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Tail risk hedging analysis and performance in the Stock Market

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ABSTRACT
The research paper is about the topic on tail risk management in the stock market. It is an empirical study being conducted in the context of quantitative analytical study that is very essential in the field of finance with the help of data analytical tools. This research paper is about how the tail risk is measured with the help of secondary historical data which is very essential to forecast the future trends and various other statistical measures would help in describing the data and giving the results on the basis of which the investors can take any decision relating to the investment strategies in order to gain more returns on investment.

Keywords: Tail risk, ARIMA model, autocorrelation, Nifty index, Tata stock.

I. INTRODUCTION

This paper talks about the research area of hedging strategies in measuring the tail risk of the stock market prices that would keep on fluctuating with the variable of time that is in time series measurement. The importance of tail risk has been a given lot since rise in the financial markets in the very recent years. Based on the historical data there has been suffer in significant losses in the equity market industry since the financial crisis in 2008 that has resulted in economic turmoil. The meaning of tail risk originates from the frequency plot of daily returns in the given asset with the expression of model in terms of probability distribution. The extreme values are defined as left and right tails of the distribution curve where the scatter values are plotted. The investors would investigate the situations whether the distribution has any extreme values in left or right tail that poses the probability risk of an asset suffering from large negative values of daily returns.

The goal and advantages of tail hedging for investors are the main topics of this paragraph's succinct and understandable description of the strategy. Below is a summary of the main ideas. Concerns among investors are mostly focused on left-tail risk, or the chance that an asset will have significant negative daily returns. Investors who experience significant drawdowns may be forced to make unfavourable choices, such as contributing funds to pension schemes at the wrong times. By limiting the size of significant negative returns, tail hedging shields investors against the worst possible financial outcomes, this enables them to take advantage of the greater potential profits while investing in risky assets like frontier market and emerging market stocks.

Reduces drawdowns: During market downturns, tail hedging shields investors from significant losses and keeps them from having to liquidate their assets at a loss.Enhances risk tolerance: Tail hedging gives investors the trust to invest in more risky asset classes by reducing risk enhances adherence: If investors' downside risk is reduced, they are more inclined to stick with their investments during market cycles.Liquidity: During market downturns, tail hedges can be utilised to create cash, which can subsequently be used to buy assets at discounted rates.

Many solutions have arisen in response to the increasing demand for tail hedging; they can be broadly classified into two categories: options-based and cash-based approaches. Put options grant an investor the authority to sell a certain asset by a specified date (expiration date) at a predefined price (the strike price). By reducing potential losses if the security's price falls drastically, they offer downside protection. With variance swaps, investors can swap anticipated volatility for real volatility. By purchasing premium, an investor effectively insures against significant price fluctuations by receiving a reward if realised volatility surpasses a predetermined threshold. Put options and digital options are comparable in that they both provide a fixed payout if the asset price drops beneath the strike price.

Portfolio diversification; The influence of tail events on any one asset can be lessened by distributing assets over a range of asset classes with varying risk profiles. Cash Reserves: Keeping a component of an investment portfolio in cash allows for easy access to funds in times of market weakness, which may be used to pay bills or buy assets at a bargain. Trend-Following Strategies; These try to profit from rising markets while limiting substantial losses during downturns by

buying and selling assets according to their present momentum. Exchange-traded funds (ETFs) that track the outcomes of investments that do well during times of market stress are known as tail risk ETFs. They provide investors with a diversified approach to hedging against tail risk.

A certain amount of your portfolio is dynamically allocated to cash as part of cash-based tail hedging. The objective of this approach is to enhance awareness of equity markets during bull markets and decrease it during bear markets. This method, which started off as portfolio insurance and eventually developed into constant proportion portfolio insurance, has been in use for many years. The performance of a new currency-based tail hedging technique is compared to that of established cash and options-based approaches in this article. This paper examines the characteristics of tail volatility and risk in equities markets prior to outlining the approach.

Tail Risk Measurement in Equity Markets

Having to reduce the risk of volatility in the equity markets during the fall of prices, the indication of such events should be required to minimise the losses and hedge the risk. Return predictions are difficult to make and frequently wrong. This is especially true for the daily return of stocks or indexes. The daily returns in Figure 1 have little to no autocorrelation, which suggests unpredictability and difficulties in predicting future moves. Volatility that is both persistent and clustered: Although daily returns are not always predictable, there is a notable degree of persistence and clustering in the market's volatility as indicated by squared returns. This implies that high fluctuations in various time intervals would be followed by adding more volatile situations and that is paradoxical in nature.

Volatility forecasting: Scholars such as Fleming and colleagues (2001, 2003), Campbell & Hentschel (1992), Akgiray (1989), and Brailsford with Faff (1996) have investigated techniques to forecast potential volatility based on historical behaviour. Portfolio construction: By considering the volatility's persistence, investors can create portfolios that can withstand market downturns and seize chances when conditions are calmer. Overall, this section highlights how crucial it is to consider both the permanence of volatility and the unpredictable nature of returns when building portfolios and making investment decisions.

A negative relationship between volatility and returns is confirmed by the paragraph: higher volatility, lower returns. According to data research, average returns were higher during times of low volatility and lower during times of high volatility. This correlation is valid for both emerging and U.S. markets. Similar degrees of volatility, notable variations in returns: Surprisingly, the average volatility for U.S. and Emerging Markets across deciles was comparable, defying the common belief that Emerging Markets are intrinsically riskier.

Increased possibility for tail hedge in emerging market: Emerging markets showed a significantly larger disparity in returns among the most volatile and bottom deciles, even with comparable levels of volatility. This means that tail hedging methods based on volatility may be more successful than those based on US equities in enhancing returns adjusted for risk for Emerging Markets.

The finding implies that, in comparison to their counterparts in American markets, traders in emerging markets may gain more from tail hedging techniques. They may be able to take advantage of the greater potential return of emerging market economies while lowering the chance of substantial losses by using tail hedging, which reduces the downside risk connected with times of high volatility.

Prediction of the CAPM: According to the CAPM, the expected return of a well-diversified portfolio should rise in direct proportion to its volatility. This implies that investments with a bigger potential payout should be riskier. It demonstrates that times of high unpredictability were linked to poorer average returns for both the United States and Emerging Markets, whereas times of low volatility provided greater average returns for relevant for stocks: This is not just an index-specific finding. More volatility does not necessarily equate to higher returns for individual equities, as numerous research on the global equity markets have shown.

Research Methodology

I have taken the data from National Stock Exchange that is Index stock as well as the company stock of Tata from the website of yahoo finance in which this is a secondary data and done some of the data collection with the variables of adjusted close with the time series data of both the variables that is NSE index and Tata stock. I have used the statistical tool such as Autocorrelation and Partial Autocorrelation analysis to estimate the number of residual values of both the stocks from the lag values of historical data.

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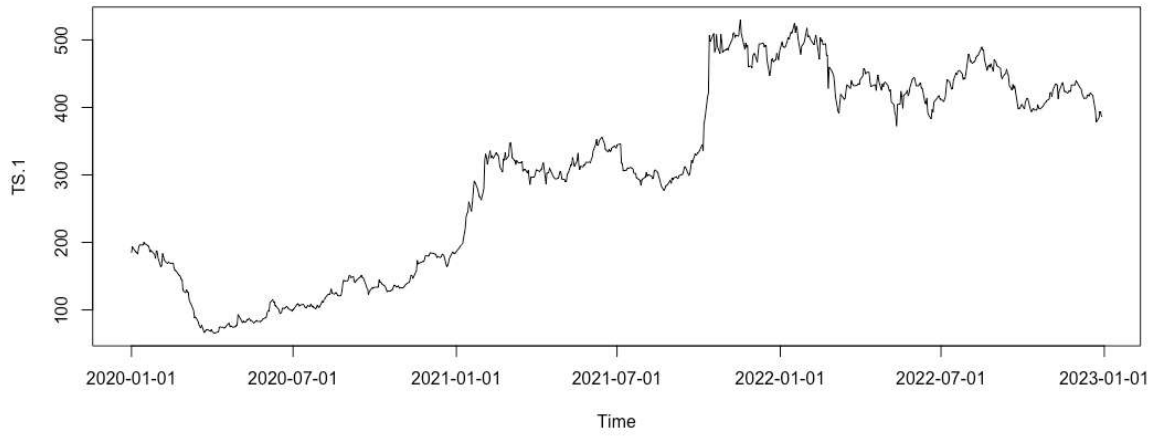
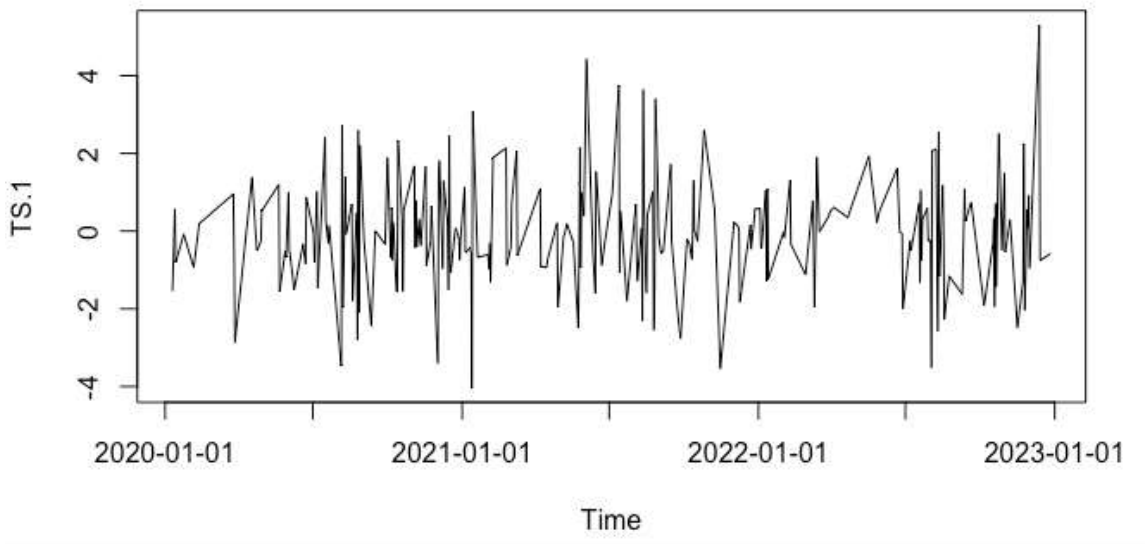
II. DATA ANALYSIS AND FINDINGS



The above graph is about the plot of Tata company stocks over the years with the using of time series analysis of historical figures. Showing the past performance of the stock over the period of four years. This is about the stock performance with the relation to the index stock of NSE that is having a bullish trend in the long term.



The above line graph shows about the timeseries of Tata company stock's returns from the time of four years which is about maintaining the returns on the adjusted close of the given stock over a period.

The below given diagrams in page number 6 would have the timeseries, this would show that the data set is said to be stationary. The below histogram shows about the Tata company's with its returns from the adjusted close.

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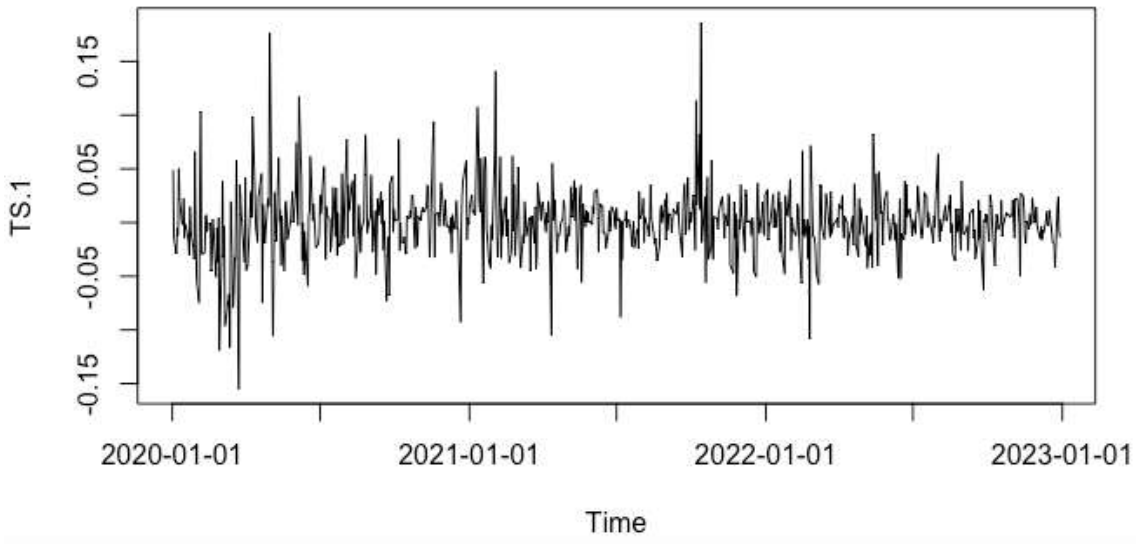

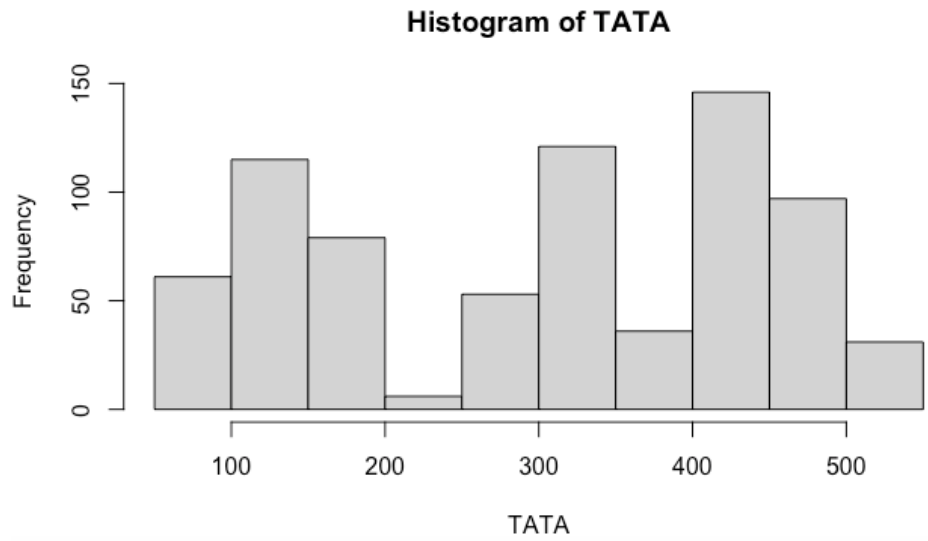

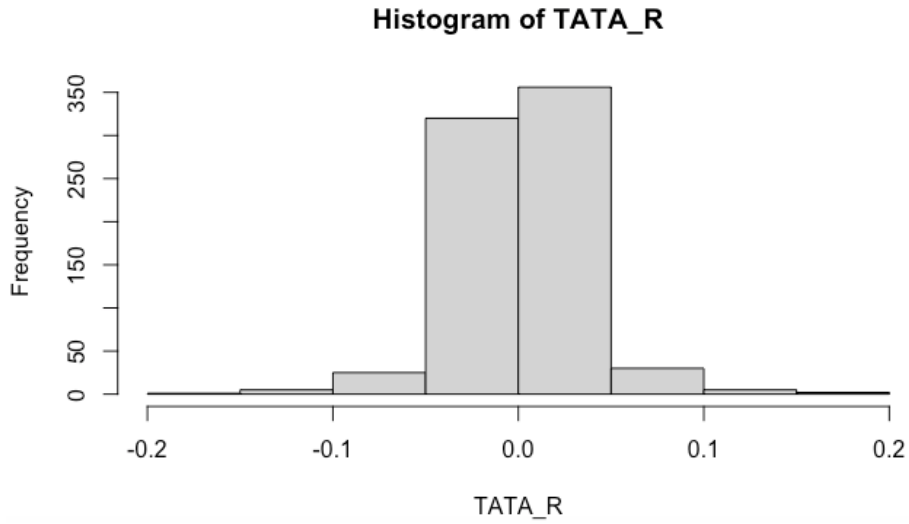

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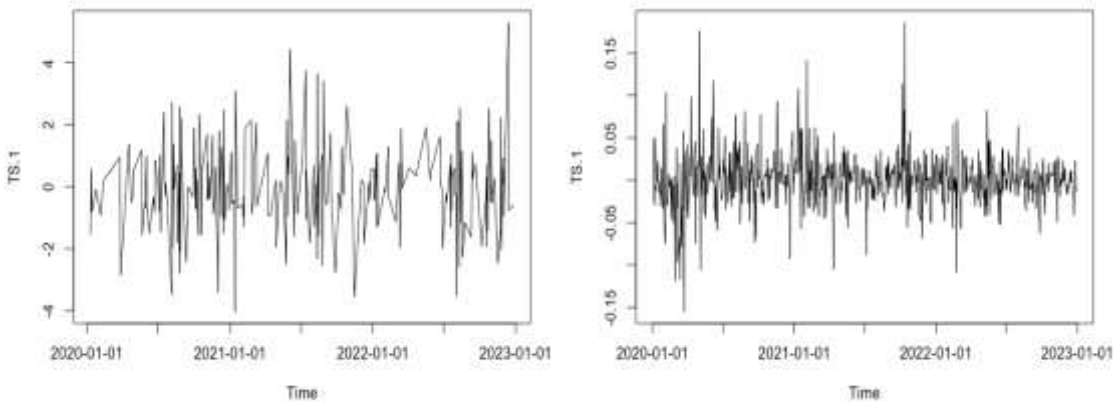
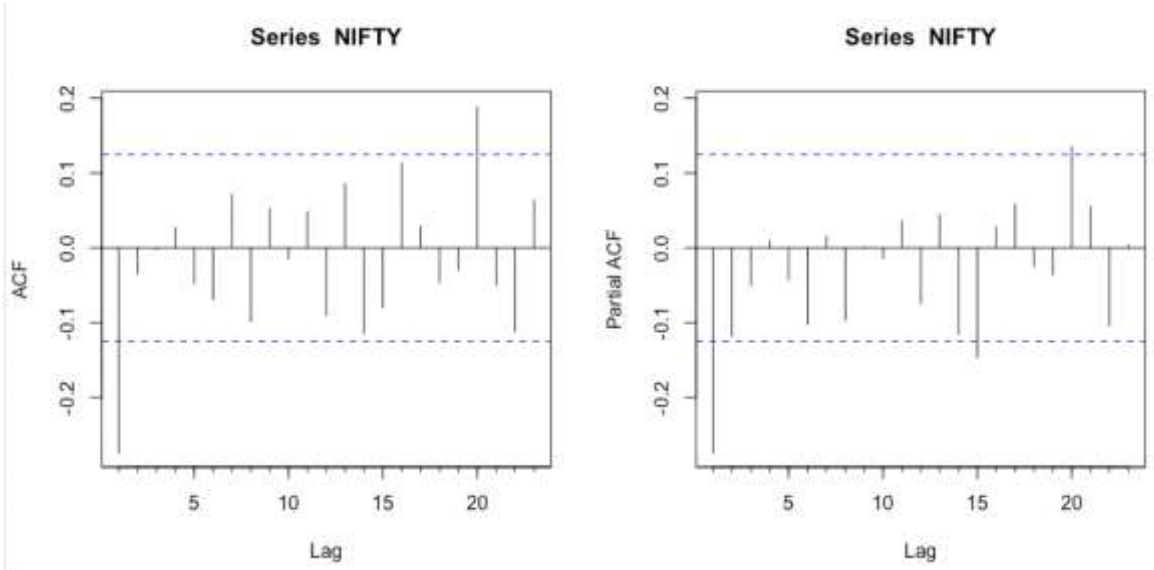


The above plot shows about the residual values of both the Nifty as well as the Tata company stocks to determine the level of stationary of both the variables in the time series analysis.

The below diagram shows the Autocorrelation function results of Nifty with its partial autocorrelation that would explain the stationary of the autoregressive values with index stocks. Given all lag values more than one, the results of both the measures in which the PACF value is more accurate than just the autocorrelation function.



The below diagram shows the similar results just like the Nifty index, the time series of Tata's company stock index is also stationary and more stationary with the lag values more than the lag values of the index stock. This means that the residual value is more accurate with the company's stock compared to the index stock.

The given below diagram also shows the residual values from the ARIMA model that would help in forecasting with the given autocorrelation among the residuals compared with seasonality.

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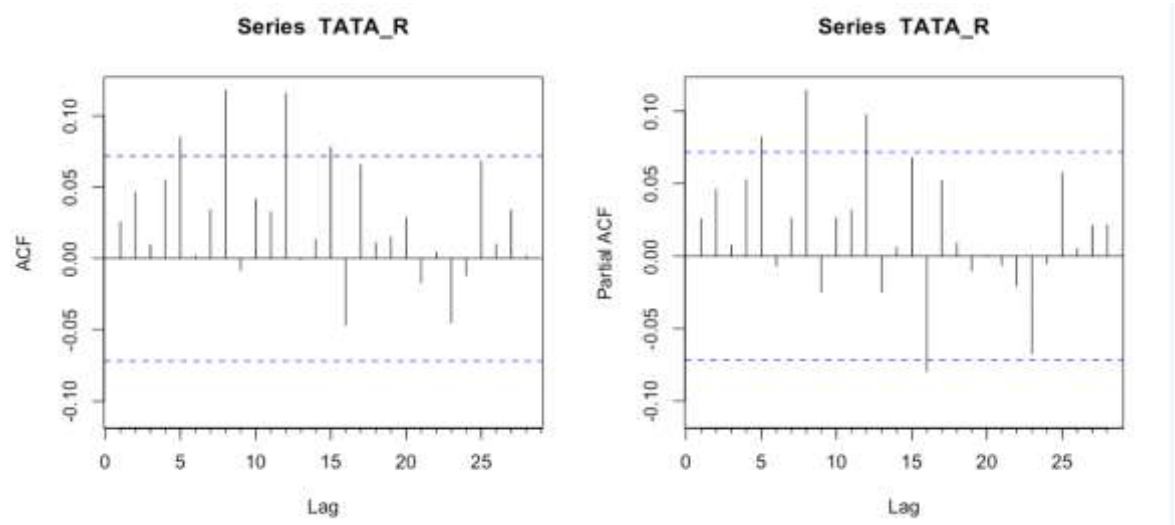

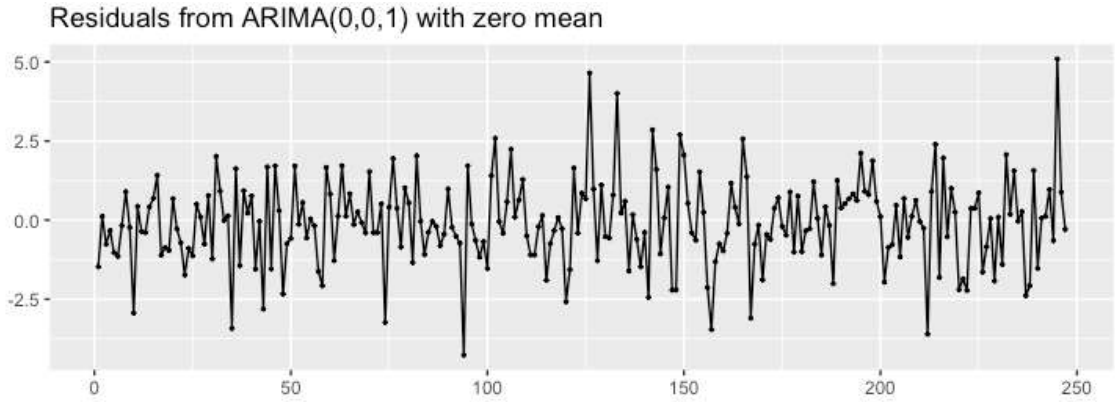

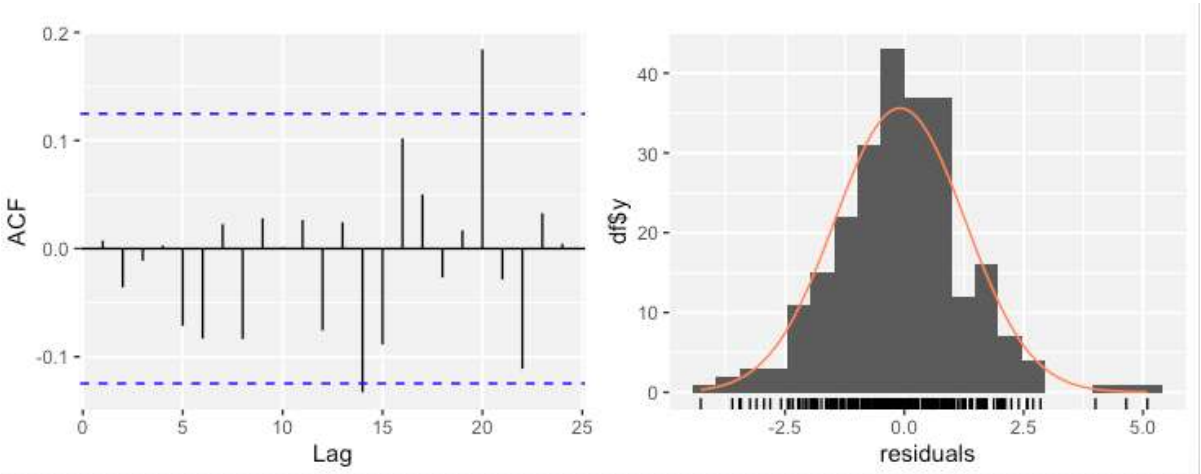

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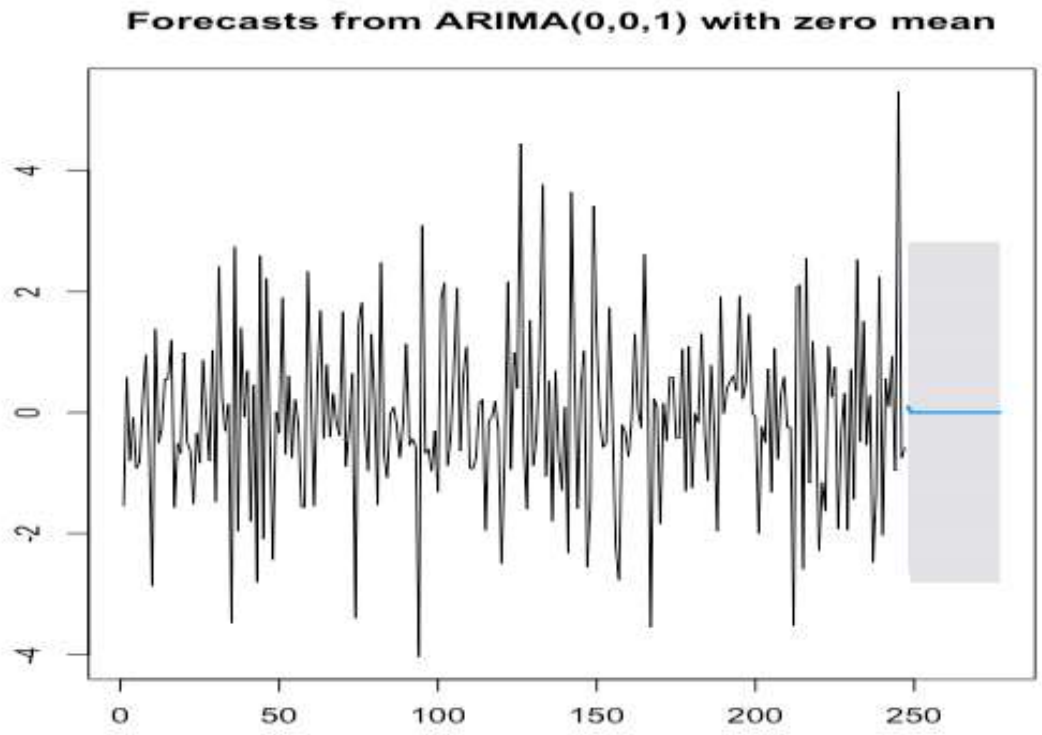


```
> #Step-6:ARIMA Model Identifying best fit model (Model Diagnosis)
> ModelN=auto.arima(NIFTY,max.p = 20,max.q = 20)
> summary(ModelN)
Series: NIFTY
ARIMA(0,0,1) with zero mean

Coefficients:
          ma1
      -0.3218
s.e.   0.0630

sigma^2 = 1.867:  log likelihood = -427.13
AIC=858.27   AICc=858.32   BIC=865.29

Training set error measures:
                     ME      RMSE       MAE       MPE
Training set -0.0904271 1.363597 1.031328 14.98829
                  MAPE      MASE        ACF1
Training set 213.5542 0.5801446 0.007496808
> checkresiduals(ModelN)

        Ljung-Box test

data:  Residuals from ARIMA(0,0,1) with zero mean
Q* = 5.5791, df = 9, p-value = 0.7812

Model df: 1.   Total lags used: 10
```

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> checkresiduals(ModelN)

        Ljung-Box test

data:  Residuals from ARIMA(0,0,1) with zero mean
Q* = 5.5791, df = 9, p-value = 0.7812

Model df: 1.   Total lags used: 10

> ModelN=auto.arima(TATA,max.p = 20,max.q = 20)
> summary(ModelN)
Series: TATA
ARIMA(3,1,3)

Coefficients:
          ar1      ar2      ar3     ma1     ma2     ma3
      -1.4322  -1.4026  -0.7976  1.4272  1.4683  0.7942
s.e.   0.0974   0.0795   0.0845  0.1052  0.0771  0.1020

sigma^2 = 80.48:  log likelihood = -2685.38
AIC=5384.77   AICc=5384.92   BIC=5417.05

Training set error measures:
                    ME     RMSE      MAE         MPE     MAPE      MASE          ACF1
Training set 0.2679609 8.928683 5.880717 0.05065321 2.149788 0.9988592 -0.001670779
> #Step-7:Forecast (once your model is fitting)
> mydischargeforecast = forecast(ModelN, level = c(95), h = 30)
> mydischargeforecast
    Point Forecast     Lo 95
248     0.09433401 -2.583693
249     0.00000000 -2.813284
250     0.00000000 -2.813284
251     0.00000000 -2.813284
252     0.00000000 -2.813284
253     0.00000000 -2.813284
254     0.00000000 -2.813284
255     0.00000000 -2.813284
256     0.00000000 -2.813284
257     0.00000000 -2.813284
258     0.00000000 -2.813284
259     0.00000000 -2.813284
260     0.00000000 -2.813284
261     0.00000000 -2.813284
262     0.00000000 -2.813284
263     0.00000000 -2.813284
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265     0.00000000 -2.813284
266     0.00000000 -2.813284
267     0.00000000 -2.813284
268     0.00000000 -2.813284
269     0.00000000 -2.813284
270     0.00000000 -2.813284
271     0.00000000 -2.813284
272     0.00000000 -2.813284
273     0.00000000 -2.813284
274     0.00000000 -2.813284
275     0.00000000 -2.813284
276     0.00000000 -2.813284
277     0.00000000 -2.813284
```

The above results show the summary of ARIMA models of both the variables such as the index stock and the company's stock. Given the residual values of the appropriate ARIMA order will be the most suitable ARIMA compared to other ARIMA models. This means that the values of both the index as well as the company's future forecast would be for another 30 days from the historical data with its residual value with the level of significance of 95 percent interval that would show the accuracy of the forecast of values with the given level of residual values that is shown above.

III. CONCLUSION

These above strategies using various statistical methods such as using ARIMA can be very useful in analysing as well as forecasting the future trends based on the historical trends that would have significant results for the investors to make good judgements that is future valuation of stocks based on stock index performance with overall systematic risks involved. This research paper provides a significant empirical test to find the appropriate statistical and probability applications which would provide the accurate estimates whether this statistical tool provides the advanced data analytics for analysing the stock market data.

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