Forecasting Volatility of Stock Returns of TATAMOTORS.NS

Abstract:

This research paper investigates the forecasting of volatility in stock returns utilizing Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models, focusing on the stock of Tata Motors Limited (TATAMOTORS.NS). The study begins with an exploratory analysis of the stock price and returns, followed by the application of GARCH models to forecast future volatility. We examine the stationarity of the stock price and returns using statistical tests and explore the autocorrelation properties. Subsequently, various GARCH models are employed to capture the time-varying volatility, and their performance is evaluated. The findings suggest that GARCH models can effectively capture the volatility clustering and heteroskedasticity in the stock returns of TATAMOTORS.NS, thereby aiding in better risk management and investment decision-making.

1. Introduction:

Forecasting volatility in financial markets is crucial for risk management and asset pricing. Volatility, characterized by the magnitude of fluctuations in asset prices, reflects the level of uncertainty and risk associated with financial investments. Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models have emerged as powerful tools for modelling and forecasting volatility, offering insights into the dynamics of financial markets.

This study focuses on forecasting volatility in the stock returns of Tata Motors Limited (TATAMOTORS.NS), a prominent player in the automotive industry. By employing GARCH models, we aim to provide valuable insights into the volatility dynamics of TATAMOTORS.NS stock, which can assist investors, portfolio managers, and risk analysts in making informed decisions.

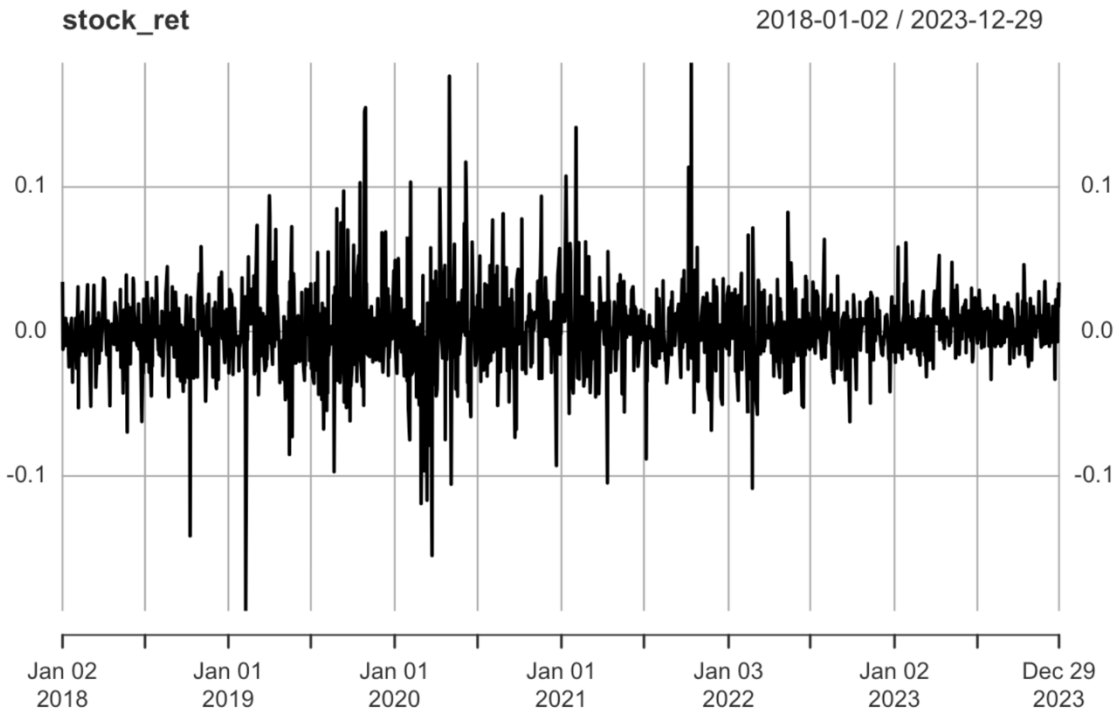
2. Data and Methodology:

The data used in this study comprises daily stock prices of TATAMOTORS.NS from January 1, 2018, to December 31, 2023. We begin with exploratory data analysis to understand the behaviour of stock prices and returns over the given period. Next, we conduct statistical tests to assess the stationarity of the data and examine autocorrelation properties.

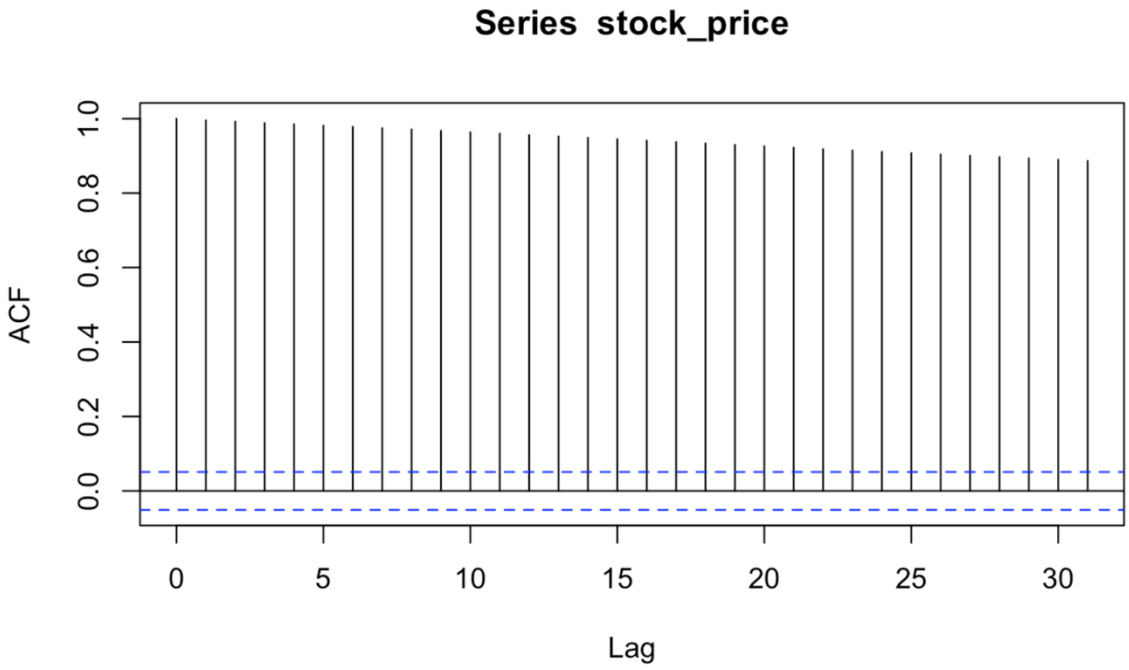
Subsequently, we employ various GARCH models to forecast future volatility. These models include the standard GARCH(1,1) model as well as more complex specifications such as ARMA-GARCH and ARFIMA-GARCH. The performance of each model is evaluated based on criteria such as log-likelihood, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC).

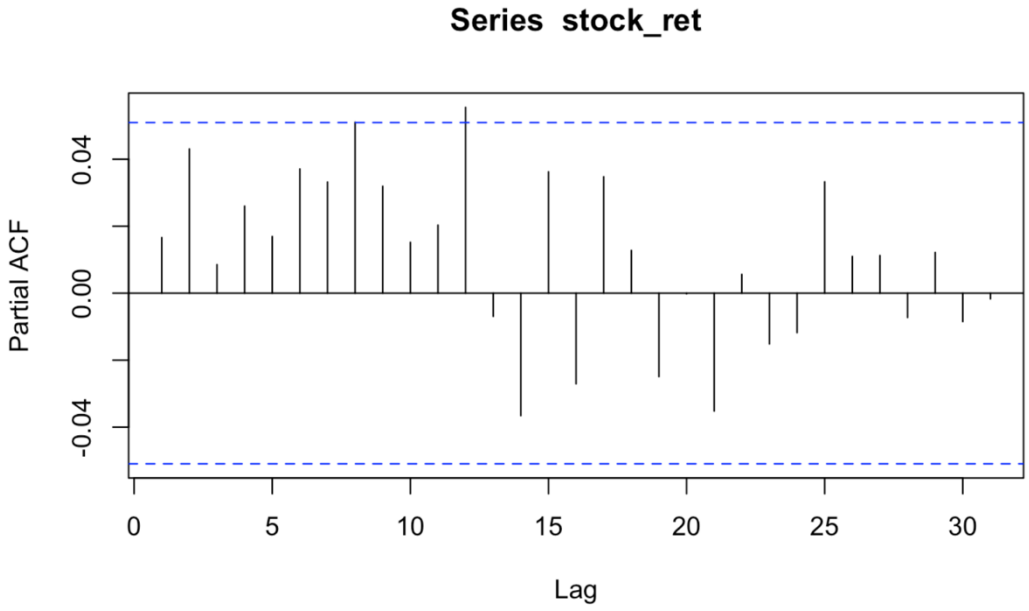
3. Results:

- **Stationarity Analysis** - The Augmented Dickey-Fuller (ADF) test was employed to assess the stationarity of the stock price and returns. The results indicated that the stock price series is non-stationary, while the differenced returns series is stationary.

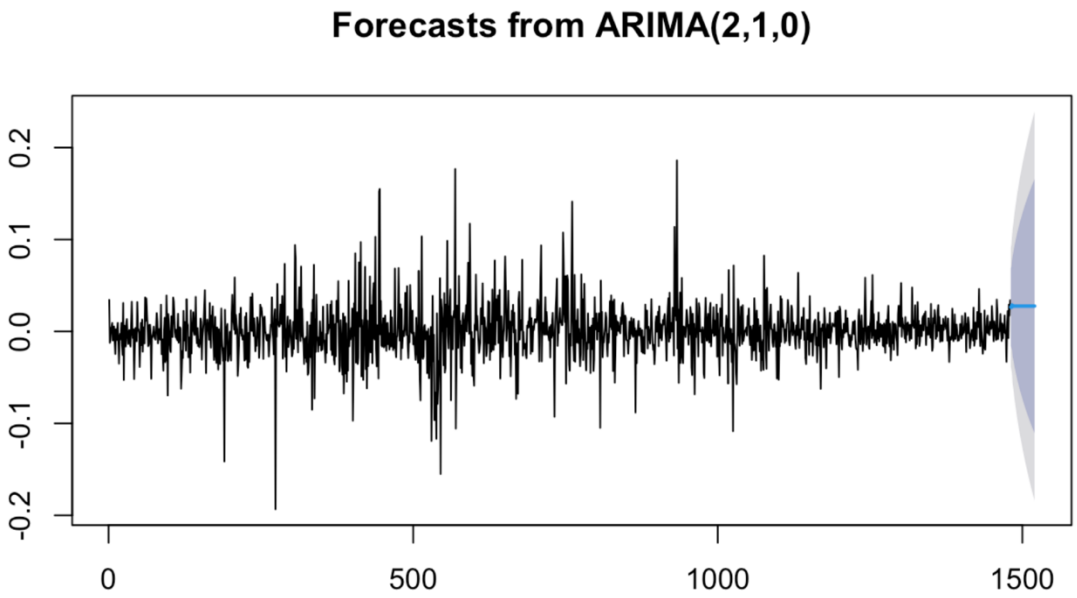


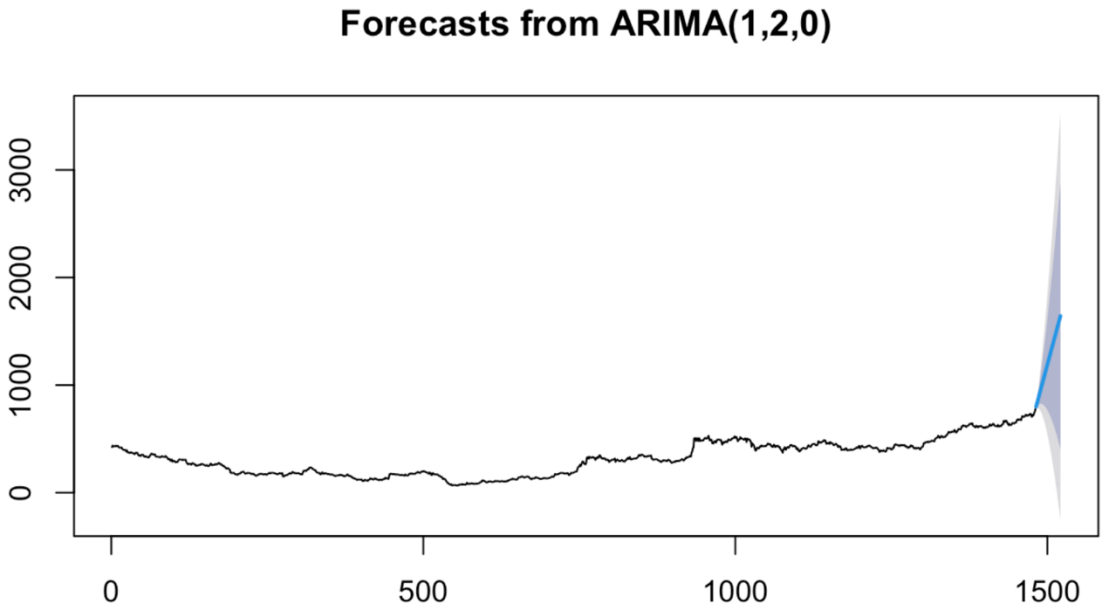
- **Autocorrelation Analysis** -The Ljung-Box test was conducted to identify autocorrelation in the stock returns series. The results suggested the presence of autocorrelation in the stationary returns series.



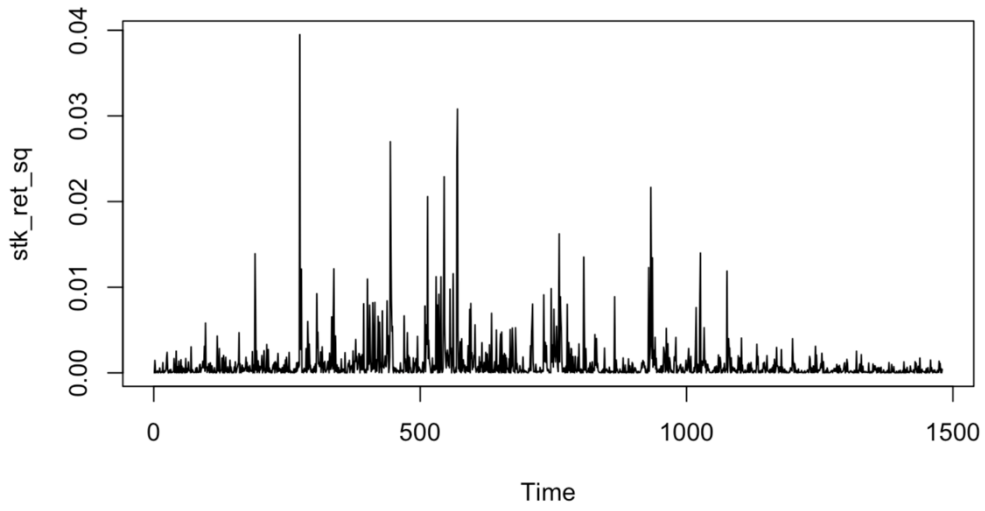


- **ARIMA Modelling** -Auto ARIMA was used to fit ARIMA models to both the stock price and returns series. The selected models were ARIMA(1,2,0) for stock price and ARIMA(2,1,0) for returns.





- **Volatility Clustering Tests**- Tests for volatility clustering and heteroskedasticity, including Box test and ARCH test, were conducted. The results indicated the presence of volatility clustering in the returns series.



- **GARCH Modelling** Two GARCH models were fitted to the returns series. The first model assumed an ARMA(0,0) mean structure, while the second model employed an ARMA(4,5) mean structure.

- **GARCH Forecasting** GARCH forecasts for the future volatility of the returns series were generated. The forecasts provided estimates of volatility for the next 50 time periods.

4. Discussion and Conclusion:

The findings of this study underscore the importance of employing GARCH models for volatility forecasting in financial markets. By accurately capturing the volatility dynamics of TATAMOTORS.NS stock returns, these models enable market participants to better understand and manage risk.

The analysis revealed the presence of autocorrelation and volatility clustering in the stock returns series of TATAMOTORS.NS. ARIMA and GARCH models were successfully fitted to the data, and forecasts for future volatility were provided.