

The Brownian Motions in the Indian Stock Market

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Abstract: A study is conducted to find the behavior of the Indian Stock Market based on the NSE data in weak form market efficiency. Three periods are selected from Yahoo Finance where two short periods are subsets of one long period. Serial correlations are calculated separately and tested for their statistical relevance to know the relations among successive price changes. This study focuses on whether trading as per various charts is useful or not.

Keywords: Finance, Random Walk, Stock Market

1. Introduction

A study is conducted to put view whether the theories of chart technique can correctly predict the Indian stock market using a statistical test. In Finance, there are two groups-one, in which people believe that the chart technique is effective; and another, in which people believe that stock market movement is random and unpredictable. But, in science, everything needs to be proved. Therefore, this study is conducted based on Nifty 50 data which is considered a benchmark of the Indian stock market.

2. Review of Literature

There is a continuous controversy between chartists and researchers of the Random walk theory. Chartist theorists believe that past prices and trends are quite useful to predict the movement of future prices. Henceforth, there is always a pattern in the movement of stock prices which can predict future stock price movement. (Fama, 1965). It assumes that price changes over a period, for individual security, are dependent (Fama, 1995). However, later, many academics and researchers popularised the term "Random Walk" which upholds the opposite of chartist techniques that successive price changes are independent. This theory hammers the job of analysts, and in this regard, Malkiel, (1973) wrote that a blindfolded chimpanzee could also select stocks and could make a portfolio just like the experts do. Long before this theory, it was the only headache of Physicists who had been working on 'Brownian Motion' which says that dust particles move randomly. Later in the year 1900, Louis Bachelier wrote a Ph. D. thesis, "Theory of Speculation" where he first used the mathematical model of Brownian Motion before 'The Quantum Theory of Light' using Brownian Motion by Prof. Albert Einstein in 1905 (Sewell, 2011). By using the motion of physics, the concept came to Finance. The same concept is called random walk from the statistical point of view and Brownian motion from the Physicists' point of view. (Cootner, 1962).

3. Efficient Stock Market

If stock prices fully reflect all available information, then the stock market will be considered 'efficient' (Fama, 1970). There are several types of the efficient market

having different characteristics. Fama, (1970) classified efficient market into three forms-weak form efficiency, semi-strong form efficiency, and strong form efficiency.

- 1) Weak form efficiency:-It means that there are no relations among successive price changes. History doesn't repeat itself. Here, technical analysis is useless (Fama, 1970).
- 2) Semi-strong form efficiency:-The pieces of publicly available information (bonus issue, stock split, etc.) don't give any chance of prediction. Here, fundamental analysis is useless (Fama, 1970).
- 3) Strong form efficiency:-It describes whether investors or groups have monopolistic access to any relevant information (Fama, 1970).

The efficient market is described by the concept of "Random Walk" which says that all subsequent price changes represent randomness (Malkiel, 2003).

4. Objective of the study

This study has the following objectives:

- a. To analyze the data based on NIFTY 50.
- b. To find out the correlation coefficient between successive price changes for the different periods selected for the study.
- c. To test these coefficients whether they're statistically significant.

5. Data and Methodology

Dataset

The sample is taken from the National Stock Exchange (NSE) of India based on the NIFTY 50 index to view the randomness of the Indian Stock Market. Nifty 50 is a weighted average of 50 companies' stocks listed on the National Stock Exchange and is widely used as a benchmark of the Indian stock market. From Yahoo Finance, closing values of 5 years' monthly data are taken. Out of that, two sub-divisions are made. Three tests are conducted based on-(i) closing values of 5 years' monthly data [1st September 2017 to 1st August 2022], (ii) closing values of 3 months' daily data during the 1st wave of COVID [About "The Indian Journal of Medical Research, the first COVID case in India was found on 27th January 2020. So, the COVID period was taken from February

onwards. On the 1st and 2nd, February was weeks off; so, the period got started on the 3rd of February. So, it is 3rd February 2020 to 30th April 2020], and (iii) closing values of 30 daily data in 2022 [29th April 2022 to 10th June 2022]. Here, (ii) and (iii) are the sub-divisions of (i).

6. Methodology

This study is conclusive and conducted statistically. Secondary data is used to conduct the research which was taken from Yahoo Finance. A Serial or Auto Correlation technique is used to test the market efficiency in weak form. Return is calculated from the closing value of Nifty which is for the period of t, and also the return for the period of t-1 is calculated. The Autocorrelation technique is used, and a correlation coefficient between R_t and R_{t-1} (taking lag value 1) is found which makes a relation among successive price changes. Finally, these correlation coefficients should have to be tested to whether they are statistically significant or not. Therefore, for this context,

a t-test is conducted at a 5% level of significance with (n-1) degrees of freedom based on the following hypothesis:

- Null hypothesis (H₀): r = 0 (There is no significant serial correlation in successive price changes.)
- Alternative hypothesis (H₁): r ≠ 0 (There is a significant serial correlation in successive price changes.)

The test statistic is: $t = \frac{r}{1/\sqrt{n-k}}$; where, r=correlation coefficient, n=no. observations, k=no. of lags [here, it's 1]. If the modulus calculated value, using the above formula, is greater than the critical value; so, the null hypothesis is rejected and vice versa.

7. Empirical Results

The overall tests give empirical results which need to be analyzed. The Auto Correlations are found for three sets of data. For, 5 years' data, it is -0.0745. For the COVID period 3 months' data, it is -0.1890. For non-COVID 30 daily data, it is -0.0905.

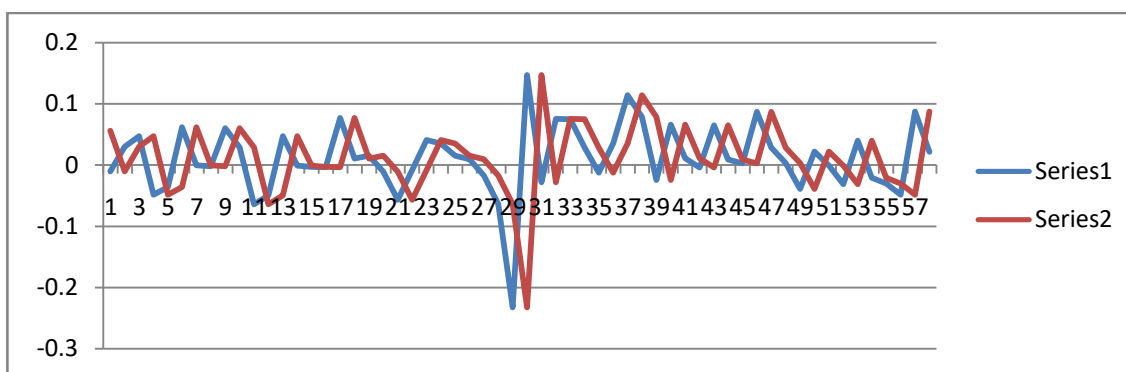


Figure 1: Series 1 shows R_t and Series 2 shows R_{t-1} over 5 years of data

(Source: As created by the Author)

It consists of 60 data and it comes to 58 to calculate Auto-Correlation.

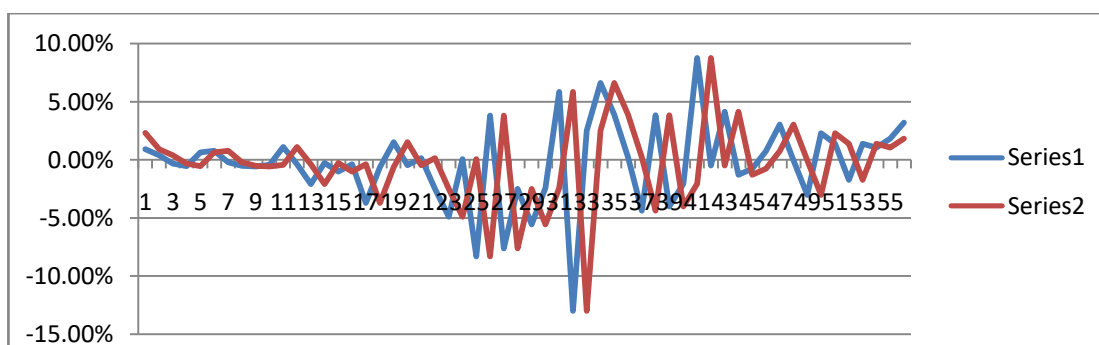


Figure 2: Series 1 shows R_t and Series 2 shows R_{t-1} over 3 months' COVID data

(Source: As created by the Author)

It consists of 58 data and it comes to 56 to calculate Auto-Correlation.

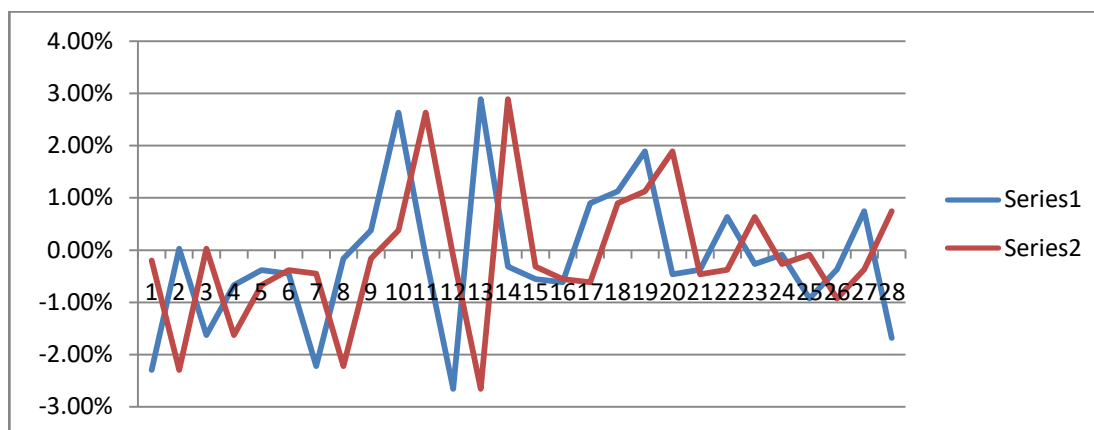


Figure 3: Series 1 shows R_t and Series 2 shows R_{t-1} over 30 daily non-COVID data

(Source: As created by the Author)

It consists of 30 data and it comes to 28 to calculate Auto-Correlation.

As earlier, it was mentioned that the sample periods were taken into three divisions and calculated correlation coefficients separately; now, the hypothesis test is also conducted for those three periods separately. For the 5 years' data, the calculated value is -0.5621 and the critical value for a 5% level of significance with 57 degrees of freedom is 2.0025. For 3 month COVID period, the calculated value is -1.4017 and the critical value for a 5% level of significance with 55 degrees of freedom is 2.0040. For non-COVID 30 daily data, the calculated value is -0.4703 and the critical value for a 5% level of significance with 27 degrees of freedom is 2.0518.

8. Conclusion

Three periods are tested separately for all cases. The overall findings have shown that the modulus calculated value is found to be less than the critical value. Therefore, the null hypothesis is accepted for all three cases. Henceforth, it can be concluded that all coefficients of correlation among successive price changes are statistically insignificant. Therefore, the behavior of the Indian Stock Market is random. There is no such relation between yesterday's price, today's price, and tomorrow's price. Moreover, the chartist techniques which are widely and popularly used have no statistical relevance for predicting future price movements. It may be said that the technical analysis cannot predict the future price movements of stocks. Thus, the belief in charts and patterns is similar to the belief in astrology. Moreover, in this weak form of an efficient market, blindly and fully relying on technical analysis may cost a trader infinitely.

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