Script-UAS-ARW.R

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library(tidyverse)

## -- Attaching packages --------------------------------------- tidyverse 1.3.0 --

## v ggplot2 3.3.2 v purrr 0.3.4  
## v tibble 3.0.6 v dplyr 1.0.2  
## v tidyr 1.1.2 v stringr 1.4.0  
## v readr 1.4.0 v forcats 0.5.0

## Warning: package 'tibble' was built under R version 4.0.3

## Warning: package 'tidyr' was built under R version 4.0.3

## Warning: package 'readr' was built under R version 4.0.3

## Warning: package 'dplyr' was built under R version 4.0.3

## -- Conflicts ------------------------------------------ tidyverse\_conflicts() --  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()

library(rugarch)

## Warning: package 'rugarch' was built under R version 4.0.5

## Loading required package: parallel

##   
## Attaching package: 'rugarch'

## The following object is masked from 'package:purrr':  
##   
## reduce

## The following object is masked from 'package:stats':  
##   
## sigma

# Data --------------------------------------------------------------------  
loc <- 'D:/\_\_SEMESTER 5/Times Series/Ujian/DATA UAS TS GASAL 2021-2022.xlsx'  
  
jci <-   
 readxl::read\_xlsx(loc, sheet = 2) %>%   
 janitor::clean\_names() %>%   
 rename(delta\_close = close\_2) %>%   
 select(-x10)

## New names:  
## \* `` -> ...10

library(xts)

## Warning: package 'xts' was built under R version 4.0.3

## Loading required package: zoo

##   
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':  
##   
## as.Date, as.Date.numeric

##   
## Attaching package: 'xts'

## The following objects are masked from 'package:dplyr':  
##   
## first, last

series <- xts(jci$lnr, order.by = jci$date, tzone = 'Asia/Jakarta')[-1,]  
  
# Visualisasi -------------------------------------------------------------  
library(ggpubr)

## Warning: package 'ggpubr' was built under R version 4.0.3

c <- jci %>%   
 mutate(date = as.Date(date)) %>%   
 ggplot(aes(x = date, y = close)) +  
 geom\_line(lwd = 0.7, colour = "steelblue") +  
 labs(  
 x = NULL, y = 'Close'  
 ) +  
 # biar gak ada yang kepotong  
 coord\_cartesian(clip = "off") +  
 theme\_minimal(  
 base\_family = "Arial Narrow",  
 base\_size = 13  
 ) +  
 scale\_x\_date(  
 date\_breaks = "3 month", date\_labels = "%b %Y",   
 limits = c(as.Date('2020-01-01'), as.Date('2021-12-08'))  
 ) +  
 theme(  
 plot.title.position = "plot",  
 text = element\_text(colour = "gray30"),  
 plot.title = element\_text(family = "Arial", face = "bold",  
 colour = "black", size = rel(1.75)),  
 axis.title.y = element\_text(hjust = 1, colour = "gray5"),  
 axis.title.x = element\_text(hjust = 0, colour = "gray5"),  
 axis.line = element\_line(colour = "gray70"),  
 axis.ticks = element\_line(colour = 'gray70'),  
 plot.margin = margin(15, 15, 15, 15)  
 )  
  
r <- jci %>%   
 mutate(date = as.Date(date)) %>%   
 ggplot(aes(x = date, y = lnr)) +  
 geom\_line(lwd = 0.7, colour = "steelblue") +  
 labs(  
 x = 'Date', y = 'Return',  
 # title = 'Jakarta Composite Index',  
 # subtitle = '02 Januari 2020 - 08 Desember 2020',  
 caption = expression(italic('Sumber : www.finance.yahoo.com'))  
 ) +  
 # biar gak ada yang kepotong  
 coord\_cartesian(clip = "off") +  
 theme\_minimal(  
 base\_family = "Arial Narrow",  
 base\_size = 13  
 ) +  
 scale\_x\_date(  
 date\_breaks = "3 month", date\_labels = "%b %Y",   
 limits = c(as.Date('2020-01-01'), as.Date('2021-12-08'))  
 ) +  
 theme(  
 plot.title.position = "plot",  
 text = element\_text(colour = "gray30"),  
 plot.title = element\_text(family = "Arial", face = "bold",  
 colour = "black", size = rel(1.75)),  
 axis.title.y = element\_text(hjust = 1, colour = "gray5"),  
 axis.title.x = element\_text(hjust = 0, colour = "gray5"),  
 axis.text.x = element\_text(angle = 0),  
 axis.line = element\_line(colour = "gray70"),  
 axis.ticks = element\_line(colour = 'gray70'),  
 plot.margin = margin(15, 15, 15, 15)  
 )  
  
fig <-   
 ggarrange(  
 c, r,  
 ncol = 1, nrow = 2  
 )

## Warning in grid.Call(C\_stringMetric, as.graphicsAnnot(x$label)): font family  
## 'Arial Narrow' not found in PostScript font database

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## 'Arial Narrow' not found in PostScript font database

## Warning: Removed 1 row(s) containing missing values (geom\_path).

annotate\_figure(  
 fig,  
 top = text\_grob("Jakarta Composite Index", color = "black", face = "bold", size = 15,  
 hjust = 0, x = 0.05)  
)

## Warning in grid.Call(C\_textBounds, as.graphicsAnnot(x$label), x$x, x$y, : font  
## family not found in Windows font database

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## family not found in Windows font database

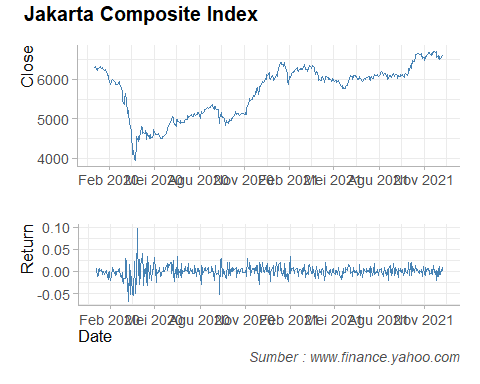
## Warning in grid.Call.graphics(C\_text, as.graphicsAnnot(x$label), x$x, x$y, :  
## font family not found in Windows font database

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## family not found in Windows font database

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## font family not found in Windows font database

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## Warning in grid.Call.graphics(C\_text, as.graphicsAnnot(x$label), x$x, x$y, :  
## font family not found in Windows font database  
  
## Warning in grid.Call.graphics(C\_text, as.graphicsAnnot(x$label), x$x, x$y, :  
## font family not found in Windows font database



# Uji Stasioneritas -------------------------------------------------------  
library(urca)  
  
ur.df(series) %>% summary()

##   
## ###############################################   
## # Augmented Dickey-Fuller Test Unit Root Test #   
## ###############################################   
##   
## Test regression none   
##   
##   
## Call:  
## lm(formula = z.diff ~ z.lag.1 - 1 + z.diff.lag)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.067032 -0.006376 0.000400 0.007056 0.094000   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## z.lag.1 -1.02599 0.06375 -16.09 <2e-16 \*\*\*  
## z.diff.lag 0.07279 0.04608 1.58 0.115   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.01357 on 468 degrees of freedom  
## Multiple R-squared: 0.4812, Adjusted R-squared: 0.479   
## F-statistic: 217.1 on 2 and 468 DF, p-value: < 2.2e-16  
##   
##   
## Value of test-statistic is: -16.0946   
##   
## Critical values for test statistics:   
## 1pct 5pct 10pct  
## tau1 -2.58 -1.95 -1.62

# Plot ACF dan PACF -------------------------------------------------------  
library(forecast)

## Registered S3 method overwritten by 'quantmod':  
## method from  
## as.zoo.data.frame zoo

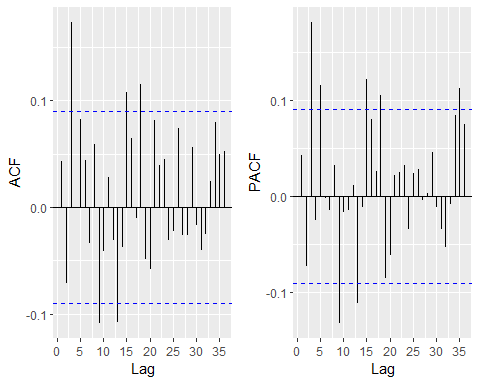
##   
## Attaching package: 'forecast'

## The following object is masked from 'package:ggpubr':  
##   
## gghistogram

library(ggpubr)  
  
ggarrange(  
 ggAcf(series, lag.max = 36) +  
 labs(  
 title = NULL  
 ) +  
 scale\_x\_continuous(  
 n.breaks = 10  
 ),  
 ggPacf(series, lag.max = 36) +  
 labs(  
 title = NULL  
 ) +  
 scale\_x\_continuous(  
 n.breaks = 10  
 ),  
 ncol = 2, nrow = 1  
)

## Scale for 'x' is already present. Adding another scale for 'x', which will  
## replace the existing scale.

## Scale for 'x' is already present. Adding another scale for 'x', which will  
## replace the existing scale.



# Dugaan model ARIMA ------------------------------------------------------  
arima(series, order = c(1, 0, 1))

##   
## Call:  
## arima(x = series, order = c(1, 0, 1))  
##   
## Coefficients:  
## ar1 ma1 intercept  
## -0.6245 0.7410 1e-04  
## s.e. 0.0997 0.0818 7e-04  
##   
## sigma^2 estimated as 0.0001802: log likelihood = 1364.94, aic = -2721.88

arima(series, order = c(2, 0, 2))

##   
## Call:  
## arima(x = series, order = c(2, 0, 2))  
##   
## Coefficients:  
## ar1 ar2 ma1 ma2 intercept  
## -1.3656 -0.7499 1.4376 0.7243 1e-04  
## s.e. 0.1057 0.0992 0.1100 0.1074 6e-04  
##   
## sigma^2 estimated as 0.0001752: log likelihood = 1371.44, aic = -2730.89

arima(series, order = c(3, 0, 3))

##   
## Call:  
## arima(x = series, order = c(3, 0, 3))  
##   
## Coefficients:  
## ar1 ar2 ar3 ma1 ma2 ma3 intercept  
## -0.5387 0.3294 0.6132 0.6356 -0.3522 -0.5317 1e-04  
## s.e. 0.1856 0.2146 0.1418 0.1955 0.2436 0.1605 8e-04  
##   
## sigma^2 estimated as 0.0001741: log likelihood = 1372.94, aic = -2729.89

auto.arima(series, stepwise = T, approximation = F)

## Series: series   
## ARIMA(2,0,2) with zero mean   
##   
## Coefficients:  
## ar1 ar2 ma1 ma2  
## -1.3649 -0.7486 1.4372 0.7232  
## s.e. 0.1062 0.0995 0.1105 0.1078  
##   
## sigma^2 estimated as 0.0001767: log likelihood=1371.43  
## AIC=-2732.86 AICc=-2732.73 BIC=-2712.07

# Uji ARCH-LM -------------------------------------------------------------  
library(aTSA)

## Warning: package 'aTSA' was built under R version 4.0.3

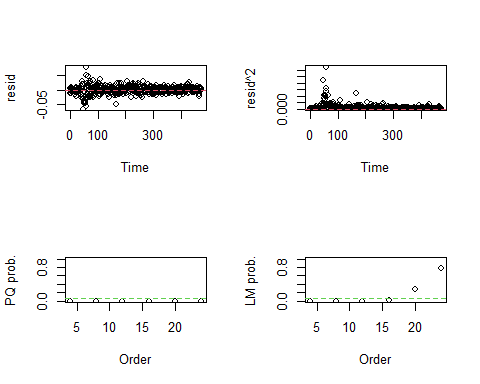
##   
## Attaching package: 'aTSA'

## The following object is masked from 'package:forecast':  
##   
## forecast

## The following object is masked from 'package:graphics':  
##   
## identify

model <- arima(series, order = c(2, 0, 2))  
hasil <- arch.test(model)

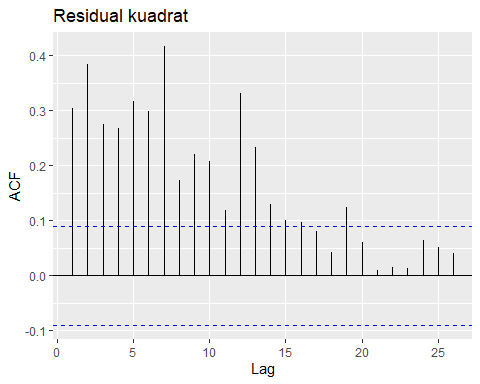
## ARCH heteroscedasticity test for residuals   
## alternative: heteroscedastic   
##   
## Portmanteau-Q test:   
## order PQ p.value  
## [1,] 4 183 0  
## [2,] 8 369 0  
## [3,] 12 471 0  
## [4,] 16 514 0  
## [5,] 20 527 0  
## [6,] 24 529 0  
## Lagrange-Multiplier test:   
## order LM p.value  
## [1,] 4 237.4 0.00e+00  
## [2,] 8 80.7 9.66e-15  
## [3,] 12 48.8 1.03e-06  
## [4,] 16 28.7 1.74e-02  
## [5,] 20 22.0 2.82e-01  
## [6,] 24 17.8 7.70e-01



hasil

## order PQ p.value LM p.value  
## [1,] 4 183.0690 0 237.41558 0.000000e+00  
## [2,] 8 368.9437 0 80.74753 9.658940e-15  
## [3,] 12 470.7125 0 48.80085 1.027055e-06  
## [4,] 16 513.5952 0 28.72862 1.742846e-02  
## [5,] 20 526.5614 0 22.04034 2.822531e-01  
## [6,] 24 528.7863 0 17.77587 7.695306e-01

ggAcf(model$residuals^2) +  
 ggtitle('Residual kuadrat')



# GARCH -------------------------------------------------------------------  
library(fGarch)

## Warning: package 'fGarch' was built under R version 4.0.5

## Loading required package: timeDate

## Loading required package: timeSeries

## Warning: package 'timeSeries' was built under R version 4.0.5

##   
## Attaching package: 'timeSeries'

## The following object is masked from 'package:zoo':  
##   
## time<-

## Loading required package: fBasics

## Warning: package 'fBasics' was built under R version 4.0.5

model11 <- garchFit(~ arma(2, 2) + garch(1, 1), data = series, trace = F)

## Warning: Using formula(x) is deprecated when x is a character vector of length > 1.  
## Consider formula(paste(x, collapse = " ")) instead.

summary(model11)

##   
## Title:  
## GARCH Modelling   
##   
## Call:  
## garchFit(formula = ~arma(2, 2) + garch(1, 1), data = series,   
## trace = F)   
##   
## Mean and Variance Equation:  
## data ~ arma(2, 2) + garch(1, 1)  
## <environment: 0x000000002ad8de80>  
## [data = series]  
##   
## Conditional Distribution:  
## norm   
##   
## Coefficient(s):  
## mu ar1 ar2 ma1 ma2 omega   
## 1.0531e-03 -9.9599e-01 -4.7452e-01 1.0000e+00 3.6503e-01 1.4552e-05   
## alpha1 beta1   
## 2.5387e-01 6.5434e-01   
##   
## Std. Errors:  
## based on Hessian   
##   
## Error Analysis:  
## Estimate Std. Error t value Pr(>|t|)   
## mu 1.053e-03 1.017e-03 1.035 0.30045   
## ar1 -9.960e-01 3.091e-01 -3.222 0.00127 \*\*   
## ar2 -4.745e-01 2.340e-01 -2.028 0.04255 \*   
## ma1 1.000e+00 3.419e-01 2.925 0.00345 \*\*   
## ma2 3.650e-01 2.809e-01 1.299 0.19384   
## omega 1.455e-05 4.454e-06 3.267 0.00109 \*\*   
## alpha1 2.539e-01 6.301e-02 4.029 5.6e-05 \*\*\*  
## beta1 6.543e-01 6.998e-02 9.350 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Log Likelihood:  
## 1466.348 normalized: 3.10667   
##   
## Description:  
## Fri Dec 17 10:59:21 2021 by user: Ridson Alfarizal   
##   
##   
## Standardised Residuals Tests:  
## Statistic p-Value   
## Jarque-Bera Test R Chi^2 30.64884 2.211506e-07  
## Shapiro-Wilk Test R W 0.9880432 0.0006576011  
## Ljung-Box Test R Q(10) 6.163537 0.8013415   
## Ljung-Box Test R Q(15) 9.569512 0.8459102   
## Ljung-Box Test R Q(20) 16.28355 0.6988848   
## Ljung-Box Test R^2 Q(10) 4.970258 0.8931559   
## Ljung-Box Test R^2 Q(15) 9.456916 0.8524418   
## Ljung-Box Test R^2 Q(20) 13.66187 0.8472176   
## LM Arch Test R TR^2 7.655485 0.8114405   
##   
## Information Criterion Statistics:  
## AIC BIC SIC HQIC   
## -6.179441 -6.108984 -6.180003 -6.151726

# GACRH 11  
spec = ugarchspec(  
 mean.model = list(armaOrder=c(2, 2))  
)  
fit = ugarchfit(data = series, spec = spec)  
fit

##   
## \*---------------------------------\*  
## \* GARCH Model Fit \*  
## \*---------------------------------\*  
##   
## Conditional Variance Dynamics   
## -----------------------------------  
## GARCH Model : sGARCH(1,1)  
## Mean Model : ARFIMA(2,0,2)  
## Distribution : norm   
##   
## Optimal Parameters  
## ------------------------------------  
## Estimate Std. Error t value Pr(>|t|)  
## mu 0.000544 0.000395 1.3780 0.168215  
## ar1 -1.012916 0.192563 -5.2602 0.000000  
## ar2 -0.589655 0.175364 -3.3625 0.000773  
## ma1 1.002871 0.212404 4.7215 0.000002  
## ma2 0.472233 0.196724 2.4005 0.016373  
## omega 0.000015 0.000004 3.8868 0.000102  
## alpha1 0.246606 0.042988 5.7366 0.000000  
## beta1 0.659927 0.020590 32.0507 0.000000  
##   
## Robust Standard Errors:  
## Estimate Std. Error t value Pr(>|t|)  
## mu 0.000544 0.000416 1.3085 0.190708  
## ar1 -1.012916 0.175955 -5.7567 0.000000  
## ar2 -0.589655 0.199398 -2.9572 0.003105  
## ma1 1.002871 0.190820 5.2556 0.000000  
## ma2 0.472233 0.209472 2.2544 0.024171  
## omega 0.000015 0.000009 1.6764 0.093670  
## alpha1 0.246606 0.057581 4.2828 0.000018  
## beta1 0.659927 0.106965 6.1695 0.000000  
##   
## LogLikelihood : 1464.87   
##   
## Information Criteria  
## ------------------------------------  
##   
## Akaike -6.1732  
## Bayes -6.1027  
## Shibata -6.1737  
## Hannan-Quinn -6.1455  
##   
## Weighted Ljung-Box Test on Standardized Residuals  
## ------------------------------------  
## statistic p-value  
## Lag[1] 0.2385 0.6253  
## Lag[2\*(p+q)+(p+q)-1][11] 4.1136 0.9998  
## Lag[4\*(p+q)+(p+q)-1][19] 6.8466 0.9211  
## d.o.f=4  
## H0 : No serial correlation  
##   
## Weighted Ljung-Box Test on Standardized Squared Residuals  
## ------------------------------------  
## statistic p-value  
## Lag[1] 0.01063 0.9179  
## Lag[2\*(p+q)+(p+q)-1][5] 1.34119 0.7789  
## Lag[4\*(p+q)+(p+q)-1][9] 2.37105 0.8564  
## d.o.f=2  
##   
## Weighted ARCH LM Tests  
## ------------------------------------  
## Statistic Shape Scale P-Value  
## ARCH Lag[3] 1.667 0.500 2.000 0.1967  
## ARCH Lag[5] 2.142 1.440 1.667 0.4407  
## ARCH Lag[7] 2.706 2.315 1.543 0.5707  
##   
## Nyblom stability test  
## ------------------------------------  
## Joint Statistic: 6.0783  
## Individual Statistics:   
## mu 0.16779  
## ar1 0.02996  
## ar2 0.04772  
## ma1 0.04487  
## ma2 0.02766  
## omega 2.01715  
## alpha1 0.64984  
## beta1 0.58250  
##   
## Asymptotic Critical Values (10% 5% 1%)  
## Joint Statistic: 1.89 2.11 2.59  
## Individual Statistic: 0.35 0.47 0.75  
##   
## Sign Bias Test  
## ------------------------------------  
## t-value prob sig  
## Sign Bias 0.9950 0.32026   
## Negative Sign Bias 0.6228 0.53369   
## Positive Sign Bias 1.0275 0.30473   
## Joint Effect 7.3829 0.06065 \*  
##   
##   
## Adjusted Pearson Goodness-of-Fit Test:  
## ------------------------------------  
## group statistic p-value(g-1)  
## 1 20 24.95 0.1622  
## 2 30 29.86 0.4208  
## 3 40 35.97 0.6090  
## 4 50 44.95 0.6380  
##   
##   
## Elapsed time : 0.258199

signbias(fit)

## t-value prob sig  
## Sign Bias 0.9949776 0.32026242   
## Negative Sign Bias 0.6228434 0.53369145   
## Positive Sign Bias 1.0274639 0.30473396   
## Joint Effect 7.3828501 0.06064618 \*

# EGARCH ------------------------------------------------------------------  
egarch\_spec <- ugarchspec(variance.model = list(model="eGARCH",   
 garchOrder=c(1, 1)),   
 mean.model = list(armaOrder=c(2, 2)),   
 distribution.model = "norm")   
egarch <- ugarchfit(spec = egarch\_spec,   
 data = series)  
egarch

##   
## \*---------------------------------\*  
## \* GARCH Model Fit \*  
## \*---------------------------------\*  
##   
## Conditional Variance Dynamics   
## -----------------------------------  
## GARCH Model : eGARCH(1,1)  
## Mean Model : ARFIMA(2,0,2)  
## Distribution : norm   
##   
## Optimal Parameters  
## ------------------------------------  
## Estimate Std. Error t value Pr(>|t|)  
## mu 0.000302 0.000421 0.71759 0.473009  
## ar1 -1.051424 0.060313 -17.43292 0.000000  
## ar2 -0.552011 0.157072 -3.51439 0.000441  
## ma1 1.051545 0.080572 13.05106 0.000000  
## ma2 0.449804 0.138100 3.25709 0.001126  
## omega -0.745455 0.242821 -3.06998 0.002141  
## alpha1 -0.104011 0.034207 -3.04059 0.002361  
## beta1 0.916382 0.026926 34.03296 0.000000  
## gamma1 0.331078 0.074216 4.46103 0.000008  
##   
## Robust Standard Errors:  
## Estimate Std. Error t value Pr(>|t|)  
## mu 0.000302 0.000416 0.72594 0.467872  
## ar1 -1.051424 0.088169 -11.92505 0.000000  
## ar2 -0.552011 0.296216 -1.86354 0.062386  
## ma1 1.051545 0.126739 8.29690 0.000000  
## ma2 0.449804 0.255560 1.76007 0.078395  
## omega -0.745455 0.364999 -2.04235 0.041117  
## alpha1 -0.104011 0.048107 -2.16207 0.030613  
## beta1 0.916382 0.040519 22.61633 0.000000  
## gamma1 0.331078 0.084808 3.90386 0.000095  
##   
## LogLikelihood : 1464.144   
##   
## Information Criteria  
## ------------------------------------  
##   
## Akaike -6.1659  
## Bayes -6.0866  
## Shibata -6.1666  
## Hannan-Quinn -6.1347  
##   
## Weighted Ljung-Box Test on Standardized Residuals  
## ------------------------------------  
## statistic p-value  
## Lag[1] 0.03255 0.8568  
## Lag[2\*(p+q)+(p+q)-1][11] 4.13956 0.9997  
## Lag[4\*(p+q)+(p+q)-1][19] 7.04478 0.9043  
## d.o.f=4  
## H0 : No serial correlation  
##   
## Weighted Ljung-Box Test on Standardized Squared Residuals  
## ------------------------------------  
## statistic p-value  
## Lag[1] 0.03021 0.8620  
## Lag[2\*(p+q)+(p+q)-1][5] 0.99419 0.8610  
## Lag[4\*(p+q)+(p+q)-1][9] 1.50435 0.9552  
## d.o.f=2  
##   
## Weighted ARCH LM Tests  
## ------------------------------------  
## Statistic Shape Scale P-Value  
## ARCH Lag[3] 1.017 0.500 2.000 0.3133  
## ARCH Lag[5] 1.580 1.440 1.667 0.5715  
## ARCH Lag[7] 1.704 2.315 1.543 0.7795  
##   
## Nyblom stability test  
## ------------------------------------  
## Joint Statistic: 1.7794  
## Individual Statistics:   
## mu 0.17998  
## ar1 0.08155  
## ar2 0.02906  
## ma1 0.10787  
## ma2 0.02486  
## omega 0.50909  
## alpha1 0.07917  
## beta1 0.46872  
## gamma1 0.09482  
##   
## Asymptotic Critical Values (10% 5% 1%)  
## Joint Statistic: 2.1 2.32 2.82  
## Individual Statistic: 0.35 0.47 0.75  
##   
## Sign Bias Test  
## ------------------------------------  
## t-value prob sig  
## Sign Bias 1.1309 0.2587   
## Negative Sign Bias 0.3910 0.6960   
## Positive Sign Bias 0.1312 0.8957   
## Joint Effect 3.7113 0.2944   
##   
##   
## Adjusted Pearson Goodness-of-Fit Test:  
## ------------------------------------  
## group statistic p-value(g-1)  
## 1 20 20.20 0.3824  
## 2 30 38.38 0.1141  
## 3 40 46.98 0.1780  
## 4 50 53.85 0.2942  
##   
##   
## Elapsed time : 0.3390238

# Uji Signiiikansi Parameter dan diagnosis residual -----------------------  
normtest::jb.norm.test(scale(egarch@fit$residuals))

##   
## Jarque-Bera test for normality  
##   
## data: scale(egarch@fit$residuals)  
## JB = 930, p-value < 2.2e-16