FINANCIAL RISK ANALYSIS AND MANAGEMENT

FIRST SEMESTER 2022-23

A logo of a science and technology company

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GROUP 49

SUBMITTED BY

|  |  |  |
| --- | --- | --- |
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**Schneider Electric Infrastructure Limited**

1. Nature of the business (Banking, software, manufacturing etc.)

Schneider Electric Infrastructure Limited is a company that manufactures, designs, builds and services products and systems for the electricity network. The nature of the business is energy management and automation, Schneider Electric Infrastructure Limited are trying to redefine the field of energy management by integrating automation and new technologies such as IoT, Big Data and are leading the digital transformation in the industry.

1. Public or private ownership

Schneider Electric Infrastructure Limited is a public company. 75% of the company is owned by the promoters and 21% is owned by retail investors. The rest of the company is owned by FIIs and DIIs.

1. When did these companies started & under what circumstances?

The company was incorporated in the year 2011 when Schneider Electric a European company saw a potential in opening an Indian subsidiary and catering to the Indian market.

1. Overall greatness of the companies

Schneider Electric Infrastructure Limited is a market leader in the energy management segment and has a market cap of about 8000 crores. They have four facilities in India spread over 3 locations and are slowly making their presence felt in the Indian landscape with their vision of leading the digitized energy world.

**Sobha Limited**

1. Nature of the business (Banking, software, manufacturing etc.)

Sobha Limited previously Sobha Developers Limited is a Luxury Realty development company whose roots can be traced to Oman but is currently based out of Bangalore.

The nature of business is construction and Sobha limited believes in benchmark quality, customer satisfaction, robust engineering, and unwavering business ethics.

1. Public or private ownership

The company is a public company and 52% of the company is held by promoters, 21% is held by retail investors, 15% is held by DII, and 11% is held by FII.

1. When did these companies started & under what circumstances?

Sobha Limited was started in 1995 with the vision of delivering quality and luxury to the Indian realty market. The founder was of Indian origin and had a 3 decade long successful and decorated career and wanted to replicate his success in India.

1. Overall greatness of the companies

The company is one of the trusted choices of an Indian consumer looking to enter the real estate market. The company has a 8000 crore market cap and stable financials and has some impressive projects namely some Omani Royal palaces.

**Swaraj Engines Limited**

1. Nature of the business (Banking, software, manufacturing etc.)

Swaraj Engines makes diesel engines with horsepower ranging from 22Hp to 66Hp. The company has highly productive and accurate machines and its nature of business is manufacturing and technology.

1. Public or private ownership

The company is a public company and 52% of the shares are held by the promoters, 36% of the shares are held by retail investors, 9% of the shares are held by DIIs and 2% are held by FIIs.

1. When did these companies started & under what circumstances?

The company started in 1985 and was promoted by 2 already established and known companies to further their interests in the field of diesel engines.

1. Overall greatness of the companies

Swaraj Engines limited is a market leader in mobility and engine design it has a 2600 crore market cap and is one of the driving forces of the nation’s development. It is very likely that if a truck is chosen out of random it is likely that it owes its power to an engine derived from swaraj engines developmental work.

**Tips Industries Limited**

1. Nature of the business (Banking, software, manufacturing etc.)

Tips industries Limited is a media company and owns copyrights to multiple popular soundtracks and Hindi movies. The nature of business is media and entertainment.

1. Public or private ownership

The company is a public company and 75% of the shares are held by the promoters, 24% are held by retail investors and 1% are held by FIIs and DIIs.

1. When did these companies started & under what circumstances?

The company started in 1975 and the founding brothers used to trade LPs for some of the biggest companies in India and by 1977 they had become one of the biggest companies in this field after that they just kept evolving with time and we can see the industry it has become today.

1. Overall greatness of the companies

The company has a market cap of 4500 crores and is one of the few companies that has made large profits to the retail investors ever since it was a penny stock. Tips owns 3500 title and boasts more platinum and gold titles than any other competitor.

**Uti Sensex Exchange Trade Fund**

1. Nature of the business (Banking, software, manufacturing etc.)

This is an exchange traded fund that works much like a mutual fund but here the under lying asset is Sensex.

1. Public or private ownership

It is an ETF, so this question is not relevant.

1. When did these companies started & under what circumstances?

This fund started to be traded on the market in 2007.

1. Overall greatness of the companies

The company that offers this fund UTI( union trust of India ) is a well-established financial services company in India.

**Wockhardt Ltd**

1. Nature of the business (Banking, software, manufacturing etc.)

Wockhardt Limited is India’s leading research based global health care enterprise that contribute to the field of Pharmaceuticals, biotechnology, active pharmaceutical ingredients, and super speciality hospitals. Wockhardt is a reputed Indian multinational pharmaceuticals company, and its nature of business is pharmaceuticals and healthcare research.

1. Public or private ownership

This is a public company with 55% of the shares being held by promoters, 42% is held by retail investors and 3% is held by FIIs.

1. When did these companies started & under what circumstances?

Wockhardt was started in the 1960s by Dr.Habil Khorakiwala. In the 1960s India was severely lacking adequate medicines and health care means Wockhardt was started to fill that void and it has gone on to acquire multiple American and European healthcare companies.

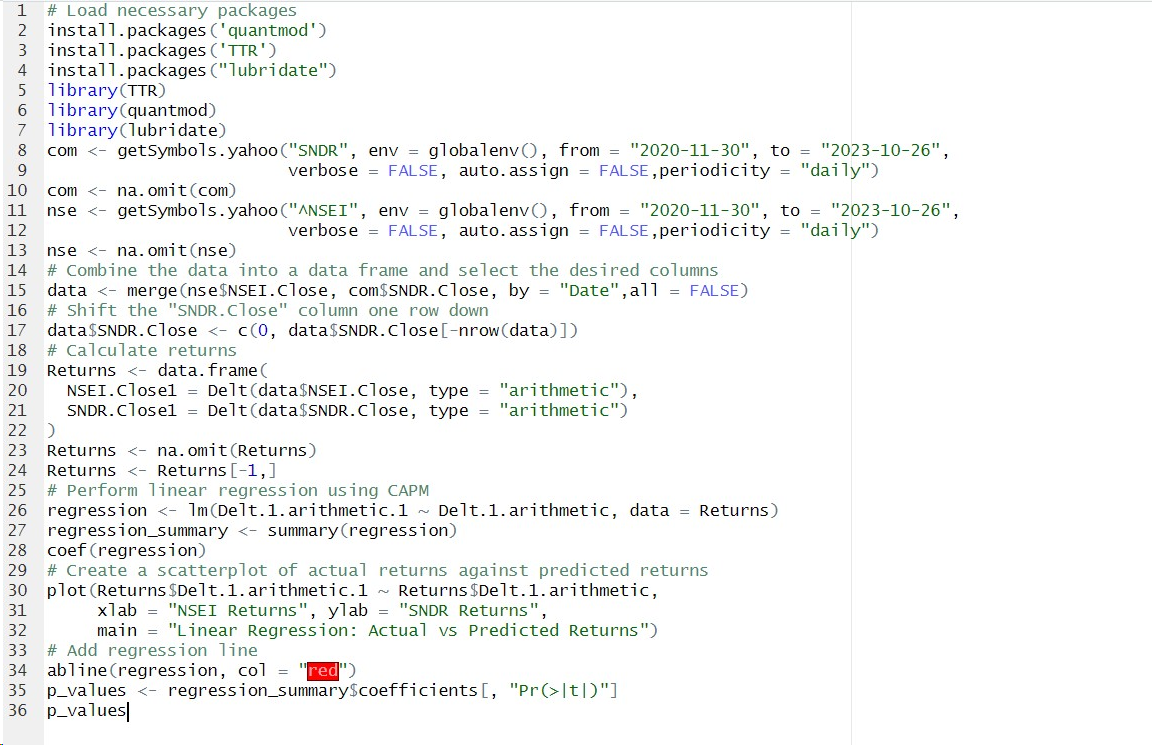
1. Overall greatness of the companies

Wockhardt has a market cap of 4800 crores and has multiple super speciality hospitals and is the first company outside us and Europe to manufacture insulin. Wockhardt is a company whose work has made the niche medicines available in India at an affordable price.

**NOTE:** The sentences highlighted in yellow are important and the sentences highlighted in green are very important.

**CAPM MODEL**

Code for CAPM model:



**Interpretation of code:**

This code performs a linear regression using the Capital Asset Pricing Model (CAPM) on stock return data obtained from Yahoo Finance for two assets, "xyz" and the NSE index (^NSEI). Here's a breakdown of what each part does:

1. **Loading Packages:** It begins by installing and loading necessary R packages (`quantmod`, `TTR`, `lubridate`) for financial analysis and handling time series data.

2. **Fetching Stock Data:** It fetches historical stock data for the "xyz" stock and the NSE index (^NSEI) from Yahoo Finance using `getSymbols.yahoo()` function from the `quantmod` package.

3. **Data Cleaning:** Removes missing values (NA) using `na.omit()`.

4**. Combining Data:** Merges the adjusted closing prices of the NSE index and "SNDR" stock into a single data frame based on the common dates.

5**. Calculating Returns:** Computes the weekly returns for both assets using the `Delt()` function with an arithmetic method. It shifts the "SNDR.Close" column by one row to align returns properly.

6. **Linear Regression:** Performs a linear regression using the CAPM model by regressing the returns of the "SNDR" stock (`Delt.1.arithmetic.1`) on the market returns (NSE index - `Delt.1.arithmetic`). The `lm()` function fits the regression model.

7. **Regression Summary:** Retrieves the summary of the regression model, including coefficients and p-values for the coefficients.

8. **Visualization:** Creates a scatterplot to visualize the relationship between the actual returns of "SNDR" and the predicted returns using the regression model. It adds a red regression line (`abline()`) to the plot.

9. **P-values:** Extracts the p-values for the coefficients from the regression summary.

This script essentially fetches stock data, calculates returns, performs a regression analysis using CAPM, and visualizes the relationship between the returns of "SNDR" and the market returns (^NSEI). The p-values can indicate the significance of each coefficient in the regression model.

**SOME DETAILS ABOUT CAPM MODEL:**

CAPM model

Expected Return=*RF*+*β*×*MRP*

Here by using the above code, we calculate the beta by using regression. The regression formula is as follows

R= ALPHA +BEAT\*(MRP)+e

R= excess return of the stock

**Note here we have taken Rf= 0 for simplicity and confidence interval is 95%**

**COMPANY 1- SCHNEIDER**

The code mentioned above gives the following output for daily returns

alpha- 0.0002743846

beta- 0.3349551738

Pvalue- 2.836022e-06

The Regression graph is

A graph with a red line and a black line

Description automatically generated

Data interpretation:

So, beta = 0.33 means that the SCHNEIDER stock is 67% less volatile than the market. Also, the p-value is less than 0.05, so the data is statistically significant, and the graph also shows that both the returns have a high correlation

The code mentioned above gives the following output for weekly returns by changing the periodicity:

Output:

alpha- 0.001587952

beta- 0.291216011

P-value- 0.05137857

The Regression graph is as follows:

A graph with a red line and black dots

Description automatically generated

Data interpretation:

So, beta = 0.29 means that the SCHNEIDER stock is 71% less volatile than the market. Also, the p-value is greater than 0.05, so the data is not statistically significant, and the graph also shows that both returns have a moderate correlation.

The data is insignificant because of underfitting of data from 252 points per year 52 points per year

The code mentioned above gives the following output for monthly returns by changing the periodicity:

Output:

alpha- 0.006221728

beta- 0.867583731

P-value- 0.08302026

The Regression graph is as follows:

A graph with a red line

Description automatically generated

Data interpretation:

So, beta = 0.87 means that the SCHNEIDER stock is 13% less volatile than the market. Also, the p-value is greater than 0.05, so the data is not statistically significant, and the graph also shows that both returns have a low correlation.

The data is insignificant because of underfitting of data from 252 points per year 12 points per year

Conclusion the variation in beta is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily beta if its less than a month than weekly and greater than month then monthly beta and data is victim of underfitting in monthly and weekly case

**COMPANY 2- SOBHA(SOBHA.NS)**

The code mentioned above gives the following output for daily returns

alpha- 0.001449661

beta- 0.253361700

Pvalue- 0.03656665

The Regression graph is

A graph with a line and a black line

Description automatically generated with medium confidence

Data interpretation:

So, beta = 0.25 means that the SCHNEIDER stock is 75% less volatile than the market. Also, the p-value is less than 0.05, so the data is statistically significant, and the graph also shows that both the returns have a high correlation

The code mentioned above gives the following output for weekly returns by changing the periodicity:

Output:

alpha- 0.001587952

beta- -0.15642629

P-value- 0.12137857

The Regression graph is as follows:

A graph with dots and lines

Description automatically generated

Data interpretation:

So, beta = -0.16 means that the SCHNEIDER stock is 116% less volatile than the market. Also, the p-value is greater than 0.05, so the data is not statistically significant, and the graph also shows that both returns have a moderate correlation.

The code mentioned above gives the following output for monthly returns by changing the periodicity:

Output:

alpha- -0.00107025

beta- 1.73149366

P-value- 0.008918299

The Regression graph is as follows:

A graph with a red line

Description automatically generated

Data interpretation:

So, beta = 1.73 means that the SCHNEIDER stock is 73% more volatile than the market. Also, the p-value is less than 0.05, so the data is statistically significant, and the graph also shows that both returns have a high correlation.

The data is significant infact has a lower p value compared to daily returns which signifies data is victim of overfitting in daily return

Conclusion the variation in beta is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily beta if its less than a month than weekly and greater than month then monthly beta and data is victim of overfitting in daily case

**COMPANY 3- Swaraj Engines Limited (SWARAJENG.NS)**

The code mentioned above gives the following output for daily returns

alpha- 0.0005662808

beta- 0.0420199717

P value- 0.5150044

The Regression graph is as follows

A graph with a number of dots

Description automatically generated

Data interpretation:

So, beta = 0.04 means that the SCHNEIDER stock is 96% less volatile than the market. Also, the p-value is greater than 0.05, so the data is statistically insignificant, and the graph also shows that both the returns have a high correlation

The code mentioned above gives the following output for weekly returns by changing the periodicity:

Output:

alpha- -0.156510752

beta- -0.156510752

P-value- -0.156510752

The Regression graph is as follows:

A graph of a line graph

Description automatically generated with medium confidence

Data interpretation:

So, beta = -0.15 means that the SCHNEIDER stock is 115% less volatile than the market. Also, the p-value is greater than 0.05, so the data is not statistically significant, and the graph also shows that both returns have a moderate correlation.

The code mentioned above gives the following output for monthly returns by changing the periodicity:

Output:

alpha- -0.02718765

beta- -0.15881718

P-value- 0.7642032

The Regression graph is as follows:

A graph with a red line

Description automatically generated

Data interpretation:

So, beta = -0.15 means that the SCHNEIDER stock is 115% less volatile than the market. Also, the p-value is greater than 0.05, so the data is statistically insignificant, and the graph also shows that both returns have a low correlation.

Conclusion the variation in beta is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily beta if its less than a month than weekly and greater than a month, then monthly beta

**COMPANY 4- Tips Industries Limited (TIPSINDLTD.NS)**

The code mentioned above gives the following output for daily returns

alpha- 0.004071922

beta- 0.038726562

P value- 0.7440129967

The Regression graph is as follows

A graph with black dots

Description automatically generated

Data interpretation:

So, beta = 0.04 eans that the SCHNEIDER stock is 96% less volatile than the market. Also, the p-value is greater than 0.05, so the data is statistically insignificant

The code mentioned above gives the following output for weekly returns by changing the periodicity:

Output:

alpha- 0.02004365

beta- 0.27040853

P-value- 0.376495754

The Regression graph is as follows:

A graph of a line graph

Description automatically generated with medium confidence

Data interpretation:

So, beta = 0.27 means that the SCHNEIDER stock is 73% less volatile than the market. Also, the p-value is greater than 0.05, so the data is not statistically significant, and the graph also shows that both returns have a moderate correlation.

The code mentioned above gives the following output for monthly returns by changing the periodicity:

Output:

alpha- 0.1118629

beta- 1.9434308

P-value- 0.1637291

The Regression graph is as follows:

A graph with a red line

Description automatically generated

Data interpretation:

So, beta = 1.94 means that the SCHNEIDER stock is 94% more volatile than the market. Also, the p-value is greater than 0.05, so the data is statistically insignificant.

Conclusion the variation in beta is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily beta if its less than a month than weekly and greater than month then monthly beta

**COMPANY 5- UTI S&P BSE Sensex ETF (UTISENSETF.NS)**

The code mentioned above gives the following output for daily returns

alpha-0.0007059989

beta- 0.0740005294

P value- 0.1059303

The Regression graph is as follows

A graph with black dots

Description automatically generated

Data interpretation:

So, beta = 0.07 means that the SCHNEIDER stock is 93% less volatile than the market. Also, the p-value is greater than 0.05, so the data is statistically insignificant

The code mentioned above gives the following output for weekly returns by changing the periodicity:

Output:

alpha- 0.002701045

beta- 0.041693065

P-value- 0.6066548

The Regression graph is as follows:

A graph of a line graph

Description automatically generated with medium confidence

Data interpretation:

So, beta = 0.04 means that the SCHNEIDER stock is 96% less volatile than the market. Also, the p-value is greater than 0.05, so the data is not statistically significant, and the graph also shows that both returns have a moderate correlation.

The code mentioned above gives the following output for monthly returns by changing the periodicity:

Output:

alpha- 0.007049157

beta- 0.711356560

P-value- 0.0005684576

The Regression graph is as follows:

A graph with a red line

Description automatically generated

Data interpretation:

So, beta = 0.72 means that the SCHNEIDER stock is 28% less volatile than the market. Also, the p-value is less than 0.05, so the data is statistically significant.

Conclusion the variation in beta is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily beta if its less than a month than weekly and greater than month then monthly beta

As beta of daily return is insignificant and monthly data is significant it suggest that data is a victim of overfitting

**COMPANY 6-Wockhardt Limited (WOCKPHARMA.NS)**

The code mentioned above gives the following output for daily returns

alpha-0.000193048

Beta- -0.185825817

P value- 0.1094212

The Regression graph is as follows

A graph with a red line and black dots

Description automatically generated

Data interpretation:

So, beta = -.0.18 means that the SCHNEIDER stock is 118% less volatile than the market. Also, the p-value is greater than 0.05, so the data is statistically insignificant

The code mentioned above gives the following output for weekly returns by changing the periodicity:

Output:

alpha- -0.002928097

beta- 0.308364283

P-value- 0.2003398

The Regression graph is as follows:

A graph with a red line and black dots

Description automatically generated

Data interpretation:

So, beta = 0.31 means that the SCHNEIDER stock is 69% less volatile than the market. Also, the p-value is greater than 0.05, so the data is not statistically significant, and the graph also shows that both returns have a moderate correlation.

The code mentioned above gives the following output for monthly returns by changing the periodicity:

Output:

alpha- -0.04207948

beta- 1.61096514

P-value- 0.02914781

The Regression graph is as follows:

A graph with a red line

Description automatically generated

Data interpretation:

So, beta = 1.61 means that the SCHNEIDER stock is 61% more volatile than the market. Also, the p-value is less than 0.05, so the data is statistically significant.

Conclusion the variation in beta is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily beta if its less than a month than weekly and greater than month then monthly beta

As beta of daily return is insignificant and monthly data is significant it suggest taha data is victim of overfitting

CONCLUSION:

As an analyst if you are expecting the market to go up you would like to purchase shares that has high beta and if you are expecting the market to go down you would purchase the stock with lower value of beta.

**ARIMA MODEL**

**CODE:**

install.packages("tseries")

install.packages("ggplot2")

install.packages("forecast")

install.packages("fpp2")

library(forecast)

library(fpp2)

library(quantmod)

library(tseries)

library(ggplot2)

# Get XYZ stock price data from Yahoo Finance

XYZ <- getSymbols.yahoo("SNDR", from = "2020-11-01", to = "2023-10-26", verbose =

FALSE, auto.assign = FALSE,periodicity = "daily")

# Calculate daily returns

Returns\_XYZ <- as.xts (tail(data.frame(XYZ$SNDR.Close), -1)/head

(data.frame(XYZ$SNDR.Close), -1) -1)

# Rename the returns column

colnames(Returns\_XYZ) <- "Returns"

# Plot XYZ stock price

plot(XYZ$SNDR.Close)

# Plot returns

plot(Returns\_XYZ$Returns)

# Check for stationarity using Augmented Dickey-Fuller test

adf\_test <- adf.test(Returns\_XYZ$Returns, alternative = "stationary")

adf\_test

# ACF and PACF plots for identifying AR and MA orders

acf\_plot <- acf(Returns\_XYZ$Returns, lag.max = 10)

pacf\_plot <- pacf(Returns\_XYZ$Returns, lag.max = 10)

# Fit an ARIMA model

arima\_model <- auto.arima(Returns\_XYZ$Returns)

result <- list(

Optimal\_P = arima\_model$p,

Optimal\_Q = arima\_model$q

)

result

print(summary(arima\_model))

# Predict using the ARIMA model

predicted <- predict(arima\_model, n.ahead = 10)

predicted

# Diagnose the ARIMA model

tsdiag(arima\_model)

# Extract end date of the original time series

end\_date <- index(Returns\_XYZ)[length(Returns\_XYZ)]

# Predict using the ARIMA model

predicted <- predict(arima\_model, n.ahead = 10)

# Create a time series for the predicted values with appropriate timestamps

predicted\_dates <- seq(end\_date + 1, by = "days", length.out = 10)

predicted\_series <- xts(predicted$pred, order.by = predicted\_dates)

# Combine original and predicted time series

combined\_series <- c(Returns\_XYZ, predicted\_series)

# Plot the combined time series with predicted values

plot(combined\_series, main = "XYZ Returns with Predicted Values", col = c("blue", "red"),

ylab = "Returns", xlab = "Date", lwd = c(2, 2), ylim = c(min(combined\_series),

max(combined\_series)))

lines(combined\_series$predicted\_series, col = "red")

**Interpretation of code:**

This code comprehensively analyses stock price data for XYZ fetched from Yahoo Finance. Here's a breakdown of the steps and their interpretations:

**Data Retrieval and Preprocessing**

1. **Library Installations and Loading**: Installs and loads necessary R libraries for financial analysis (`tseries`, `ggplot2`, `forecast`, `fpp2`, `quantmod`).

2. **Fetching Stock Data:** Retrieves the stock price data for XYZ ("SNDR") from Yahoo Finance within the specified date range and at a daily periodicity.

3**. Calculating Daily Returns:** Computes daily returns from the stock price data using the formula: \(\frac{{\text{Today's Price}}}{{\text{Yesterday's Price}}} - 1\). The result represents daily returns as a percentage.

4. **Rename and Plot Data**: Renames the calculated returns column and creates plots for both the XYZ stock prices and the calculated returns.

Time Series Analysis

5. **Stationarity Test:** Conducts an Augmented Dickey-Fuller test (`adf.test`) to check for stationarity in the returns data. A stationarity test helps assess if a time series is consistent in statistical properties over time.

6. **ACF and PACF Plots:** Generates Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots to identify potential autoregressive (AR) and moving average (MA) orders for an ARIMA model.

7. **ARIMA Modelling**: Fits an ARIMA (Autoregressive Integrated Moving Average) model to the returns data using `auto.arima`. This function automatically determines the optimal ARIMA parameters based on the data.

8. **ARIMA Model Diagnostics:** Evaluates the fitted ARIMA model using diagnostic plots (`tsdiag`) to assess model adequacy.

Forecasting

9. **Forecasting**: Predicts future values of the returns using the fitted ARIMA model via `predict`. The code forecasts return for the next 10 days.

10. **Time Series Combination and Plotting:** Creates a combined time series of original returns and predicted values. The code plots the original returns and the predicted returns on the same graph, allowing visual comparison.

Overall, this script covers various steps, from fetching stock data to performing time series analysis, model fitting, forecasting, and visualizing the results to understand and predict XYZ stock returns.

**ARIMA MODEL IN BRIEF:**

the ARIMA (Autoregressive Integrated Moving Average) model is a popular time series analysis technique used for forecasting future values based on past observations. It combines autoregressive (AR) and moving average (MA) components and differencing to handle non-stationary data.

Here's a brief overview of the ARIMA model components:

1. AutoRegressive (AR) Component: AR terms represent the linear relationship between the variable and its own past values. An AR(p) model uses p-lagged observations of the series to predict the current value.

(AUTO-REGRESSIVE IS ALSO CONSIDERED OLDER PART OF ARIMA)

2. Integrated (I) Component: The differencing step (denoted by the 'I' term) transforms a non-stationary time series into a stationary one by subtracting each observation from its previous value. The number of differences required for stationarity is denoted by the 'd' parameter in ARIMA(d).

3. Moving Average (MA) Component: The MA component represents the relationship between the variable and the residual errors. An MA(q) model uses q-lagged forecast errors to predict the current value.(IT IS ALSO KNOWN AS THE RECENT PART. IN ARIMA).

In summary, an ARIMA model is denoted as ARIMA(p, d, q), where:

p = order of the autoregressive component.

d = degree of differencing required to achieve stationarity.

q = order of the moving average component.

The 'auto. arima()' function in R automatically selects the optimal ARIMA parameters based on the provided data, fitting the best ARIMA model according to certain criteria (e.g., AIC, BIC).

Once the ARIMA model is fitted, it can be used for forecasting future values based on historical data patterns, allowing for prediction and analysis of time series data.

**COMPANY 1- SCHNEIDER**

**OUTPUT**: The output contain the following results plot of returns, acf, and pacf plots, optimal p,q,d values using auto arima , Diagnosis test, predicted values, predicted standard deviation, and the final graph of returns with the predicted values.

**HERE WE HAVE USED AUTO.ARIMA() AS A FUNCTION TO GET THE OPTIMAL VALUE OF P, D, Q.**

|  | **MONTHLY** | **WEEKLY** | **DAILY** |
| --- | --- | --- | --- |
| **RETURNS** | **A graph with lines and numbers  Description automatically generated** | **A graph of a graph  Description automatically generated** | **A graph of a sound wave  Description automatically generated** |
| **ACF** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **Pacf** | **A graph of a line graph  Description automatically generated** |  | **A graph with numbers and lines  Description automatically generated** |
| **optimal p,q,d values using auto arima** | **(0,0,0)** | **(0,0,0)** | **(1,0,1)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **OUTPUT** | **MONTHLY** | **WEEKLY** | **DAILY** |
| **Diagnosis test** | **A diagram of a number of data  Description automatically generated with medium confidence** | **A diagram of a graph  Description automatically generated with medium confidence** | **A graph of a number of data  Description automatically generated with medium confidence** |
| **predicted values** | **0 0 0 0 0 0 0 0 0 0** | **0 0 0 0 0 0 0 0 0 0** | **0.0005233134 0.0002187898 0.0005079918 0.0002333406 0.0004941732 0.0002464639 0.0004817101 0.0002583000 0.0004704696 0.0002689749** |
| **predicted standard deviation** | **0.0755422 0.0755422 0.0755422 0.0755422 0.0755422 0.0755422 0.0755422 0.0755422 0.0755422 0.0755422** | **0.03679616 0.03679616 0.03679616 0.03679616 0.03679616 0.03679616 0.03679616 0.03679616 0.03679616 0.03679616** | **0.01795724 0.01795940 0.01796134 0.01796309 0.01796467 0.01796610 0.01796738 0.01796854 0.01796958 0.01797053** |
| **the final graph of returns with the predicted values.** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** |
| **ARIMA MODEL REUSLT** | **Series: Returns\_SBI$Returns**  **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.001354: log likelihood = 291.93**  **AIC=-581.86 AICc=-581.84 BIC=-578.82**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.002043015 0.03679616 0.02816518 100 100 1 0.02632199** | **Series: Returns\_SBI$Returns**  **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.005707: log likelihood = 40.74**  **AIC=-79.49 AICc=-79.37 BIC=-77.93**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.0082844 0.0755422 0.06260979 100 100 1 -0.1475222** | **ARIMA(1,0,1) with non-zero mean**  **Coefficients:**  **ar1 ma1 mean**  **-0.9497 0.9652 4e-04**  **s.e. 0.0477 0.0386 7e-04**  **sigma^2 = 0.0003225: log likelihood = 1949.5**  **AIC=-3891 AICc=-3890.95 BIC=-3872.53**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 7.8252e-06 0.01792124 0.01321688 NaN Inf 0.9985994 -0.03048317** |

**Here please note that for the optimal output we are using auto.arima() function so their is no use of ACF,pacf, and adfuller test.**

**ECONOMIC INTERPRETATION:**

**DAILY RETURNS:**

The model's coefficients indicate a negative correlation between the current and previous returns, with a negative coefficient indicating a negative relationship. A positive coefficient indicates a positive relationship between the current and previous error terms in predicting returns. The mean, representing the expected value of returns when lagged values and errors are accounted for, is approximately 0.0004, representing the non-zero mean component in the model.

THE values of p=1,d=0,q=1, which means that ar of lag1 and q ma of lag 1 is used and data is stationary, so there is no need for differencing

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is significant as p value is less than one for almost every outcome and data has non zero expected return

**WEEKLY RETURNS:**

The ARIMA model, fitted to stock price returns, has a simple white noise structure with zero mean. Its model statistics include a low residual variance, a high log-likelihood, and a good fit to the data. The model's training set error measures include a mean error of 0.002043015, a root mean squared error of 0.03679616, a mean absolute error of 0.02816518, a mean percentage error of 100, a mean absolute scaled error of 1, and an autocorrelation of residuals at lag 1. The model's low RMSE and MAE suggest accurate predictions on the training data, while the high log-likelihood suggests a decent fit. However, the absence of AR and MA terms suggests a simple model that may not capture potential patterns or dependencies within the data.

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is significant as p value is less than one for almost every outcome

**MONTHLY RETURNS:**

The ARIMA(0,0,0) model is a pure white noise model with no autoregressive or moving average components. It has a zero mean, indicating the expected value of the series is zero. The model's statistics include Sigma^2, log-likelihood, AIC, AICc, and Bayesian Information Criterion. Training set error measures include ME, RMSE, MAE, MPE, MAPE, MASE, and ACF1. The model's performance is compared to a naive model, and its autocorrelation of residuals at lag 1 is -0.1475222. The output summarizes the model's statistics, including fit to the data, error measures, and diagnostic statistics.

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is significant as p value is less than one for almost every outcome

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

**COMPANY 2- SOBHA(SOBHA.NS)**

OUTPUT: The output contain the following results plot of returns, acf, and pacf plots, optimal p,q,d values using auto arima , Diagnosis test, predicted values, predicted standard deviation, and the final graph of returns with the predicted values.

**HERE WE HAVE USED AUTO.ARIMA() AS A FUNCTION TO GET THE OPTIMAL VALUE OF P, D, Q.**

|  | **MONTHLY** | **WEEKLY** | **DAILY** |
| --- | --- | --- | --- |
| **RETURNS** | **A graph with lines and numbers  Description automatically generated** | **A graph of a graph  Description automatically generated** | **A graph of a graph showing a wave  Description automatically generated with medium confidence** |
| **ACF** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** | **A graph of a line graph  Description automatically generated with medium confidence** |
| **Pacf** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **optimal p,q,d values using auto arima** | **(0,0,0)** | **(0,0,0)** | **(0,0,0)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **OUTPUT** | **MONTHLY** | **WEEKLY** | **DAILY** |
| **Diagnosis test** |  | **A diagram of a graph  Description automatically generated with medium confidence** | **A diagram of a graph  Description automatically generated with medium confidence** |
| **predicted values** | **0 0 0 0 0 0 0 0 0 0** | **0 0 0 0 0 0 0 0 0 0** | **0.001653806 0.001653806 0.001653806 0.001653806 0.001653806 0.001653806 0.001653806 0.001653806 0.001653806 0.001653806** |
| **predicted standard deviation** | **0.1251195 0.1251195 0.1251195 0.1251195 0.1251195 0.1251195 0.1251195 0.1251195 0.1251195 0.1251195** | **0.06945826 0.06945826 0.06945826 0.06945826 0.06945826 0.06945826 0.06945826 0.06945826 0.06945826 0.06945826** | **0.03003637 0.03003637 0.03003637 0.03003637 0.03003637 0.03003637 0.03003637 0.03003637 0.03003637 0.03003637** |
| **the final graph of returns with the predicted values.** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** |
| **ARIMA MODEL REUSLT** | **Series: Returns\_SBI$Returns**  **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.01565: log likelihood = 23.08**  **AIC=-44.17 AICc=-44.05 BIC=-42.61**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.03099928 0.1251195 0.09245462 100 100 1 0.1082064** | **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.004824: log likelihood = 193.45**  **AIC=-384.91 AICc=-384.88 BIC=-381.86**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.007849936 0.06945826 0.04795851 100 100 1 -0.02653307** | **ARIMA(0,0,0) with non-zero mean**  **Coefficients:**  **mean**  **0.0017**  **s.e. 0.0011**  **sigma^2 = 0.0009022: log likelihood = 1540.27**  **AIC=-3076.54 AICc=-3076.52 BIC=-3067.33**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set -1.963965e-15 0.03001602 0.02041829 -Inf Inf 1.007043 0.003005043** |

**Here please note that for the optimal output we are using auto.arima() function so their is no use of ACF,pacf, and adfuller test.**

**ECONOMIC INTERPRETATION:**

**DAILY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 ma=0 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is significant as p value is less than one for almost every outcome and data has non zero expected return

**WEEKLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 ma=0 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is significant as p value is less than one for almost every outcome

**MONTHLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 ma=0 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to high and consistent this implies low confidence interval and data is not pretty stable and the data is insignificant as p value is greater than one for almost every outcome

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

**COMPANY 3- Swaraj Engines Limited (SWARAJENG.NS)**

OUTPUT: The output contain the following results plot of returns, acf, and pacf plots, optimal p,q,d values using auto arima , Diagnosis test, predicted values, predicted standard deviation, and the final graph of returns with the predicted values.

**HERE WE HAVE USED AUTO.ARIMA() AS A FUNCTION TO GET THE OPTIMAL VALUE OF P, D, Q.**

|  | **MONTHLY** | **WEEKLY** | **DAILY** |
| --- | --- | --- | --- |
| **RETURNS** | **A graph of a graph  Description automatically generated with medium confidence** |  | **A graph of a graph showing a wave  Description automatically generated with medium confidence** |
| **ACF** | **A graph with numbers and lines  Description automatically generated** |  | **A graph with numbers and lines  Description automatically generated** |
| **Pacf** | **A graph with numbers and lines  Description automatically generated** | **A graph with lines and numbers  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **optimal p,q,d values using auto arima** | **(0,0,0)** | **(0,0,0)** | **(2,0,2)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **OUTPUT** | **MONTHLY** | **WEEKLY** | **DAILY** |
| **Diagnosis test** | **A diagram of a graph  Description automatically generated with medium confidence** | **A diagram of a graph  Description automatically generated with medium confidence** | **A diagram of a graph  Description automatically generated with medium confidence** |
| **predicted values** | **0 0 0 0 0 0 0 0 0 0** | **0 0 0 0 0 0 0 0 0 0** | **-0.0028508989 0.0021533527 0.0030122301 -0.0011524280 -0.0029109259 0.0003023740 0.0026166573 0.0003691478 -0.0021969960 -0.0008543235** |
| **predicted standard deviation** | **0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502** | **0.03362653 0.03362653 0.03362653 0.03362653 0.03362653 0.03362653 0.03362653 0.03362653 0.03362653 0.03362653** | **0.01620005 0.01622812 0.01625581 0.01626703 0.01629621 0.01629882 0.01632491 0.01632494 0.01634520 0.01634608** |
| **the final graph of returns with the predicted values.** |  |  | **A graph with blue lines  Description automatically generated** |
| **ARIMA MODEL REUSLT** | **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.006612: log likelihood = 38.17**  **AIC=-74.33 AICc=-74.21 BIC=-72.78**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.01342033 0.08131502 0.05788898 100 100 1 -0.001425225** | **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.001131: log likelihood = 305.89**  **AIC=-609.79 AICc=-609.76 BIC=-606.74**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.002929299 0.03362653 0.02465784 100 100 1 -0.01918403** | **ARIMA(2,0,2) with zero mean**  **Coefficients:**  **ar1 ar2 ma1 ma2**  **0.2420 -0.8738 -0.1832 0.9181**  **s.e. 0.0424 0.0687 0.0376 0.0572**  **sigma^2 = 0.0002624: log likelihood = 1997.27**  **AIC=-3984.54 AICc=-3984.46 BIC=-3961.52**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.0005632679 0.01615609 0.01104503 -Inf Inf 1.004252 0.01007508** |

**Here please note that for the optimal output we are using auto.arima() function so their is no use of ACF,pacf, and adfuller test.**

**ECONOMIC INTERPRETATION:**

**DAILY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=2,q=2,d=0 implies lag for ar=ma=2 and diffrencing=0 which implies data to be stationary

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is insignificant as p value is not less than one for almost every outcome and data has non zero expected return

**WEEKLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 ma=0 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is significant as p value is less than one for almost every outcome

**MONTHLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 ma=0 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to high and consistent this implies low confidence interval and data is not pretty stable and the data is insignificant as p value is greater than one for outcome

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

**COMPANY 4- Tips Industries Limited (TIPSINDLTD.NS)**

OUTPUT: The output contain the following results plot of returns, acf, and pacf plots, optimal p,q,d values using auto arima , Diagnosis test, predicted values, predicted standard deviation, and the final graph of returns with the predicted values.

**HERE WE HAVE USED AUTO.ARIMA() AS A FUNCTION TO GET THE OPTIMAL VALUE OF P, D, Q.**

|  | **MONTHLY** | **WEEKLY** | **DAILY** |
| --- | --- | --- | --- |
| **RETURNS** | **A graph of a line  Description automatically generated with medium confidence** | **A graph of a graph  Description automatically generated** | **A graph with black lines  Description automatically generated** |
| **ACF** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **Pacf** | **A graph with lines and numbers  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **optimal p,q,d values using auto arima** | **(0,0,0)** | **(0,0,1)** | **(1,0,0)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **OUTPUT** | **MONTHLY** | **WEEKLY** | **DAILY** |
| **Diagnosis test** | **A diagram of a number of data  Description automatically generated with medium confidence** | **A diagram of a graph  Description automatically generated with medium confidence** | **A diagram of a graph  Description automatically generated with medium confidence** |
| **predicted values** | **0.09707734 0.09707734 0.09707734 0.09707734 0.09707734 0.09707734 0.09707734 0.09707734 0.09707734 0.09707734** | **0.002341689 0.019430063 0.019430063 0.019430063 0.019430063 0.019430063 0.019430063 0.019430063 0.019430063 0.019430063** | **0.003627369 0.004003371 0.004069000 0.004080456 0.004082455 0.004082804 0.004082865 0.004082876 0.004082877 0.004082878** |
| **predicted standard deviation** | **0.2059167 0.2059167 0.2059167 0.2059167 0.2059167 0.2059167 0.2059167 0.2059167 0.2059167 0.2059167** | **0.07470003 0.07610982 0.07610982 0.07610982 0.07610982 0.07610982 0.07610982 0.07610982 0.07610982 0.07610982** | **0.02960009 0.03004761 0.03006114 0.03006155 0.03006156 0.03006156 0.03006156 0.03006156 0.03006156 0.03006156** |
| **the final graph of returns with the predicted values.** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** |
| **ARIMA MODEL REUSLT** | **ARIMA(0,0,0) with non-zero mean**  **Coefficients:**  **mean**  **0.0971**  **s.e. 0.0343**  **sigma^2 = 0.0424: log likelihood = 6.15**  **AIC=-8.31 AICc=-7.93 BIC=-5.2**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 3.180585e-18 0.2029537 0.1624488 138.2957 162.0458 0.9513251 0.1797134** | **ARIMA(0,0,1) with non-zero mean**  **Coefficients:**  **ma1 mean**  **0.1952 0.0194**  **s.e. 0.0775 0.0071**  **sigma^2 = 0.00558: log likelihood = 183.16**  **AIC=-360.33 AICc=-360.17 BIC=-351.2**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set -6.207716e-06 0.07421653 0.05618842 114.1451 153.163 1.010911 0.003598566** | **ARIMA(1,0,0) with non-zero mean**  **Coefficients:**  **ar1 mean**  **0.1745 0.0041**  **s.e. 0.0362 0.0013**  **sigma^2 = 0.0008762: log likelihood = 1551.55**  **AIC=-3097.11 AICc=-3097.07 BIC=-3083.29**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 5.737991e-06 0.02955996 0.02256647 -Inf Inf 0.9975586 -0.002467457** |

**Here please note that for the optimal output we are using auto.arima() function so their is no use of ACF,pacf, and adfuller test.**

**ECONOMIC INTERPRETATION:**

**DAILY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=1,q=0,d=0 implies ar=1 so ar lags by 1 ma=0 and diffrencing=0 data is staionary

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is insignificant as p value is not less than one for almost every outcome and data has non zero expected return

**WEEKLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=1,d=0 implies ar=0 ma=1 so ma lags by 1 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is insignificant as p value is not less than one for almost every outcome and data has non zero expected return

**MONTHLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 ma=0 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to high and consistent this implies a low confidence interval and data is not pretty stable and the data is insignificant as p value is greater than one for almost every outcome and data has non zero expected return

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

**COMPANY 5- UTI S&P BSE Sensex ETF (UTISENSETF.NS)**

OUTPUT: The output contain the following results plot of returns, acf, and pacf plots, optimal p,q,d values using auto arima , Diagnosis test, predicted values, predicted standard deviation, and the final graph of returns with the predicted values.

**HERE WE HAVE USED AUTO.ARIMA() AS A FUNCTION TO GET THE OPTIMAL VALUE OF P, D, Q.**

|  | **MONTHLY** | **WEEKLY** | **DAILY** |
| --- | --- | --- | --- |
| **RETURNS** | **A graph of a graph  Description automatically generated with medium confidence** | **A graph with black lines  Description automatically generated** | **A graph of a graph showing a wave  Description automatically generated with medium confidence** |
| **ACF** | **A graph with numbers and lines  Description automatically generated** | **A graph with lines and numbers  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **Pacf** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **optimal p,q,d values using auto arima** | **(0,0,0)** | **(2,0,2)** | **(2,0,2)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **OUTPUT** | **MONTHLY** | **WEEKLY** | **DAILY** |
| **Diagnosis test** | **A diagram of a graph  Description automatically generated with medium confidence** |  | **A diagram of a graph  Description automatically generated with medium confidence** |
| **predicted values** | **0 0 0 0 0 0 0 0 0 0** | **0.0070153626 0.0105693374 -0.0008512959 -0.0040733594 0.0067731372 0.0096882125 -0.0006112216 -0.0032425582 0.0065357190 0.0089049971** | **-0.0029109259 0.0003023740 0.0003023740 0.0026166573 0.0003691478 -0.0021969960 -0.000854323 -0.0026166573 0.0003691478 -0.0021969960 -0.0008543235** |
| **predicted standard deviation** | **0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502 0.08131502** | **0.02011734 0.02012776 0.02025040 0.02025886 0.02036874 0.02037558 0.02047407 0.02047957 0.02056788 0.02057228** | **0.01620005 0.01622812 0.01625581 0.01626703 0.01629621 0.01629882 0.01632491 0.01632494 0.01634520 0.01634608** |
| **the final graph of returns with the predicted values.** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** |  |
| **ARIMA MODEL REUSLT** | **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.006612: log likelihood = 38.17**  **AIC=-74.33 AICc=-74.21 BIC=-72.78**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.01342033 0.08131502 0.05788898 100 100 1 -0.001425225** | **ARIMA(2,0,2) with non-zero mean**  **Coefficients:**  **ar1 ar2 ma1 ma2 mean**  **-0.0123 -0.9462 0.0445 0.8360 0.0030**  **s.e. 0.0563 0.1164 0.0803 0.1966 0.0015**  **sigma^2 = 0.0004047: log likelihood = 387.71**  **AIC=-763.43 AICc=-762.86 BIC=-745.17**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 7.431569e-05 0.0197902 0.01498461 46.48434 185.0013 0.9073208 0.008390071** | **ARIMA(2,0,2) with zero mean**  **Coefficients:**  **ar1 ar2 ma1 ma2**  **0.2420 -0.8738 -0.1832 0.9181**  **s.e. 0.0424 0.0687 0.0376 0.0572**  **sigma^2 = 0.0002624: log likelihood = 1997.27**  **AIC=-3984.54 AICc=-3984.46 BIC=-3961.52**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.0005632679 0.01615609 0.01104503 -Inf Inf 1.004252 0.01007508** |

**Here please note that for the optimal output we are using auto.arima() function so their is no use of ACF,pacf, and adfuller test.**

**ECONOMIC INTERPRETATION:**

**DAILY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=2,q=2,d=0 implies lag for ar=ma=2 and diffrencing=0 which implies data to be stationary

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is insignificant as p value is not less than one for almost every outcome and data has non zero expected return

**WEEKLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=2,q=2,d=0 implies lag for ar=ma=2 and diffrencing=0 which implies data to be stationary

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable, and the data is significant as p value is less than one for almost every outcome and non zero expected return

**MONTHLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, including its residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 ma=0 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to high and consistent this implies low confidence interval and data is not pretty stable and the data is insignificant as p value is greater than one for outcome

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

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OUTPUT: The output contain the following results plot of returns, acf, and pacf plots, optimal p,q,d values using auto arima , Diagnosis test, predicted values, predicted standard deviation, and the final graph of returns with the predicted values.

**HERE WE HAVE USED AUTO.ARIMA() AS A FUNCTION TO GET THE OPTIMAL VALUE OF P, D, Q.**

|  | **MONTHLY** | **WEEKLY** | **DAILY** |
| --- | --- | --- | --- |
| **RETURNS** | **A graph of a graph  Description automatically generated with medium confidence** | **A graph of a graph  Description automatically generated** | **A graph with black lines  Description automatically generated** |
| **ACF** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **Pacf** | **A graph with numbers and lines  Description automatically generated** | **A graph with lines and numbers  Description automatically generated** | **A graph with numbers and lines  Description automatically generated** |
| **optimal p,q,d values using auto arima** | **(0,0,0)** | **(3,0,1)** | **(0,0,0)** |

|  |  |  |  |
| --- | --- | --- | --- |
| **OUTPUT** | **MONTHLY** | **WEEKLY** | **DAILY** |
| **Diagnosis test** | **A diagram of a number of data  Description automatically generated with medium confidence** | **A diagram of a graph  Description automatically generated with medium confidence** | **A graph of a number of data  Description automatically generated with medium confidence** |
| **predicted values** | **0 0 0 0 0 0 0 0 0 0** | **-5.479487e-04 -8.591986e-03 -5.240774e-03 1.596848e-03 -1.694889e-03 3.280595e-04 -9.231203e-05 -9.044313e-05**  **5.999833e-05 -3.762210e-05** | **0 0 0 0 0 0 0 0 0 0** |
| **predicted standard deviation** | **0.1395291 0.1395291 0.1395291 0.1395291 0.1395291 0.1395291 0.1395291 0.1395291 0.1395291 0.1395291** | **0.06693474 0.06759266 0.06759266 0.06788924 0.06791227 0.06792091 0.06792091 0.06792097 0.06792110 0.06792113** | **0.02940333 0.02940333 0.02940333 0.02940333 0.02940333 0.02940333 0.02940333 0.02940333 0.02940333 0.02940333** |
| **the final graph of returns with the predicted values.** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** |
| **ARIMA MODEL REUSLT** | **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.01947: log likelihood = 19.27**  **AIC=-36.54 AICc=-36.42 BIC=-34.98**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set -0.01022556 0.1395291 0.1048119 100 100 1 -0.1017655** | **ARIMA(3,0,1) with zero mean**  **Coefficients:**  **ar1 ar2 ar3 ma1**  **-0.4075 0.0572 0.0866 0.5481**  **s.e. 0.3416 0.1045 0.0945 0.3350**  **sigma^2 = 0.00448: log likelihood = 201.19**  **AIC=-392.38 AICc=-391.97 BIC=-377.16**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1**  **Training set 0.0001305316 0.06606542 0.04902224 88.95599 112.7955 0.994234 0.003557966** | **ARIMA(0,0,0) with zero mean**  **sigma^2 = 0.0008646: log likelihood = 1555.49**  **AIC=-3108.98 AICc=-3108.97 BIC=-3104.37**  **Training set error measures:**  **ME RMSE MAE MPE MAPE MASE ACF1** |

**Here please note that for the optimal output we are using auto.arima() function so their is no use of ACF,pacf, and adfuller test.**

**ECONOMIC INTERPRETATION:**

**DAILY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, residuals, log-likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 so ar lags by 0 ma=0 and diffrencing=0 data is staionary

DATA INTERPRETATION:

The standard error seems to low and consistent this implies a high confidence interval and the data is pretty stable and the data is significant as p value is less than one for almost every outcome and data has zero expected return

**WEEKLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, residuals, log-likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=3,q=1,d=0 implies ar=0 ma=1 so ma lags by 1 and ar by 3 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to low and consistent this implies high confidence interval and data is pretty stable and the data is insignificant as p value is not less than one for almost every outcome and data has non zero expected return

**MONTHLY RETURNS:**

The output provides information on the ARIMA model's summary and training set error measures for the `` time series. It includes the ARIMA model information, residuals, log likelihood, and information criteria for comparison. The training set error measures include the mean error, root mean squared error, mean absolute error, mean percentage error, mean absolute percentage error, mean absolute scaled error, and mean absolute scaled error. Lower values indicate better accuracy and fit to the training data, while higher values indicate better-fitting models. The output helps in model comparison, with lower values indicating better-fitting models.

p=0,q=0,d=0 implies ar=0 ma=0 and diffrencing=0

DATA INTERPRETATION:

The standard error seems to low and consistent this implies a high confidence interval and the data is pretty stable and the data is significant as p value is less than one for almost every outcome and data has zero expected return

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

CONCLUSION:

As an investor you could invest in a stock which has higher cv by taking standard error as risk parameters and returns as expected mean

**GRACH AND E-GRACH MODEL**

**CODE:**

install.packages("quantmod")

install.packages("rugarch")

library(quantmod)

library(rugarch)

# Fetch stock price data from Yahoo Finance

data <- getSymbols("xyz", from = "2020-11-01", to = "2023-10-26", auto.assign = FALSE)

# Extract adjusted close prices

prices <- Cl(data)

# Fit an ARIMA model to the returns

returns <- diff(log(prices))

returns <- na.omit(returns)

# Fit a GARCH model to handle heteroscedasticity

garch\_spec <- ugarchspec(mean.model = list(armaOrder = c(1, 1)),

variance.model = list(model = "sGARCH", garchOrder = c(1, 1)),

fixed.pars = list(alpha1 = 0.1, beta1 = 0.8))

E\_spec <- ugarchspec(variance.model = list(model = "eGARCH"))

# Fit the GARCH model with constrained parameter space

garch\_fit <- ugarchfit(data = returns, spec = garch\_spec, solver = "solnp",

solver.control = list(trace = FALSE))

earch\_fit <- ugarchfit(data = returns, spec = E\_spec)

# Assuming 'garch\_fit' contains your fitted GARCH model (uGARCHfit object)

# Forecast 10 steps ahead

forecast\_steps <- 10

garch\_forecast <- ugarchforecast(garch\_fit, n.ahead = forecast\_steps)

print(garch\_forecast)

forecast\_sigma <- sigma(garch\_forecast)

# Create a vector of dates corresponding to the actual returns

dat <- index(returns)

# Plotting the actual returns and forecasted volatility

plot(dat, returns, type = "l", col = "blue", ylim = c(min(returns, forecast\_sigma), max(returns,

forecast\_sigma)), xlab = "Date", ylab = "Returns", main = "Actual and Forecasted Returns")

garch\_fit

earch\_fit

print(garch\_forecast)

**Interpretation of code:**

This code conducts a time series analysis and forecasting for xyz (xyz Inc.) stock prices retrieved from Yahoo Finance using the `quantmod` and `rugarch` packages in R.

Here's the breakdown of the steps:

**1. Data Retrieval and Preparation:**

- Fetches the historical stock price data for xyz (`xyz`) from November 1, 2020, to October 26, 2023, using `getSymbols()` from Yahoo Finance.

- Extracts the adjusted close prices (`Cl(data)`).

**2. Returns Calculation:**

- Calculates the log returns (`returns`) of the adjusted closing prices using the `diff()` and `log()` functions.

- Removes any `NA` values from the returns data using `na.omit()`.

**3. GARCH Model Specification:**

- Specifies the GARCH model (`garch\_spec`) using `ugarchspec()` from the `rugarch` package. It's a GARCH(1,1) model with a mean model (ARMA) of order (1,1) and a variance model of standard GARCH(1,1).

- Specifies an EGARCH model (`E\_spec`) using `ugarchspec()`.

**4. Fitting GARCH Model:**

- Fits the GARCH model (`garch\_fit`) to the returns data using `ugarchfit()`, specifying a constrained parameter space and using the solver `solnp`.

- Fits an EGARCH model (`earch\_fit`) to the returns data using `ugarchfit()`.

**5. Forecasting:**

- Generates a GARCH forecast (`garch\_forecast`) for a specified number of steps ahead (`forecast\_steps`) using `ugarchforecast()`.

- Retrieves the forecasted volatility values (`forecast\_sigma`) from the GARCH forecast.

**6. Plotting:**

- Creates a plot displaying the actual returns and forecasted volatility. The plot represents the time series of returns (`returns`) and the forecasted volatility (`forecast\_sigma`) against the dates.

**7. Printing Model Information:**

- Prints the summary of the GARCH model (`garch\_fit`), the EGARCH model (`earch\_fit`), and the GARCH forecast (`garch\_forecast`) to the console using `print()`.

This code conducts a comprehensive analysis including data retrieval, returns calculation, GARCH model specification, fitting, forecasting, and visualization for xyz's stock price returns while considering volatility modeling with GARCH and EGARCH models. It aims to forecast future volatility based on historical returns and fitted GARCH models.

**SOME DETAILS ABOUT GRACH AND EGRACH MODEL:**

**GARCH (Generalized Autoregressive Conditional Heteroskedasticity) Model:**

- Purpose: GARCH models are used to model and forecast volatility in financial time series data, such as stock prices or asset returns.

- Key Concept: GARCH models the variance of a time series as a function of its past variances and errors. It assumes that volatility clusters in time, meaning periods of high volatility tend to be followed by more high-volatility periods and vice versa.

- Components:

- Conditional Variance: It's expressed as a linear combination of past variances and squared errors.

- GARCH(p, q): The model involves parameters p and q that represent the number of lagged squared errors and lagged variances used in the model.

- ARCH (AutoRegressive Conditional Heteroskedasticity): The GARCH model includes an ARCH component that captures volatility clustering.

- Example: A GARCH(1,1) model includes one lag of the squared errors and one lag of the conditional variance.

**EGARCH (Exponential GARCH) Model:**

- Purpose: EGARCH models are an extension of the GARCH model and are particularly useful in capturing asymmetric effects of volatility, where negative and positive shocks have different impacts on volatility.

- Key Concept: EGARCH models address the asymmetry in volatility by allowing for asymmetric responses to positive and negative shocks in financial time series data.

- Components:

- Exponential Form: EGARCH models the logarithm of conditional variance using an exponential function of lagged conditional variances and errors.

- Asymmetric Effects: Captures the asymmetric response to positive and negative shocks separately.

- Advantages: EGARCH models are flexible and can better capture the asymmetric behavior observed in financial markets, where negative shocks might have different effects on volatility than positive shocks.

- Example: An EGARCH(1,1) model might include asymmetry parameters to capture differing responses to positive and negative shocks.

**Summary:**

- GARCH models are fundamental tools for modeling and forecasting volatility in financial data, focusing on capturing volatility clustering.

- EGARCH models extend the GARCH framework by incorporating asymmetry, allowing for different responses to positive and negative shocks in the time series. This can be particularly valuable in financial modeling where asymmetry is observed.

**COMPANY 1- SCHNEIDER**

**OUTPUT:**

The output contains garch and egarch model summary and output next for 10 intervals using egrach model as mentioned above egrach is a better choice as a model as it incorporates asymmetry

|  |  |  |  |
| --- | --- | --- | --- |
|  | DAILY | WEEKLY | MONTHLY |
| GARCH MODEL | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.000007 0.000630 0.010704 0.99146**  **ar1 -0.941168 0.014466 -65.062203 0.00000**  **ma1 0.963524 0.005629 171.162585 0.00000**  **omega 0.000035 0.000003 11.634981 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.000007 0.000665 0.010131 0.99192**  **ar1 -0.941168 0.012311 -76.450540 0.00000**  **ma1 0.963524 0.000855 1126.345006 0.00000**  **omega 0.000035 0.000004 8.350476 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 1954.258**  **Information Criteria**  **------------------------------------**    **Akaike -5.2076**  **Bayes -5.1830**  **Shibata -5.2077**  **Hannan-Quinn -5.1981**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1668 0.6830**  **Lag[2\*(p+q)+(p+q)-1][5] 1.2124 0.9999**  **Lag[4\*(p+q)+(p+q)-1][9] 2.3689 0.9628**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 3.125 0.07711**  **Lag[2\*(p+q)+(p+q)-1][5] 4.595 0.18863**  **Lag[4\*(p+q)+(p+q)-1][9] 6.048 0.29270**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.0008793 0.500 2.000 0.9763**  **ARCH Lag[5] 0.8986896 1.440 1.667 0.7632**  **ARCH Lag[7] 2.1382304 2.315 1.543 0.6881**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.6368**  **Individual Statistics:**  **mu 0.04231**  **ar1 0.18754**  **ma1 0.26155**  **omega 0.12152**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.7160 0.086586 \***  **Negative Sign Bias 0.6033 0.546481**  **Positive Sign Bias 2.8392 0.004647 \***  **Joint Effect 8.7720 0.032482**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 31.85 0.03245**  **2 30 46.42 0.02130**  **3 40 46.25 0.19791**  **4 50 67.89 0.03819** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001433 0.002847 0.50351 0.614603**  **ar1 -0.790945 0.328066 -2.41094 0.015912**  **ma1 0.774304 0.336861 2.29859 0.021528**  **omega 0.000154 0.000030 5.06191 0.000000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001433 0.002824 0.50747 0.611823**  **ar1 -0.790945 0.091948 -8.60206 0.000000**  **ma1 0.774304 0.087909 8.80807 0.000000**  **omega 0.000154 0.000036 4.31421 0.000016**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 292.207**  **Information Criteria**  **------------------------------------**    **Akaike -3.7188**  **Bayes -3.6403**  **Shibata -3.7201**  **Hannan-Quinn -3.6869**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1936 0.6599**  **Lag[2\*(p+q)+(p+q)-1][5] 1.2849 0.9997**  **Lag[4\*(p+q)+(p+q)-1][9] 4.8884 0.4792**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.0062 0.9372**  **Lag[2\*(p+q)+(p+q)-1][5] 2.0444 0.6080**  **Lag[4\*(p+q)+(p+q)-1][9] 3.2149 0.7230**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 1.049 0.500 2.000 0.3056**  **ARCH Lag[5] 1.496 1.440 1.667 0.5933**  **ARCH Lag[7] 1.949 2.315 1.543 0.7281**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.274**  **Individual Statistics:**  **mu 0.04758**  **ar1 0.09958**  **ma1 0.09927**  **omega 0.07958**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.09504 0.9244**  **Negative Sign Bias 0.05903 0.9530**  **Positive Sign Bias 0.25220 0.8012**  **Joint Effect 0.06755 0.9954**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 16.48 0.6248**  **2 30 27.52 0.5439**  **3 40 38.29 0.5021**  **4 50 49.19 0.4654** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.029724 0.028901 1.02848 0.303724**  **ar1 0.501905 0.956168 0.52491 0.599644**  **ma1 -0.355818 1.027396 -0.34633 0.729095**  **omega 0.001678 0.000707 2.37516 0.017541**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.029724 0.030711 0.96787 0.333111**  **ar1 0.501905 0.902043 0.55641 0.577931**  **ma1 -0.355818 0.930716 -0.38231 0.702235**  **omega 0.001678 0.000848 1.97902 0.047814**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 24.16757**  **Information Criteria**  **------------------------------------**    **Akaike -1.15243**  **Bayes -0.97468**  **Shibata -1.17515**  **Hannan-Quinn -1.09107**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.004545 0.9462**  **Lag[2\*(p+q)+(p+q)-1][5] 0.224733 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.109592 0.9996**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 1.089 0.2968**  **Lag[2\*(p+q)+(p+q)-1][5] 1.954 0.6294**  **Lag[4\*(p+q)+(p+q)-1][9] 2.818 0.7886**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.5777 0.500 2.000 0.4472**  **ARCH Lag[5] 1.5083 1.440 1.667 0.5901**  **ARCH Lag[7] 1.7511 2.315 1.543 0.7698**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.5435**  **Individual Statistics:**  **mu 0.33479**  **ar1 0.08085**  **ma1 0.10104**  **omega 0.04225**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.0237 0.3142**  **Negative Sign Bias 0.9702 0.3397**  **Positive Sign Bias 0.4914 0.6267**  **Joint Effect 3.6241 0.3050**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 14.71 0.7406**  **2 30 20.71 0.8693**  **3 40 25.57 0.9519**  **4 50 40.71 0.7942** |
| EGRACH  MODEL | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.000740 0.000466 1.58932 0.11199**  **ar1 -0.950832 0.010382 -91.58268 0.00000**  **ma1 0.968378 0.000851 1138.12906 0.00000**  **omega -9.999998 1.513886 -6.60551 0.00000**  **alpha1 0.001435 0.009024 0.15899 0.87367**  **beta1 -0.234354 0.186070 -1.25950 0.20785**  **gamma1 0.539876 0.072473 7.44930 0.00000**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.000740 0.000436 1.699161 0.089289**  **ar1 -0.950832 0.013026 -72.992968 0.000000**  **ma1 0.968378 0.001431 676.857726 0.000000**  **omega -9.999998 2.617440 -3.820526 0.000133**  **alpha1 0.001435 0.030466 0.047091 0.962441**  **beta1 -0.234354 0.320017 -0.732319 0.463974**  **gamma1 0.539876 0.143276 3.768068 0.000165**  **LogLikelihood : 1976.775**  **Information Criteria**  **------------------------------------**    **Akaike -5.2597**  **Bayes -5.2166**  **Shibata -5.2599**  **Hannan-Quinn -5.2431**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.270 0.6033**  **Lag[2\*(p+q)+(p+q)-1][5] 1.602 0.9956**  **Lag[4\*(p+q)+(p+q)-1][9] 2.931 0.9009**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.03246 0.8570**  **Lag[2\*(p+q)+(p+q)-1][5] 1.48587 0.7434**  **Lag[4\*(p+q)+(p+q)-1][9] 3.21236 0.7234**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.4314 0.500 2.000 0.5113**  **ARCH Lag[5] 2.4765 1.440 1.667 0.3752**  **ARCH Lag[7] 3.2795 2.315 1.543 0.4624**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.3899**  **Individual Statistics:**  **mu 0.03311**  **ar1 0.15896**  **ma1 0.19935**  **omega 0.14005**  **alpha1 0.08475**  **beta1 0.17439**  **gamma1 0.07539**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.5416 0.1236**  **Negative Sign Bias 0.9416 0.3467**  **Positive Sign Bias 1.3120 0.1899**  **Joint Effect 2.8771 0.4110**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 25.29 0.1514**  **2 30 37.13 0.1430**  **3 40 39.52 0.4467**  **4 50 50.53 0.4127** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001520 0.002980 0.510090 0.609988**  **ar1 -0.028560 1.312922 -0.021753 0.982645**  **ma1 0.047088 1.308706 0.035980 0.971298**  **omega -10.000000 1.968457 -5.080121 0.000000**  **alpha1 -0.117807 0.087117 -1.352296 0.176281**  **beta1 -0.508140 0.294085 -1.727871 0.084011**  **gamma1 0.190999 0.177162 1.078109 0.280985**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001520 0.003056 0.497389 0.618915**  **ar1 -0.028560 0.414967 -0.068825 0.945129**  **ma1 0.047088 0.400883 0.117460 0.906496**  **omega -10.000000 1.086349 -9.205148 0.000000**  **alpha1 -0.117807 0.087798 -1.341807 0.179659**  **beta1 -0.508140 0.167201 -3.039090 0.002373**  **gamma1 0.190999 0.165867 1.151524 0.249517**  **LogLikelihood : 294.1207**  **Information Criteria**  **------------------------------------**    **Akaike -3.7048**  **Bayes -3.5673**  **Shibata -3.7086**  **Hannan-Quinn -3.6490**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.01748 0.8948**  **Lag[2\*(p+q)+(p+q)-1][5] 1.62360 0.9949**  **Lag[4\*(p+q)+(p+q)-1][9] 5.76274 0.2973**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.006343 0.9365**  **Lag[2\*(p+q)+(p+q)-1][5] 1.023700 0.8543**  **Lag[4\*(p+q)+(p+q)-1][9] 1.734630 0.9342**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.6337 0.500 2.000 0.4260**  **ARCH Lag[5] 0.8052 1.440 1.667 0.7915**  **ARCH Lag[7] 1.0170 2.315 1.543 0.9108**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.7363**  **Individual Statistics:**  **mu 0.05390**  **ar1 0.04480**  **ma1 0.04350**  **omega 0.07483**  **alpha1 0.15998**  **beta1 0.07249**  **gamma1 0.09778**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.03929 0.9687**  **Negative Sign Bias 0.12874 0.8977**  **Positive Sign Bias 0.03975 0.9683**  **Joint Effect 0.03684 0.9981**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 12.61 0.8578**  **2 30 26.35 0.6065**  **3 40 33.65 0.7123** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001976 0.000003 697.95 0**  **ar1 0.159782 0.000068 2353.70 0**  **ma1 0.019985 0.000049 411.73 0**  **omega -2.048007 0.000375 -5454.60 0**  **alpha1 0.116221 0.000039 3008.47 0**  **beta1 0.545952 0.000050 10876.77 0**  **gamma1 -1.682055 0.000282 -5964.69 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001976 0.000000 12792.9 0**  **ar1 0.159782 0.000002 83058.3 0**  **ma1 0.019985 0.000001 21490.1 0**  **omega -2.048007 0.001391 -1472.1 0**  **alpha1 0.116221 0.000009 12347.5 0**  **beta1 0.545952 0.000529 1032.0 0**  **gamma1 -1.682055 0.000514 -3275.3 0**  **LogLikelihood : 33.75628**  **Information Criteria**  **------------------------------------**    **Akaike -1.5289**  **Bayes -1.2179**  **Shibata -1.5925**  **Hannan-Quinn -1.4215**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.01118 0.9158**  **Lag[2\*(p+q)+(p+q)-1][5] 1.71462 0.9907**  **Lag[4\*(p+q)+(p+q)-1][9] 2.34993 0.9642**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1577 0.69126**  **Lag[2\*(p+q)+(p+q)-1][5] 7.2753 0.04445**  **Lag[4\*(p+q)+(p+q)-1][9] 9.7166 0.05764**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 1.781 0.500 2.000 0.1821**  **ARCH Lag[5] 2.595 1.440 1.667 0.3541**  **ARCH Lag[7] 3.605 2.315 1.543 0.4072**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 2.4546**  **Individual Statistics:**  **mu 0.01571**  **ar1 0.01587**  **ma1 0.01594**  **omega 0.01566**  **alpha1 0.01568**  **beta1 0.01567**  **gamma1 0.01565**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.88481 0.3833**  **Negative Sign Bias 0.05913 0.9532**  **Positive Sign Bias 0.95993 0.3448**  **Joint Effect 1.07654 0.7827**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 34.14 0.01768**  **2 30 43.00 0.04553**  **3 40 57.57 0.02793**  **4 50 60.71 0.12171** |
| FORECAST  VALUES | **Series Sigma**  **T+1 0.0009765 0.01743**  **T+2 0.0005154 0.01741**  **T+3 0.0009538 0.01741**  **T+4 0.0005369 0.01741**  **T+5 0.0009333 0.01741**  **T+6 0.0005564 0.01741**  **T+7 0.0009148 0.01741**  **T+8 0.0005740 0.01741**  **T+9 0.0008980 0.01741**  **T+10 0.0005900 0.01741** | **0-roll forecast [T0=2023-10-23]:**  **Series Sigma**  **T+1 0.001468 0.03228**  **T+2 0.001406 0.03304**  **T+3 0.001455 0.03370**  **T+4 0.001416 0.03429**  **T+5 0.001447 0.03481**  **T+6 0.001422 0.03527**  **T+7 0.001442 0.03568**  **T+8 0.001427 0.03605**  **T+9 0.001439 0.03637**  **T+10 0.001429 0.03666** | **0-roll forecast [T0=2023-09-30]:**  **Series Sigma**  **T+1 0.03283 0.1167**  **T+2 0.03128 0.1180**  **T+3 0.03051 0.1192**  **T+4 0.03012 0.1203**  **T+5 0.02992 0.1213**  **T+6 0.02982 0.1221**  **T+7 0.02977 0.1229**  **T+8 0.02975 0.1236**  **T+9 0.02974 0.1242**  **T+10 0.02973 0.1247** |
| GRAPH OF ACTUAL AND FORECASTED VALUES |  | **A graph showing a number of numbers and a line  Description automatically generated with medium confidence** | **A graph of a graph showing the time of a period  Description automatically generated with medium confidence** |

**DAILY RETURNS ANALYSIS:**

Both the models seems to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten days appears relatively stable and has a low and consistent standard error, so data seems stationary and has a high confidence interval.

**WEEKLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten week appears to be relatively stable and has a low and consistent standard error, so data seems to be stationary and have a high confidence interval.

**MONTHLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten Month appears to be relatively stable and has a high and consistent standard error, so data seems to be stationary and have a low confidence interval

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

**COMPANY 2- SOBHA(SOBHA.NS)**

**OUTPUT:**

The output contains garch and egarch model summary and output next for 10 intervals using egrach model as mentioned above egrach is a better choice as a model as it incorporates asymmetry

|  |  |  |  |
| --- | --- | --- | --- |
|  | DAILY | WEEKLY | MONTHLY |
| GARCH MODEL | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001107 0.000936 1.1834 0.236648**  **ar1 0.793006 0.406913 1.9488 0.051315**  **ma1 -0.806460 0.393792 -2.0479 0.040566**  **omega 0.000089 0.000008 11.4337 0.000000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001107 0.000904 1.2245 0.220777**  **ar1 0.793006 0.339203 2.3379 0.019395**  **ma1 -0.806460 0.326613 -2.4692 0.013543**  **omega 0.000089 0.000016 5.7349 0.000000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 1576.039**  **Information Criteria**  **------------------------------------**    **Akaike -4.2603**  **Bayes -4.2353**  **Shibata -4.2603**  **Hannan-Quinn -4.2506**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 1.043 0.3071**  **Lag[2\*(p+q)+(p+q)-1][5] 2.492 0.7831**  **Lag[4\*(p+q)+(p+q)-1][9] 4.445 0.5845**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.005108 0.9430**  **Lag[2\*(p+q)+(p+q)-1][5] 0.084135 0.9987**  **Lag[4\*(p+q)+(p+q)-1][9] 0.544142 0.9980**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.08815 0.500 2.000 0.7665**  **ARCH Lag[5] 0.15408 1.440 1.667 0.9759**  **ARCH Lag[7] 0.24402 2.315 1.543 0.9954**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.3961**  **Individual Statistics:**  **mu 0.15349**  **ar1 0.02472**  **ma1 0.02320**  **omega 0.17043**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.75305 0.4517**  **Negative Sign Bias 1.77145 0.0769 \***  **Positive Sign Bias 0.09796 0.9220**  **Joint Effect 3.22746 0.3579**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 96.04 2.776e-12**  **2 30 104.76 1.667e-10**  **3 40 115.98 1.432e-09**  **4 50 129.34 3.592e-09** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.006708 0.007800 0.85997 0.389804**  **ar1 0.947790 0.176006 5.38500 0.000000**  **ma1 -0.934787 0.187897 -4.97500 0.000001**  **omega 0.000618 0.000107 5.76547 0.000000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.006708 0.008654 0.77509 0.438289**  **ar1 0.947790 0.134994 7.02097 0.000000**  **ma1 -0.934787 0.128695 -7.26356 0.000000**  **omega 0.000618 0.000166 3.71517 0.000203**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 194.8647**  **Information Criteria**  **------------------------------------**    **Akaike -2.4628**  **Bayes -2.3842**  **Shibata -2.4641**  **Hannan-Quinn -2.4309**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.001852 0.9657**  **Lag[2\*(p+q)+(p+q)-1][5] 0.551254 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.038128 0.9997**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.06322 0.8015**  **Lag[2\*(p+q)+(p+q)-1][5] 1.89892 0.6425**  **Lag[4\*(p+q)+(p+q)-1][9] 3.41822 0.6884**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.5193 0.500 2.000 0.4711**  **ARCH Lag[5] 2.5723 1.440 1.667 0.3581**  **ARCH Lag[7] 3.0265 2.315 1.543 0.5086**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.5319**  **Individual Statistics:**  **mu 0.34834**  **ar1 0.04544**  **ma1 0.04733**  **omega 0.07158**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.4379 0.6621**  **Negative Sign Bias 0.5701 0.5695**  **Positive Sign Bias 0.5716 0.5684**  **Joint Effect 1.0729 0.7836**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 44.61 0.0007763**  **2 30 51.90 0.0055882**  **3 40 59.45 0.0189924**  **4 50 76.94 0.0065864** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.029724 0.028901 1.02848 0.303724**  **ar1 0.501905 0.956168 0.52491 0.599644**  **ma1 -0.355818 1.027396 -0.34633 0.729095**  **omega 0.001678 0.000707 2.37516 0.017541**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.029724 0.030711 0.96787 0.333111**  **ar1 0.501905 0.902043 0.55641 0.577931**  **ma1 -0.355818 0.930716 -0.38231 0.702235**  **omega 0.001678 0.000848 1.97902 0.047814**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 24.16757**  **Information Criteria**  **------------------------------------**    **Akaike -1.15243**  **Bayes -0.97468**  **Shibata -1.17515**  **Hannan-Quinn -1.09107**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.004545 0.9462**  **Lag[2\*(p+q)+(p+q)-1][5] 0.224733 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.109592 0.9996**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 1.089 0.2968**  **Lag[2\*(p+q)+(p+q)-1][5] 1.954 0.6294**  **Lag[4\*(p+q)+(p+q)-1][9] 2.818 0.7886**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.5777 0.500 2.000 0.4472**  **ARCH Lag[5] 1.5083 1.440 1.667 0.5901**  **ARCH Lag[7] 1.7511 2.315 1.543 0.7698**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.5435**  **Individual Statistics:**  **mu 0.33479**  **ar1 0.08085**  **ma1 0.10104**  **omega 0.04225**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.0237 0.3142**  **Negative Sign Bias 0.9702 0.3397**  **Positive Sign Bias 0.4914 0.6267**  **Joint Effect 3.6241 0.3050**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 14.71 0.7406**  **2 30 20.71 0.8693**  **3 40 25.57 0.9519**  **4 50 40.71 0.7942** |
| EGRACH  MODEL | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001125 0.001023 1.100255 0.271221**  **ar1 -0.037704 0.110341 -0.341702 0.732575**  **ma1 0.083751 0.112542 0.744174 0.456771**  **omega -1.223685 0.369203 -3.314399 0.000918**  **alpha1 -0.003483 0.048169 -0.072311 0.942354**  **beta1 0.822859 0.052175 15.771015 0.000000**  **gamma1 0.424201 0.076216 5.565803 0.000000**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001125 0.001021 1.101949 0.270484**  **ar1 -0.037704 0.029884 -1.261662 0.207070**  **ma1 0.083751 0.037635 2.225350 0.026058**  **omega -1.223685 0.668786 -1.829711 0.067293**  **alpha1 -0.003483 0.080355 -0.043348 0.965424**  **beta1 0.822859 0.095318 8.632806 0.000000**  **gamma1 0.424201 0.117970 3.595832 0.000323**  **LogLikelihood : 1588.851**  **Information Criteria**  **------------------------------------**    **Akaike -4.2869**  **Bayes -4.2432**  **Shibata -4.2870**  **Hannan-Quinn -4.2700**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.00195 0.9648**  **Lag[2\*(p+q)+(p+q)-1][5] 1.72760 0.9899**  **Lag[4\*(p+q)+(p+q)-1][9] 3.70007 0.7591**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.2991 0.5845**  **Lag[2\*(p+q)+(p+q)-1][5] 0.5397 0.9514**  **Lag[4\*(p+q)+(p+q)-1][9] 0.8609 0.9913**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.0006127 0.500 2.000 0.9803**  **ARCH Lag[5] 0.0806891 1.440 1.667 0.9903**  **ARCH Lag[7] 0.0965382 2.315 1.543 0.9994**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.1702**  **Individual Statistics:**  **mu 0.11704**  **ar1 0.45278**  **ma1 0.45710**  **omega 0.22907**  **alpha1 0.04041**  **beta1 0.21508**  **gamma1 0.29652**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.6539 0.5134**  **Negative Sign Bias 0.8042 0.4215**  **Positive Sign Bias 0.8813 0.3784**  **Joint Effect 1.4799 0.6869**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 91.76 1.618e-11**  **2 30 86.72 1.156e-07**  **3 40 106.99 3.000e-08**  **4 50 125.28 1.317e-08** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.000571 0.000005 -104.43 0**  **ar1 0.141924 0.000116 1225.23 0**  **ma1 -0.221272 0.000068 -3239.08 0**  **omega -0.218174 0.000097 -2251.19 0**  **alpha1 -0.018108 0.000015 -1211.93 0**  **beta1 0.964604 0.000288 3352.95 0**  **gamma1 -0.230867 0.000143 -1615.38 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.000571 0.000254 -2.2475 0.024608**  **ar1 0.141924 0.005901 24.0511 0.000000**  **ma1 -0.221272 0.001433 -154.3681 0.000000**  **omega -0.218174 0.005261 -41.4716 0.000000**  **alpha1 -0.018108 0.000880 -20.5838 0.000000**  **beta1 0.964604 0.019977 48.2856 0.000000**  **gamma1 -0.230867 0.008063 -28.6335 0.000000**  **LogLikelihood : 211.7908**  **Information Criteria**  **------------------------------------**    **Akaike -2.6425**  **Bayes -2.5050**  **Shibata -2.6463**  **Hannan-Quinn -2.5866**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.2203 0.6388**  **Lag[2\*(p+q)+(p+q)-1][5] 0.7095 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.3598 0.9984**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.0003805 0.9844**  **Lag[2\*(p+q)+(p+q)-1][5] 1.6258510 0.7089**  **Lag[4\*(p+q)+(p+q)-1][9] 2.6277409 0.8185**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.2324 0.500 2.000 0.6297**  **ARCH Lag[5] 1.2436 1.440 1.667 0.6623**  **ARCH Lag[7] 1.6800 2.315 1.543 0.7846**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 4.2266**  **Individual Statistics:**  **mu 0.01299**  **ar1 0.01369**  **ma1 0.01375**  **omega 0.01264**  **alpha1 0.01292**  **beta1 0.02960**  **gamma1 0.01247**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.3725 0.7100**  **Negative Sign Bias 0.0478 0.9619**  **Positive Sign Bias 0.2897 0.7724**  **Joint Effect 0.5692 0.9035**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 27.58 0.09184**  **2 30 33.32 0.26492**  **3 40 49.65 0.11813**  **4 50 47.26 0.54399** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001976 0.000003 697.95 0**  **ar1 0.159782 0.000068 2353.70 0**  **ma1 0.019985 0.000049 411.73 0**  **omega -2.048007 0.000375 -5454.60 0**  **alpha1 0.116221 0.000039 3008.47 0**  **beta1 0.545952 0.000050 10876.77 0**  **gamma1 -1.682055 0.000282 -5964.69 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001976 0.000000 12792.9 0**  **ar1 0.159782 0.000002 83058.3 0**  **ma1 0.019985 0.000001 21490.1 0**  **omega -2.048007 0.001391 -1472.1 0**  **alpha1 0.116221 0.000009 12347.5 0**  **beta1 0.545952 0.000529 1032.0 0**  **gamma1 -1.682055 0.000514 -3275.3 0**  **LogLikelihood : 33.75628**  **Information Criteria**  **------------------------------------**    **Akaike -1.5289**  **Bayes -1.2179**  **Shibata -1.5925**  **Hannan-Quinn -1.4215**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.01118 0.9158**  **Lag[2\*(p+q)+(p+q)-1][5] 1.71462 0.9907**  **Lag[4\*(p+q)+(p+q)-1][9] 2.34993 0.9642**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1577 0.69126**  **Lag[2\*(p+q)+(p+q)-1][5] 7.2753 0.04445**  **Lag[4\*(p+q)+(p+q)-1][9] 9.7166 0.05764**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 1.781 0.500 2.000 0.1821**  **ARCH Lag[5] 2.595 1.440 1.667 0.3541**  **ARCH Lag[7] 3.605 2.315 1.543 0.4072**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 2.4546**  **Individual Statistics:**  **mu 0.01571**  **ar1 0.01587**  **ma1 0.01594**  **omega 0.01566**  **alpha1 0.01568**  **beta1 0.01567**  **gamma1 0.01565**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.88481 0.3833**  **Negative Sign Bias 0.05913 0.9532**  **Positive Sign Bias 0.95993 0.3448**  **Joint Effect 1.07654 0.7827**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 34.14 0.01768**  **2 30 43.00 0.04553**  **3 40 57.57 0.02793**  **4 50 60.71 0.12171** |
| FORECAST  VALUES | **0-roll forecast [T0=2023-10-25]:**  **Series Sigma**  **T+1 0.0005863 0.02811**  **T+2 0.0011457 0.02871**  **T+3 0.0011246 0.02920**  **T+4 0.0011254 0.02962**  **T+5 0.0011254 0.02996**  **T+6 0.0011254 0.03025**  **T+7 0.0011254 0.03049**  **T+8 0.0011254 0.03068**  **T+9 0.0011254 0.03085**  **T+10 0.0011254 0.03098** | **0-roll forecast [T0=2023-10-22]:**  **Series Sigma**  **T+1 4.143e-03 0.04563**  **T+2 9.832e-05 0.04564**  **T+3 -4.758e-04 0.04565**  **T+4 -5.572e-04 0.04565**  **T+5 -5.688e-04 0.04566**  **T+6 -5.704e-04 0.04567**  **T+7 -5.707e-04 0.04568**  **T+8 -5.707e-04 0.04568**  **T+9 -5.707e-04 0.04569**  **T+10 -5.707e-04 0.04570** | **0-roll forecast [T0=2023-09-30]:**  **Series Sigma**  **T+1 0.002930 0.1107**  **T+2 0.002128 0.1080**  **T+3 0.002000 0.1066**  **T+4 0.001980 0.1058**  **T+5 0.001976 0.1054**  **T+6 0.001976 0.1051**  **T+7 0.001976 0.1050**  **T+8 0.001976 0.1049**  **T+9 0.001976 0.1049**  **T+10 0.001976 0.1049** |
| GRAPH OF ACTUAL AND FORECASTED VALUES |  |  |  |

**DAILY RETURNS ANALYSIS:**

Both the models seems to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten days appears relatively stable and has a low and consistent standard error, so data seems stationary and has a high confidence interval.

**WEEKLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten week appears to be relatively stable and has a low and consistent standard error, so data seems to be stationary and have a high confidence interval.

**MONTHLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten Month appears to be relatively stable and has a high and consistent standard error, so data seems to be stationary and have a low confidence interval.

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

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**OUTPUT:**

The output contains garch and egarch model summary and output next for 10 intervals using egrach model as mentioned above egrach is a better choice as a model as it incorporates asymmetry

|  |  |  |  |
| --- | --- | --- | --- |
|  | DAILY | WEEKLY | MONTHLY |
| GARCH MODEL | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.000401 0.000625 0.64069 0.52172**  **ar1 0.236835 0.340944 0.69465 0.48728**  **ma1 -0.168356 0.344334 -0.48893 0.62489**  **omega 0.000031 0.000002 12.51172 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.000401 0.000633 0.63261 0.52699**  **ar1 0.236835 0.178142 1.32947 0.18369**  **ma1 -0.168356 0.177268 -0.94973 0.34225**  **omega 0.000031 0.000005 6.37039 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 2002.157**  **Information Criteria**  **------------------------------------**    **Akaike -5.4151**  **Bayes -5.3901**  **Shibata -5.4151**  **Hannan-Quinn -5.4054**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.0323 0.8574**  **Lag[2\*(p+q)+(p+q)-1][5] 2.1841 0.9127**  **Lag[4\*(p+q)+(p+q)-1][9] 5.7576 0.2982**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.09435 0.7587**  **Lag[2\*(p+q)+(p+q)-1][5] 1.12614 0.8305**  **Lag[4\*(p+q)+(p+q)-1][9] 1.72760 0.9349**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.005379 0.500 2.000 0.9415**  **ARCH Lag[5] 0.033960 1.440 1.667 0.9972**  **ARCH Lag[7] 0.574434 2.315 1.543 0.9712**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.6228**  **Individual Statistics:**  **mu 0.02972**  **ar1 0.22169**  **ma1 0.22110**  **omega 0.14115**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.50521 0.6136**  **Negative Sign Bias 0.05587 0.9555**  **Positive Sign Bias 0.41407 0.6789**  **Joint Effect 1.02487 0.7952**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 115.0 9.665e-16**  **2 30 133.3 2.560e-15**  **3 40 137.6 6.504e-13**  **4 50 150.1 3.465e-12** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.002221 0.002554 0.86947 0.38459**  **ar1 0.461481 0.677920 0.68073 0.49604**  **ma1 -0.505849 0.656641 -0.77036 0.44109**  **omega 0.000154 0.000027 5.63070 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.002221 0.002475 0.89722 0.369599**  **ar1 0.461481 0.286736 1.60943 0.107523**  **ma1 -0.505849 0.265869 -1.90263 0.057089**  **omega 0.000154 0.000038 4.00389 0.000062**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 302.124**  **Information Criteria**  **------------------------------------**    **Akaike -3.8468**  **Bayes -3.7682**  **Shibata -3.8480**  **Hannan-Quinn -3.8149**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.0001496 0.9902**  **Lag[2\*(p+q)+(p+q)-1][5] 1.3685503 0.9994**  **Lag[4\*(p+q)+(p+q)-1][9] 2.7906949 0.9198**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.5762 0.4478**  **Lag[2\*(p+q)+(p+q)-1][5] 2.0265 0.6122**  **Lag[4\*(p+q)+(p+q)-1][9] 3.3496 0.7001**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 1.460 0.500 2.000 0.2270**  **ARCH Lag[5] 2.400 1.440 1.667 0.3895**  **ARCH Lag[7] 2.801 2.315 1.543 0.5519**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.3595**  **Individual Statistics:**  **mu 0.07753**  **ar1 0.18130**  **ma1 0.17764**  **omega 0.05251**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.6703 0.5037**  **Negative Sign Bias 1.1456 0.2538**  **Positive Sign Bias 0.2006 0.8413**  **Joint Effect 1.4308 0.6983**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 33.00 0.02404**  **2 30 38.74 0.10671**  **3 40 43.97 0.26926**  **4 50 53.06 0.32036** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.029724 0.028901 1.02848 0.303724**  **ar1 0.501905 0.956168 0.52491 0.599644**  **ma1 -0.355818 1.027396 -0.34633 0.729095**  **omega 0.001678 0.000707 2.37516 0.017541**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.029724 0.030711 0.96787 0.333111**  **ar1 0.501905 0.902043 0.55641 0.577931**  **ma1 -0.355818 0.930716 -0.38231 0.702235**  **omega 0.001678 0.000848 1.97902 0.047814**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 24.16757**  **Information Criteria**  **------------------------------------**    **Akaike -1.15243**  **Bayes -0.97468**  **Shibata -1.17515**  **Hannan-Quinn -1.09107**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.004545 0.9462**  **Lag[2\*(p+q)+(p+q)-1][5] 0.224733 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.109592 0.9996**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 1.089 0.2968**  **Lag[2\*(p+q)+(p+q)-1][5] 1.954 0.6294**  **Lag[4\*(p+q)+(p+q)-1][9] 2.818 0.7886**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.5777 0.500 2.000 0.4472**  **ARCH Lag[5] 1.5083 1.440 1.667 0.5901**  **ARCH Lag[7] 1.7511 2.315 1.543 0.7698**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.5435**  **Individual Statistics:**  **mu 0.33479**  **ar1 0.08085**  **ma1 0.10104**  **omega 0.04225**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.0237 0.3142**  **Negative Sign Bias 0.9702 0.3397**  **Positive Sign Bias 0.4914 0.6267**  **Joint Effect 3.6241 0.3050**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 14.71 0.7406**  **2 30 20.71 0.8693**  **3 40 25.57 0.9519**  **4 50 40.71 0.7942** |
| EGRACH  MODEL | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.000784 0.000276 2.8407 0.004501**  **ar1 0.071876 0.023911 3.0060 0.002647**  **ma1 0.011433 0.011065 1.0333 0.301487**  **omega -1.279284 0.310887 -4.1150 0.000039**  **alpha1 0.142842 0.032165 4.4409 0.000009**  **beta1 0.843347 0.037772 22.3274 0.000000**  **gamma1 0.175030 0.049341 3.5473 0.000389**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.000784 0.000123 6.3553 0.000000**  **ar1 0.071876 0.013110 5.4827 0.000000**  **ma1 0.011433 0.001950 5.8633 0.000000**  **omega -1.279284 0.386547 -3.3095 0.000935**  **alpha1 0.142842 0.042188 3.3858 0.000710**  **beta1 0.843347 0.046210 18.2502 0.000000**  **gamma1 0.175030 0.075370 2.3223 0.020218**  **LogLikelihood : 2014.312**  **Information Criteria**  **------------------------------------**    **Akaike -5.4399**  **Bayes -5.3962**  **Shibata -5.4400**  **Hannan-Quinn -5.4230**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.03601 0.8495**  **Lag[2\*(p+q)+(p+q)-1][5] 2.17126 0.9167**  **Lag[4\*(p+q)+(p+q)-1][9] 5.66169 0.3158**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.887 0.3463**  **Lag[2\*(p+q)+(p+q)-1][5] 1.612 0.7124**  **Lag[4\*(p+q)+(p+q)-1][9] 2.448 0.8453**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.03023 0.500 2.000 0.8620**  **ARCH Lag[5] 0.17494 1.440 1.667 0.9713**  **ARCH Lag[7] 0.99251 2.315 1.543 0.9148**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.2297**  **Individual Statistics:**  **mu 0.03909**  **ar1 0.24041**  **ma1 0.23844**  **omega 0.08814**  **alpha1 0.56734**  **beta1 0.08930**  **gamma1 0.10085**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.8099 0.41827**  **Negative Sign Bias 1.7405 0.08219 \***  **Positive Sign Bias 0.1255 0.90019**  **Joint Effect 3.0560 0.38307**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 97.39 1.584e-12**  **2 30 103.38 2.794e-10**  **3 40 120.86 2.631e-10**  **4 50 142.35 4.874e-11** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.003723 0.000011 344.63 0**  **ar1 0.314059 0.000772 406.60 0**  **ma1 -0.394010 0.000014 -27650.57 0**  **omega -0.738263 0.000159 -4643.81 0**  **alpha1 -0.039021 0.000066 -591.95 0**  **beta1 0.897750 0.000158 5668.56 0**  **gamma1 -0.401548 0.000004 -111080.77 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.003723 0.000062 59.873 0**  **ar1 0.314059 0.000510 615.404 0**  **ma1 -0.394010 0.000020 -19368.468 0**  **omega -0.738263 0.000446 -1656.951 0**  **alpha1 -0.039021 0.000729 -53.534 0**  **beta1 0.897750 0.001604 559.684 0**  **gamma1 -0.401548 0.000043 -9383.799 0**  **LogLikelihood : 314.6669**  **Information Criteria**  **------------------------------------**    **Akaike -3.9699**  **Bayes -3.8325**  **Shibata -3.9737**  **Hannan-Quinn -3.9141**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1810 0.6705**  **Lag[2\*(p+q)+(p+q)-1][5] 0.8115 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 2.0189 0.9837**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1239 0.7248**  **Lag[2\*(p+q)+(p+q)-1][5] 1.5961 0.7162**  **Lag[4\*(p+q)+(p+q)-1][9] 3.8054 0.6220**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.6003 0.500 2.000 0.4385**  **ARCH Lag[5] 2.4650 1.440 1.667 0.3773**  **ARCH Lag[7] 2.8035 2.315 1.543 0.5514**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.1438**  **Individual Statistics:**  **mu 0.01659**  **ar1 0.01720**  **ma1 0.01703**  **omega 0.01652**  **alpha1 0.01628**  **beta1 0.05039**  **gamma1 0.01662**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.3614 0.7183**  **Negative Sign Bias 0.5640 0.5736**  **Positive Sign Bias 0.4090 0.6831**  **Joint Effect 2.0526 0.5616**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 20.87 0.34397**  **2 30 43.00 0.04553**  **3 40 45.52 0.21920**  **4 50 50.48 0.41463** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001976 0.000003 697.95 0**  **ar1 0.159782 0.000068 2353.70 0**  **ma1 0.019985 0.000049 411.73 0**  **omega -2.048007 0.000375 -5454.60 0**  **alpha1 0.116221 0.000039 3008.47 0**  **beta1 0.545952 0.000050 10876.77 0**  **gamma1 -1.682055 0.000282 -5964.69 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001976 0.000000 12792.9 0**  **ar1 0.159782 0.000002 83058.3 0**  **ma1 0.019985 0.000001 21490.1 0**  **omega -2.048007 0.001391 -1472.1 0**  **alpha1 0.116221 0.000009 12347.5 0**  **beta1 0.545952 0.000529 1032.0 0**  **gamma1 -1.682055 0.000514 -3275.3 0**  **LogLikelihood : 33.75628**  **Information Criteria**  **------------------------------------**    **Akaike -1.5289**  **Bayes -1.2179**  **Shibata -1.5925**  **Hannan-Quinn -1.4215**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.01118 0.9158**  **Lag[2\*(p+q)+(p+q)-1][5] 1.71462 0.9907**  **Lag[4\*(p+q)+(p+q)-1][9] 2.34993 0.9642**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1577 0.69126**  **Lag[2\*(p+q)+(p+q)-1][5] 7.2753 0.04445**  **Lag[4\*(p+q)+(p+q)-1][9] 9.7166 0.05764**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 1.781 0.500 2.000 0.1821**  **ARCH Lag[5] 2.595 1.440 1.667 0.3541**  **ARCH Lag[7] 3.605 2.315 1.543 0.4072**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 2.4546**  **Individual Statistics:**  **mu 0.01571**  **ar1 0.01587**  **ma1 0.01594**  **omega 0.01566**  **alpha1 0.01568**  **beta1 0.01567**  **gamma1 0.01565**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.88481 0.3833**  **Negative Sign Bias 0.05913 0.9532**  **Positive Sign Bias 0.95993 0.3448**  **Joint Effect 1.07654 0.7827**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 34.14 0.01768**  **2 30 43.00 0.04553**  **3 40 57.57 0.02793**  **4 50 60.71 0.12171** |
| FORECAST  VALUES | **0-roll forecast [T0=2023-10-25]:**  **Series Sigma**  **T+1 0.0010478 0.01635**  **T+2 0.0008029 0.01643**  **T+3 0.0007853 0.01650**  **T+4 0.0007841 0.01655**  **T+5 0.0007840 0.01660**  **T+6 0.0007840 0.01664**  **T+7 0.0007840 0.01667**  **T+8 0.0007840 0.01670**  **T+9 0.0007840 0.01672**  **T+10 0.0007840 0.01674** | **0-roll forecast [T0=2023-10-22]:**  **Series Sigma**  **T+1 0.005391 0.02590**  **T+2 0.004247 0.02602**  **T+3 0.003888 0.02612**  **T+4 0.003775 0.02621**  **T+5 0.003740 0.02630**  **T+6 0.003728 0.02637**  **T+7 0.003725 0.02644**  **T+8 0.003724 0.02650**  **T+9 0.003724 0.02656**  **T+10 0.003723 0.02661** | **0-roll forecast [T0=2023-09-30]:**  **Series Sigma**  **T+1 0.002930 0.1107**  **T+2 0.002128 0.1080**  **T+3 0.002000 0.1066**  **T+4 0.001980 0.1058**  **T+5 0.001976 0.1054**  **T+6 0.001976 0.1051**  **T+7 0.001976 0.1050**  **T+8 0.001976 0.1049**  **T+9 0.001976 0.1049**  **T+10 0.001976 0.1049** |
| GRAPH OF ACTUAL AND FORECASTED VALUES | A graph with blue lines  Description automatically generated |  |  |

**DAILY RETURNS ANALYSIS:**

Both the models seems to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten days appears relatively stable and has a low and consistent standard error, so data seems stationary and has a high confidence interval.

**WEEKLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten week appears to be relatively stable and has a low and consistent standard error, so data seems to be stationary and have a high confidence interval.

**MONTHLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten Month appears to be relatively stable and has a high and consistent standard error, so data seems to be stationary and have a low confidence interval

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

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**OUTPUT:**

The output contains garch and egarch model summary and output next for 10 intervals using egrach model as mentioned above egrach is a better choice as a model as it incorporates asymmetry

|  |  |  |  |
| --- | --- | --- | --- |
|  | DAILY | WEEKLY | MONTHLY |
| GARCH MODEL | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.002977 0.001212 2.45663 0.014025**  **ar1 0.139171 0.283536 0.49084 0.623539**  **ma1 0.044627 0.288610 0.15463 0.877115**  **omega 0.000082 0.000007 11.01060 0.000000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.002977 0.001218 2.44364 0.01454**  **ar1 0.139171 0.376654 0.36949 0.71176**  **ma1 0.044627 0.380022 0.11743 0.90652**  **omega 0.000082 0.000009 9.62911 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 1593.868**  **Information Criteria**  **------------------------------------**    **Akaike -4.3086**  **Bayes -4.2836**  **Shibata -4.3086**  **Hannan-Quinn -4.2990**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.03885 0.8437**  **Lag[2\*(p+q)+(p+q)-1][5] 1.55127 0.9970**  **Lag[4\*(p+q)+(p+q)-1][9] 3.37836 0.8253**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 4.045 0.044313**  **Lag[2\*(p+q)+(p+q)-1][5] 9.067 0.015922**  **Lag[4\*(p+q)+(p+q)-1][9] 13.798 0.006937**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.1358 0.500 2.000 0.71253**  **ARCH Lag[5] 7.8298 1.440 1.667 0.02205**  **ARCH Lag[7] 10.6254 2.315 1.543 0.01315**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.935**  **Individual Statistics:**  **mu 0.3152**  **ar1 0.3183**  **ma1 0.2676**  **omega 0.2082**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.1076 0.9143**  **Negative Sign Bias 1.0467 0.2956**  **Positive Sign Bias 1.1222 0.2622**  **Joint Effect 2.3835 0.4967**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 45.69 0.0005490**  **2 30 61.92 0.0003544**  **3 40 64.38 0.0064339**  **4 50 87.34 0.0006212** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.015081 0.006600 2.284993 0.022313**  **ar1 0.004050 0.376210 0.010764 0.991411**  **ma1 0.193150 0.364770 0.529512 0.596450**  **omega 0.000546 0.000108 5.073334 0.000000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.015081 0.006342 2.378020 0.017406**  **ar1 0.004050 0.282949 0.014312 0.988581**  **ma1 0.193150 0.272725 0.708224 0.478806**  **omega 0.000546 0.000130 4.188410 0.000028**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 192.3915**  **Information Criteria**  **------------------------------------**    **Akaike -2.4309**  **Bayes -2.3523**  **Shibata -2.4321**  **Hannan-Quinn -2.3990**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.01741 0.8950**  **Lag[2\*(p+q)+(p+q)-1][5] 0.21814 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.19129 0.9993**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.06997 0.7914**  **Lag[2\*(p+q)+(p+q)-1][5] 0.93286 0.8747**  **Lag[4\*(p+q)+(p+q)-1][9] 1.54471 0.9518**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.3655 0.500 2.000 0.5455**  **ARCH Lag[5] 1.1537 1.440 1.667 0.6879**  **ARCH Lag[7] 1.3846 2.315 1.543 0.8442**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.7**  **Individual Statistics:**  **mu 0.3266**  **ar1 0.3254**  **ma1 0.3294**  **omega 0.2474**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.8882 0.060929 \***  **Negative Sign Bias 0.8861 0.376993**  **Positive Sign Bias 0.3420 0.732830**  **Joint Effect 12.6762 0.005392 \*\*\***  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 21.39 0.3158**  **2 30 24.81 0.6883**  **3 40 37.77 0.5257**  **4 50 52.42 0.3428** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.079328 0.034903 2.272810 0.023038**  **ar1 0.016051 1.054461 0.015222 0.987855**  **ma1 0.146160 1.046488 0.139667 0.888923**  **omega 0.003230 0.001709 1.890053 0.058751**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.079328 0.035921 2.208411 0.027216**  **ar1 0.016051 0.929205 0.017274 0.986218**  **ma1 0.146160 0.931892 0.156842 0.875370**  **omega 0.003230 0.001777 1.817487 0.069143**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 11.11606**  **Information Criteria**  **------------------------------------**    **Akaike -0.40663**  **Bayes -0.22888**  **Shibata -0.42935**  **Hannan-Quinn -0.34527**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.04579 0.8306**  **Lag[2\*(p+q)+(p+q)-1][5] 0.14455 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.40946 0.9980**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.4095 0.5222**  **Lag[2\*(p+q)+(p+q)-1][5] 1.8071 0.6647**  **Lag[4\*(p+q)+(p+q)-1][9] 3.4179 0.6884**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.8376 0.500 2.000 0.3601**  **ARCH Lag[5] 1.8086 1.440 1.667 0.5151**  **ARCH Lag[7] 2.8468 2.315 1.543 0.5430**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.7531**  **Individual Statistics:**  **mu 0.2846**  **ar1 0.1261**  **ma1 0.1413**  **omega 0.3614**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.4482 0.1579**  **Negative Sign Bias 0.5050 0.6173**  **Positive Sign Bias 0.1255 0.9010**  **Joint Effect 4.0135 0.2600**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 35.29 0.0129**  **2 30 27.57 0.5409**  **3 40 46.14 0.2009**  **4 50 43.57 0.6922** |
| EGRACH  MODEL | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.002911 0.000805 3.61368 0.000302**  **ar1 0.113344 0.032493 3.48822 0.000486**  **ma1 0.064629 0.026066 2.47946 0.013158**  **omega -1.863356 0.466484 -3.99447 0.000065**  **alpha1 0.027968 0.037322 0.74937 0.453635**  **beta1 0.739309 0.065144 11.34890 0.000000**  **gamma1 0.325940 0.064518 5.05188 0.000000**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.002911 0.000749 3.8836 0.000103**  **ar1 0.113344 0.021335 5.3126 0.000000**  **ma1 0.064629 0.012837 5.0345 0.000000**  **omega -1.863356 0.501778 -3.7135 0.000204**  **alpha1 0.027968 0.038513 0.7262 0.467716**  **beta1 0.739309 0.068827 10.7416 0.000000**  **gamma1 0.325940 0.065790 4.9543 0.000001**  **LogLikelihood : 1595.827**  **Information Criteria**  **------------------------------------**    **Akaike -4.3058**  **Bayes -4.2621**  **Shibata -4.3059**  **Hannan-Quinn -4.2889**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1563 0.6925**  **Lag[2\*(p+q)+(p+q)-1][5] 1.5783 0.9963**  **Lag[4\*(p+q)+(p+q)-1][9] 3.2311 0.8526**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.591 0.442017**  **Lag[2\*(p+q)+(p+q)-1][5] 7.589 0.037232**  **Lag[4\*(p+q)+(p+q)-1][9] 13.327 0.008956**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.009785 0.500 2.000 0.9212012**  **ARCH Lag[5] 13.401015 1.440 1.667 0.0009568**  **ARCH Lag[7] 15.734266 2.315 1.543 0.0007591**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 2.0702**  **Individual Statistics:**  **mu 0.3445**  **ar1 0.2987**  **ma1 0.2445**  **omega 0.3878**  **alpha1 0.2704**  **beta1 0.3455**  **gamma1 0.1854**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.1095 0.9128**  **Negative Sign Bias 0.4363 0.6627**  **Positive Sign Bias 0.1613 0.8719**  **Joint Effect 0.4014 0.9400**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 52.41 0.0000575**  **2 30 60.21 0.0005813**  **3 40 67.85 0.0028426**  **4 50 73.92 0.0122254** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.016220 0.006856 2.36565 0.017999**  **ar1 0.066729 0.254529 0.26216 0.793194**  **ma1 0.105132 0.261153 0.40257 0.687264**  **omega -6.178381 0.939101 -6.57904 0.000000**  **alpha1 0.553601 0.116425 4.75500 0.000002**  **beta1 -0.136566 0.170843 -0.79937 0.424078**  **gamma1 -0.028602 0.159996 -0.17877 0.858120**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.016220 0.007067 2.29524 0.021719**  **ar1 0.066729 0.165108 0.40415 0.686102**  **ma1 0.105132 0.208454 0.50434 0.614020**  **omega -6.178381 0.846242 -7.30097 0.000000**  **alpha1 0.553601 0.076989 7.19066 0.000000**  **beta1 -0.136566 0.145689 -0.93738 0.348564**  **gamma1 -0.028602 0.180094 -0.15882 0.873813**  **LogLikelihood : 201.4485**  **Information Criteria**  **------------------------------------**    **Akaike -2.5090**  **Bayes -2.3716**  **Shibata -2.5129**  **Hannan-Quinn -2.4532**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 2.178e-05 0.9963**  **Lag[2\*(p+q)+(p+q)-1][5] 7.727e-01 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.897e+00 0.9884**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1462 0.7022**  **Lag[2\*(p+q)+(p+q)-1][5] 2.5275 0.5001**  **Lag[4\*(p+q)+(p+q)-1][9] 4.3060 0.5378**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.2762 0.500 2.000 0.5992**  **ARCH Lag[5] 2.5164 1.440 1.667 0.3680**  **ARCH Lag[7] 2.9556 2.315 1.543 0.5220**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.4823**  **Individual Statistics:**  **mu 0.14576**  **ar1 0.07216**  **ma1 0.08566**  **omega 0.31607**  **alpha1 0.06013**  **beta1 0.33758**  **gamma1 0.21753**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.01769 0.9859**  **Negative Sign Bias 0.64851 0.5176**  **Positive Sign Bias 0.14199 0.8873**  **Joint Effect 0.94028 0.8157**  **Adjusted Pearson Goodness-of-Fit Test:**  **---------------------------**  **---------**  **group statistic p-value(g-1)**  **1 20 33.77 0.019537**  **2 30 45.71 0.025072**  **3 40 63.06 0.008678**  **4 50 74.35 0.011212** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.024246 0.000010 2491.2 0**  **ar1 0.226783 0.000096 2373.8 0**  **ma1 -0.141701 0.000052 -2735.9 0**  **omega -0.482865 0.000209 -2313.4 0**  **alpha1 0.171335 0.000057 2986.7 0**  **beta1 0.871875 0.000223 3909.7 0**  **gamma1 -1.285727 0.000381 -3377.4 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.024246 0.062258 0.38945 0.696942**  **ar1 0.226783 0.371944 0.60972 0.542045**  **ma1 -0.141701 0.275649 -0.51406 0.607208**  **omega -0.482865 0.115441 -4.18279 0.000029**  **alpha1 0.171335 0.343060 0.49943 0.617476**  **beta1 0.871875 2.480965 0.35143 0.725269**  **gamma1 -1.285727 3.137741 -0.40976 0.681981**  **LogLikelihood : 17.28824**  **Information Criteria**  **------------------------------------**    **Akaike -0.58790**  **Bayes -0.27683**  **Shibata -0.65143**  **Hannan-Quinn -0.48052**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.0439 0.8340**  **Lag[2\*(p+q)+(p+q)-1][5] 0.3883 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.5186 0.9968**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.2578 0.6116**  **Lag[2\*(p+q)+(p+q)-1][5] 1.5035 0.7390**  **Lag[4\*(p+q)+(p+q)-1][9] 2.0802 0.8952**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.9094 0.500 2.000 0.3403**  **ARCH Lag[5] 1.2147 1.440 1.667 0.6705**  **ARCH Lag[7] 1.2976 2.315 1.543 0.8609**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 3.4371**  **Individual Statistics:**  **mu 0.01864**  **ar1 0.01864**  **ma1 0.01864**  **omega 0.02552**  **alpha1 0.01864**  **beta1 0.14742**  **gamma1 0.01865**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.7117 0.4821**  **Negative Sign Bias 0.5273 0.6019**  **Positive Sign Bias 1.3339 0.1923**  **Joint Effect 2.3018 0.5122**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 26.14 0.12626**  **2 30 31.00 0.36542**  **3 40 39.29 0.45708**  **4 50 63.57 0.07884** |
| FORECAST  VALUES | **Series Sigma**  **T+1 0.003329 0.02940**  **T+2 0.002958 0.02904**  **T+3 0.002916 0.02878**  **T+4 0.002911 0.02858**  **T+5 0.002911 0.02844**  **T+6 0.002911 0.02834**  **T+7 0.002911 0.02826**  **T+8 0.002911 0.02821**  **T+9 0.002911 0.02816**  **T+10 0.002911 0.02813** | **0-roll forecast [T0=2023-10-22]:**  **Series Sigma**  **T+1 0.003192 0.04935**  **T+2 0.015350 0.06868**  **T+3 0.016162 0.06565**  **T+4 0.016216 0.06606**  **T+5 0.016220 0.06600**  **T+6 0.016220 0.06601**  **T+7 0.016220 0.06601**  **T+8 0.016220 0.06601**  **T+9 0.016220 0.06601**  **T+10 0.016220 0.06601** | **0-roll forecast [T0=2023-09-30]:**  **Series Sigma**  **T+1 0.03315 0.1054**  **T+2 0.02627 0.1105**  **T+3 0.02470 0.1151**  **T+4 0.02435 0.1192**  **T+5 0.02427 0.1230**  **T+6 0.02425 0.1264**  **T+7 0.02425 0.1294**  **T+8 0.02425 0.1321**  **T+9 0.02425 0.1345**  **T+10 0.02425 0.1366** |
| GRAPH OF ACTUAL AND FORECASTED VALUES |  | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** |

**DAILY RETURNS ANALYSIS:**

Both the models seems to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten days appears relatively stable and has a low and consistent standard error, so data seems stationary and has a high confidence interval.

**WEEKLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten week appears to be relatively stable and has a low and consistent standard error, so data seems to be stationary and have a high confidence interval.

**MONTHLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten Month appears to be relatively stable and has a high and consistent standard error, so data seems to be stationary and have a low confidence interval

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

**COMPANY 5- UTI S&P BSE Sensex ETF (UTISENSETF.NS)**

**OUTPUT:**

The output contains garch and egarch model summary and output next for 10 intervals using egrach model as mentioned above egrach is a better choice as a model as it incorporates asymmetry

|  |  |  |  |
| --- | --- | --- | --- |
|  | DAILY | WEEKLY | MONTHLY |
| GARCH MODEL | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001302 0.000357 3.64832 0.000264**  **ar1 0.425916 0.473003 0.90045 0.367880**  **ma1 -0.458173 0.462344 -0.99098 0.321696**  **omega 0.000013 0.000001 22.49602 0.000000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001302 0.000407 3.2009 0.001370**  **ar1 0.425916 0.239118 1.7812 0.074880**  **ma1 -0.458173 0.230073 -1.9914 0.046434**  **omega 0.000013 0.000001 12.7127 0.000000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 2304.901**  **Information Criteria**  **------------------------------------**    **Akaike -6.2355**  **Bayes -6.2106**  **Shibata -6.2356**  **Hannan-Quinn -6.2259**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 2.065 0.1507**  **Lag[2\*(p+q)+(p+q)-1][5] 2.917 0.5244**  **Lag[4\*(p+q)+(p+q)-1][9] 5.291 0.3897**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 7.229 0.007175**  **Lag[2\*(p+q)+(p+q)-1][5] 7.447 0.040348**  **Lag[4\*(p+q)+(p+q)-1][9] 7.650 0.150598**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.1874 0.500 2.000 0.6651**  **ARCH Lag[5] 0.3603 1.440 1.667 0.9238**  **ARCH Lag[7] 0.4664 2.315 1.543 0.9813**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 2.469**  **Individual Statistics:**  **mu 0.09472**  **ar1 0.19473**  **ma1 0.18373**  **omega 0.97096**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.9385 0.05295 \***  **Negative Sign Bias 0.5693 0.56933**  **Positive Sign Bias 2.0569 0.04005 \*\***  **Joint Effect 6.9029 0.07506 \***  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 79.89 1.946e-09**  **2 30 85.50 1.767e-07**  **3 40 93.00 2.637e-06**  **4 50 111.59 8.737e-07** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.002003 0.001329 1.50708 0.13179**  **ar1 0.678578 1.232593 0.55053 0.58196**  **ma1 -0.738704 1.065394 -0.69336 0.48808**  **omega 0.000000 0.000002 0.19859 0.84259**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.002003 0.006844 0.292609 0.76982**  **ar1 0.678578 10.351205 0.065555 0.94773**  **ma1 -0.738704 8.973643 -0.082319 0.93439**  **omega 0.000000 0.000010 0.044935 0.96416**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 346.877**  **Information Criteria**  **------------------------------------**    **Akaike -4.4242**  **Bayes -4.3457**  **Shibata -4.4255**  **Hannan-Quinn -4.3923**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 1.429 0.2319**  **Lag[2\*(p+q)+(p+q)-1][5] 3.272 0.3130**  **Lag[4\*(p+q)+(p+q)-1][9] 6.901 0.1378**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.6503 0.4200**  **Lag[2\*(p+q)+(p+q)-1][5] 4.9913 0.1538**  **Lag[4\*(p+q)+(p+q)-1][9] 6.1516 0.2811**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.8336 0.500 2.000 0.3612**  **ARCH Lag[5] 1.3092 1.440 1.667 0.6439**  **ARCH Lag[7] 1.7024 2.315 1.543 0.7800**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 3.4926**  **Individual Statistics:**  **mu 0.06937**  **ar1 0.06961**  **ma1 0.05907**  **omega 3.00067**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.7512 0.08195 \***  **Negative Sign Bias 0.5303 0.59672**  **Positive Sign Bias 0.5301 0.59683**  **Joint Effect 8.6903 0.03370 \*\***  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 52.10 6.399e-05**  **2 30 72.03 1.590e-05**  **3 40 87.84 1.256e-05**  **4 50 95.65 7.599e-05** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.012051 0.003222 3.7405 0.000184**  **ar1 0.842821 0.044105 19.1093 0.000000**  **ma1 -1.000000 0.098339 -10.1689 0.000000**  **omega 0.000119 0.000063 1.8820 0.059832**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.012051 0.003742 3.2202 0.001281**  **ar1 0.842821 0.112043 7.5223 0.000000**  **ma1 -1.000000 0.077399 -12.9201 0.000000**  **omega 0.000119 0.000051 2.3455 0.019003**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 66.29981**  **Information Criteria**  **------------------------------------**    **Akaike -3.5600**  **Bayes -3.3822**  **Shibata -3.5827**  **Hannan-Quinn -3.4986**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.2679 0.6048**  **Lag[2\*(p+q)+(p+q)-1][5] 0.7306 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 2.3607 0.9634**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.06808 0.7941**  **Lag[2\*(p+q)+(p+q)-1][5] 1.28801 0.7918**  **Lag[4\*(p+q)+(p+q)-1][9] 2.51757 0.8351**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.1136 0.500 2.000 0.7361**  **ARCH Lag[5] 1.5534 1.440 1.667 0.5784**  **ARCH Lag[7] 1.9536 2.315 1.543 0.7272**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.6969**  **Individual Statistics:**  **mu 0.1838**  **ar1 0.3386**  **ma1 0.1075**  **omega 0.1093**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 2.2078 0.03505 \*\***  **Negative Sign Bias 1.8961 0.06762 \***  **Positive Sign Bias 0.1223 0.90345**  **Joint Effect 6.9201 0.07449 \***  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 25.00 0.16054**  **2 30 41.29 0.06501**  **3 40 37.00 0.56141**  **4 50 57.86 0.18080** |
| EGRACH  MODEL | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001076 0.000212 5.0849 0e+00**  **ar1 0.508830 0.034516 14.7419 0e+00**  **ma1 -0.580528 0.033425 -17.3678 0e+00**  **omega -2.464401 0.509650 -4.8355 1e-06**  **alpha1 -0.208879 0.041193 -5.0707 0e+00**  **beta1 0.727007 0.055353 13.1340 0e+00**  **gamma1 0.673101 0.068823 9.7801 0e+00**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.001076 0.000192 5.6186 0.000000**  **ar1 0.508830 0.027612 18.4278 0.000000**  **ma1 -0.580528 0.027474 -21.1300 0.000000**  **omega -2.464401 1.068934 -2.3055 0.021140**  **alpha1 -0.208879 0.106803 -1.9557 0.050496**  **beta1 0.727007 0.120154 6.0506 0.000000**  **gamma1 0.673101 0.237240 2.8372 0.004551**  **LogLikelihood : 2351.522**  **Information Criteria**  **------------------------------------**    **Akaike -6.3537**  **Bayes -6.3100**  **Shibata -6.3539**  **Hannan-Quinn -6.3369**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.603 0.4374**  **Lag[2\*(p+q)+(p+q)-1][5] 1.846 0.9802**  **Lag[4\*(p+q)+(p+q)-1][9] 5.250 0.3984**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.5589 0.4547**  **Lag[2\*(p+q)+(p+q)-1][5] 1.3491 0.7769**  **Lag[4\*(p+q)+(p+q)-1][9] 1.8272 0.9246**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 1.137 0.500 2.000 0.2863**  **ARCH Lag[5] 1.261 1.440 1.667 0.6573**  **ARCH Lag[7] 1.456 2.315 1.543 0.8301**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 2.7793**  **Individual Statistics:**  **mu 0.07404**  **ar1 0.08767**  **ma1 0.09754**  **omega 0.63590**  **alpha1 0.13811**  **beta1 0.61727**  **gamma1 0.85571**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.0839 0.2788**  **Negative Sign Bias 1.0109 0.3124**  **Positive Sign Bias 0.2229 0.8237**  **Joint Effect 1.5656 0.6672**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 46.44 0.0004287**  **2 30 52.98 0.0042350**  **3 40 57.99 0.0256739**  **4 50 81.24 0.0025803** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.003269 0.001193 2.73963 0.006151**  **ar1 -0.554544 0.066217 -8.37471 0.000000**  **ma1 0.642350 0.058313 11.01561 0.000000**  **omega -9.999992 2.957823 -3.38086 0.000723**  **alpha1 -0.358488 0.110504 -3.24413 0.001178**  **beta1 -0.260333 0.371759 -0.70027 0.483756**  **gamma1 0.291640 0.192323 1.51641 0.129417**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.003269 0.000966 3.38318 0.000717**  **ar1 -0.554544 0.021702 -25.55214 0.000000**  **ma1 0.642350 0.019934 32.22304 0.000000**  **omega -9.999992 3.499648 -2.85743 0.004271**  **alpha1 -0.358488 0.119252 -3.00613 0.002646**  **beta1 -0.260333 0.443835 -0.58655 0.557503**  **gamma1 0.291640 0.240986 1.21019 0.226204**  **LogLikelihood : 392.6504**  **Information Criteria**  **------------------------------------**    **Akaike -4.9761**  **Bayes -4.8387**  **Shibata -4.9800**  **Hannan-Quinn -4.9203**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.01872 0.8912**  **Lag[2\*(p+q)+(p+q)-1][5] 2.76174 0.6241**  **Lag[4\*(p+q)+(p+q)-1][9] 7.34856 0.0980**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.01522 0.9018**  **Lag[2\*(p+q)+(p+q)-1][5] 0.80245 0.9025**  **Lag[4\*(p+q)+(p+q)-1][9] 4.74414 0.4679**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.08846 0.500 2.000 0.7661**  **ARCH Lag[5] 1.08000 1.440 1.667 0.7093**  **ARCH Lag[7] 5.18053 2.315 1.543 0.2069**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.5317**  **Individual Statistics:**  **mu 0.4233**  **ar1 0.3226**  **ma1 0.3314**  **omega 0.4518**  **alpha1 0.3320**  **beta1 0.4818**  **gamma1 0.1528**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.6477 0.1015**  **Negative Sign Bias 1.0251 0.3070**  **Positive Sign Bias 0.4922 0.6233**  **Joint Effect 2.9586 0.3981**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 15.19 0.71022**  **2 30 29.45 0.44174**  **3 40 50.16 0.10861**  **4 50 62.10 0.09911** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.010302 0.000008 1330.9 0**  **ar1 0.350424 0.000126 2786.6 0**  **ma1 -0.710205 0.000353 -2012.3 0**  **omega -0.559180 0.000172 -3251.0 0**  **alpha1 0.015452 0.000014 1075.9 0**  **beta1 0.906975 0.000354 2564.2 0**  **gamma1 -0.607622 0.000097 -6258.5 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu 0.010302 0.000004 2331.7 0**  **ar1 0.350424 0.000042 8356.9 0**  **ma1 -0.710205 0.000033 -21497.9 0**  **omega -0.559180 0.000061 -9233.9 0**  **alpha1 0.015452 0.000014 1132.3 0**  **beta1 0.906975 0.000554 1637.1 0**  **gamma1 -0.607622 0.000029 -20854.8 0**  **LogLikelihood : 68.73958**  **Information Criteria**  **------------------------------------**    **Akaike -3.5280**  **Bayes -3.2169**  **Shibata -3.5915**  **Hannan-Quinn -3.4206**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.7514 0.3860**  **Lag[2\*(p+q)+(p+q)-1][5] 1.5845 0.9961**  **Lag[4\*(p+q)+(p+q)-1][9] 3.2933 0.8413**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.2551 0.6135**  **Lag[2\*(p+q)+(p+q)-1][5] 1.3043 0.7878**  **Lag[4\*(p+q)+(p+q)-1][9] 3.0545 0.7499**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.7861 0.500 2.000 0.3753**  **ARCH Lag[5] 1.5366 1.440 1.667 0.5827**  **ARCH Lag[7] 1.7959 2.315 1.543 0.7604**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 4.4876**  **Individual Statistics:**  **mu 0.03454**  **ar1 0.02581**  **ma1 0.02577**  **omega 0.02633**  **alpha1 0.02621**  **beta1 0.02629**  **gamma1 0.02447**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.5114 0.6128**  **Negative Sign Bias 0.2765 0.7841**  **Positive Sign Bias 0.2263 0.8225**  **Joint Effect 0.2893 0.9620**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 30.71 0.043383**  **2 30 39.57 0.091192**  **3 40 70.41 0.001515**  **4 50 60.01 0.134591** |
| FORECAST  VALUES | **0-roll forecast [T0=2023-10-25]:**  **Series Sigma**  **T+1 0.002731 0.01767**  **T+2 0.001918 0.01551**  **T+3 0.001505 0.01410**  **T+4 0.001294 0.01317**  **T+5 0.001187 0.01252**  **T+6 0.001133 0.01207**  **T+7 0.001105 0.01176**  **T+8 0.001091 0.01153**  **T+9 0.001084 0.01137**  **T+10 0.001080 0.01126** | **0-roll forecast [T0=2023-10-22]:**  **Series Sigma**  **T+1 0.001401 0.02494**  **T+2 0.004304 0.01762**  **T+3 0.002694 0.01928**  **T+4 0.003587 0.01883**  **T+5 0.003092 0.01895**  **T+6 0.003367 0.01892**  **T+7 0.003214 0.01893**  **T+8 0.003299 0.01893**  **T+9 0.003252 0.01893**  **T+10 0.003278 0.01893** | **0-roll forecast [T0=2023-09-30]:**  **Series Sigma**  **T+1 0.02392 0.03103**  **T+2 0.01507 0.03241**  **T+3 0.01197 0.03371**  **T+4 0.01089 0.03494**  **T+5 0.01051 0.03609**  **T+6 0.01037 0.03717**  **T+7 0.01033 0.03817**  **T+8 0.01031 0.03911**  **T+9 0.01030 0.03997**  **T+10 0.01030 0.04078** |
| GRAPH OF ACTUAL AND FORECASTED VALUES |  |  |  |

**DAILY RETURNS ANALYSIS:**

Both the models seems to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten days appears relatively stable and has a low and consistent standard error, so data seems stationary and has a high confidence interval.

**WEEKLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten week appears to be relatively stable and has a low and consistent standard error, so data seems to be stationary and have a high confidence interval.

**MONTHLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten Month appears to be relatively stable and has a low and consistent standard error, so data seems to be stationary and have a high confidence interval

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

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**OUTPUT:**

The output contains garch and egarch model summary and output next for 10 intervals using egrach model as mentioned above egrach is a better choice as a model as it incorporates asymmetry

|  |  |  |  |
| --- | --- | --- | --- |
|  | DAILY | WEEKLY | MONTHLY |
| GARCH MODEL | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.001215 0.001024 -1.18662 0.23538**  **ar1 -0.254300 0.488515 -0.52056 0.60268**  **ma1 0.305320 0.481101 0.63463 0.52567**  **omega 0.000089 0.000008 11.81048 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.001215 0.000993 -1.22360 0.22110**  **ar1 -0.254300 0.332140 -0.76564 0.44389**  **ma1 0.305320 0.317346 0.96210 0.33600**  **omega 0.000089 0.000015 6.01615 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 1590.016**  **Information Criteria**  **------------------------------------**    **Akaike -4.2981**  **Bayes -4.2732**  **Shibata -4.2982**  **Hannan-Quinn -4.2885**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 1.041 0.3075**  **Lag[2\*(p+q)+(p+q)-1][5] 2.222 0.9003**  **Lag[4\*(p+q)+(p+q)-1][9] 4.251 0.6314**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1781 0.6730**  **Lag[2\*(p+q)+(p+q)-1][5] 0.6000 0.9412**  **Lag[4\*(p+q)+(p+q)-1][9] 1.5278 0.9533**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.06831 0.500 2.000 0.7938**  **ARCH Lag[5] 0.33474 1.440 1.667 0.9309**  **ARCH Lag[7] 1.30965 2.315 1.543 0.8586**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.1403**  **Individual Statistics:**  **mu 0.05509**  **ar1 0.16096**  **ma1 0.16629**  **omega 0.46173**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.7086 0.4788**  **Negative Sign Bias 0.2038 0.8386**  **Positive Sign Bias 0.7276 0.4671**  **Joint Effect 3.0545 0.3833**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 81.57 9.972e-10**  **2 30 95.17 5.710e-09**  **3 40 110.46 9.411e-09**  **4 50 120.81 5.355e-08** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.003832 0.005812 -0.65930 0.50970**  **ar1 -0.189734 0.747673 -0.25377 0.79968**  **ma1 0.316115 0.720471 0.43876 0.66083**  **omega 0.000451 0.000084 5.39882 0.00000**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.003832 0.006400 -0.59867 0.549393**  **ar1 -0.189734 0.829193 -0.22882 0.819011**  **ma1 0.316115 0.807892 0.39128 0.695588**  **omega 0.000451 0.000136 3.31555 0.000915**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 203.3836**  **Information Criteria**  **------------------------------------**    **Akaike -2.5727**  **Bayes -2.4942**  **Shibata -2.5740**  **Hannan-Quinn -2.5408**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.04634 0.8296**  **Lag[2\*(p+q)+(p+q)-1][5] 0.27776 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.26755 0.9990**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.3463 0.5562**  **Lag[2\*(p+q)+(p+q)-1][5] 0.8489 0.8928**  **Lag[4\*(p+q)+(p+q)-1][9] 1.1664 0.9783**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.1389 0.500 2.000 0.7093**  **ARCH Lag[5] 0.5264 1.440 1.667 0.8758**  **ARCH Lag[7] 0.5836 2.315 1.543 0.9702**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.2908**  **Individual Statistics:**  **mu 0.12169**  **ar1 0.08843**  **ma1 0.09853**  **omega 0.05962**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.9072 0.05841 \***  **Negative Sign Bias 0.2857 0.77547**  **Positive Sign Bias 2.0701 0.04016 \*\***  **Joint Effect 6.1136 0.10621**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 24.23 0.1876**  **2 30 34.87 0.2088**  **3 40 46.55 0.1896**  **4 50 49.19 0.4654** | **GARCH Model : sGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.019470 0.021986 -0.8856 0.37583**  **ar1 -0.641978 0.433401 -1.4813 0.13854**  **ma1 0.544981 0.464182 1.1741 0.24037**  **omega 0.002086 0.000928 2.2478 0.02459**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.019470 0.023006 -0.84633 0.397370**  **ar1 -0.641978 0.214629 -2.99110 0.002780**  **ma1 0.544981 0.164372 3.31553 0.000915**  **omega 0.002086 0.001149 1.81559 0.069433**  **alpha1 0.100000 NA NA NA**  **beta1 0.800000 NA NA NA**  **LogLikelihood : 19.65556**  **Information Criteria**  **------------------------------------**    **Akaike -0.89460**  **Bayes -0.71685**  **Shibata -0.91732**  **Hannan-Quinn -0.83324**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.01803 0.8932**  **Lag[2\*(p+q)+(p+q)-1][5] 0.96597 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.96612 0.9859**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.02876 0.8653**  **Lag[2\*(p+q)+(p+q)-1][5] 0.87157 0.8880**  **Lag[4\*(p+q)+(p+q)-1][9] 1.65807 0.9417**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.1356 0.500 2.000 0.7127**  **ARCH Lag[5] 0.4840 1.440 1.667 0.8883**  **ARCH Lag[7] 0.9696 2.315 1.543 0.9185**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 0.6039**  **Individual Statistics:**  **mu 0.14507**  **ar1 0.04988**  **ma1 0.06767**  **omega 0.05786**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.07 1.24 1.6**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.3380 0.7377**  **Negative Sign Bias 0.0614 0.9514**  **Positive Sign Bias 0.1170 0.9077**  **Joint Effect 0.2608 0.9672**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 18.14 0.51292**  **2 30 31.00 0.36542**  **3 40 57.57 0.02793**  **4 50 57.86 0.18080** |
| EGRACH  MODEL | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.000529 0.001372 -0.38525 0.700052**  **ar1 -0.066067 0.022835 -2.89327 0.003813**  **ma1 0.119046 0.023145 5.14344 0.000000**  **omega -1.288749 0.428972 -3.00427 0.002662**  **alpha1 0.095279 0.033976 2.80432 0.005042**  **beta1 0.816385 0.060107 13.58225 0.000000**  **gamma1 0.263148 0.054211 4.85412 0.000001**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.000529 0.002239 -0.23605 0.813392**  **ar1 -0.066067 0.062610 -1.05521 0.291328**  **ma1 0.119046 0.011362 10.47747 0.000000**  **omega -1.288749 0.711310 -1.81180 0.070018**  **alpha1 0.095279 0.061498 1.54930 0.121311**  **beta1 0.816385 0.100930 8.08860 0.000000**  **gamma1 0.263148 0.082212 3.20084 0.001370**  **LogLikelihood : 1598.293**  **Information Criteria**  **------------------------------------**    **Akaike -4.3124**  **Bayes -4.2688**  **Shibata -4.3126**  **Hannan-Quinn -4.2956**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.7369 0.3906**  **Lag[2\*(p+q)+(p+q)-1][5] 1.7629 0.9876**  **Lag[4\*(p+q)+(p+q)-1][9] 3.7888 0.7395**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.02953 0.8636**  **Lag[2\*(p+q)+(p+q)-1][5] 0.40480 0.9713**  **Lag[4\*(p+q)+(p+q)-1][9] 1.27614 0.9718**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.02359 0.500 2.000 0.8779**  **ARCH Lag[5] 0.35543 1.440 1.667 0.9252**  **ARCH Lag[7] 1.22871 2.315 1.543 0.8738**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 1.7997**  **Individual Statistics:**  **mu 0.21497**  **ar1 0.08432**  **ma1 0.08775**  **omega 0.65127**  **alpha1 0.10472**  **beta1 0.64911**  **gamma1 0.27878**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.7400 0.4596**  **Negative Sign Bias 0.1063 0.9153**  **Positive Sign Bias 0.2166 0.8286**  **Joint Effect 0.9769 0.8068**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 75.39 1.144e-08**  **2 30 102.33 4.140e-10**  **3 40 108.40 1.877e-08**  **4 50 115.66 2.593e-07** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.002097 1.0e-06 -3015.0 0**  **ar1 -0.127888 3.1e-05 -4109.0 0**  **ma1 0.279730 6.2e-05 4477.2 0**  **omega -0.119053 1.4e-05 -8776.8 0**  **alpha1 0.117761 1.9e-05 6213.4 0**  **beta1 0.978190 1.0e-04 9779.4 0**  **gamma1 -0.191484 2.7e-05 -7183.3 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.002097 0.000646 -3.2451 0.001174**  **ar1 -0.127888 0.044817 -2.8536 0.004323**  **ma1 0.279730 0.089767 3.1162 0.001832**  **omega -0.119053 0.025173 -4.7294 0.000002**  **alpha1 0.117761 0.020031 5.8789 0.000000**  **beta1 0.978190 0.219938 4.4476 0.000009**  **gamma1 -0.191484 0.037060 -5.1669 0.000000**  **LogLikelihood : 213.313**  **Information Criteria**  **------------------------------------**    **Akaike -2.6621**  **Bayes -2.5247**  **Shibata -2.6660**  **Hannan-Quinn -2.6063**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.3764 0.5396**  **Lag[2\*(p+q)+(p+q)-1][5] 0.7411 1.0000**  **Lag[4\*(p+q)+(p+q)-1][9] 1.6265 0.9952**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.1025 0.7488**  **Lag[2\*(p+q)+(p+q)-1][5] 3.1549 0.3795**  **Lag[4\*(p+q)+(p+q)-1][9] 4.3768 0.5262**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 4.315 0.500 2.000 0.03778**  **ARCH Lag[5] 4.844 1.440 1.667 0.11163**  **ARCH Lag[7] 4.921 2.315 1.543 0.23265**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 3.6013**  **Individual Statistics:**  **mu 0.01409**  **ar1 0.01410**  **ma1 0.01409**  **omega 0.01410**  **alpha1 0.01409**  **beta1 0.74401**  **gamma1 0.01406**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 0.733359 0.4645**  **Negative Sign Bias 0.002068 0.9984**  **Positive Sign Bias 1.144005 0.2544**  **Joint Effect 1.420955 0.7006**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 23.45 0.2180**  **2 30 35.26 0.1962**  **3 40 49.65 0.1181**  **4 50 58.87 0.1578** | **GARCH Model : eGARCH(1,1)**  **Mean Model : ARFIMA(1,0,1)**  **Distribution : norm**  **Optimal Parameters**  **------------------------------------**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.016654 0.000018 -943.22 0**  **ar1 -0.550242 0.000099 -5534.65 0**  **ma1 0.025664 0.000316 81.11 0**  **omega -1.288834 0.002327 -553.96 0**  **alpha1 0.149961 0.000088 1705.81 0**  **beta1 0.713359 0.001242 574.37 0**  **gamma1 -1.305566 0.001457 -896.10 0**  **Robust Standard Errors:**  **Estimate Std. Error t value Pr(>|t|)**  **mu -0.016654 0.000359 -46.4190 0e+00**  **ar1 -0.550242 0.001654 -332.6780 0e+00**  **ma1 0.025664 0.005162 4.9718 1e-06**  **omega -1.288834 0.040460 -31.8543 0e+00**  **alpha1 0.149961 0.000048 3144.3831 0e+00**  **beta1 0.713359 0.019771 36.0806 0e+00**  **gamma1 -1.305566 0.024492 -53.3049 0e+00**  **LogLikelihood : 25.82381**  **Information Criteria**  **------------------------------------**    **Akaike -1.07565**  **Bayes -0.76458**  **Shibata -1.13917**  **Hannan-Quinn -0.96827**  **Weighted Ljung-Box Test on Standardized Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 6.760 9.323e-03**  **Lag[2\*(p+q)+(p+q)-1][5] 7.790 2.653e-08**  **Lag[4\*(p+q)+(p+q)-1][9] 8.794 2.883e-02**  **d.o.f=2**  **H0 : No serial correlation**  **Weighted Ljung-Box Test on Standardized Squared Residuals**  **------------------------------------**  **statistic p-value**  **Lag[1] 0.2774 0.5984**  **Lag[2\*(p+q)+(p+q)-1][5] 1.9093 0.6400**  **Lag[4\*(p+q)+(p+q)-1][9] 2.8204 0.7882**  **d.o.f=2**  **Weighted ARCH LM Tests**  **------------------------------------**  **Statistic Shape Scale P-Value**  **ARCH Lag[3] 0.05639 0.500 2.000 0.8123**  **ARCH Lag[5] 0.92203 1.440 1.667 0.7562**  **ARCH Lag[7] 1.19536 2.315 1.543 0.8799**  **Nyblom stability test**  **------------------------------------**  **Joint Statistic: 4.8791**  **Individual Statistics:**  **mu 0.06919**  **ar1 0.06841**  **ma1 0.06848**  **omega 0.06900**  **alpha1 0.06828**  **beta1 0.06890**  **gamma1 0.07045**  **Asymptotic Critical Values (10% 5% 1%)**  **Joint Statistic: 1.69 1.9 2.35**  **Individual Statistic: 0.35 0.47 0.75**  **Sign Bias Test**  **------------------------------------**  **t-value prob sig**  **Sign Bias 1.0457 0.30404**  **Negative Sign Bias 0.1586 0.87505**  **Positive Sign Bias 2.3969 0.02297 \*\***  **Joint Effect 5.8738 0.11791**  **Adjusted Pearson Goodness-of-Fit Test:**  **------------------------------------**  **group statistic p-value(g-1)**  **1 20 15.86 0.6668**  **2 30 22.43 0.8020**  **3 40 30.14 0.8446**  **4 50 35.00 0.9342** |
| FORECAST  VALUES | **0-roll forecast [T0=2023-10-25]:**  **Series Sigma**  **T+1 -0.0008287 0.02910**  **T+2 -0.0005087 0.02925**  **T+3 -0.0005298 0.02937**  **T+4 -0.0005284 0.02947**  **T+5 -0.0005285 0.02955**  **T+6 -0.0005285 0.02962**  **T+7 -0.0005285 0.02967**  **T+8 -0.0005285 0.02972**  **T+9 -0.0005285 0.02975**  **T+10 -0.0005285 0.02978** | **0-roll forecast [T0=2023-10-22]:**  **Series Sigma**  **T+1 -0.0151205 0.06506**  **T+2 -0.0004313 0.06507**  **T+3 -0.0023099 0.06507**  **T+4 -0.0020696 0.06508**  **T+5 -0.0021004 0.06508**  **T+6 -0.0020964 0.06508**  **T+7 -0.0020969 0.06509**  **T+8 -0.0020969 0.06509**  **T+9 -0.0020969 0.06509**  **T+10 -0.0020969 0.06510** | **0-roll forecast [T0=2023-09-30]:**  **Series Sigma**  **T+1 -0.00613 0.09501**  **T+2 -0.02245 0.09793**  **T+3 -0.01347 0.10007**  **T+4 -0.01841 0.10162**  **T+5 -0.01569 0.10274**  **T+6 -0.01719 0.10355**  **T+7 -0.01636 0.10413**  **T+8 -0.01682 0.10455**  **T+9 -0.01657 0.10485**  **T+10 -0.01670 0.10506** |
| GRAPH OF ACTUAL AND FORECASTED VALUES |  | **A graph with blue lines  Description automatically generated** | **A graph with blue lines  Description automatically generated** |

**DAILY RETURNS ANALYSIS:**

Both the models seems to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten days appears relatively stable and has a low and consistent standard error, so data seems stationary and has a high confidence interval.

**WEEKLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten week appears to be relatively stable and has a low and consistent standard error, so data seems to be stationary and have a high confidence interval.

**MONTHLY RETURNS ANALYSIS:**

Both the models seem to have low p-values for most tests, indicating significant results in detecting various aspects like residual autocorrelation, ARCH effects, and goodness-of-fit. However, always consider the context of the data and the model assumptions while interpreting these results for practical implications.

DATA INTERPRETATION:

The return for the next ten Month appears to be relatively stable and has a high and consistent standard error, so data seems to be stationary and have a low confidence interval

Conclusion the variation in returns is because of time frame sensitivity so if your investment horizon is for less than a week you would consider daily returns if its less than a month than weekly and greater than month then monthly returns

CONCLUSION:

As an investor you could invest in a stock which has higher cv by taking standard error as risk parameters and returns as expected mean

**CALCULATING VaR**

The VaR is a statistical measure that is used to estimate the potential loss of a portfolio of financial assets in a certain time period with a certain confidence level. It can be seen as an estimated loss that a portfolio might experience under normal market conditions. VaR is used by the fund managers, investors and financial institutions to assess and manage risk.

**CONFIDENCE INTERVAL**

It represents the probability that actual loss will not exceed the VaR. 95%,99%,99.99% are some of the commonly used confidence intervals.

Example: A 99% confidence interval means there is only 1% probability that the actual loss will exceed the VaR.

**ASSUMPTION OF NORMAL DISTRIBUTION**

VaR models assume that the returns of financial assets follow normal distribution. This assumption may not solve the problem completely but simplifies the calculation.

**LIMITATIONS**

VaR may not fully capture the extreme events. It comes up with a single point estimate but not a probable interval of potential losses.

**TIME HORIZON**

The time horizon should be defined for determining the potential risk. This is very critical factor. VaR can be calculated for different time periods like daily, weekly and yearly.

**CALCULATION METHODS**

Parametric models, Monte Carlo simulation and historical simulation are prominent methods of calculation of VaR. Every method has its own strengths and weaknesses and the choice of methods depends on the available data and the nature of the portfolio.

**PORTFOLIO DIVERSIFICATION**

By diversifying the portfolios, we can reduce the risk of investment. Because if one sector fails, the other might balance it. If one industry fails, another industry can balance it. Simply, diversification allows us to offset the losses in one area with gains in another area. VaR takes diversification into account.

**NEED FOR CONTINUOUS MONITORING**

Changes in market conditions can impact VaR over time. So, it is necessary to continuously update and monitor VaR values.

A graph of loss and loss with Ryugyong Hotel in the background

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In this section we will calculate the Value at Risk(VaR) of a portfolio containing

|  |  |
| --- | --- |
| Schneider Electric | 250 shares |
| Sobha Ltd | 150 shares |
| Swaraj Engines Ltd | 150 shares |
| Tips Industries Ltd | 200 shares |
| Wockhardt Ltd | 320 shares |
| UTI sensex ETF | 20 units |

**VaR vs other Risk measures**

Value-at-Risk (VaR) has become a widely used metric for measuring market risk and is required to be reported to regulators. VaR provides a single risk number that can be useful for analyzing risk trends at a high level. It also enables a 'drill-down' analysis to identify the primary sources of a firm's overall risk, which is beneficial to senior management. In addition, VaR can be used to estimate the capital requirements for the entire firm and individual business units, with higher risk portfolios requiring more capital. It can also help assign risk limits for different business units and serve as an input in the capital allocation decision for these units. Finally, VaR estimates can be used to determine remuneration rules and assess the risk practices of traders and managers who may otherwise be incentivized based solely on profits. However, VaR only provides part of the total risk picture.

**RESULTS AND OUTPUT**

**VaR for the portfolio using daily data from 02/11/2020 to 26/10/2023**

A blue line with numbers

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X: Confidence interval

Y: Total value at risk

**Dataframe(df)**

A table with numbers and numbers

Description automatically generated

**Correlation Matrix**

A screenshot of a computer

Description automatically generated

**Standard Deviation**

A black screen with white text

Description automatically generated

**VaR for the portfolio using weekly data from 02/11/2020 to 26/10/2023**

A blue line with numbers

Description automatically generated

X: Confidence interval Y: Total value at risk

**Data frame**

A screenshot of a computer screen

Description automatically generated

**Correlation matrix**

A screenshot of a computer

Description automatically generated

**Standard deviation**

A black screen with white text

Description automatically generated

**VaR for the portfolio using monthly data from 02/11/2020 to 26/10/2023**

A blue line with numbers

Description automatically generated

X: Confidence interval

Y: Total value at risk

**Dataframe**

A screenshot of a computer

Description automatically generated

A screenshot of a computer screen

Description automatically generated

**Correlation matrix**

A screenshot of a computer screen

Description automatically generated

**Standard deviation**

A black screen with white text

Description automatically generated

**Interpretation of outputs**

The closing prices for the stocks and the ETF are downloaded from Yahoo Finance using the **yfinance** package. The user can set the number of shares bought of each stock and the end date for the analysis. The initial invested value is calculated assuming all money is invested on the current day. Returns are calculated and the correlation matrix is extracted. The code then runs a simulation to calculate VaR for different confidence intervals ranging from 75 to 100 with a step of 0.01. The VaR values are calculated using the standard normal distribution and the initial investment, standard deviation of returns, and correlation matrix. In the plots, we can see that the values of VaR are increasing at an increasing rate with increase in confidence interval, which makes sense.

The plot can be interpreted as follows

1. We can be 75% sure that the returns will vary by a maximum of around Rs. 28574.554 if we hold the portfolio from 02/11/2020 to 26/10/2023.
2. We can be 95% sure that the returns will vary by a maximum of around Rs. 69789.322 if we hold the portfolio from 02/11/2020 to 26/10/2023.
3. We can be 99.9% sure that the returns will vary by a maximum of Rs. 176781.043 if we hold the portfolio from 02/11/2020 to 26/10/2023.

**CONCLUSION**

1. Beta Analysis:

* The beta calculated by regressing excess stock returns on excess market returns on various frequencies for all of the above mentioned companies namely **Schneider Electric, Sobha Ltd, Swaraj Engines Ltd, Tips Industries Ltd, Wockhardt Ltd and UTI sensex ETF** gave results with values less than 1. The beta values indicate the stock's sensitivity to market movements. A beta less than 1 suggests that the stock is less volatile than the market.

1. ARIMA Modelling:

* Based on the above mentioned results, we can infer that ARIMA (0, 0, 0) was found to be the best model for daily, weekly and monthly returns for **Schneider Electric, Sobha Ltd, Swaraj Engines Ltd, Tips Industries Ltd, Wockhardt Ltd and UTI sensex ETF** .

1. GARCH Modelling:

* Utilizing the GARCH(1,1) model across all frequencies provided robust predictions for predicting conditional volatility and it was used to project volatility over the next 10 time periods. . The GARCH (1,1) model suggests that the stock exhibits volatility persistence, meaning past volatility affects future volatility.

1. Serial Correlation Analysis:

* The p-values for both Standardized Residuals and Squared Residuals were well above 0.05 for all frequencies which implies no serial correlation in all the 3 models.

From the above findings, We recommend a long-term investment strategy for this diversified portfolio. Both GARCH and ARIMA models predict positive returns for future time periods. Therefore, this portfolio is well-suited for investors who have a long-term perspective.