MA 374 Financial Engineering Lab Lab 06

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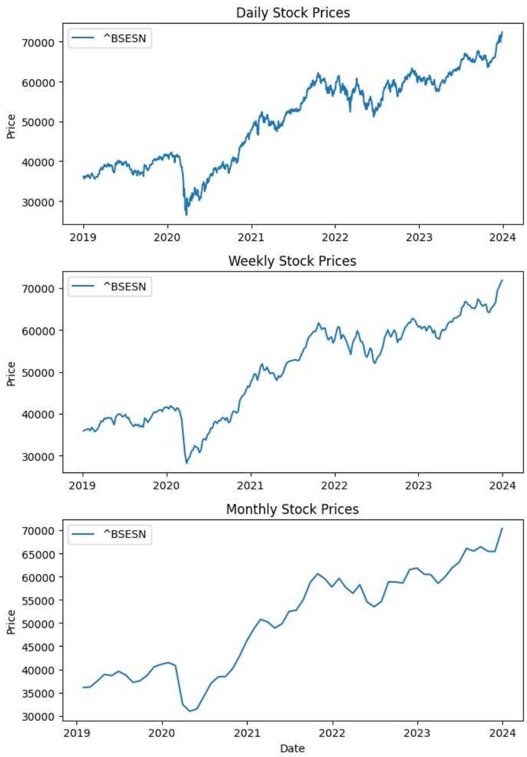
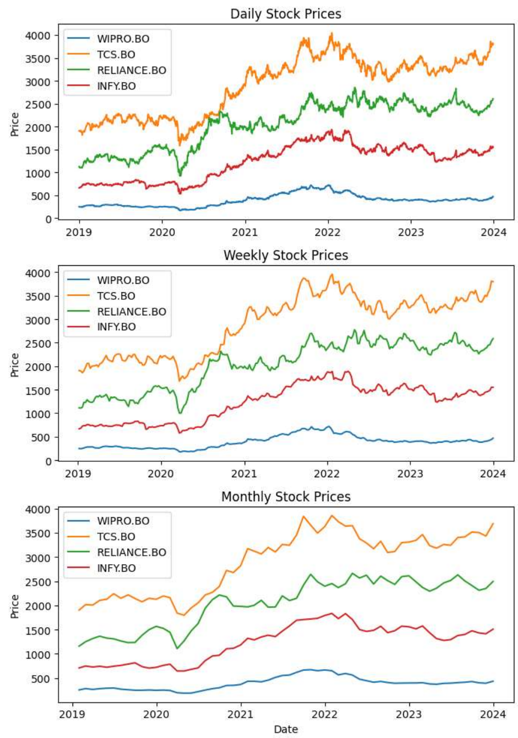
Analysis is done on the following stocks data used for other than market indices:

- BSE - *WIPRO.BO, TCS.BO, RELIANCE.BO, INFY.BO*
- NSE- *TATACHEM.NS, ACC.NS, MGL.NS, GODREJIND.NS*

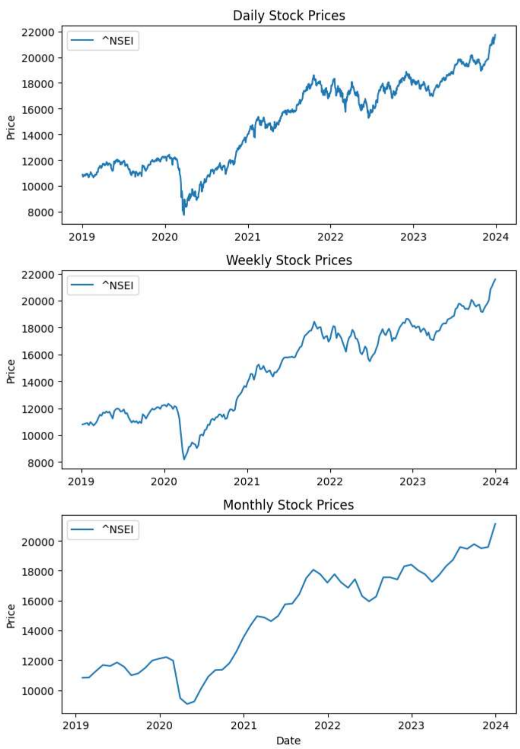
1. Plot the prices against time (daily, weekly and monthly).

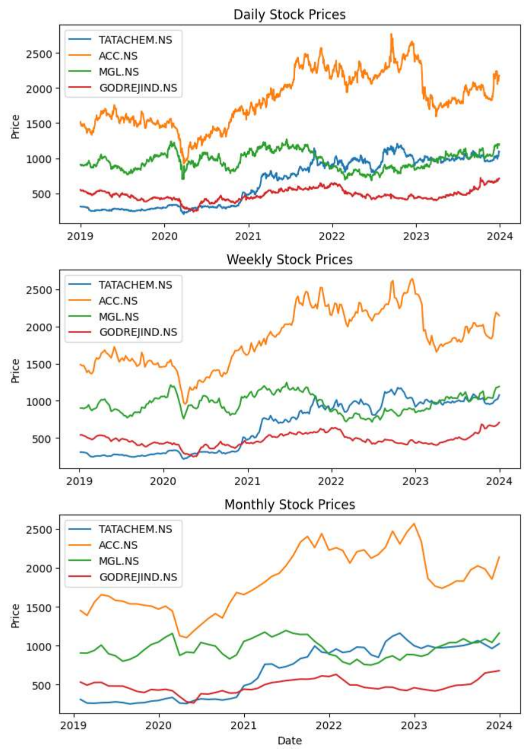
For bsedata1





For nsedata1





2. Compute the returns R_i (daily, weekly and monthly) and plot histograms of normalized returns

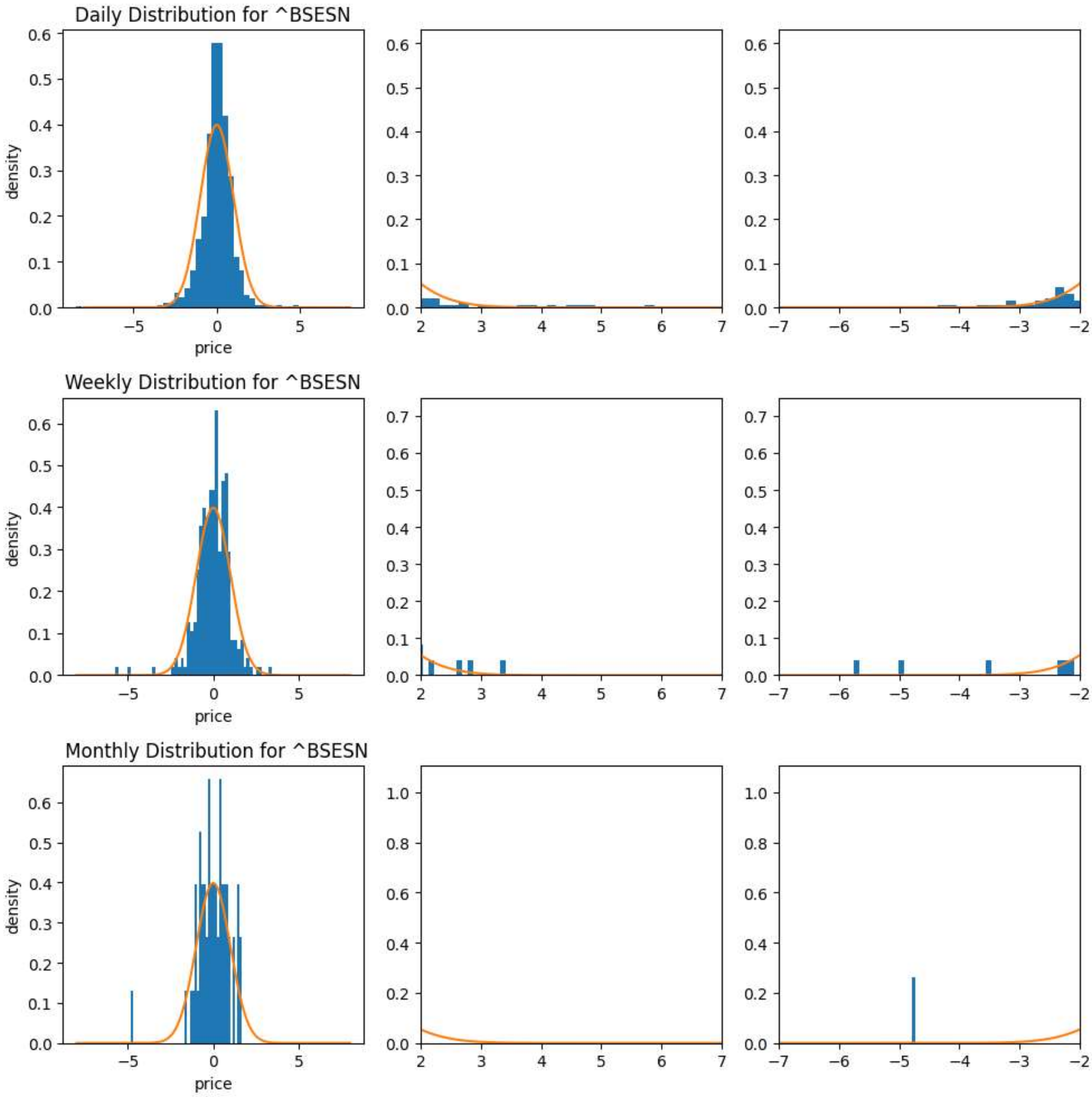
$$\widehat{R}_i = \frac{R_i - \mu}{\sigma},$$

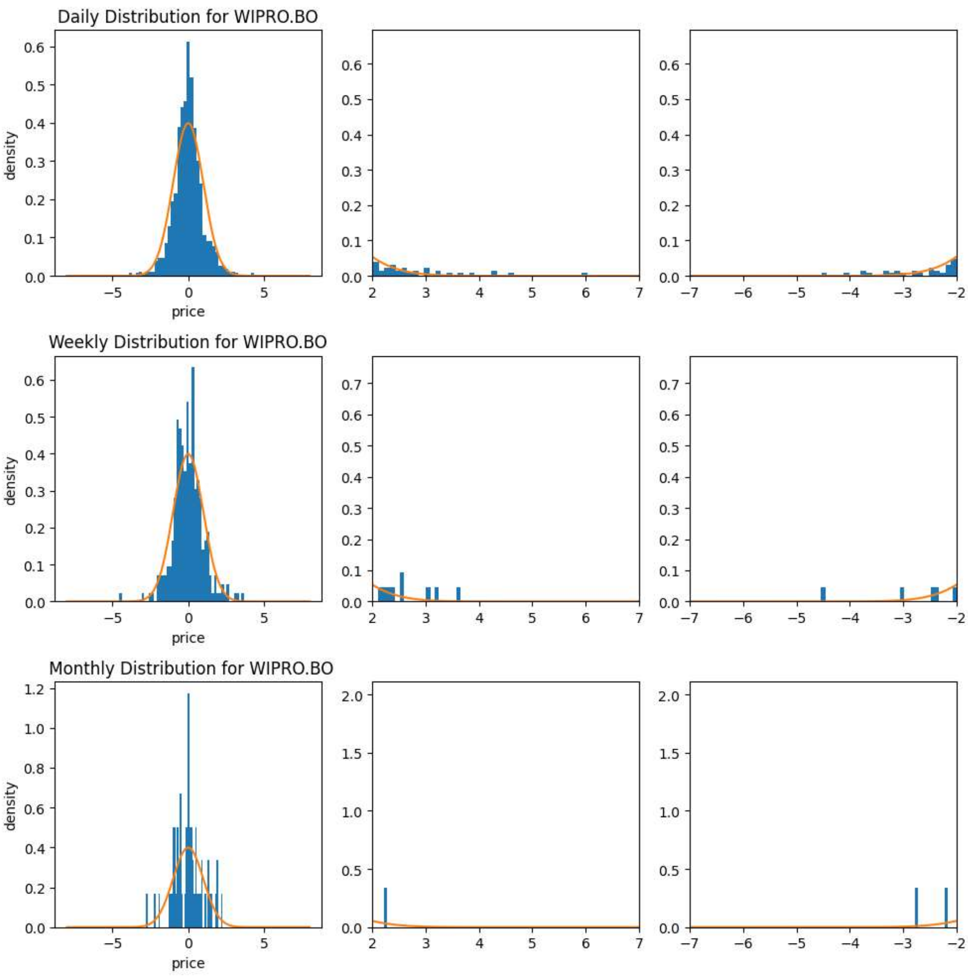
where μ and σ are sample mean and sample standard deviation respectively. Superimpose on each of these histograms a graph of the density function $\mathcal{N}(0, 1)$.

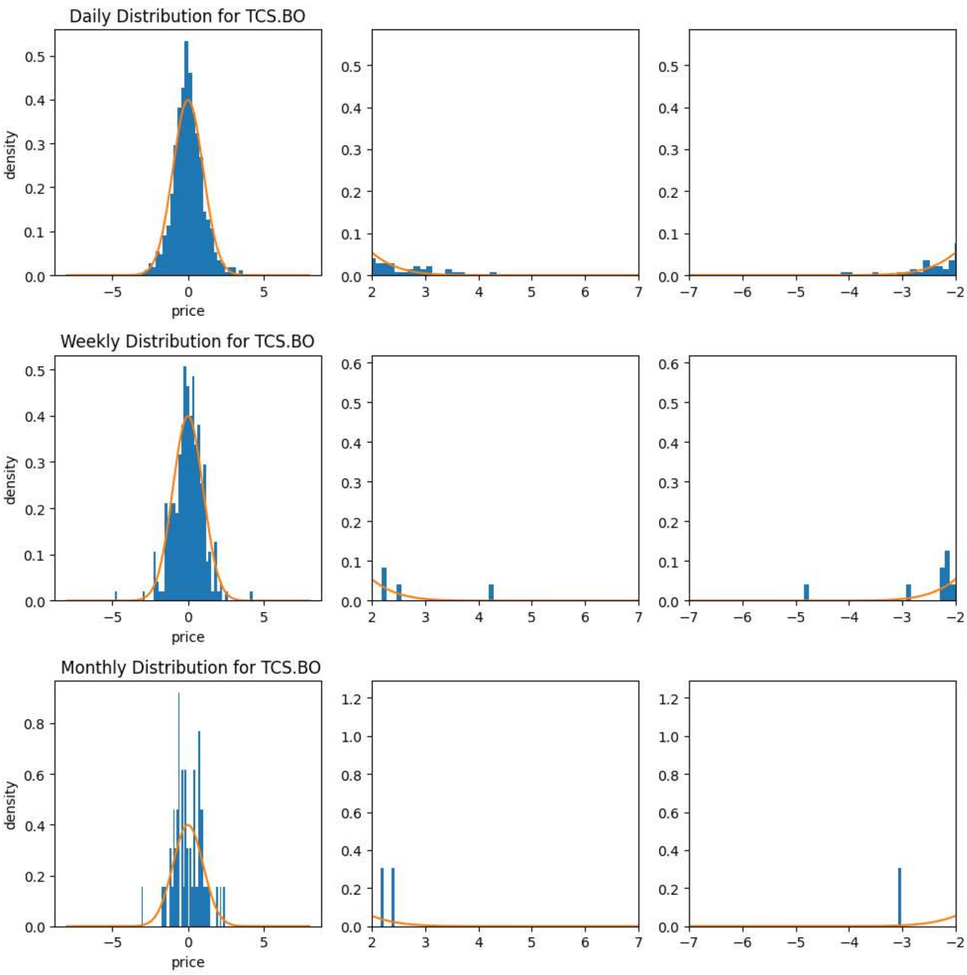
Now, zoom into the tails of all these plots. What are your observations ?

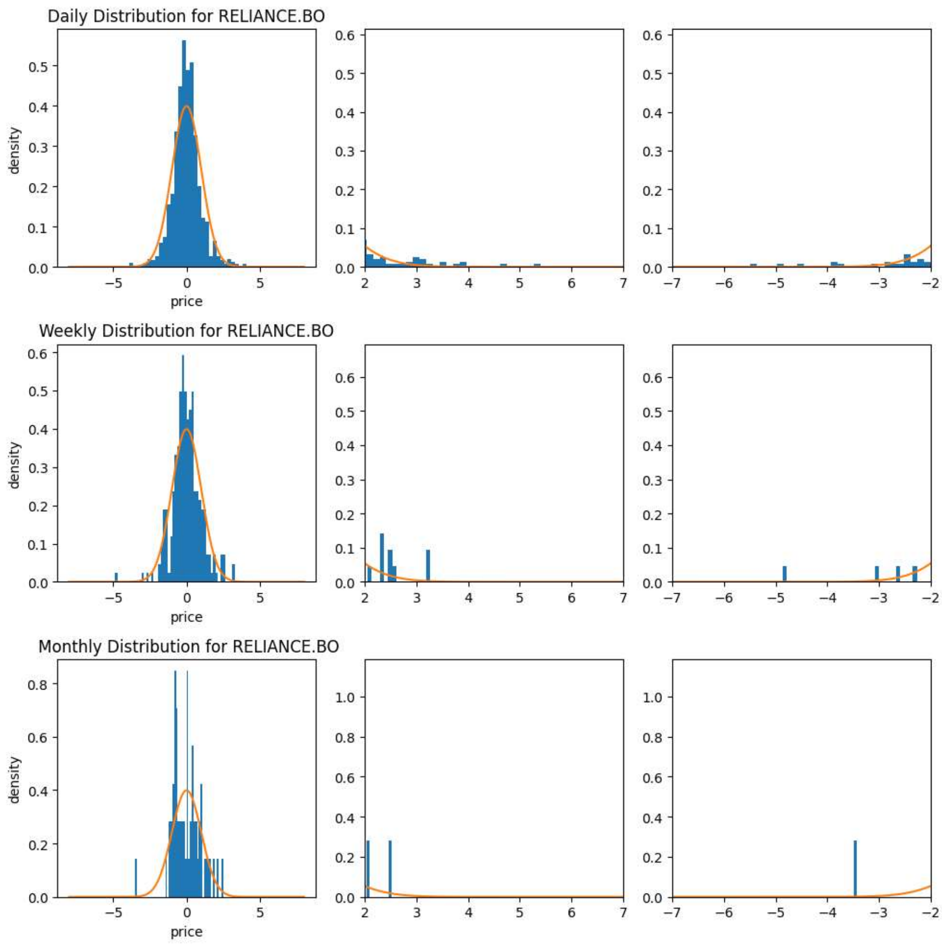
Ans) Histograms and their corresponding zoomed tail

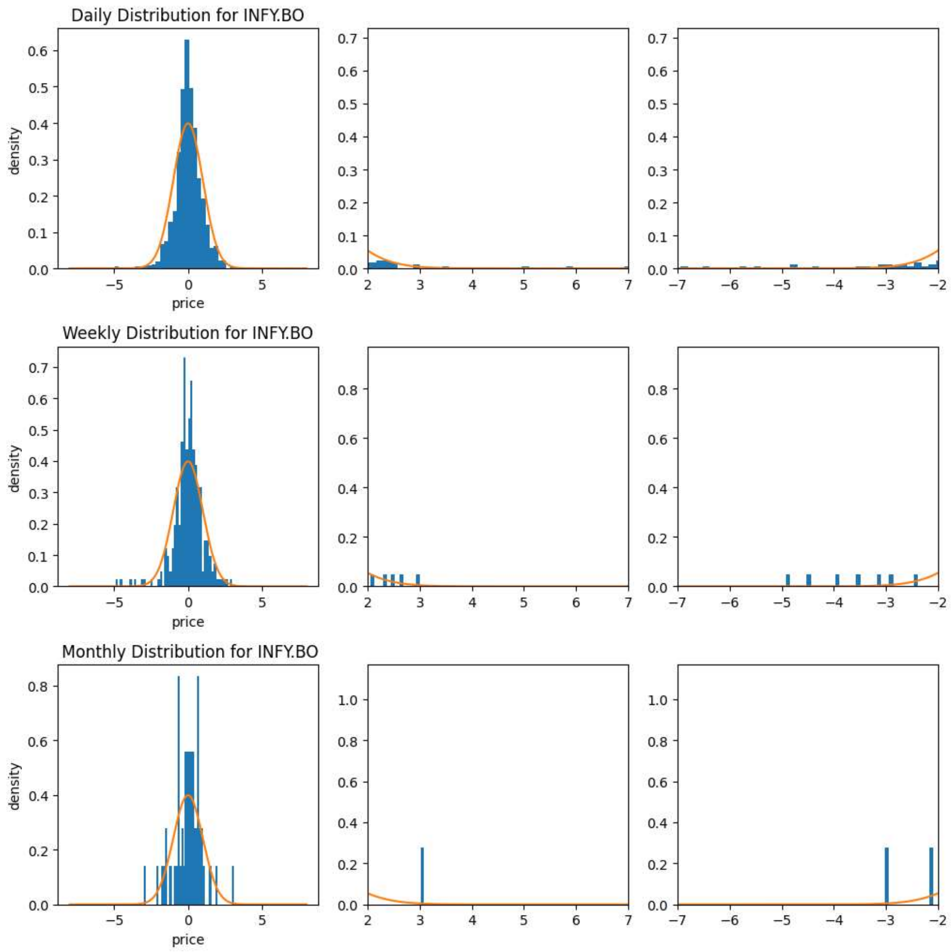
For bsedata1



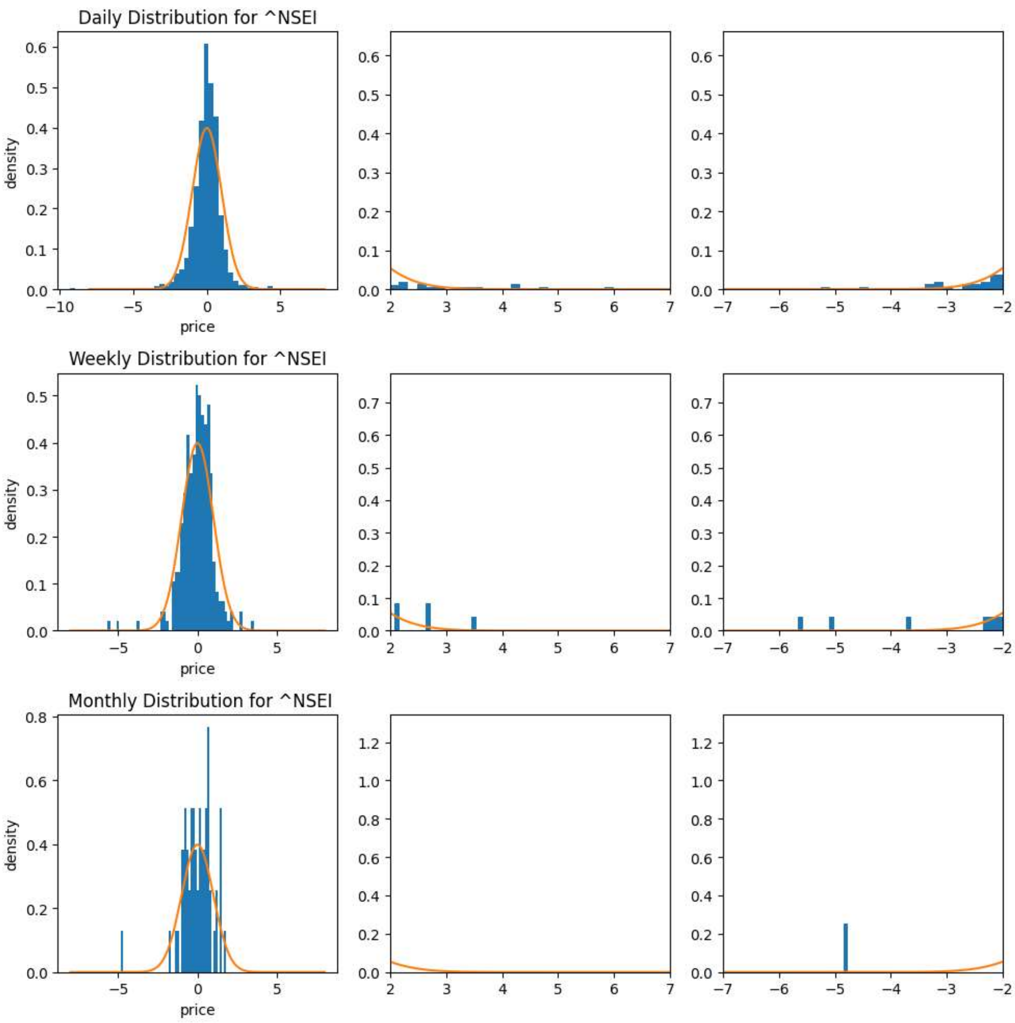

Daily Distribution for WIPRO.BO
Weekly Distribution for WIPRO.BO
Monthly Distribution for WIPRO.BO
density
price

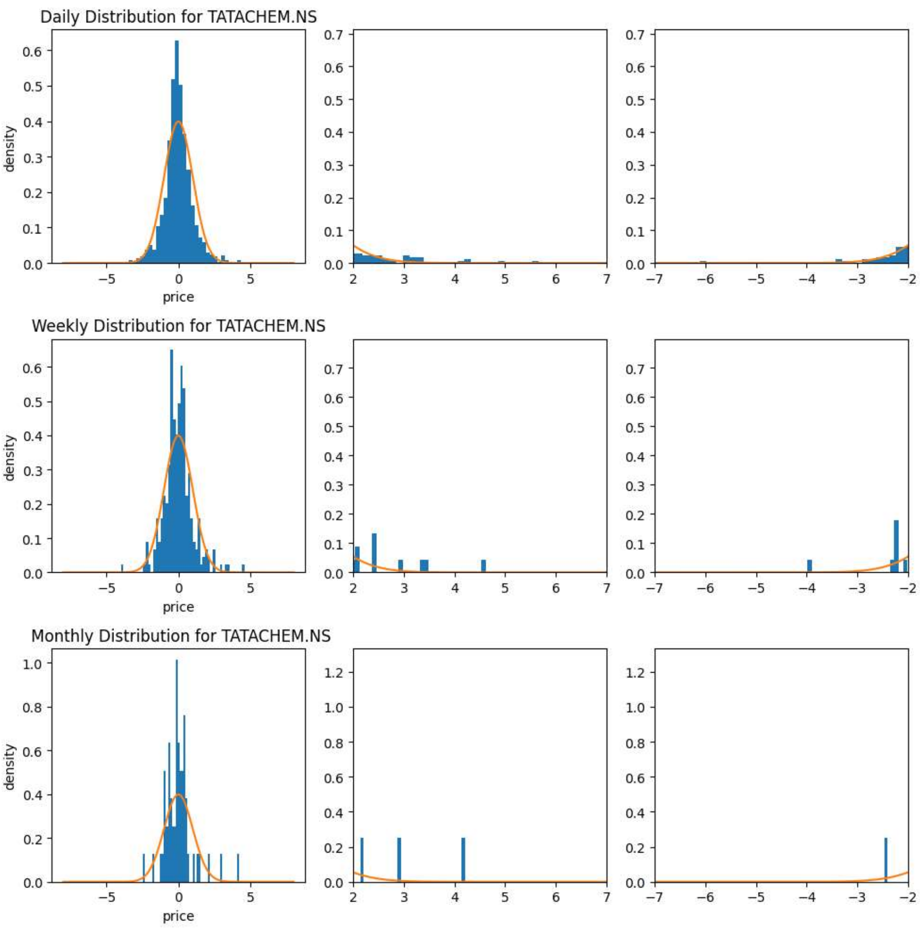

Daily Distribution for TCS.BO
Weekly Distribution for TCS.BO
Monthly Distribution for TCS.BO
density
price

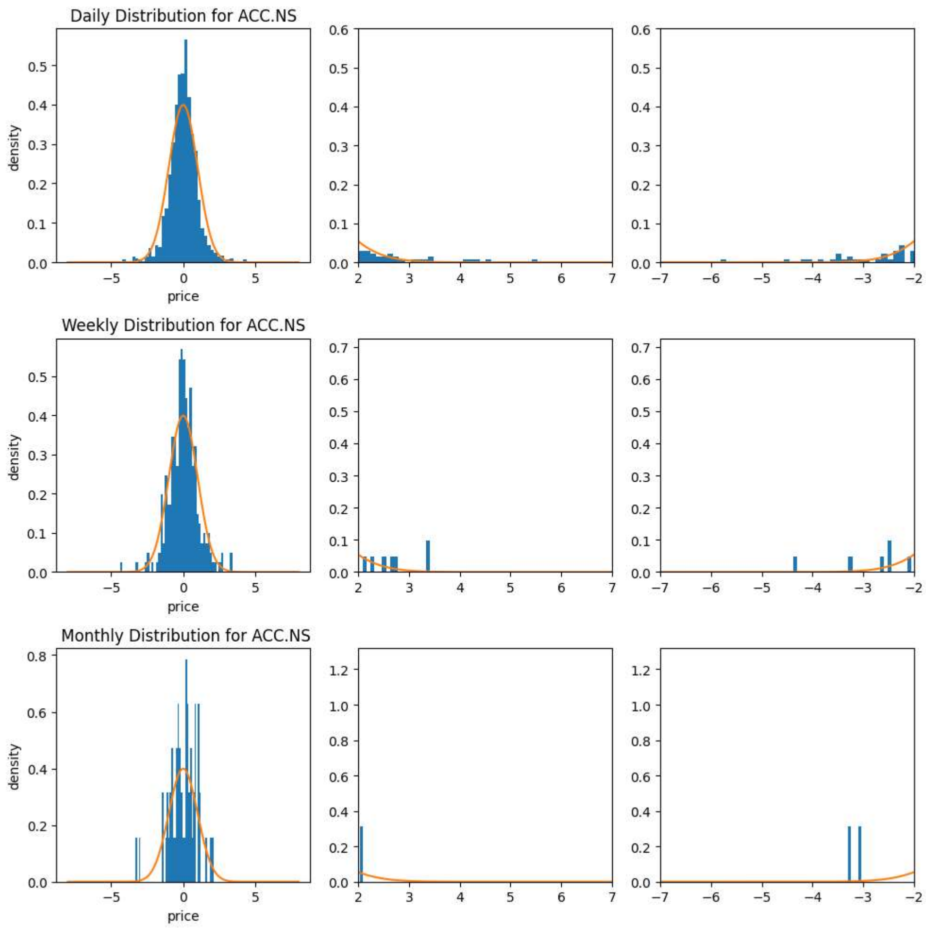


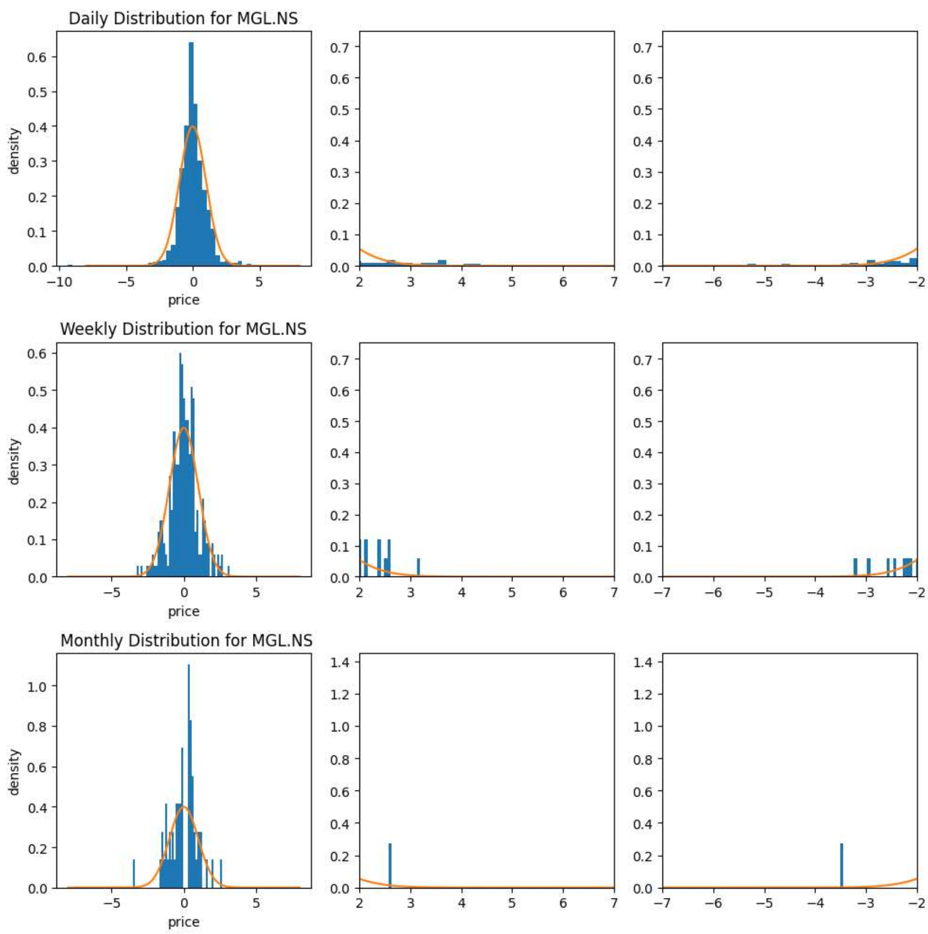


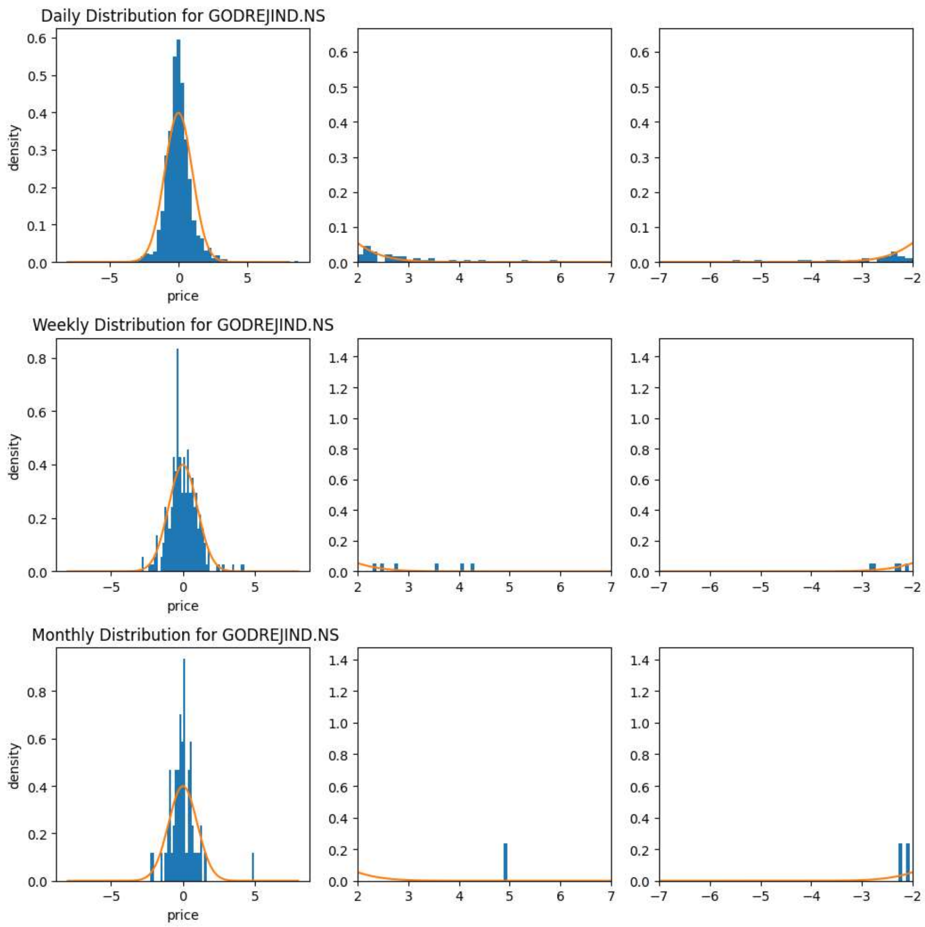
For nsedata1


Daily Distribution for ^NSEI
Weekly Distribution for ^NSEI
Monthly Distribution for ^NSEI
density
price


Daily Distribution for TATACHEM.NS
Weekly Distribution for TATACHEM.NS
Monthly Distribution for TATACHEM.NS
density
price


Daily Distribution for ACC.NS
Weekly Distribution for ACC.NS
Monthly Distribution for ACC.NS
density
price


Daily Distribution for MGL.NS
Weekly Distribution for MGL.NS
Monthly Distribution for MGL.NS
density
price



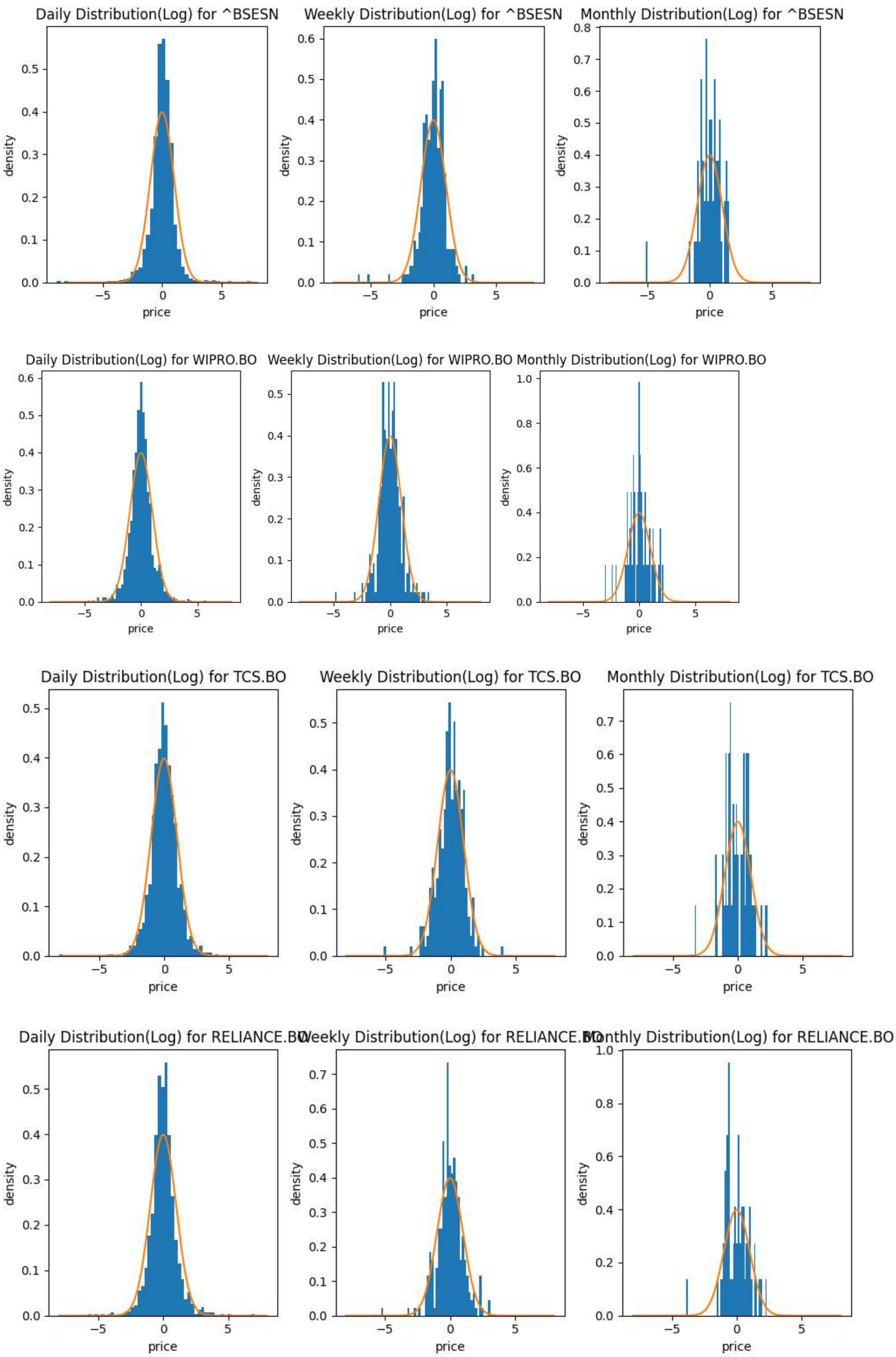
Observations –

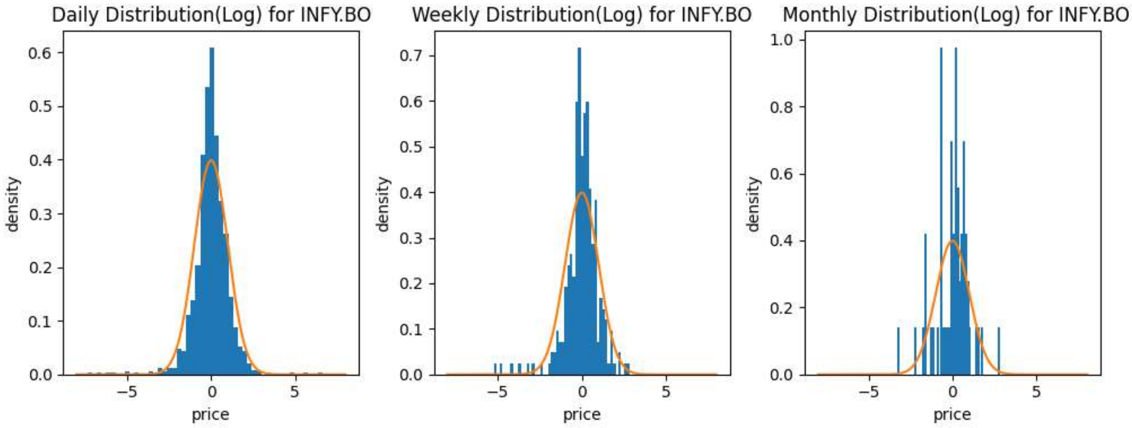
1. We can observe that the N(0, 1) roughly estimates the normalized returns, which is more accurate if the returns are computed on daily basis instead of weekly or monthly.
2. The deviations are due to the random fluctuations in the real world market, so, naïve Gaussian distribution can't completely model it.
3. It is more evident when a closer look is taken at the tails of these plots. The curve for N(0, 1) steeply decreases to 0, but the returns on the prices does not. At the tails, there seem to be more deviations, and more proper model using a mix of different distributions is required to capture those changes.
4. Such a behaviour is called as leptokurtic, i.e., high peaks and heavy tails. Jump diffusion model (by Merton) take these so called jumps at the tails into account.

3. Will the observations be different if you instead use the log returns ?

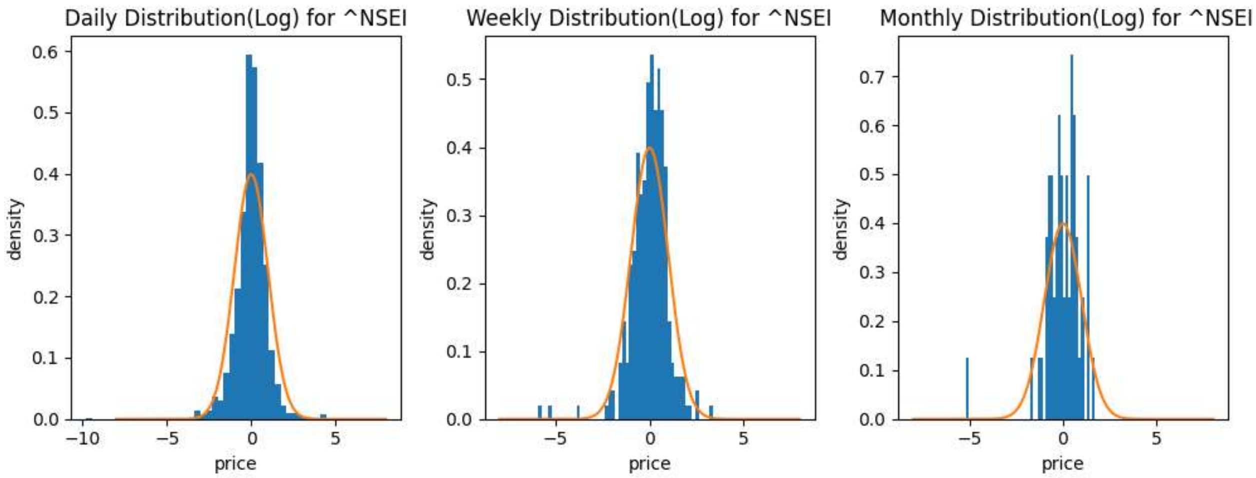
Ans) Plots but using log returns:

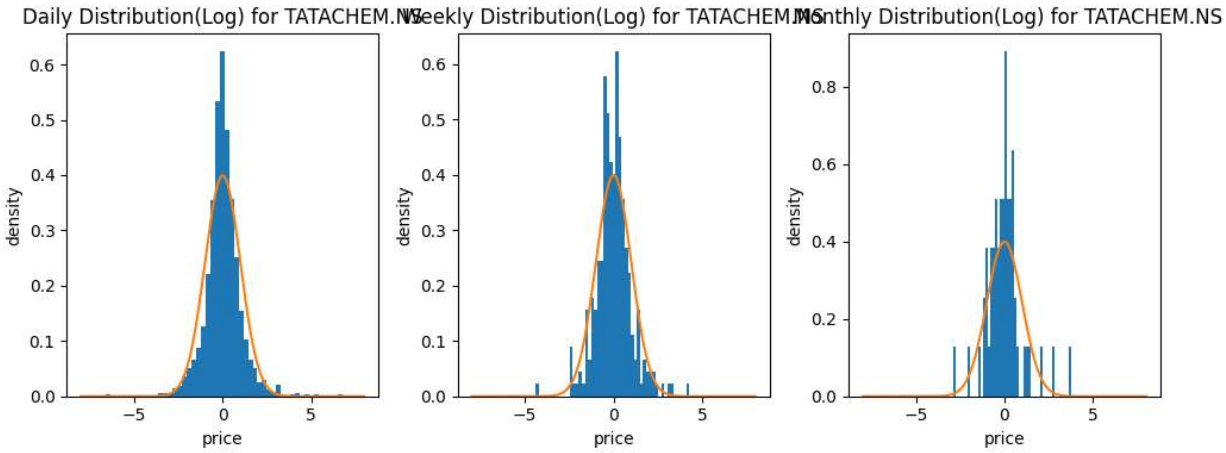
For bsedata1

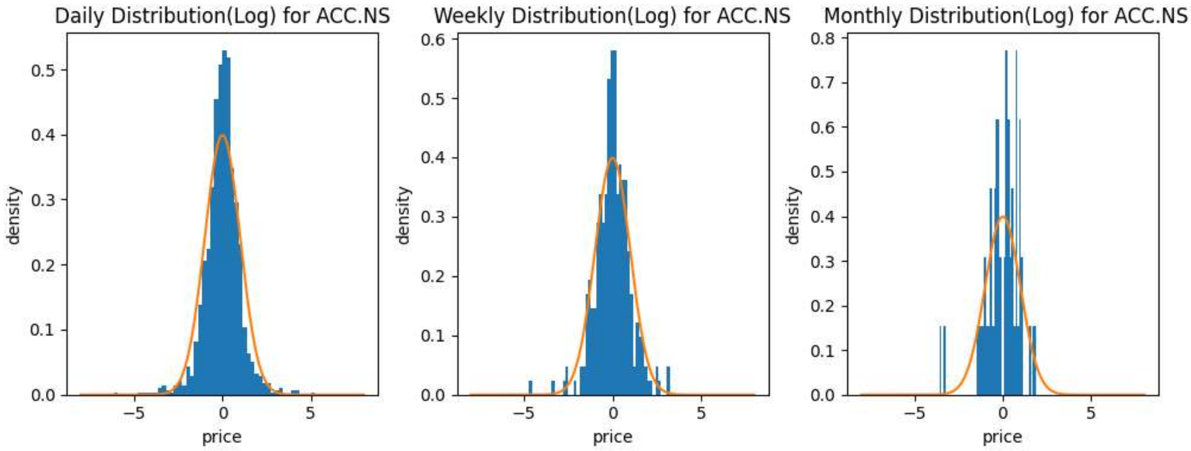

Daily Distribution(Log) for ^BSESN
Weekly Distribution(Log) for ^BSESN
Monthly Distribution(Log) for ^BSESN
Daily Distribution(Log) for WIPRO.BO
Weekly Distribution(Log) for WIPRO.BO
Monthly Distribution(Log) for WIPRO.BO
Daily Distribution(Log) for TCS.BO
Weekly Distribution(Log) for TCS.BO
Monthly Distribution(Log) for TCS.BO
Daily Distribution(Log) for RELIANCE.BO
Weekly Distribution(Log) for RELIANCE.BO
Monthly Distribution(Log) for RELIANCE.BO
density
price

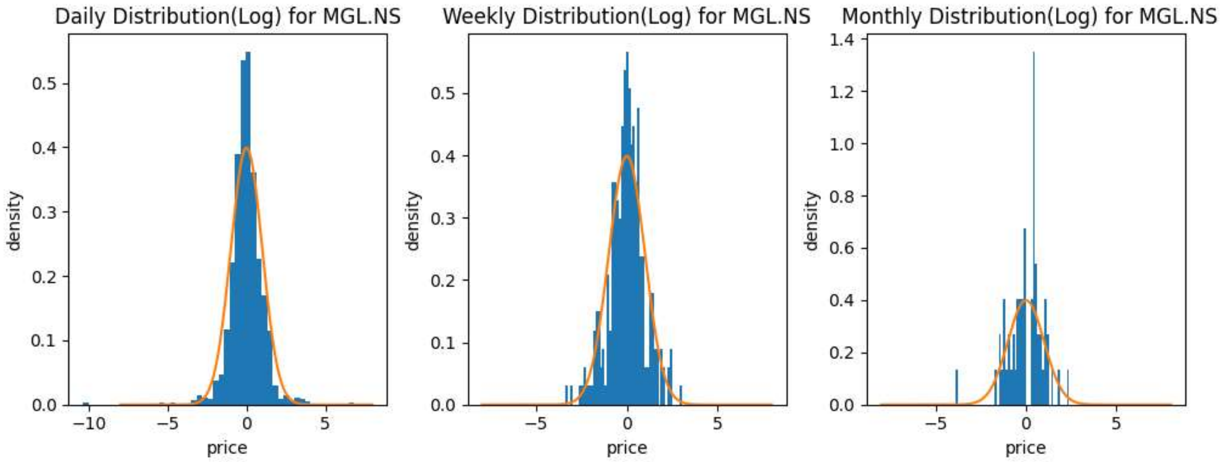


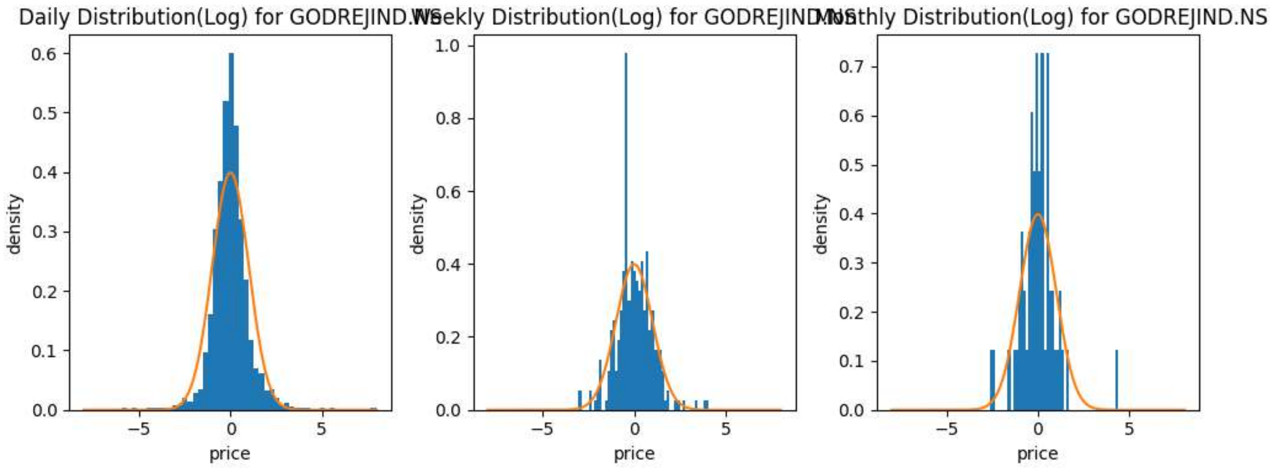
For nsedata1











4. Now, consider the daily data only for the period January 1, 2019 to December 31, 2022 and estimate the μ and σ using log returns. Using the μ and σ, generate a path of stock prices that resembles (as closely as possible) the actual path of the stock for the period of January 1, 2023 to December 31, 2023.

5. Repeat the above with weekly and monthly data.

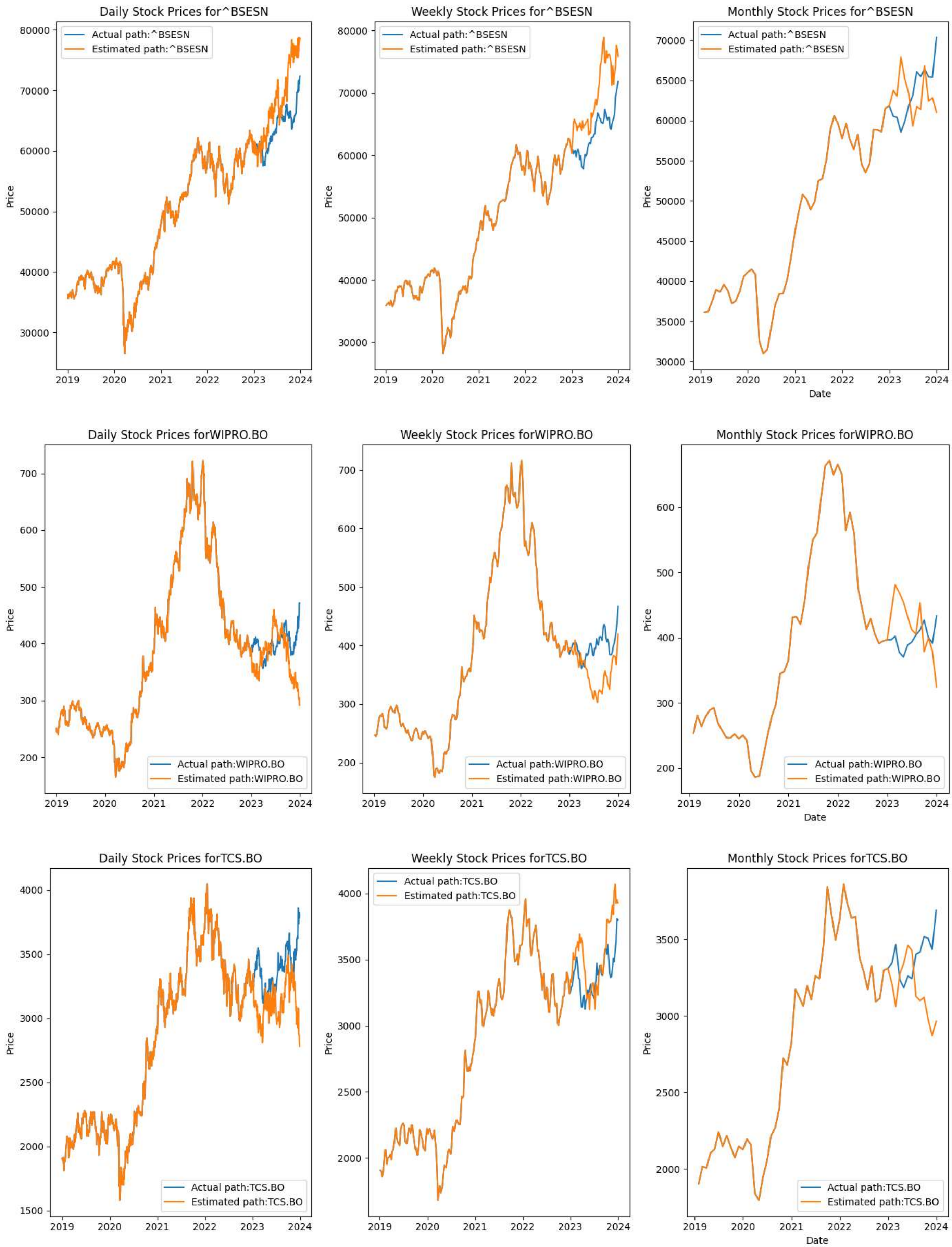
Ans)

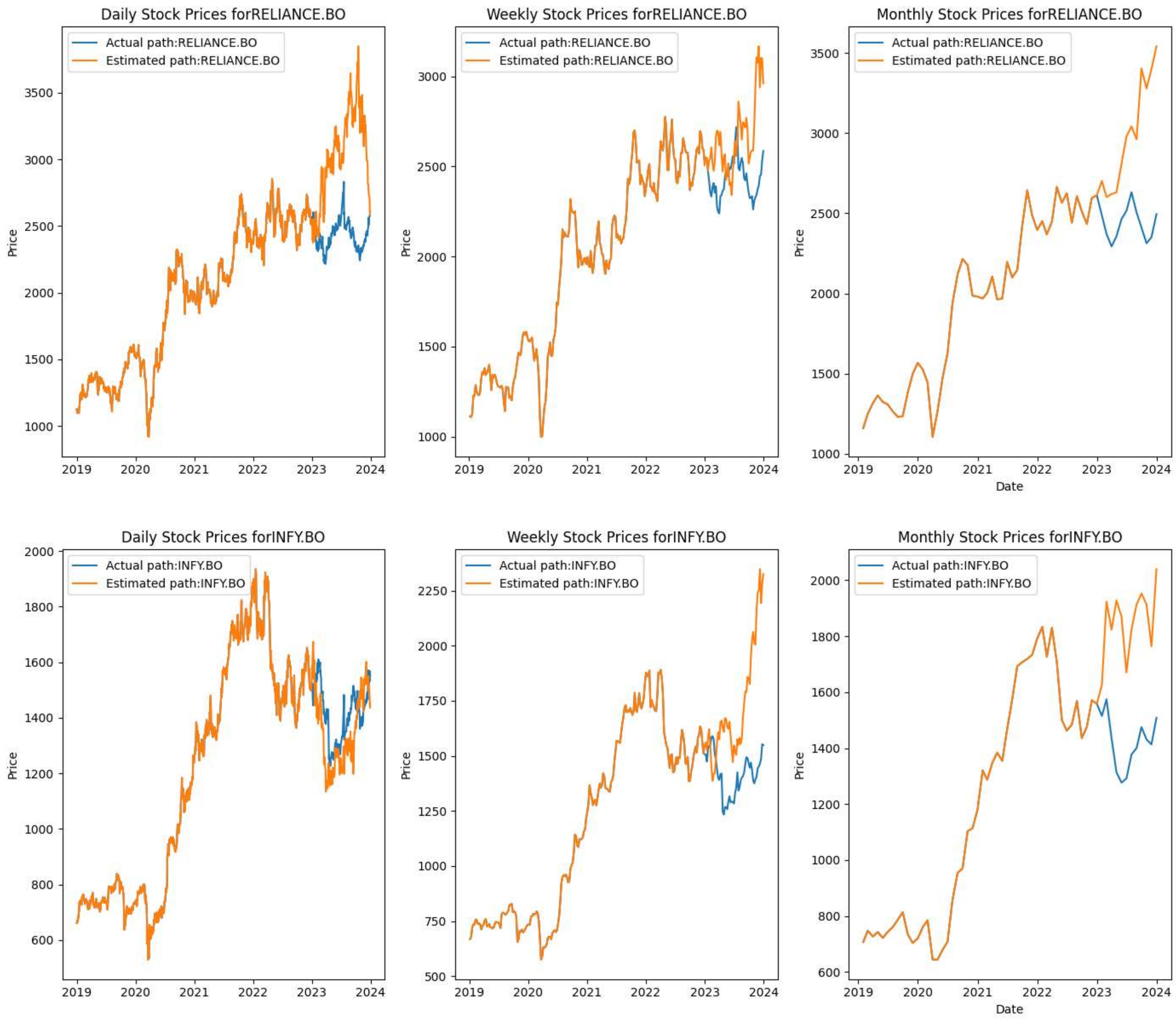
<u>Formulae used</u> –

- Geometric Brownian motion is used to model the scenario since stock prices behave like a stochastic process:

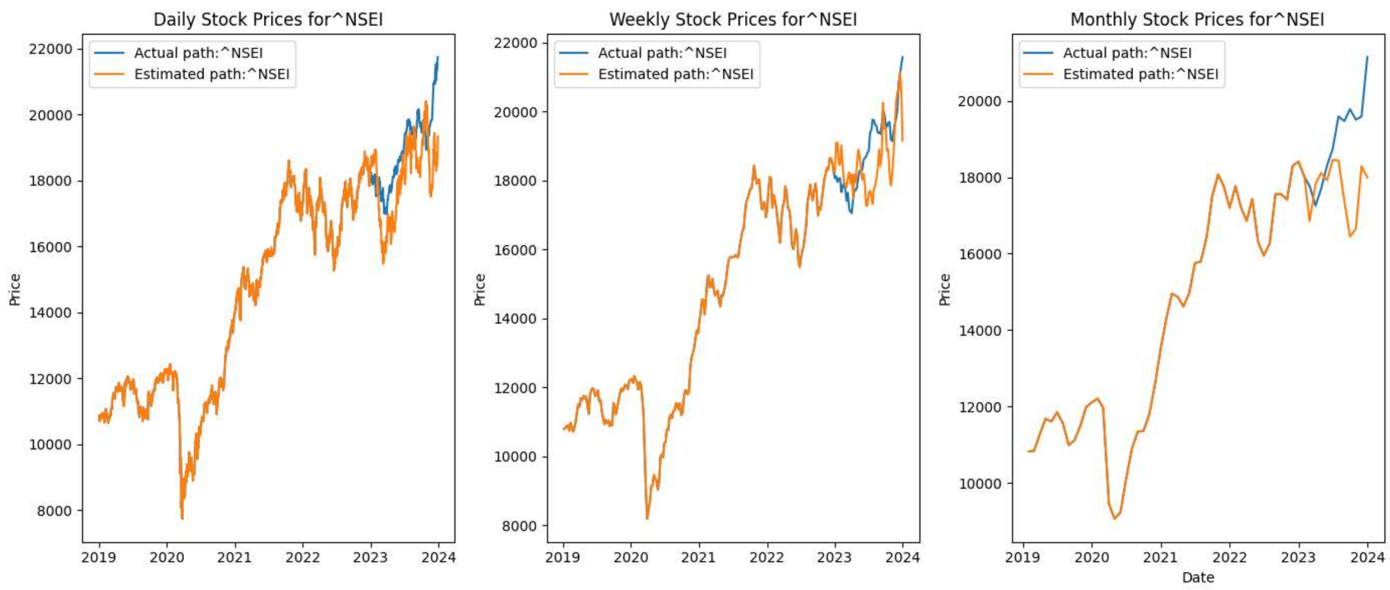
$$S(t_{i+1}) = S(t_i)\exp((\mu - 0.5\,\sigma^2)(t_{i+1} - t_i) + \sigma\sqrt{t_{i+1} - t_i}\,Z_{i+1})$$

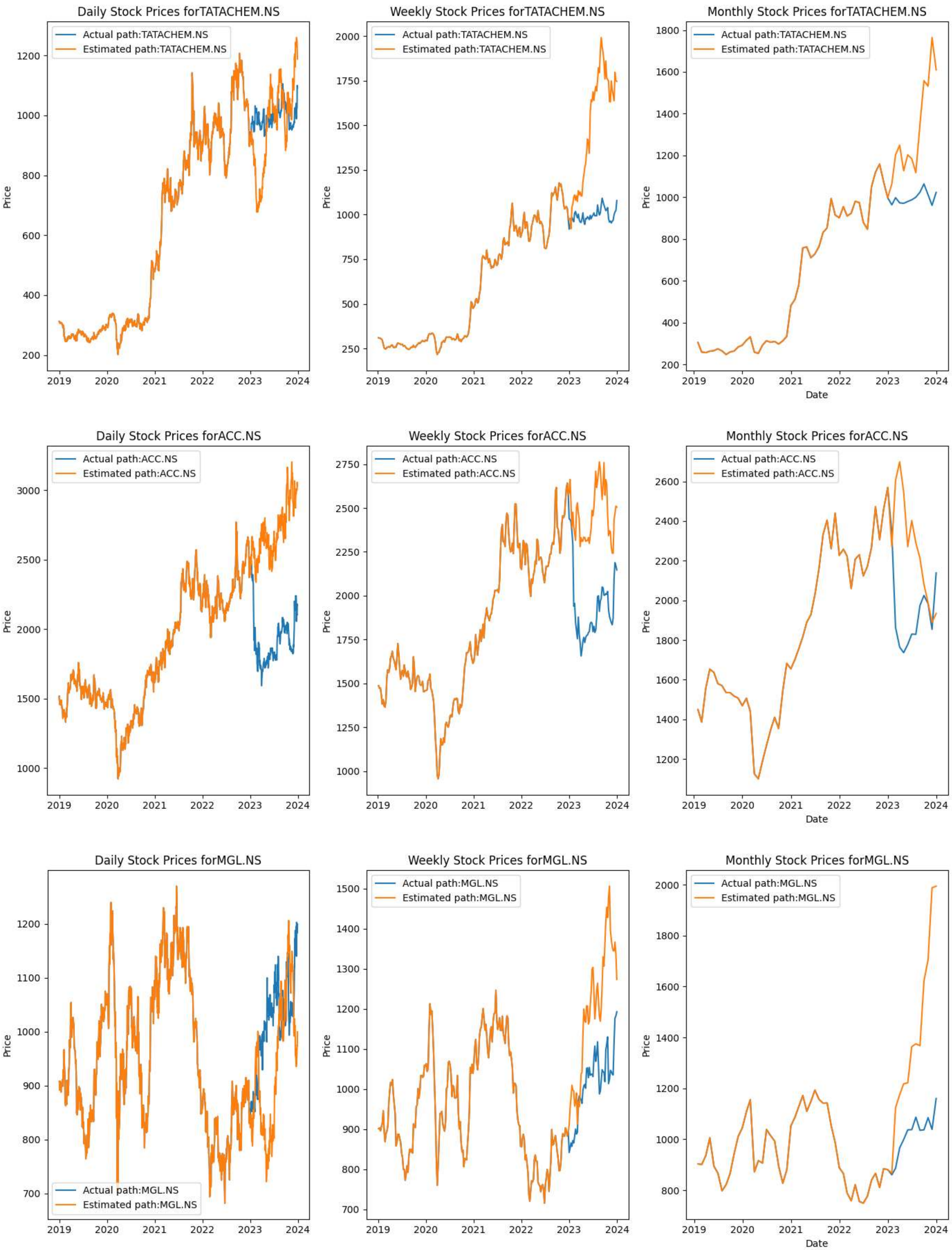
For bsedata1

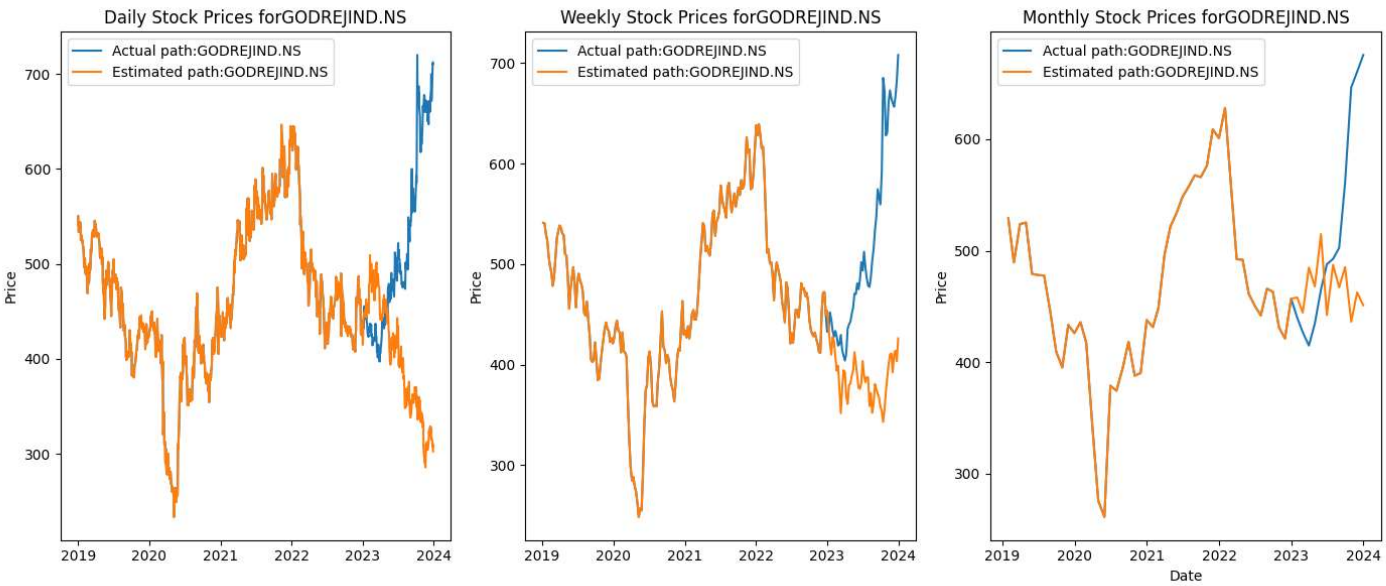

Daily Stock Prices for^BSESN
Actual path:^BSESN
Estimated path:^BSESN
Price
Weekly Stock Prices for^BSESN
Actual path:^BSESN
Estimated path:^BSESN
Price
Monthly Stock Prices for^BSESN
Actual path:^BSESN
Estimated path:^BSESN
Price
Date
Daily Stock Prices forWIPRO.BO
Actual path:WIPRO.BO
Estimated path:WIPRO.BO
Price
Weekly Stock Prices forWIPRO.BO
Actual path:WIPRO.BO
Estimated path:WIPRO.BO
Price
Monthly Stock Prices forWIPRO.BO
Actual path:WIPRO.BO
Estimated path:WIPRO.BO
Price
Date
Daily Stock Prices forTCS.BO
Actual path:TCS.BO
Estimated path:TCS.BO
Price
Weekly Stock Prices forTCS.BO
Actual path:TCS.BO
Estimated path:TCS.BO
Price
Monthly Stock Prices forTCS.BO
Actual path:TCS.BO
Estimated path:TCS.BO
Price
Date



For nsedata1




Daily Stock Prices forTATACHEM.NS
Actual path:TATACHEM.NS
Estimated path:TATACHEM.NS
Price
Weekly Stock Prices forTATACHEM.NS
Actual path:TATACHEM.NS
Estimated path:TATACHEM.NS
Price
Monthly Stock Prices forTATACHEM.NS
Actual path:TATACHEM.NS
Estimated path:TATACHEM.NS
Price
Date
Daily Stock Prices forACC.NS
Actual path:ACC.NS
Estimated path:ACC.NS
Price
Weekly Stock Prices forACC.NS
Actual path:ACC.NS
Estimated path:ACC.NS
Price
Monthly Stock Prices forACC.NS
Actual path:ACC.NS
Estimated path:ACC.NS
Price
Date
Daily Stock Prices forMGL.NS
Actual path:MGL.NS
Estimated path:MGL.NS
Price
Weekly Stock Prices forMGL.NS
Actual path:MGL.NS
Estimated path:MGL.NS
Price
Monthly Stock Prices forMGL.NS
Actual path:MGL.NS
Estimated path:MGL.NS
Price
Date



Daily Stock Prices forGODREJIND.NS
Actual path:GODREJIND.NS
Estimated path:GODREJIND.NS
Price
Weekly Stock Prices forGODREJIND.NS
Actual path:GODREJIND.NS
Estimated path:GODREJIND.NS
Price
Monthly Stock Prices forGODREJIND.NS
Actual path:GODREJIND.NS
Estimated path:GODREJIND.NS
Price
Date