

# **Financial Engineering Lab (MA374)**

**Name - Kartikeya Singh**

**Roll Number - 180123021**

**Lab - 06**

To run the code type **python3 180123021\_Kartikeya\_Singh\_q1.py** into the terminal. (Similarly for other files as well). The weekly and monthly analysis (q5) is done in the codes for q2 , 3, and 4.

- Stocks included in BSE are - **[Axis Bank, Bajaj Auto, HDFC, HUL, Infosys, Reliance, SBI, Tata Steel, Sun Pharma, Asian Paints]**
- Stocks included in NSE are - **[COAL INDIA, GAIL, IOC, ICICI, ITC, NTPC, WIPRO, ADANIPORTS, CIPLA, JSWSTEEL]**

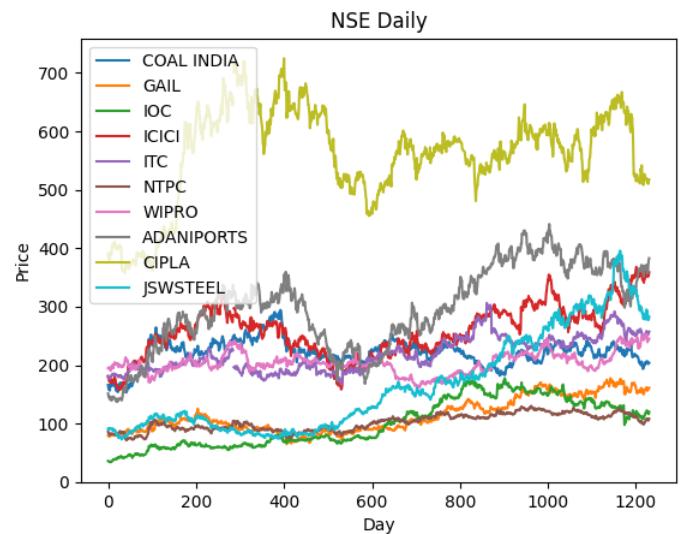
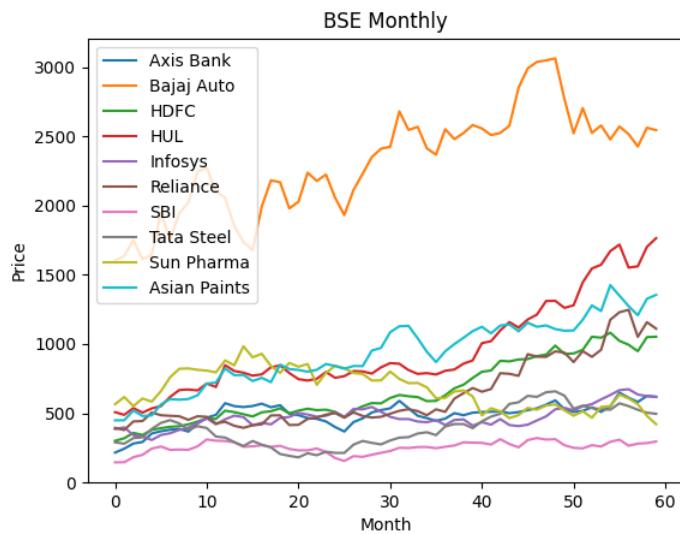
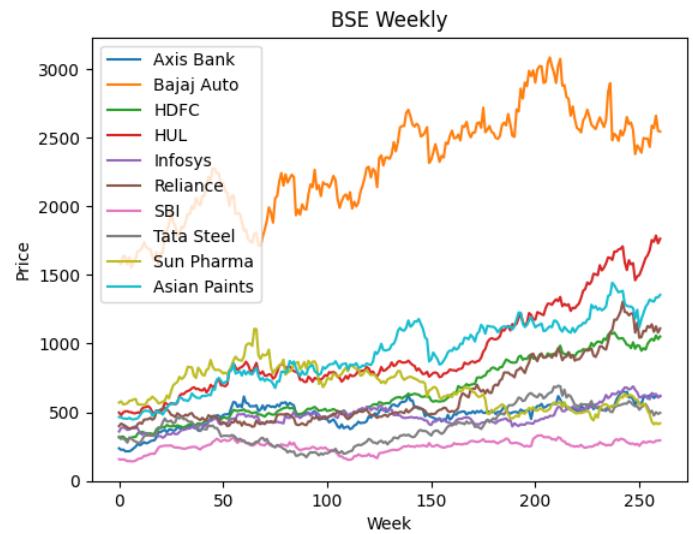
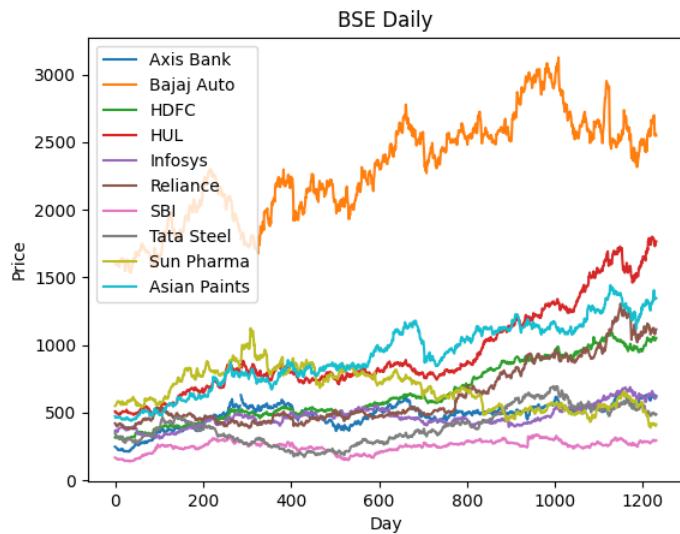
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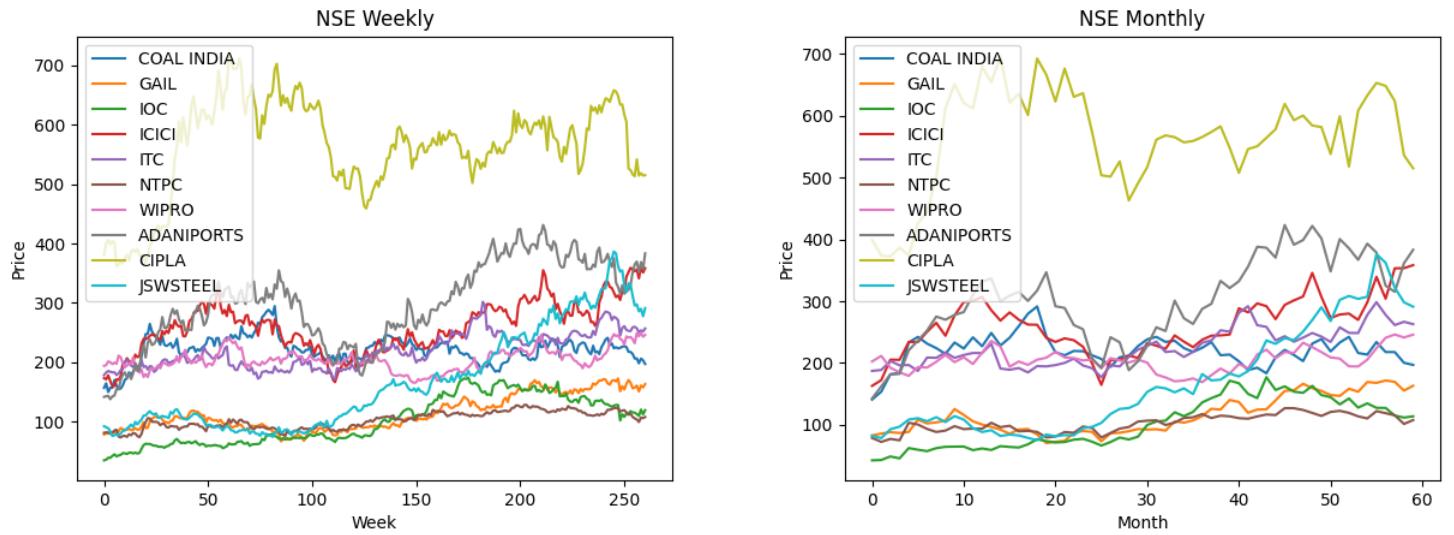
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## Question 1

The prices of the stocks (daily, weekly, and monthly) are plotted below -



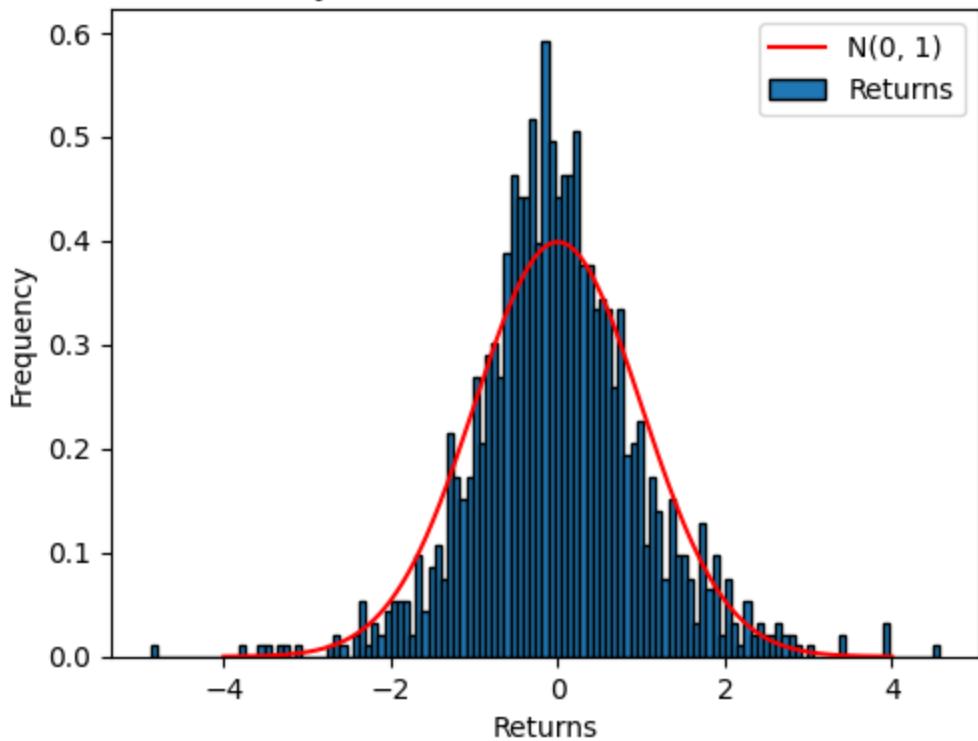


## Question 2

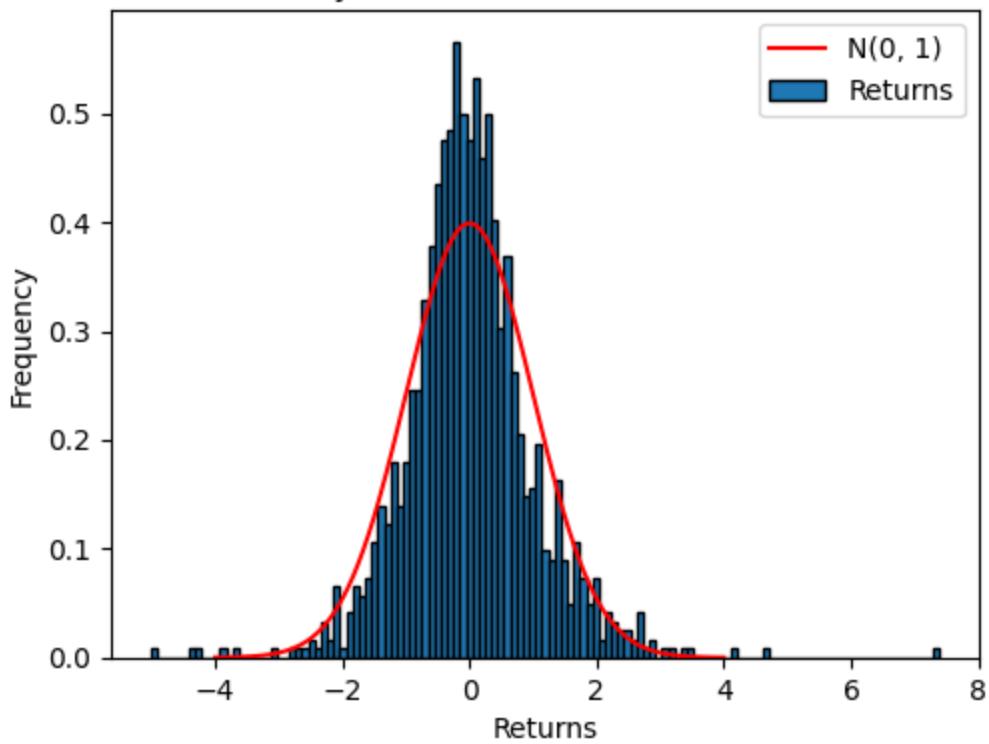
In the below graphs, on zooming into the tail, it can be observed that in some cases, there are high positive and high negative returns on a significant number of days, which should not be the case ideally, as the Gaussian Distribution tends to 0 near the tails, these high returns are due to the external factors which cannot be modelled using a Gaussian Distribution.

The Daily returns are calculated and normalized, and the distribution of these returns are plotted below -

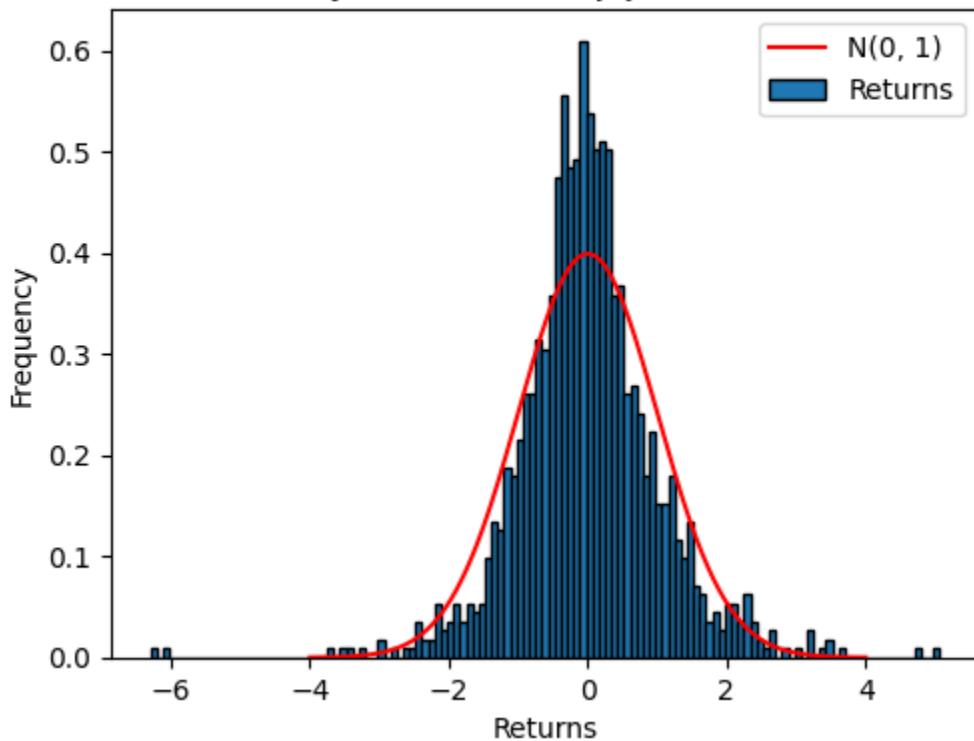
Daily Returns for Asian Paints (BSE)



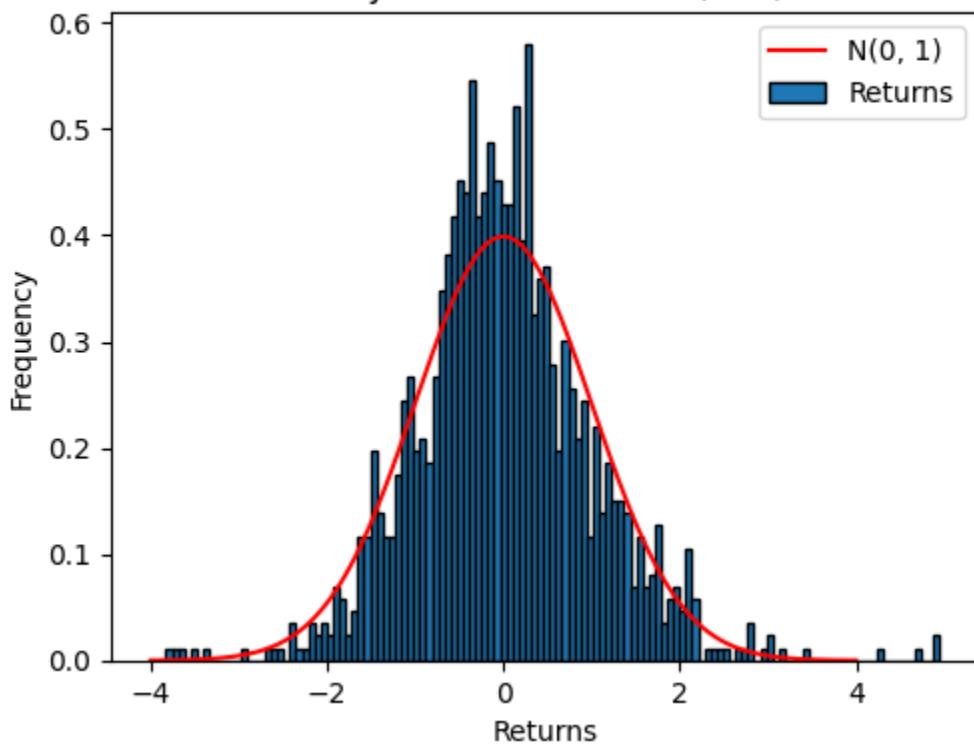
Daily Returns for Axis Bank (BSE)



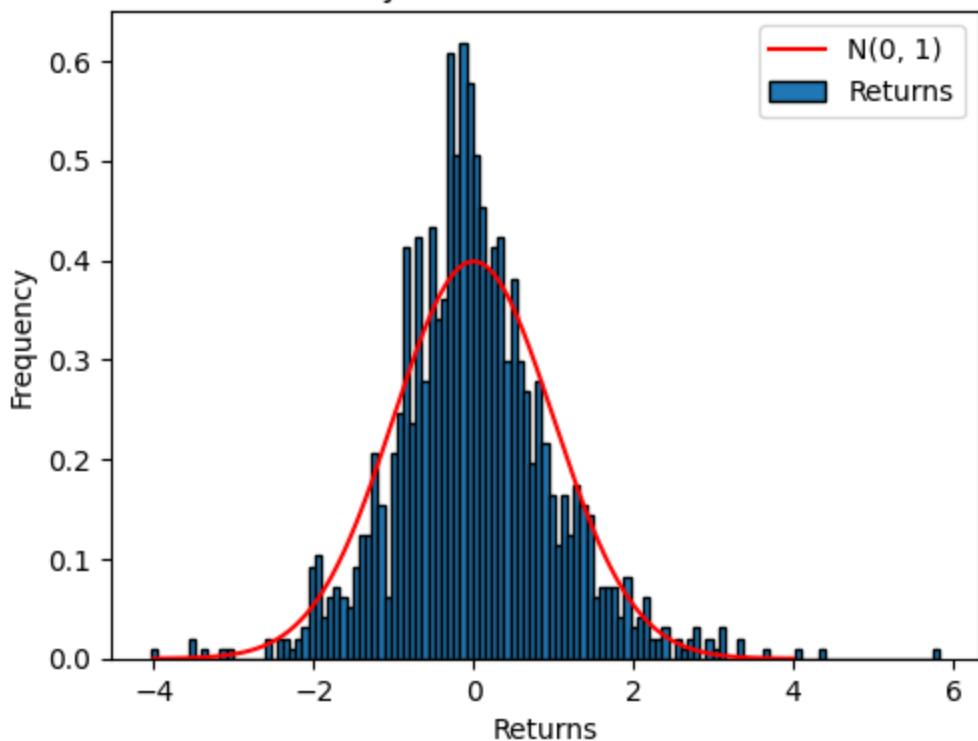
Daily Returns for Bajaj Auto (BSE)



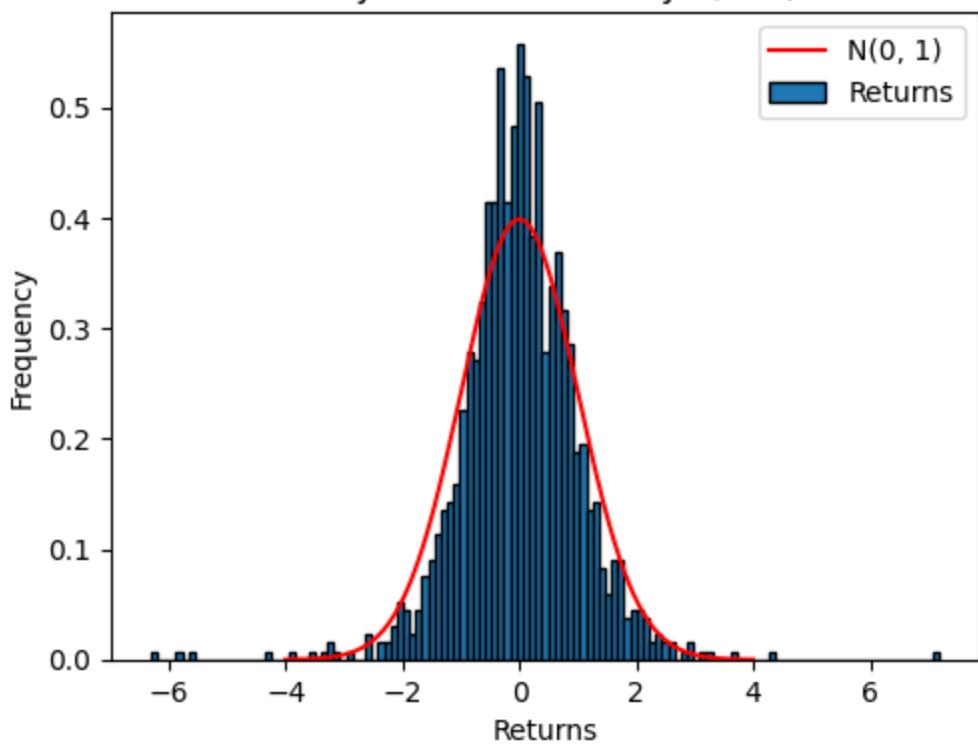
Daily Returns for HDFC (BSE)



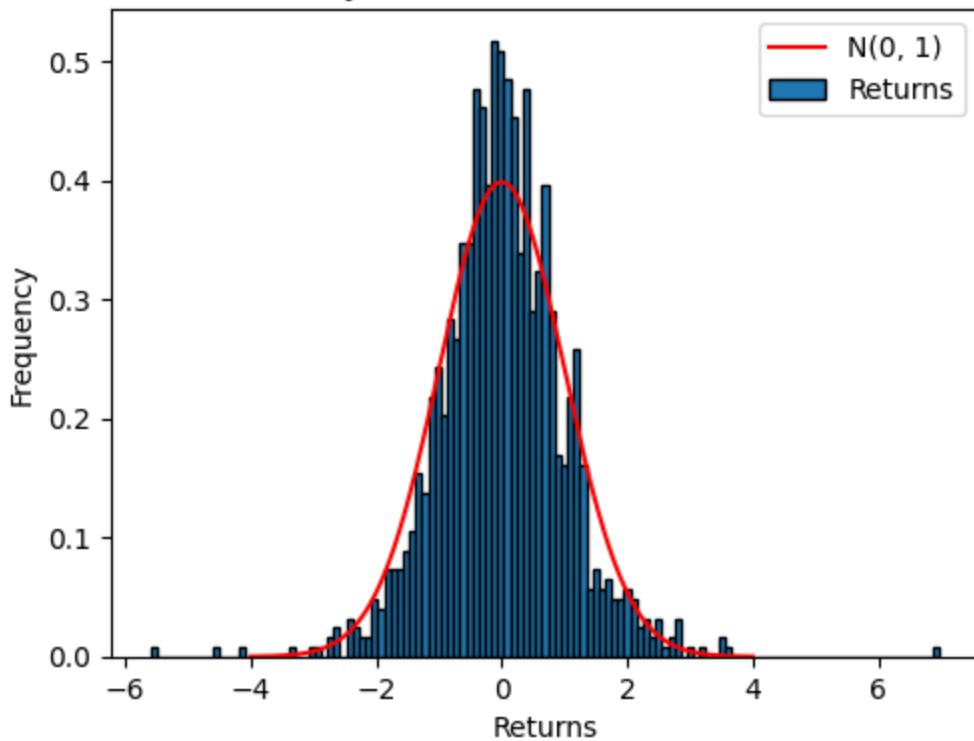
Daily Returns for HUL (BSE)



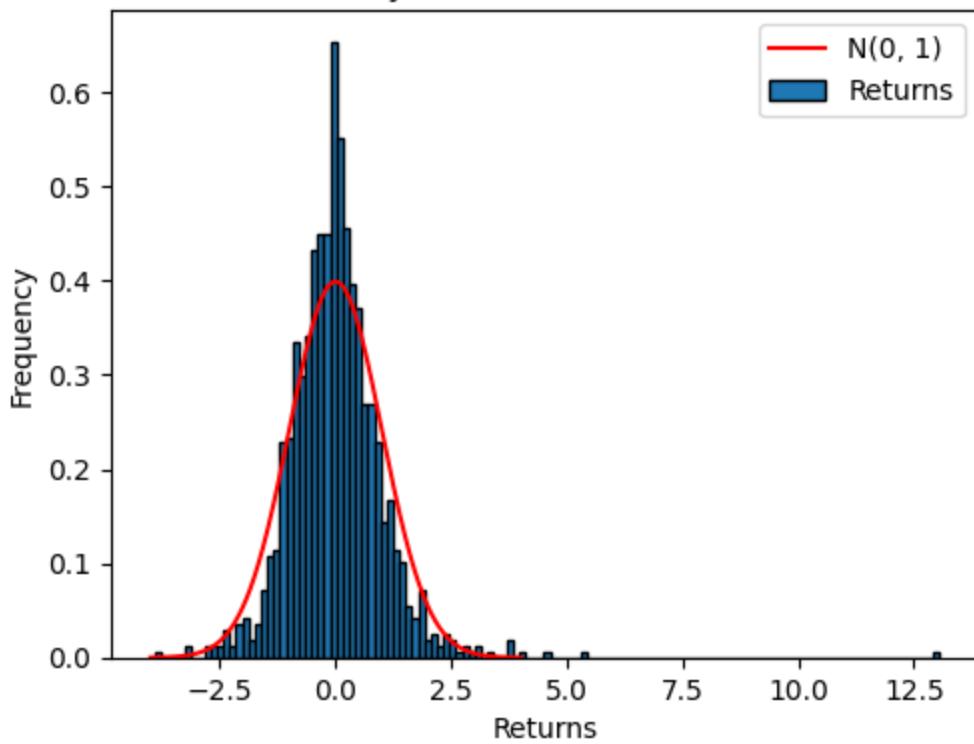
Daily Returns for Infosys (BSE)



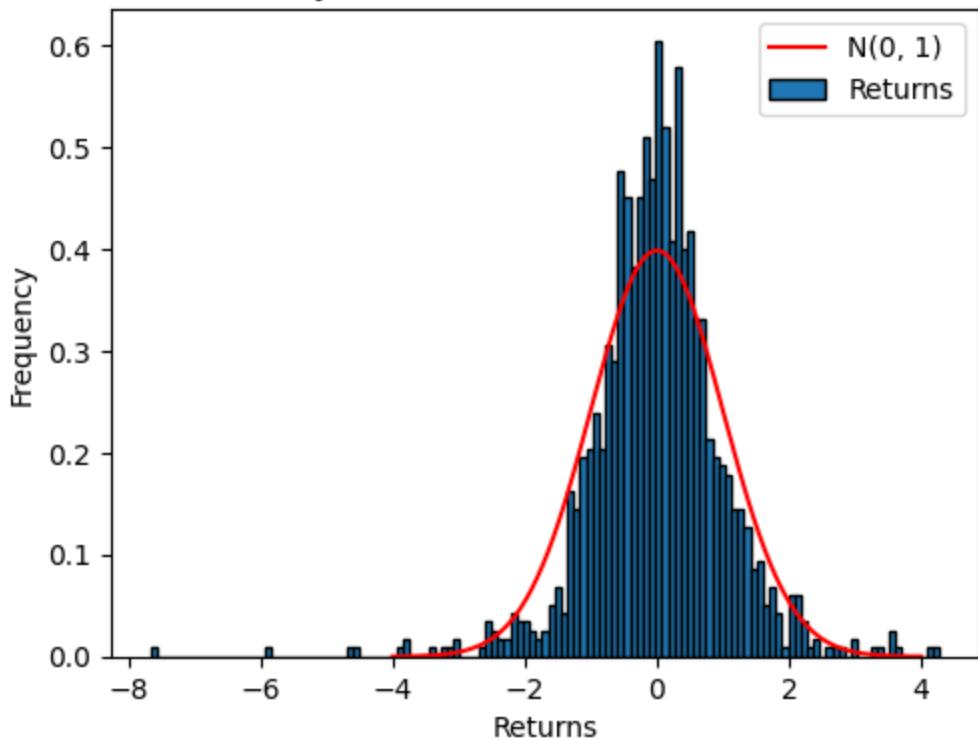
Daily Returns for Reliance (BSE)



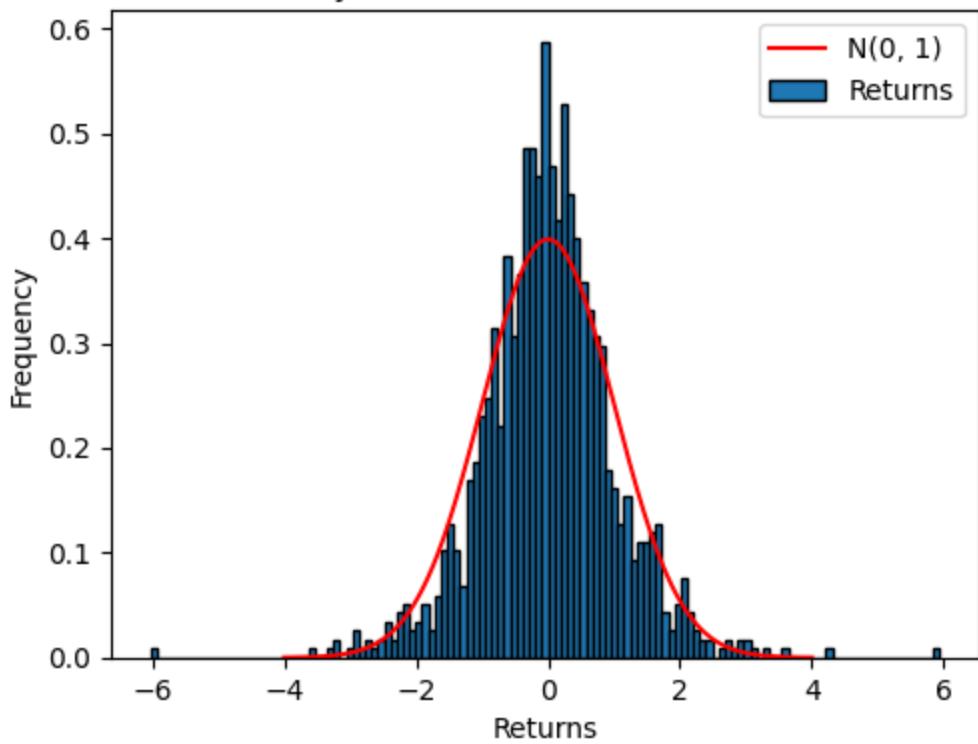
Daily Returns for SBI (BSE)



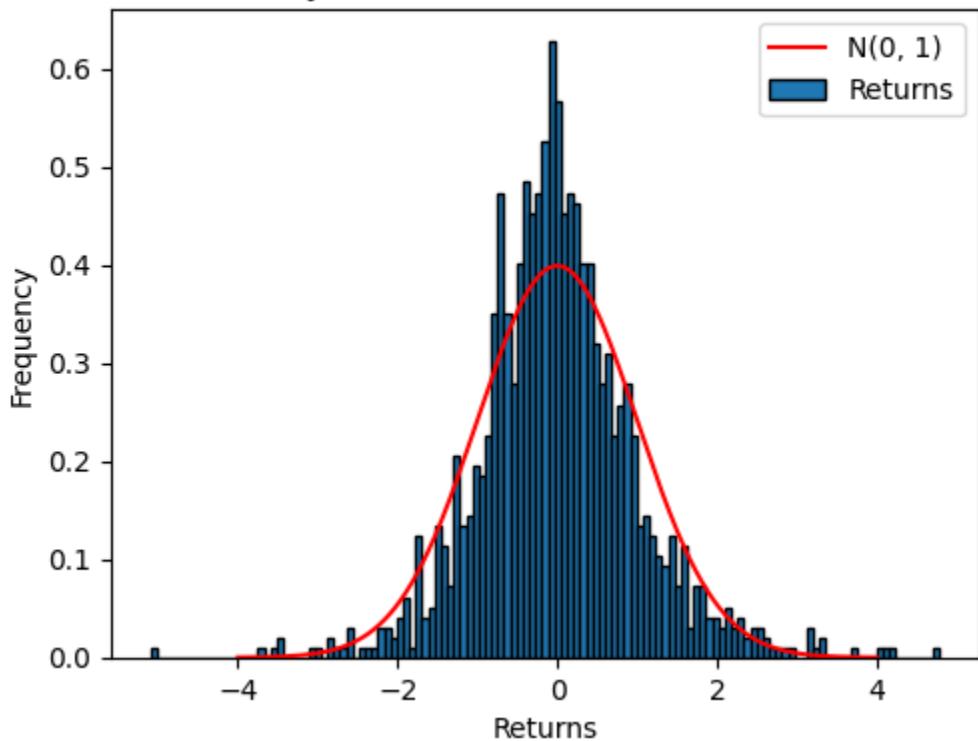
Daily Returns for Sun Pharma (BSE)



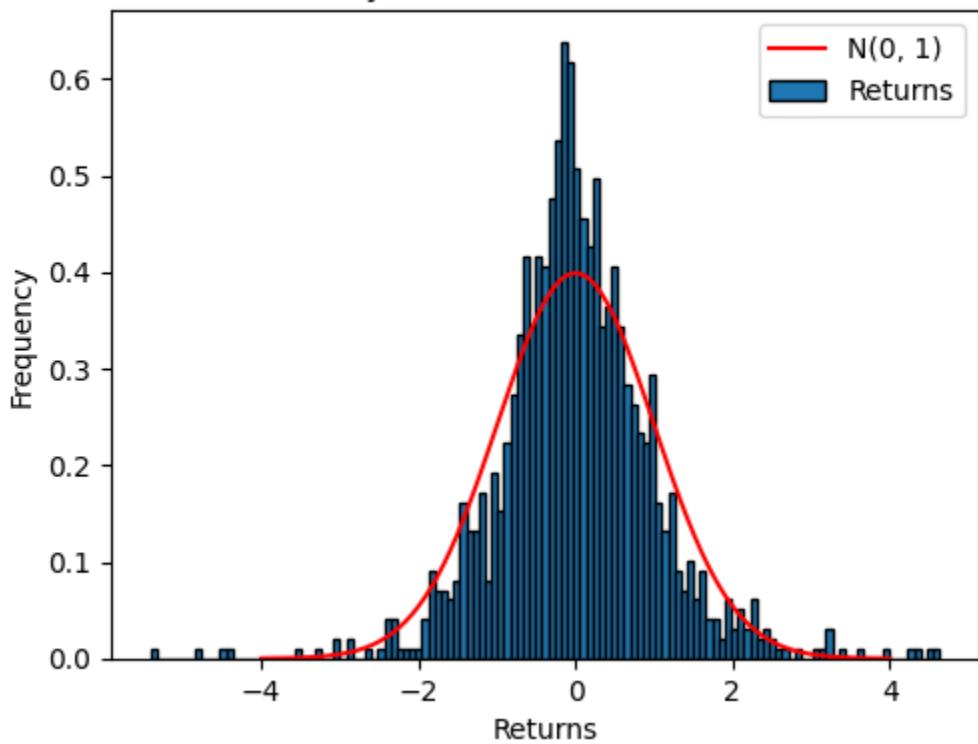
Daily Returns for Tata Steel (BSE)



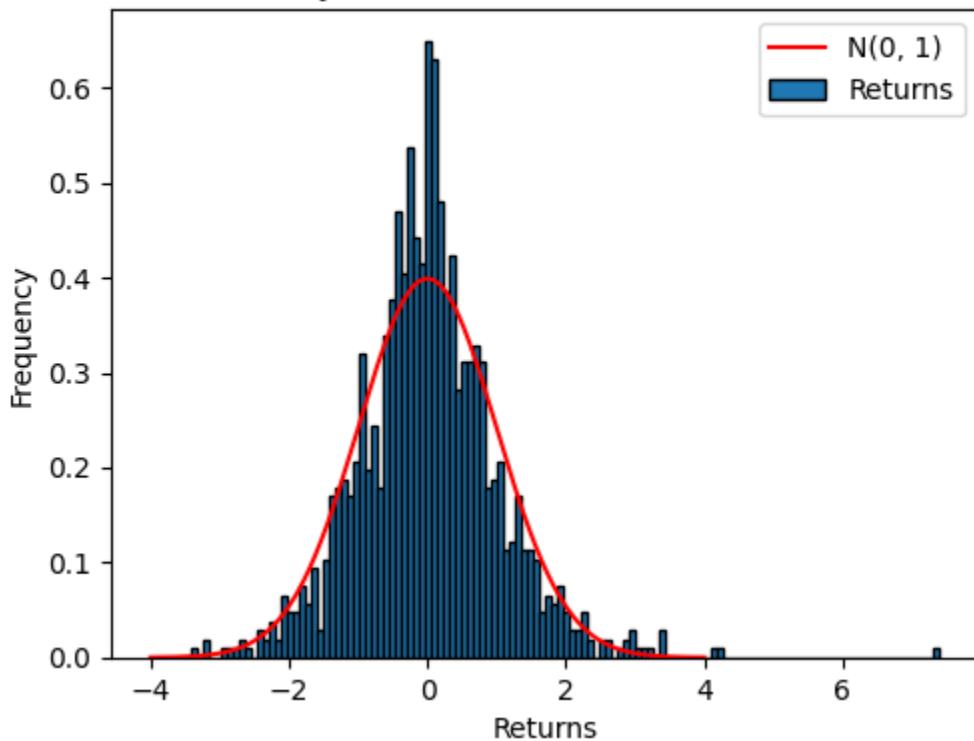
Daily Returns for ADANIPORTS (NSE)



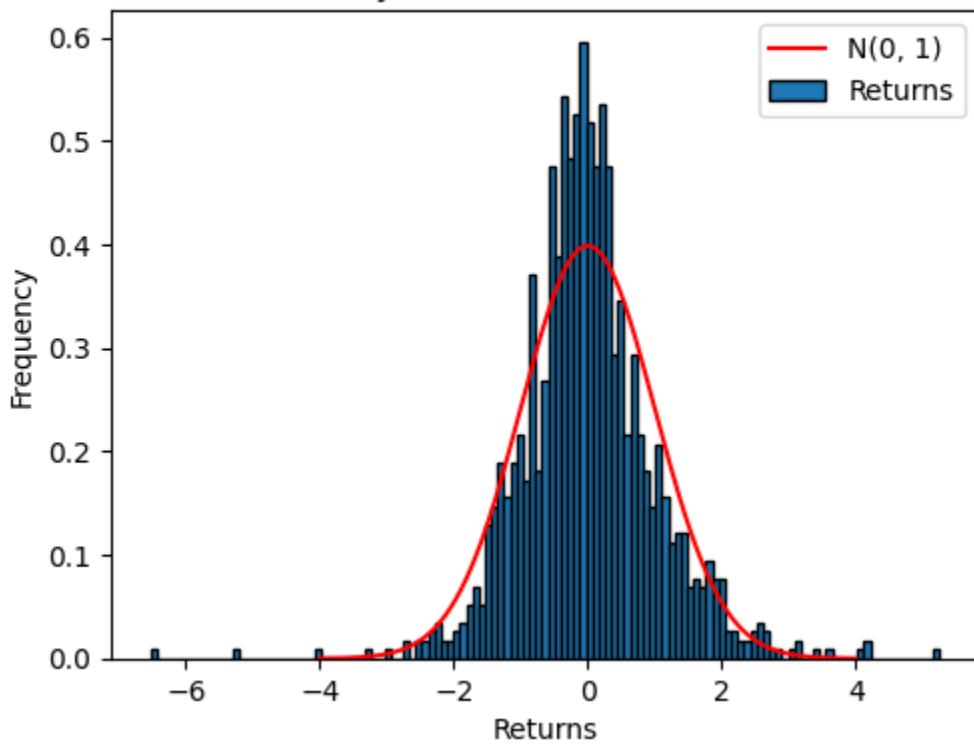
Daily Returns for CIPLA (NSE)



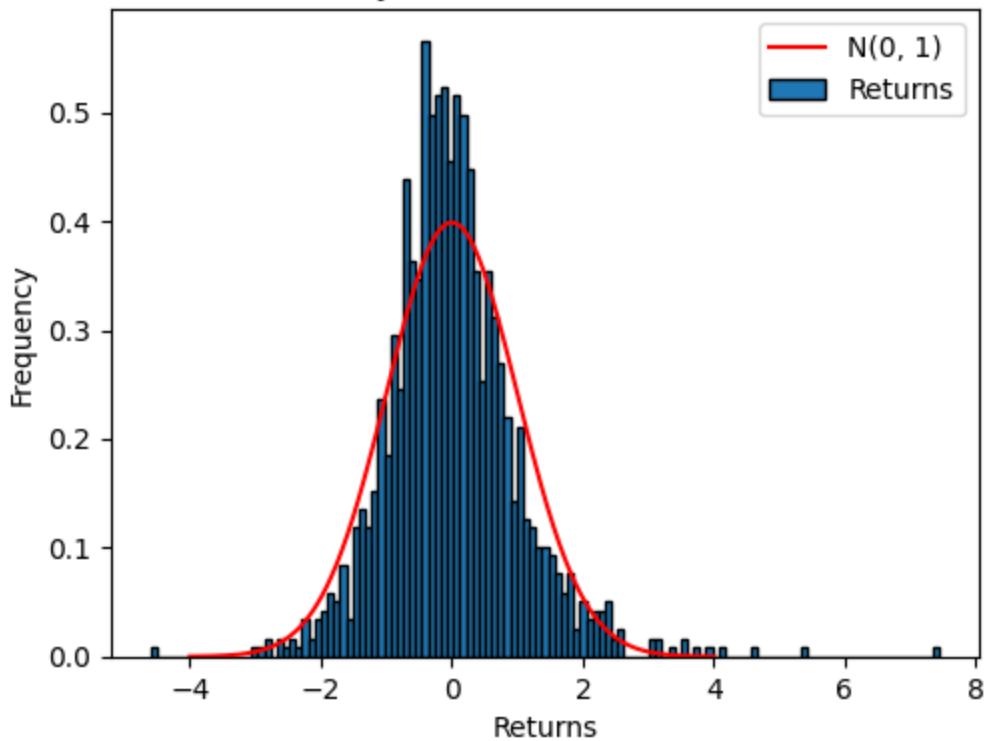
Daily Returns for COAL INDIA (NSE)



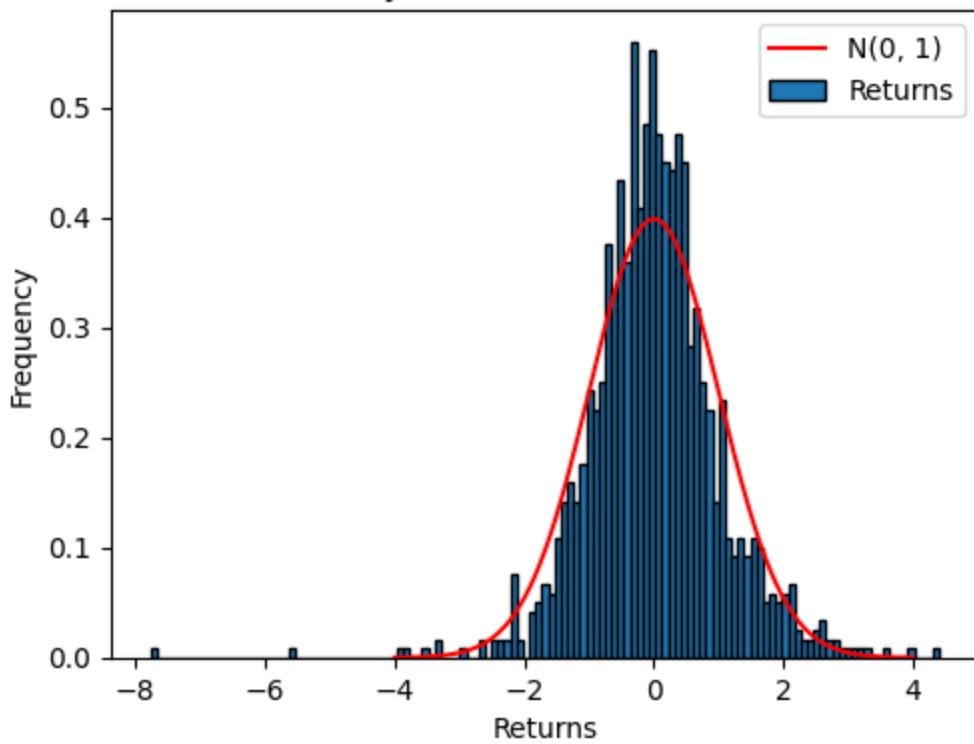
Daily Returns for GAIL (NSE)



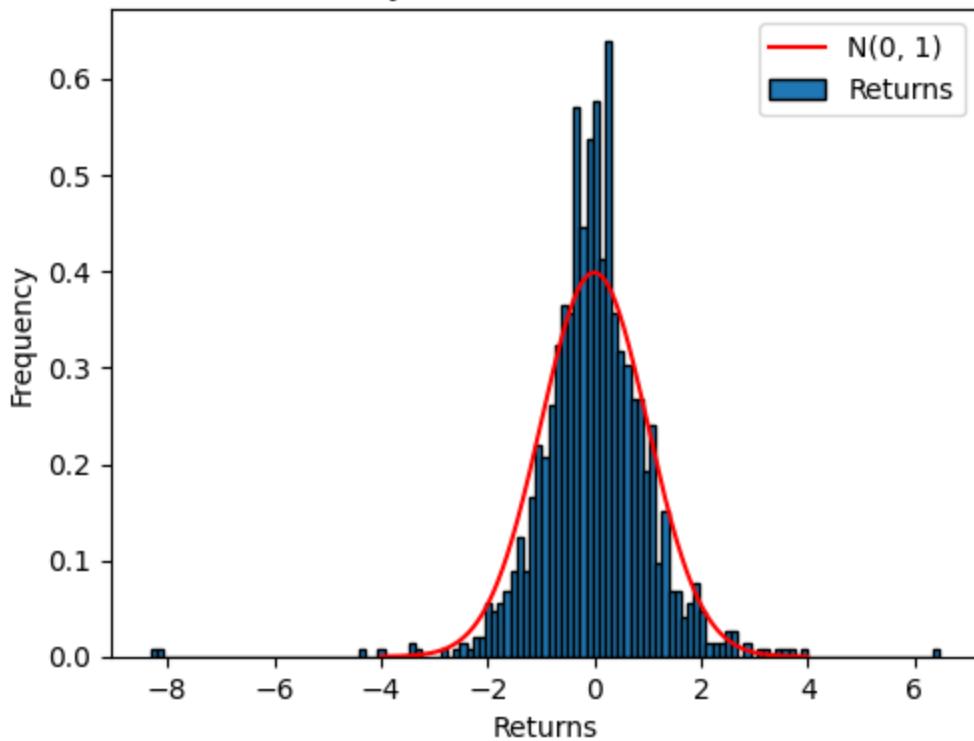
Daily Returns for ICICI (NSE)



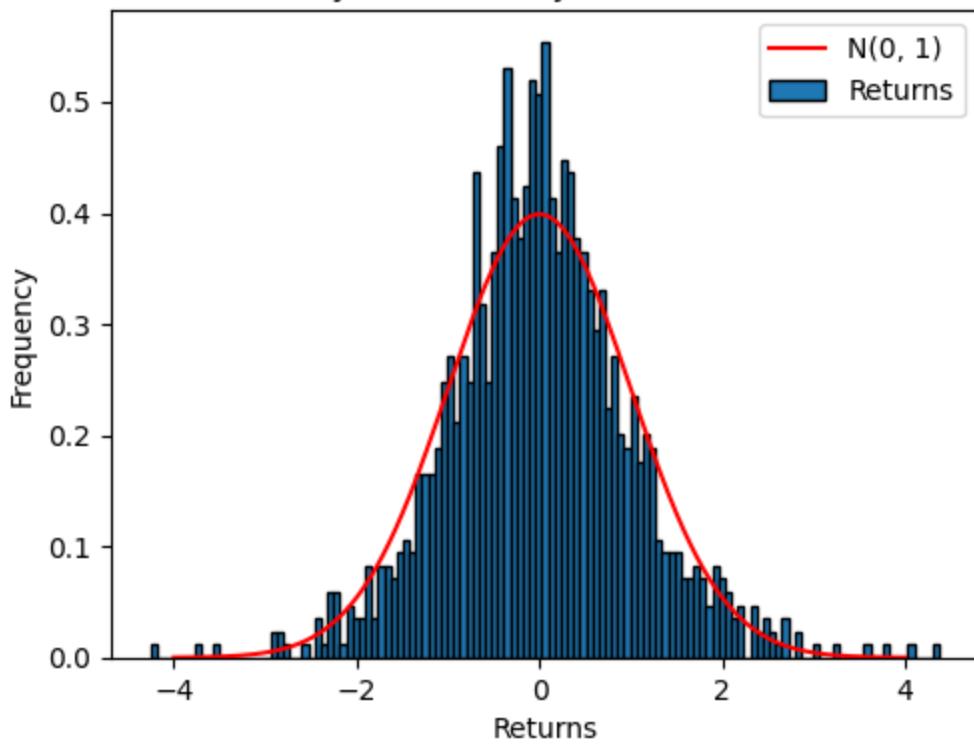
Daily Returns for IOC (NSE)



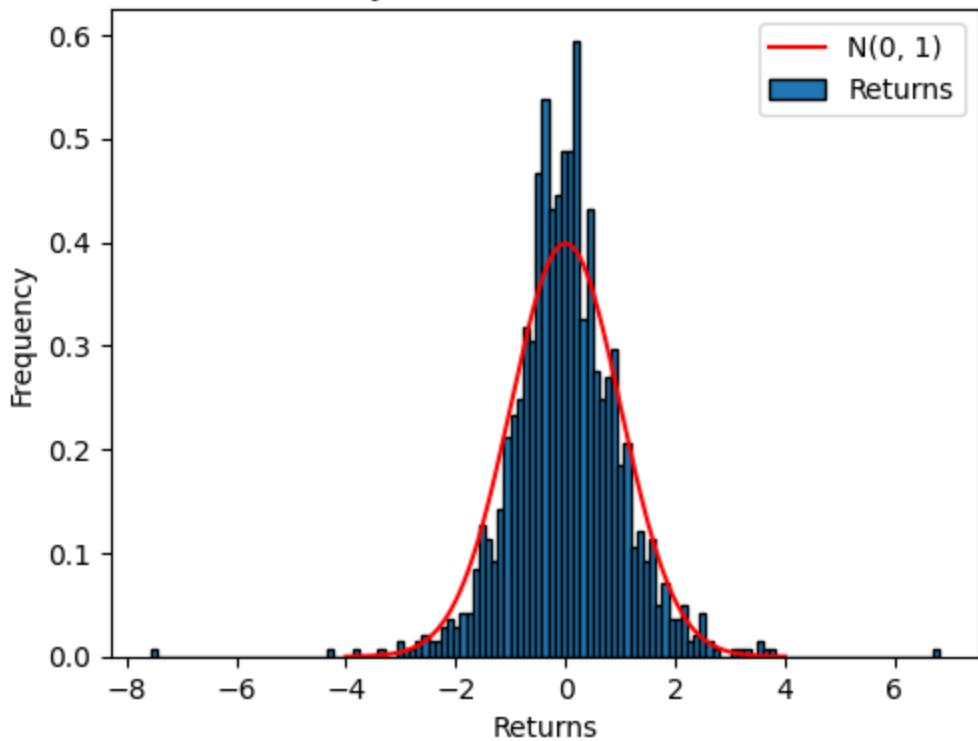
Daily Returns for ITC (NSE)



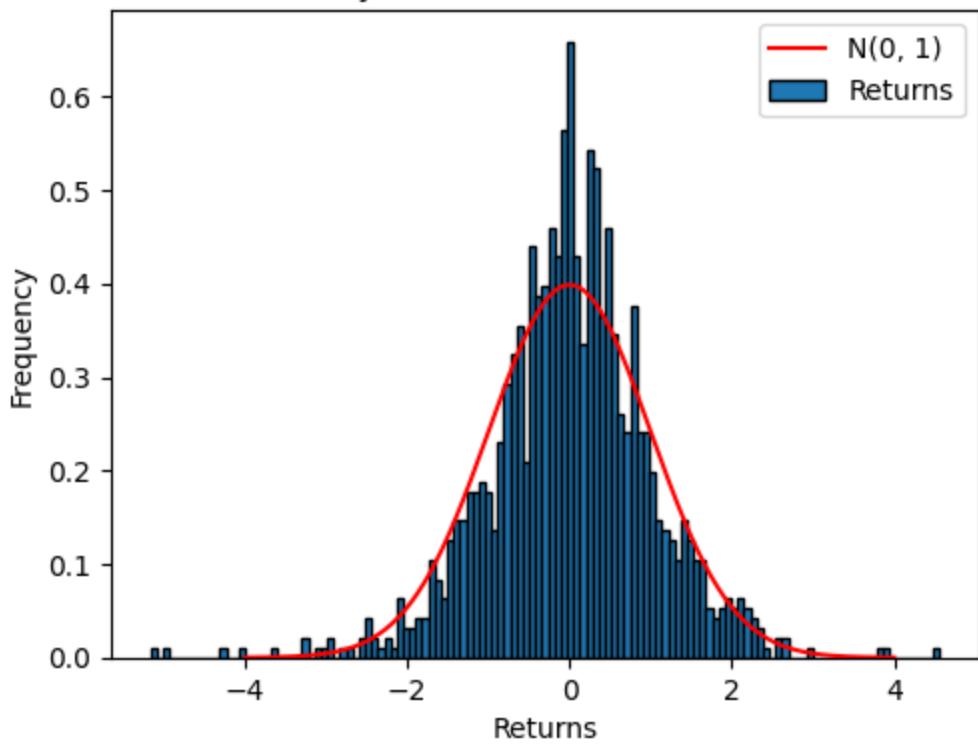
Daily Returns for JSWSTEEL (NSE)



Daily Returns for NTPC (NSE)



Daily Returns for WIPRO (NSE)



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### Question 3

The log-returns are calculated using the equation -

$$R_i' = \ln(1 + R_i)$$

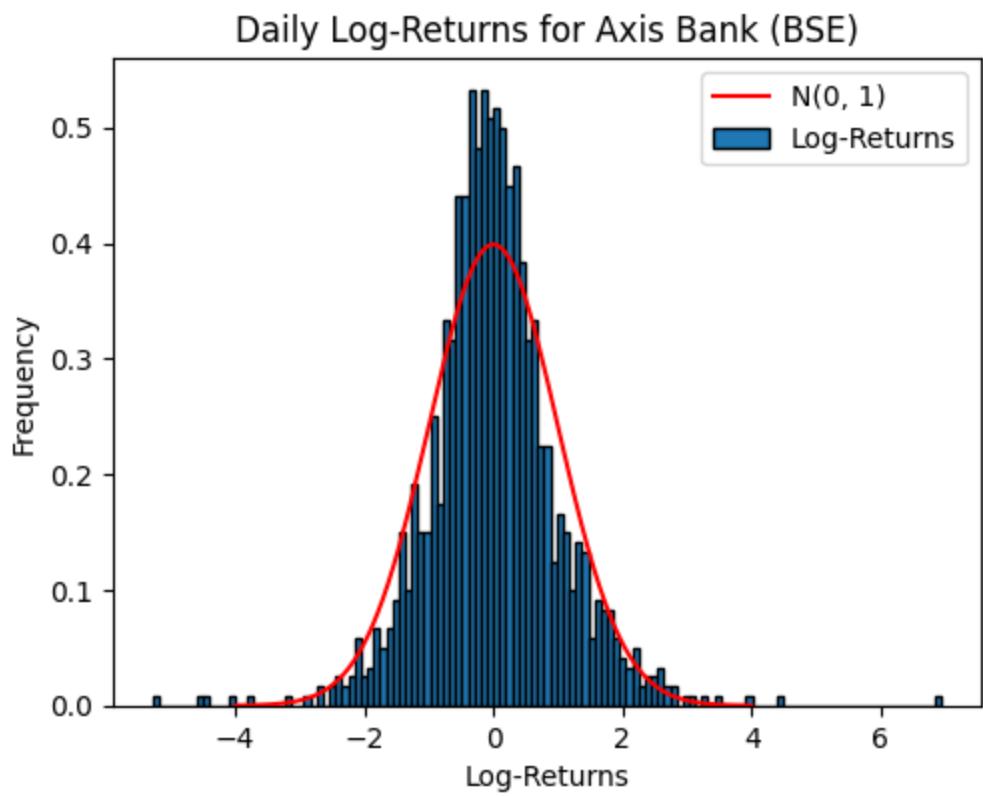
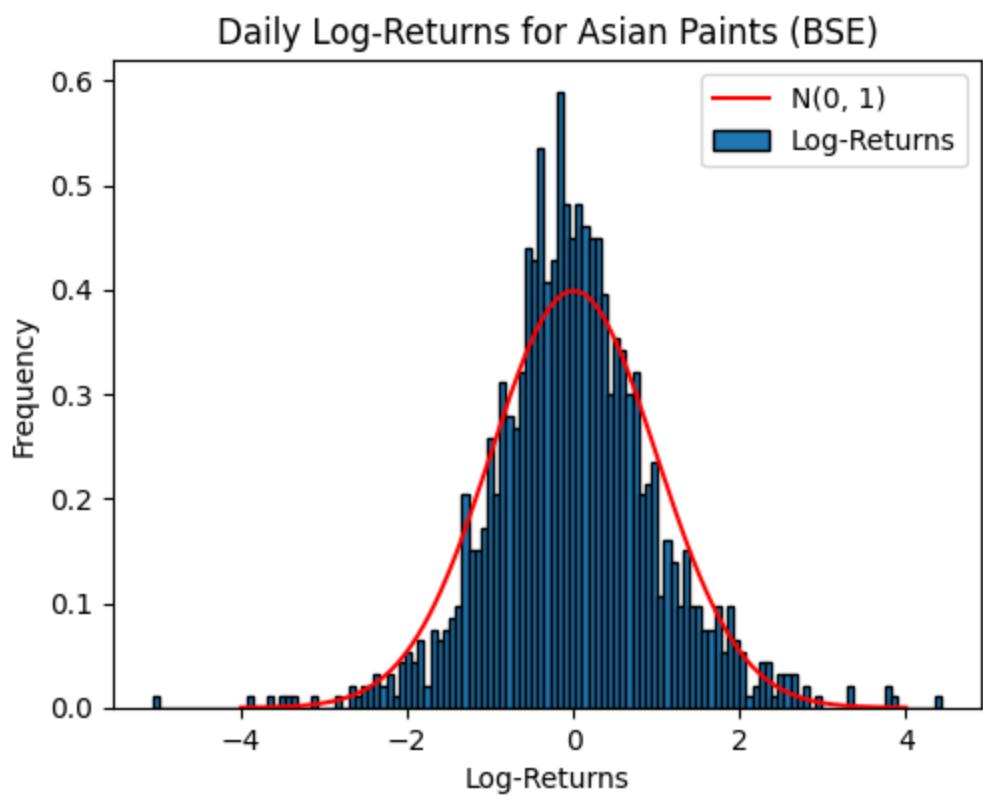
Here  $R_i$  represents the returns and  $R_i'$  represents the log-returns.

Now, the log-returns are normalized using the equation -

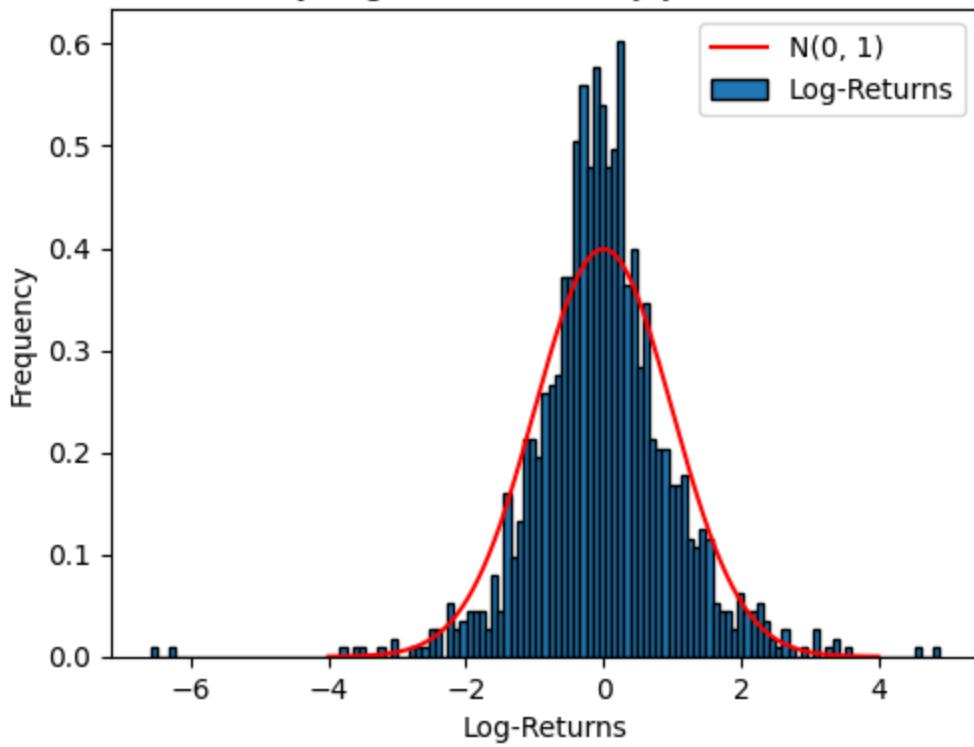
$$\hat{R}_i' = \frac{R_i' - \mu}{\sigma}$$

Here  $\mu$  and  $\sigma$  represents the mean and variance of the log-returns.

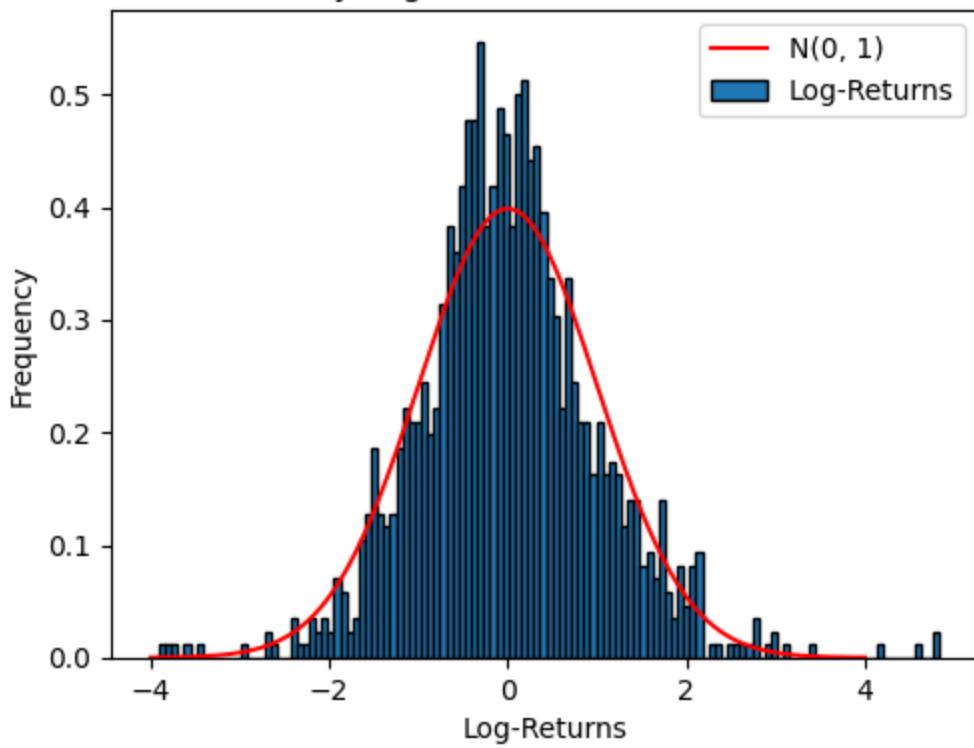
The graphs are plotted below -



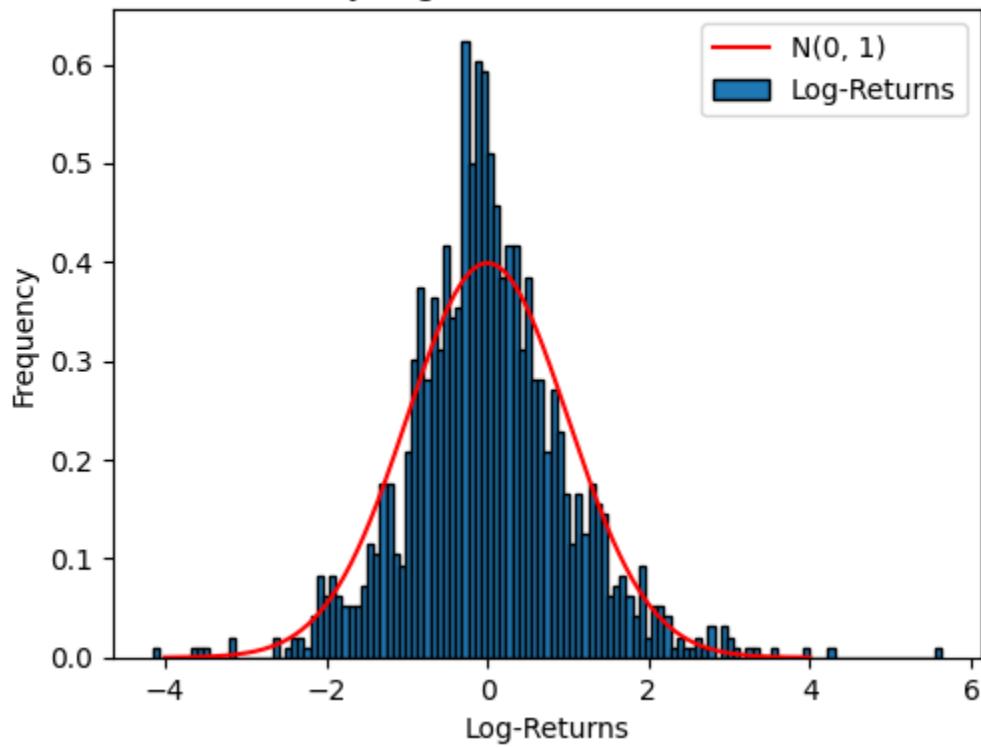
Daily Log-Returns for Bajaj Auto (BSE)



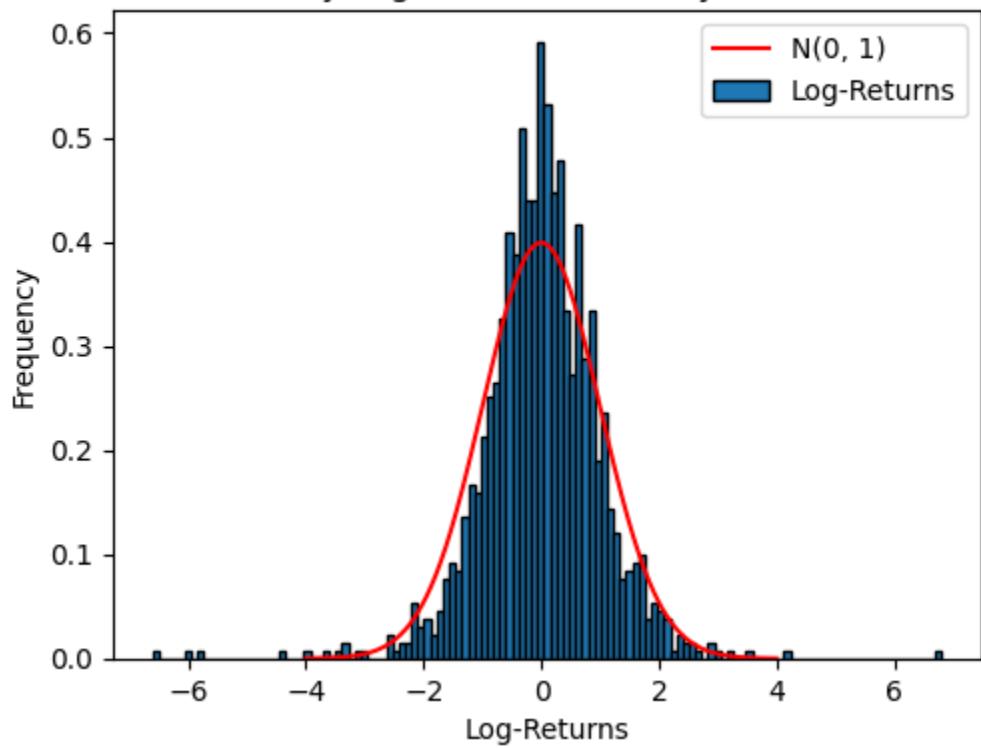
Daily Log-Returns for HDFC (BSE)



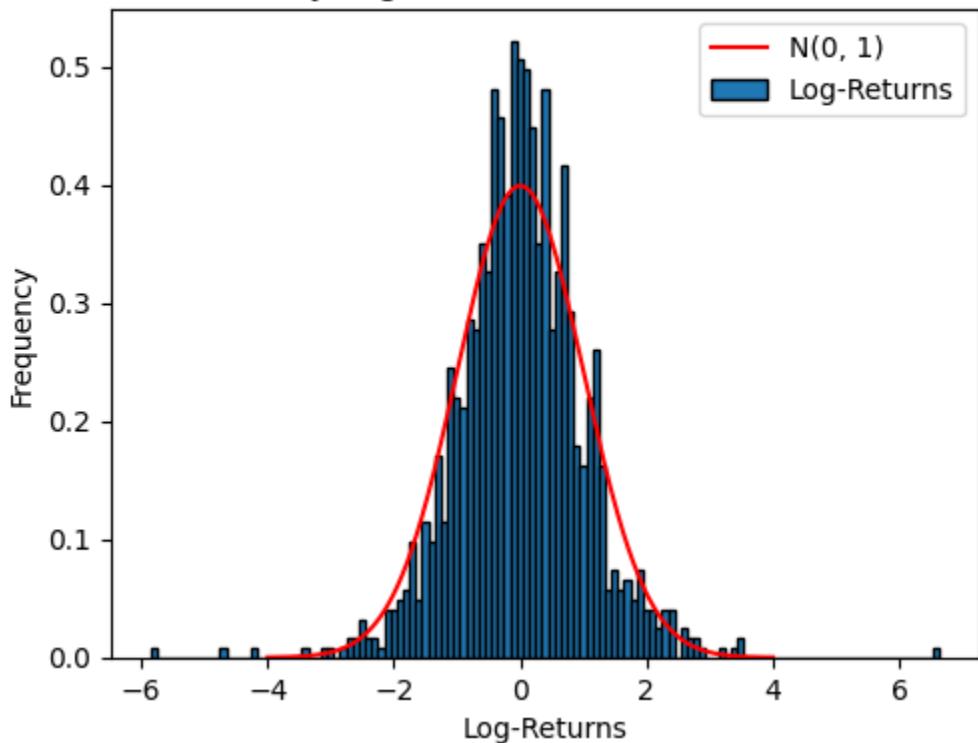
Daily Log-Returns for HUL (BSE)



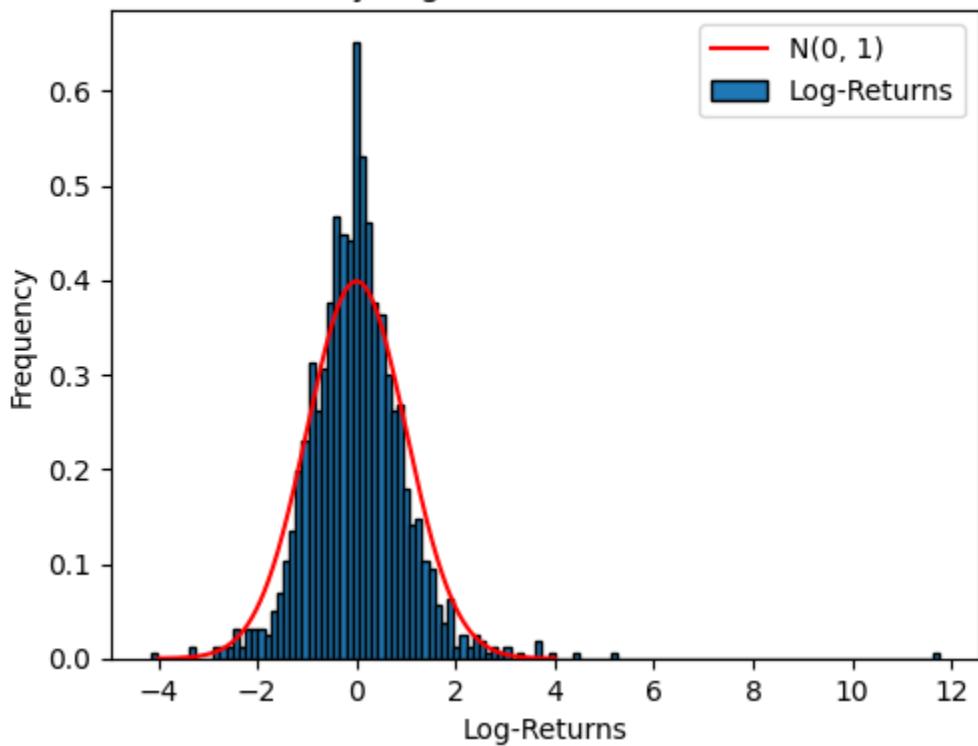
Daily Log-Returns for Infosys (BSE)

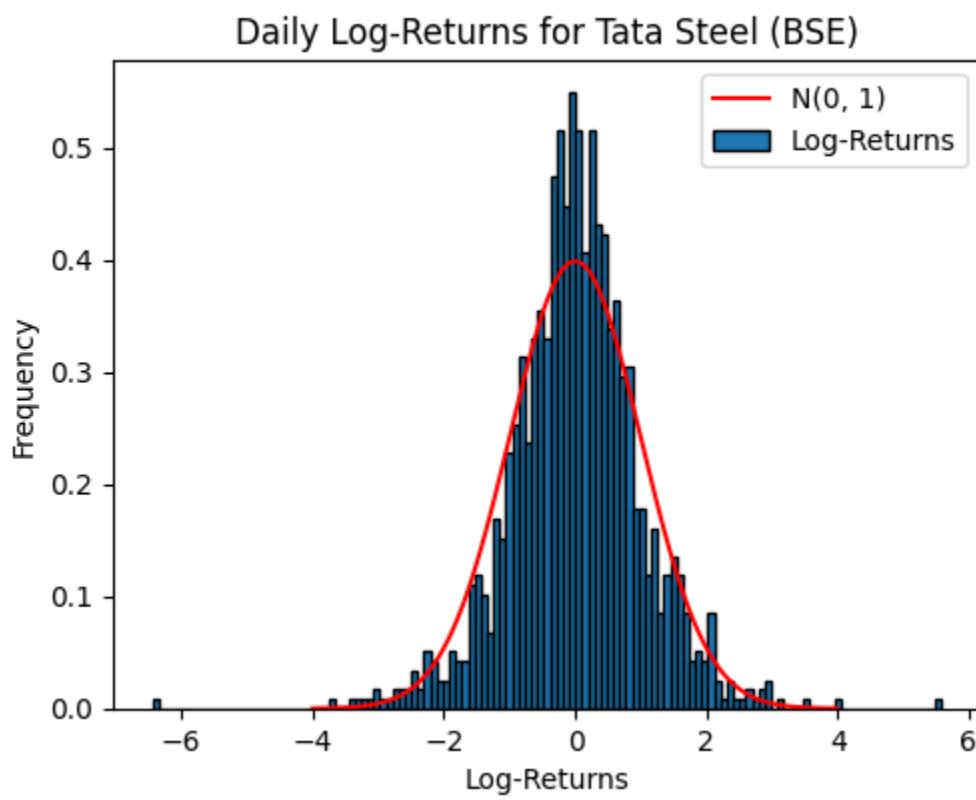
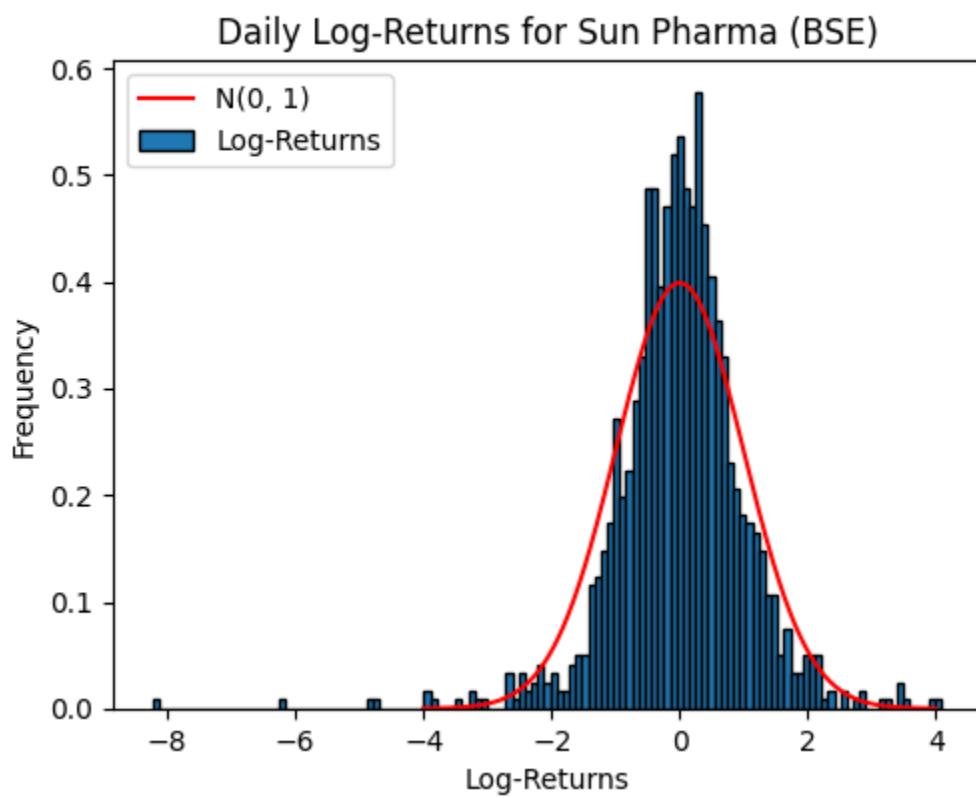


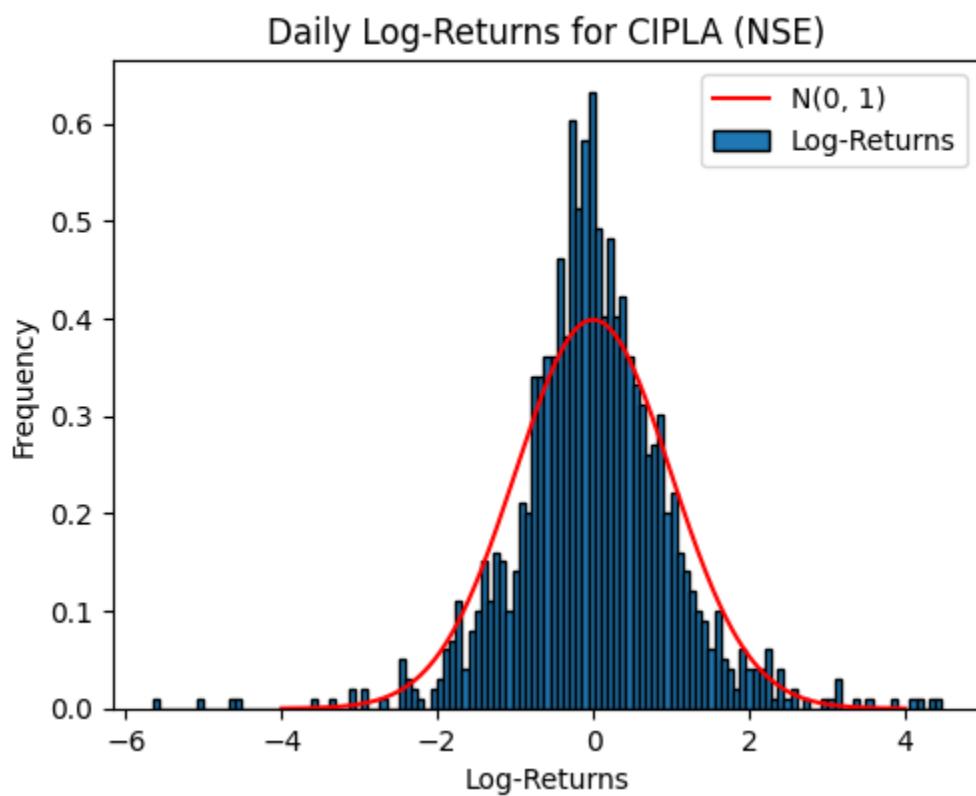
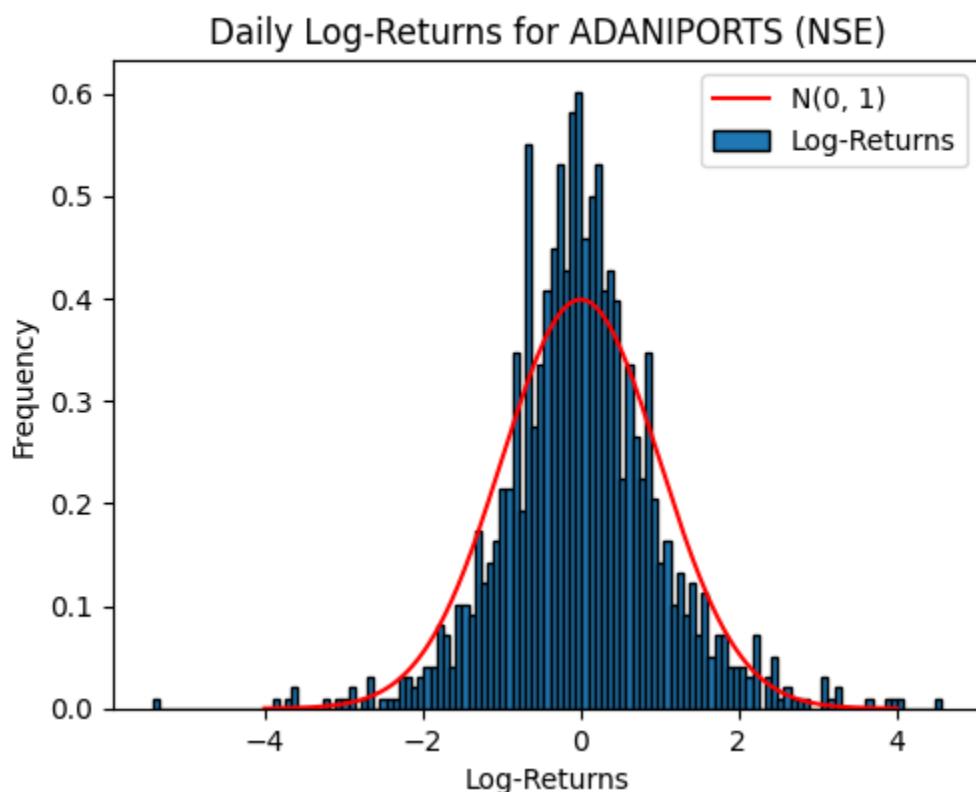
Daily Log-Returns for Reliance (BSE)

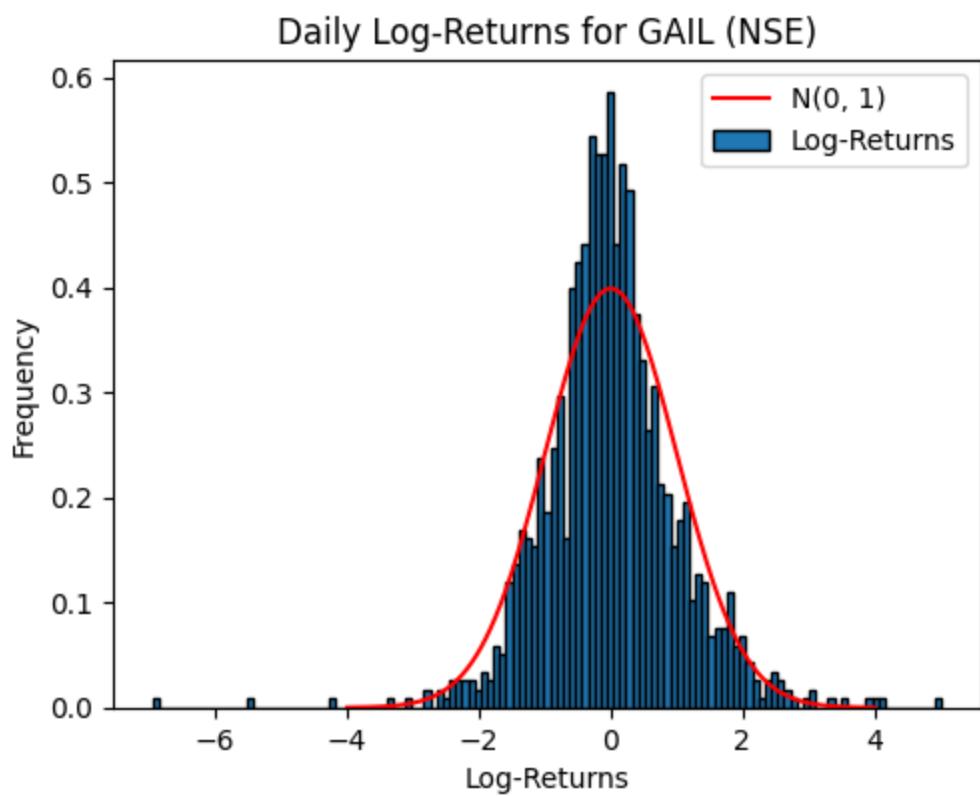
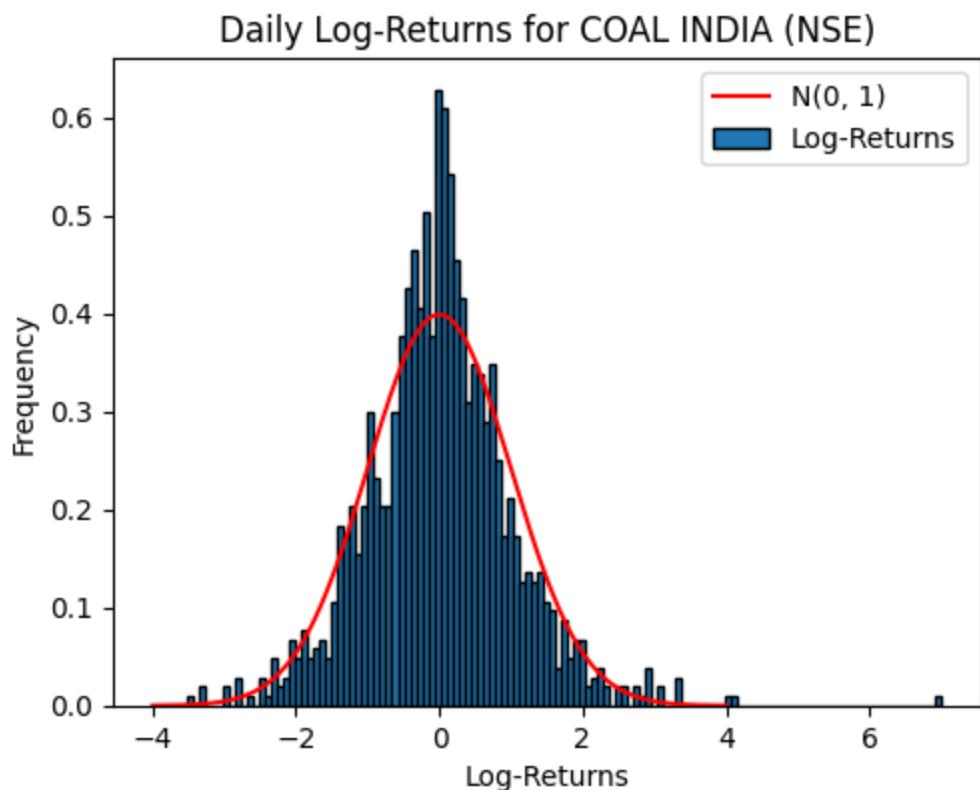


Daily Log-Returns for SBI (BSE)

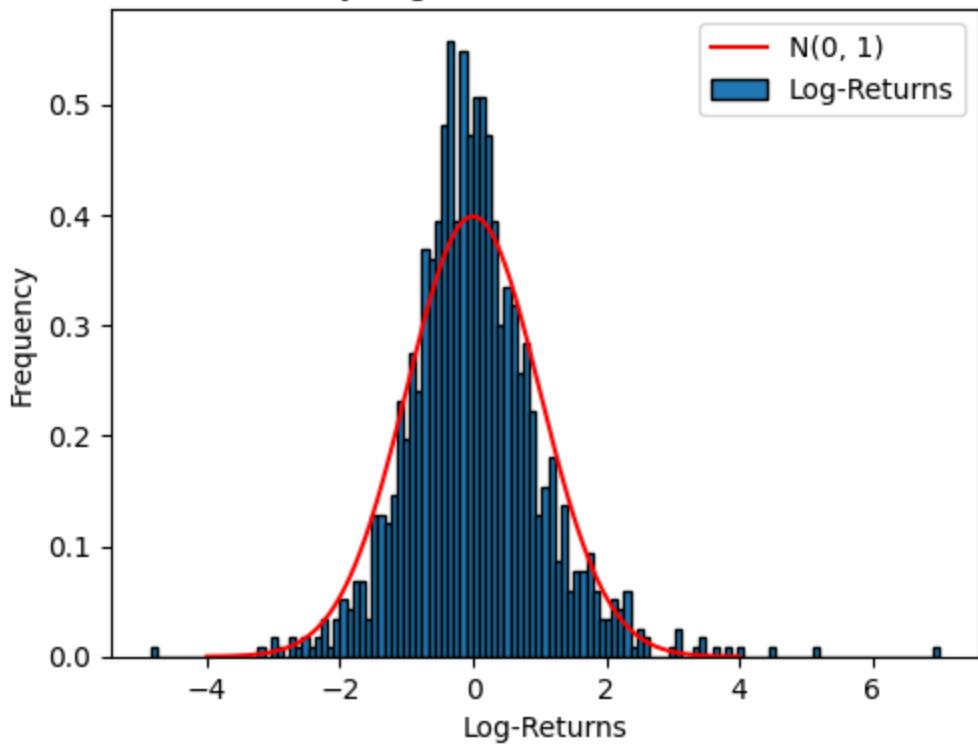




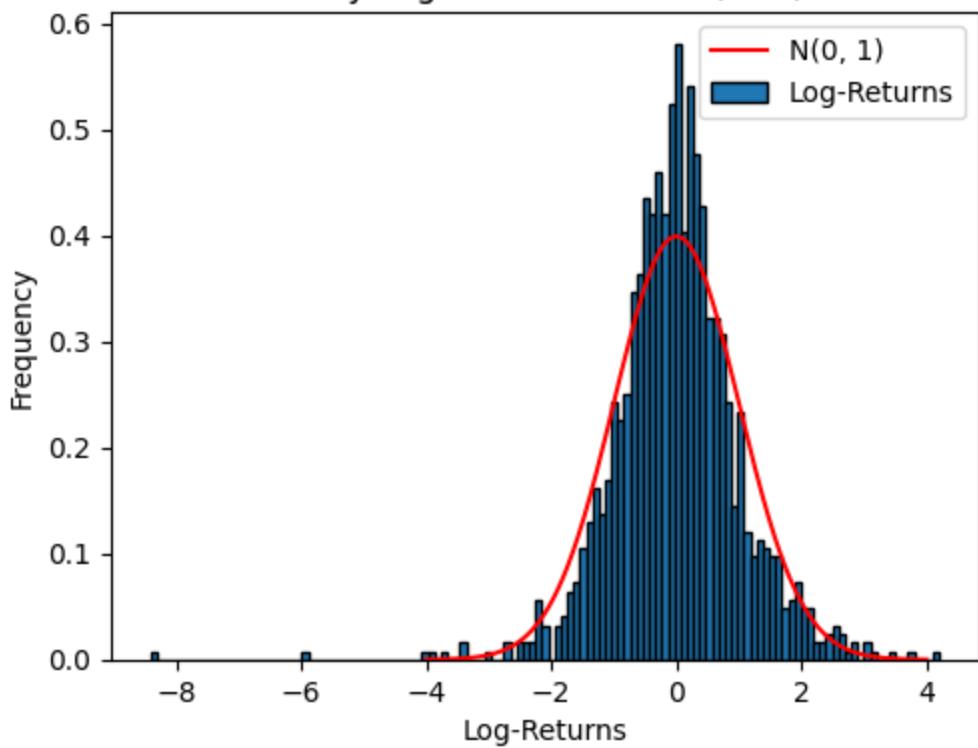




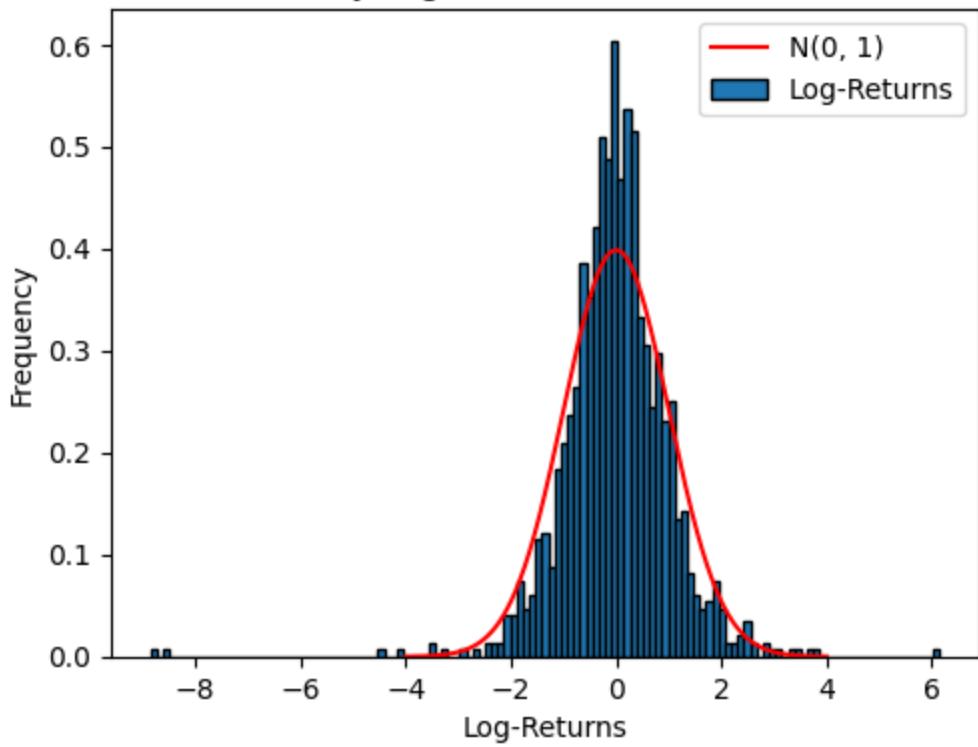
Daily Log-Returns for ICICI (NSE)



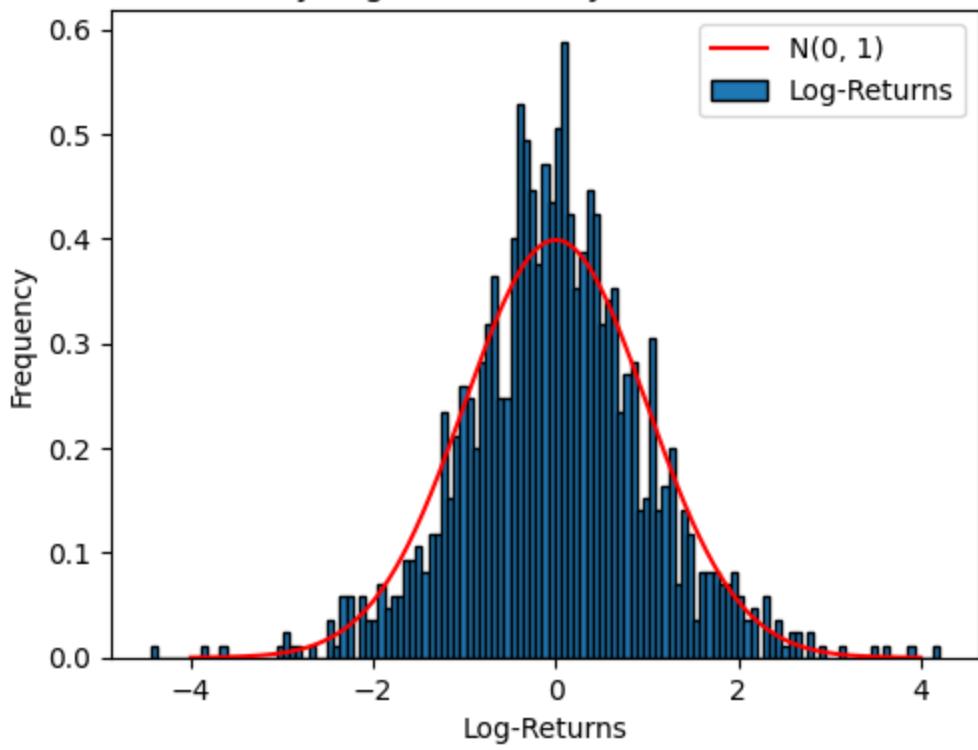
Daily Log-Returns for IOC (NSE)



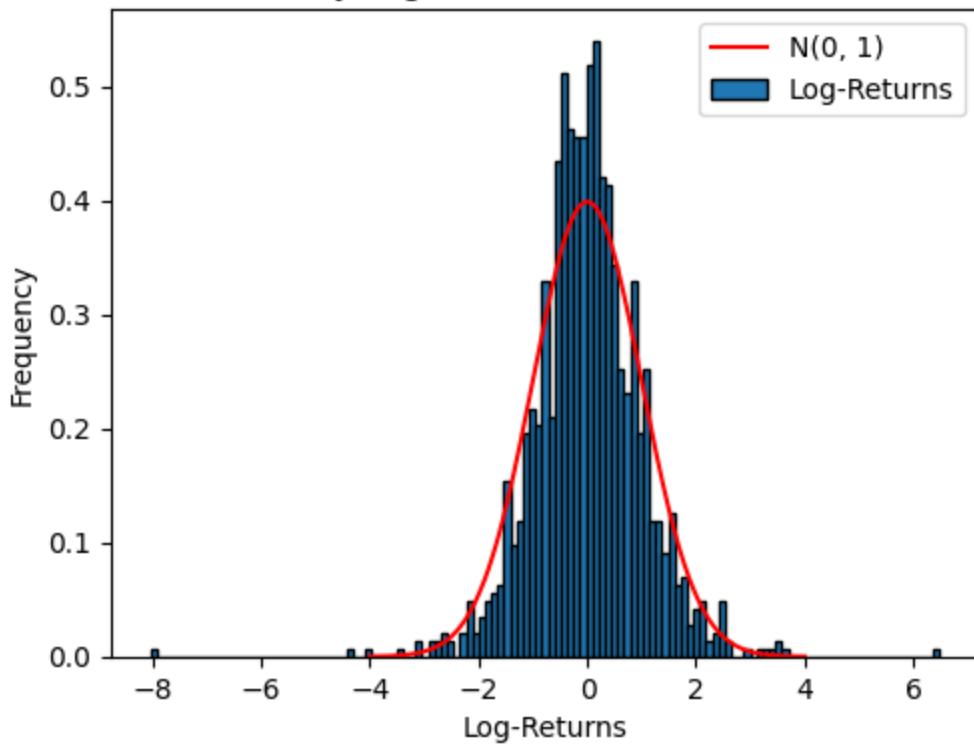
Daily Log-Returns for ITC (NSE)



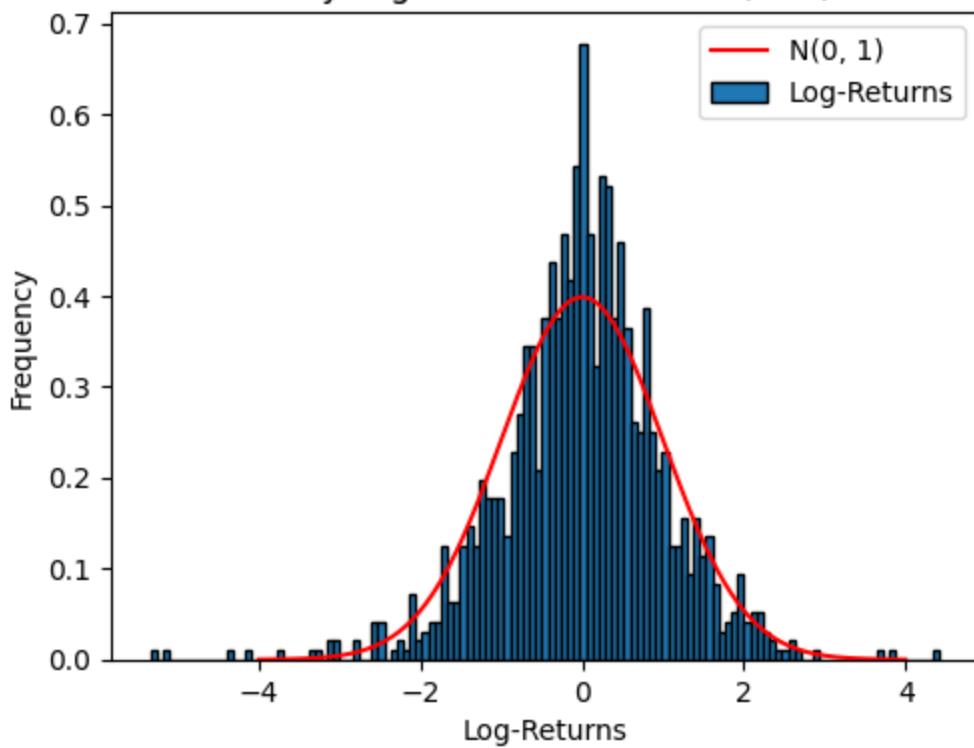
Daily Log-Returns for JSWSTEEL (NSE)



Daily Log-Returns for NTPC (NSE)



Daily Log-Returns for WIPRO (NSE)

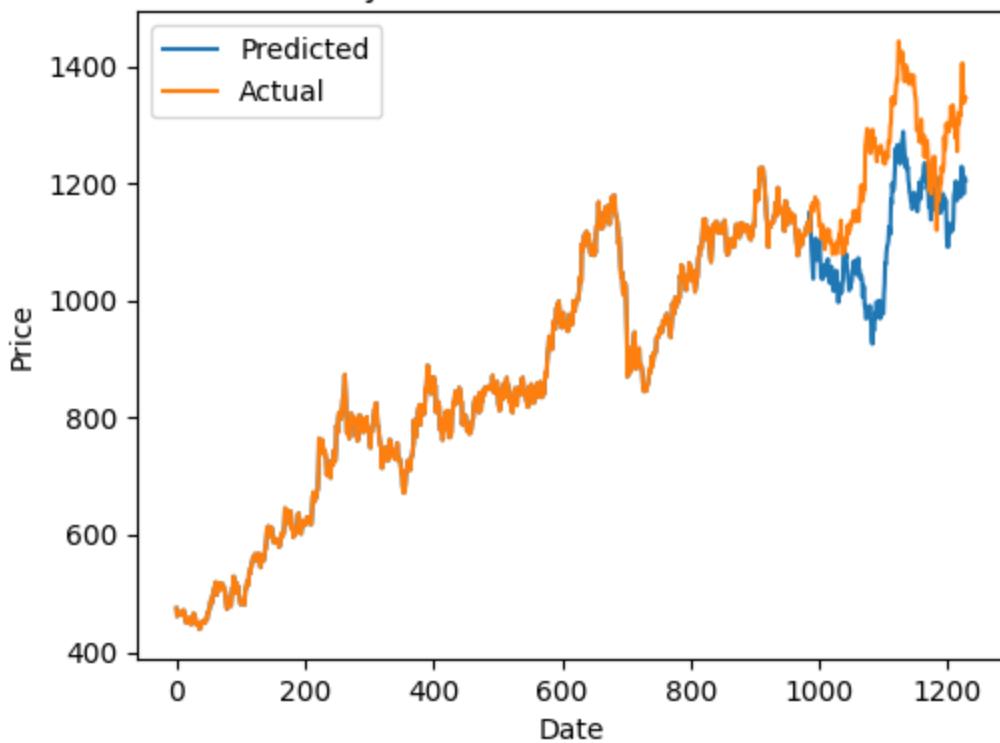


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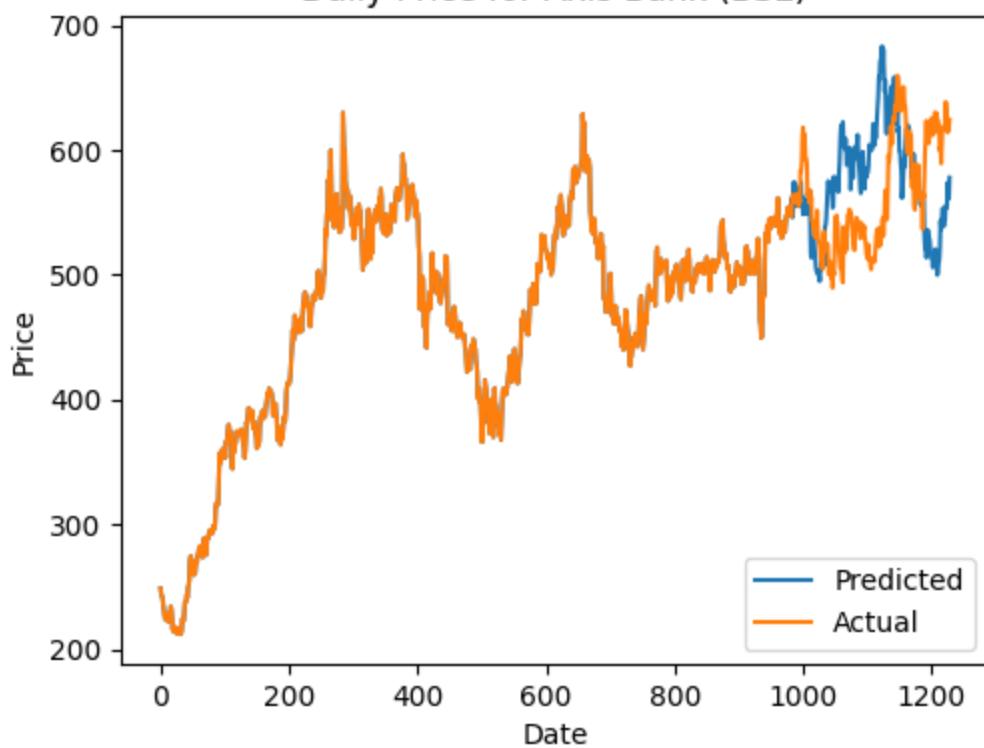
## Question 4

The values of  $\mu$  and  $\sigma$  are calculated by considering the log returns from January 1, 2014 to December 31, 2017. Now to generate a path similar to the actual path, It is assumed that the **stock prices  $S(t)$  follow a jump-diffusion process**. We are simulating the stock prices assuming fixed dates. The graphs are plotted below -

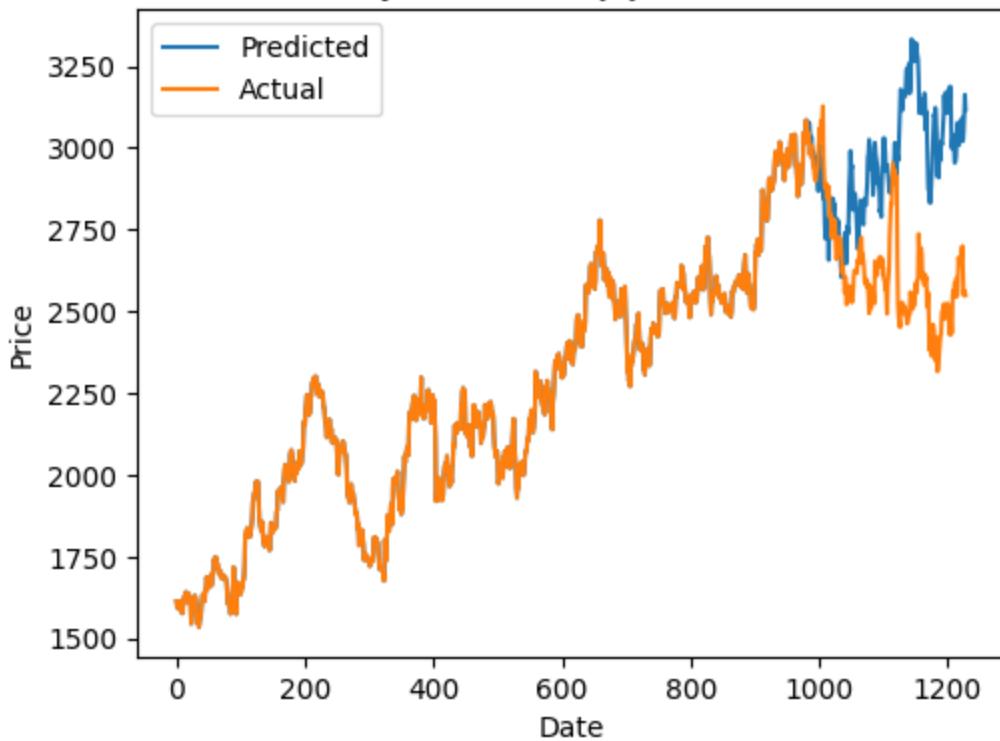
### Daily Price for Asian Paints (BSE)



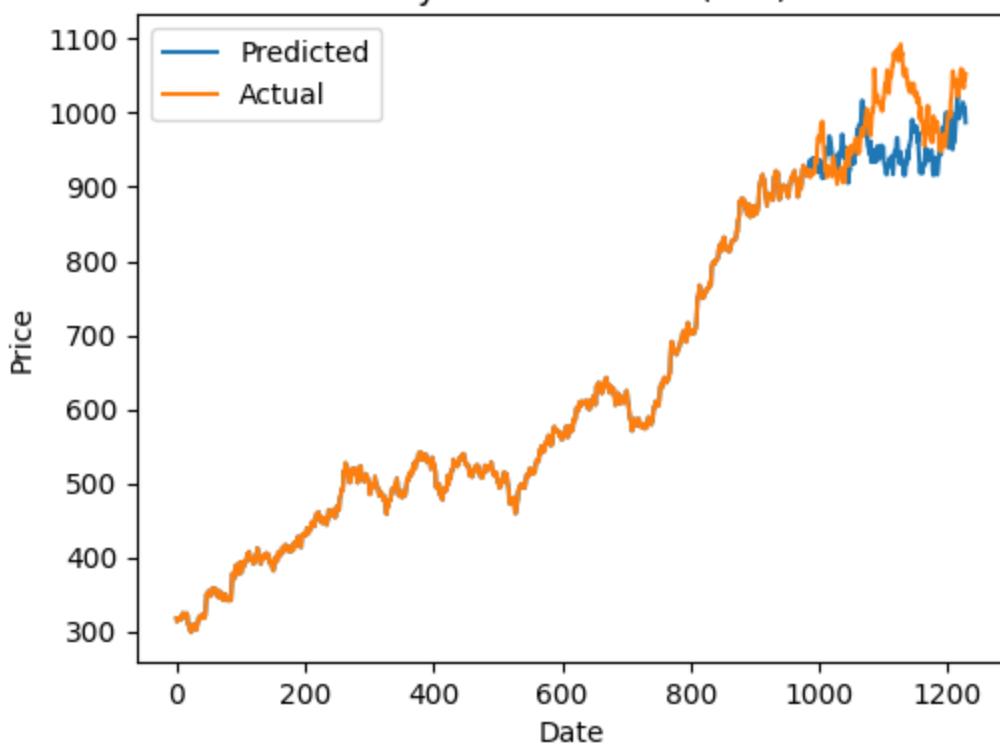
### Daily Price for Axis Bank (BSE)



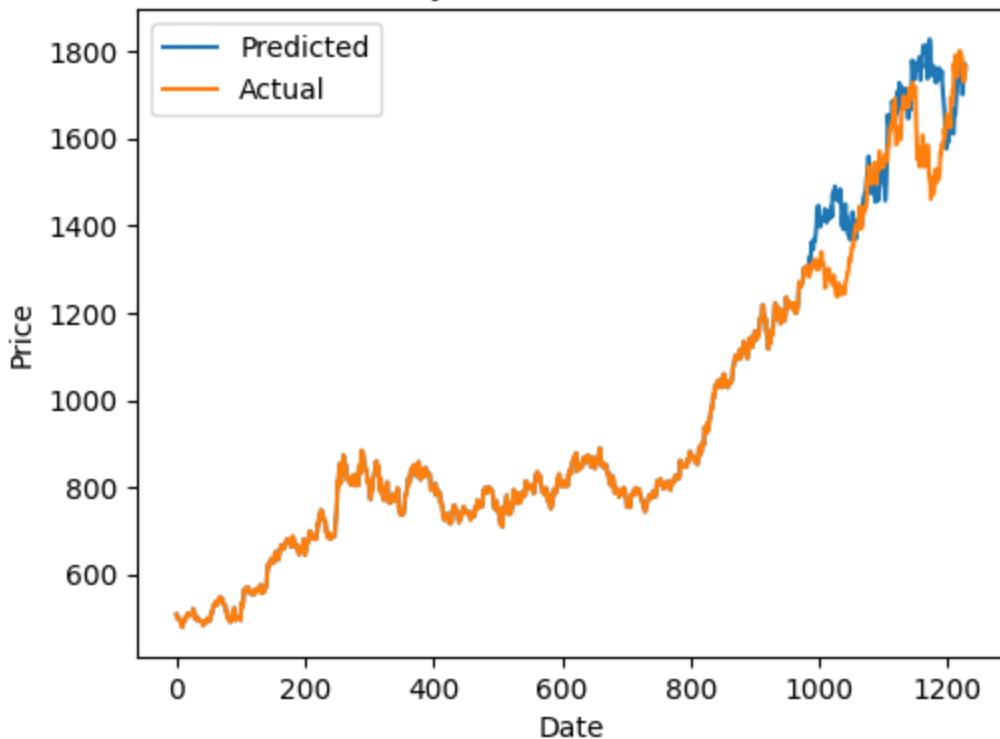
### Daily Price for Bajaj Auto (BSE)



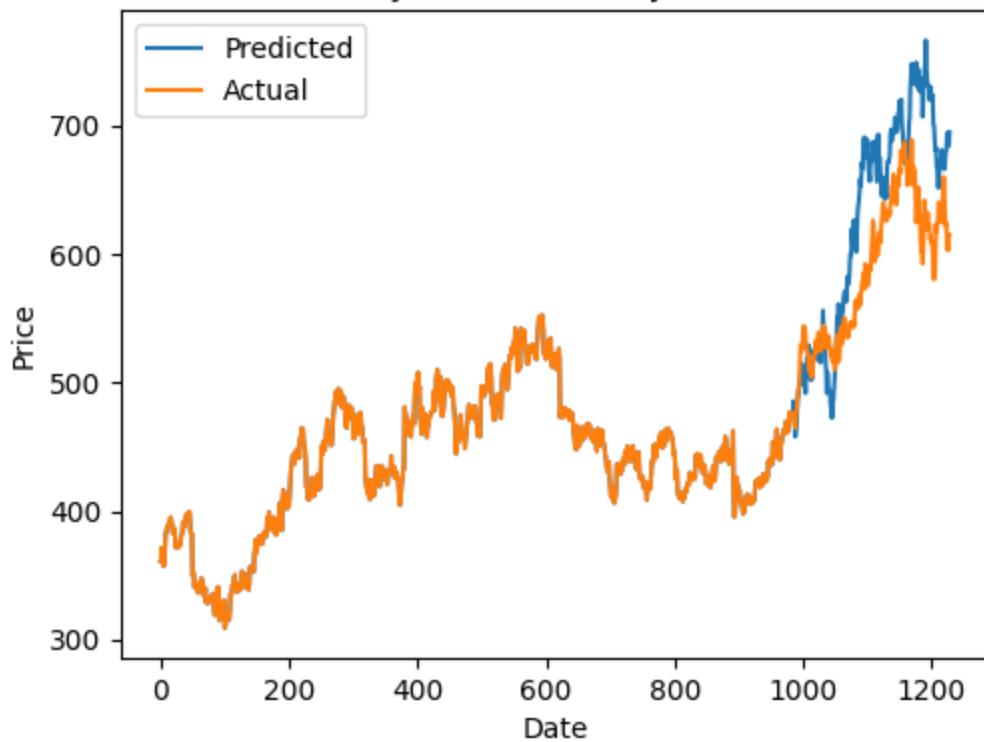
### Daily Price for HDFC (BSE)



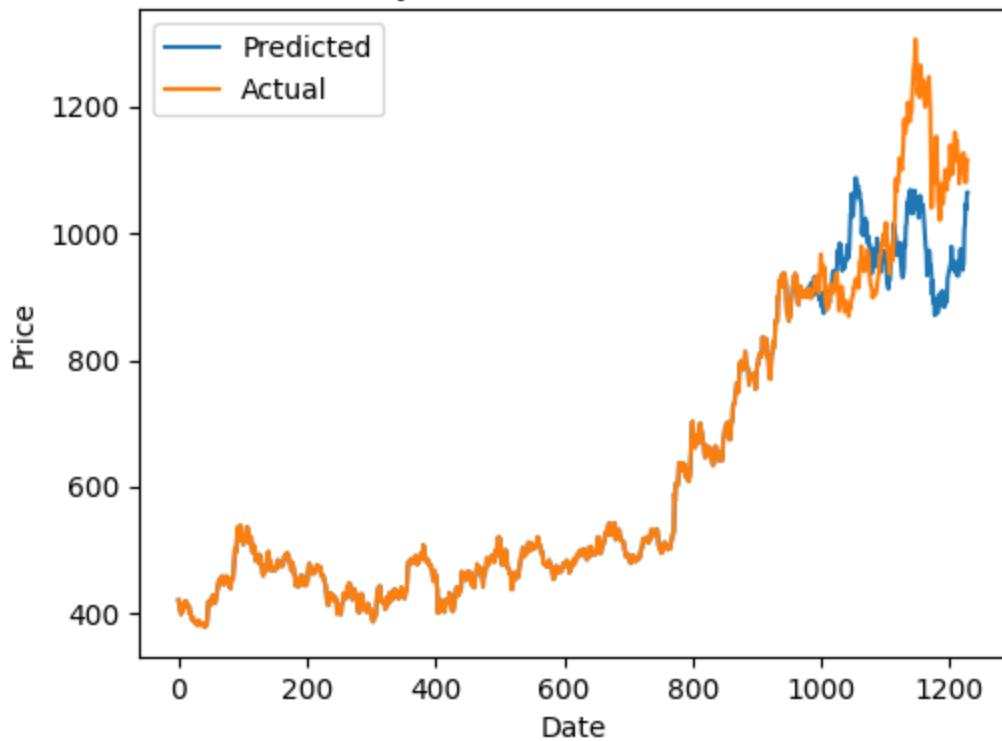
Daily Price for HUL (BSE)



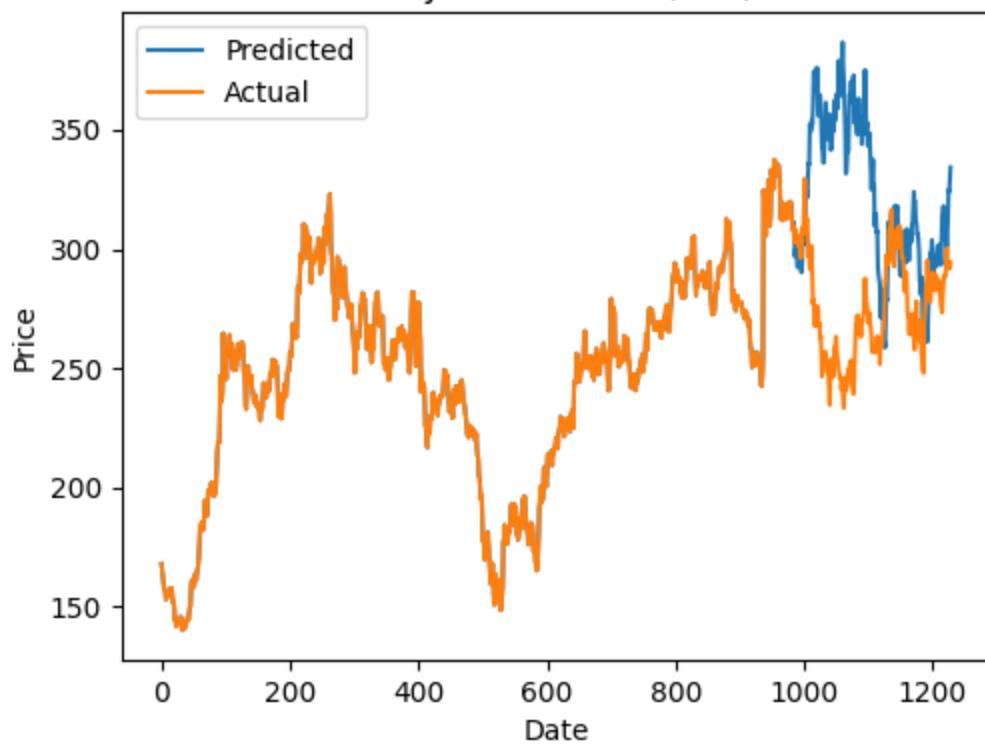
Daily Price for Infosys (BSE)



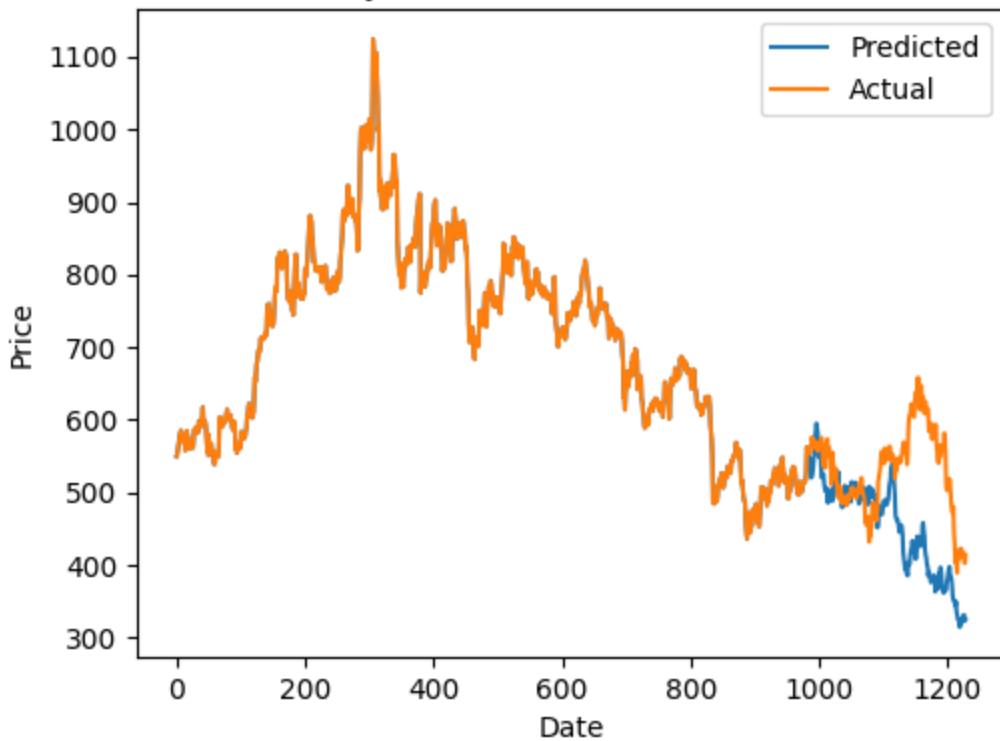
### Daily Price for Reliance (BSE)



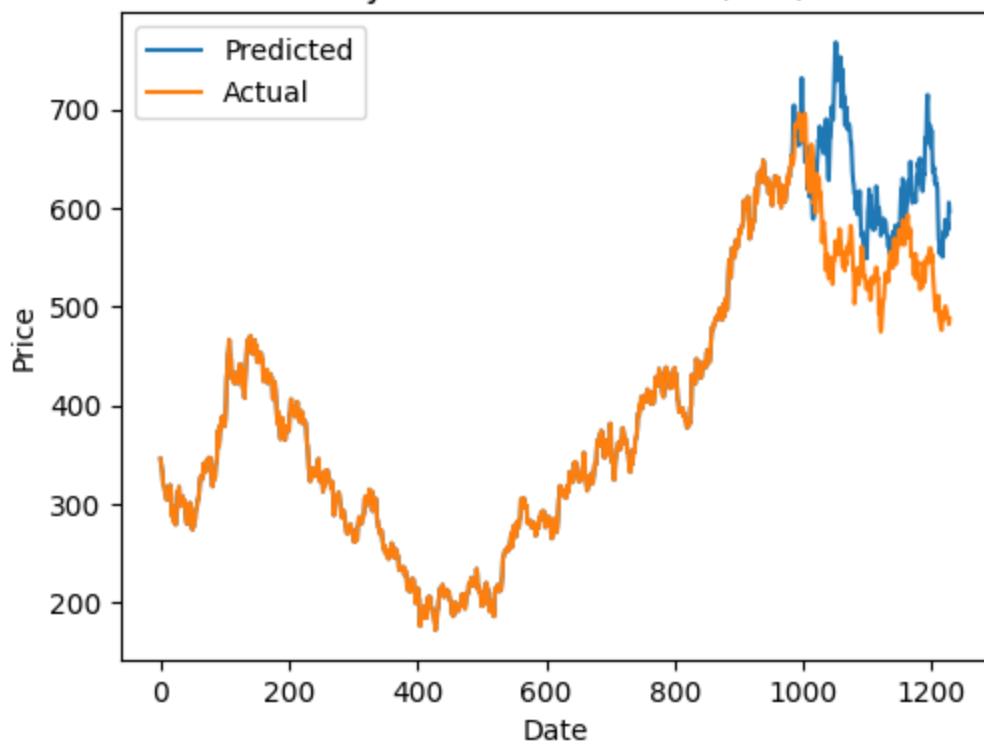
### Daily Price for SBI (BSE)



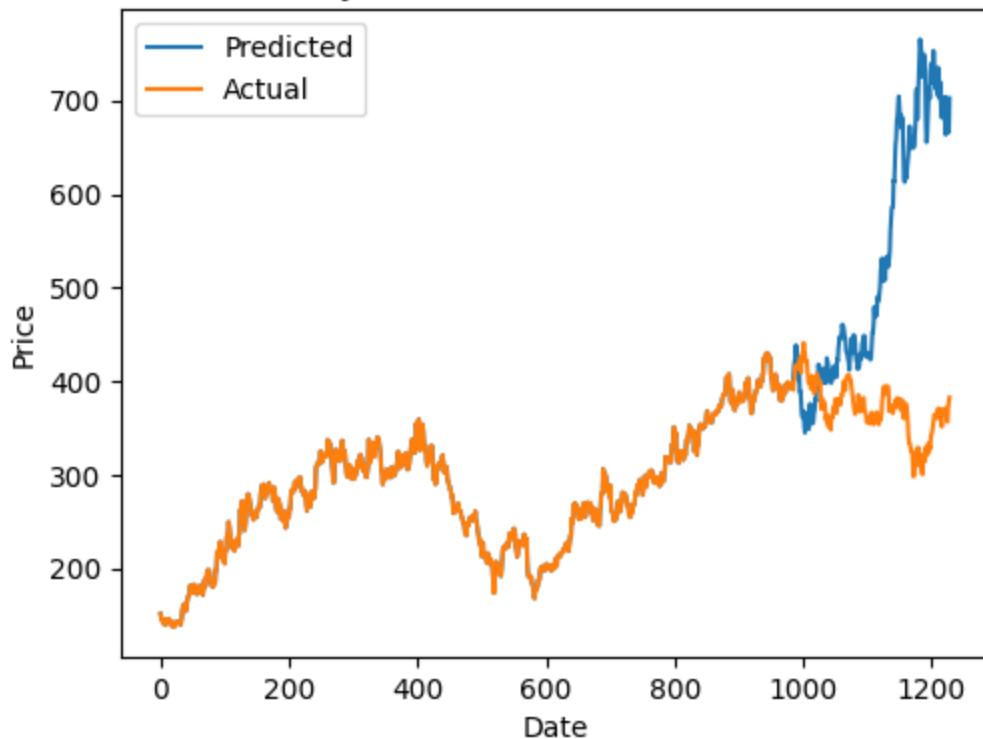
### Daily Price for Sun Pharma (BSE)



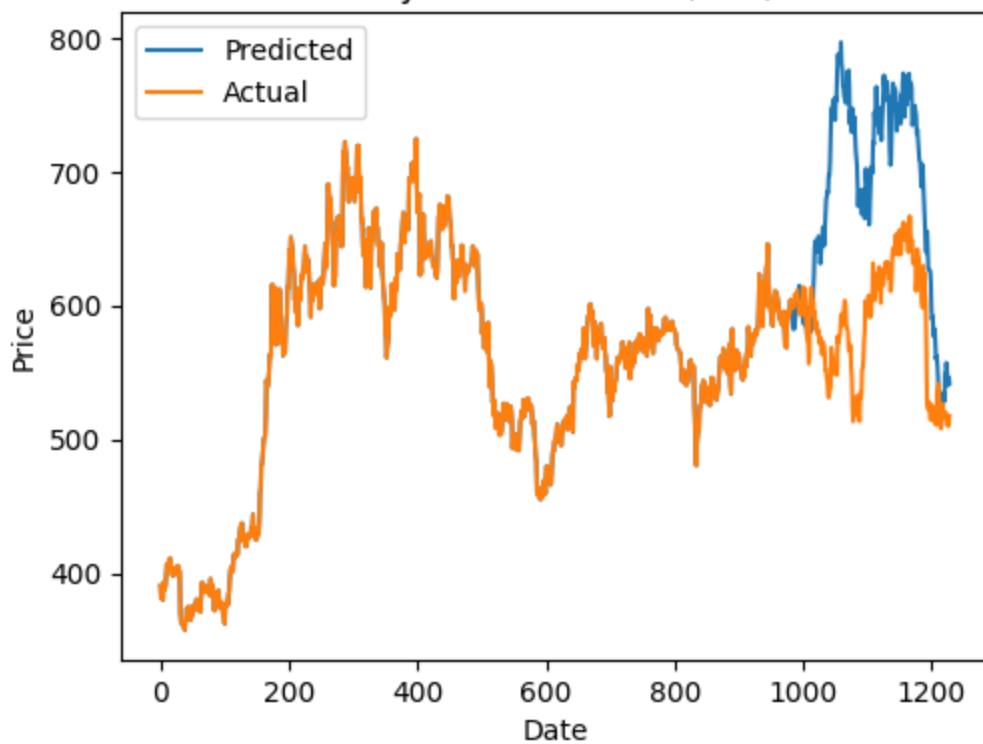
### Daily Price for Tata Steel (BSE)

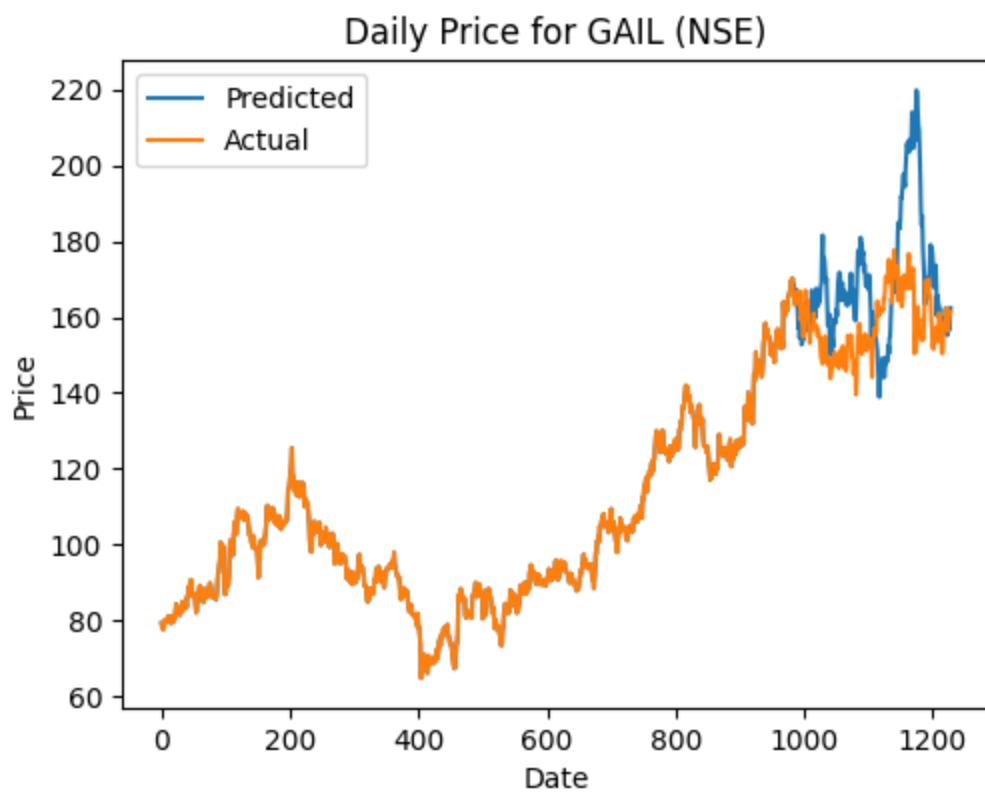
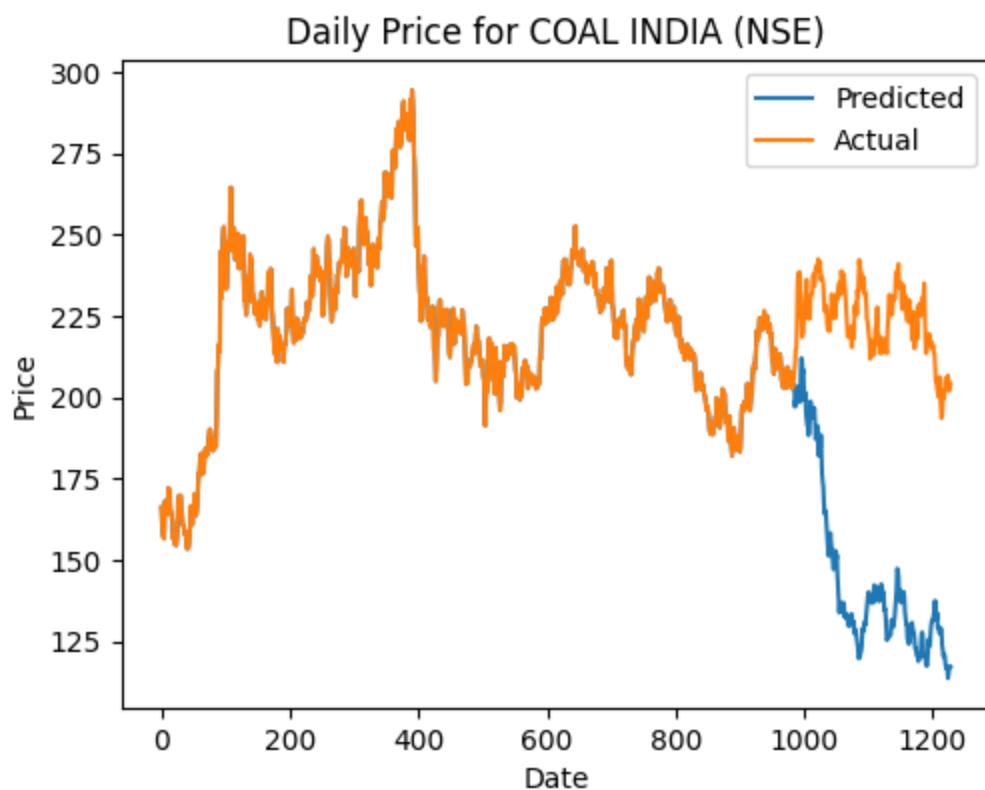


Daily Price for ADANIPORTS (NSE)

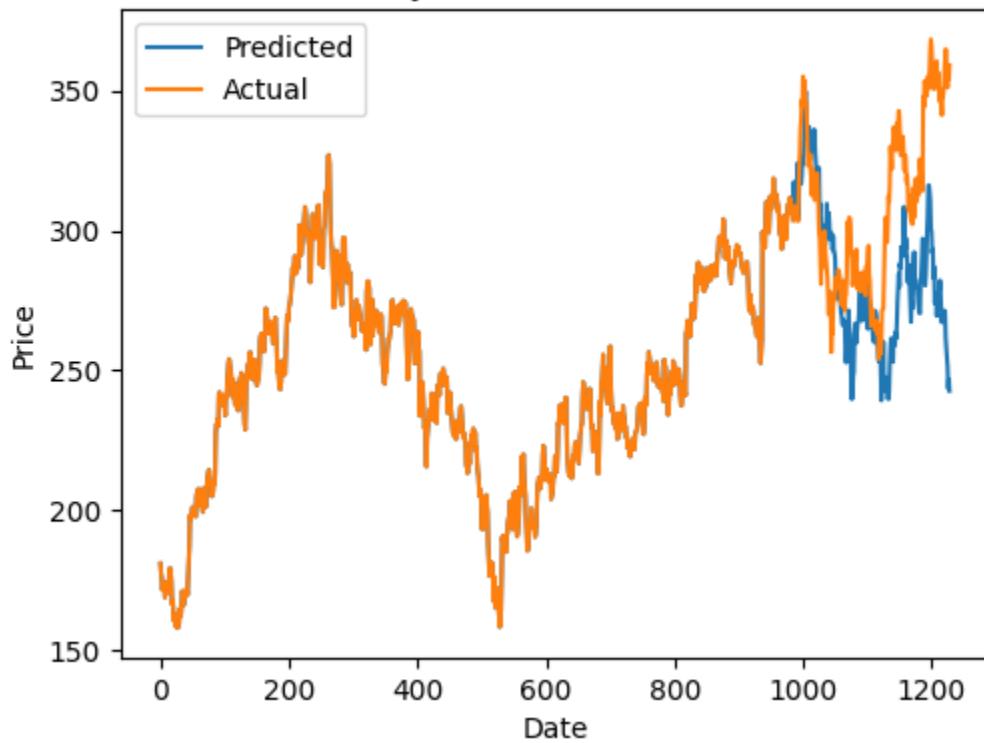


Daily Price for CIPLA (NSE)

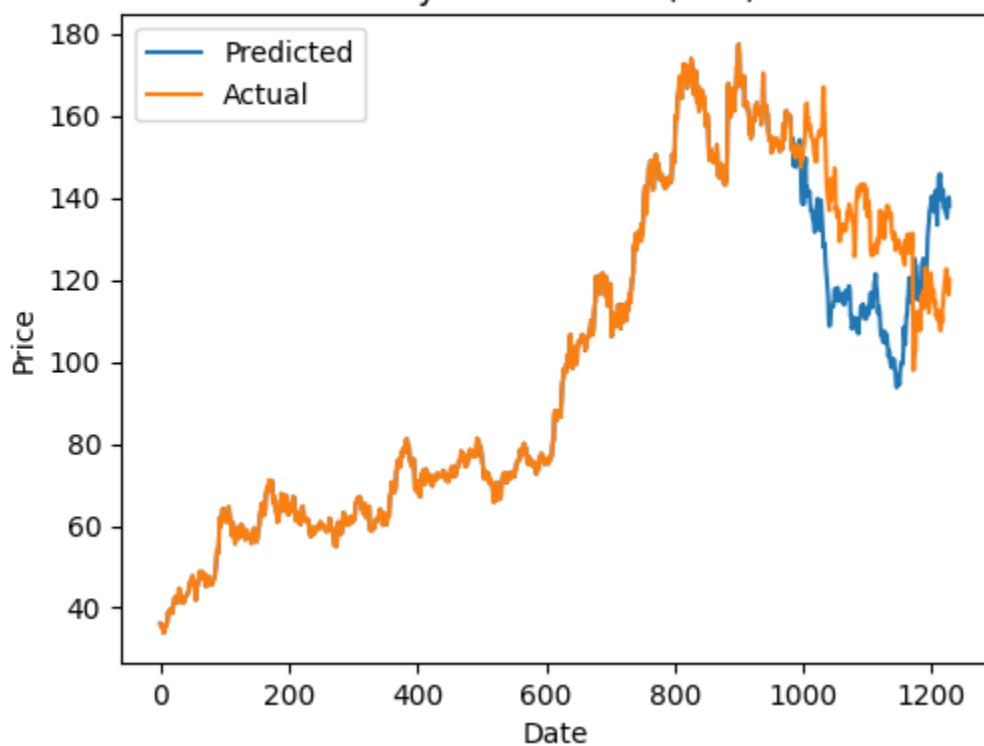




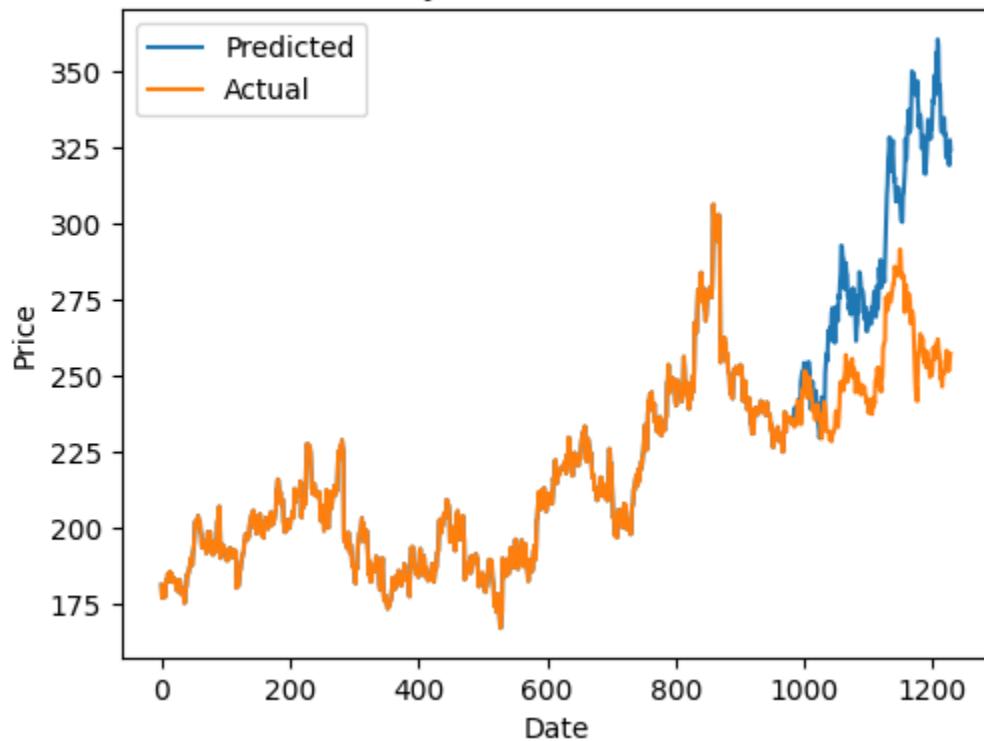
### Daily Price for ICICI (NSE)



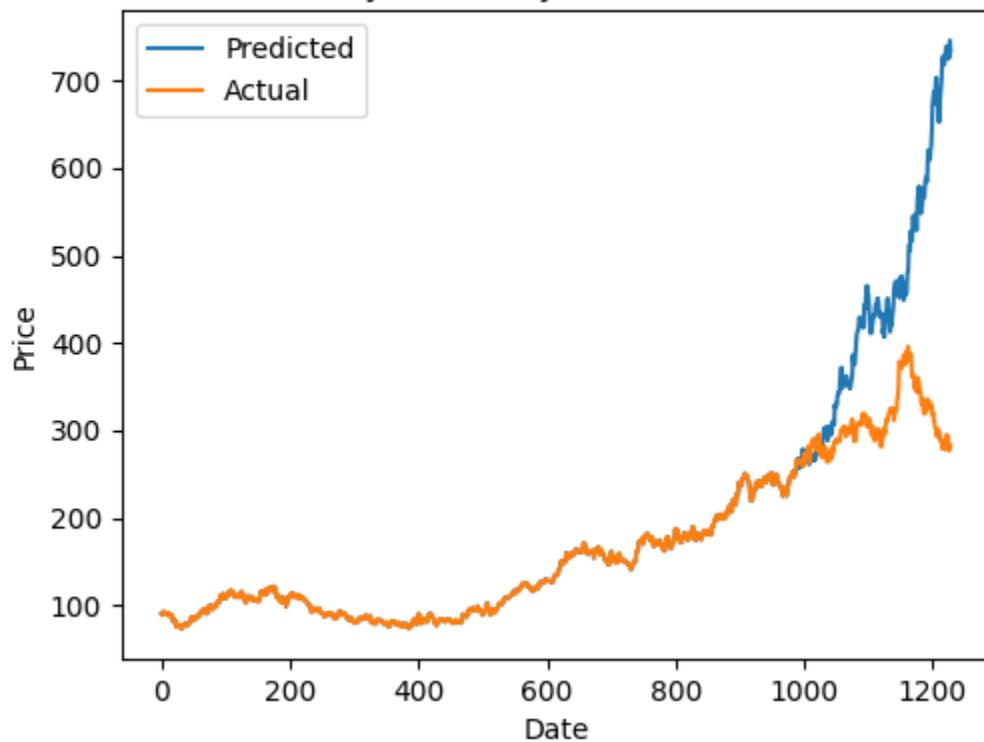
### Daily Price for IOC (NSE)



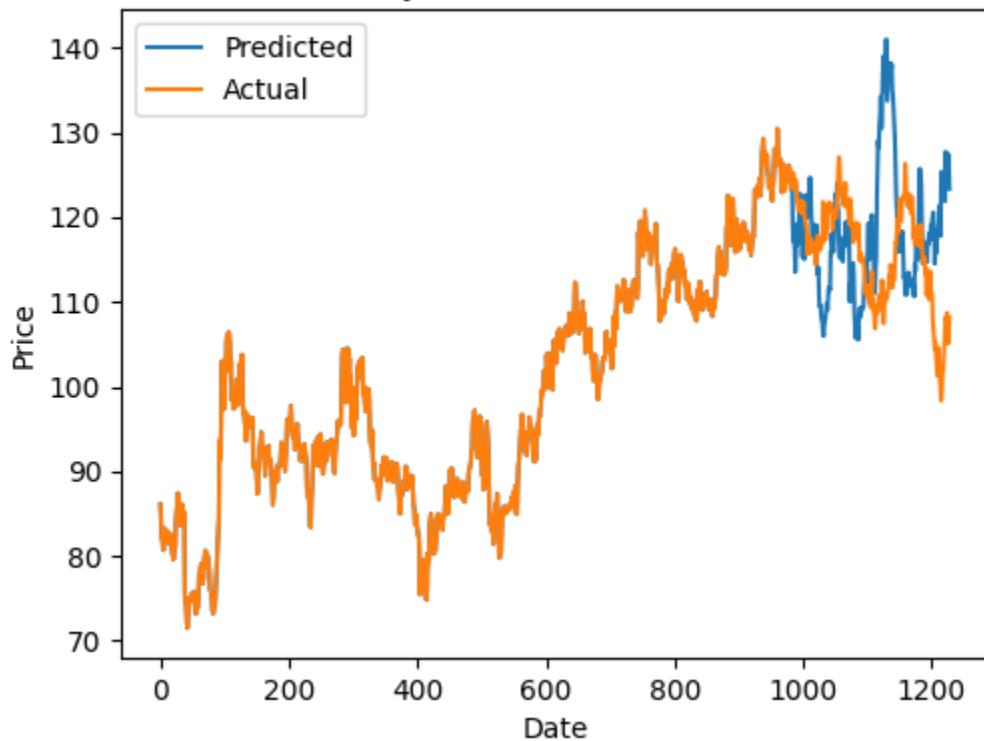
### Daily Price for ITC (NSE)



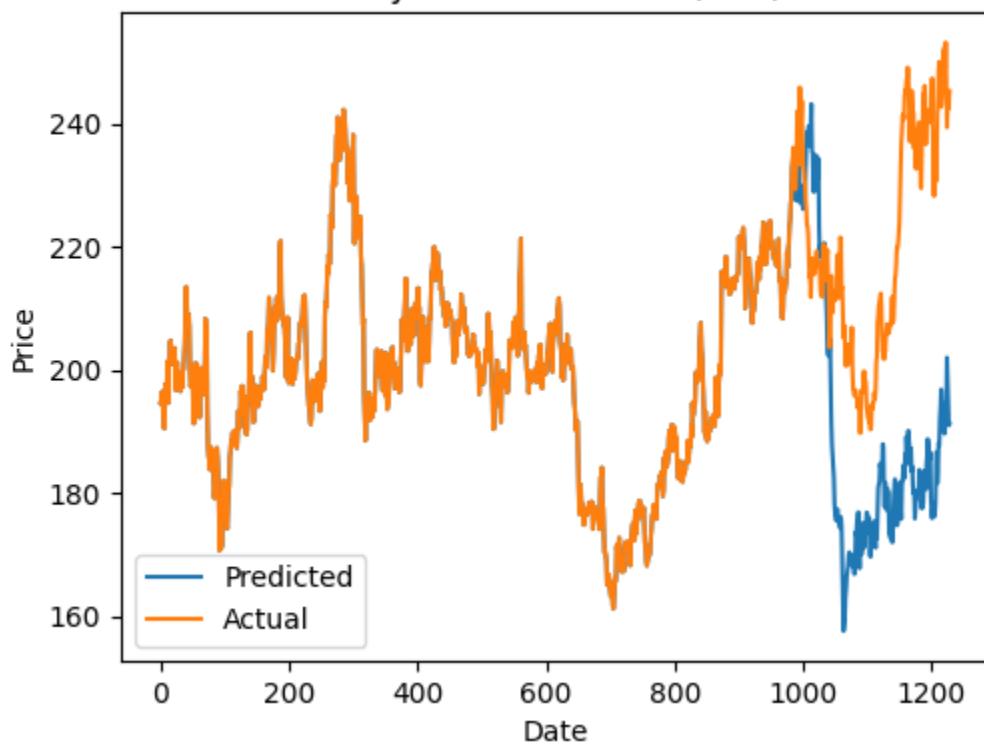
### Daily Price for JSWSTEEL (NSE)



### Daily Price for NTPC (NSE)



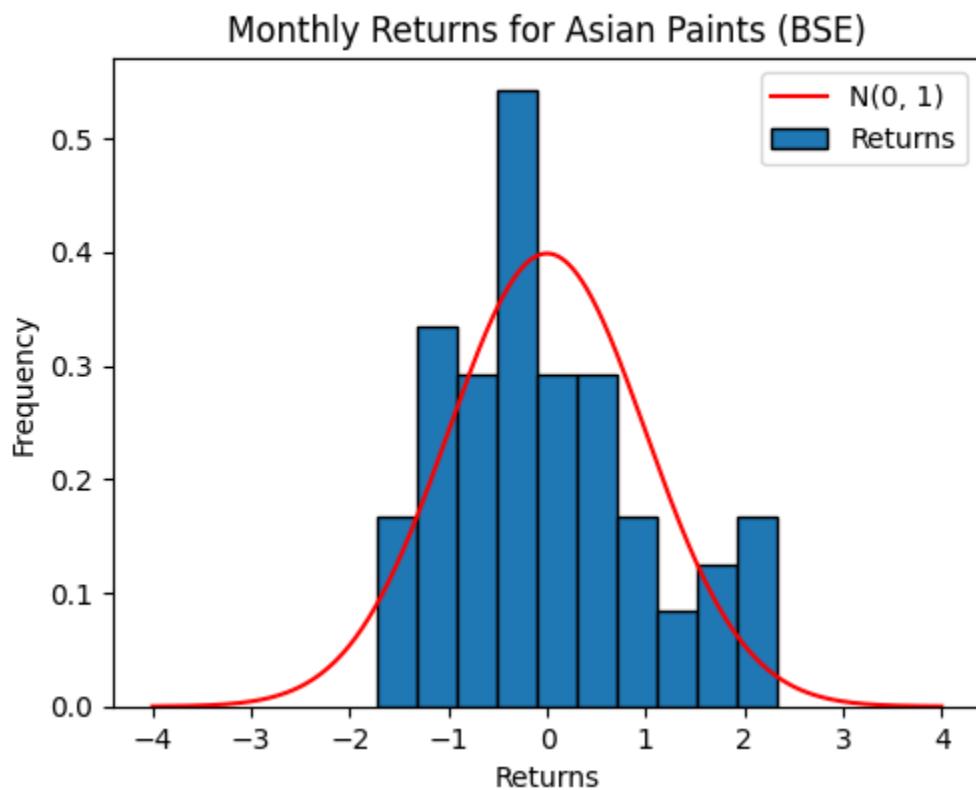
### Daily Price for WIPRO (NSE)



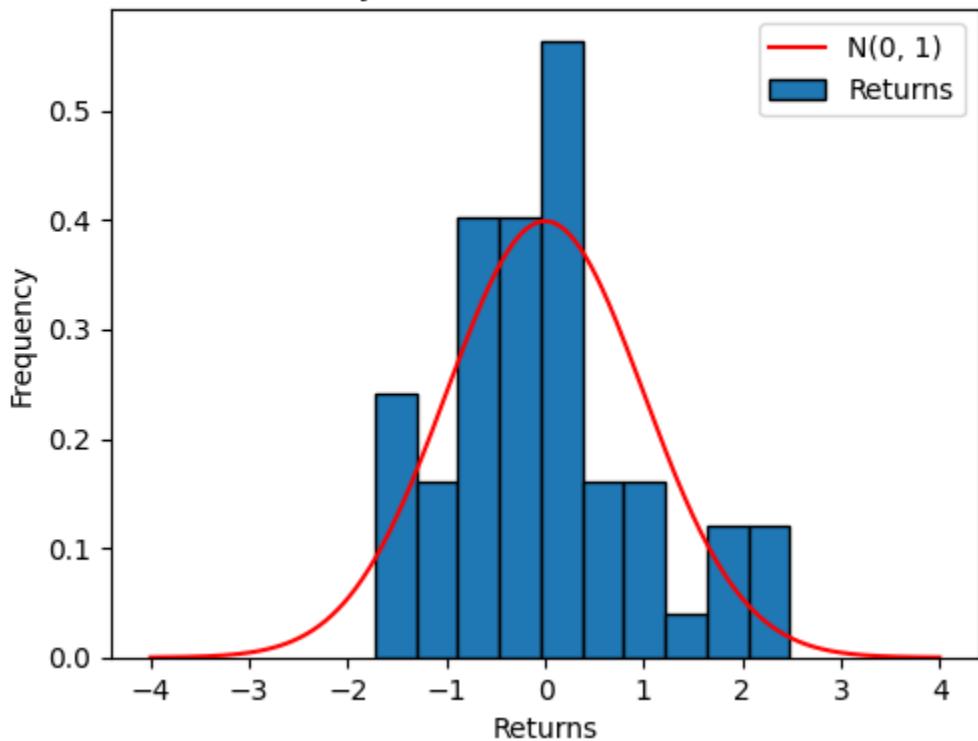
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## Question 5

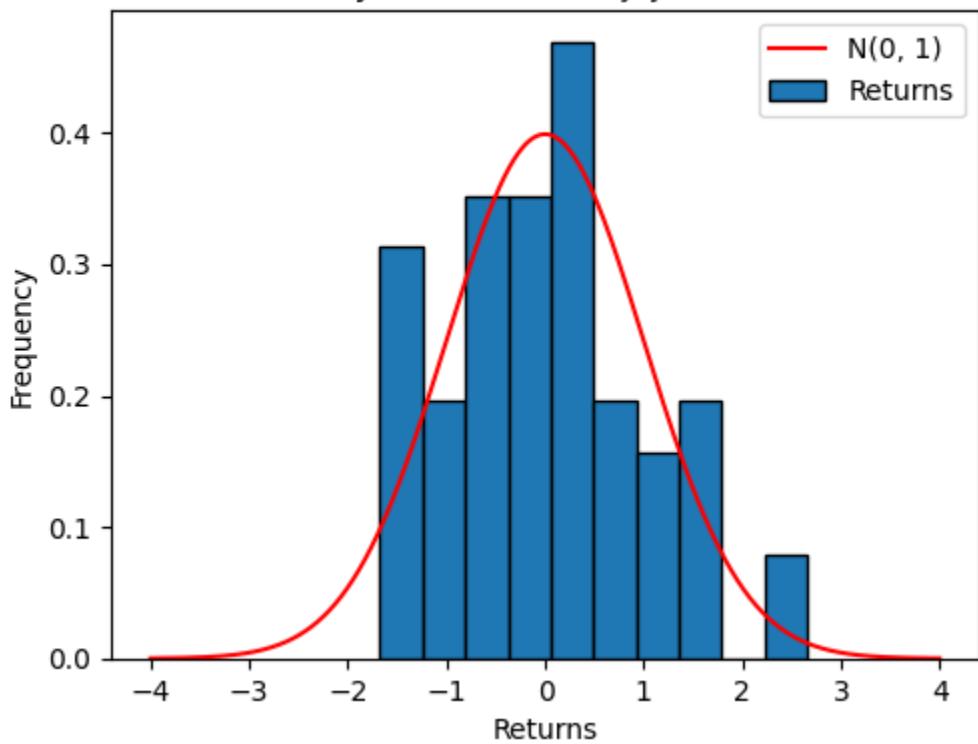
The above questions were repeated for Weekly and Monthly data as well. The graphs are given below -



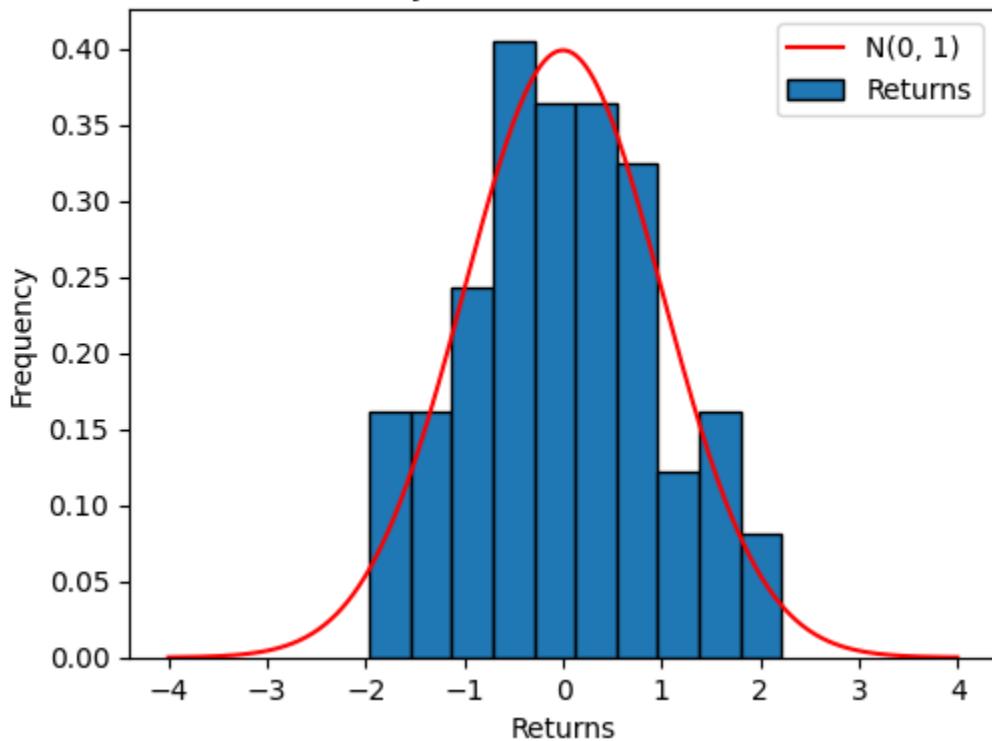
Monthly Returns for Axis Bank (BSE)



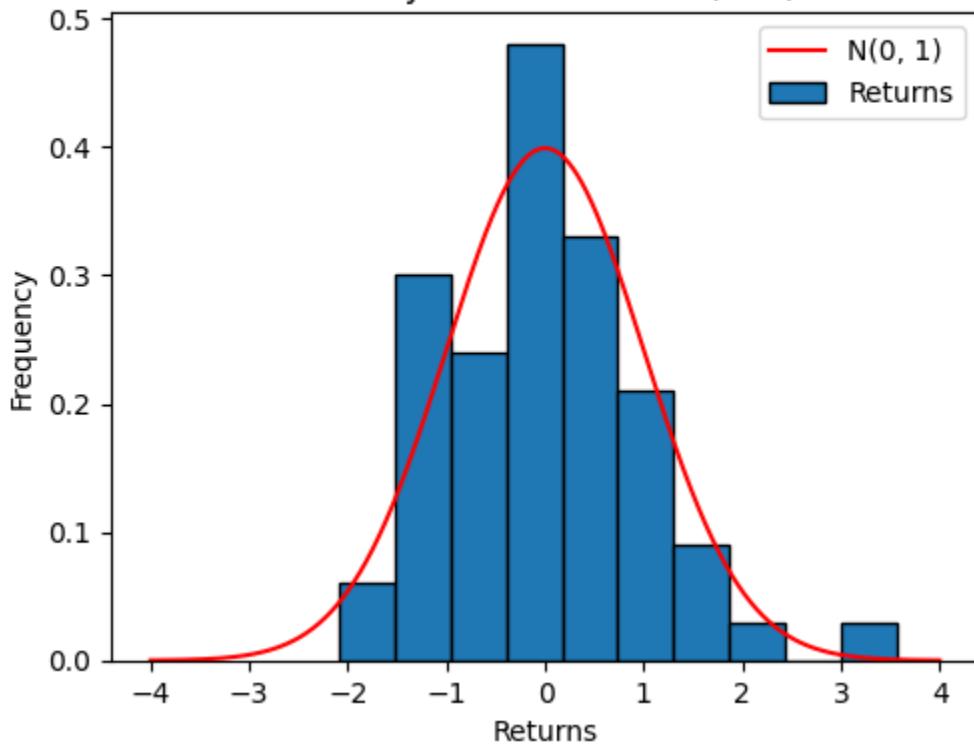
Monthly Returns for Bajaj Auto (BSE)



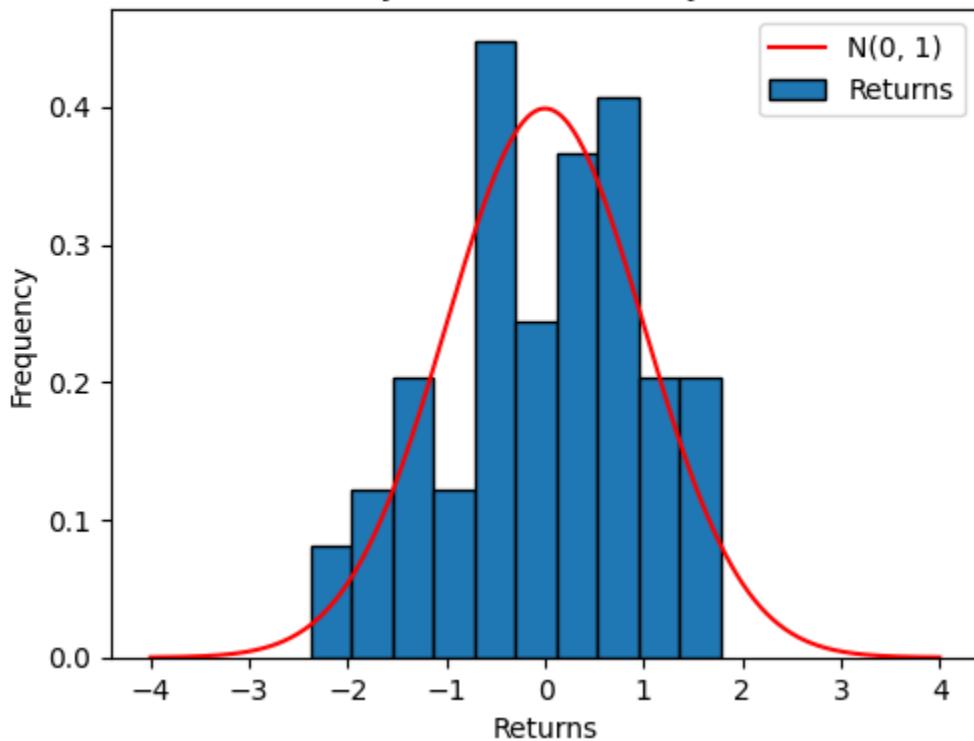
Monthly Returns for HDFC (BSE)



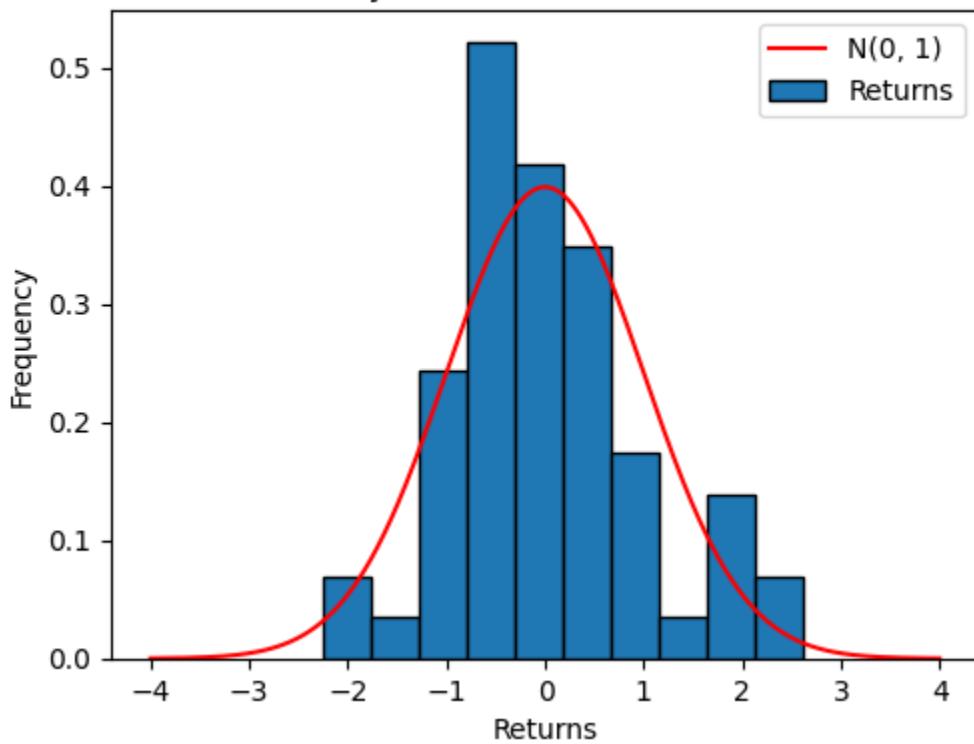
Monthly Returns for HUL (BSE)



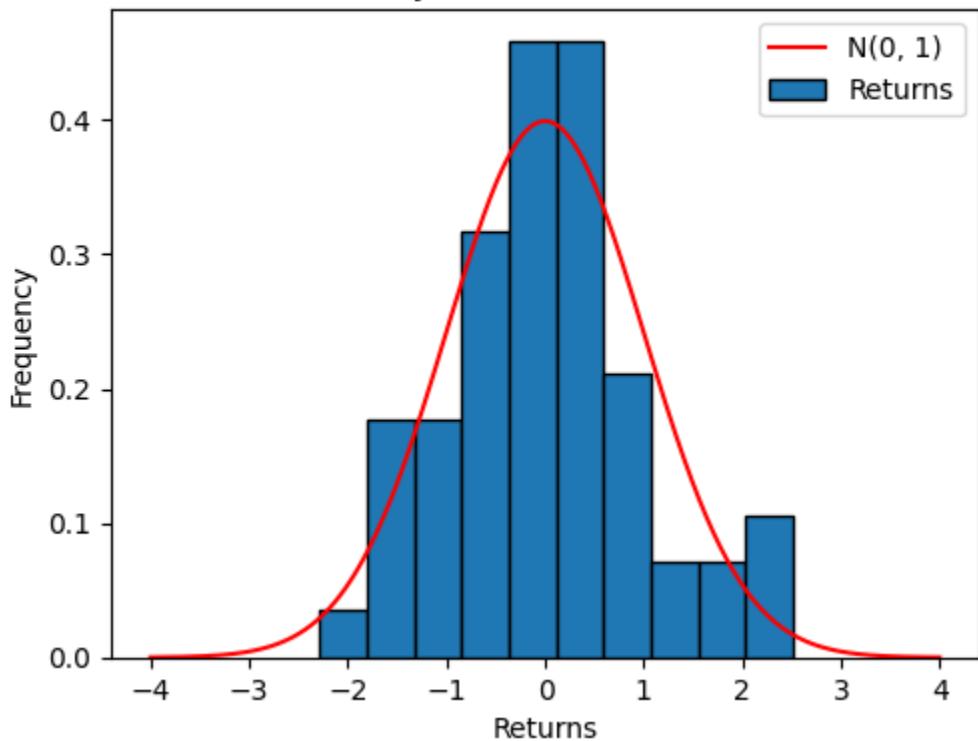
Monthly Returns for Infosys (BSE)



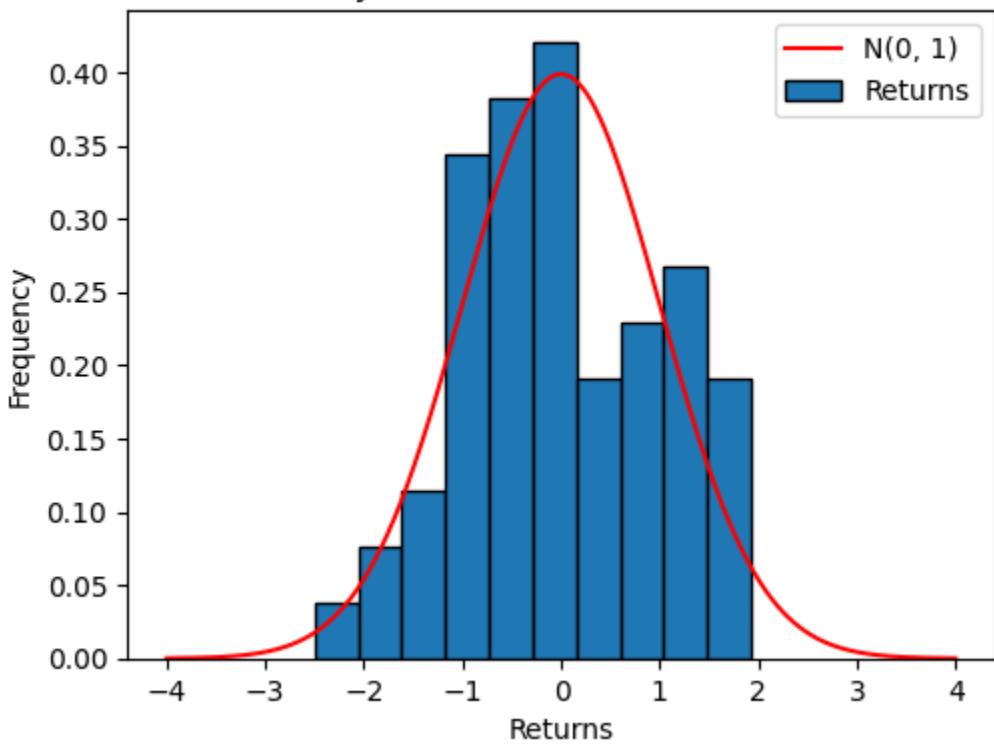
Monthly Returns for Reliance (BSE)



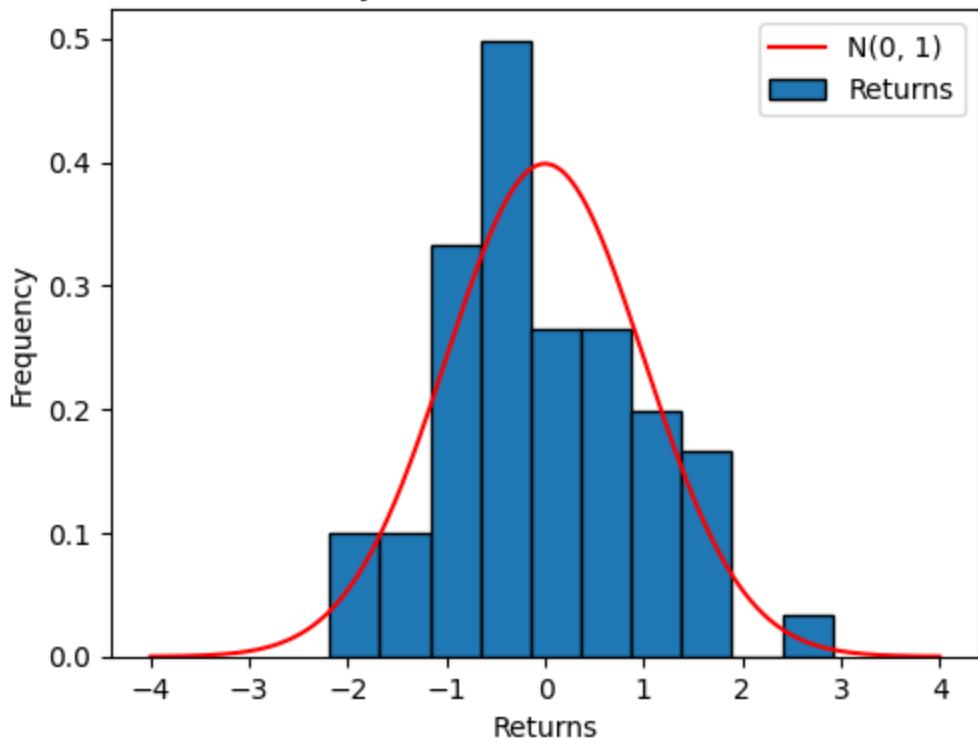
Monthly Returns for SBI (BSE)



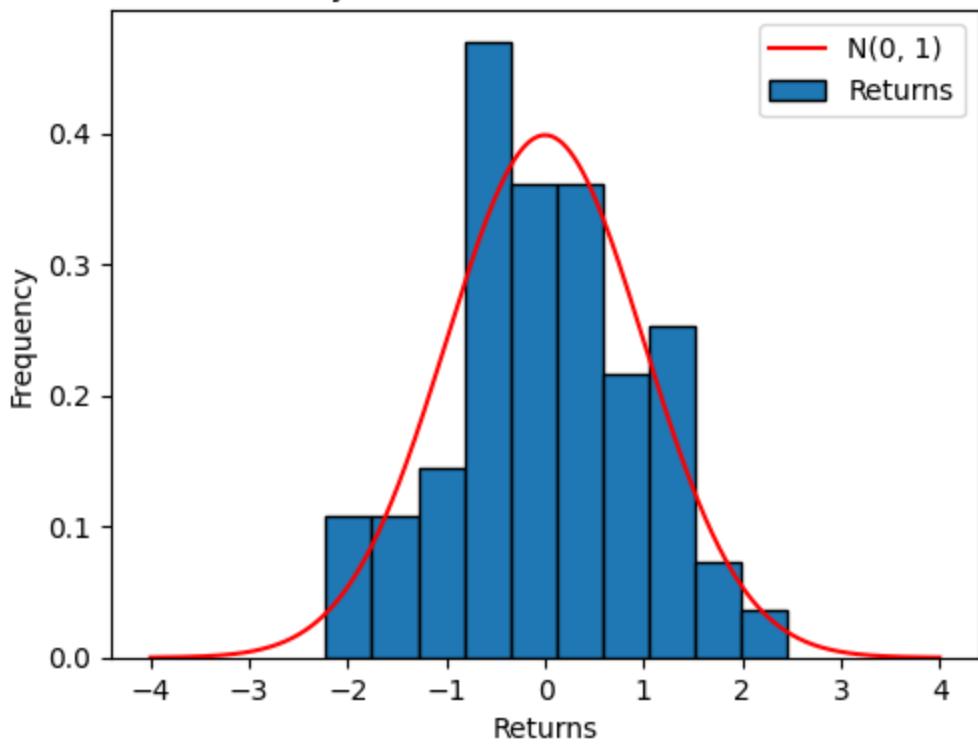
Monthly Returns for Sun Pharma (BSE)



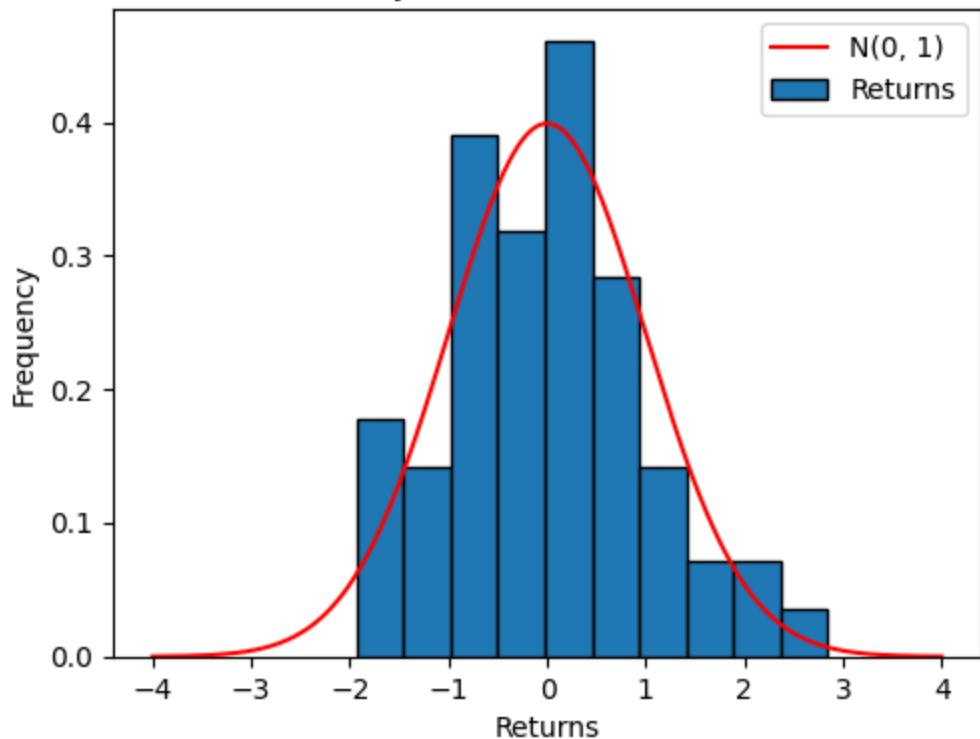
Monthly Returns for Tata Steel (BSE)



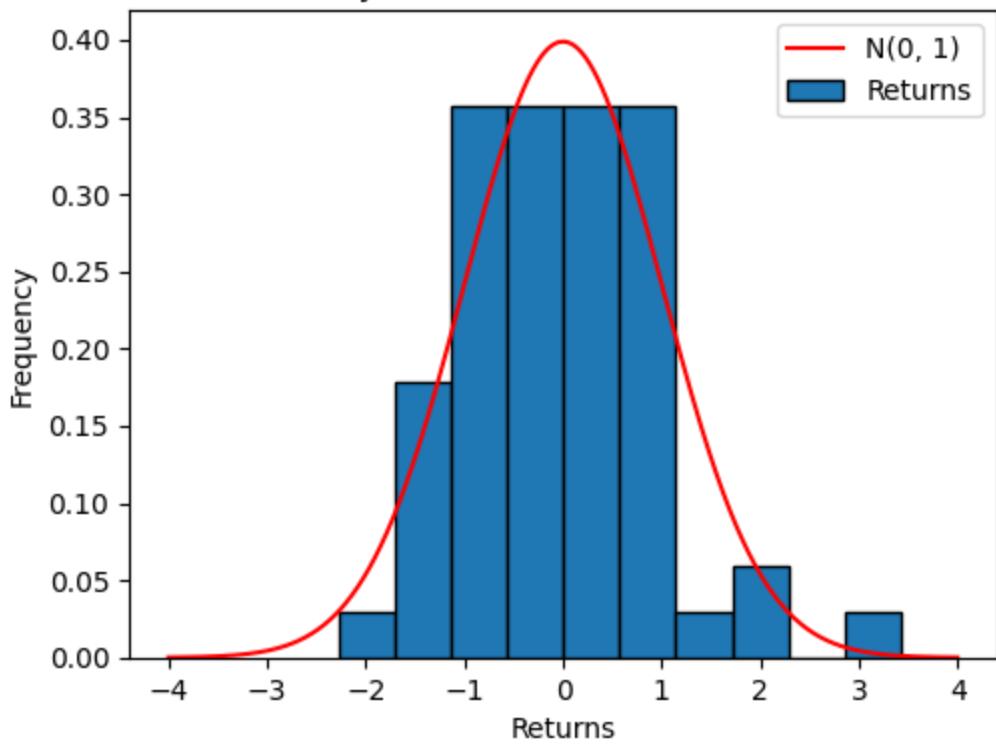
Monthly Returns for ADANIPORTS (NSE)

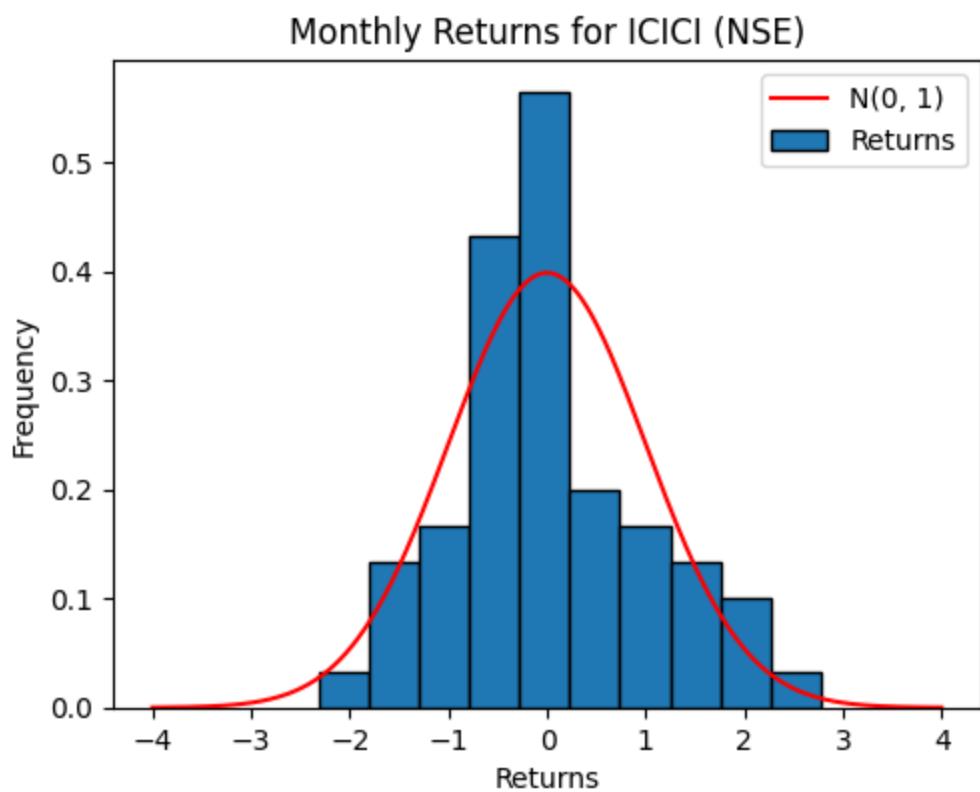
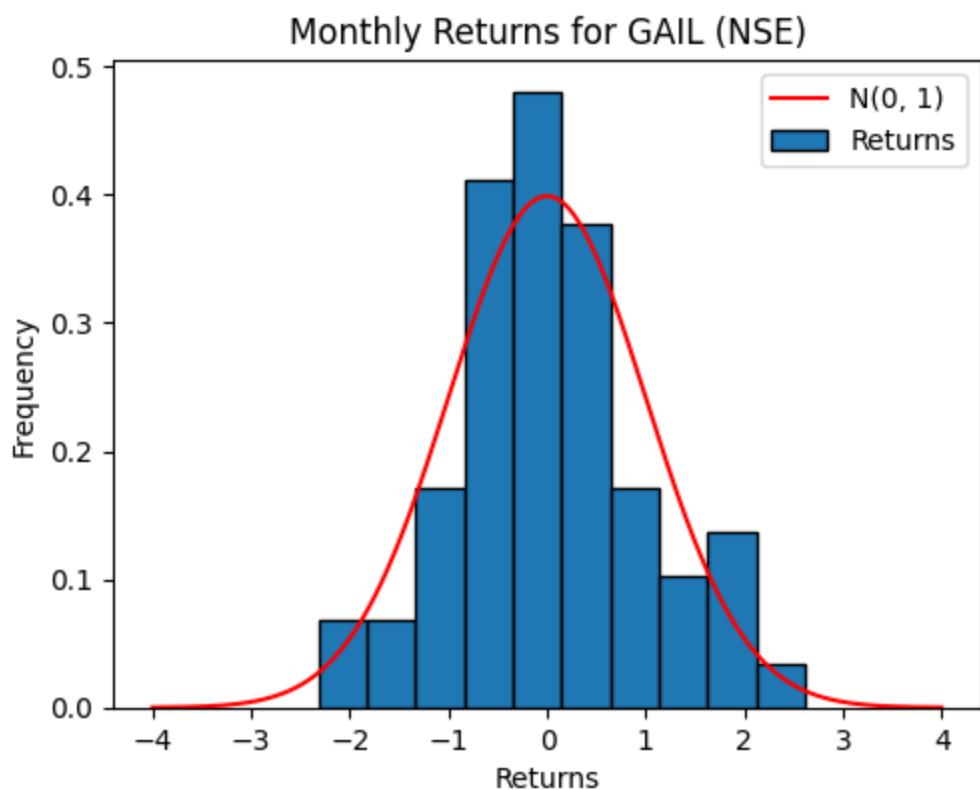


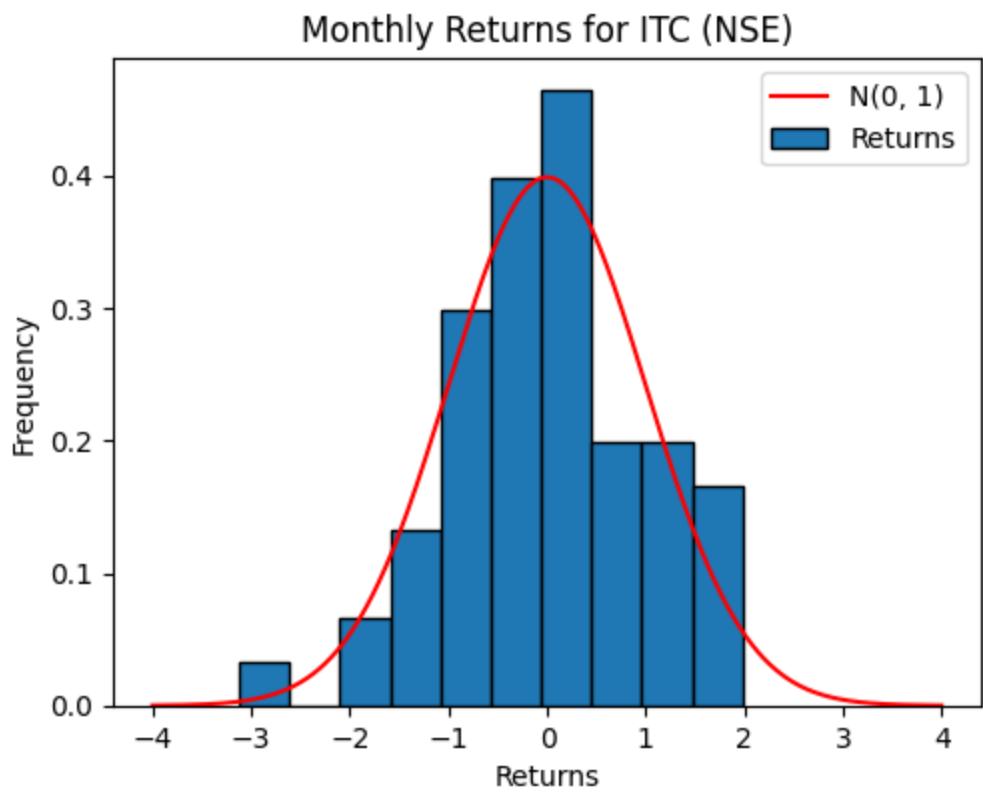
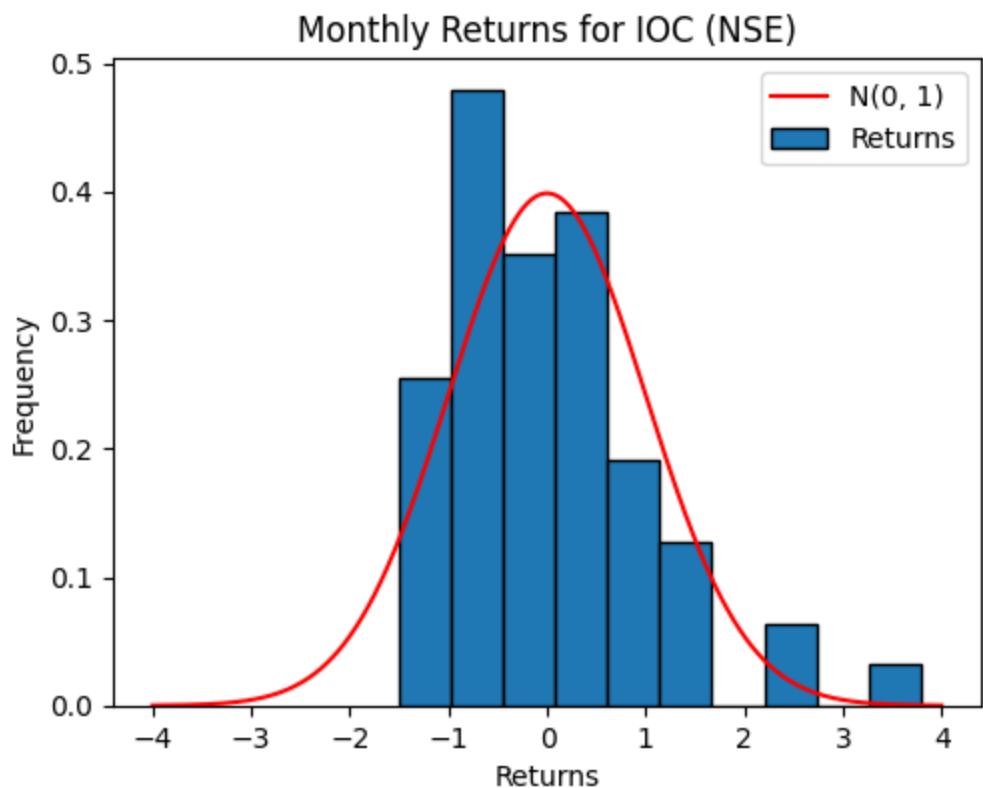
Monthly Returns for CIPLA (NSE)



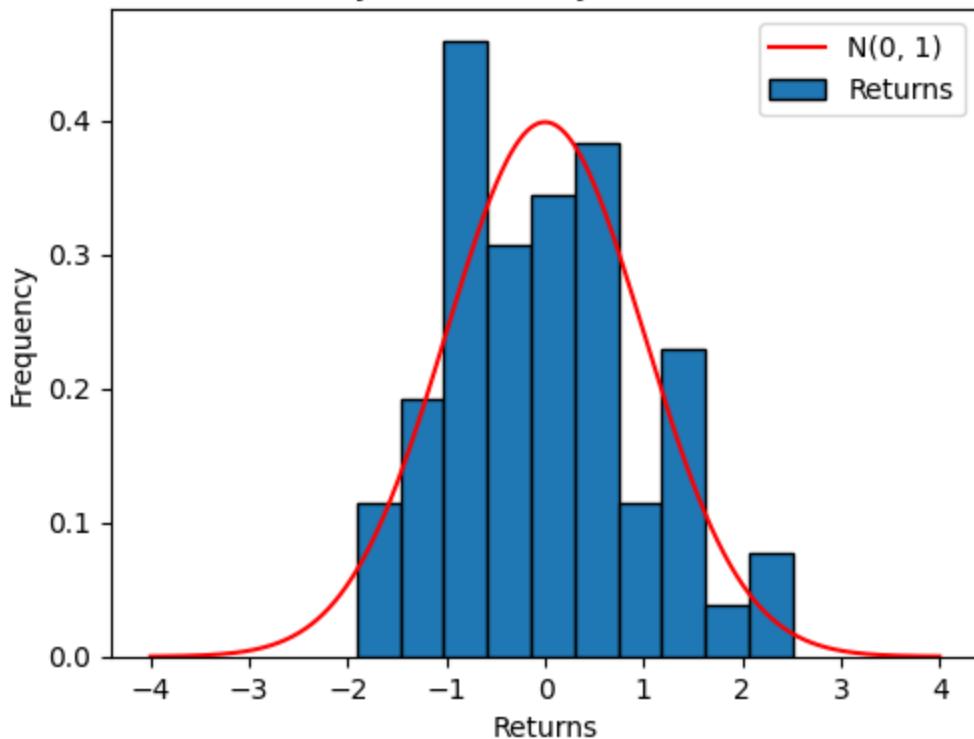
Monthly Returns for COAL INDIA (NSE)



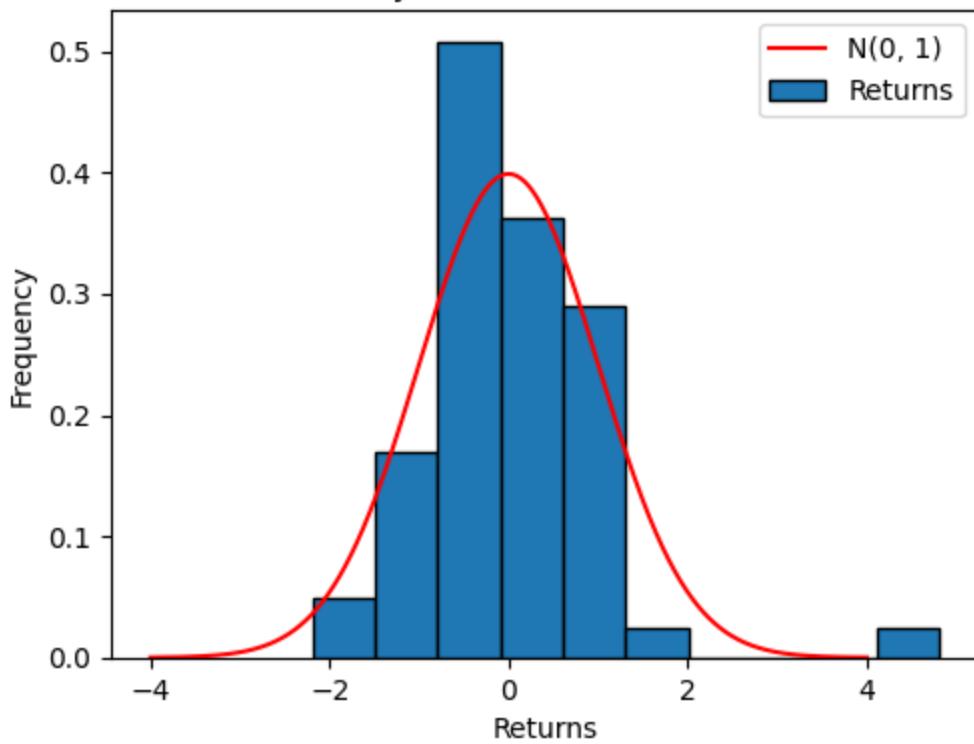




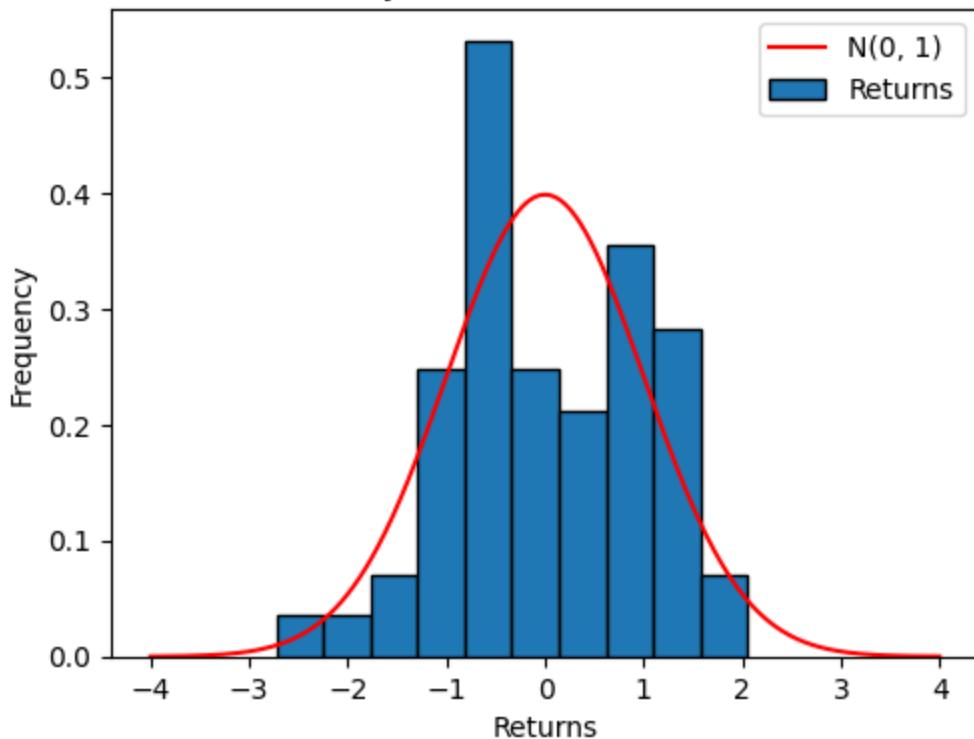
Monthly Returns for JSWSTEEL (NSE)



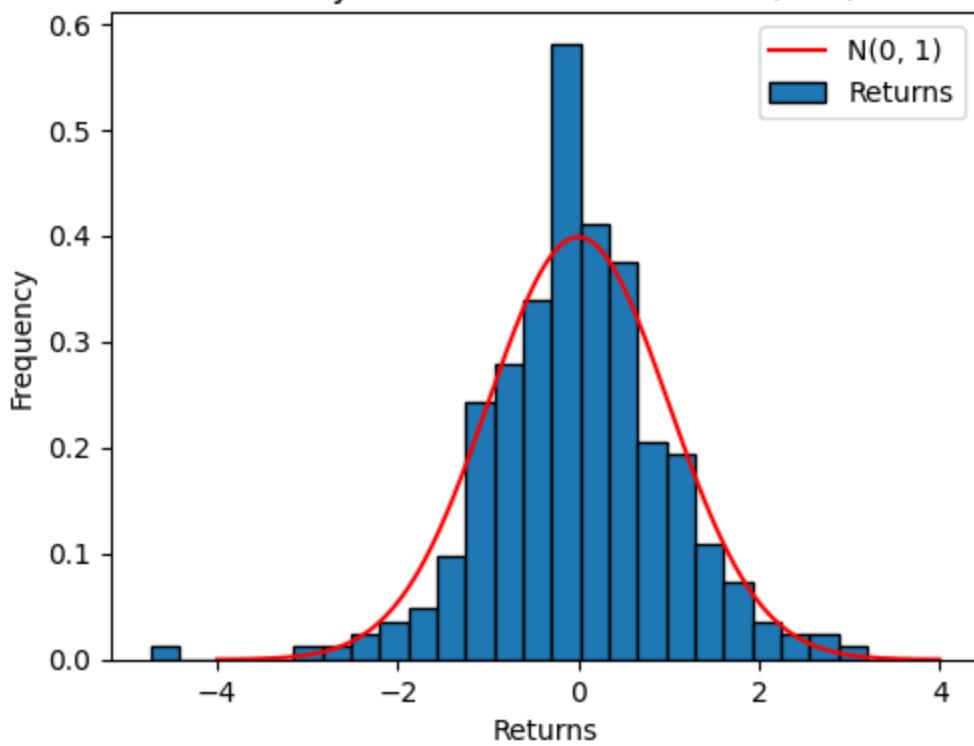
Monthly Returns for NTPC (NSE)



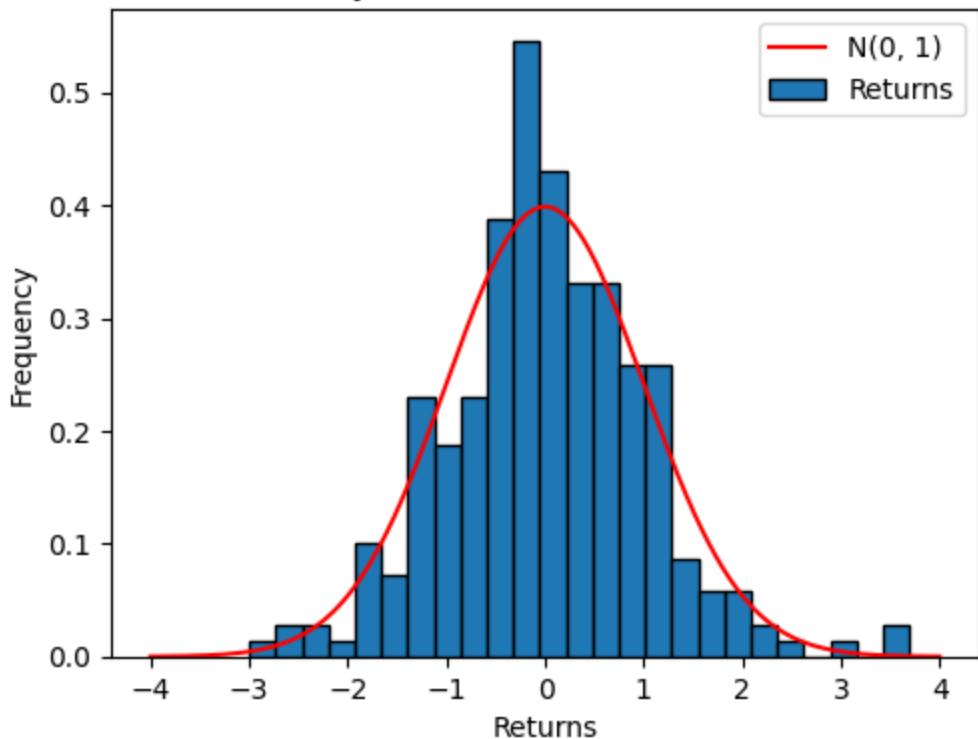
Monthly Returns for WIPRO (NSE)



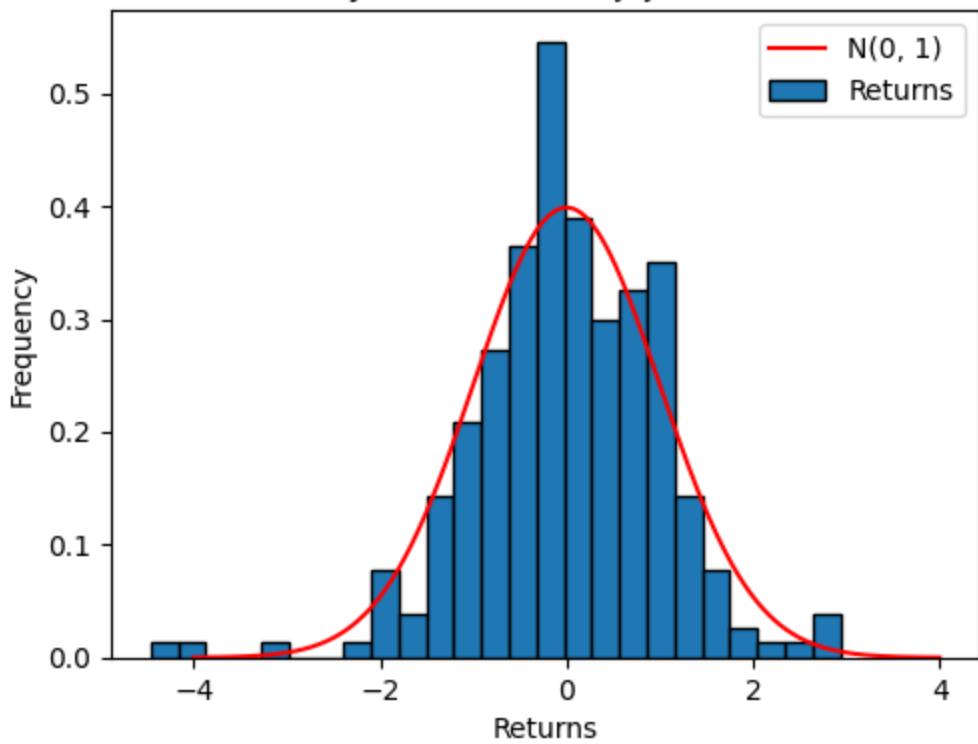
Weekly Returns for Asian Paints (BSE)

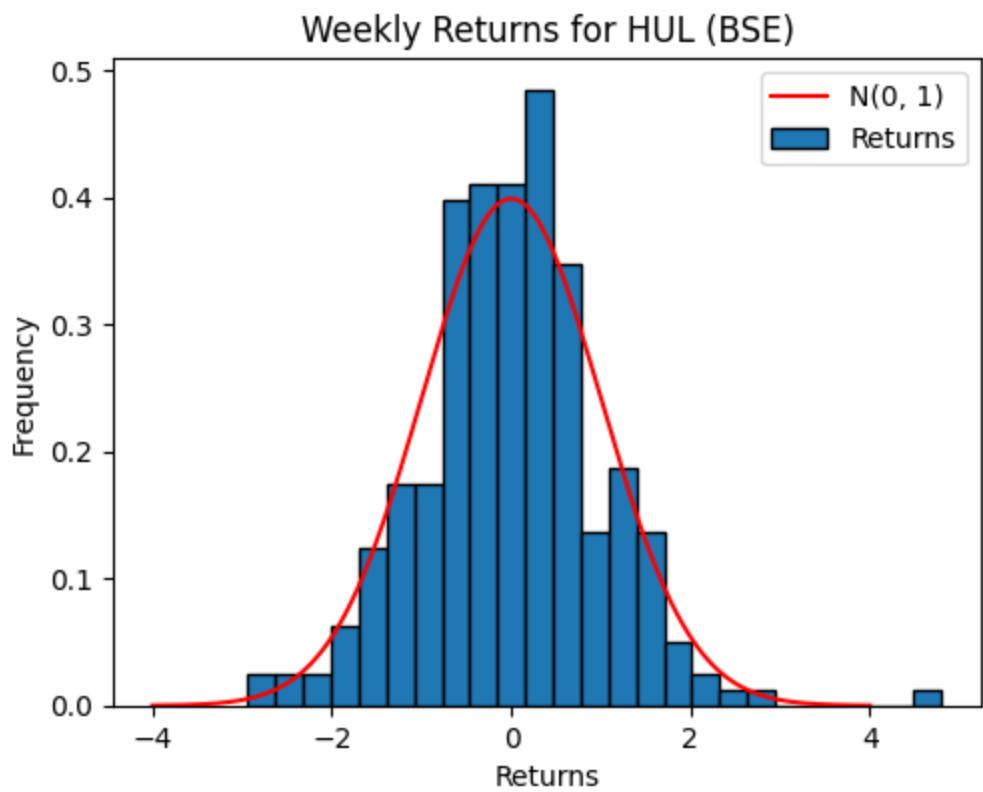
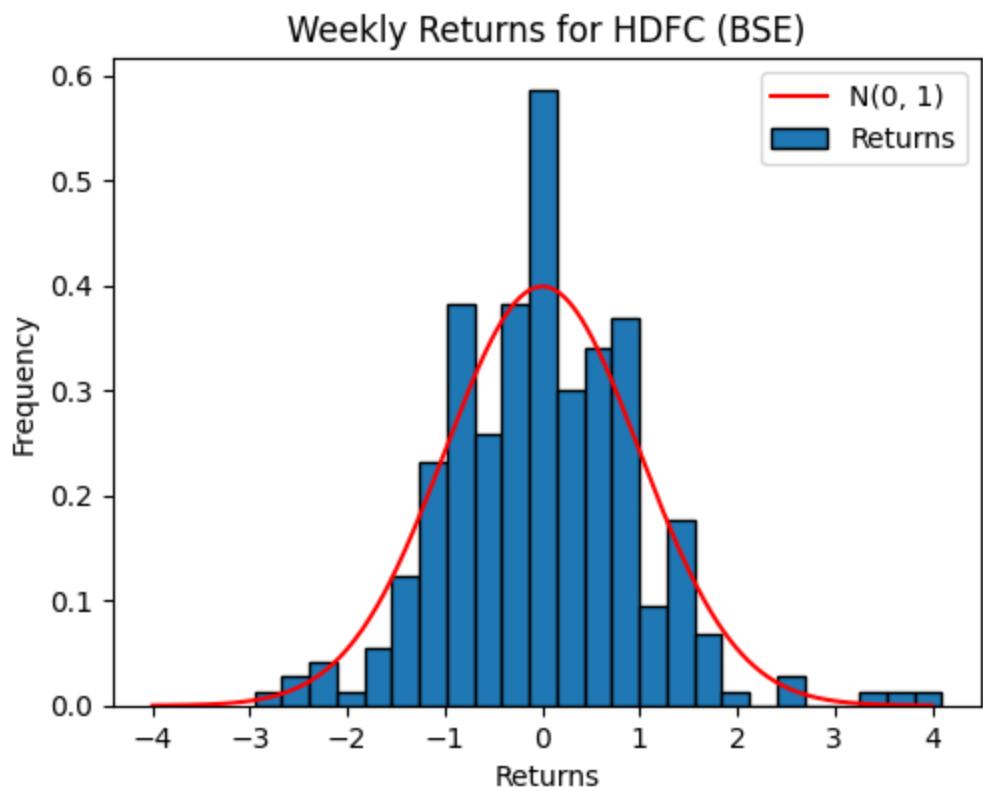


Weekly Returns for Axis Bank (BSE)

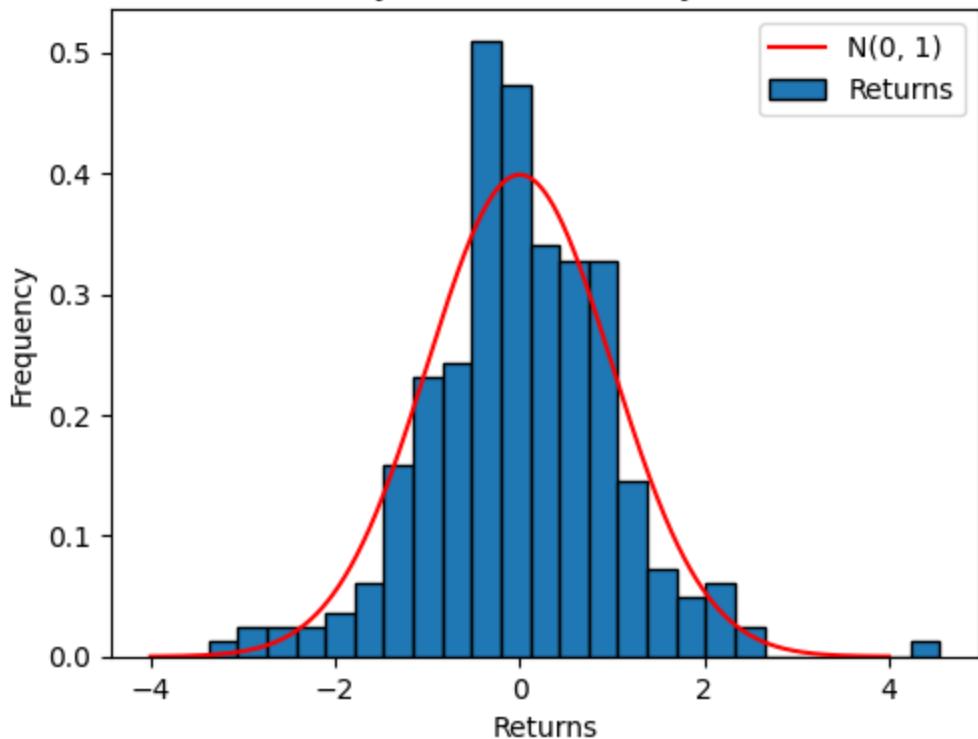


Weekly Returns for Bajaj Auto (BSE)

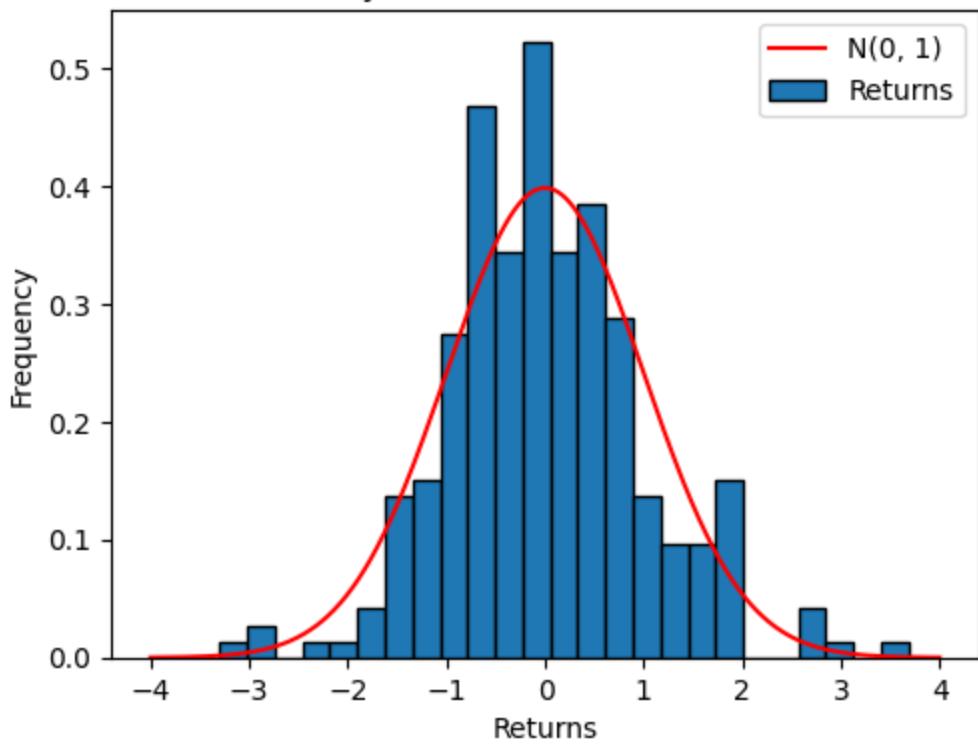




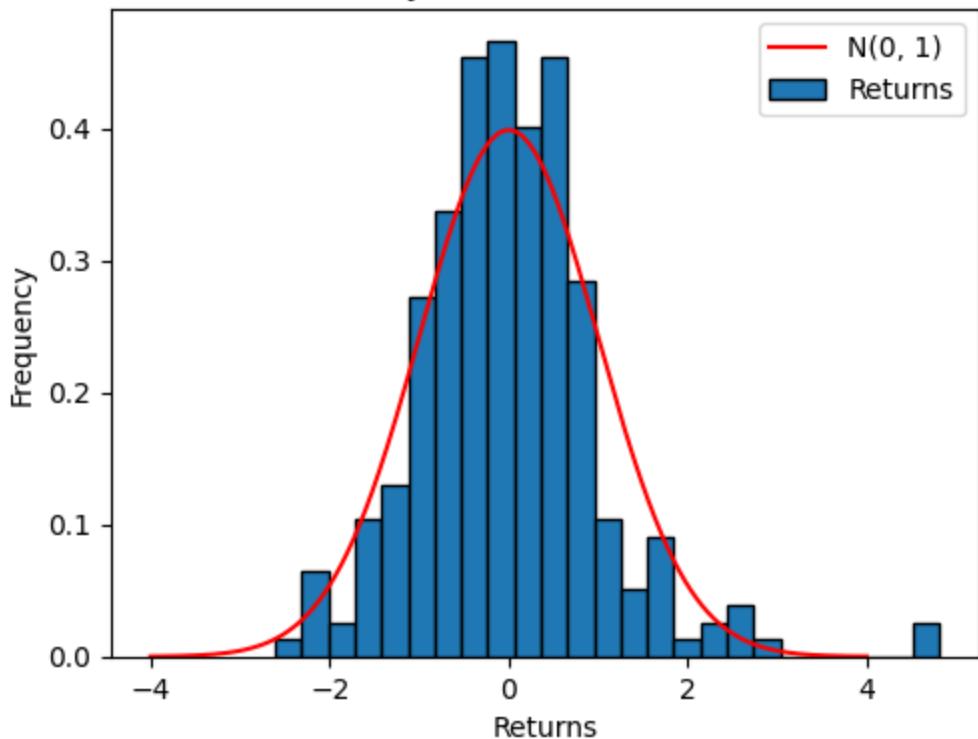
Weekly Returns for Infosys (BSE)



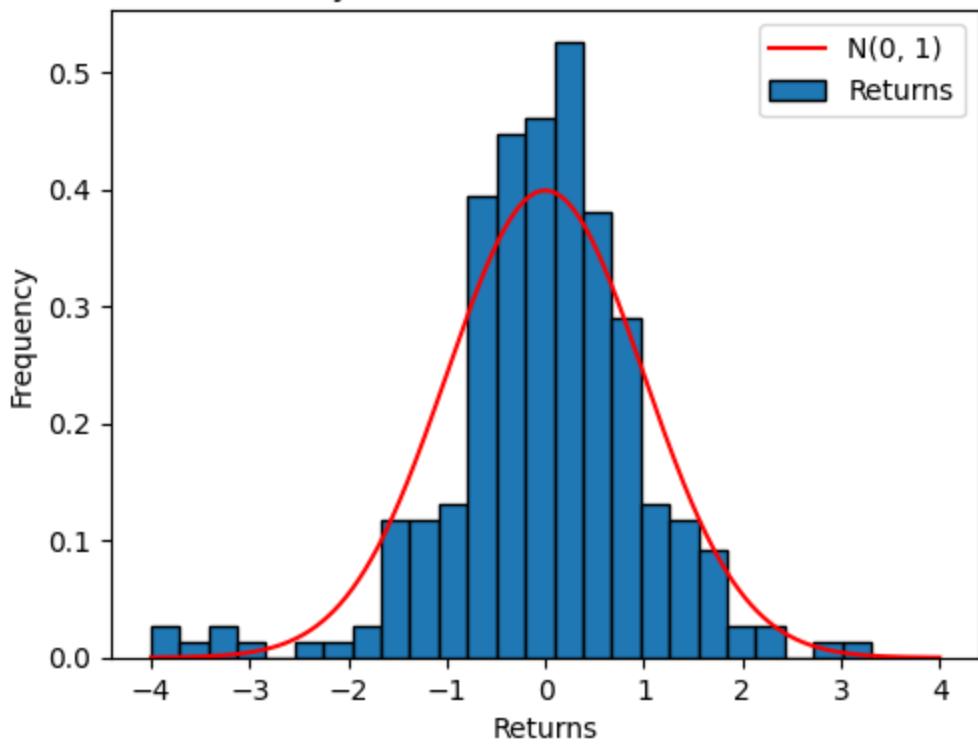
Weekly Returns for Reliance (BSE)



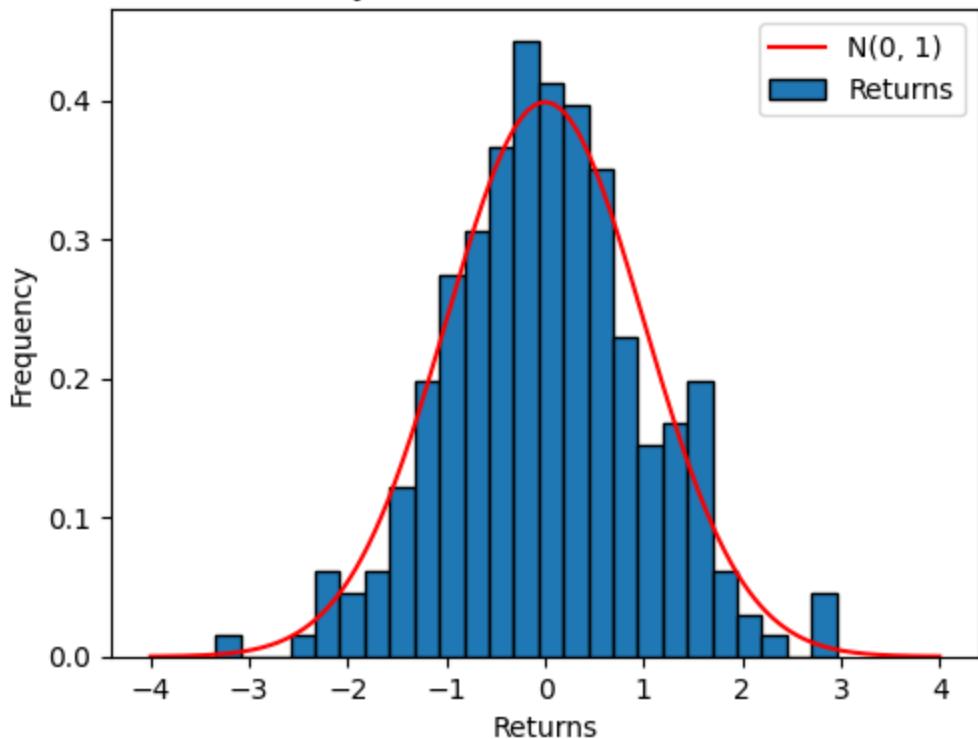
Weekly Returns for SBI (BSE)



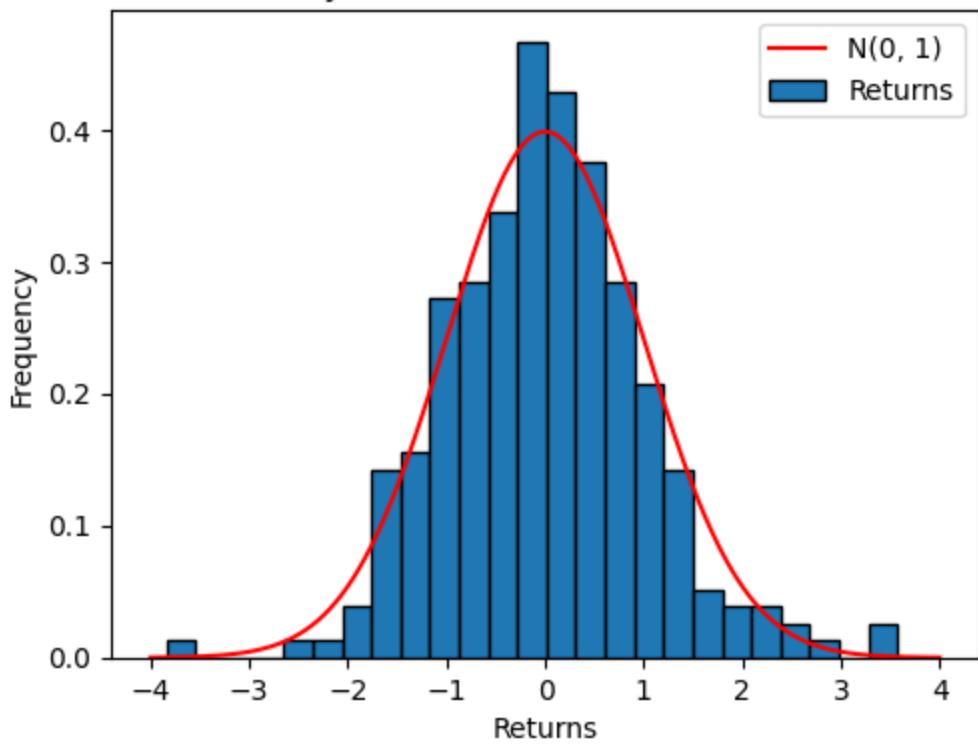
Weekly Returns for Sun Pharma (BSE)



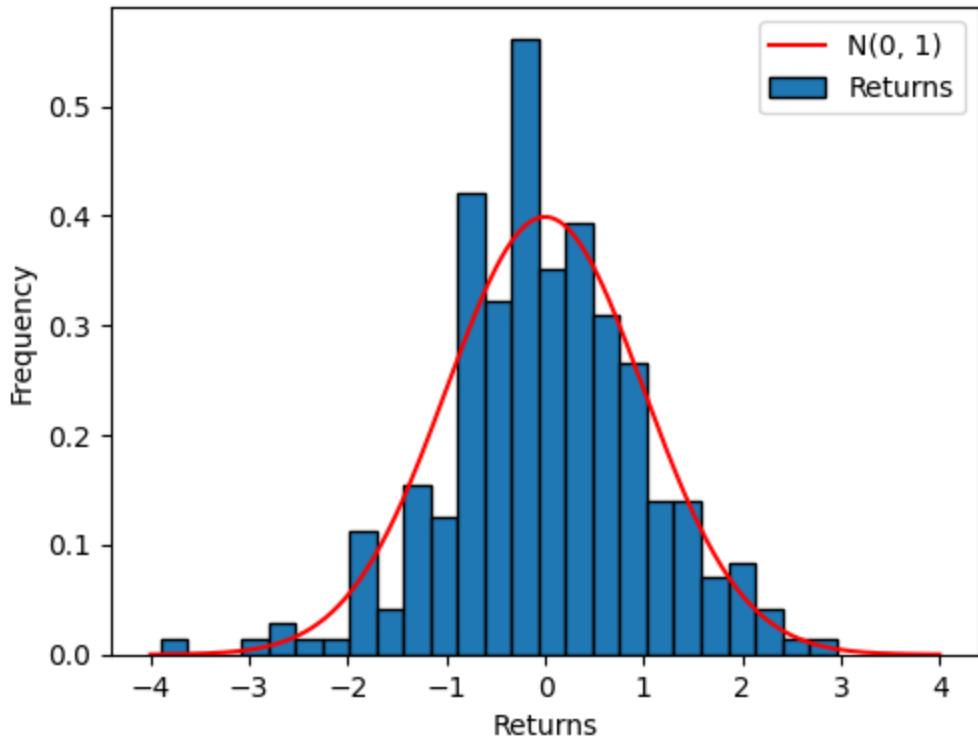
Weekly Returns for Tata Steel (BSE)



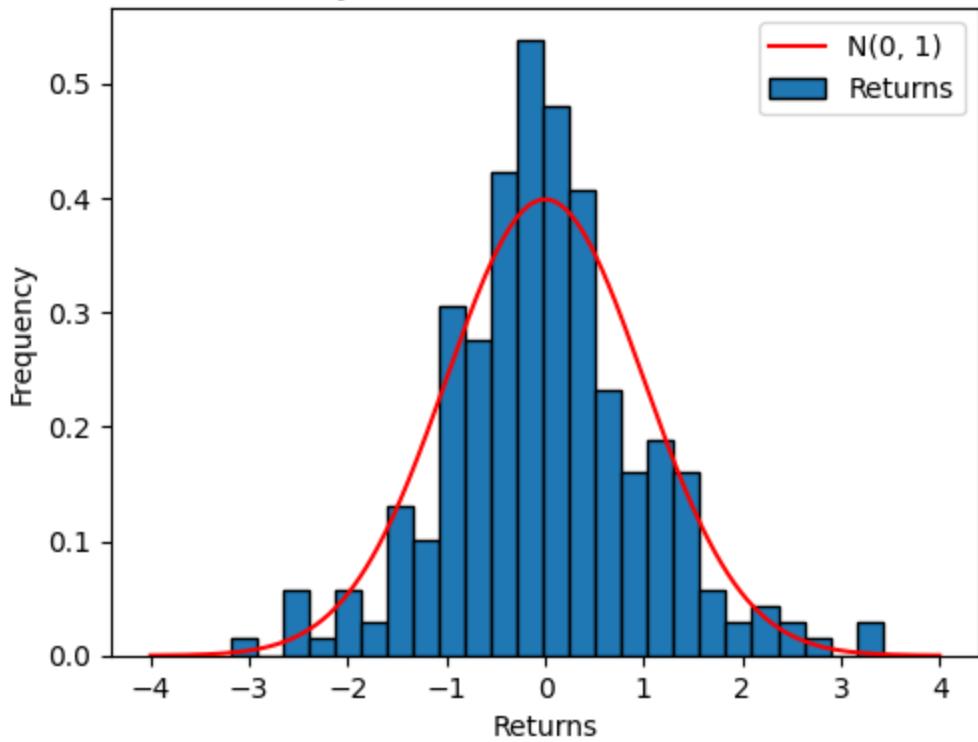
Weekly Returns for ADANIPORTS (NSE)



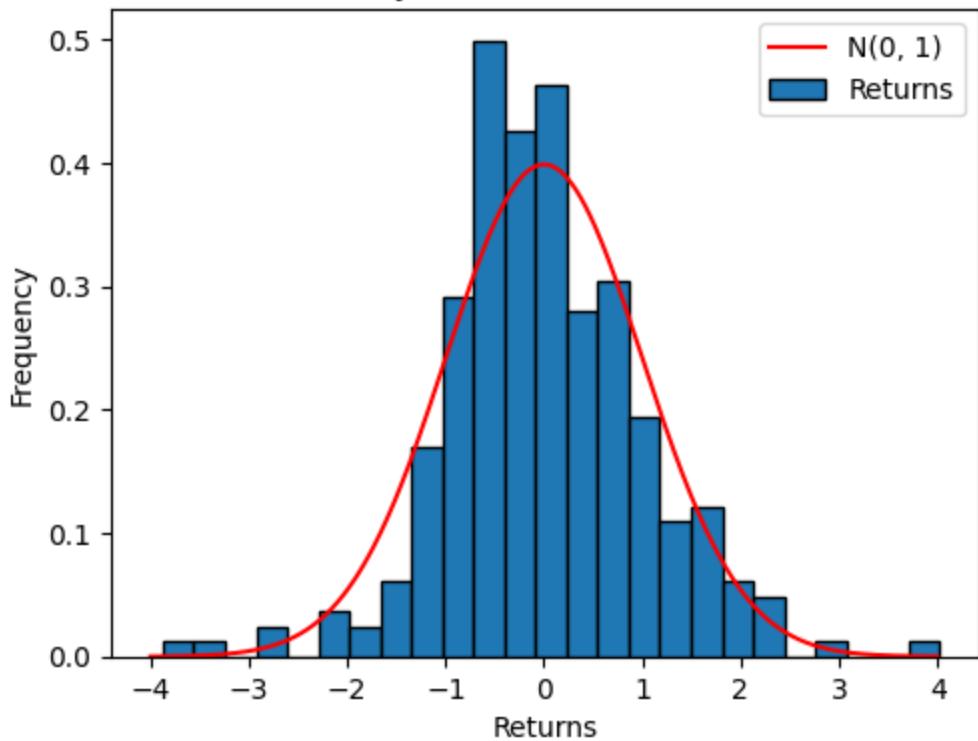
Weekly Returns for CIPLA (NSE)



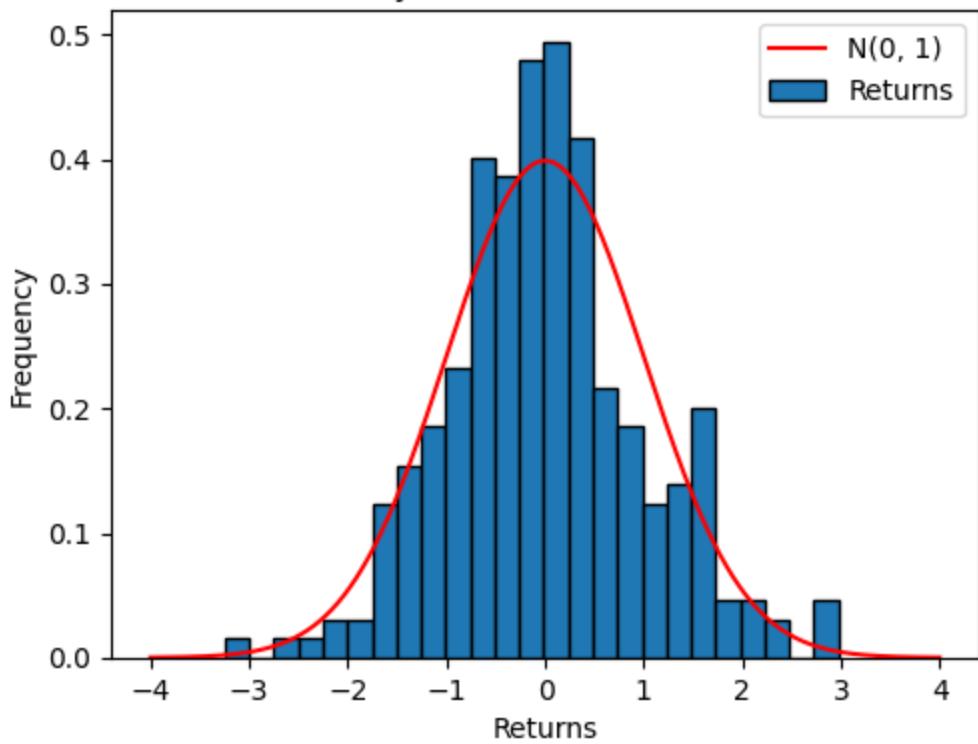
Weekly Returns for COAL INDIA (NSE)



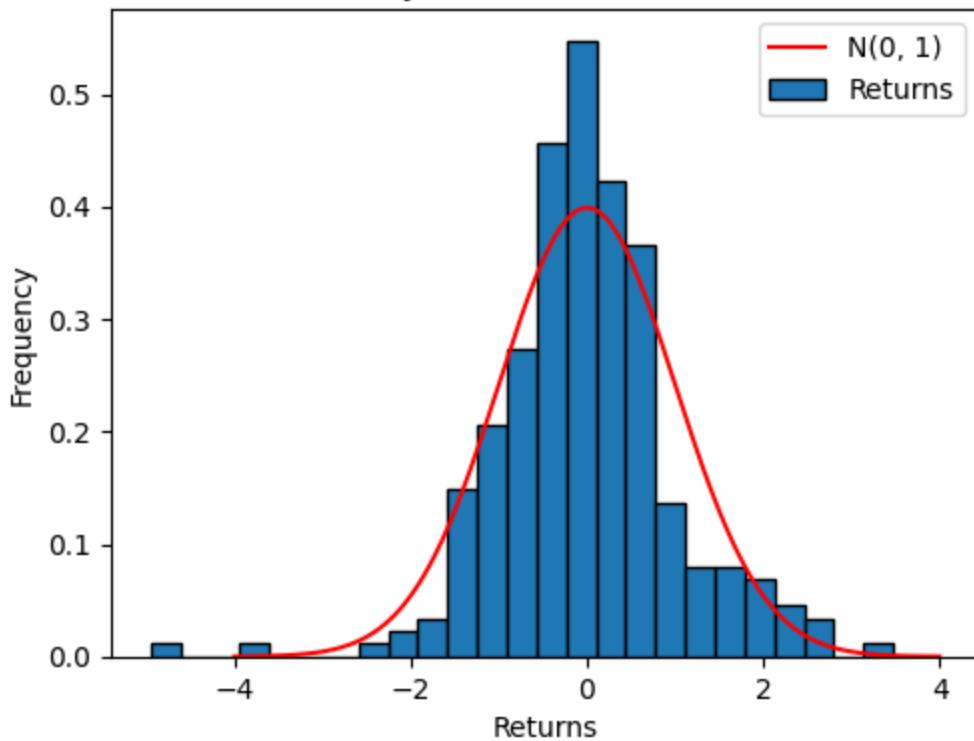
Weekly Returns for GAIL (NSE)



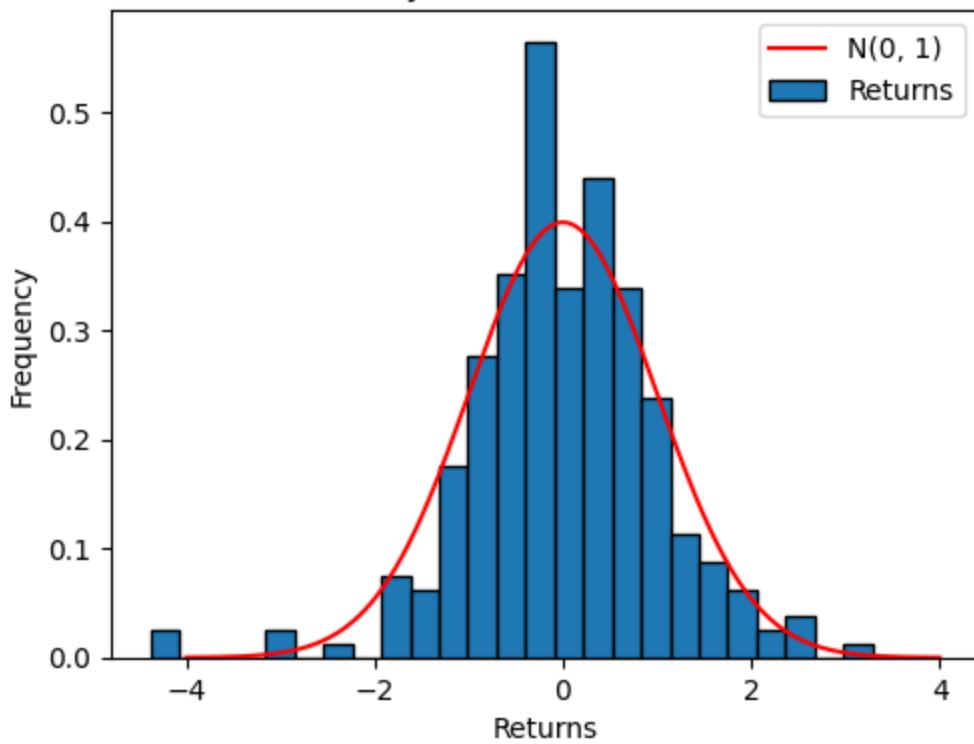
Weekly Returns for ICICI (NSE)



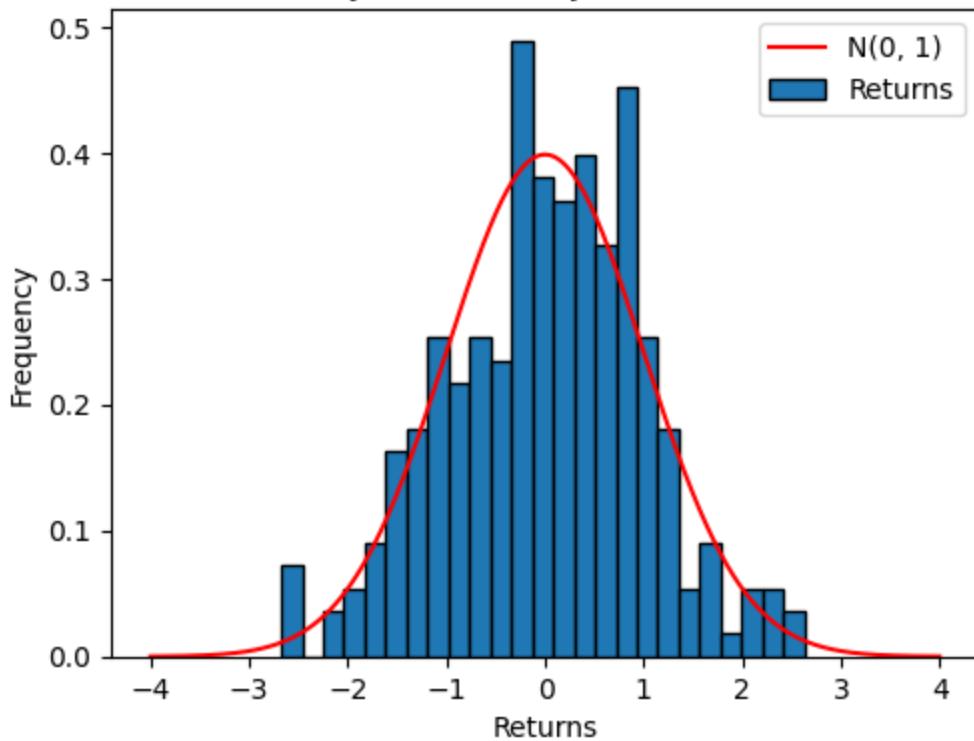
Weekly Returns for IOC (NSE)



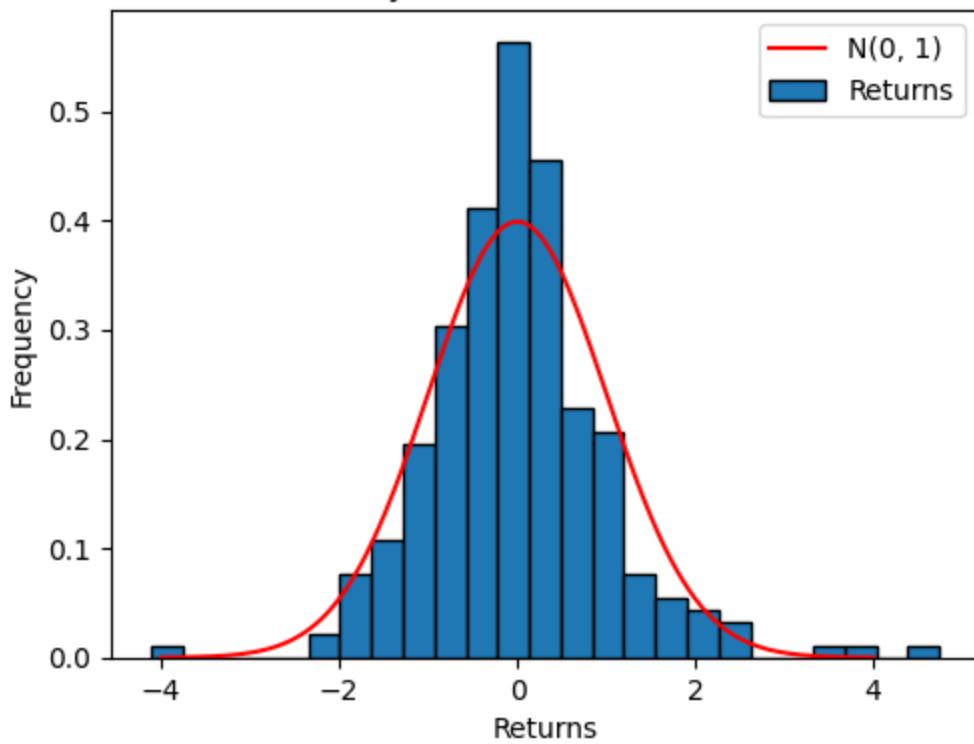
Weekly Returns for ITC (NSE)



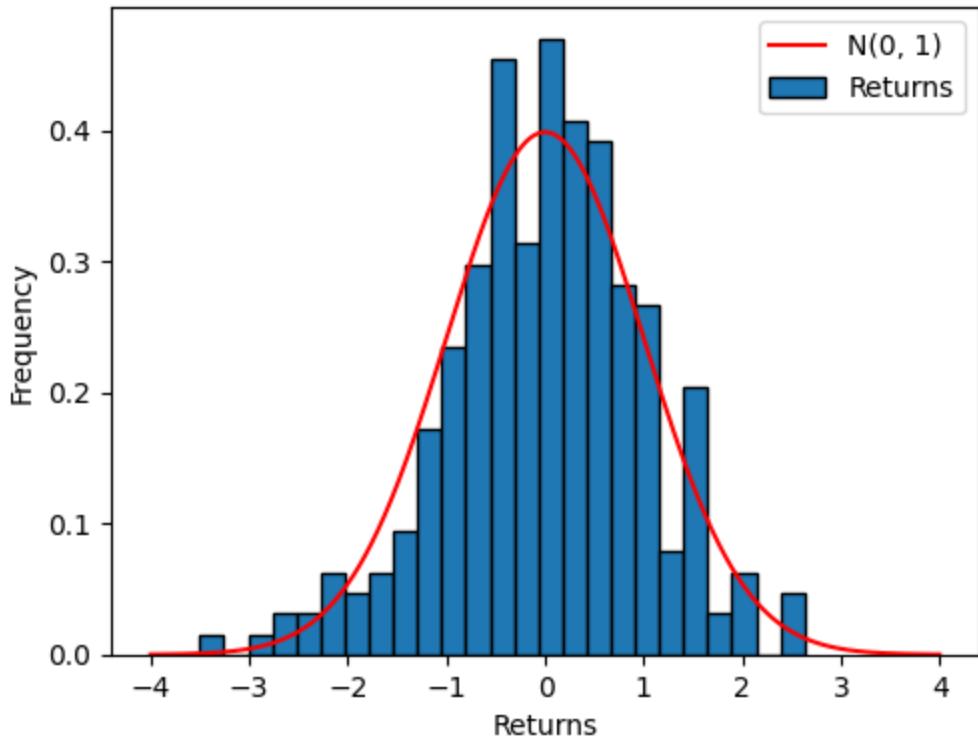
Weekly Returns for JSWSTEEL (NSE)



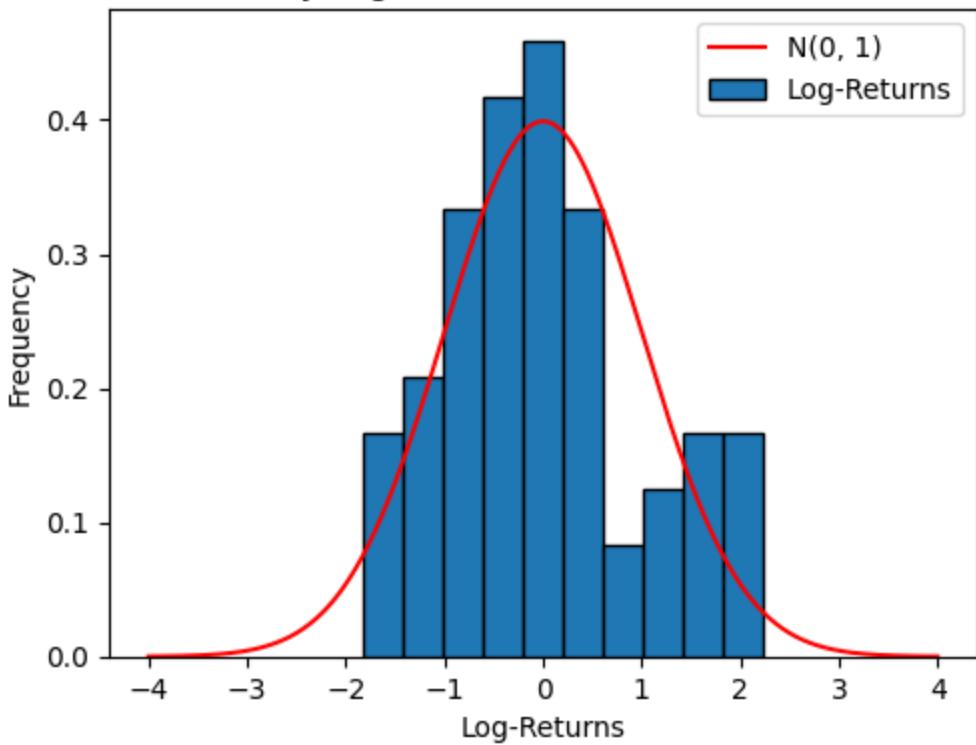
Weekly Returns for NTPC (NSE)



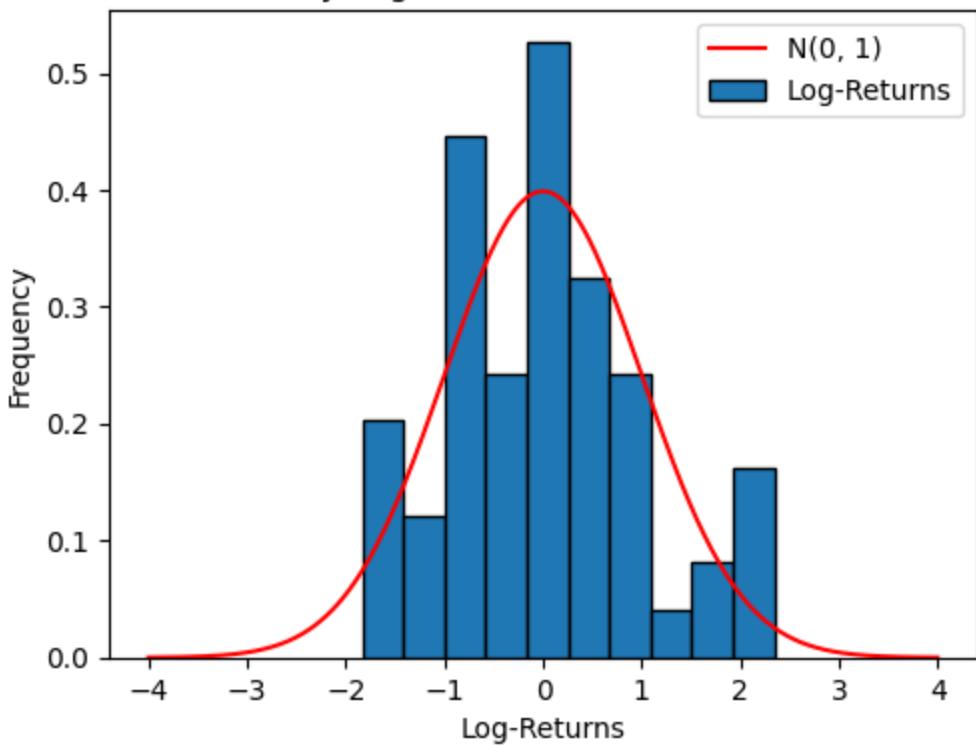
Weekly Returns for WIPRO (NSE)



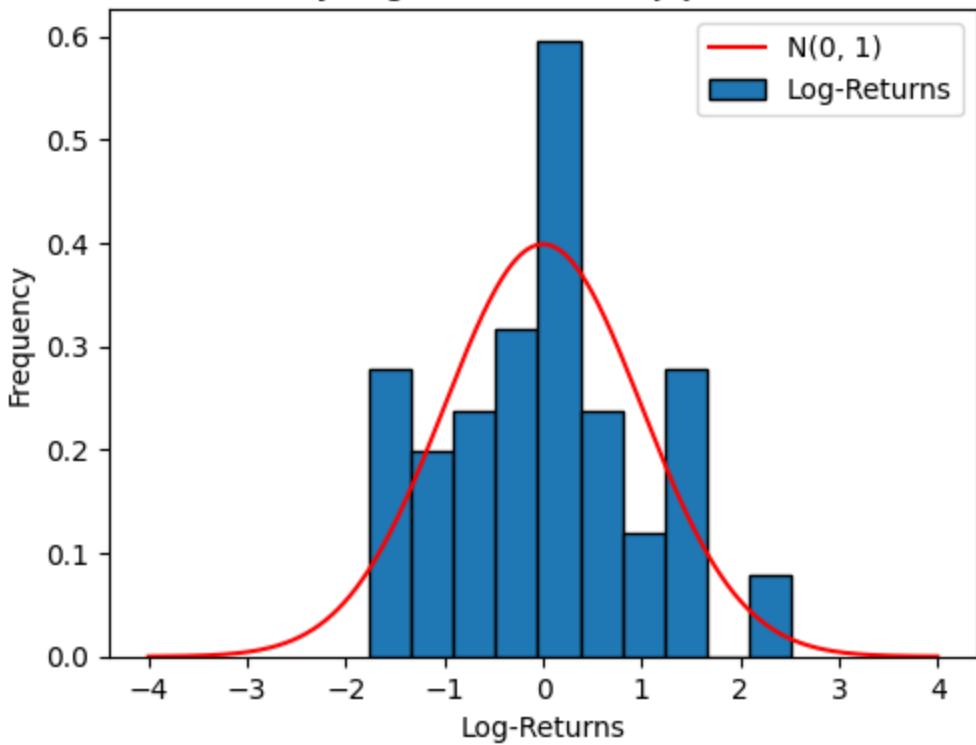
Monthly Log-Returns for Asian Paints (BSE)



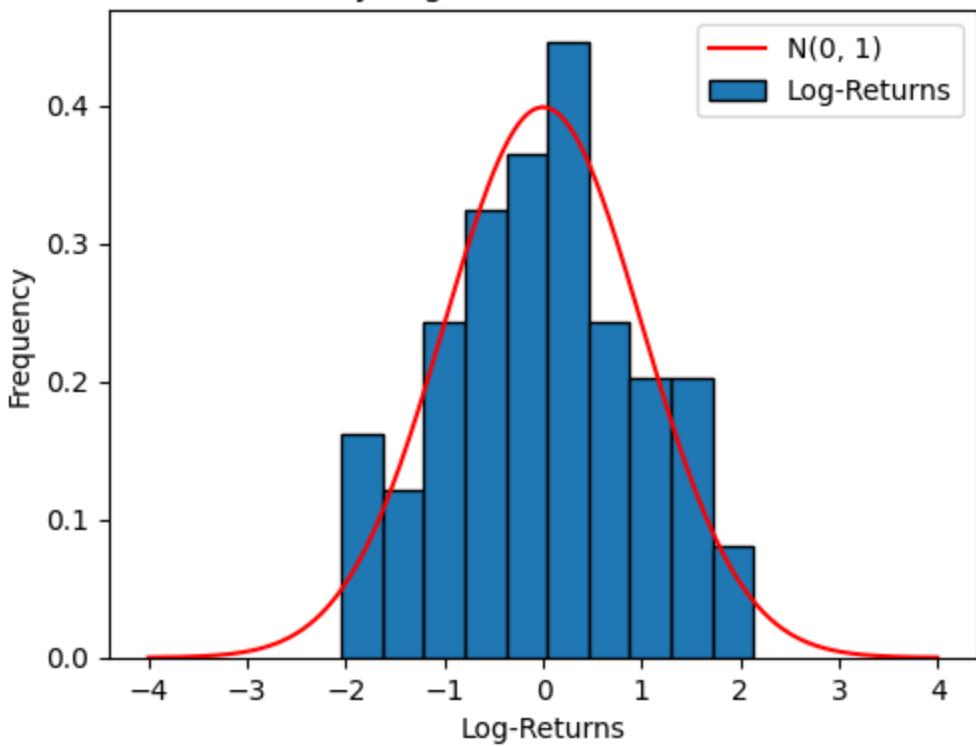
Monthly Log-Returns for Axis Bank (BSE)



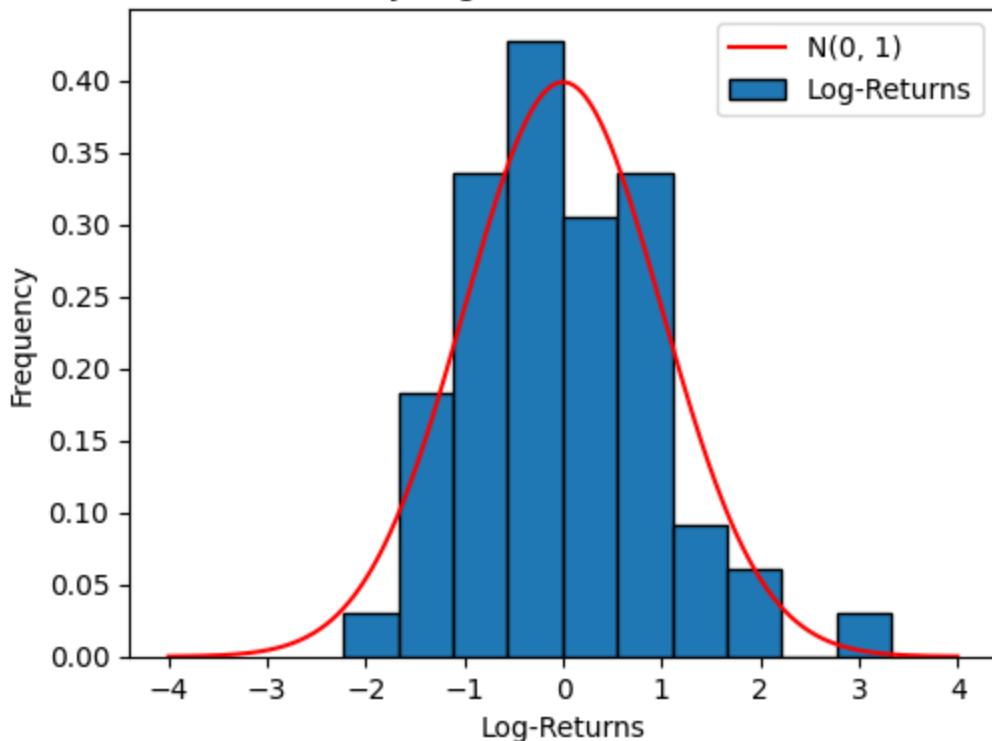
Monthly Log-Returns for Bajaj Auto (BSE)



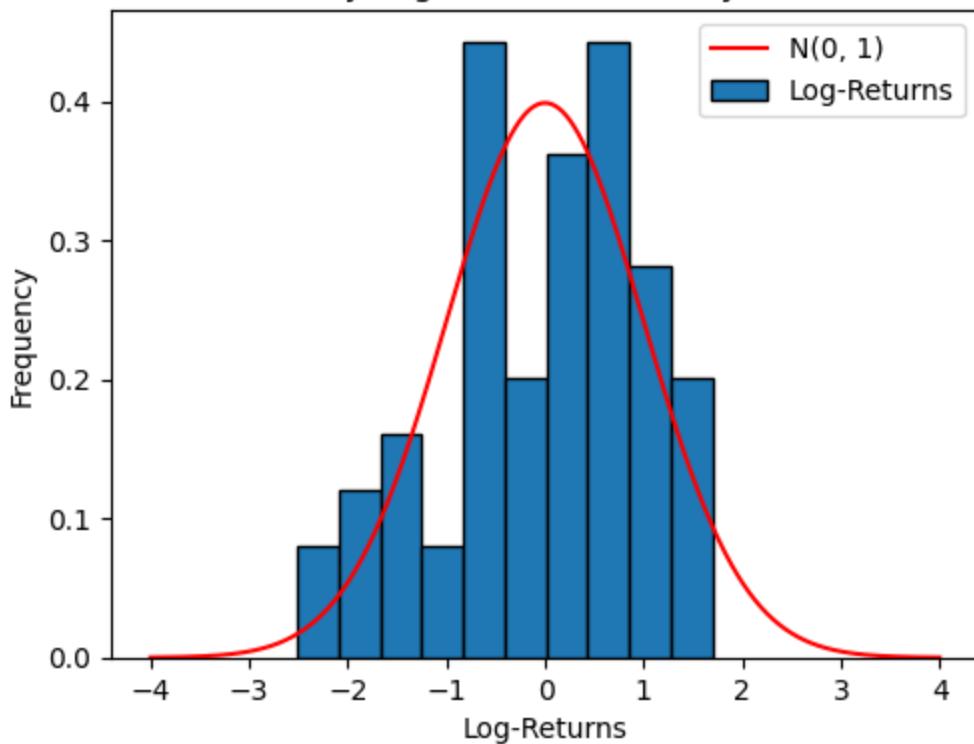
Monthly Log-Returns for HDFC (BSE)

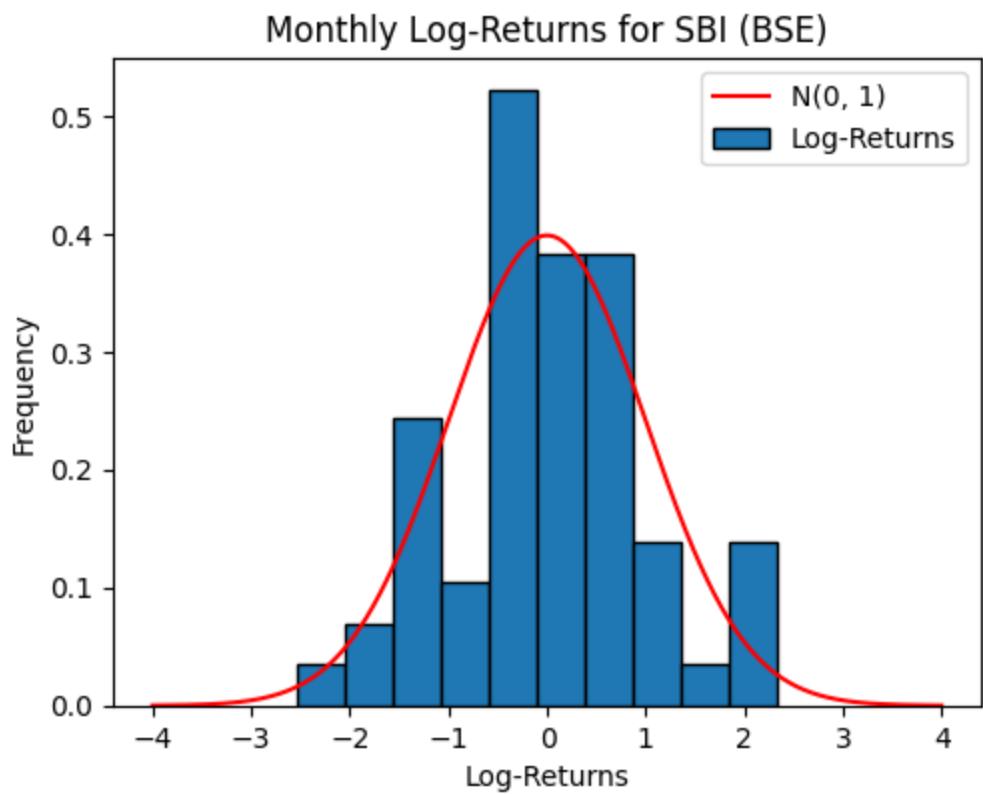
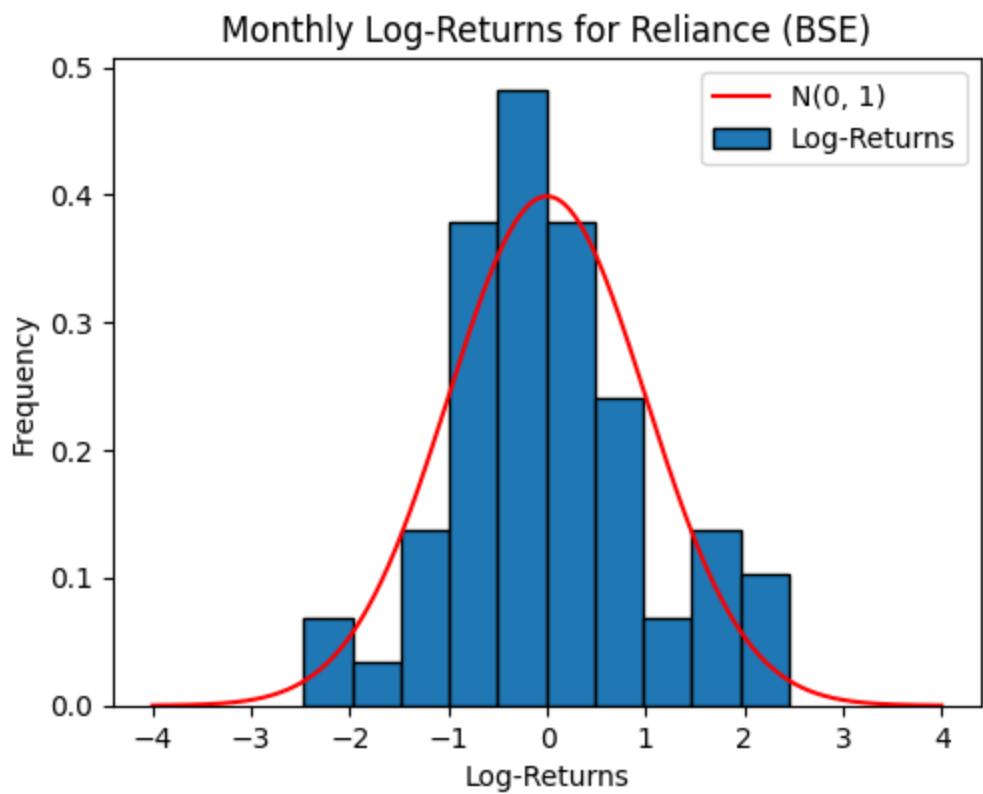


Monthly Log-Returns for HUL (BSE)

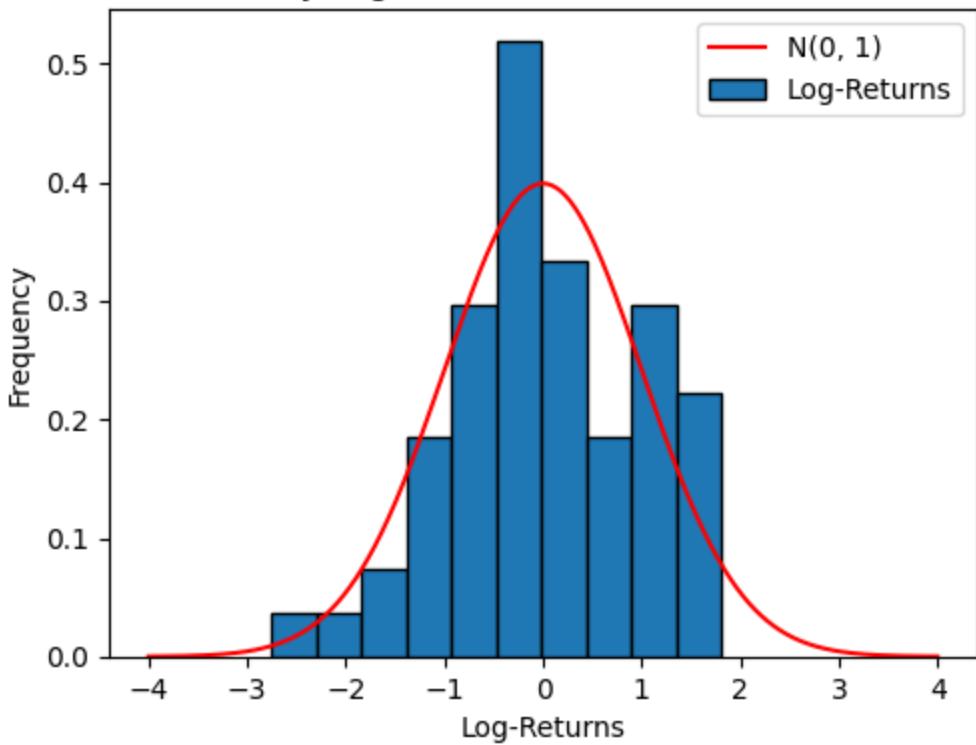


Monthly Log-Returns for Infosys (BSE)

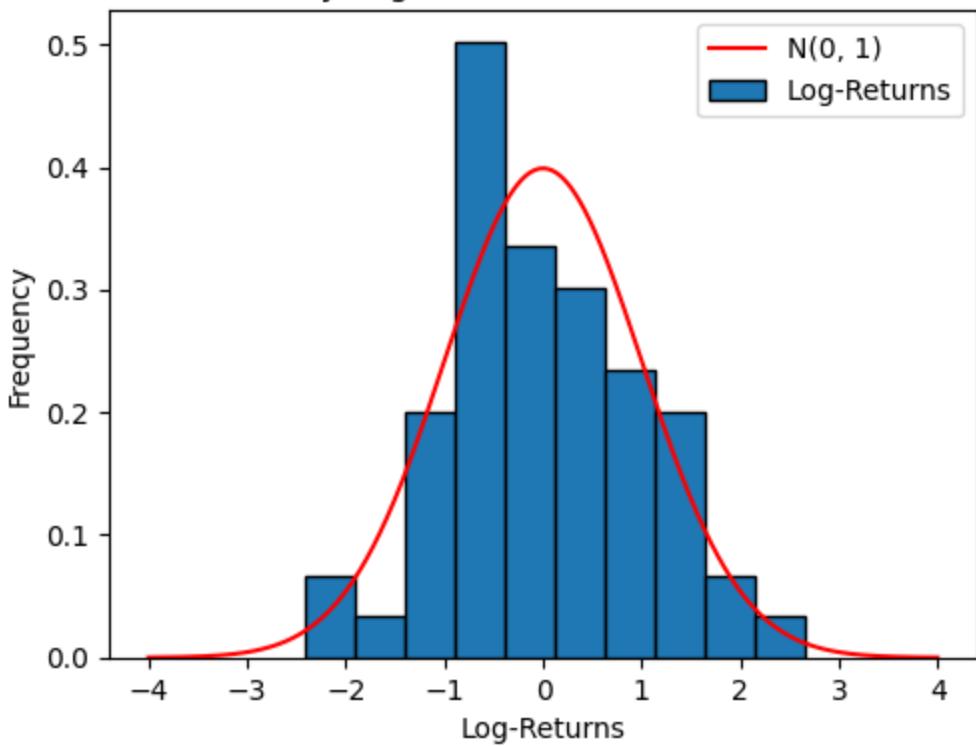




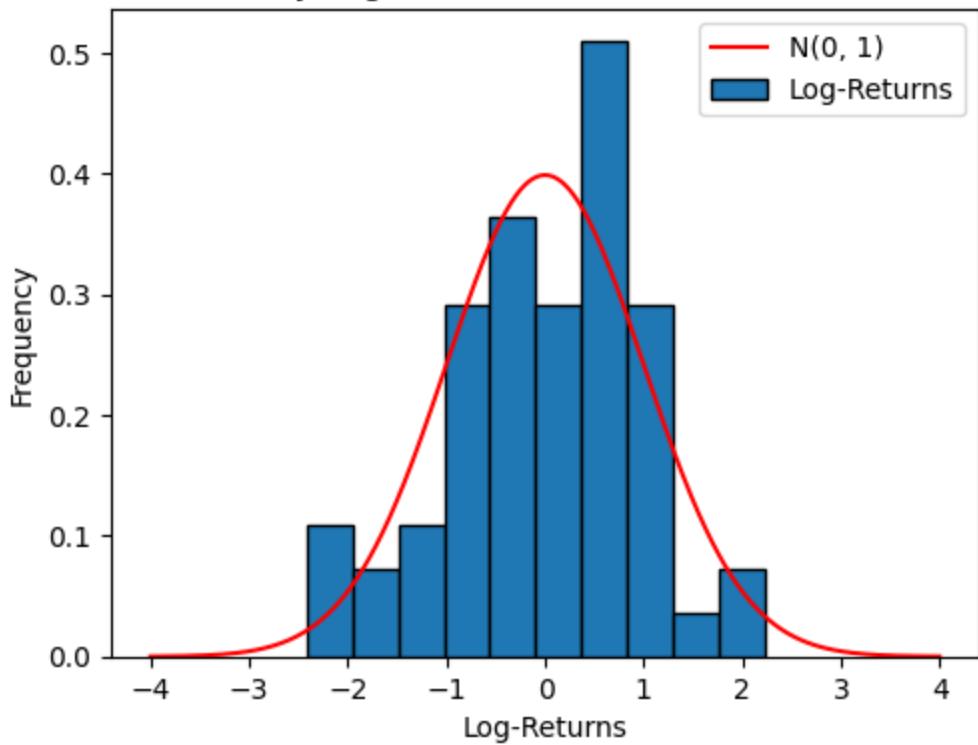
Monthly Log-Returns for Sun Pharma (BSE)



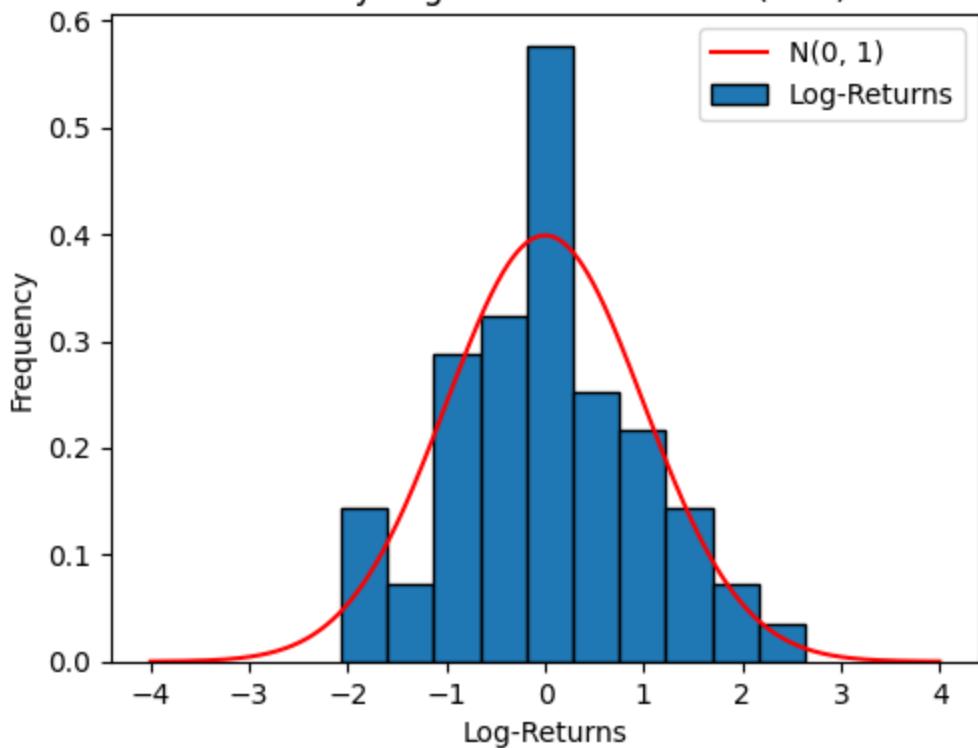
Monthly Log-Returns for Tata Steel (BSE)



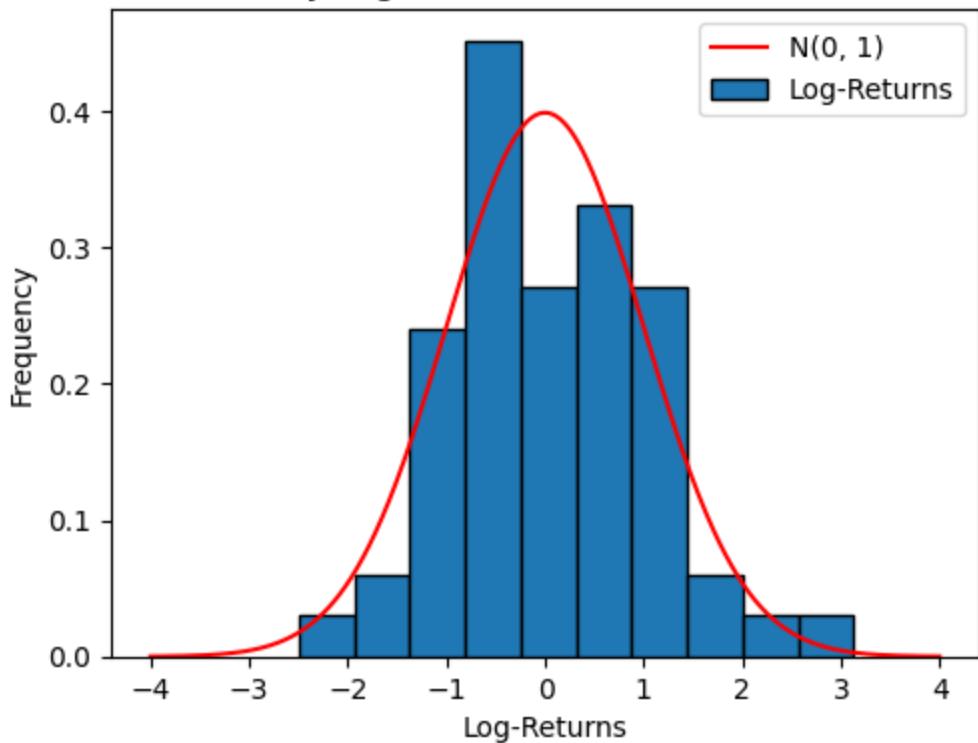
Monthly Log-Returns for ADANIPORTS (NSE)



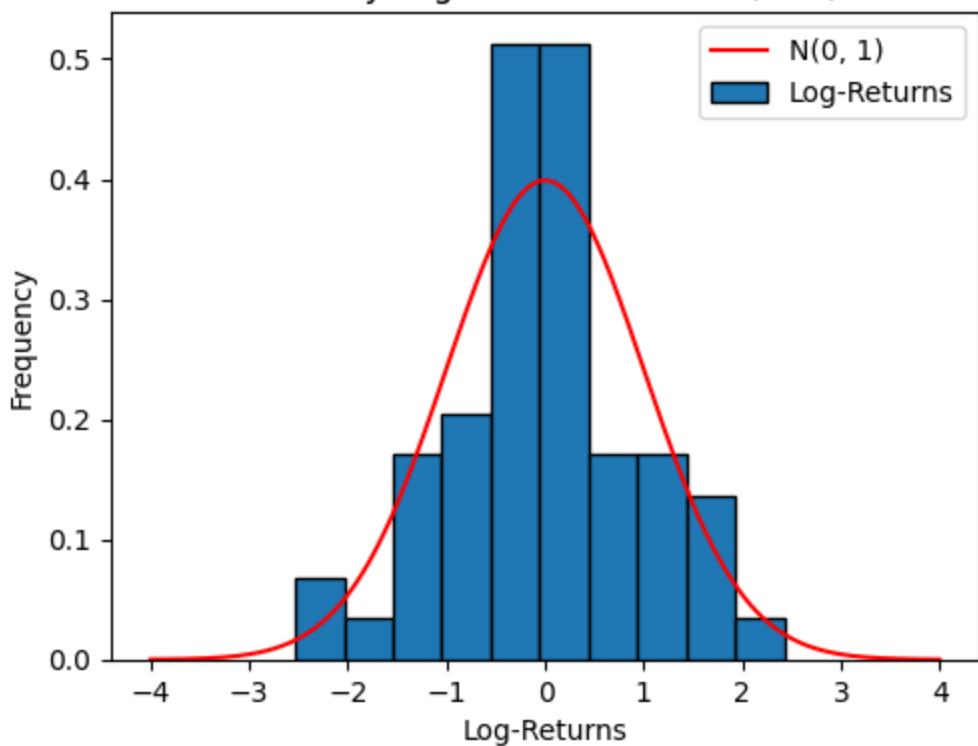
Monthly Log-Returns for CIPLA (NSE)



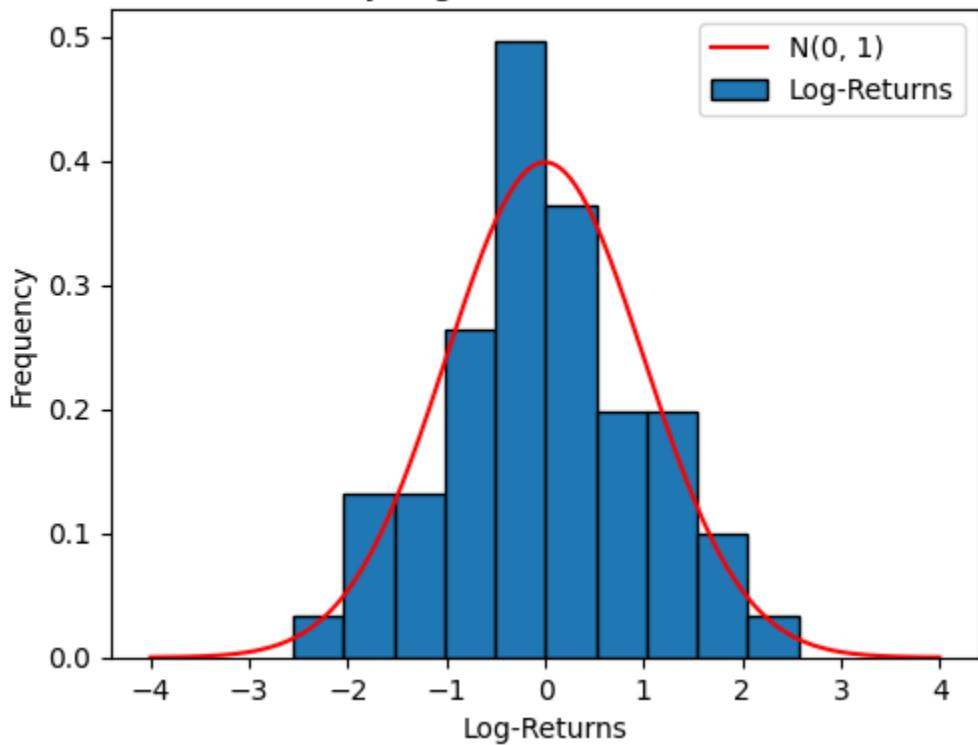
Monthly Log-Returns for COAL INDIA (NSE)



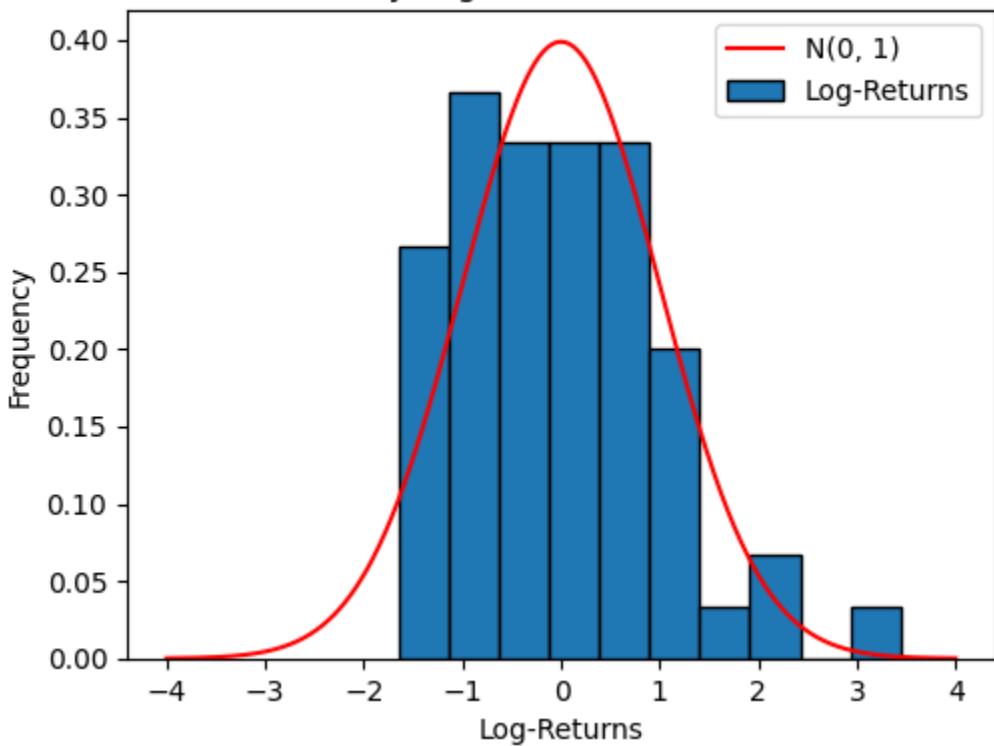
Monthly Log-Returns for GAIL (NSE)



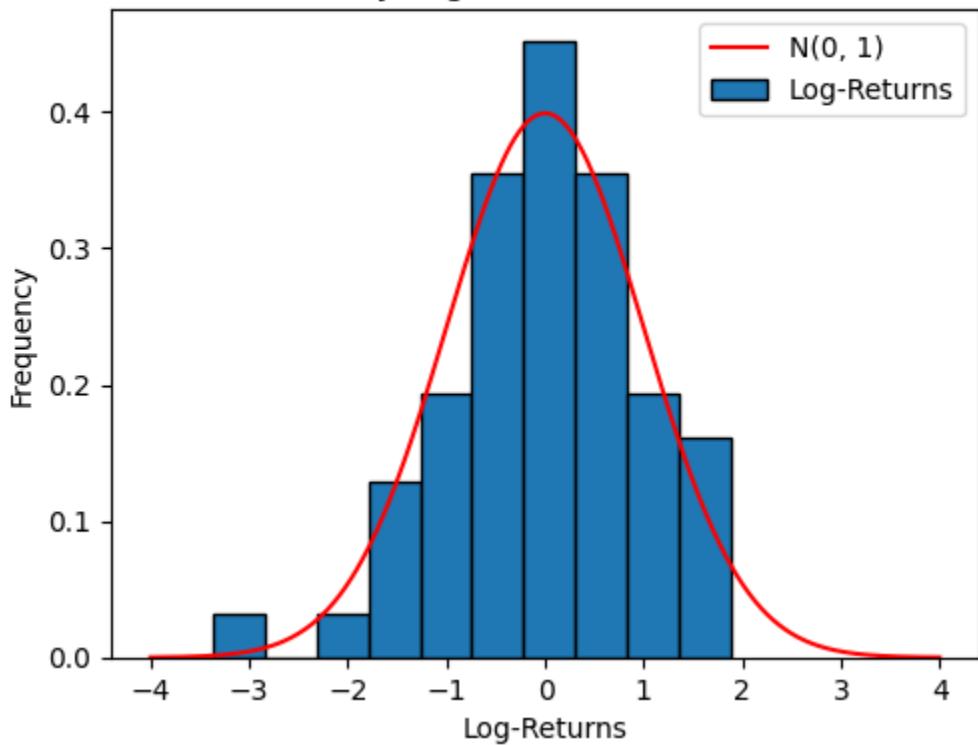
Monthly Log-Returns for ICICI (NSE)



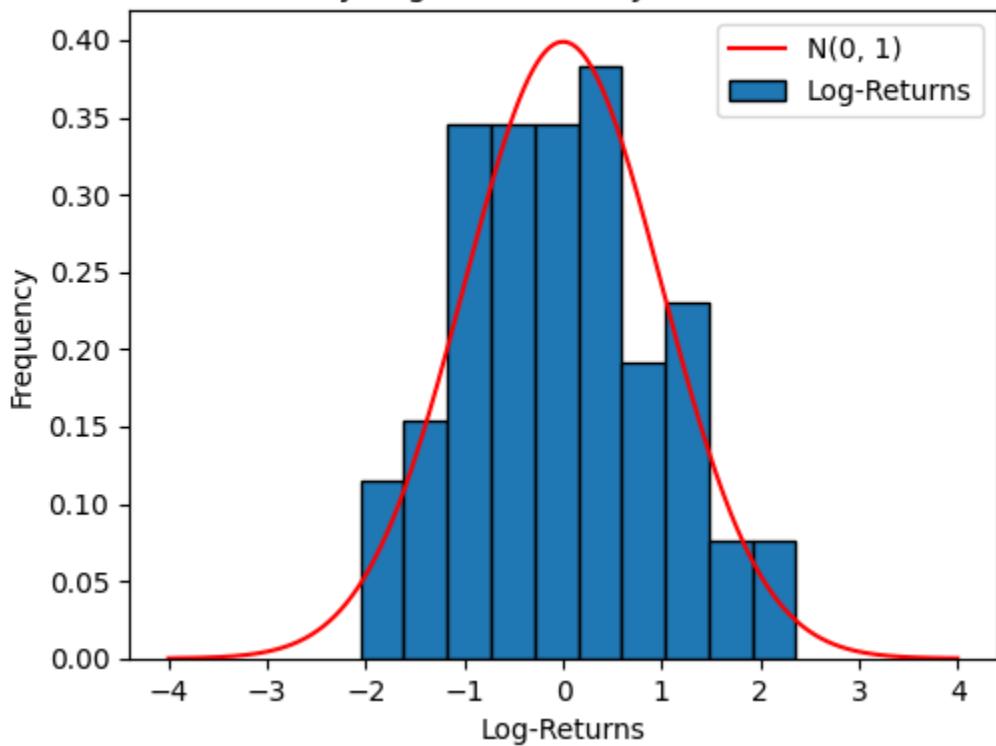
Monthly Log-Returns for IOC (NSE)



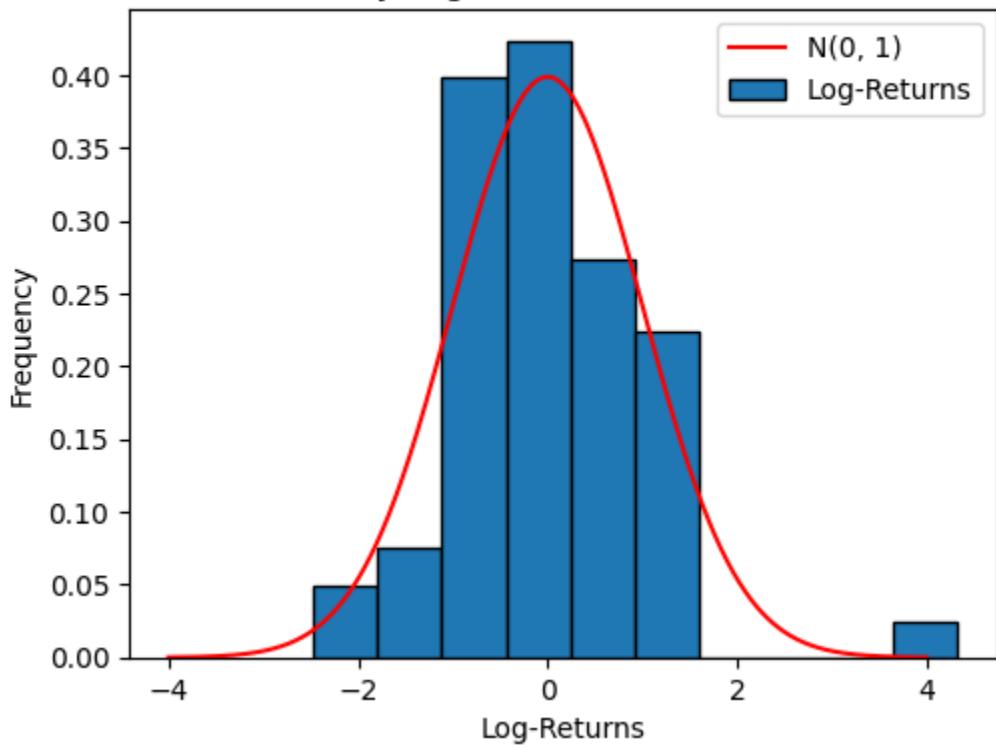
Monthly Log-Returns for ITC (NSE)



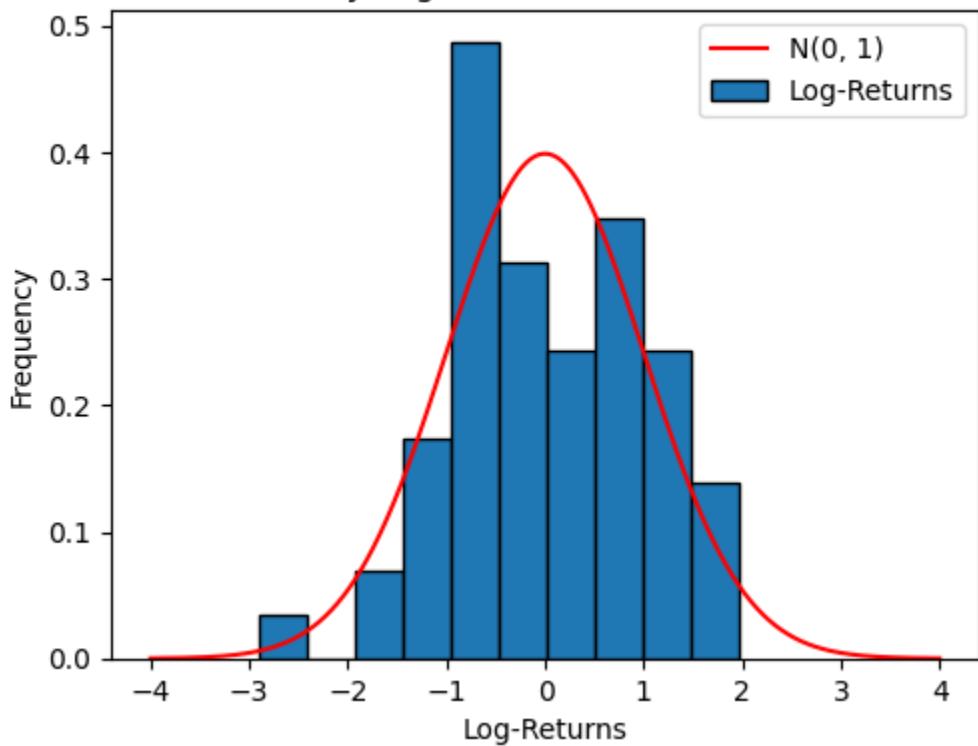
Monthly Log-Returns for JSWSTEEL (NSE)



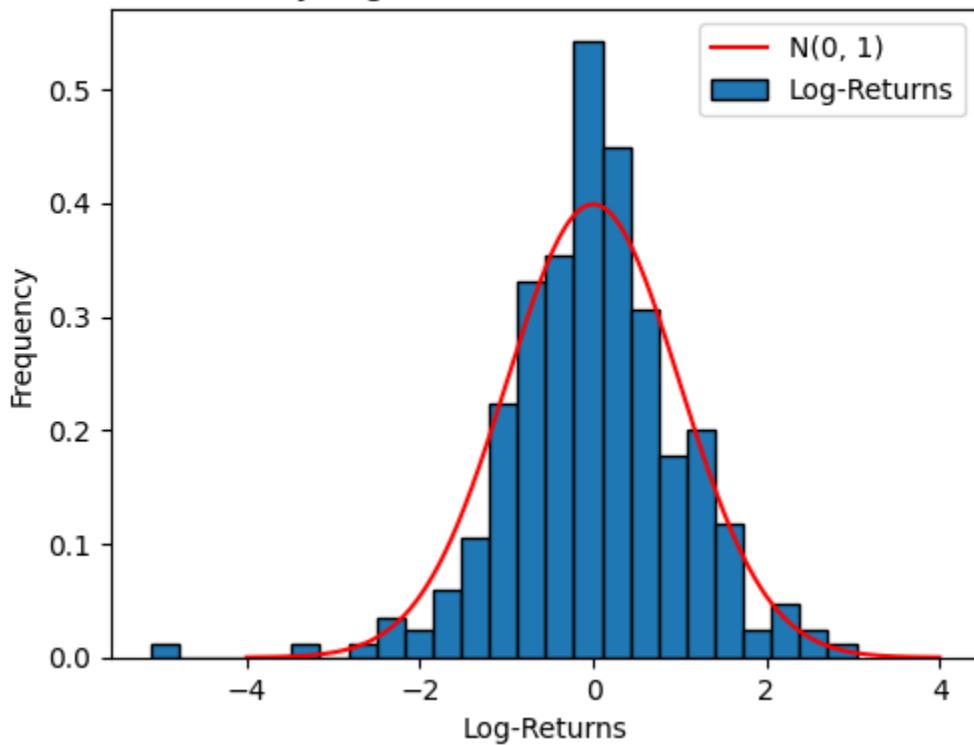
Monthly Log-Returns for NTPC (NSE)



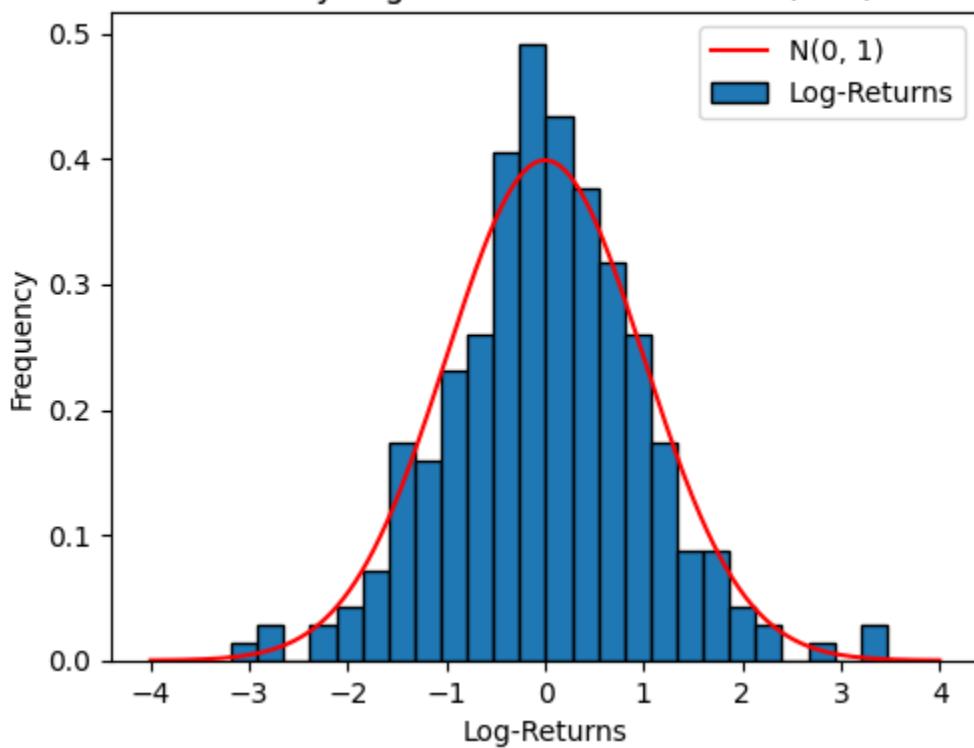
Monthly Log-Returns for WIPRO (NSE)

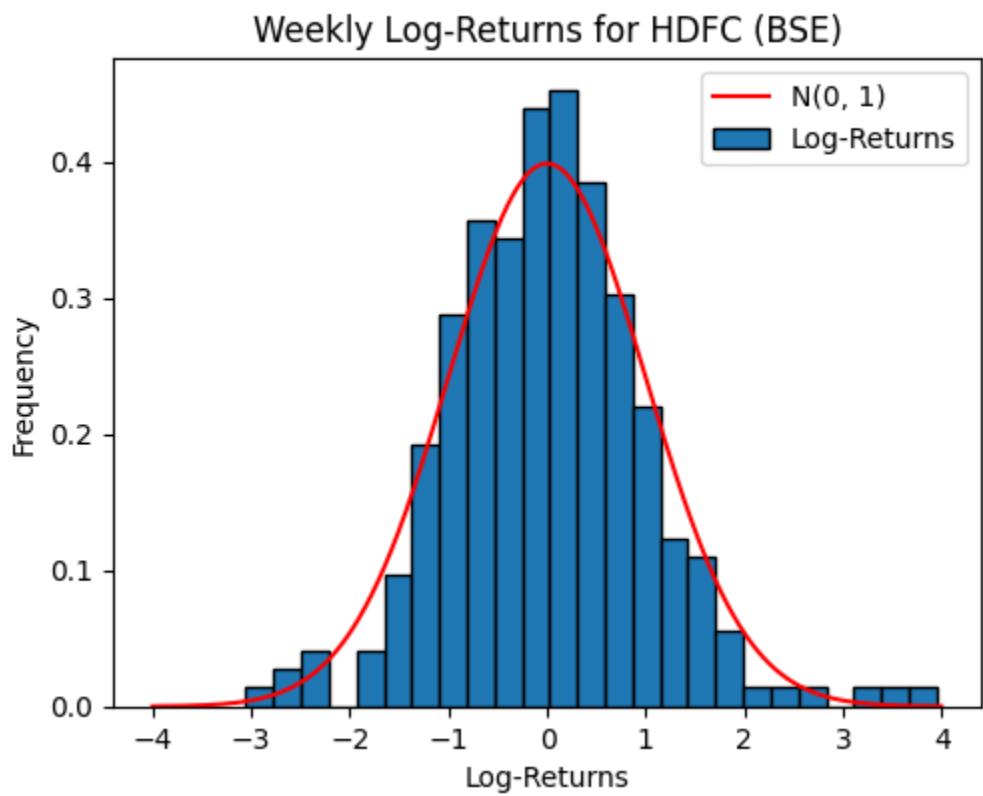
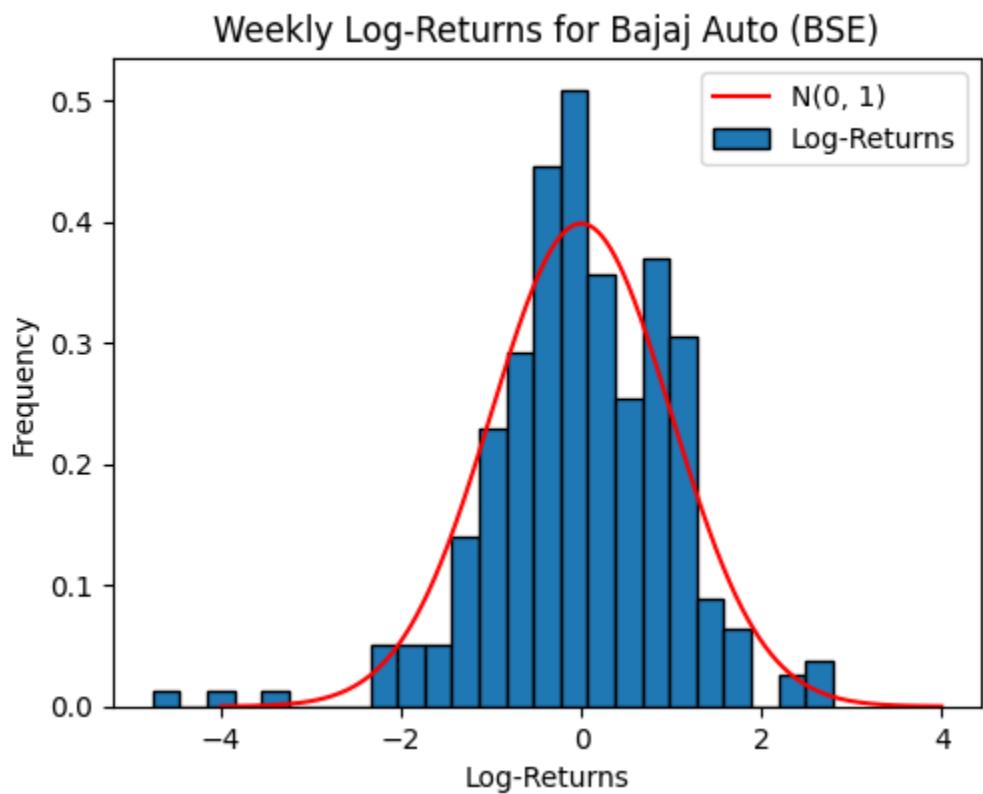


Weekly Log-Returns for Asian Paints (BSE)

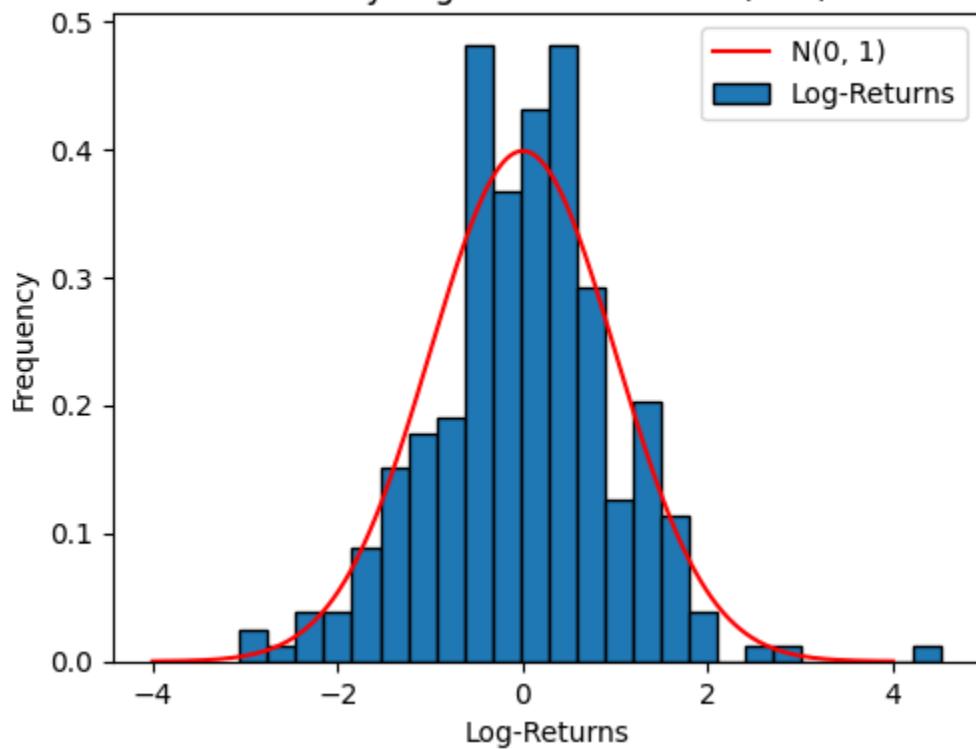


Weekly Log-Returns for Axis Bank (BSE)

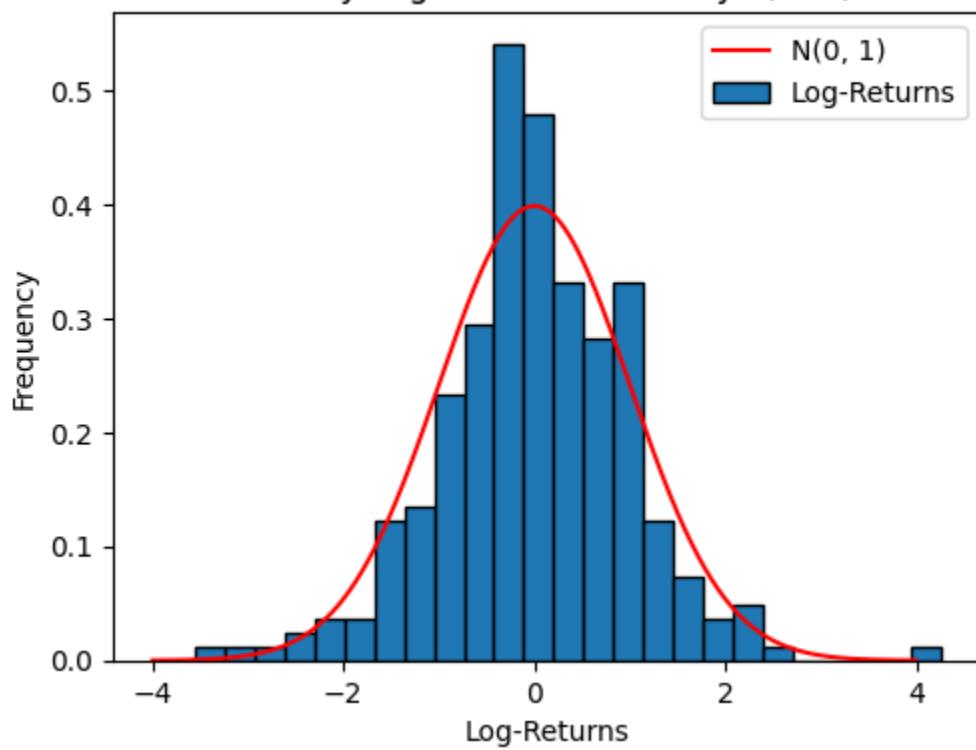




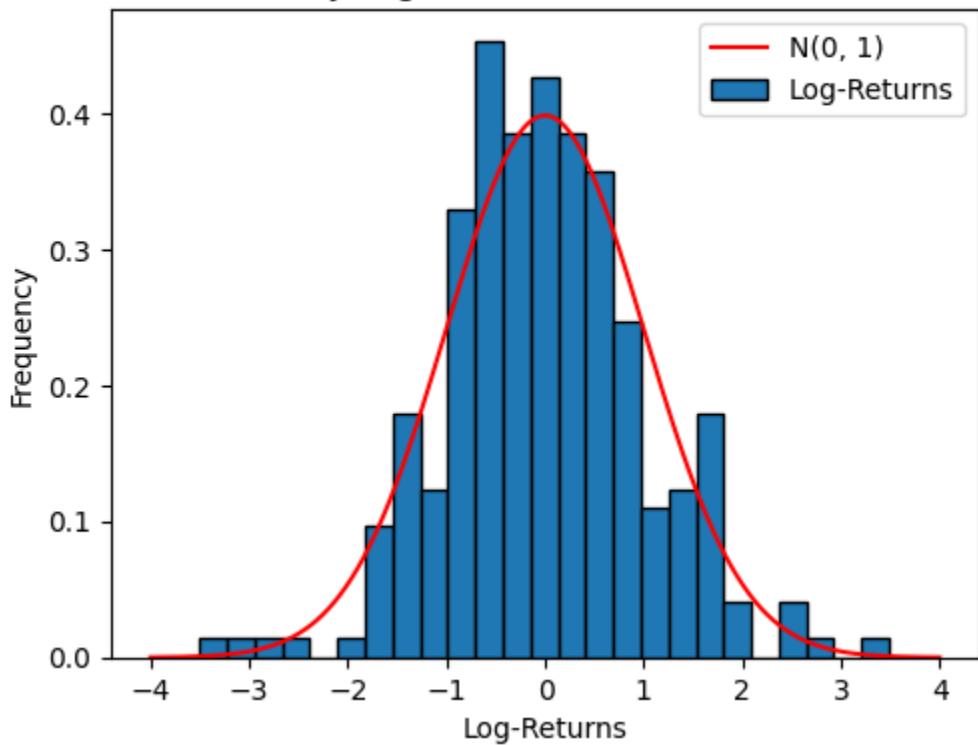
Weekly Log-Returns for HUL (BSE)



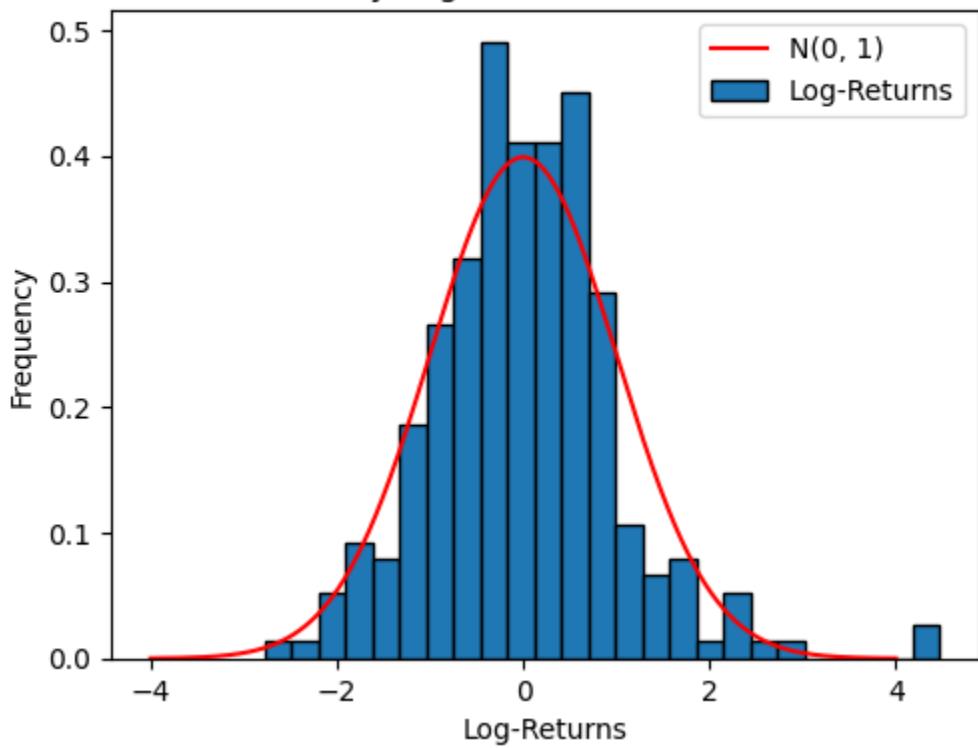
Weekly Log-Returns for Infosys (BSE)



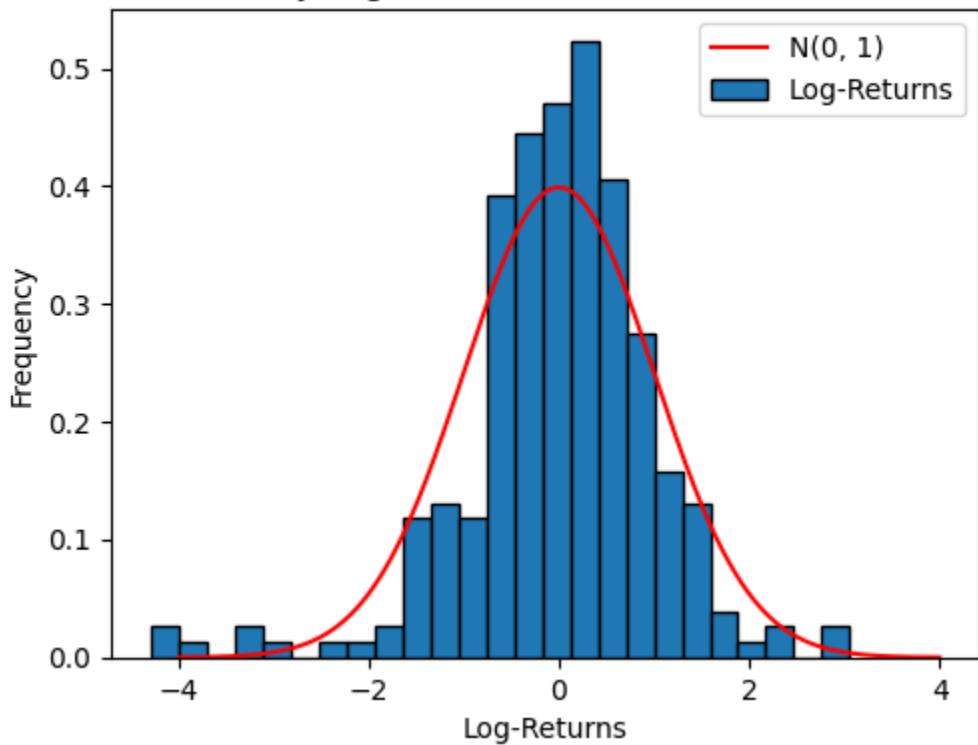
Weekly Log-Returns for Reliance (BSE)



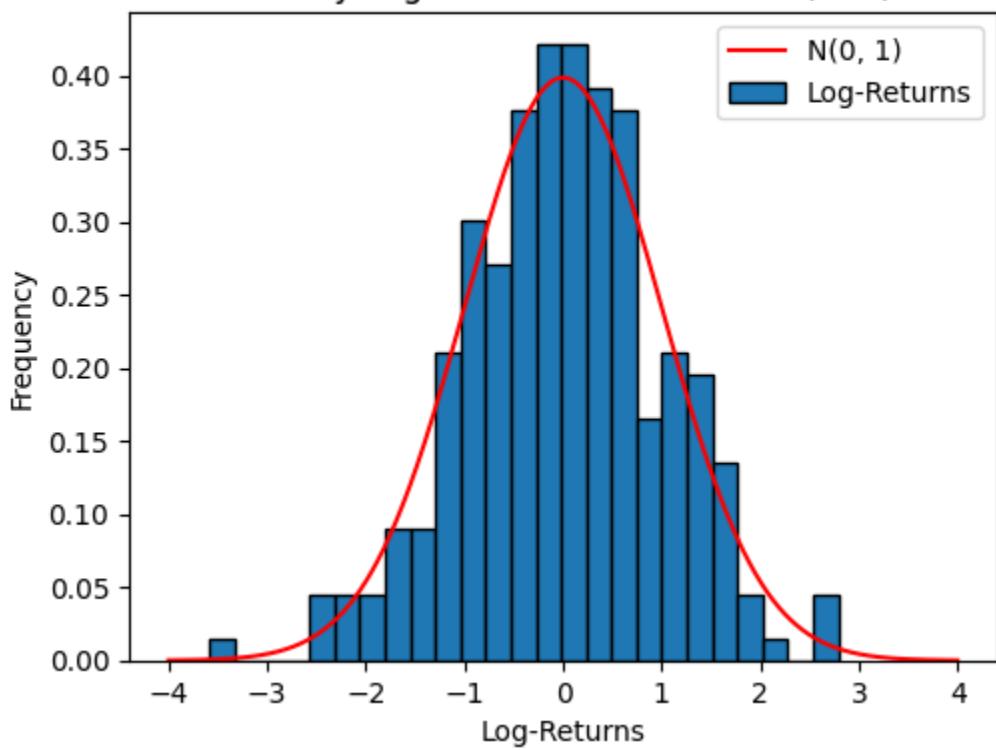
Weekly Log-Returns for SBI (BSE)



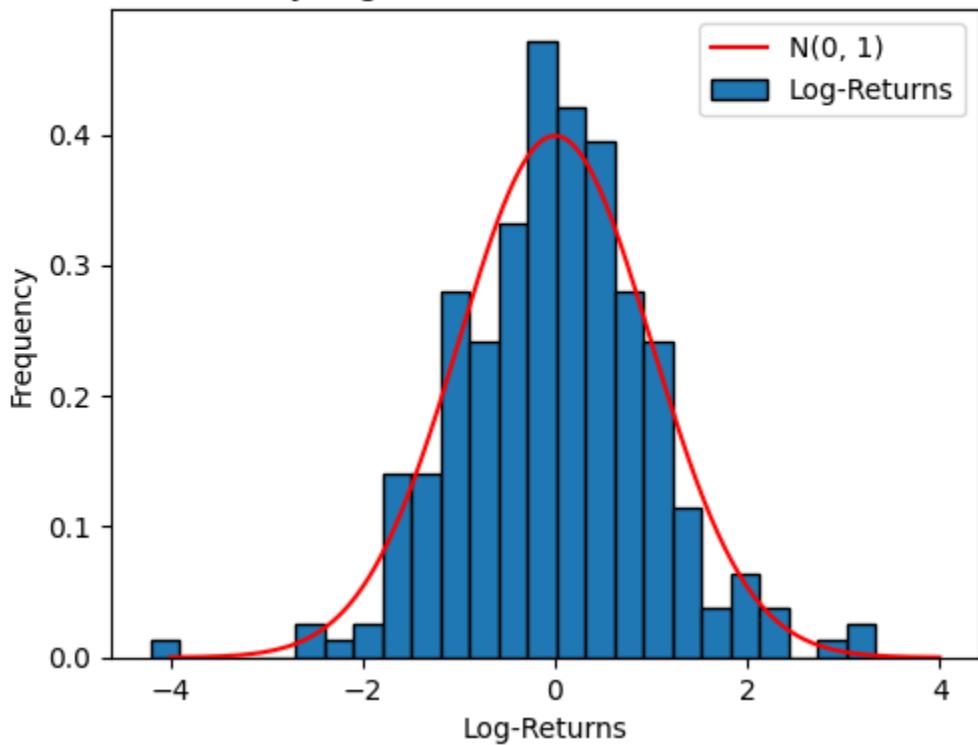
Weekly Log-Returns for Sun Pharma (BSE)



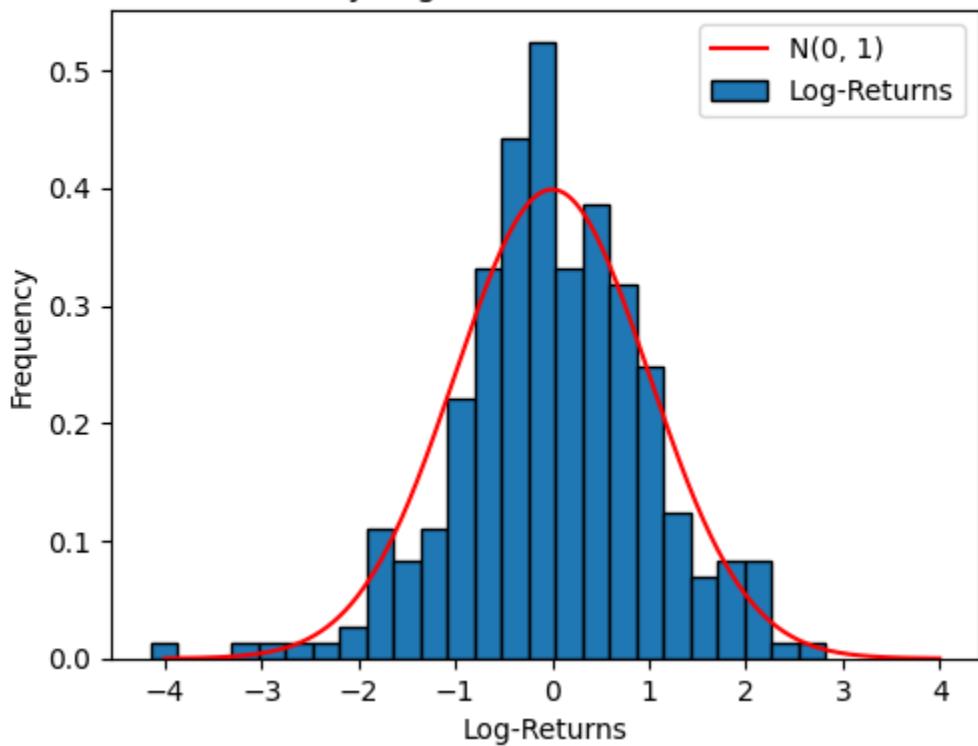
Weekly Log-Returns for Tata Steel (BSE)



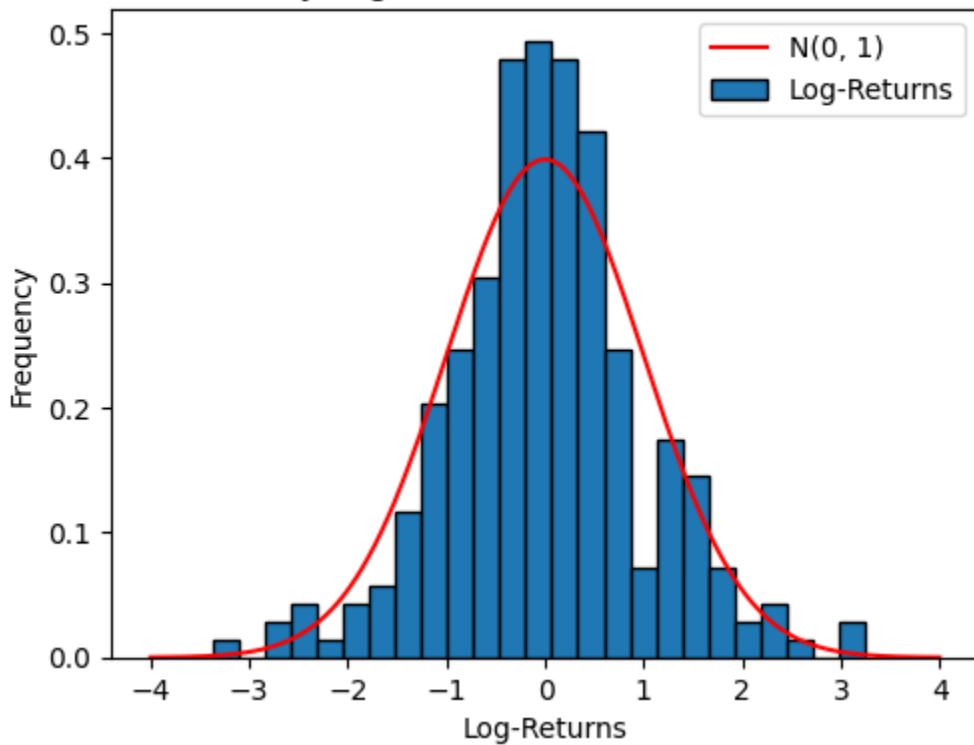
Weekly Log-Returns for ADANIPORTS (NSE)



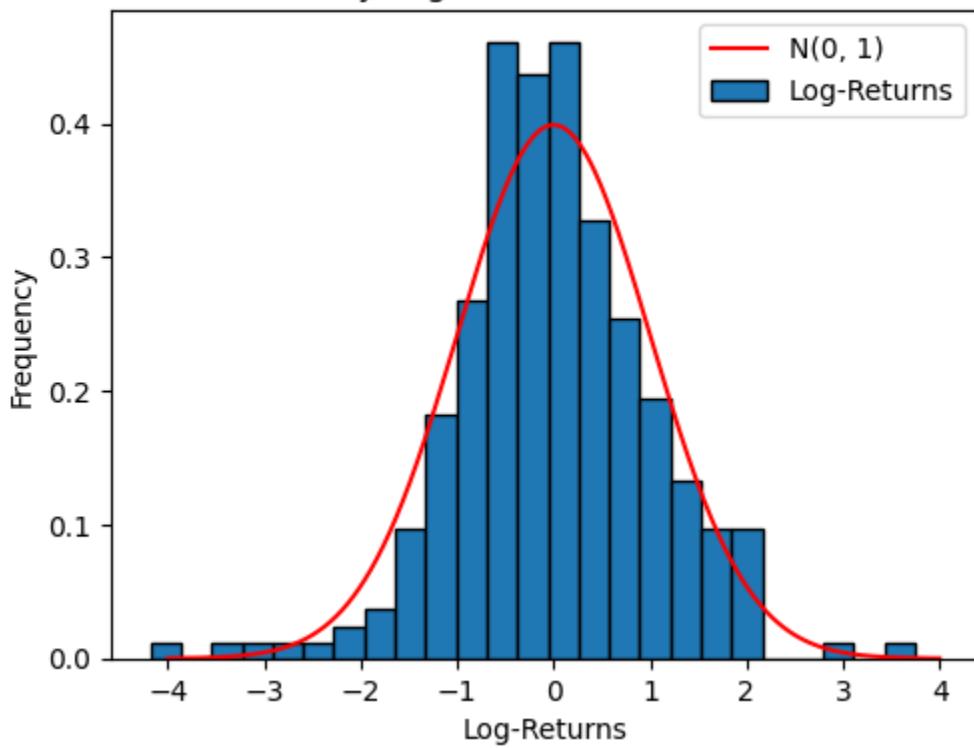
Weekly Log-Returns for CIPLA (NSE)



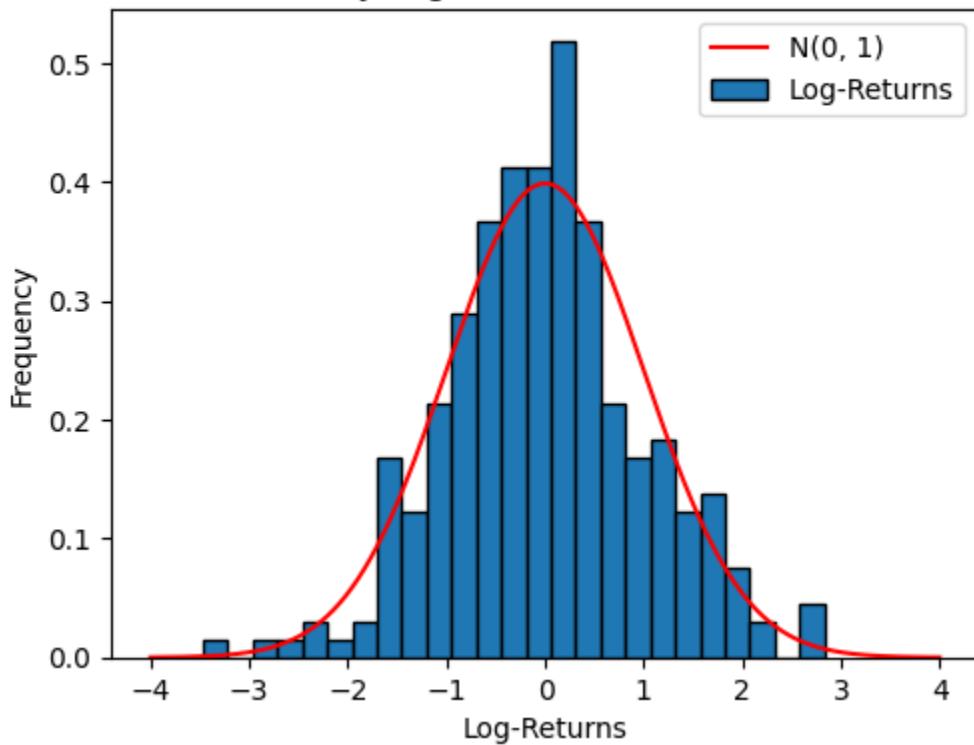
Weekly Log-Returns for COAL INDIA (NSE)



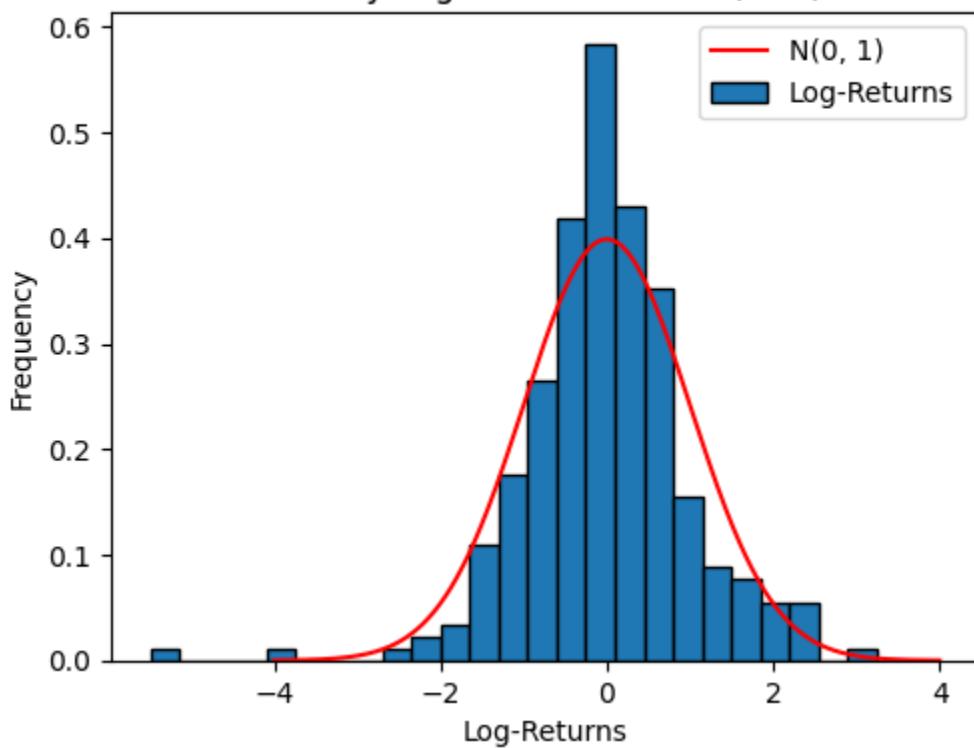
Weekly Log-Returns for GAIL (NSE)



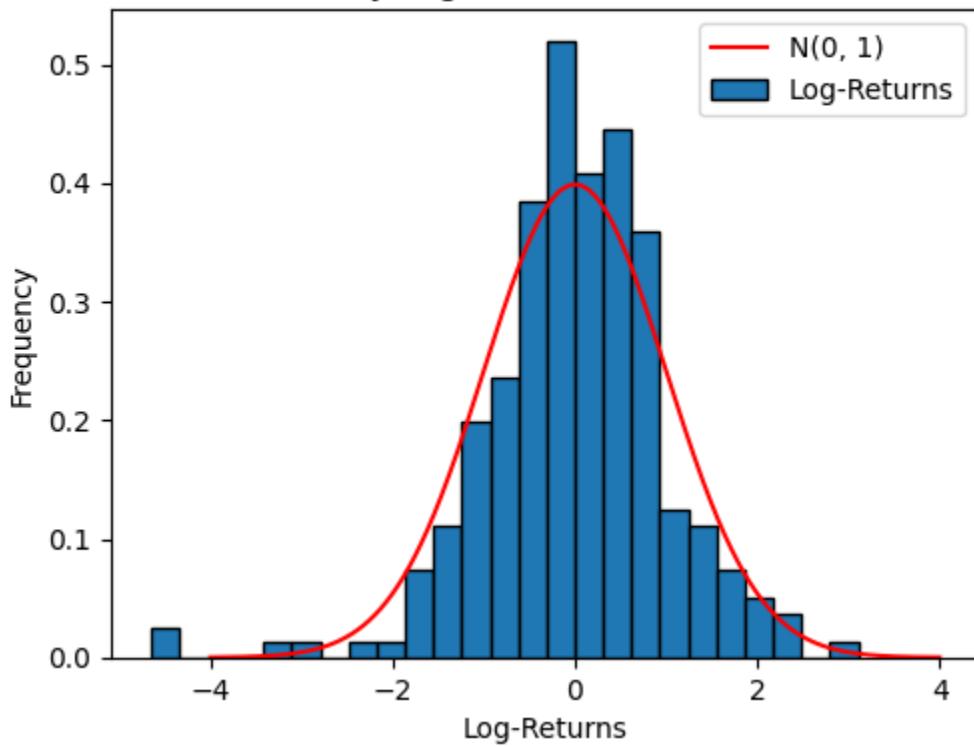
Weekly Log-Returns for ICICI (NSE)



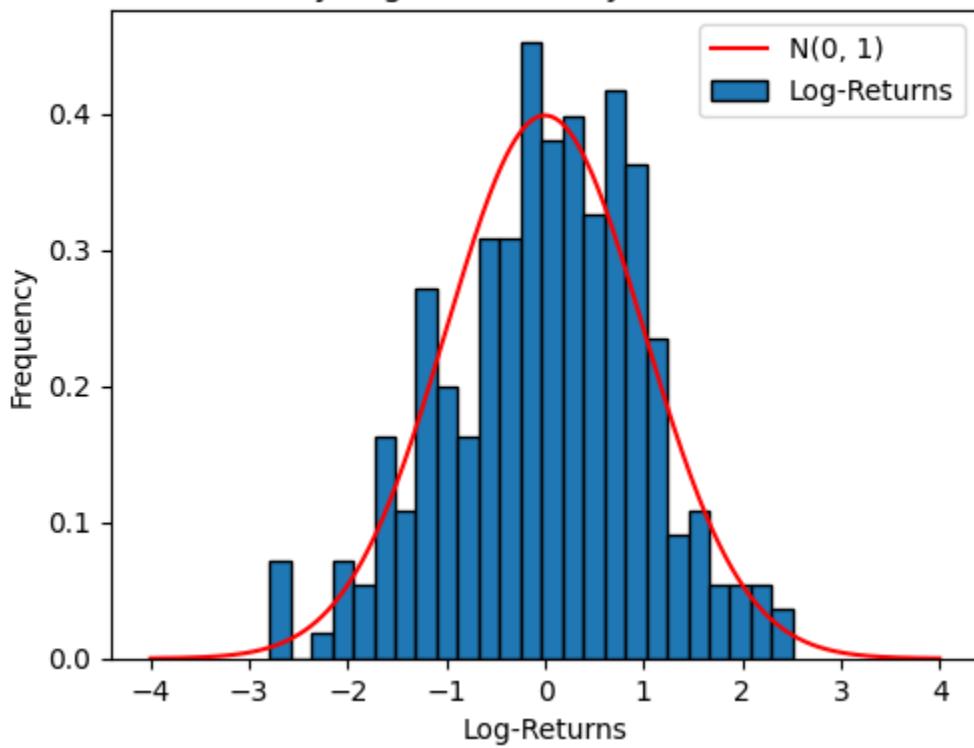
Weekly Log-Returns for IOC (NSE)



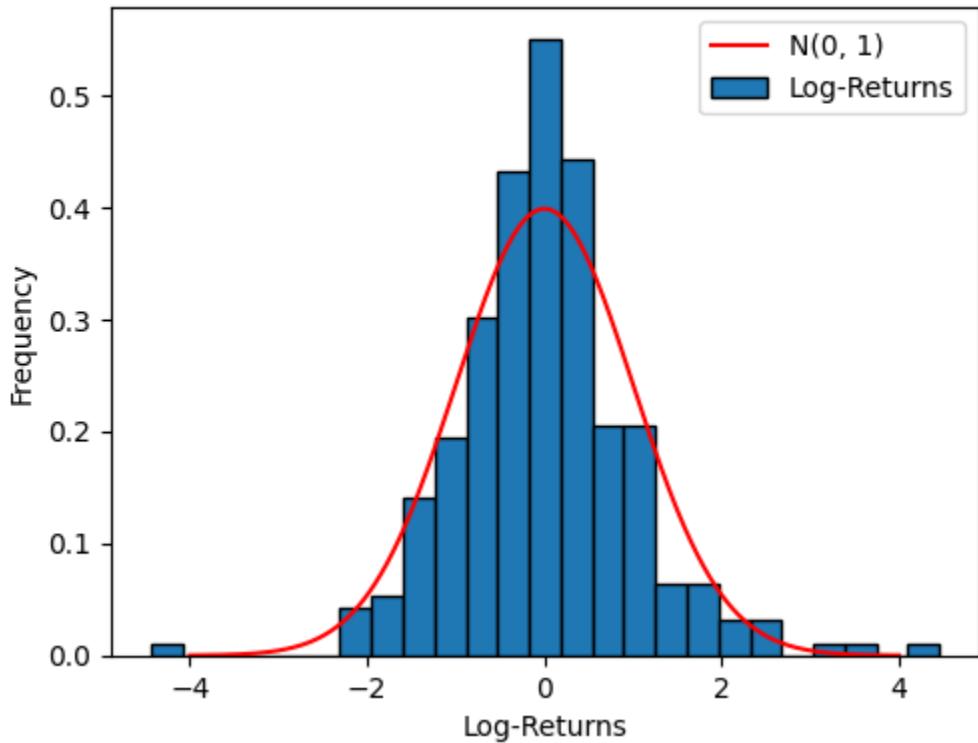
Weekly Log-Returns for ITC (NSE)



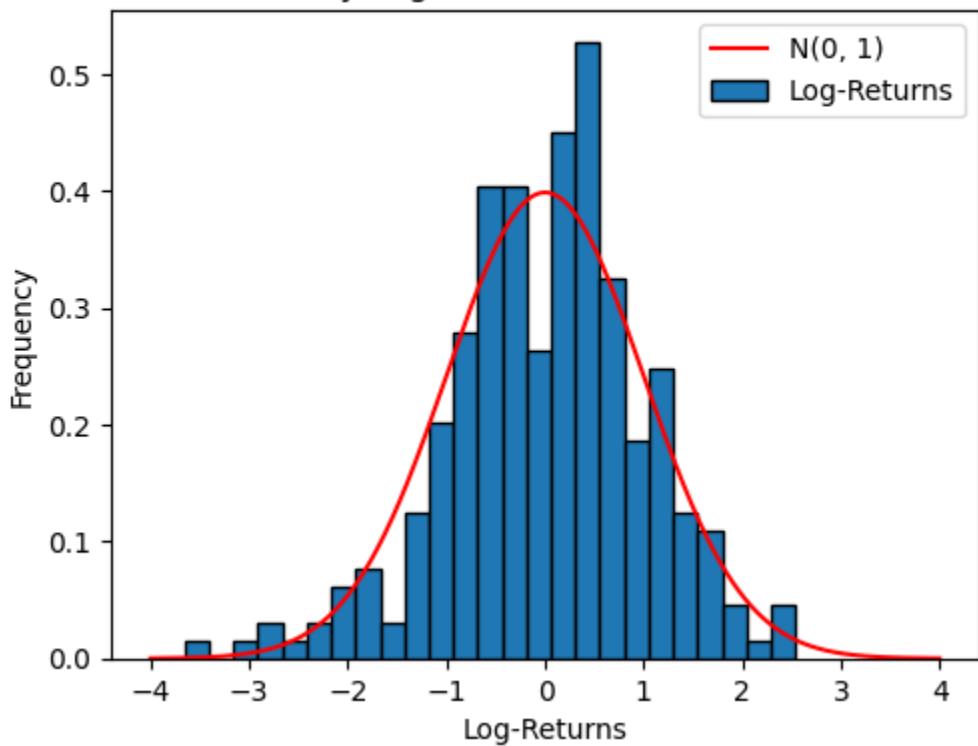
Weekly Log-Returns for JSWSTEEL (NSE)



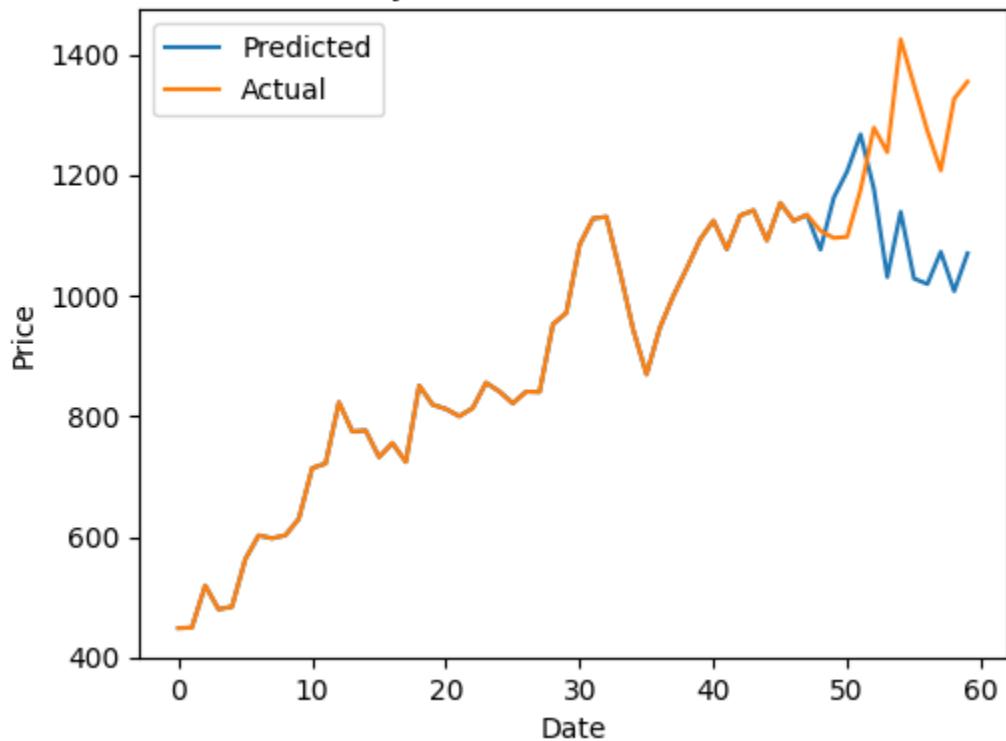
Weekly Log-Returns for NTPC (NSE)



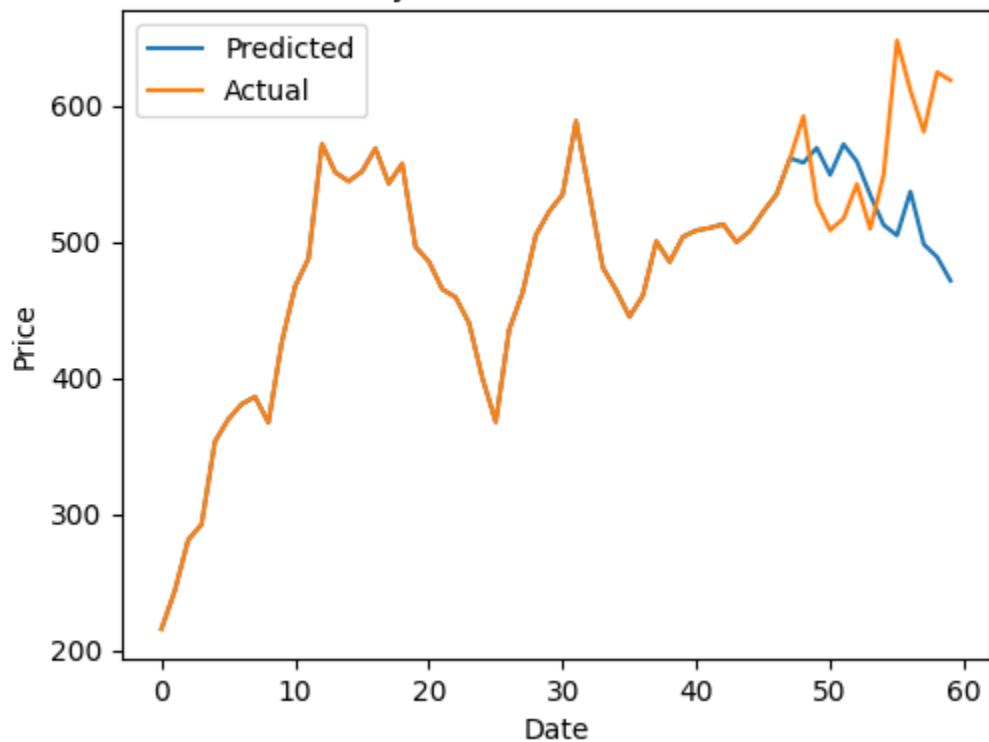
Weekly Log-Returns for WIPRO (NSE)



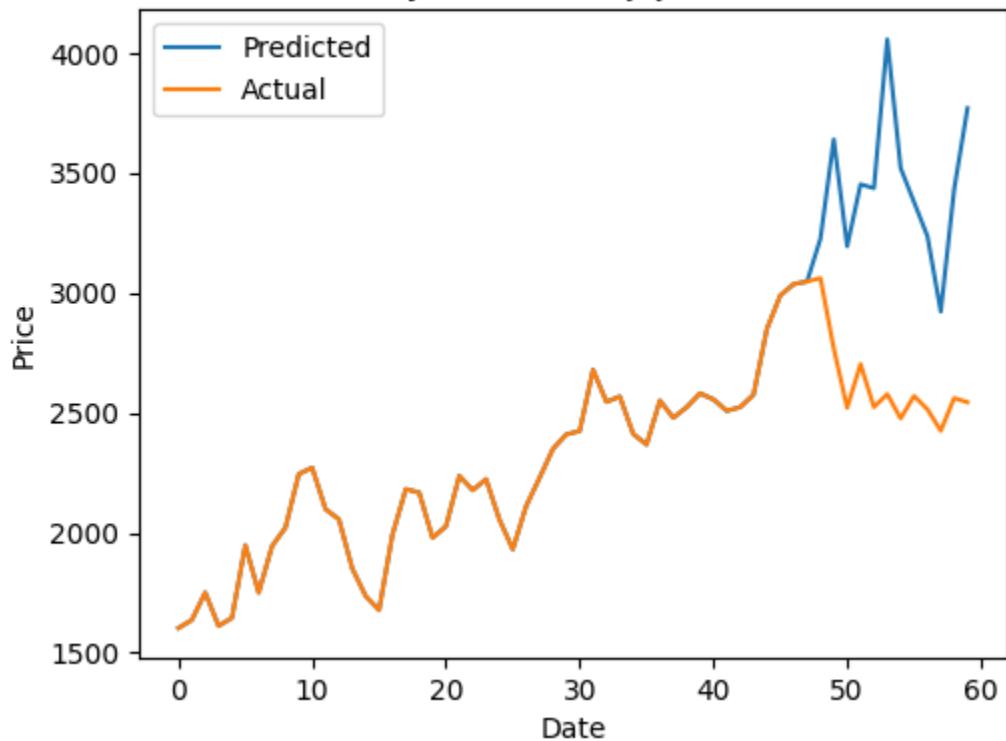
### Monthly Price for Asian Paints (BSE)



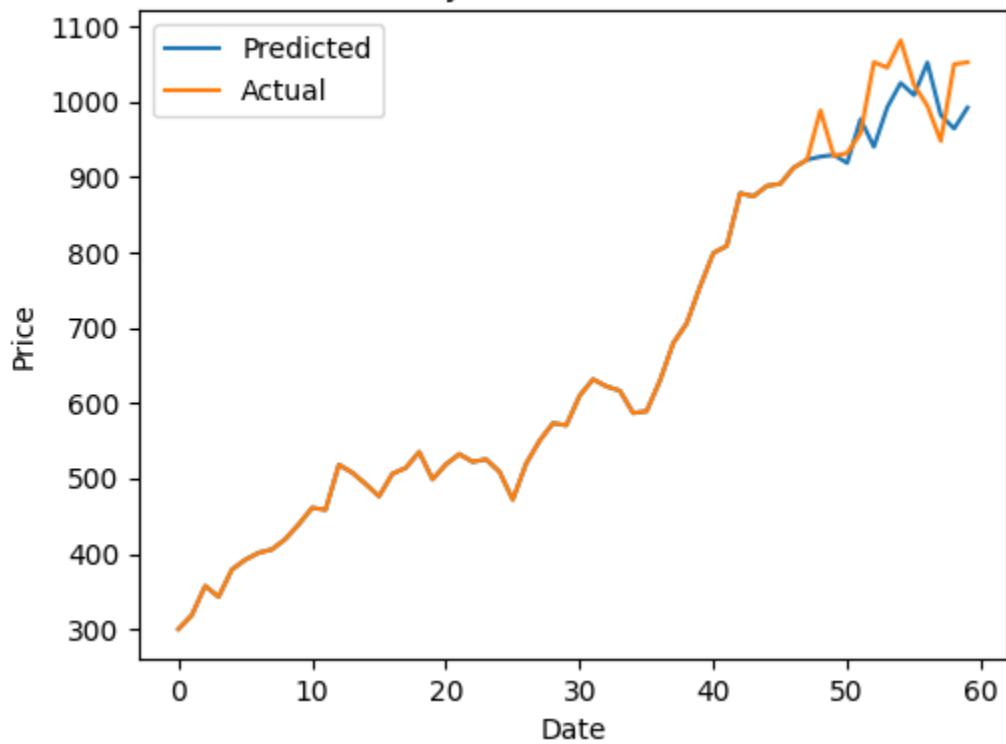
### Monthly Price for Axis Bank (BSE)

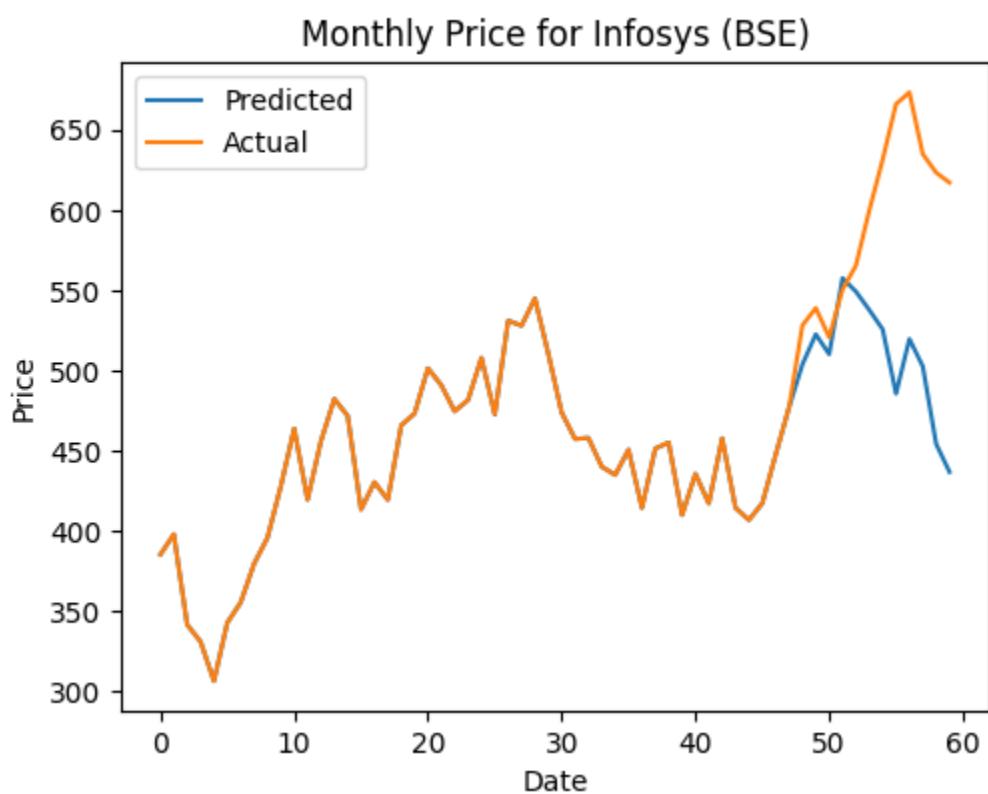
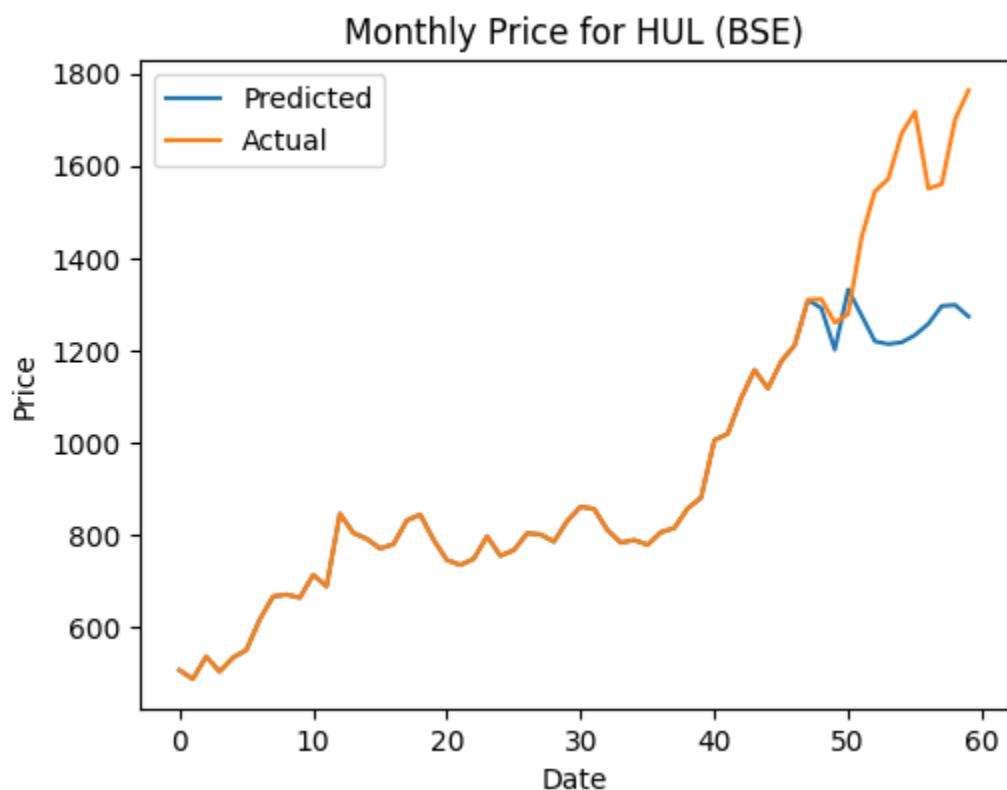


### Monthly Price for Bajaj Auto (BSE)

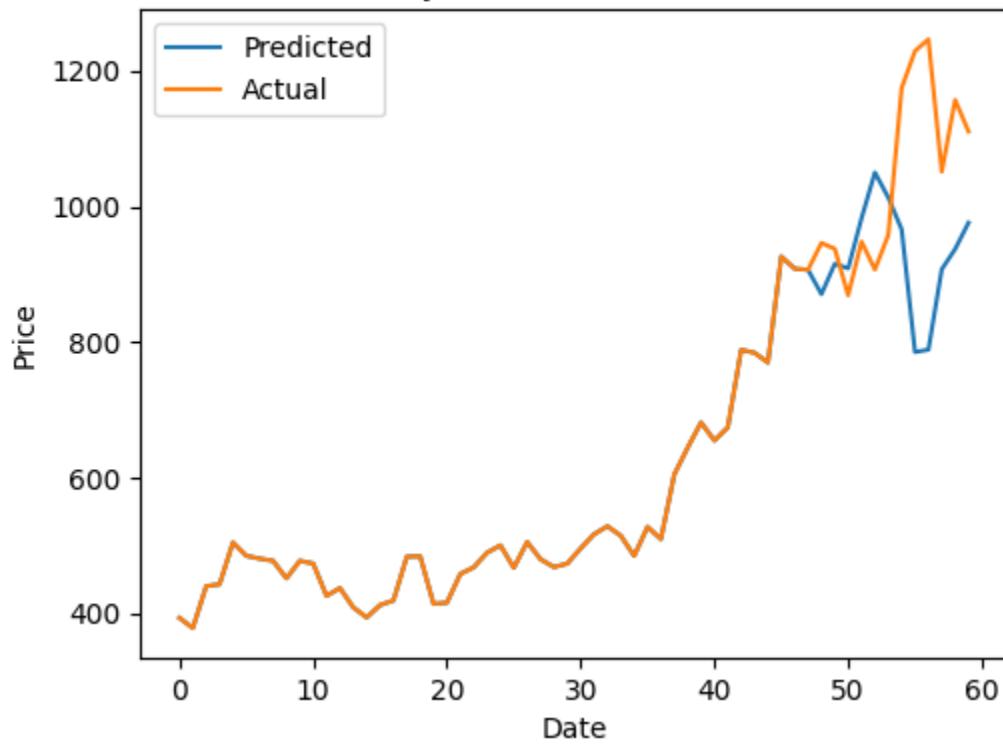


### Monthly Price for HDFC (BSE)

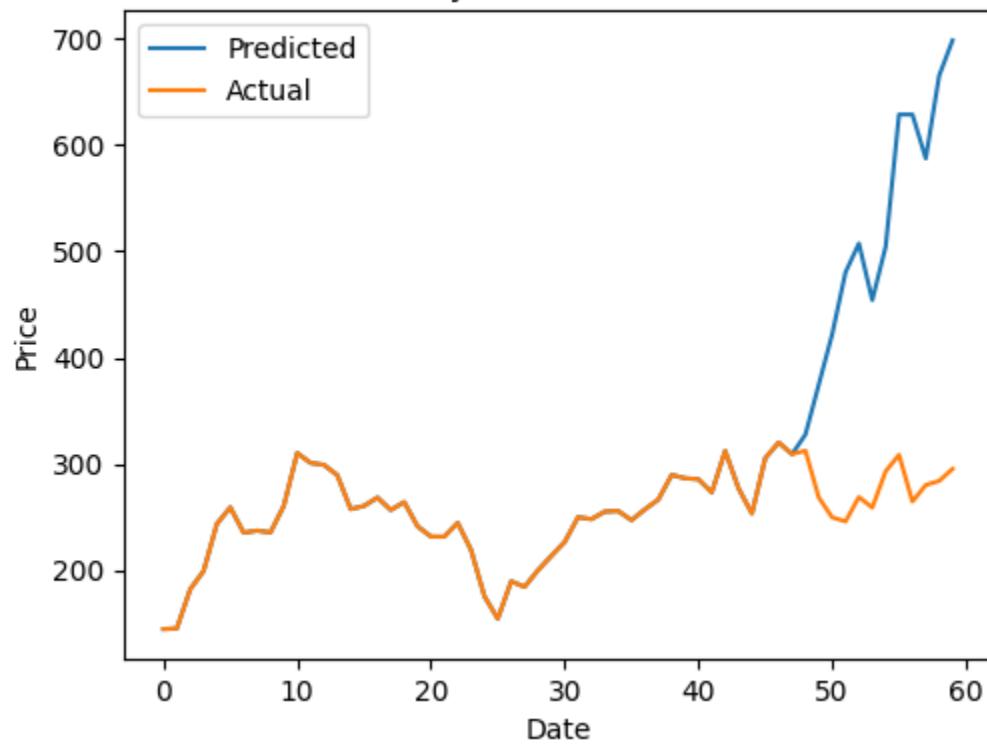


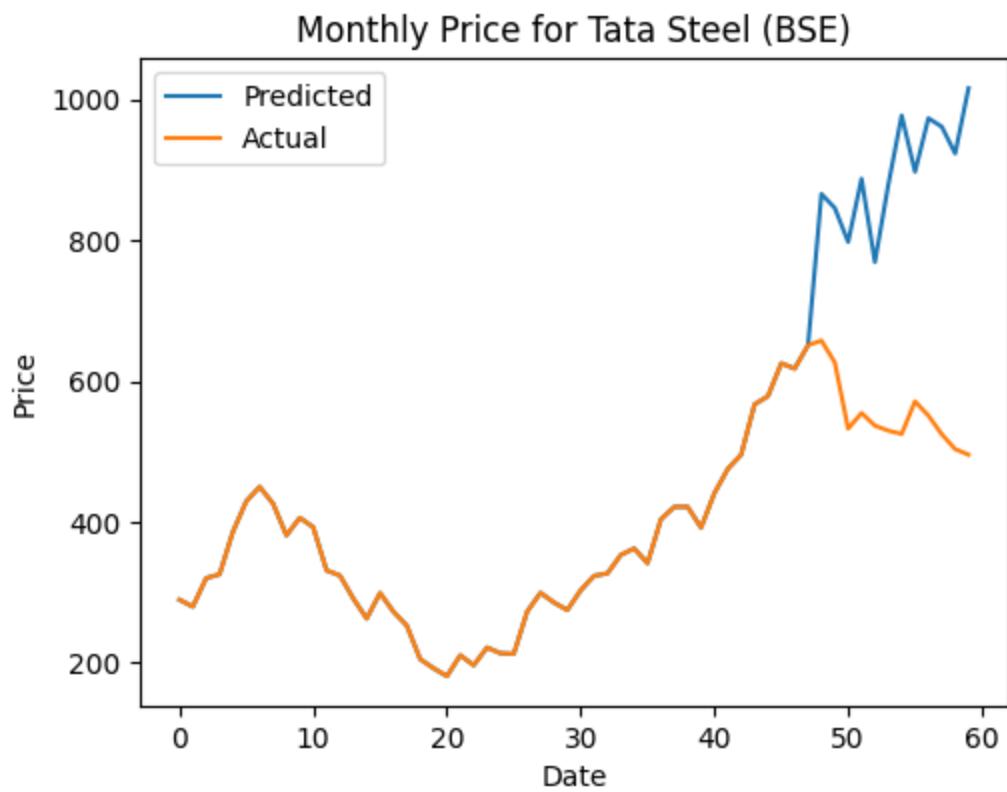
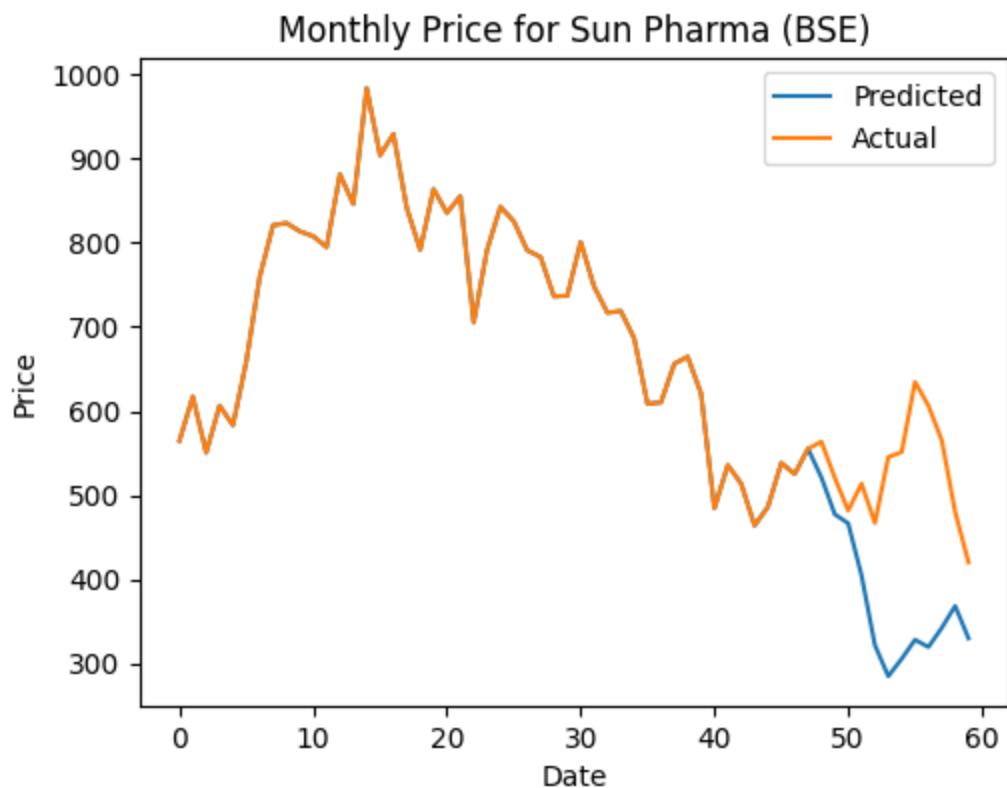


### Monthly Price for Reliance (BSE)

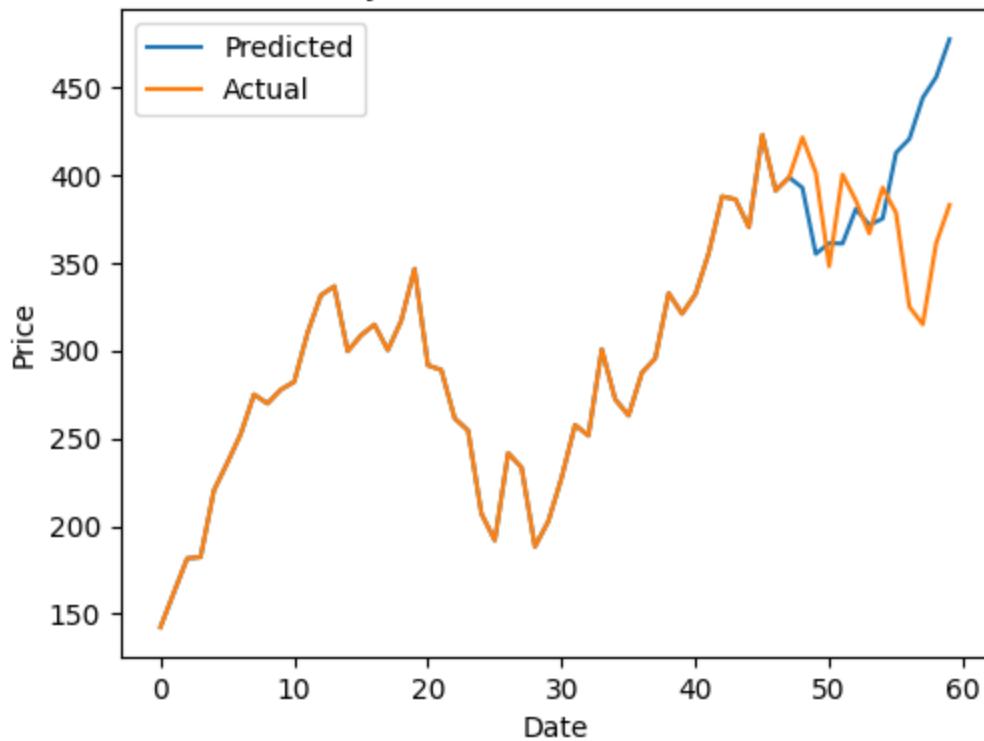


### Monthly Price for SBI (BSE)

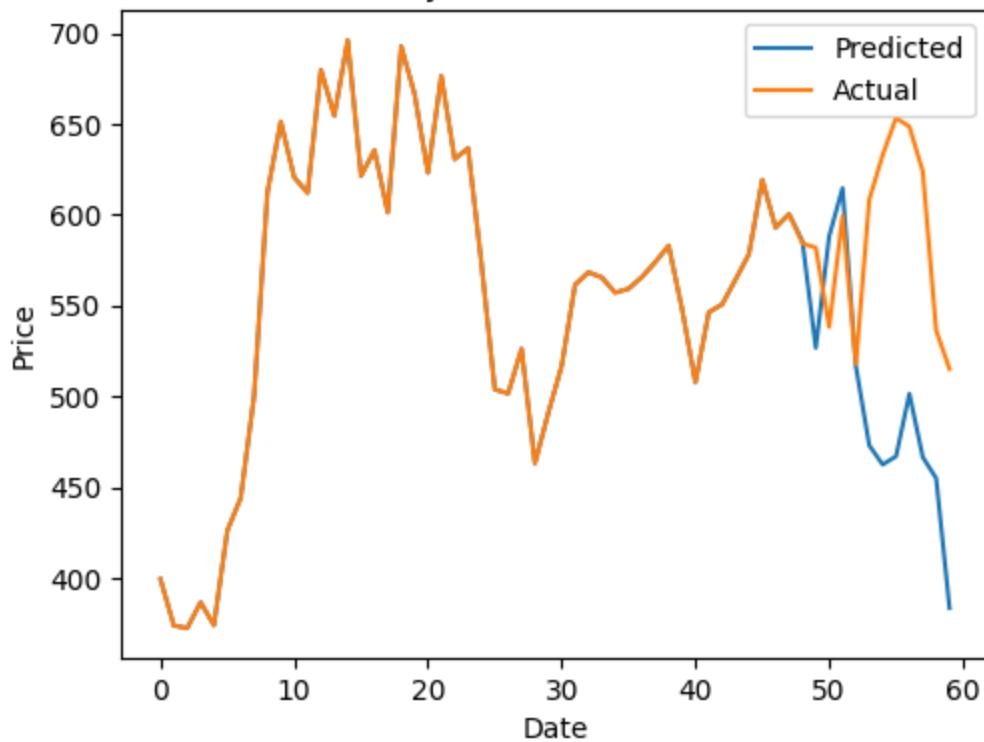




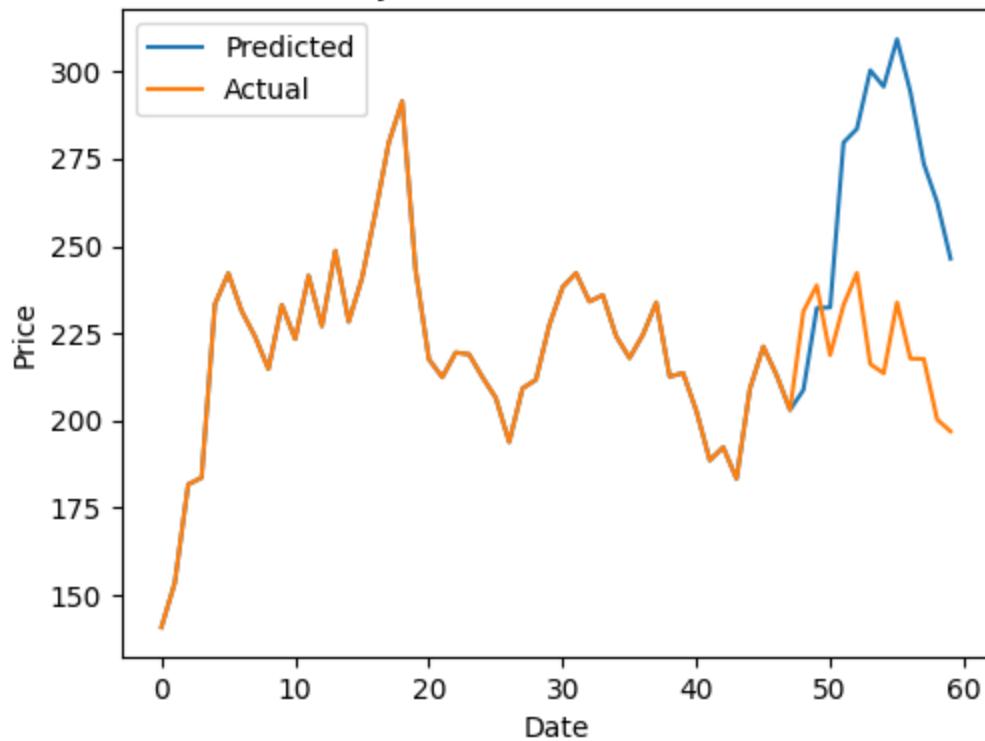
### Monthly Price for ADANIPORTS (NSE)



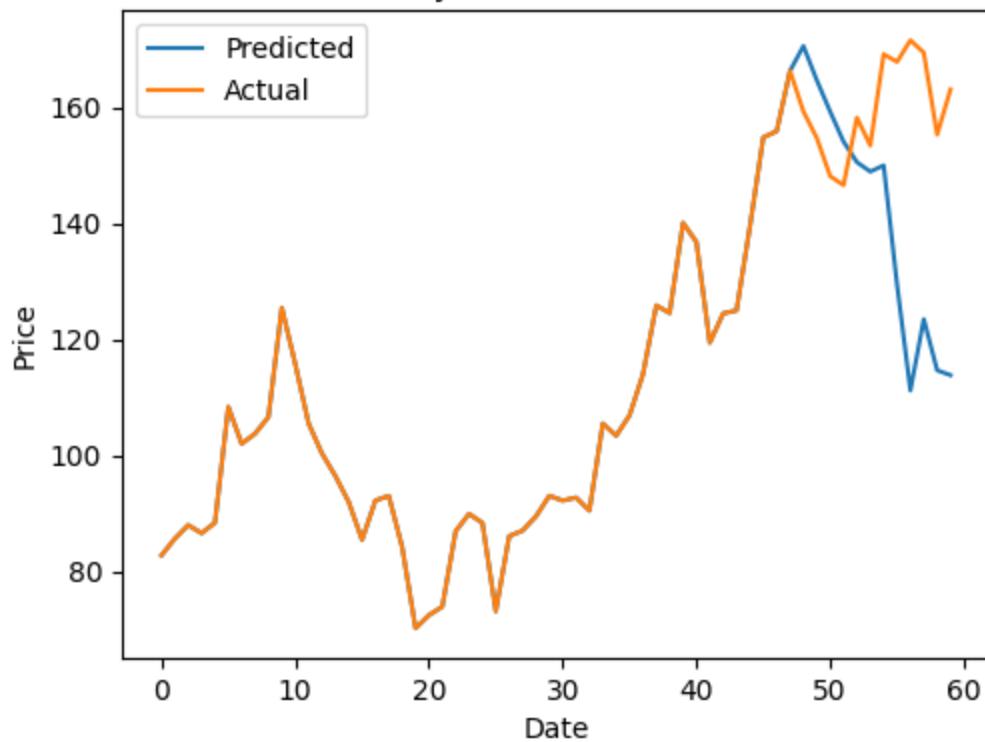
### Monthly Price for CIPLA (NSE)



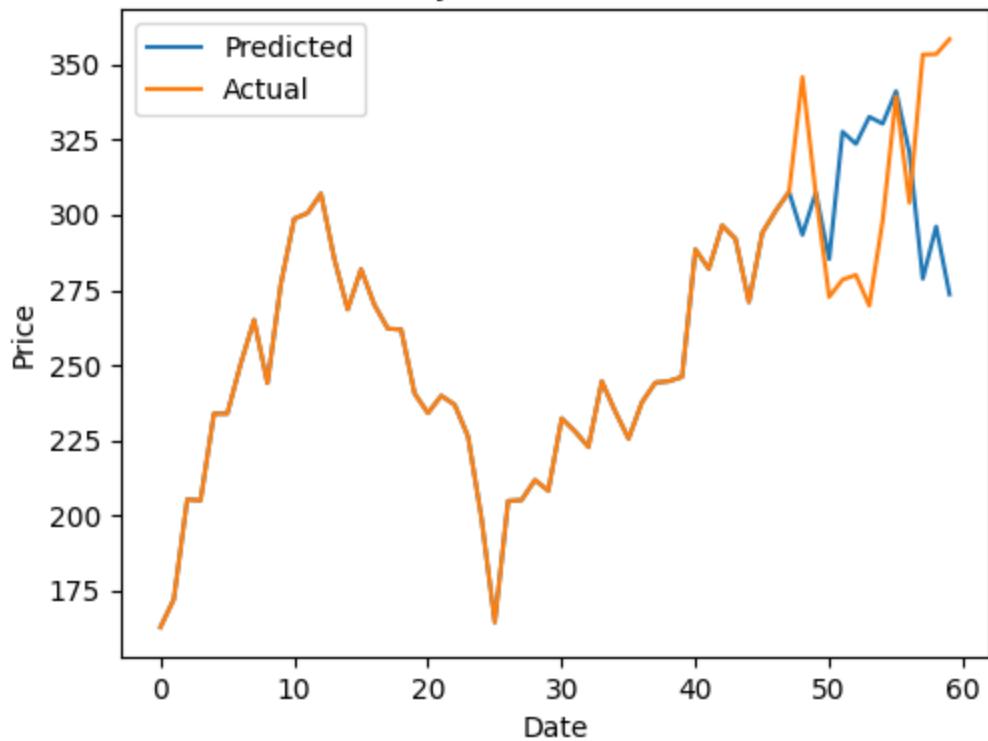
### Monthly Price for COAL INDIA (NSE)



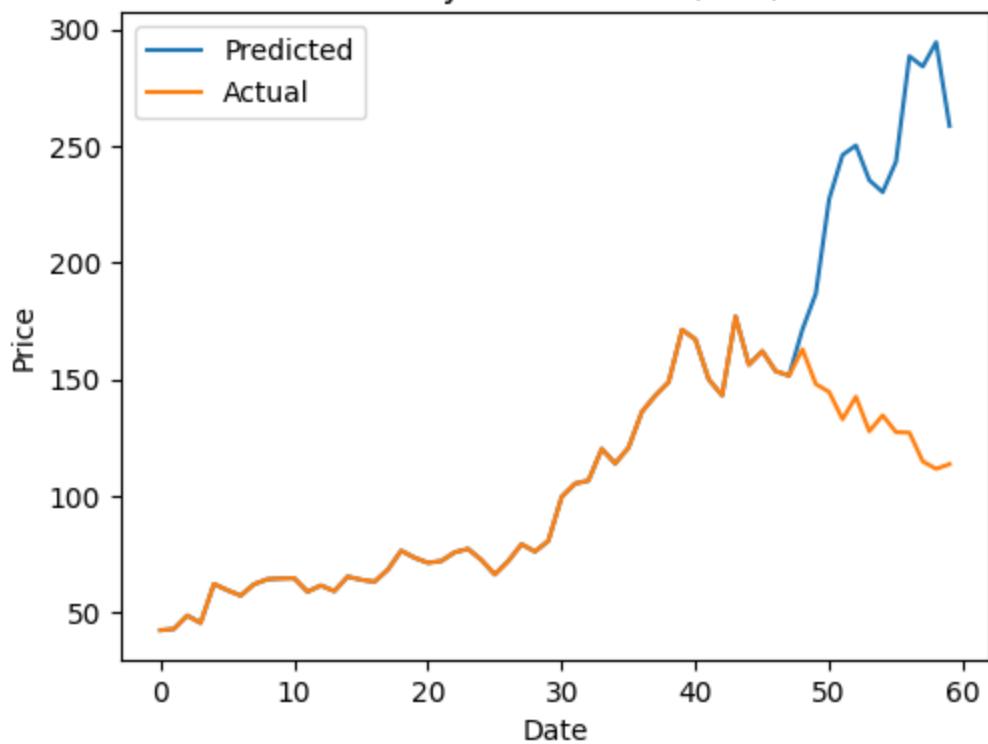
### Monthly Price for GAIL (NSE)

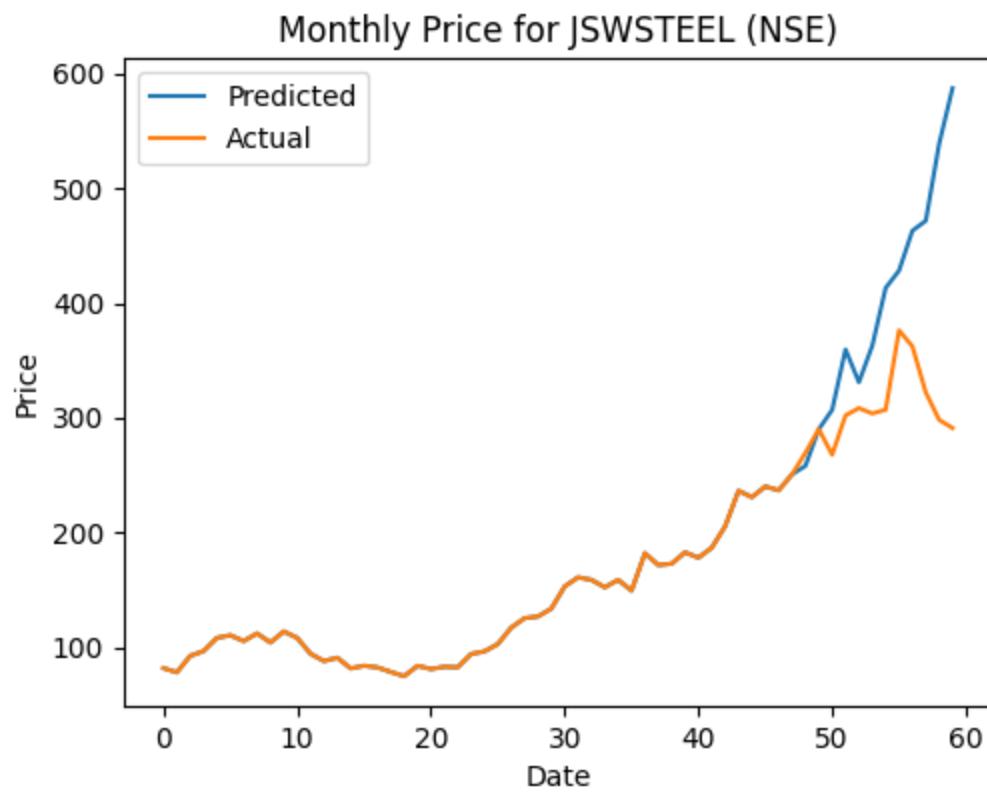
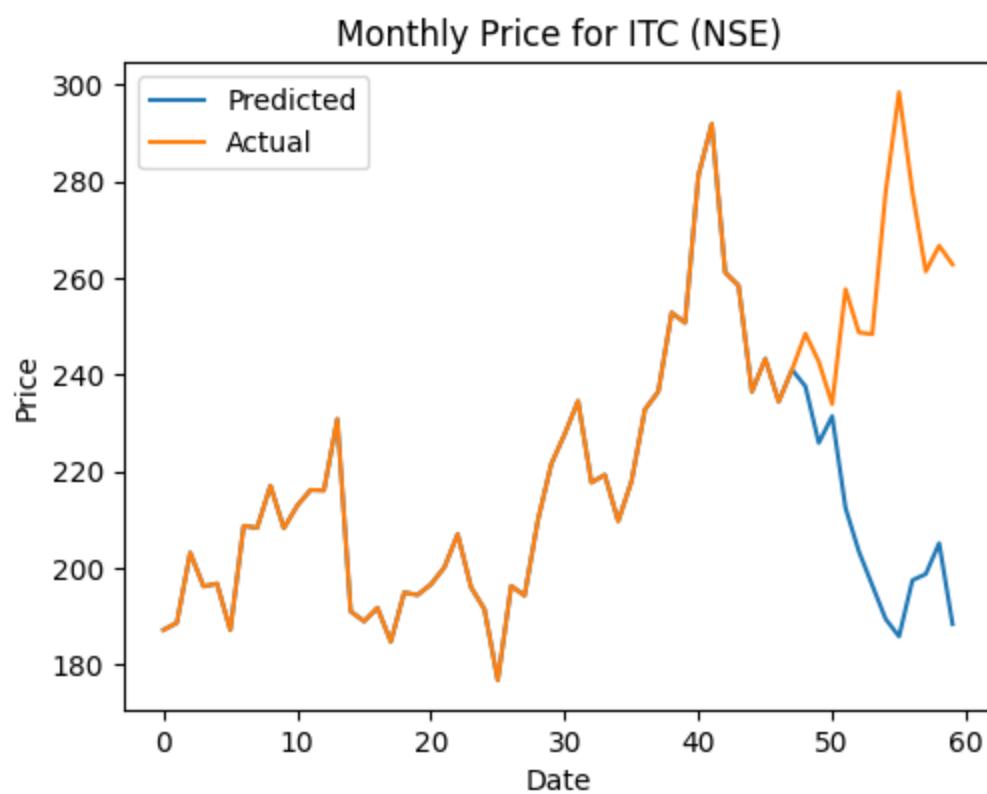


### Monthly Price for ICICI (NSE)

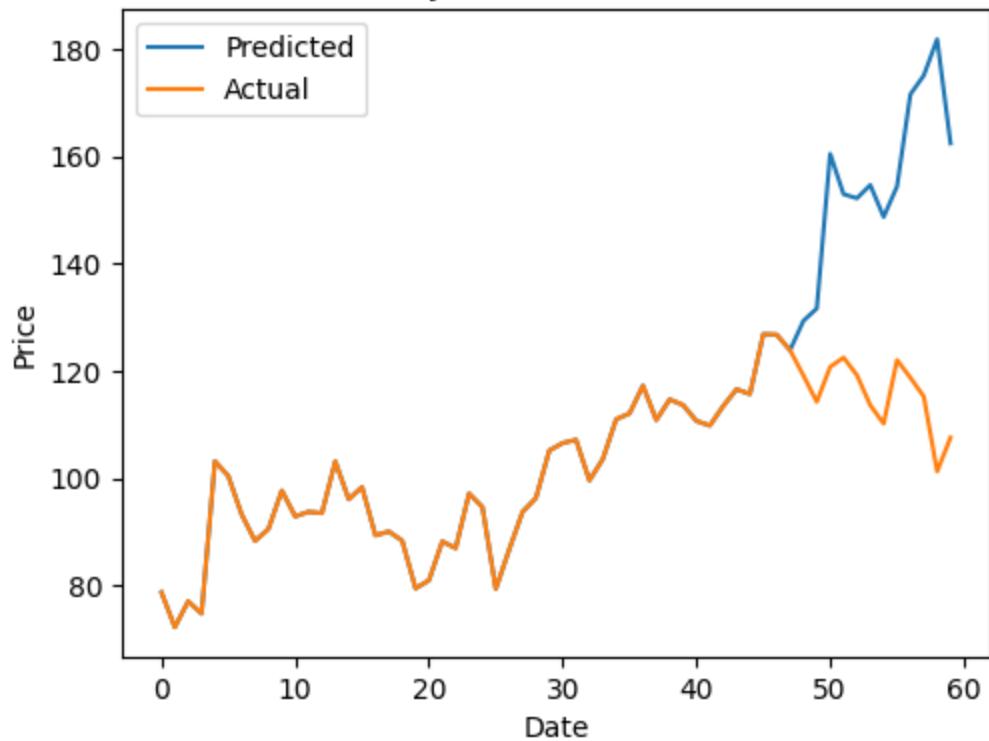


### Monthly Price for IOC (NSE)

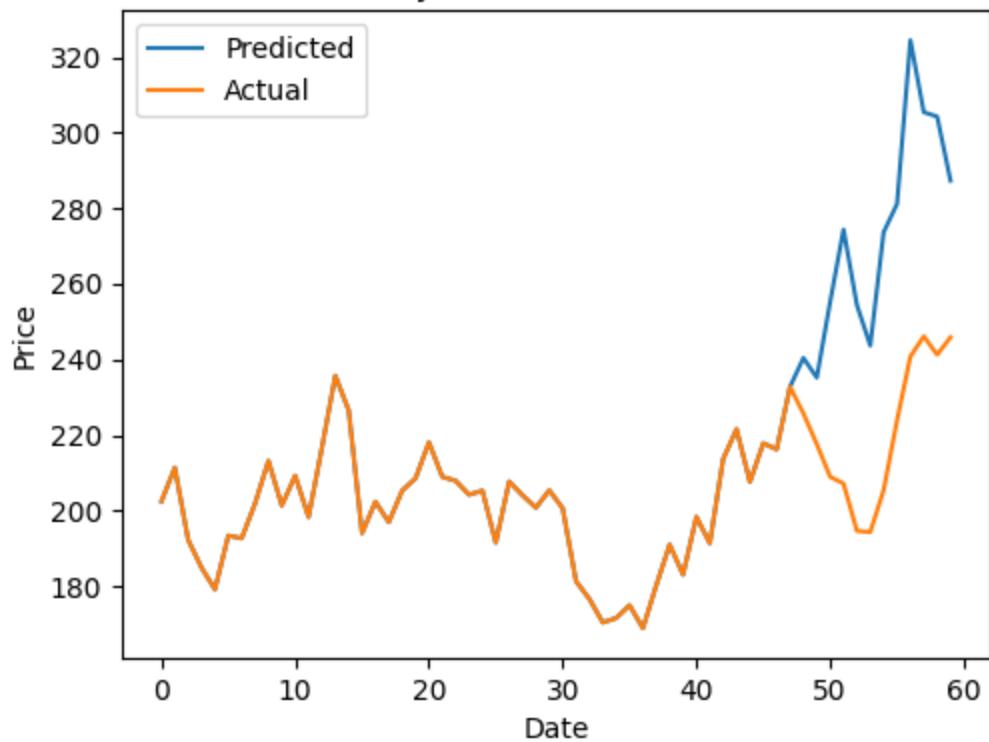




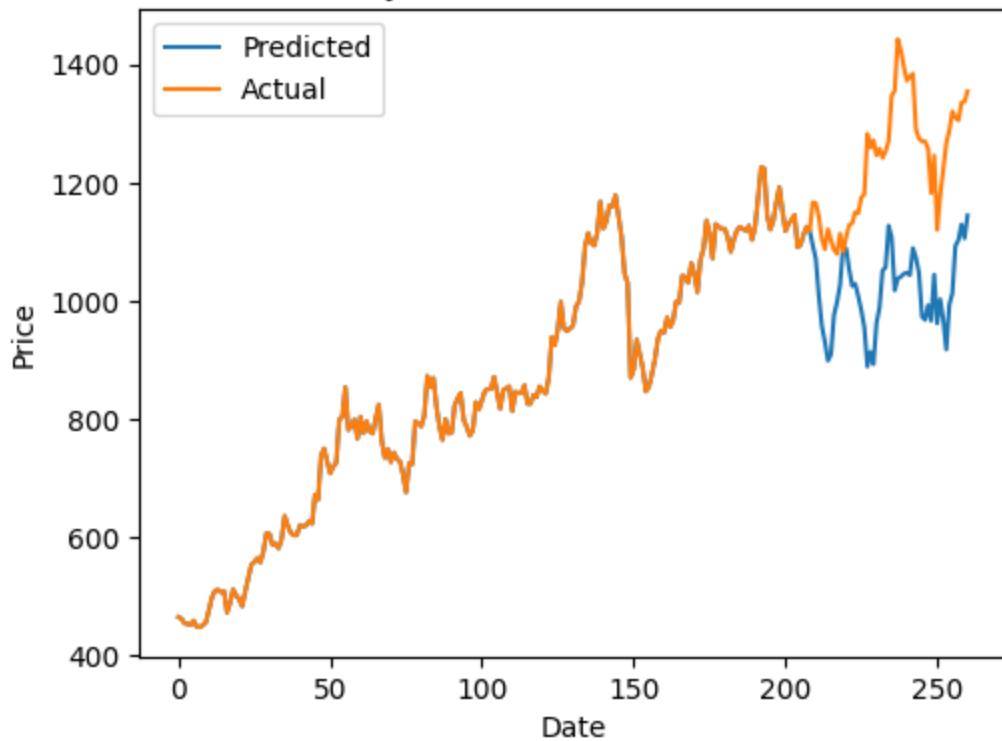
### Monthly Price for NTPC (NSE)



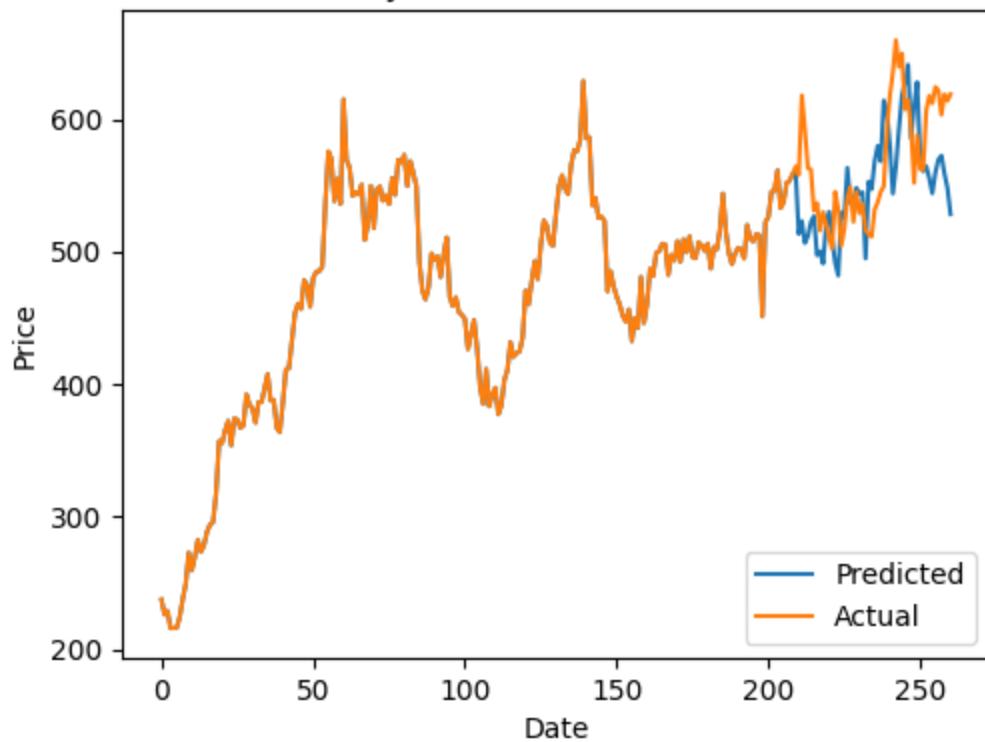
### Monthly Price for WIPRO (NSE)

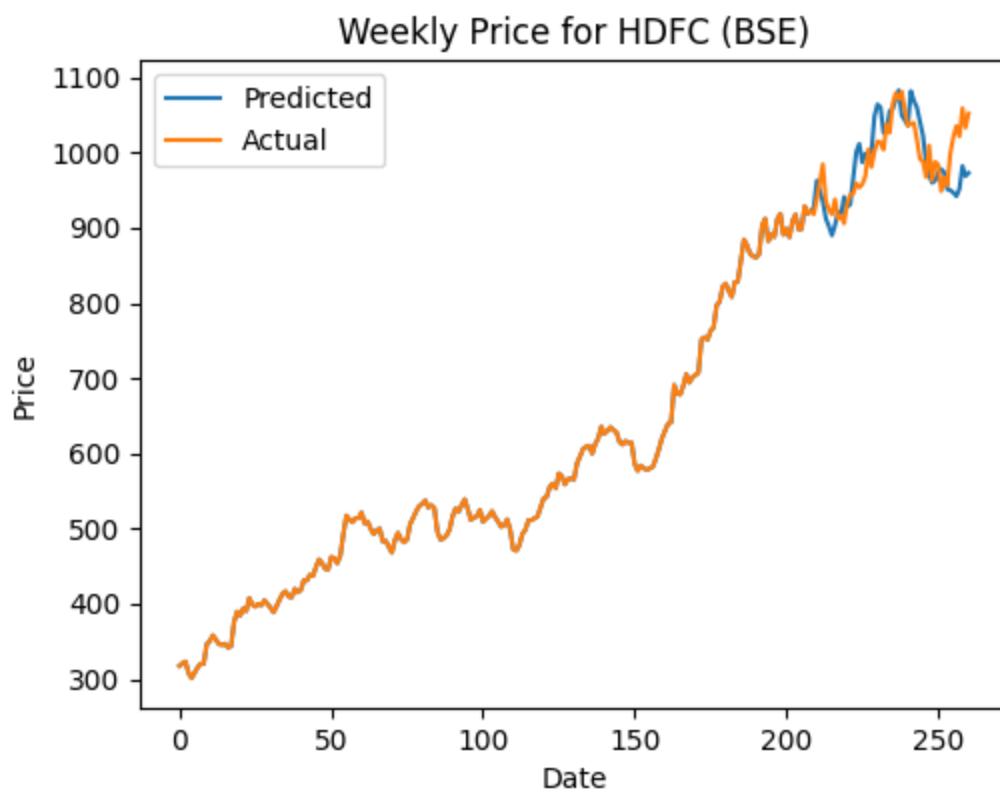
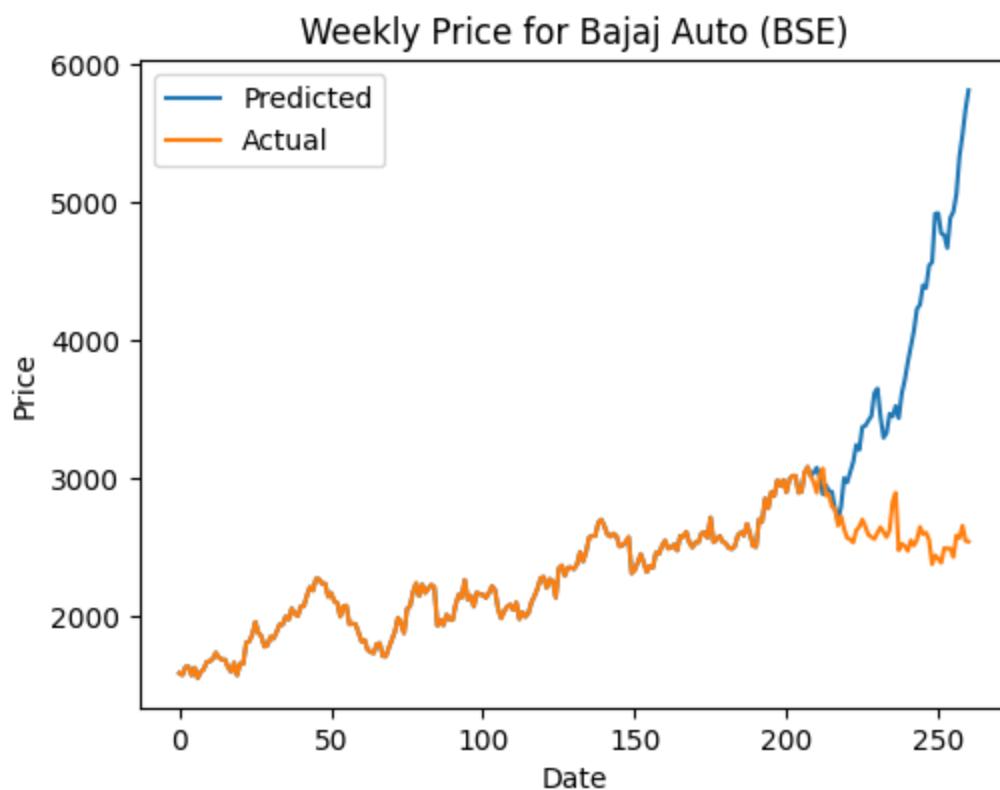


### Weekly Price for Asian Paints (BSE)

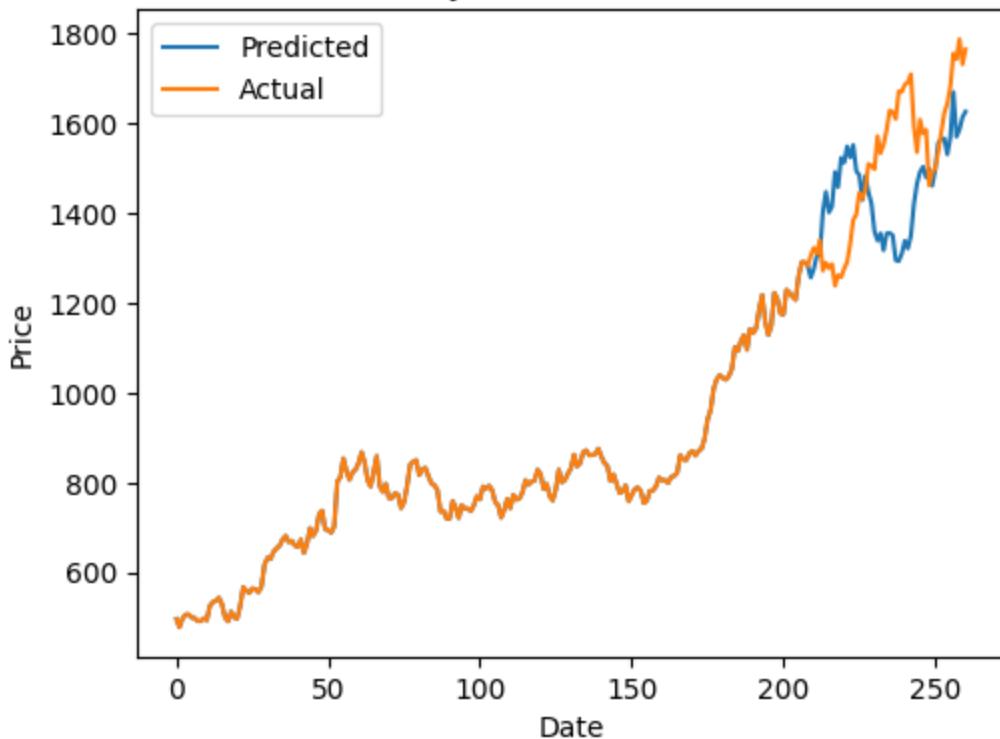


### Weekly Price for Axis Bank (BSE)

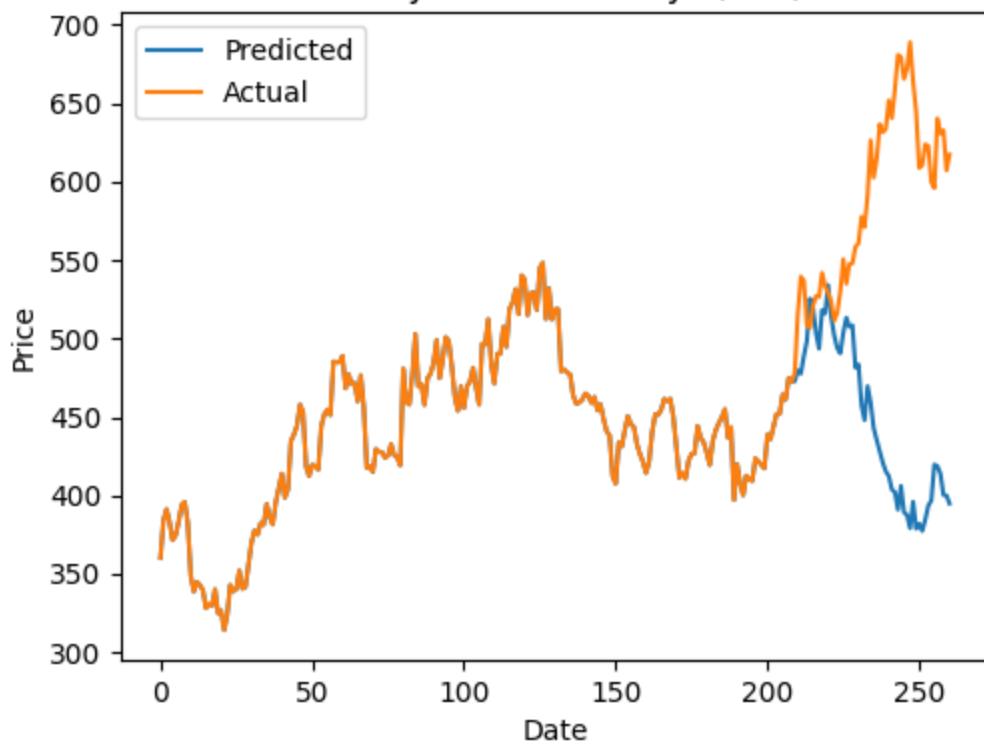




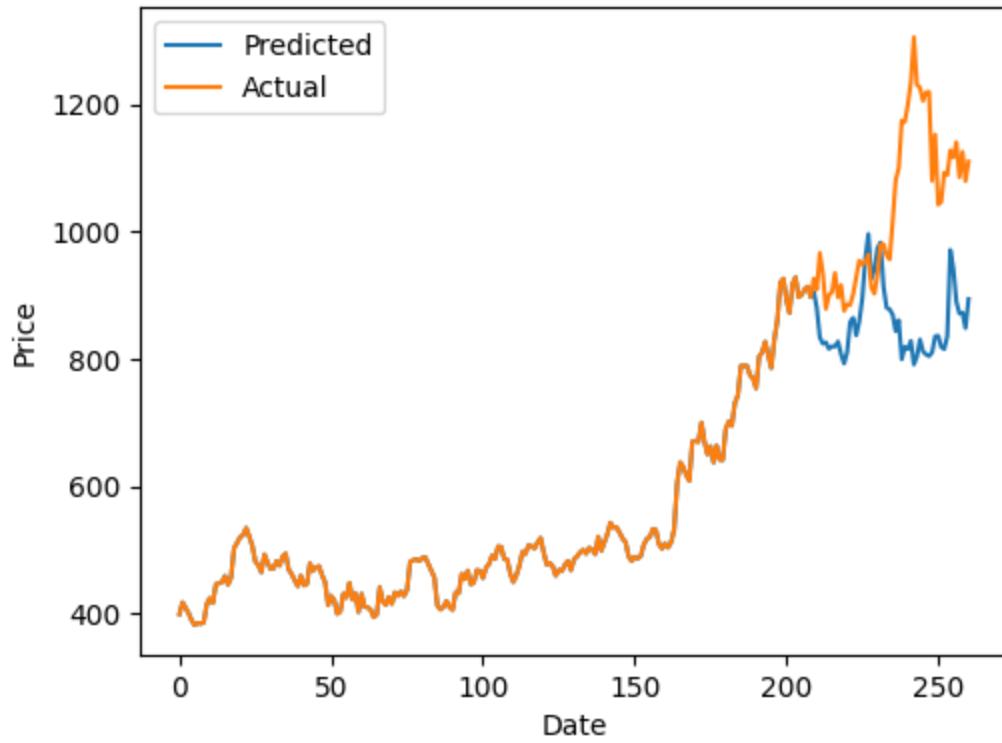
Weekly Price for HUL (BSE)



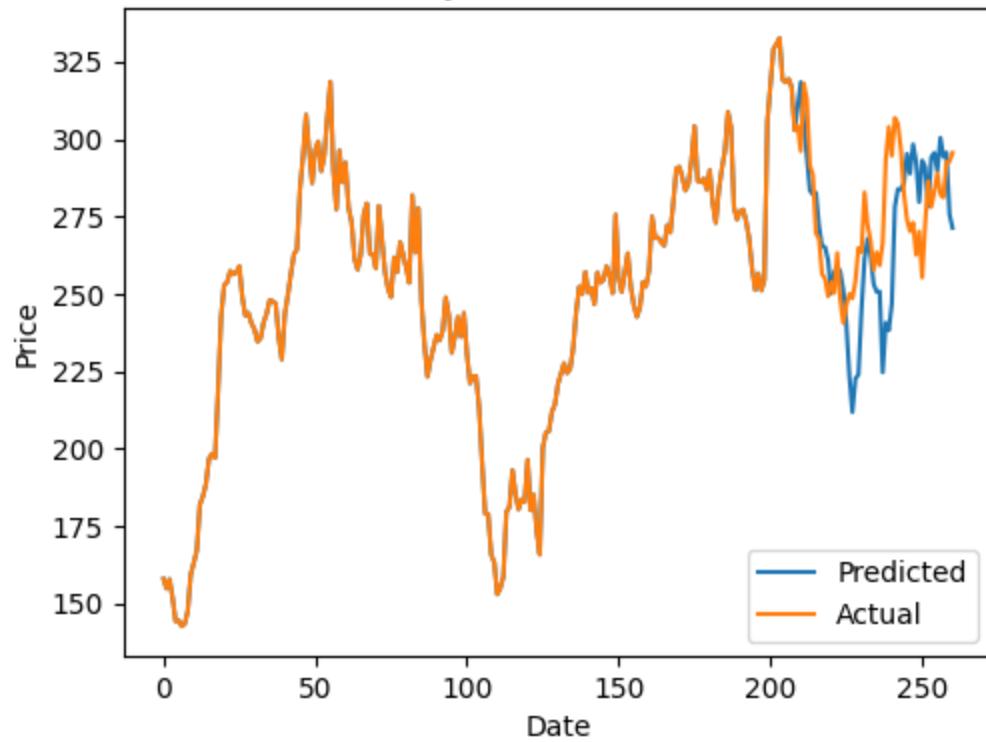
Weekly Price for Infosys (BSE)

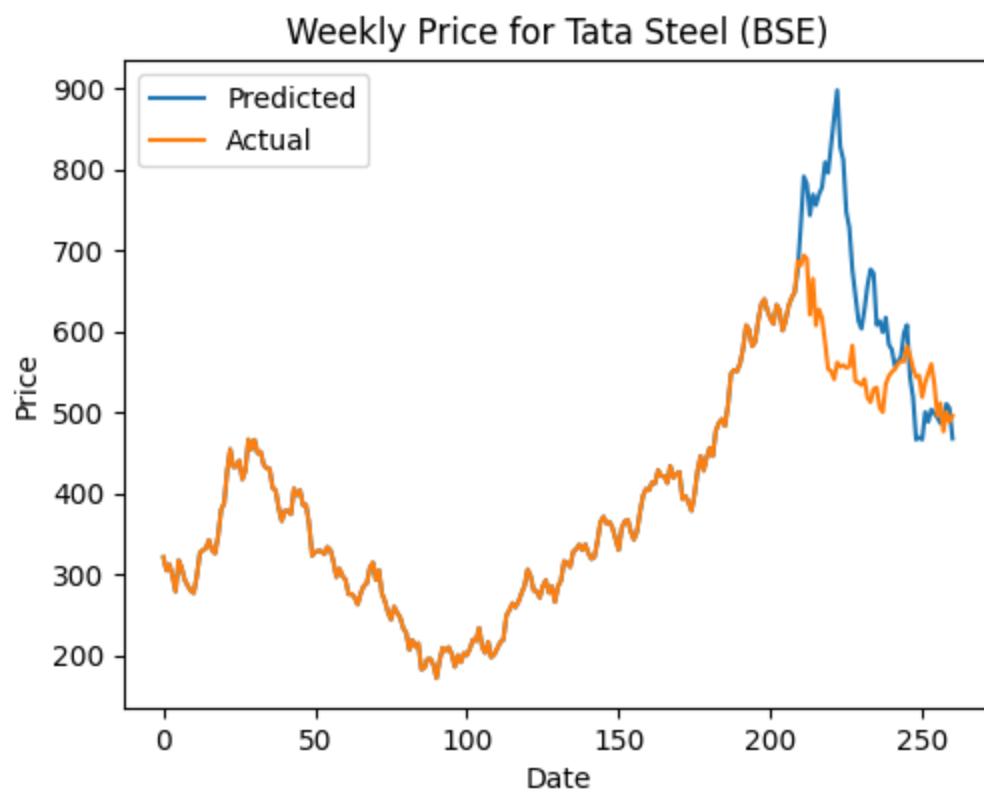
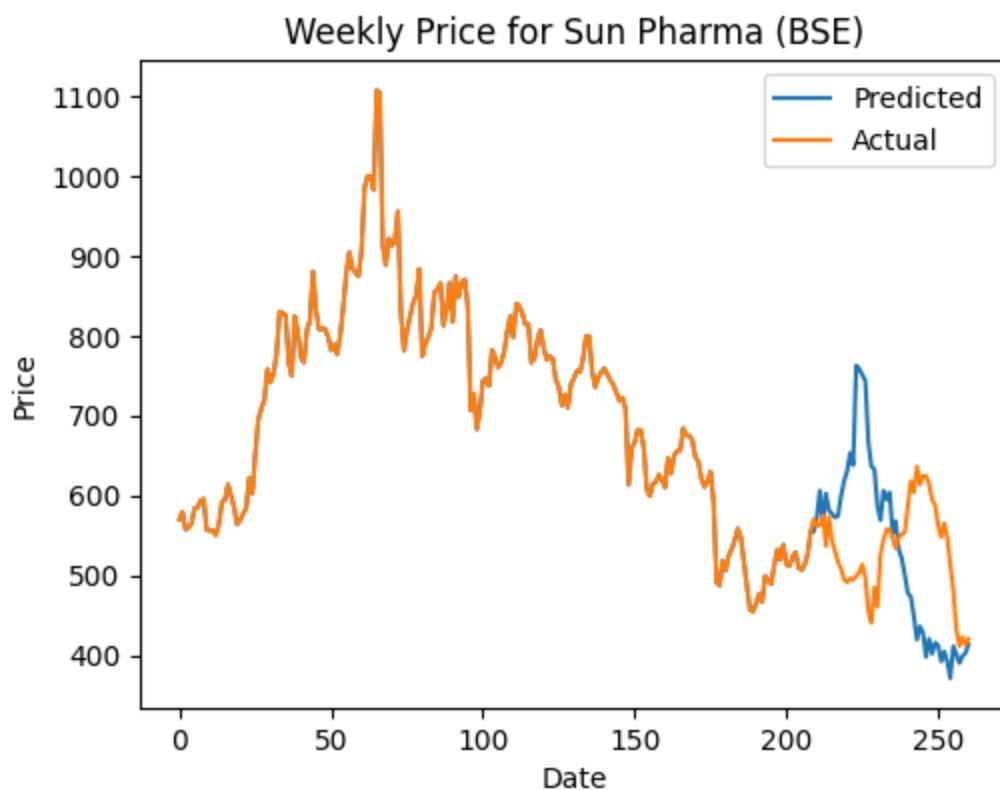


### Weekly Price for Reliance (BSE)

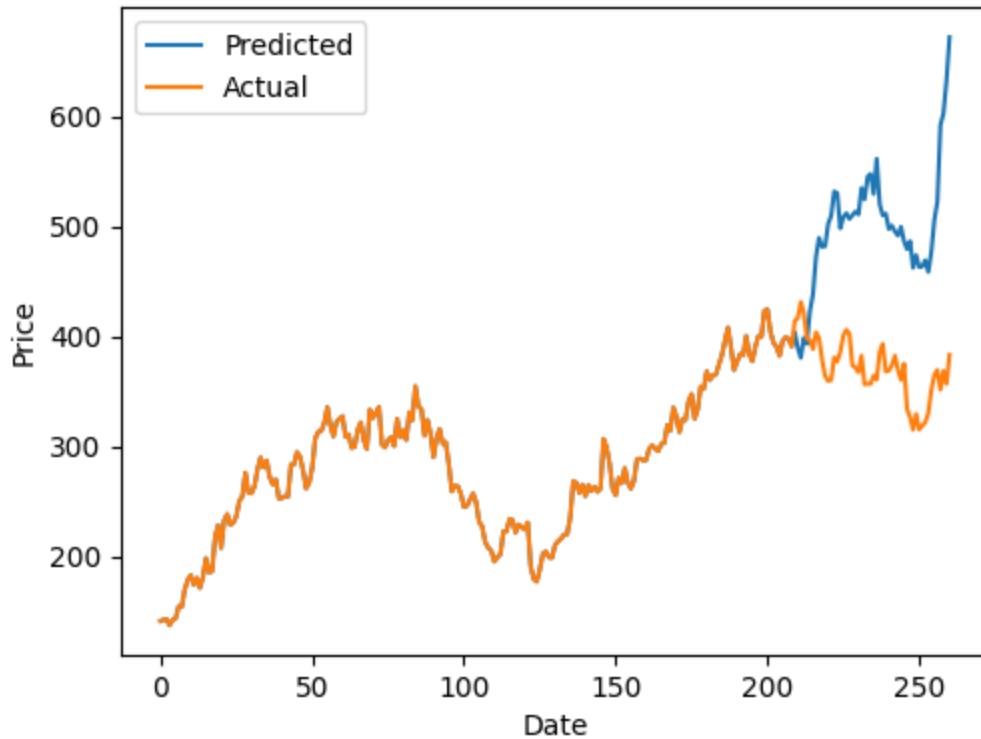


### Weekly Price for SBI (BSE)

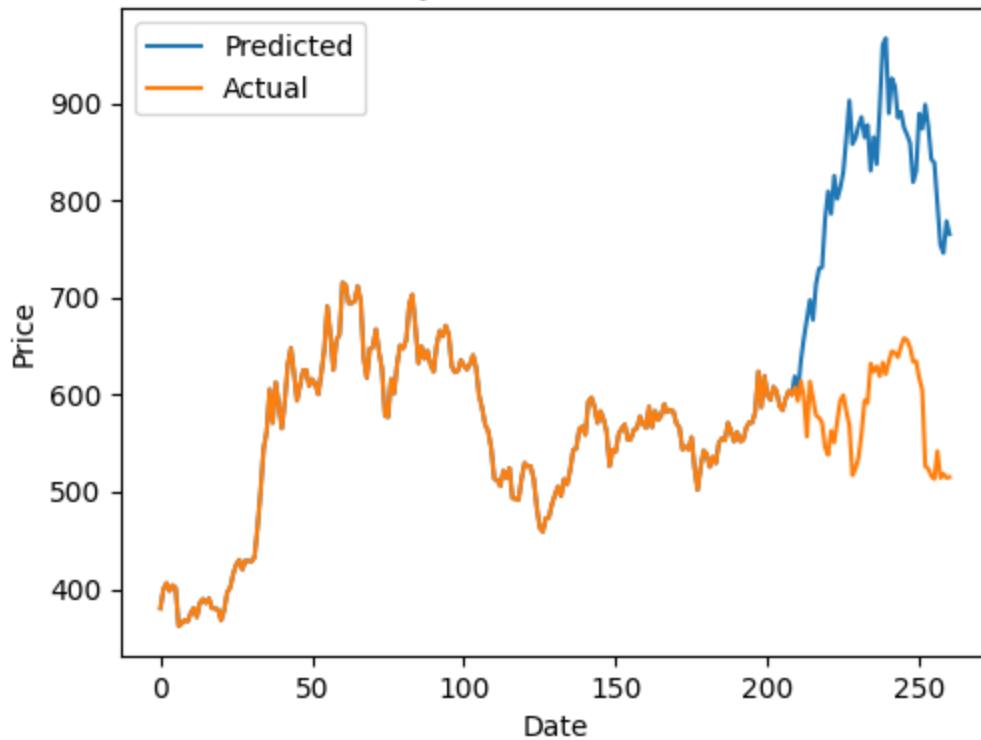


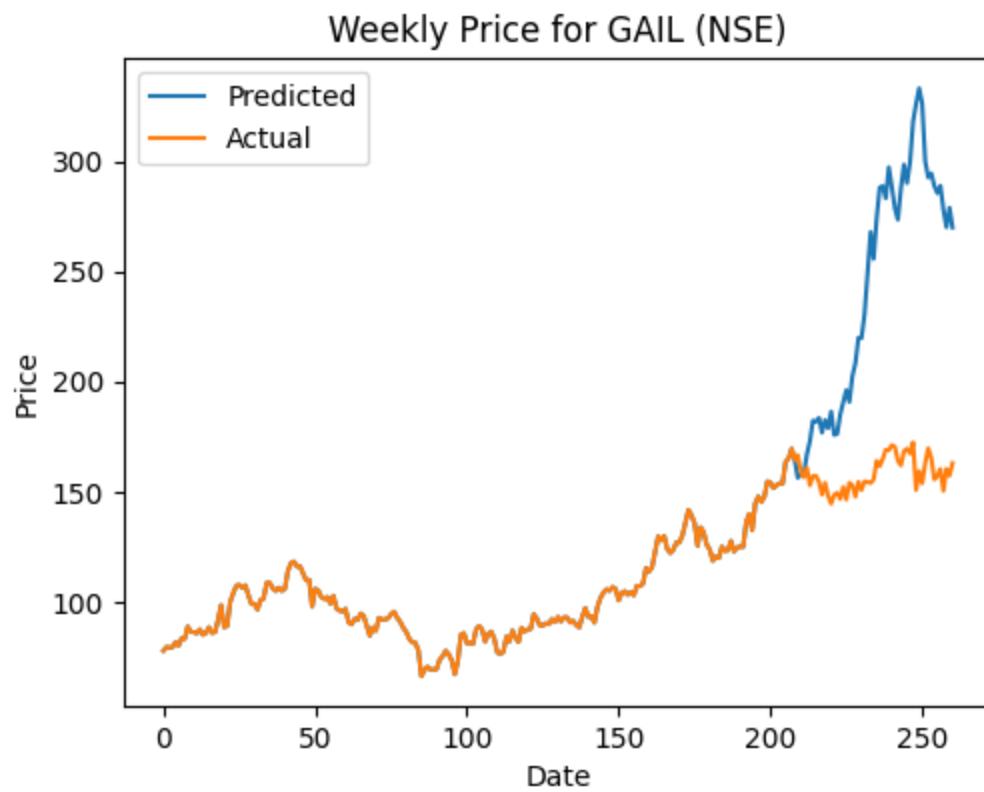
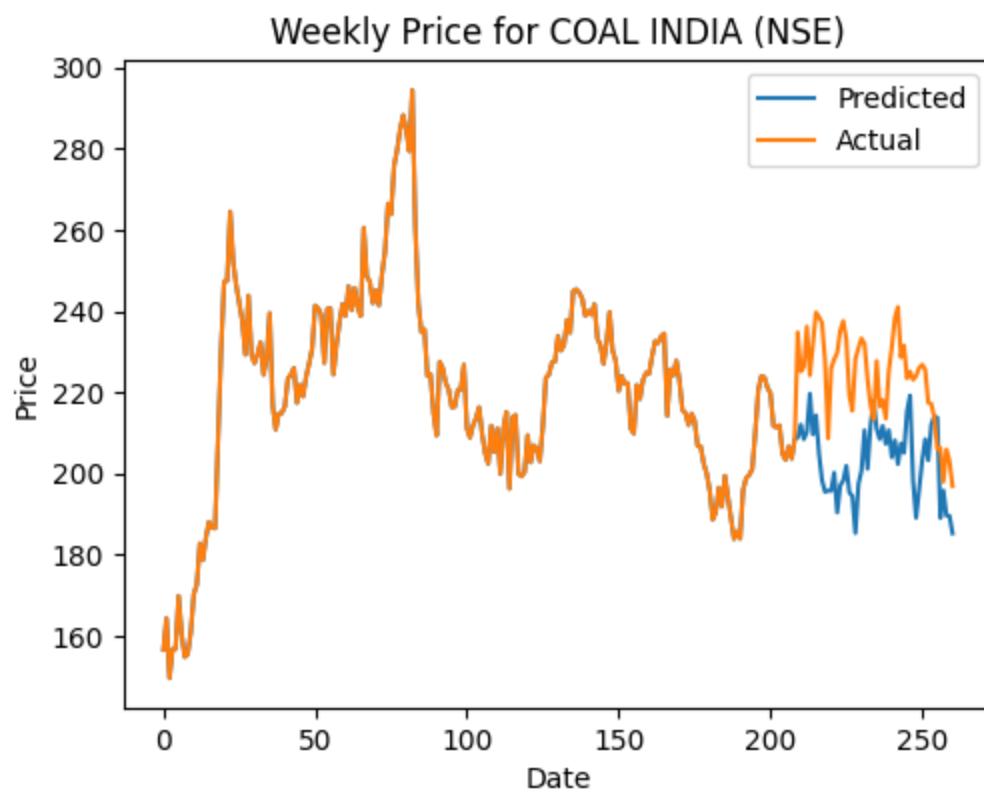


### Weekly Price for ADANIPORTS (NSE)

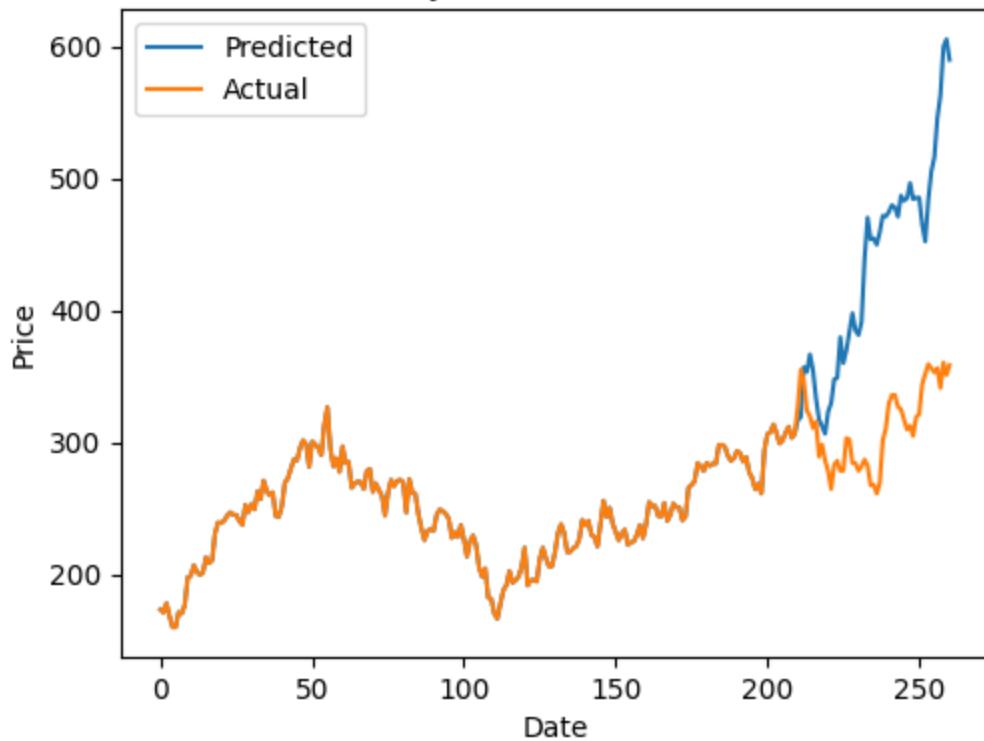


### Weekly Price for CIPLA (NSE)

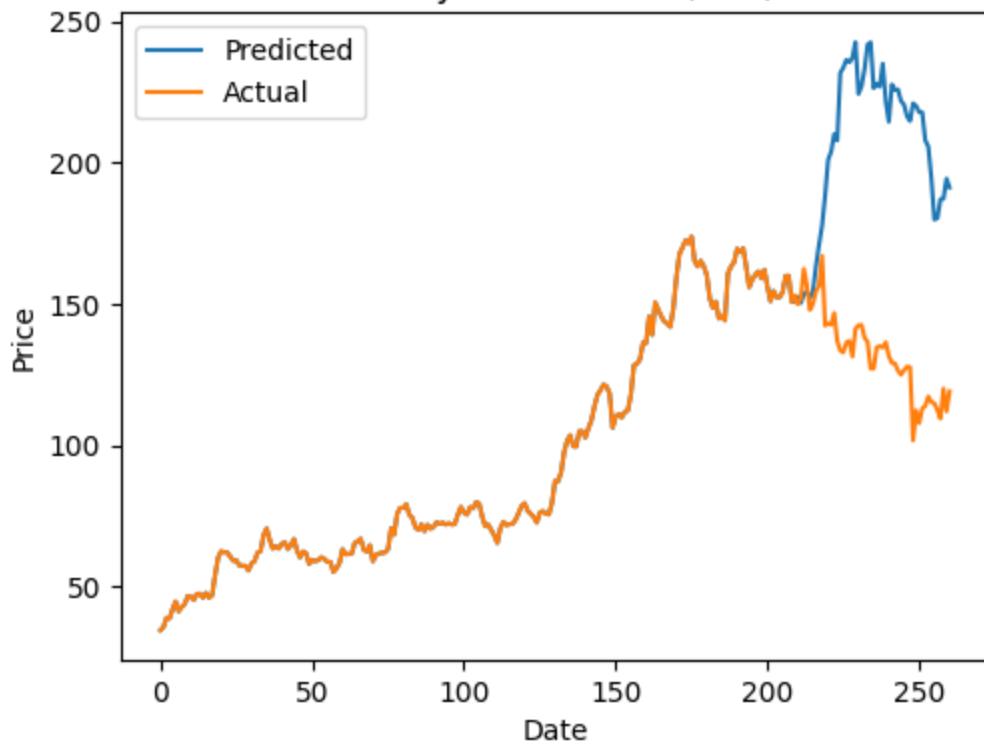


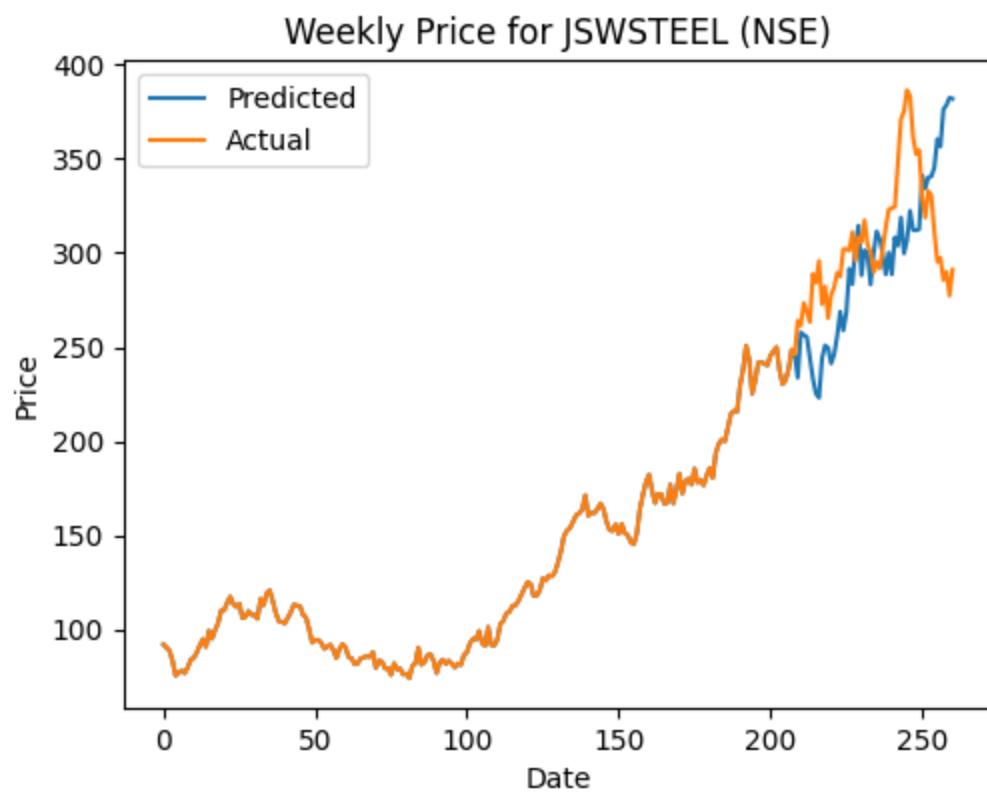
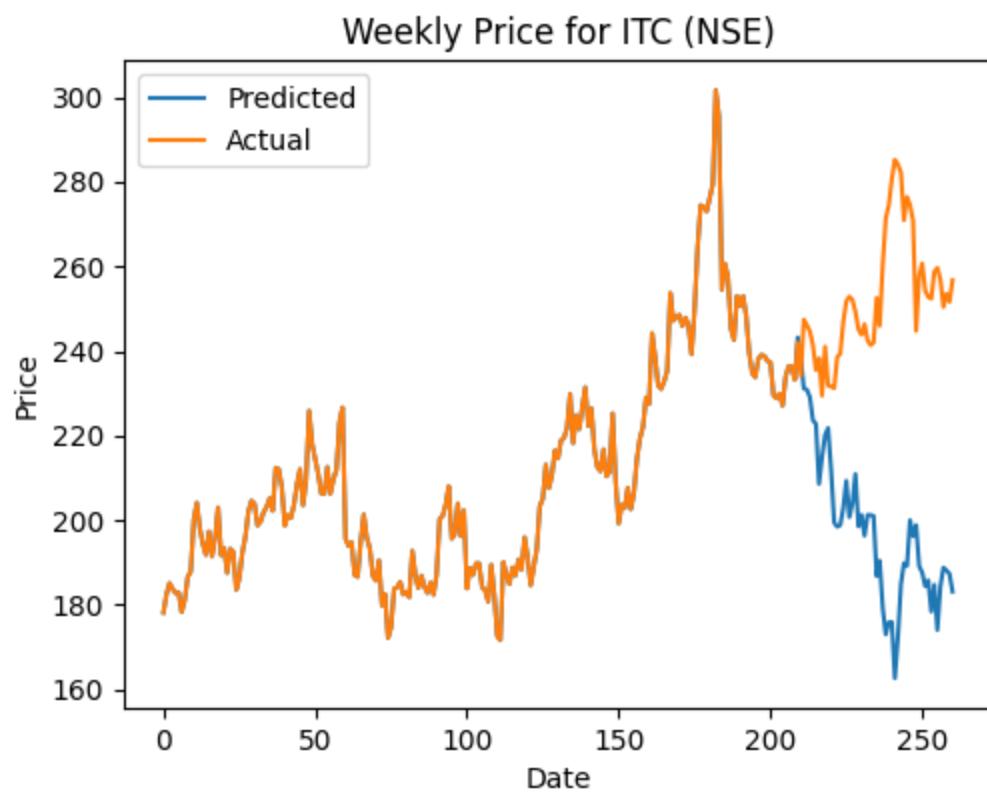


Weekly Price for ICICI (NSE)

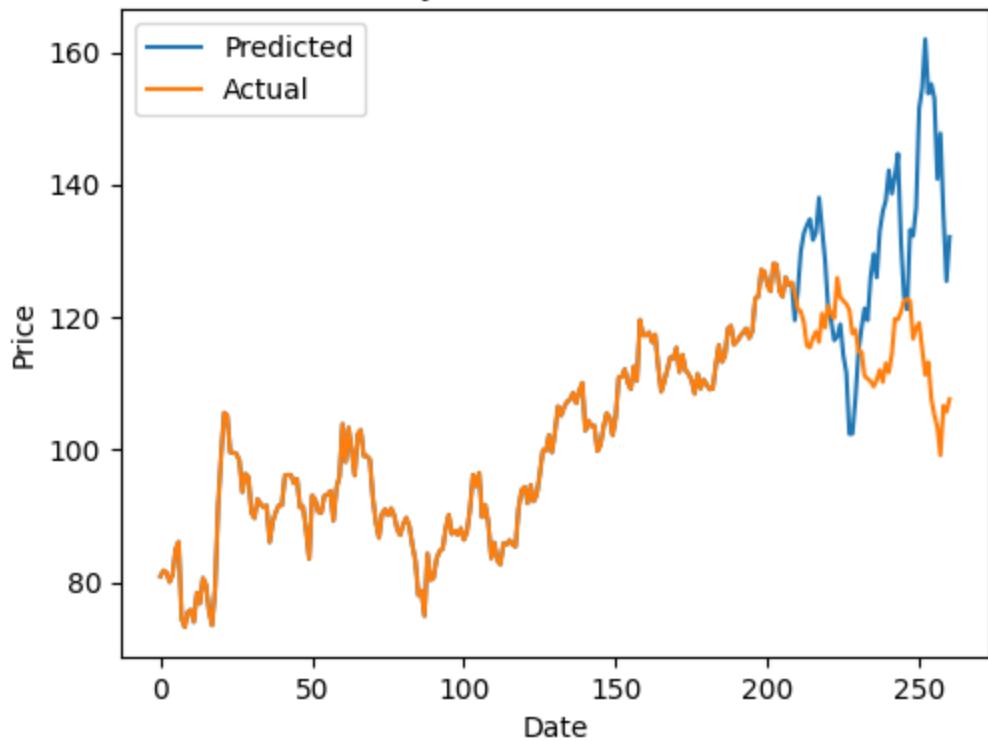


Weekly Price for IOC (NSE)





### Weekly Price for NTPC (NSE)



### Weekly Price for WIPRO (NSE)

