deviations become more evident when examining the tails of the plots.
- The curve for N(0,1) steeply decreases to zero, but returns on prices do not.
- More deviations occur at the tails, and a more proper model using a mix of different distributions is required to capture those changes.
- Such a behavior is called leptokurtic, meaning high peaks and heavy tails.
- Jump Diffusion model (by Merton) takes these jumps at the tails into account.

Box plot observations

- It can be observed that in the majority of cases, the maximum return falls between 1.5 and 2, while the minimum return falls between -1 and -1.5.

- The frequency of values within the first and third quartile decreases uniformly across the range.
- The distribution is symmetric about 0 in some cases while resembling with the Normal distribution with some error.

Quantile-quantile plot observations

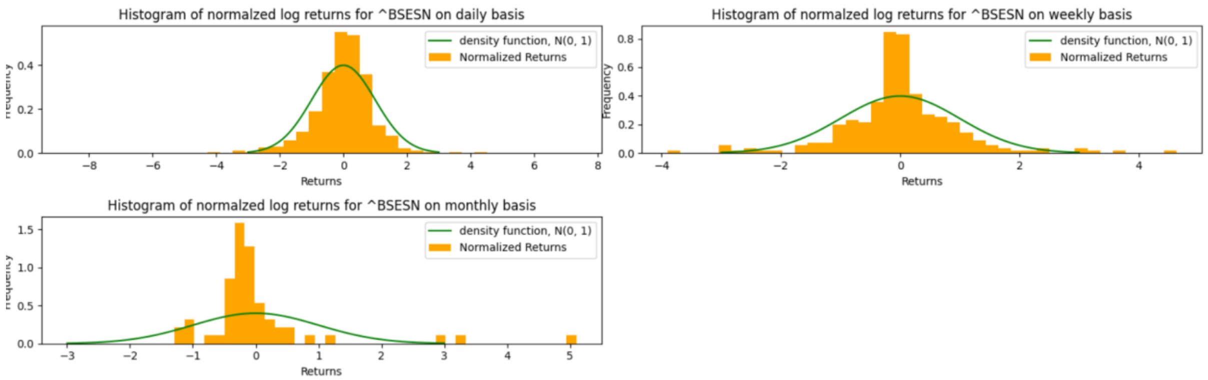
- It can be observed that the distribution is similar to the Normal distribution because the theoretical and actual quantiles almost overlap on the x=y line. However, this similarity is not as noticeable for large quantiles, such as monthly returns, because the distribution diverges.

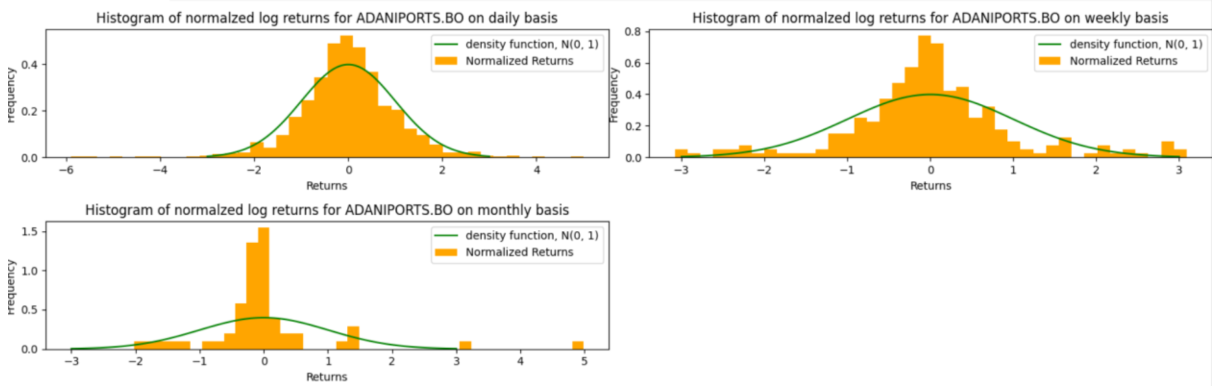
Q3

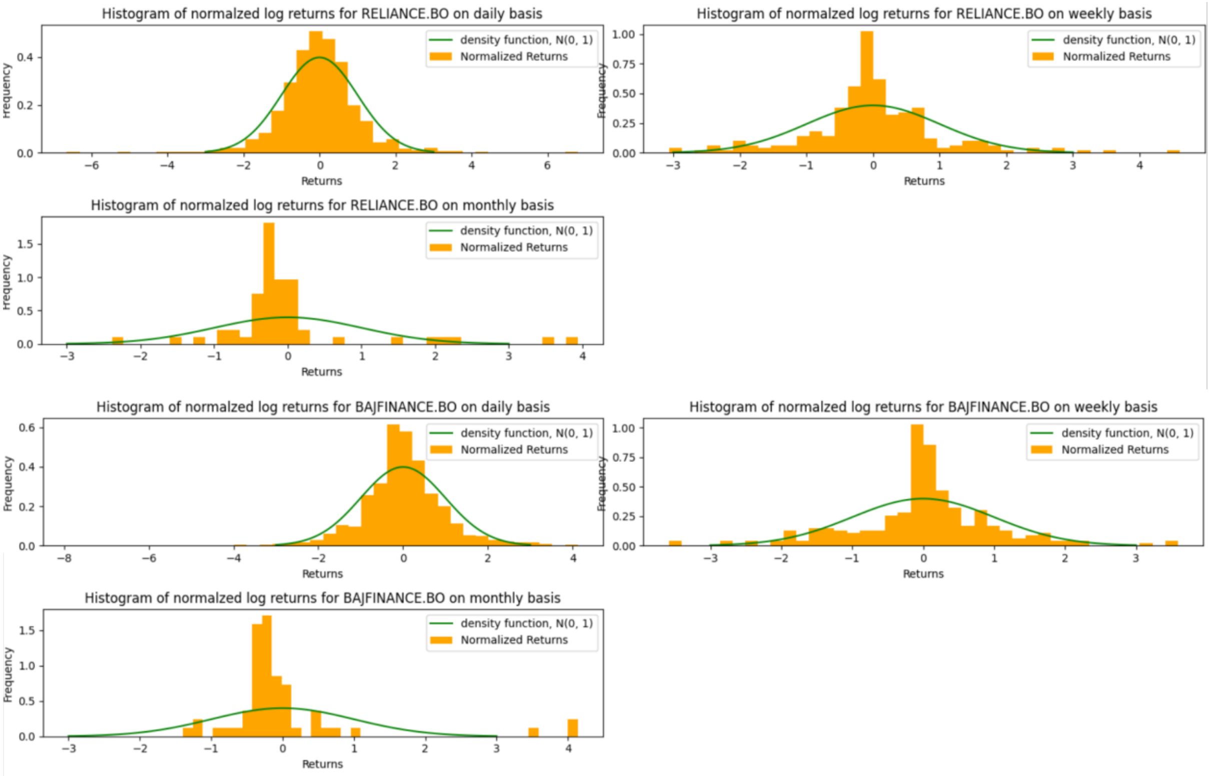
Log Returns Data Analysis

BSE DATA ANALYSIS

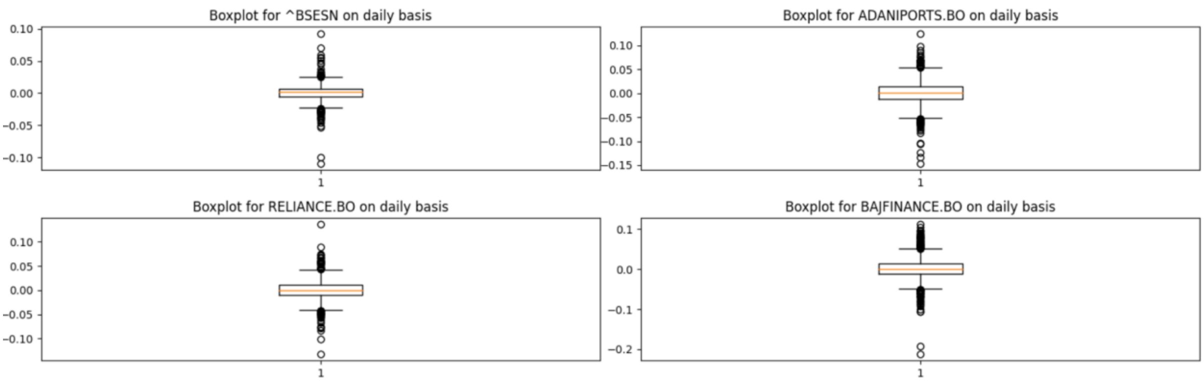
- Plots (not all) for returns (Ri) for **bsedata1** are:



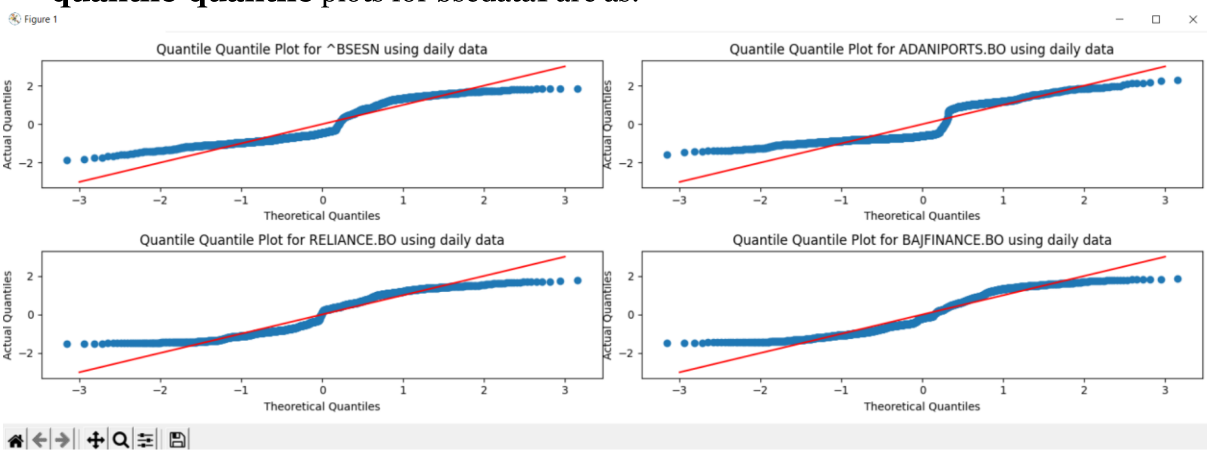




- **boxplots** for bsedata1 are as:

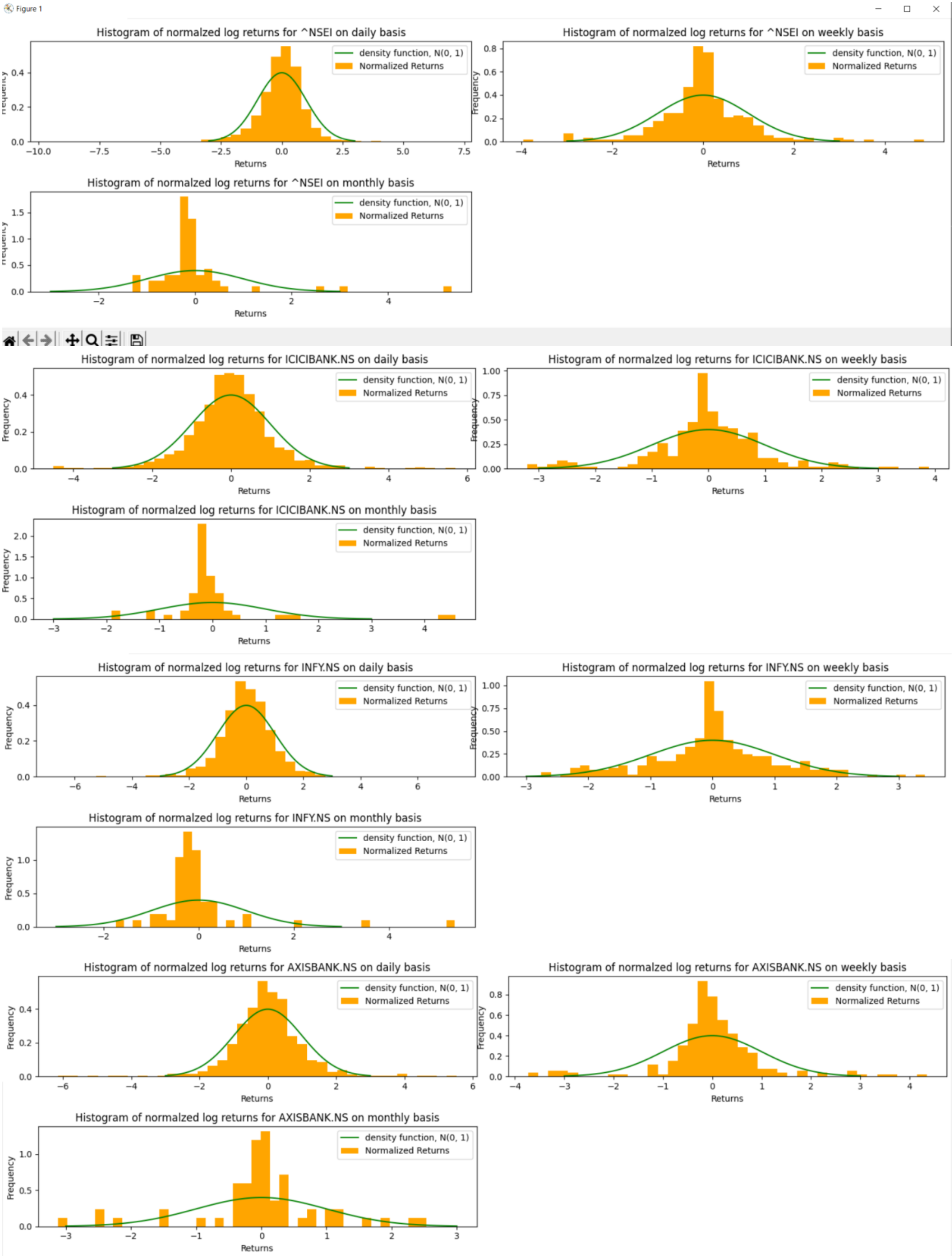


- **quantile-quantile** plots for bsedata1 are as:

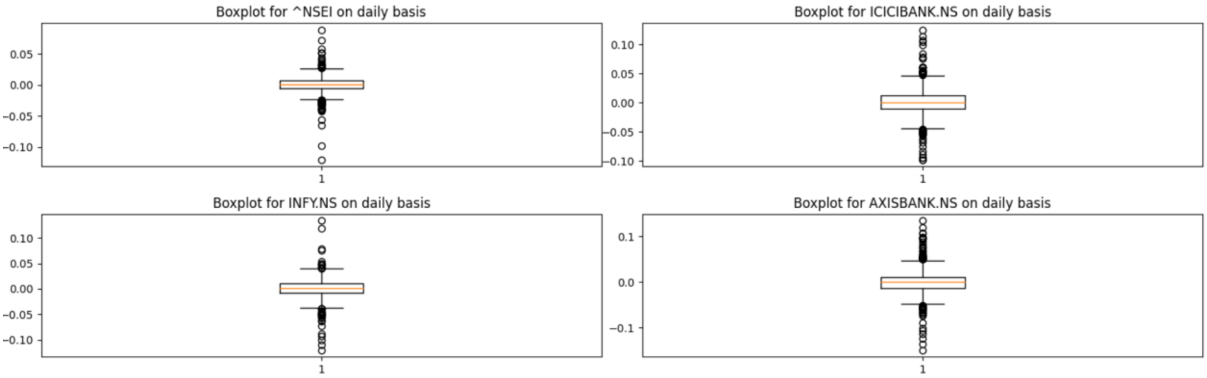


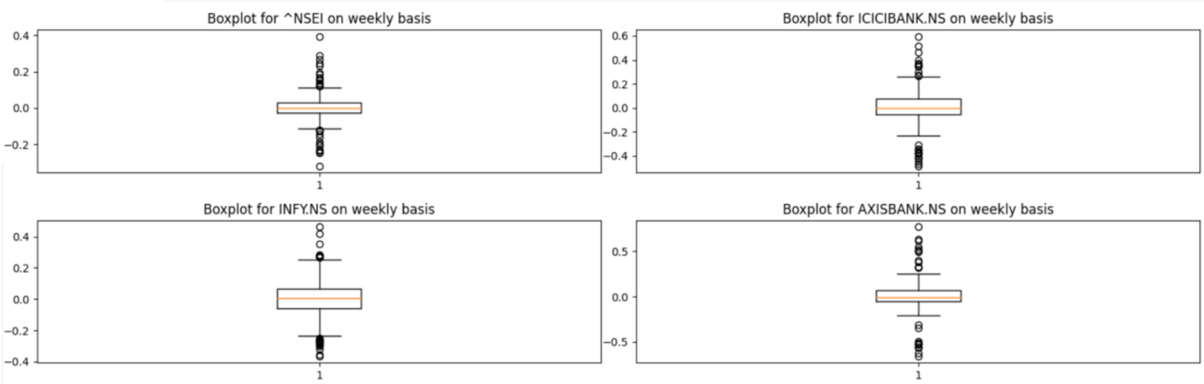
NSE DATA ANALYSIS

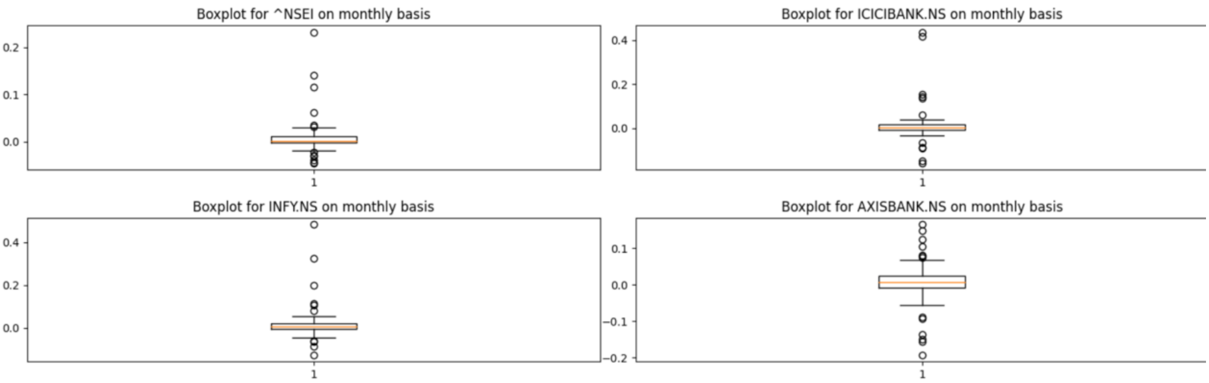
- Plots (not all) for log returns (Ri) for **nsedata1** are:



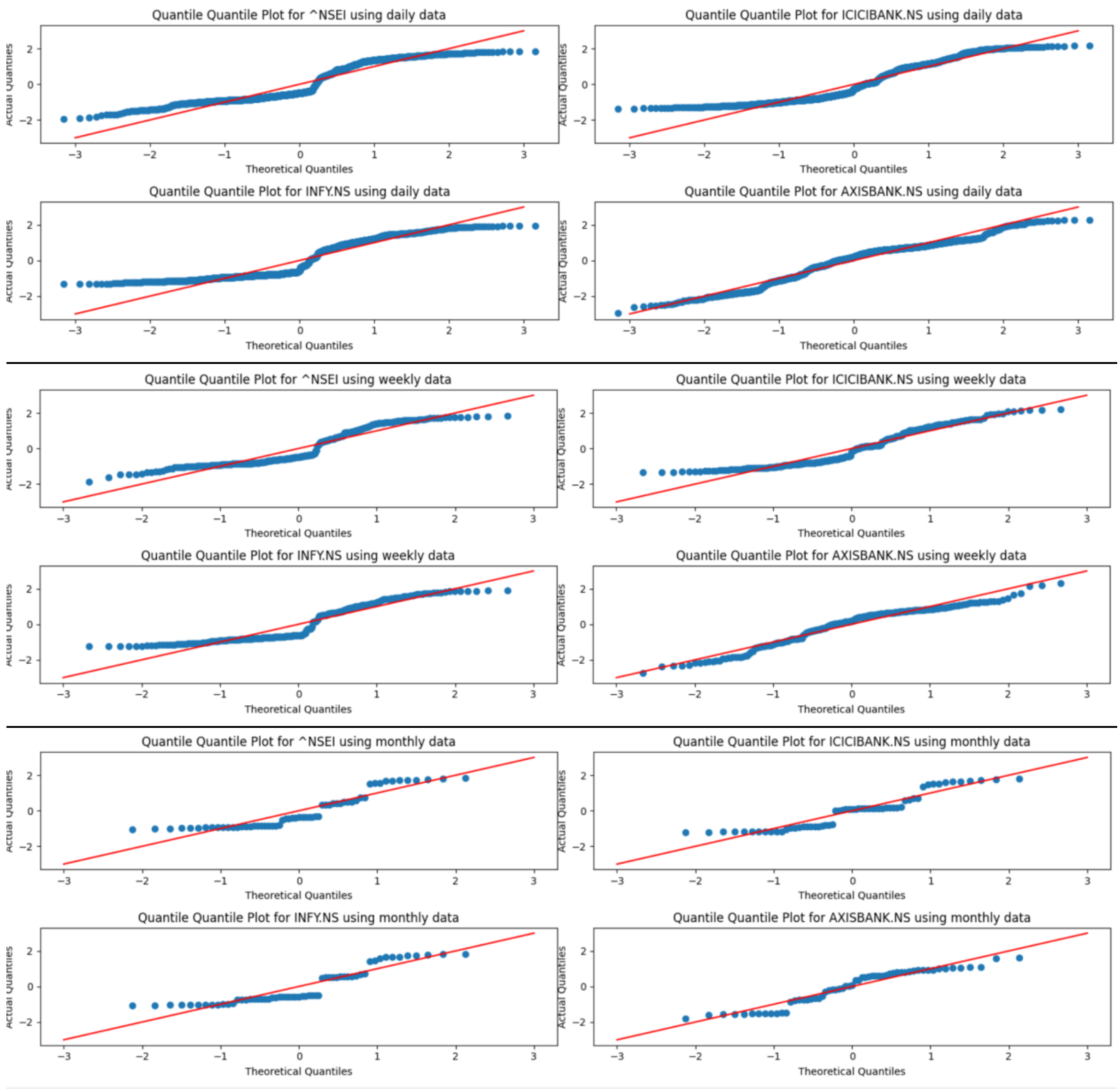
- **boxplots** for nsedata1 are as:







- **quantile-quantile** plots for bsedata1 are as:



Observation

- The observations are exact similar to 2nd question, but here we see little less deviation between the N(0,1) curve the histogram plotted.

Q 4 and Q5

Geometric Brownian motion is a suitable mathematical model for representing the behavior of stock prices as a stochastic process. The stock price at time t_(i+1) can be described by the equation

$$S(t_{i+1}) = S(t_i)\exp\left((\mu - 0.5\sigma^2)(t_{i+1} - t_i) + \sigma\sqrt{t_{i+1} - t_i}Z_{i+1}\right)$$

, where μ and σ^2 are determined by solving the following equations:

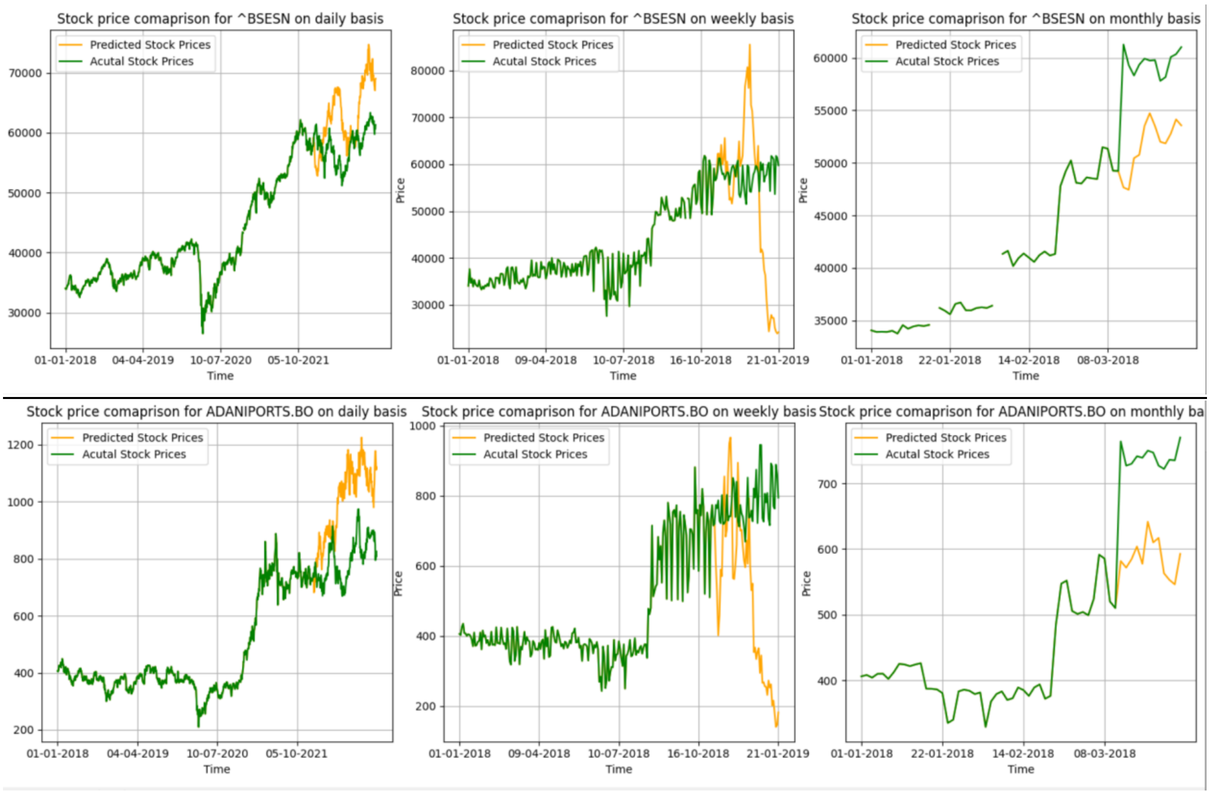
$$\mu - \frac{\sigma^2}{2} = \frac{1}{n}\sum_{1}^{n} u_i = E(u)$$

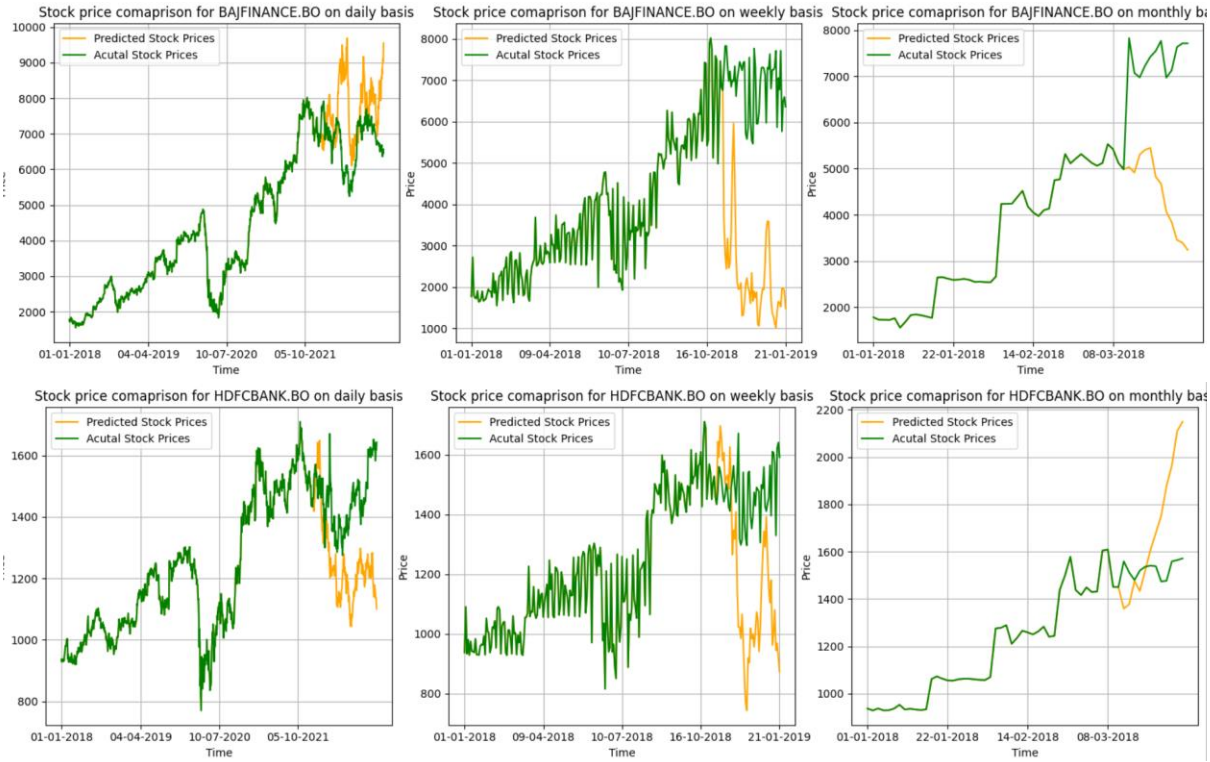
$$\sigma^2 = \frac{1}{n-1}\sum_{1}^{n} (u_i - E(u))^2$$

$$u_i = \ln\left(\frac{s_i}{s_{i-1}}\right)$$

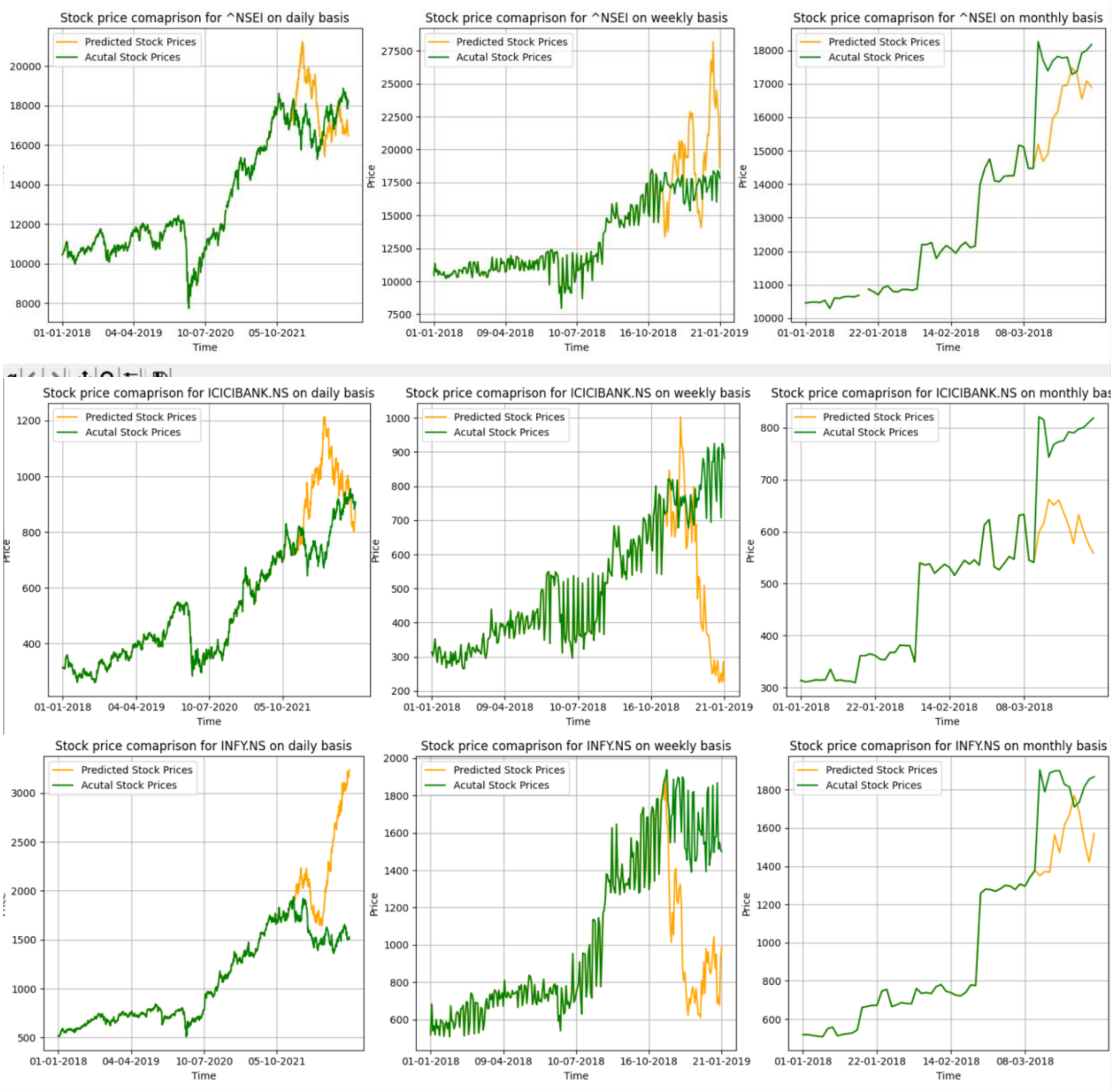
Here, u_i is the log return of day i, s_i and s_(i-1) are the adjacent closing stock prices of day i-1 and day i, respectively. Additionally, Z_1,Z_2,...,Z_n are independent N(0,1) variables.

BSE DATA ANALYSIS





<u>NSE DATA ANALYSIS</u>


Stock price comaprison for ^NSEI on daily basis
Predicted Stock Prices
Acutal Stock Prices
01-01-2018
04-04-2019
10-07-2020
05-10-2021
Time
Stock price comaprison for ^NSEI on weekly basis
Predicted Stock Prices
Acutal Stock Prices
Price
01-01-2018
09-04-2018
10-07-2018
16-10-2018
21-01-2019
Time
Stock price comaprison for ^NSEI on monthly basis
Predicted Stock Prices
Acutal Stock Prices
Price
01-01-2018
22-01-2018
14-02-2018
08-03-2018
Time
Stock price comaprison for ICICIBANK.NS on daily basis
Predicted Stock Prices
Acutal Stock Prices
Price
01-01-2018
04-04-2019
10-07-2020
05-10-2021
Time
Stock price comaprison for ICICIBANK.NS on weekly basis
Predicted Stock Prices
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01-01-2018
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Stock price comaprison for ICICIBANK.NS on monthly bas
Predicted Stock Prices
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01-01-2018
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Time
Stock price comaprison for INFY.NS on daily basis
Predicted Stock Prices
Acutal Stock Prices
01-01-2018
04-04-2019
10-07-2020
05-10-2021
Time
Stock price comaprison for INFY.NS on weekly basis
Predicted Stock Prices
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Price
01-01-2018
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