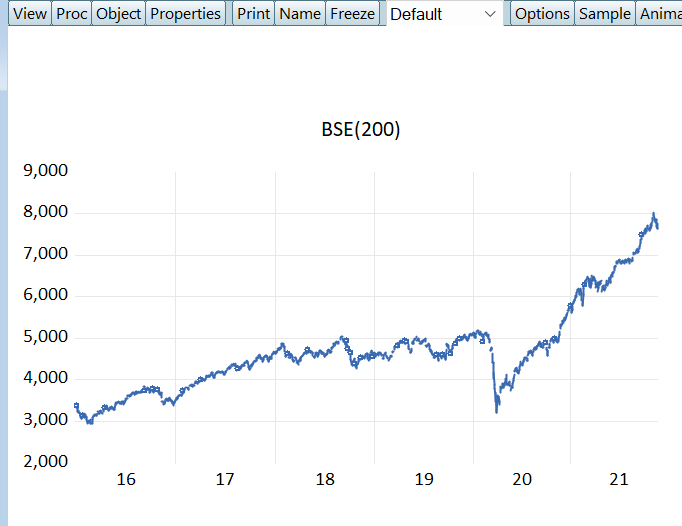
Name : Bhanu Dixit

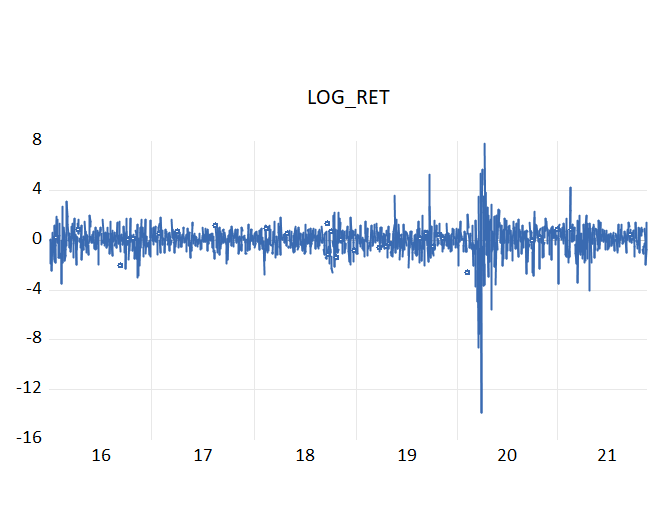
Roll Number:- 2023DSS1009(MSDSM/01/08)

BSE200(2016-20)

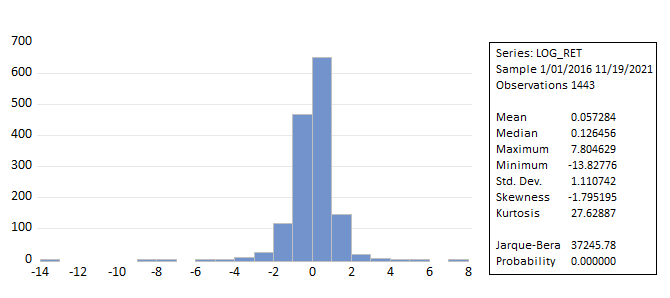
1.Plat for BSE 200 data. As we can see that this plot has a trend initially as follows:



But after one logarithmic difference it plots is as follows:-



2. Descriptive statsistc as as follows:



**Max :**

* This indicates that the maximum return in one day is 7.8 %

**Min**: -13.82776

* This indicates that the maximum negative return is one day is 13.8 %

**Mean** :

* The average value of log returns is 0.057 slightly positive, suggesting a small upward trend in returns over the observed period.

**Median**:

* The median is slightly higher than the mean, indicating a slight positive skew with value of 0.12.

**Standard Deviation**:

* Indicates a moderate level of volatility in the log returns with a value of 1.110742.

3. AR, MA , and ARIMA model are applicable to stationary series and we need to check the log returns are stationary or not. Therefore we will run a unit root test.

A screenshot of a computer

Description automatically generated

Fig :- One root Unit Test

As we can see, the p-value is less than the significance level, which means it is stationary.

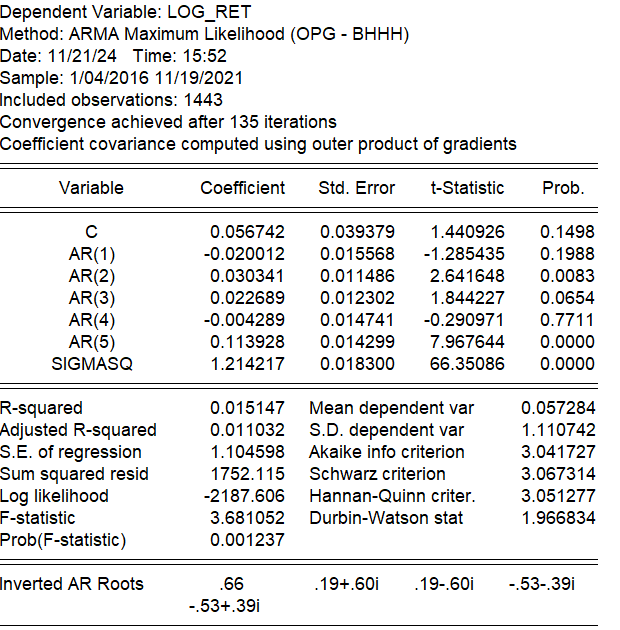
A screenshot of a data

Description automatically generated

To find the value of p , for AR and MA model we need to plot the Correlogram

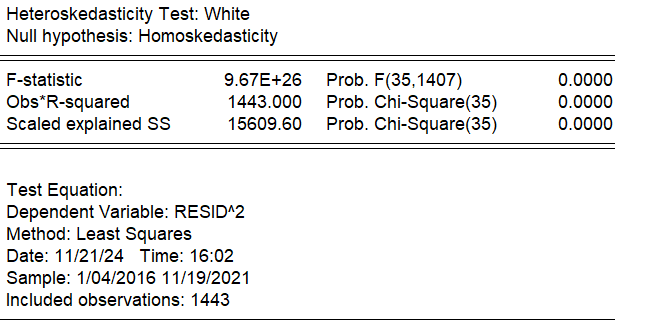
As we can see I the above graph we p=5 or p=6 could be chosen.

1. p= 5



1. **Durbin-Watson Statistic:**
   * Value = 1.966834
   * This statistic is close to 2, indicating little evidence of autocorrelation in the residuals.
2. **F-statistic:**
   * Value = 3.681052, with a p-value = 0.001237.
   * Indicates the model as a whole is statistically significant.

Now we will check residuals



This means this is heteroskedastic and we need to find some other model and we are getting similar results for p=6.

B) For MA model we take q= 6 based on correlogram

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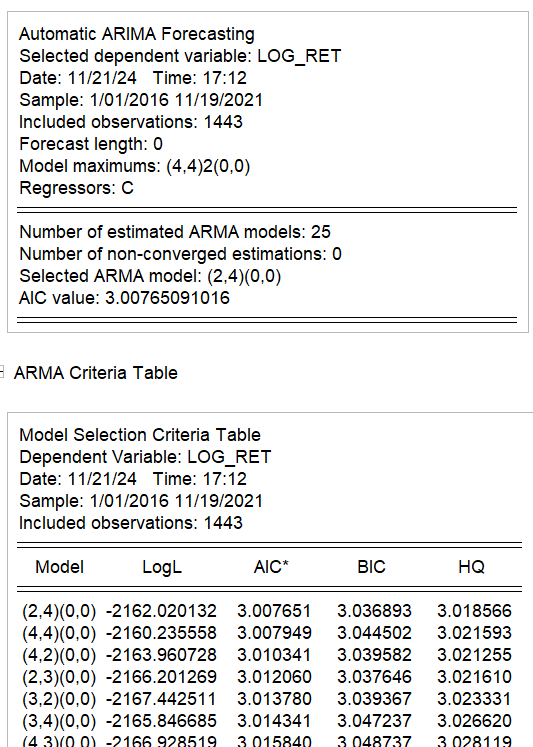
The model seems to be significant, but we need to check Residuals as well.

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This means residuals are heteroskedastic.

C) For Arima we run auto arima and found results as follows:



So we have some models with as(2,4),(4,4.)and (4,2) as minimum value of AIC.

So will make an equation dor each of them then check if they are valis or not.

For (2,4)

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And Residuals

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For (4,4)

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And Residuals

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For (4,2)

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For residuals

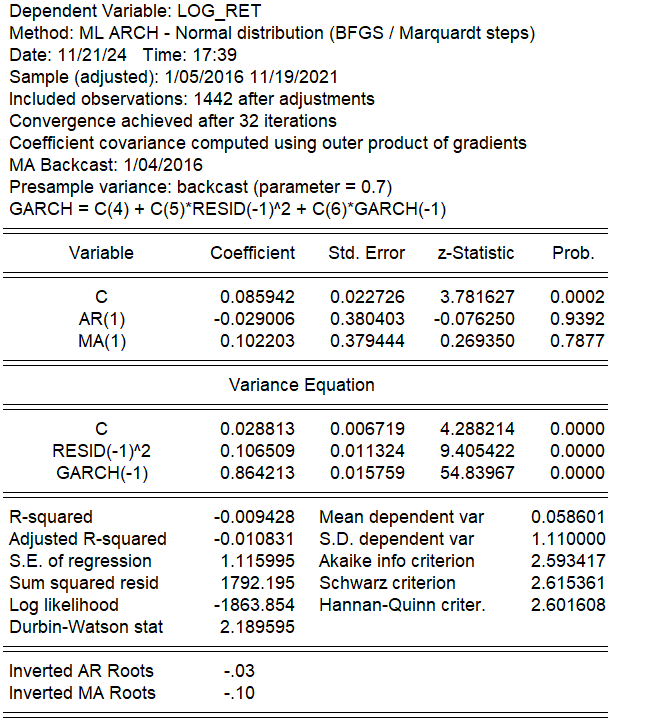
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In all the above combinations of p and q, we got a provability value less than significant level but they are heteroskedastic

4.

We have check ar for 3 ,odels as (1,1) (1.,0) and (0,1) and results are as follows.



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Only the (0 1 ) model is able to justify homoscedastic . Else. All others are there heteroskedastic even after having a p-value less than the significance level.

**R-squared**: −0.009303-0.009303−0.009303

* Indicates poor explanatory power for the mean equation. This is common in financial return models where the focus is on modeling volatility rather than returns.

**Log-likelihood**: −1865.704-1865.704−1865.704

* Used to compare model fit across specifications.

**Akaike (AIC) and Schwarz Criterion (SIC):**

* AIC = 2.592798, SIC = 2.611074
* Lower values indicate better model fit.

**Durbin-Watson Stat (2.18):**

* Close to 2, indicating little to no autocorrelation in residuals.

This output summarizes the results of a GARCH (1,1) model for the dependent variable LOG\_RET\text{LOG\\_RET}LOG\_RET, which appears to be a time series of log returns. Here's the interpretation of the key results:

**Mean Equation**

The mean equation is modeled as:

LOG\_RET=C+MA(1)+ϵt\text{LOG\\_RET} = C + \text{MA(1)} + \epsilon\_tLOG\_RET=C+MA(1)+ϵt​

* **C (Constant):**
  + Coefficient = **0.085637**
  + ppp-value = **0.0002** (significant at the 1% level).
  + Interpretation: The constant term is positive and statistically significant, indicating a positive average return over the period.
* **MA(1) (Moving Average):**
  + Coefficient = **0.073219**
  + ppp-value = **0.0121** (significant at the 5% level).
  + Interpretation: The MA(1) term is significant, suggesting that the model accounts for short-term dependencies in the time series data.

**Variance Equation (GARCH Model)**

The variance equation is modeled as:

σt2=C+α⋅ϵt−12+β⋅σt−12\sigma\_t^2 = C + \alpha \cdot \epsilon\_{t-1}^2 + \beta \cdot \sigma\_{t-1}^2σt2​=C+α⋅ϵt−12​+β⋅σt−12​

Where:

* ϵt−12\epsilon\_{t-1}^2ϵt−12​: Lagged squared residual (ARCH term)
* σt−12\sigma\_{t-1}^2σt−12​: Lagged conditional variance (GARCH term)
* **C (Constant in variance):**
  + Coefficient = **0.028992**
  + ppp-value = **0.0000** (significant).
  + Interpretation: This represents the long-term variance. It is positive and statistically significant, indicating the baseline level of volatility.
* **RESID(-1)^2 (ARCH term):**
  + Coefficient = **0.106301**
  + ppp-value = **0.0000** (significant).
  + Interpretation: The ARCH effect is significant, meaning that past shocks to returns influence current volatility.
* **GARCH(-1) (GARCH term):**
  + Coefficient = **0.863915**
  + ppp-value = **0.0000** (significant).
  + Interpretation: The GARCH effect is dominant, suggesting a strong persistence of volatility over time.

**Sum of ARCH and GARCH coefficients (α+β\alpha + \betaα+β):**

* α+β=0.106301+0.863915=0.970216\alpha + \beta = 0.106301 + 0.863915 = 0.970216α+β=0.106301+0.863915=0.970216
* This is less than 1, satisfying the stationarity condition of the GARCH model. However, the high value indicates persistent volatility.

**Model Diagnostics**

* **R-squared**: −0.009303-0.009303−0.009303
  + Indicates poor explanatory power for the mean equation. This is common in financial return models where the focus is on modeling volatility rather than returns.
* **Log-likelihood**: −1865.704-1865.704−1865.704
  + Used to compare model fit across specifications.
* **Akaike (AIC) and Schwarz Criterion (SIC):**
  + AIC = 2.592798, SIC = 2.611074
  + Lower values indicate better model fit.
* **Durbin-Watson Stat (2.18):**
  + Close to 2, indicating little to no autocorrelation in residuals.

**Conclusion**

* The mean equation shows a significant constant and MA(1) term, indicating modest predictability in returns.
* GARRCH is better than ARIMA as it id homoscsdic.
* The variance equation effectively captures volatility clustering, with significant ARCH and GARCH terms and persistent volatility.
* Diagnostic statistics suggest that the model is well-specified for modeling volatility but has limited explanatory power for returns, as expected in financial time series analysis.