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# A Statistical Analysis on Stock Prices of Pharmaceutical Industry

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**ABSTRACT:** Pharmacy Industry is one of the most important sector in the world. Multiple companies in this sector have also come out to research and even find out multiple drugs for numerous diseases. Especially during the pandemic, many of the top most companies have joined hands and tried to produce a vaccine for the Covid-19 pandemic. But because of this pandemic, stock prices of multiple companies have fluctuated. Even the Pharmaceutical Industry has faced the same situations. Stock prices are very volatile and an investor need to keep an close eye on the prices and have a detailed study on the historical indices to predict and achieve higher returns. In this research, we would be comparing the stock prices of last decade of the Cipla Ltd, Sun Pharma Ltd and the Lupin Ltd. Monthly stock prices have been analyzed of these three pharmaceutical companies.

In this study, we see that stock prices of Cipla has been least volatile among all three. However the volatility rate is quite high for the Lupin Ltd due to it's higher fluctuations. Sun Pharma Ltd. Had quite similar share prices that to the Cipla. Lupin was the one who has best performed in the last decade due to the higher returns.

**KEYWORDS:** Pharmaceutical Industry, Stock Prices, Historical Indices, Statistical analysis

## I. INTRODUCTION

Pharmaceutical Industry in India has always been an important sector. Being the largest supplier of multiple generic drugs globally, the country also has a huge pool of scientists and engineers who can help the industry expand. More than half of the global demands for multiple vaccines are provided from India. Currently 70% of the antiretroviral drugs that are used worldwide to battle the AIDS (Acquired Immune Deficiency Syndrome) are supplied by the country's pharmaceutical sector. The current COVID-19 pandemic's emergence has reignited interest in the pharmaceutical industry as a whole. There is an extreme increase in demand for some particular important drugs; this gave the sector a much-needed boost. Pharmaceutical industries, like other industries, are also at the same time facing difficulties as a result of the pandemic lockdown, with factories functioning with lower workforce capability, delivering critical and limited products.

The pharmaceutical industry is an industry made up from numerous scientists to research and develops multiple treatments for the diseases. Some of the largest and well-known companies in India, which are global suppliers, too, are Cipla Ltd., Sun Pharma Ltd. and Lupin Ltd. The pharmaceutical industry has catered to all types of investors, whether they choose valuation, growth, or dividends. From 2009 to 2016, the pharma index had a 30 percent compound annual growth rate (CAGR). Without a doubt, if you had invested in the best pharma stocks at the moment, you would have gotten a better return. After the changes in the liberalization in economy, multiple companies create funds for different projects by selling their shares. Nevertheless it's very risky for the investors, so they have to keep an eye on all the prices and changes for higher returns. In this paper, we would be studying about the stock prices and performance in the capital market of the three pharmaceutical companies namely Cipla Ltd., Sun Pharma Ltd. and Lupin Ltd. The data we used for this study would be from March 2011 to March 2021 for better understanding. Statistical analysis was performed on this data to achieve more accurate conclusion.

## II. LITERATURE SURVEY

Stock prices are consistently increased in the contemplation of many people, agents and authorities. Many speculations are held for the stock market trades that are infrequent in nature, and it is senseless to endeavor to envision them. Since various components are incorporated, anticipating the stock worth itself is a troublesome issue. (2020, pp. 2-3) Until further notice, the market continues like a popularity based machine, yet as time goes on, it acts like a measuring machine, so it can foresee exhibit designs over a progressively broadened time period. The utilization of machine learning advancement and various counts in stock worth examination and figure is a promising field. In this paper, we first rapidly plot the logical classification of the stock markets and taxonomy of stock market prediction methods

(Priya, 2019) The fluctuations of stock returns are due to several economic and non-economic factors. An investor can only succeed in his investment when they are able to select the right share in right sector. The investors must watch the situations keenly in the market like political, economy, company progress, industrial profile, returns and the risk involved in a share before investing in the share. Stock market prediction is not a straightforward procedure as stock behavior doesn't depend solely on one factor but is determined by a mix of factors. There is no direct cause that one factor enforces on another. For example, economic growth indirectly contributes to earnings growth. Thus considering these indirect factors becomes complex. (Lee, 2014) As a consequence, an increasing attention has been given in recent literature to the topic of international transmission of stock market returns and volatility. Using international stock return data, previous studies generally found evidence for spillover effects across international stock markets.

## III. MATERIALS AND METHODS

The study in this paper is intended for analyzing the stock price movement in three Bombay Stock Exchange (BSE) listed Pharmaceutical companies namely Cipla Limited, Lupin Ltd and Sun Pharma Ltd using simple statistical analysis techniques. These three companies were selected based upon the market capitalization of their stocks, minimum age of 50 years of the foundation and its status in handling in different Medicinal projects. The pertained data on closing, opening, high and low prices at monthly time step were collected from the secondary sources viz. Yahoo! Finance official website (<https://in.finance.yahoo.com>). The monthly share prices of above-mentioned companies were taken for a period of March 2011 to March 2021.

Statistical Tools Used: The various statistical tools were used in this study ranging from simple descriptive statistics to some advanced statistical indices to interpret the financial soundness of the various pharmaceutical companies.

Descriptive statistics: It includes mean, median, standard deviation; coefficient of variance gives a required insight and help understanding the basic characteristics of the stocks. We would be estimation different characteristics to determine the results for these all three datasets. By comparing these characteristics of the above mentioned companies it would be way to understand their stock price movement. We would also be using some graphs to compare the prices of the stock for better understanding.

## IV. PROPOSED ANALYSIS APPROACH AND RESULTS

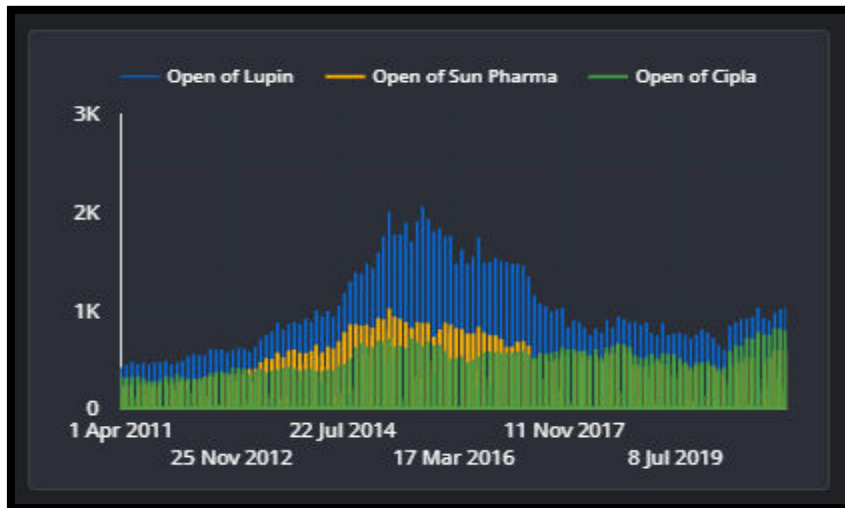
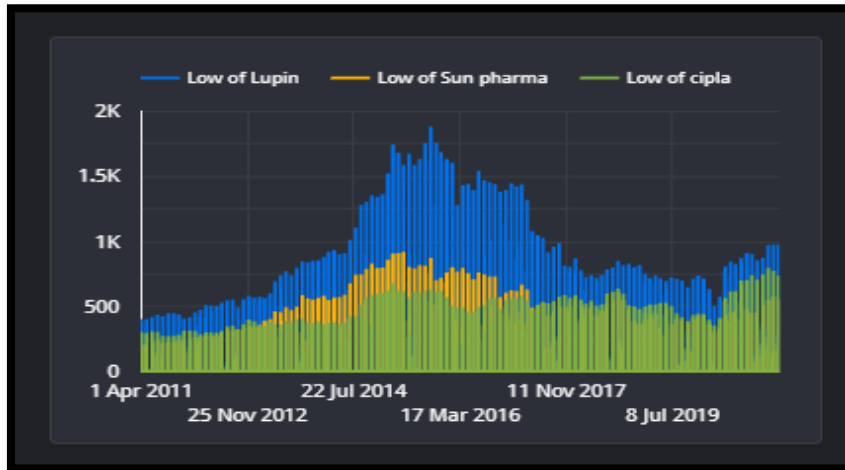
The data we collected was from March 2011 to March 2021. For the particular data we found the sample using the simple random sampling. Stock prices were monthly based and the population total was 121 and the sample size was of 20. Covariance events how two particular shares move mutually. A positive covariance means the shares tend to move together when their prices go up or down. A negative covariance means the shares move opposite of each other. Variance, on the other hand, refers to how far a stock moves relative to its mean. For example, variance is used in measuring the volatility of an individual stock's price over time.

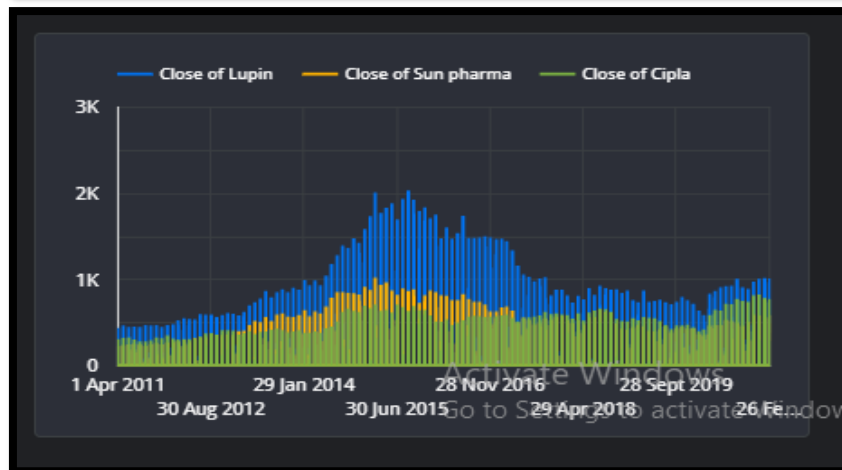
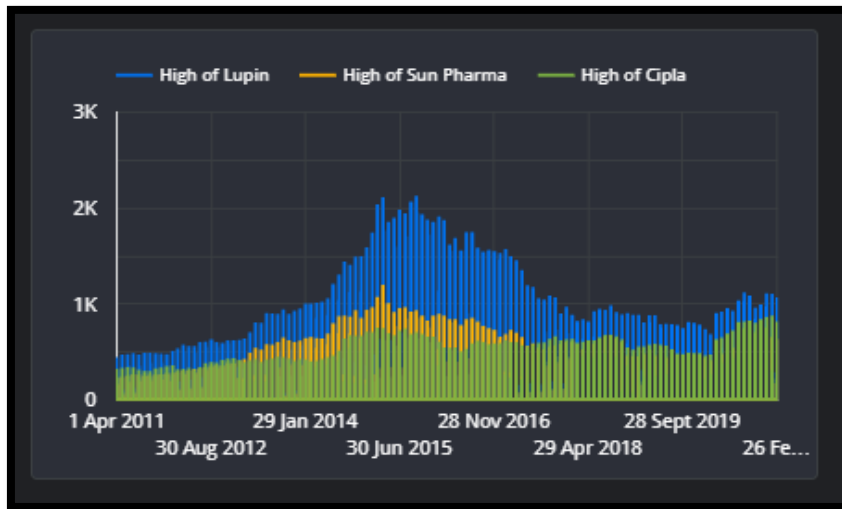
The beta index value of benchmark index is generally considered as one. And if the price is greater than one share shows that the share price of a company is more volatile than the market itself. Thus, a company with a beta of greater than one will tend to strengthen market movements in either positive or negative direction. It means a company with high beta may offer higher return during certain period of time but that comes along with higher risk caused by unpredictability.



Visualization of the Data

The basic statistical analysis of all the prices like open, close, high and low ;of all the three stocks are presented in the figures 1-4 in a time series analysis chart. The statistical features of open share prices of all three pharmaceutical companies are presented in the figure 1. The maximum share prices of all three pharmaceutical companies are presented in the figure 2. The statistical features of Minimum share prices of all three pharmaceutical companies are presented in the figure 3. The closing share prices of all three pharmaceutical companies are presented in the figure 4.





The spread of maximum and minimum closing prices of the stocks during the study periods indicates that there is decline in the values of all the three stocks during Nov 2017 to 2019. However, it is maximum for Lupin Ltd followed by almost similar stock prices range of Sun Pharma Ltd. and Cipla Ltd. In terms of percentage decline, Lupin Ltd has suffered highest wearing down in stock price amounting 89.6% of its maximum value followed by Sun Pharma Ltd which suffered a decline of 79.2%. Cipla suffered a least loss costing till 37.09% among the three pharmaceutical companies during the study period of ten years. It indicates that Lupin has lost reasonably less capital per share while in true sense Cipla had suffered least capital in absolute term during the period of study.

#### Statistical Approach

We would be finding the Population and Sample Mean for the Data. There were three datasets for the three companies which were blended together for much easier calculations. The first step for this approach would be finding the Population Mean ( $\mu$ ) and the Sample Mean.

$$\text{Mean} = \frac{\text{Total Sum of the entries}}{\text{Size of the entries}}$$

As we have in total 121 entries for Population and 19 entries for the sample dataset, the average would be:

$$\mu = \frac{\text{Total Sum of the entries of each company}}{121}$$



$$\bar{x} = \frac{\text{Total Sum of the entries of each company}}{19}$$

So now the calculations are:

$\mu_{\text{CIPLA}} = 549.6483365$
$\mu_{\text{SunPharma}} = 593.1812528$
$\mu_{\text{LUPIN}} = 1073.59042$

$\bar{x}_{\text{CIPLA}} = 518.4900039$
$\bar{x}_{\text{SunPharma}} = 714.7150054$
$\bar{x}_{\text{LUPIN}} = 1033.220004$

Estimate the Variance

$$S^2 = \frac{\sum(x_i - \bar{x})^2}{n - 1}$$

Where;

$S^2$  Variance

$X_i$  is the value of one entry / observation

$\bar{x}$  is the Mean

n is the size

S is the Standard Deviation

POPULATION	Variance	Standard Deviation
Cipla Ltd.	20651.68084	144.3094743
Sun Pharma Ltd.	44853.02758	211.7853337
Lupin Ltd.	202579.6195	450.0884574

SAMPLE	Variance	Standard Deviation
Cipla Ltd.	15602.78752	124.9111185
Sun Pharma Ltd.	27590.72302	166.1045545
Lupin Ltd.	172973.6219	415.9009761

Computing the Standard Error

$$SE = \sqrt{\frac{1 - n}{N} * \frac{s^2}{n}}$$

Where;

SE is the Standard Error

N is Population Size

n is the number of samples

$s^2$  is estimate of the population standard deviation

So now after putting the values into the formula it would be:

COMPANIES	STANDARD ERROR
Cipla Ltd.	13.06426608
Sun Pharma Ltd.	19.25321216
Lupin Ltd.	40.91713249



For this Analysis, we would be taking the confidence level of 95%. Now let's find the Critical Value:

$$\alpha = 1 - \frac{\text{confidence level}}{100}$$

$$\alpha = 1 - \frac{95}{100}$$

$$\alpha = 0.05$$

To find the Critical Value we need to follow some steps like: we need to find the degree of freedom. Basically DF(Degree of freedom ) is one values less than the sample size. And as we have sample size less than 30 we will be using the critical t- statistic which will be having different degree of freedoms equal to our degree of freedom and the cumulative probability with that will be the critical probability.

If our sample size was larger than 30 then we would have used z-score.

$$\text{Critical Probability} = 1 - \frac{\alpha}{2}$$

$$\text{Critical Probability} = 1 - \frac{0.05}{2}$$

$$\text{Critical Probability} = 0.975$$

Critical value of all three Companies would be the same as we are using the same sized sample data. Here our DF would be 19.

CRITICAL VALUE = 2.093024054

Margin Of Error

Now to calculate Margin Error we would be needing critical value and standard error.

$$\text{Margin Error (ME)} = \text{Critical Value} * \text{Standard Error}$$

Pharmaceutical Companies	Margin Error
CiplaLtd.	27.34382317
Sun Pharma Ltd.	40.29743617
Lupin Ltd.	85.64054254

Confidence Level

$$CI_{min} = \bar{x} - (SE * CV)$$

$$CI_{max} = \bar{x} + (SE * CV)$$

Where;

CI<sub>min</sub> is the minimum value of the confidence level.

CI<sub>max</sub> is the maximum value of the confidence interval

$\bar{x}$  is the sample mean

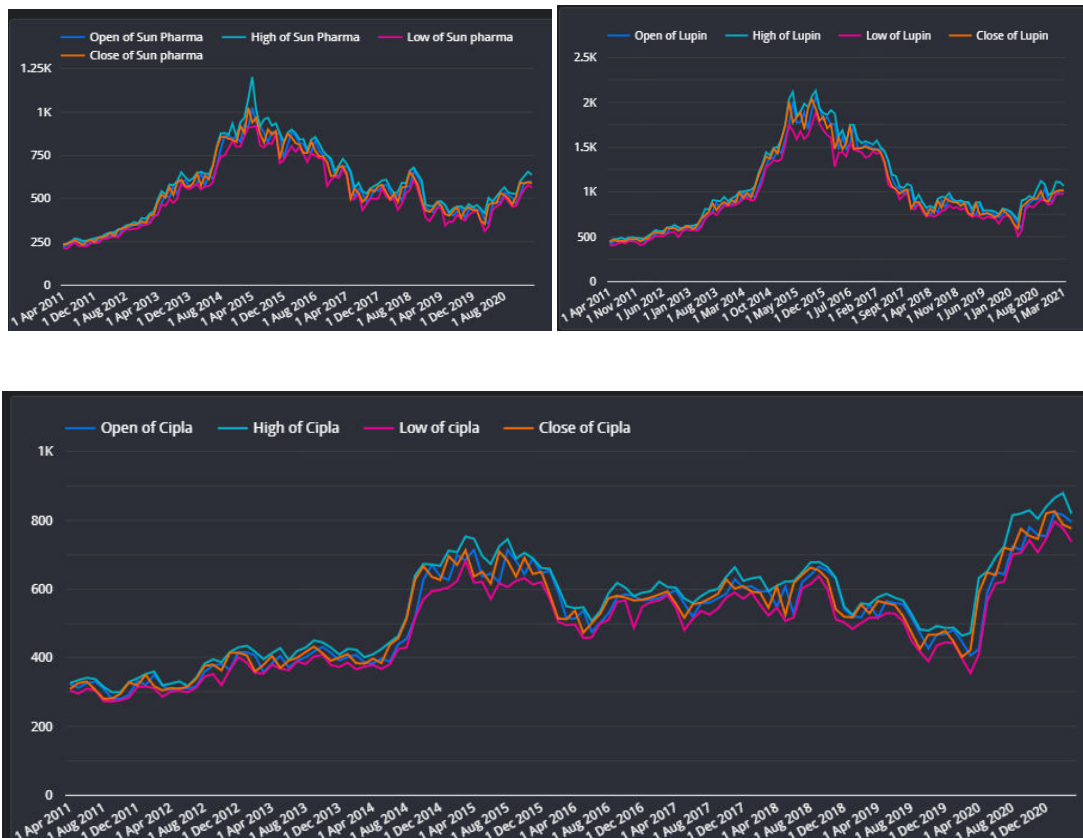
SE is the Standard error

CV is the critical Value

Pharmaceutical Companies	Minimum Value of CI	Maximum Value of CI
Cipla Ltd.	491.1461807	545.8338271
Sun Pharma Ltd.	674.4175692	755.0124416
Lupin Ltd.	947.5794615	1118.860547

**V. FUTURE SCOPE & DISCUSSION**

Below given figure represents that the share price of all the companies experienced different magnitudes of fluctuations along with broader market index (BSE Sensex). It is also revealed that stock of Lupin Ltd. faced more fluctuations due to its comparatively high stock prices. The fluctuations for Cipla Ltd. are quite low because of a average stock prices throughout years. The share price of Sun pharma Ltd. also faced the same situation as the Cipla Ltd. due the similarities in the prices of the stocks. Figure 5-7 shows the comparative fluctuation in the prices of stocks of the three companies during the ten years of study period. It indicates than even Lupin has the highest share price, it mostly results in no returns.



With the help of statistical analysis approach , we can see that the turn down was most severe for Lupin Ltd, as it stock price was higher than other two companies in the middleof the study period but after Nov 2016, its stock price went below and only a little difference than other companies . Moreover, at the end of the study period, Cipla and Lupin recovered a little but the Sun Pharma shares had more returns than those two shares.

As we have observed all the shares of these three companies from last 10 years, monthly high is known as the high volatile factor and monthly low is least volatile one. However, stock closing price is logically more important from investor point of view. Herein, Lupin is observed to be most volatile followed by Sun Pharma and Cipla.

**VI. CONCLUSION**

In this study, we compared the stocks of the three Pharmaceutical companies from last 10 years with the help of statistical analysis. After the detailed study about the data in the study period, it was easy to understand the results and it helped us to understand the nature of the stock prices. Even with the help of visualization, it was easy to see the effect of the pandemic on the stock prices during 2020. In the study it was also possible to see all the fluctuations in stock prices. After analyzing all the prices, it would be easy to conclude that Stock prices of Lupin have been more volatile in the whole study period. However least volatile and most stable prices were of Cipla Ltd.





Volatility can also be referred to the amount of uncertainty and the risk related which is proportional to the fluctuation in the stock prices. Most volatile would mean that a share price value can potentially be spread out over a larger range of values. This also in turn means that the share value can change noticeably over a short time period in either direction.

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