

Time Series Analysis: A Study on the Pharmaceutical Industry in India

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Abstract—Time series analysis is a method that helps one to understand how various variables change with time. It helps one to take various important decisions in various aspects. One such important decisions involve the decision relating to investments. This study assists investors regarding the confusion in deciding which companies from the pharmaceutical industry to invest in. It also advises the investors on taking long and short positions. The companies chosen for the study are Dr Reddy's, Cipla, Lupin, Sun Pharma and Divis Lab. The data collected include the opening price, closing price, volume of trade, day's high and day's low for each of the above-mentioned companies for the last three years. The data was collected from the National Stock Exchange. The analysis includes the calculation of cumulative log returns and rolling statistics represented in the form of graphs. The study advises investors to hold long positions for Cipla and Sun Pharma and short positions for Lupin and Divis labs. It suggests intraday trading for the shares of Dr Reddy. As the study was limited to Pharmaceutical Industry, It opens the scope for study in other industries.

Keywords: Finance, Pharma, Decision, Stock prediction, Time Series Analysis

INTRODUCTION

Time has been the greatest factor in all the types of analysis one could think of. The value of financial securities, investments and money has always been dependent on time. Data recording is been taking place for a very long period and time has been the most crucial aspect of the same. Therefore, by default, time series data becomes the important data type in finance.

Time series analysis is the method of studying the data related to a particular sequence/series. In other words, it is a study of data related to a particular collection of figures and numbers recorded at regular intervals. For example, the stock prices at a particular stock exchange; financial statements belonging to a particular industry for a period of 5 years etc.

A time series study helps us to identify how various variables change with time. It typically shows how a particular variable adjusts itself with time and helps us to predict future trends based on the historical behaviour of the variable.

Organisations and Researchers mainly use time series analysis to predict/forecast the future trend, make investment-related investments, alter the organisation structure, and track its risk and progress over time, for a better understanding of the variables, segment and classify data as per the nature. Time series analysis is also used in descriptive and intervention analysis.

Stock market analysis is a time series analysis that involves the evaluation of a particular stock, industry, or the market itself using various tools to predict the investment potential and to analyse future growth and behaviour. The popular types of stock market analysis are fundamental analysis and technical analysis.

Fundamental analysis helps us forecast stock prices using the company's financial activities/financial statements such as the Balance sheet, Income statement, and Cash Flow Statement. It also involves the use of various ratio analyses which help draw relationships between various variables. Ratios like liquidity ratio and solvency ratio can be used.

Technical analysis is a practice that uses historical stock prices to predict future data. It refers to using stock prices, charts, trends, and statistical indicators. It is also based on historical values. Technical analysis is affected by various market factors. It is mostly based on the opening and closing prices and the corresponding technical charts. This Study uses technical analysis to study the pharmaceutical industry.

This study focuses on analysing the trend of the top companies in the pharmaceutical industry. The objective of the study is to analyse and bring out the future trend in the industry and to study the investment opportunity in the industry.

LITERATURE REVIEW:

Sl no	Year	Title	Author(s)	Problem(s)	Purpose	Algorithms	Evaluations	Summary
1.	2019	Stock Market Analysis: A Review and Taxonomy of Prediction Techniques	Dev Shah, Haruna Isah and Farhana Zulkarnaen, School of Computing, Queen's University, Kingston, ON K7L 2N8, Canada; dshah@cs.queensu.ca (D.S.); farhana@cs.queensu.ca	A review and Taxonomy of the stock market prediction techniques.	To discuss technical, fundamental, short- and long-term approaches used for stock analysis. To present some challenges and research opportunities in this field.	Based on secondary data. Based on the literature review.	This paper discusses the various prediction techniques of Stock market prediction. It presents a detailed literature study of the state-of-the-art algorithms and methods that are commonly applied to stock market prediction. It also discusses some of the never-ending challenges in this domain that require more attention and provides opportunities for future development and research	The paper brings out the challenges involved in predicting the market and stock prices. It says predicting stock prices has been one of the greatest challenges ever. The article defines and throws light on the two main techniques of stock market analysis, Fundamental Analysis and Technical analysis. It elaborates on statistical, pattern recognition, machine learning and sentimental analysis. The methodology followed was a literature survey. It also includes a discussion based on the most suitable technique that can be used for predicting the market. It finally concludes that a hybrid or a combination of the techniques could be more suitable to predict the stock prices and it also establishes the gap for further research in the same.
2.	2019	Python for Finance, Chapter 8	Yves Hilpisch	Financial Time Series	To discuss the method of analysis of time series data using various tools of analysis using Python.	Based on secondary data. Analysis of High-frequency data using various statistical tools.	This article deals with financial time series, probably the most important data type in the financial field. It concludes that pandas are a powerful package for dealing with such data sets, allowing for efficient data analyses and easy visualizations. pandas are also helpful in reading such data sets from different sources as well as in exporting the data sets to different technical file formats effectively.	The article explains the importance of time series data and the use of Python and pandas in the analysis of time series data. It provides step by step explanation of analysing time series data, using various statistical techniques with the help of pandas and Python. The steps of analysis include identifying financial data, data import, summary statistics, understanding the changes in data over time, resampling if necessary, rolling statistics, technical and correlation analysis, regression and finally dealing with high-frequency data. It concludes that pandas are a powerful package for dealing with such data sets, allowing for efficient data analyses and easy visualizations.

RESEARCH METHODOLOGY

The study is based on secondary data. It consists of data from the top companies in the pharmaceutical Industries. The samples include- Cipla, Dr Reddy, Sun Pharma, Divis Lab and Lupin. The data set consisted of the opening price, closing price, volume of trade, day's high and day's low for each of the above-mentioned companies for the last three years.

ANALYSIS REPORT

Considering the five companies for analyzing the financial times series data. The analysis is categorized into the following sections as shown below:

A financial Analysis

The companies involved in the following study are:

Data columns (total 5 columns):

Column Non-Null Count Dtype

```
-----
0 cipla 497 non-null float64
1 divislab 497 non-null float64
2 drreddy 497 non-null float64
3 lupin 497 non-null float64
4 sunpharma 497 non-null float64
```

To visualize the complete informational index by means of various subplots the accompanying picture is utilized

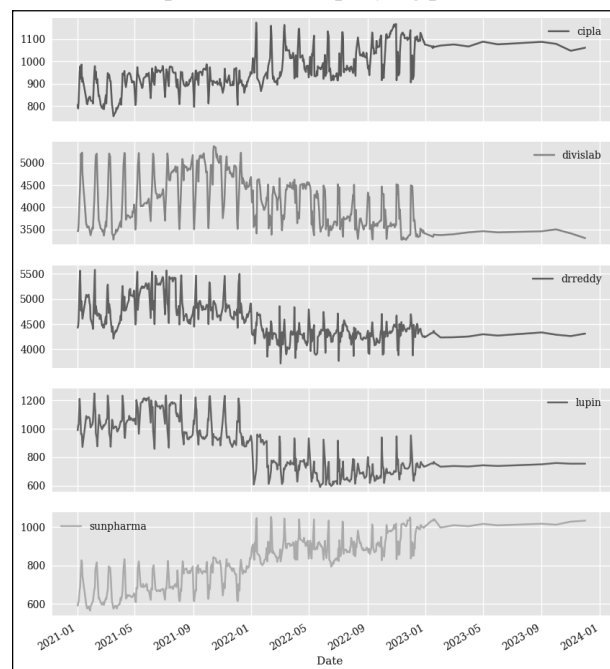


Figure 1: Showing index by means of subplots

Summary statistics are given below:

	cipla	divislab	drreddy	lupin	sunpharma
count	497.00	497.00	497.00	497.00	497.00
mean	963.30	4106.65	4570.21	870.43	817.87
std	87.95	577.13	387.92	183.42	125.54
min	755.15	3265.95	3718.85	590.25	564.35
25%	910.60	3587.65	4302.80	714.45	703.00
50%	950.50	4061.45	4481.00	881.75	829.25
75%	1025.65	4530.40	4792.35	1018.35	905.90
max	1173.40	5372.15	5575.70	1247.25	1051.95

Figure 2: summary statistics

Pct change () is visualized using a bar plot as shown below.

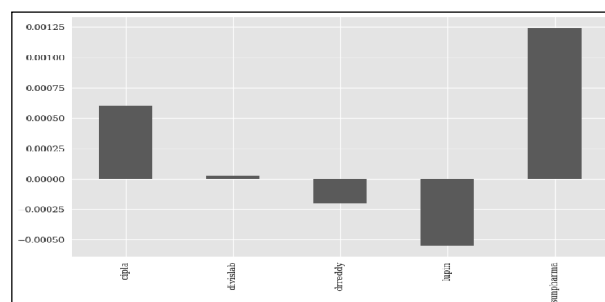


Figure 3: Showing Pct Change

Insights from the bar plot: There is an increase in the mean percentage change for Cipla, Divislab and Sunpharma shares. But there is a decrease in the mean percentage change of Drreddy and Lupin shares.

Cumulative log-returns of the financial time series data are shown below for all the shares:

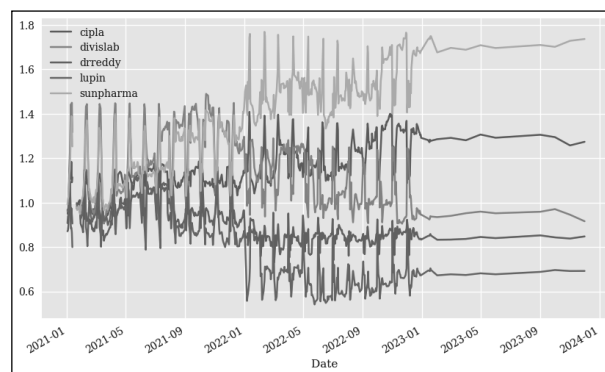


Figure 4: showing Cumulative log returns

Insights from the log time series data: Cumulative log returns over time are shown in Fig _____. On 20-01-2021 Cipla's share cumulative log return is 0.98

and later on 19-01-2023, the share price increased to 1.28. On 20-01-2021 Divislab share cumulative log return is 0.999; later on 19-01-2023 the share price decreased to 0.94. On 20-01-2021 Dr Reddy's share cumulative log return is 0.994; later on 19-01-2023, the share price decreased to 0.853. On 20-01-2021 Lupin's share cumulative log return is 0.981; later 19-01-2023, the share price decreased to 0.698. On 20-01-2021 Sunpharma's share cumulative log return is 0.98; later on 19-01-2023, the share price increased to 1.75.

By resampling the data by monthly time intervals cumulative log returns are computed and the plot is shown below:

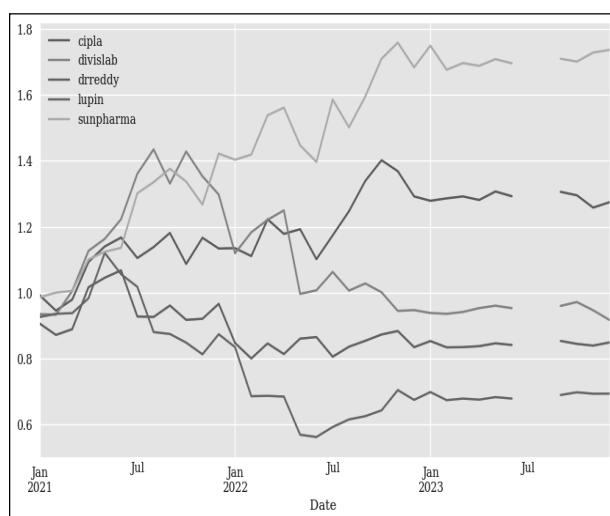


Figure 5: Showing cumulative log returns based on monthly time intervals

Insights from the log time series data: Cumulative log returns over time are shown in fig 5. On 31-01-2021 Cipla's share cumulative log return is 0.99; later on 31-12-2023, the share price increased to 1.27. On 31-01-2021, Divislab's cumulative log return is 0.93; later on 31-12-2023, the share price decreased to 0.92. On 31-01-2021 Drreddy's share cumulative log return is 0.90; later on 31-12-2023, the share price decreased to 0.85. On 31-01-2021 Lupin's share cumulative log return is 0.93; later on 31-12-2023, the share price decreased to 0.69. On 31-01-2021 Sunpharma's share cumulative log return is 0.99; later on 31-12-2023, the share price increased to 1.74.

Rolling Statistics

Minimum, Mean and Maximum statistic parameters are Plotted showing rolling statistics for the final 200 data rows for 5 shares are given below.

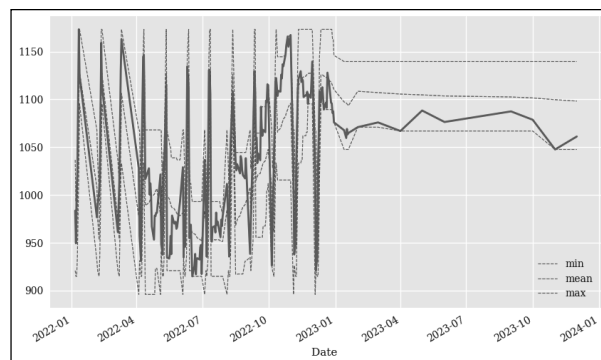


Figure 6: Rolling statistics for cipla

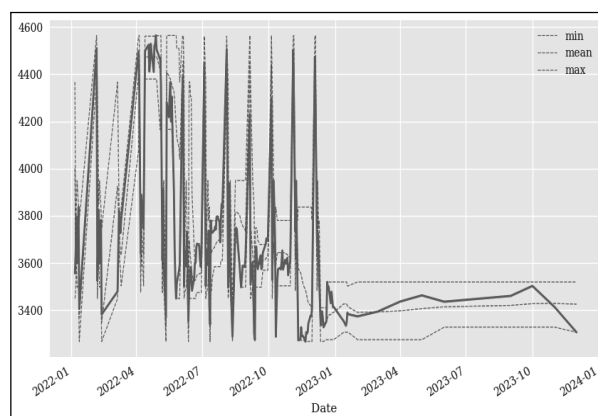


Figure 7: Rolling statistics for DivisLab

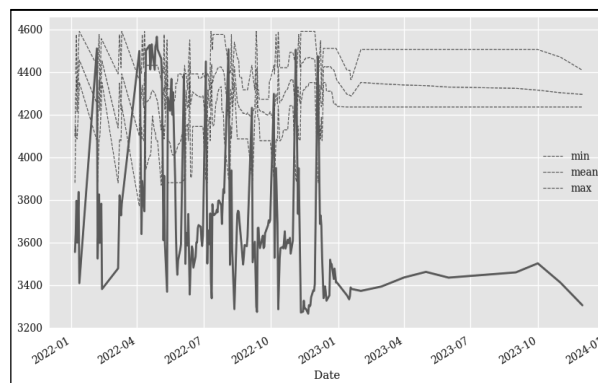


Figure 8: Rolling statistics for Dr Reddy's

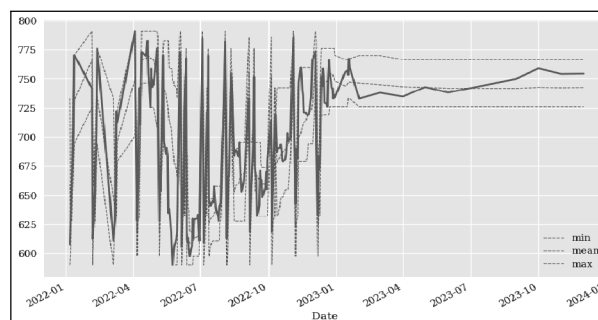


Figure 9: Rolling statistics for Lupin

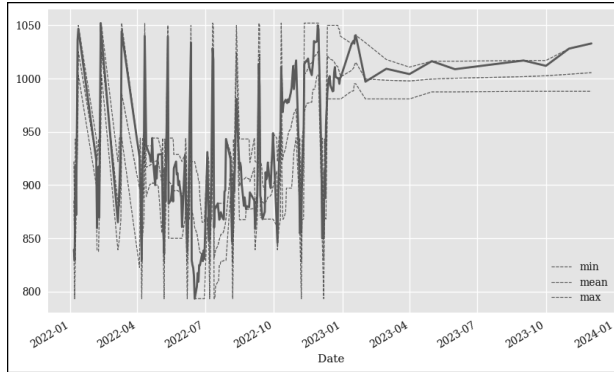


Figure 10: Rolling Statistics for Sun Pharma

A traditional trading strategy for technical analysis is computed using two simple moving averages (SMAs) for all 5 Medi shares. The idea is that the trader should go long on a stock (or financial instrument in general) when the shorter-term SMA is above the longer-term SMA and should go short when the opposite holds true. Short-term SMA is for the window = 42 and Long term SMA is for the window = 252. Visualizes a long position by a value of 1 and a short position by a value of -1. The change in the position is triggered (visually) by a crossover of the two lines representing the SMA time series:

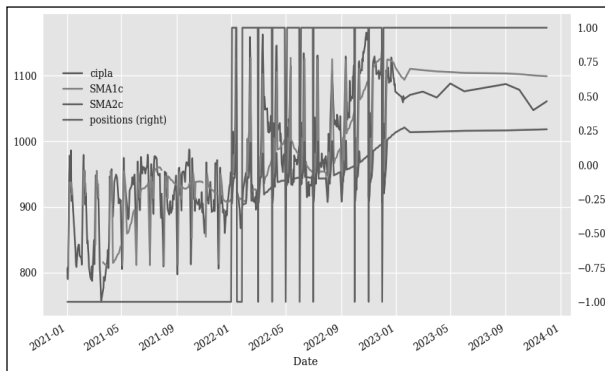


Figure 11: SMA Cipla

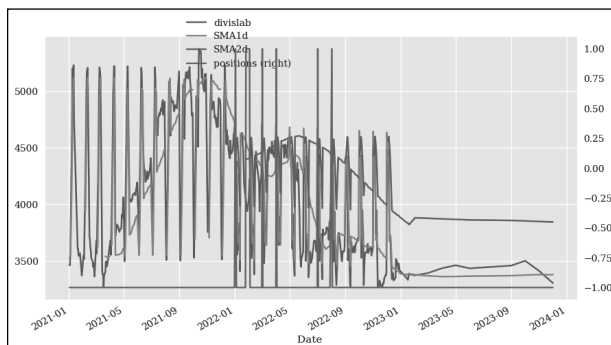


Figure 12: SMA Divislab

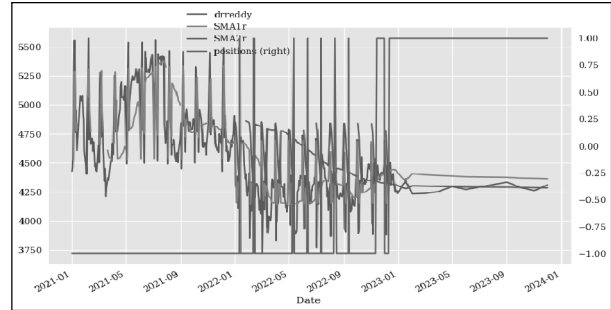


Figure 13: SMA Dr Reddy's

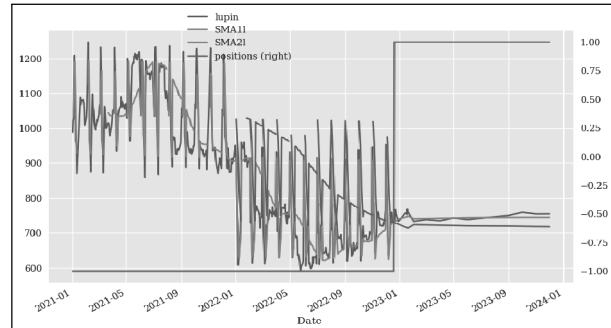


Figure 14: SMA Lupin

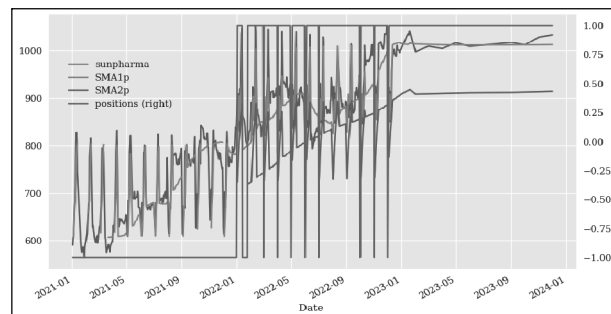


Figure 15: SMA Sunpharma

CONCLUSION

From the above analysis we can observe that Share prices of Cipla and Sun pharma are showing an upward trend in the market which indicates it can sustain the market fluctuations and maintain an upward trend in the market. Therefore, the investors are advised to take long positions with respect to these shares. On the other hand, Lupin and Divis Labs are showing bearish traits as there is a downward trend observed. With respect to these shares, the investors are advised to go short in the market or reconsider the investment. However, Dr Reddy's is taking a neutral and sustainable stand, where there are possibilities for the share to move up and down frequently. Intra-day users can take advantage of this scenario and make the best of it.

Here the study focused only on the companies from the pharmaceutical industry. Therefore, it widens the scope for further research in other industries.

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