Untitled

me

7/27/2020

```
5+5
```

```
## [1] 10
```

```
library(zoo)
```

```
##
## Attaching package: 'zoo'
```

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

```
library(tseries)
```

```
## Warning: package 'tseries' was built under R version 4.0.2
```

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

```
library(FinTS)
```

```
## Warning: package 'FinTS' was built under R version 4.0.2
```

```
library(rugarch)
```

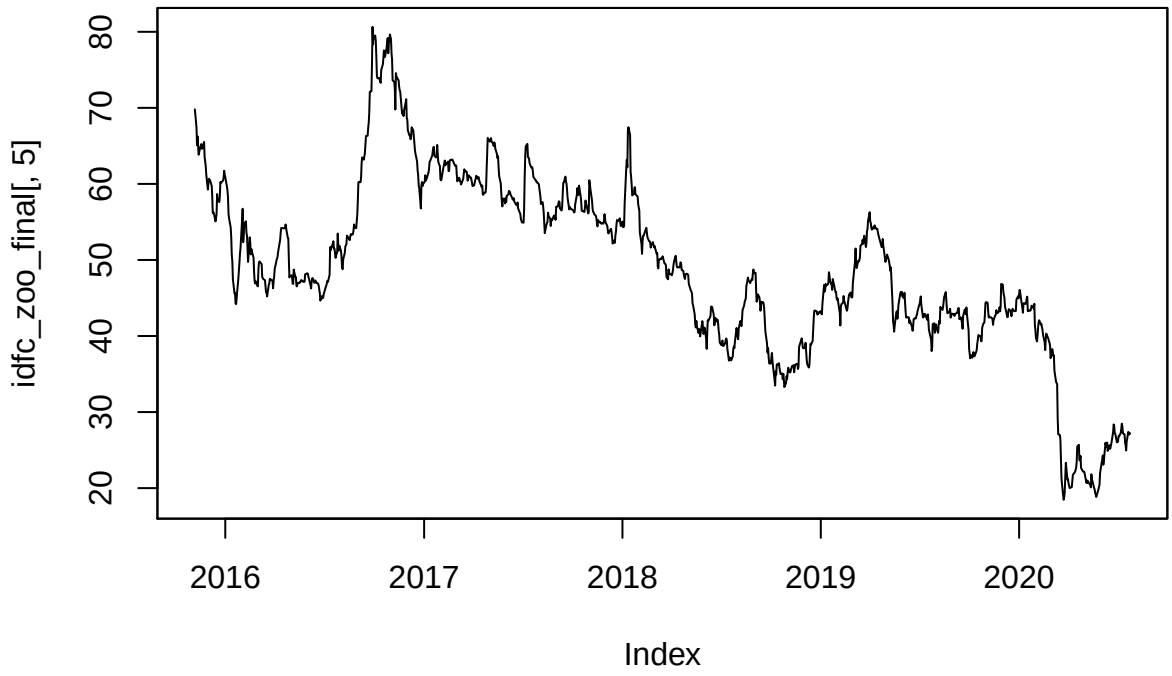
```
## Warning: package 'rugarch' was built under R version 4.0.2
```

```
## Loading required package: parallel
```

```
##
## Attaching package: 'rugarch'
```

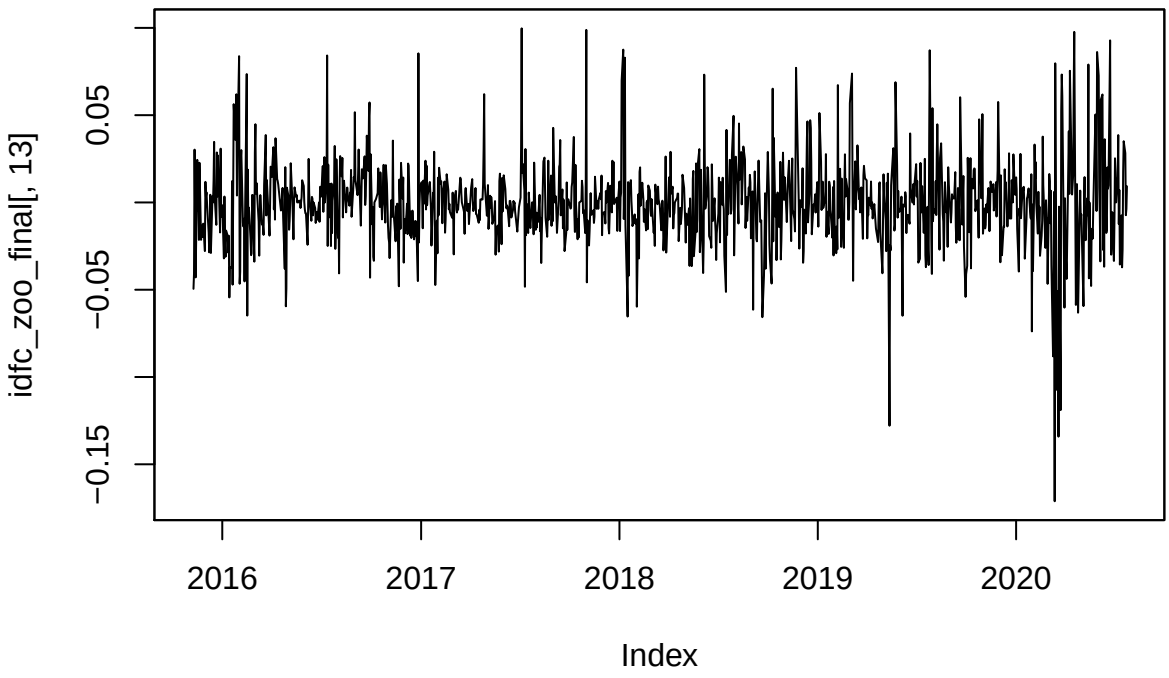
```
## The following object is masked from 'package:stats':
##
##     sigma
```

```
idfc_zoo_final<-read.zoo("IDFC.csv",header=TRUE,sep=",",format="%d-%b-%y",FUN = as.Date)
plot(idfc_zoo_final[,5])
```



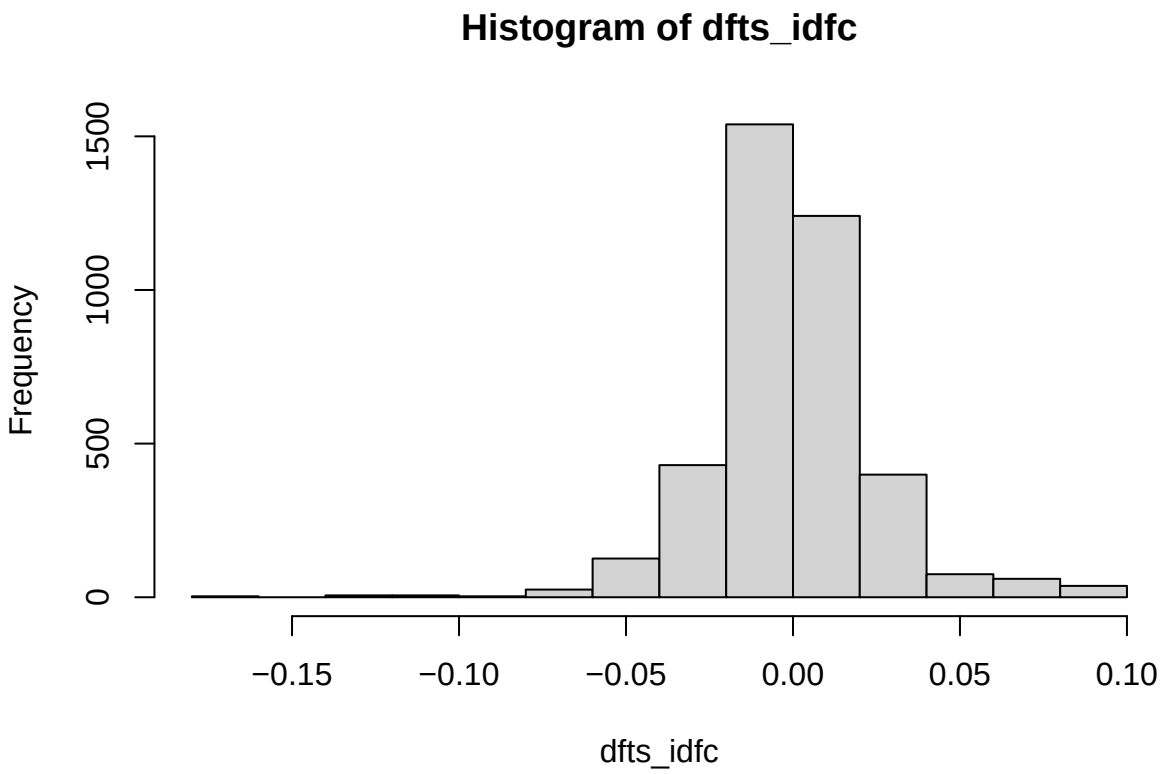
there is a trend in the closing price hence i am taking the differnce and considering the log return.

```
plot(idfc_zoo_final[,13])
```



the return series seems to show some seasonality be constant at mean zero and volatility clustering is visible in graph

```
ret_idfc<-idfc_zoo_final[-1,13]
dfts_idfc<- ts(ret_idfc,start=c(2010,1),end=c(2020,300),frequency = 365)
hist(dfts_idfc)
```



the return appears to be noormally distributed.

```
shapiro.test(dfts_idfc)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  dfts_idfc
## W = 0.93062, p-value < 2.2e-16
```

the series is staionary.

```
mean(dfts_idfc)
```

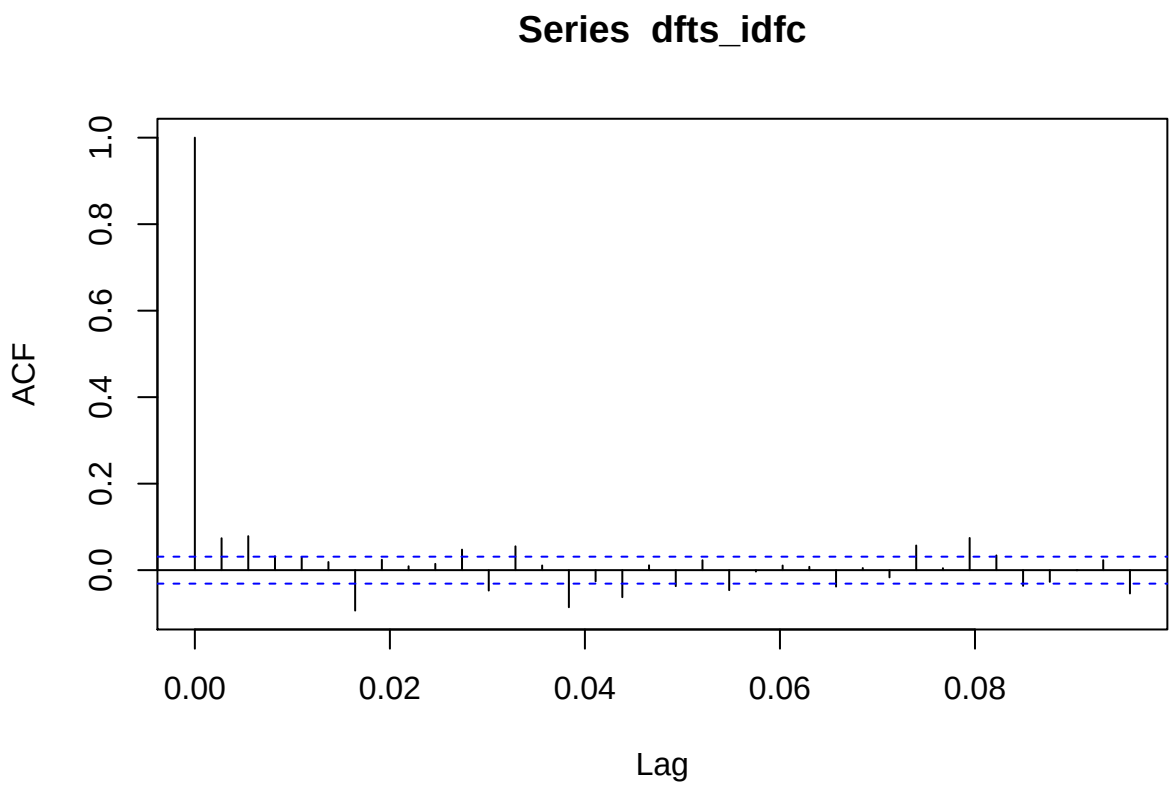
```
## [1] -0.0004732237
```

```
adf.test(ret_idfc)
```

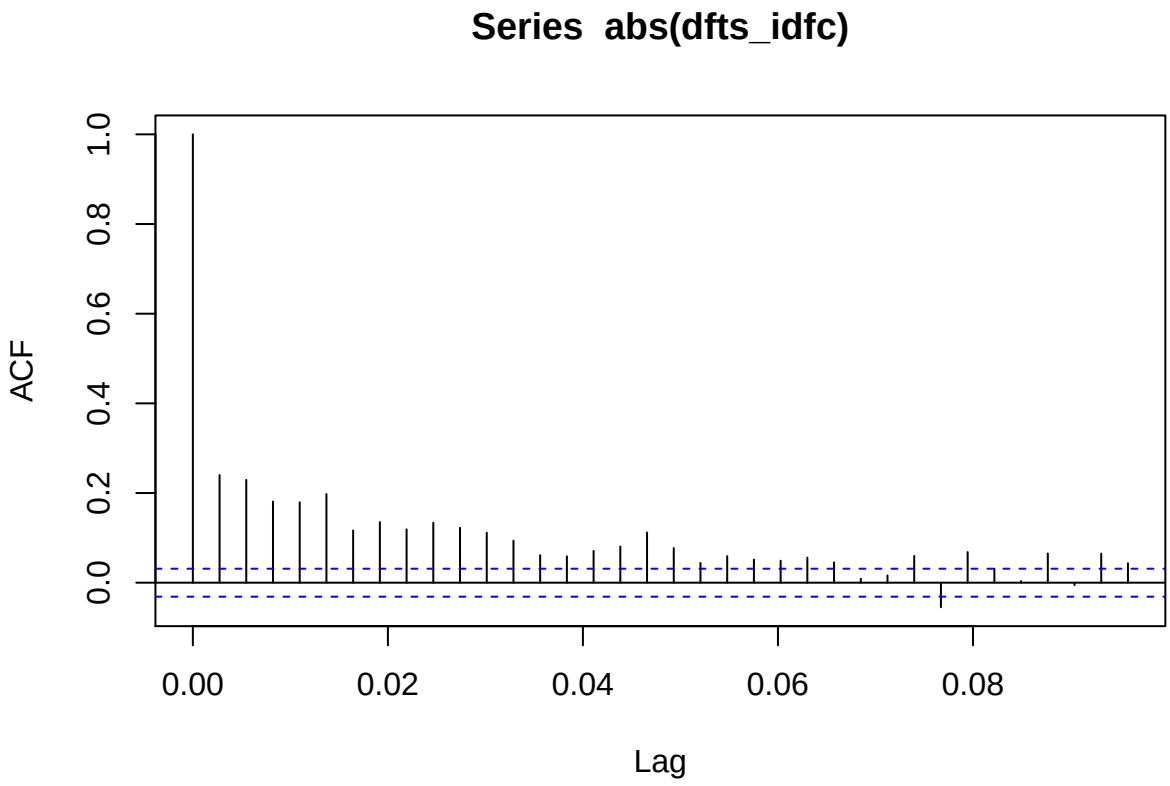
```
## Warning in adf.test(ret_idfc): p-value smaller than printed p-value

##
##  Augmented Dickey-Fuller Test
##
## data:  ret_idfc
## Dickey-Fuller = -9.9388, Lag order = 10, p-value = 0.01
## alternative hypothesis: stationary
```

since p value is smaller than 0.05 hence we are rejecting the null hypothesis hence the series is stationary. also the series is normal around mean 0.

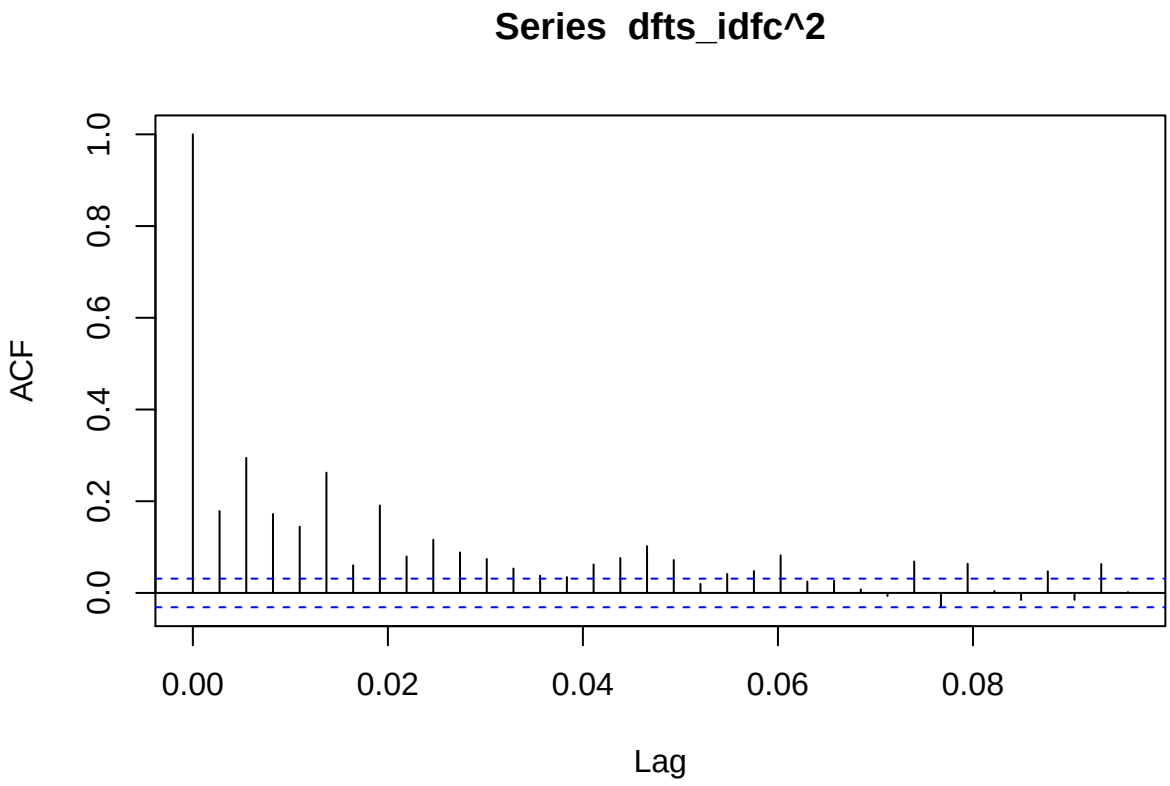
```
acf(dfts_idfc)
```




```
acf(abs(dfts_idfc))
```



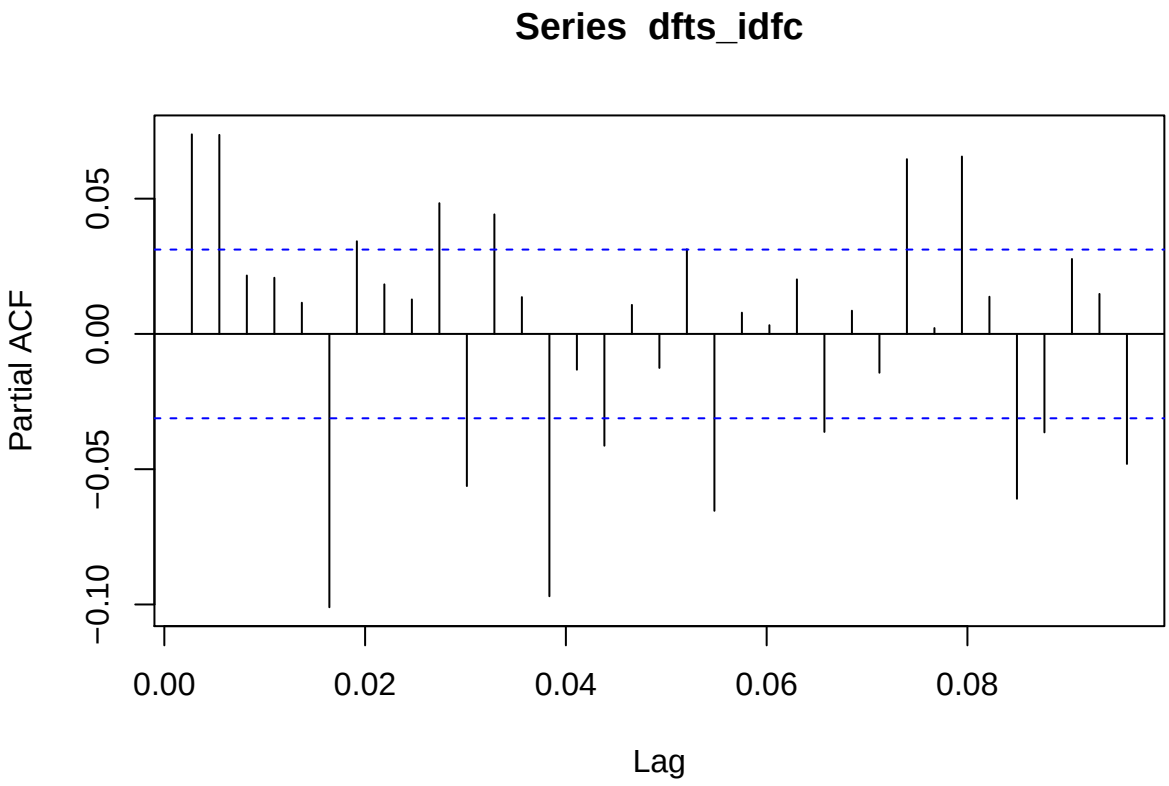

```
acf(dfts_idfc^2)
```



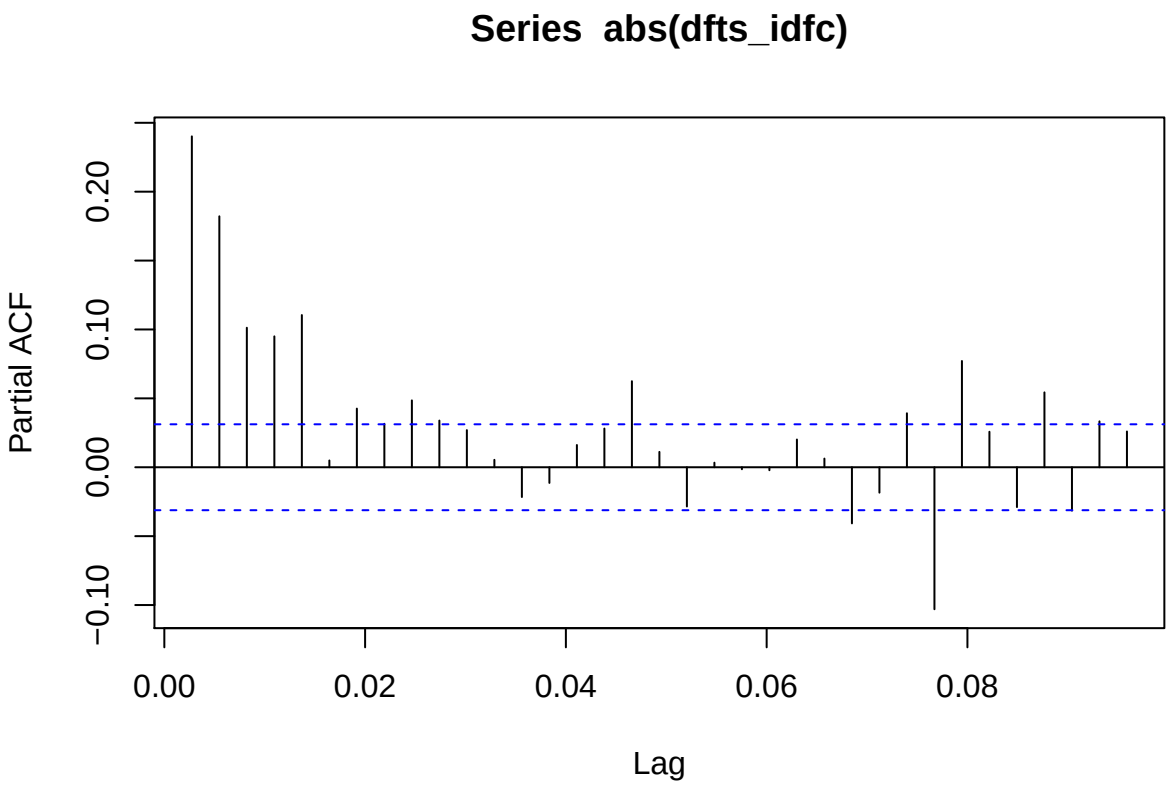
by acf function of return we can say there is no auto correlation and there will be no need of MA model also by looking at the acf of absolute return we can say that the large return are followed by large returns regardless of sign

by acf function we can say there is no seeasonality

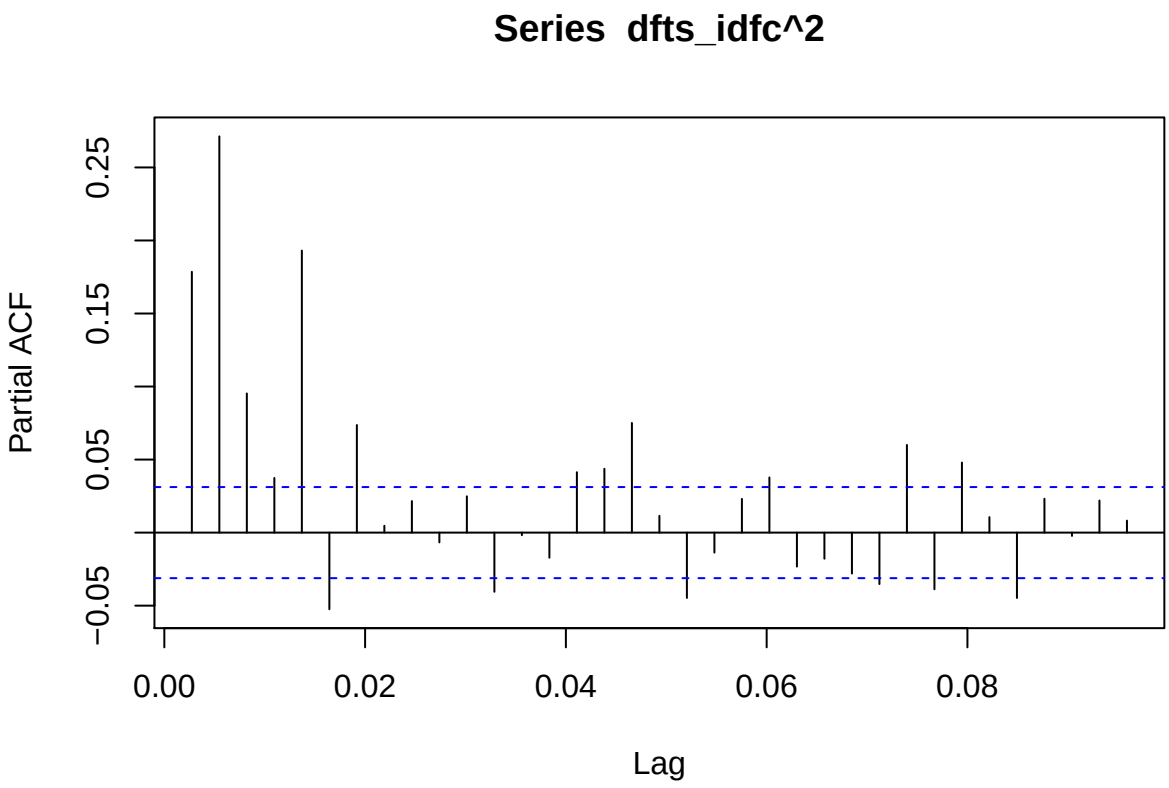
```
pacf(dfts_idfc)
```




```
pacf(abs(dfts_idfc))
```




```
pacf(dfts_idfc^2)
```



AR(2) model to predict the return series.

```
Box.test(ret_idfc,lag=12,type="Ljung")
```

```
##
##  Box-Ljung test
##
## data:  ret_idfc
## X-squared = 54.905, df = 12, p-value = 1.883e-07
```

```
ArchTest(ret_idfc)
```

```
##
##  ARCH LM-test; Null hypothesis: no ARCH effects
##
## data:  ret_idfc
## Chi-squared = 185.84, df = 12, p-value < 2.2e-16
```

since p value is less than 0.05 we are rejecting the null hypothesis and thus we can say there is arch effect in the series.

```
arima010=arima(ret_idfc,order=c(0,1,0))
AIC(arima010)
```

```
## [1] -4456.105
```

```
arima110=arima(ret_idfc,order=c(1,1,0))
AIC(arima110)
```

```
## [1] -4831.178
```

```
arima011=arima(ret_idfc,order=c(0,1,1))
AIC(arima011)
```

```
## [1] -5258.216
```

```
arima111=arima(ret_idfc,order=c(1,1,1))
AIC(arima111)
```

```
## [1] -5257.902
```

```
arima012=arima(ret_idfc,order=c(0,1,2))
AIC(arima012)
```

```
## [1] -5257.778
```

```
arima210=arima(ret_idfc,order=c(2,1,0))
AIC(arima210)
```

```
## [1] -4984.845
```

```
arima112=arima(ret_idfc,order=c(1,1,2))
AIC(arima112)
```

```
## [1] -5255.634
```

```
arima211=arima(ret_idfc,order=c(2,1,1))
AIC(arima211)
```

```
## [1] -5258.114
```

```
arima212=arima(ret_idfc,order=c(2,1,2))
AIC(arima212)
```

```
## [1] -5253.903
```

```
arima020=arima(ret_idfc,order=c(0,2,0))
AIC(arima020)
```

```
## [1] -2881.3
```

```
arima120=arima(ret_idfc,order=c(1,2,0))
AIC(arima120)
```

```
## [1] -3701.373
```

```
arima021=arima(ret_idfc,order=c(0,2,1))
AIC(arima021)
```

```
## [1] -4441.558
```

```
arima121=arima(ret_idfc,order=c(1,2,1))
AIC(arima121)
```

```
## [1] -4815.475
```

```
arima022=arima(ret_idfc,order=c(0,2,2))
AIC(arima022)
```

```
## [1] -5221.159
```

```
arima220=arima(ret_idfc,order=c(2,2,0))
AIC(arima220)
```

```
## [1] -4083.893
```

```
arima122=arima(ret_idfc,order=c(1,2,2))
AIC(arima122)
```

```
## [1] -5225.009
```

```
arima221=arima(ret_idfc,order=c(2,2,1))
AIC(arima221)
```

```
## [1] -4968.379
```

```
arima222=arima(ret_idfc,order=c(2,2,2))
AIC(arima222)
```

```
## [1] -5224.629
```

```
arima002=arima(ret_idfc,order=c(0,0,2))
AIC(arima002)
```

```
## [1] -5269.451
```

```
arima001=arima(ret_idfc,order=c(0,0,1))
AIC(arima001)
```

```
## [1] -5270.313
```

```
arima100=arima(ret_idfc,order=c(1,0,0))
AIC(arima100)
```

```
## [1] -5270.43
```

```
arima200=arima(ret_idfc,order=c(2,0,0))
AIC(arima200)
```

```
## [1] -5270.557
```

ARIMA(2,0,0)<- (1,0,0)<-(0,0,1)<-c(0,0,2) is the best choice since there was not any reccomendation from acf and pacf function we will ignore these model for now .

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(1,0)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(1,0)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : norm
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.001680    0.000809 -2.07807 0.037703
## ar1     0.251892    0.034713  7.25641 0.000000
## ar2     0.011631    0.031212  0.37263 0.709424
## omega   0.000382    0.000026 14.74810 0.000000
## alpha1  0.476718    0.078697  6.05767 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.001680    0.001014 -1.65682 0.097557
## ar1     0.251892    0.080089  3.14515 0.001660
## ar2     0.011631    0.043145  0.26957 0.787491
## omega   0.000382    0.000059  6.45067 0.000000
## alpha1  0.476718    0.207875  2.29329 0.021831
##
## LogLikelihood : 2702.095
```

```
##
## Information Criteria
## -------------------------------------
##
## Akaike       -4.6422
## Bayes        -4.6204
## Shibata      -4.6422
## Hannan-Quinn -4.6339
##
## Weighted Ljung-Box Test on Standardized Residuals
## -------------------------------------
##                         statistic   p-value
## Lag[1]                      7.082 7.785e-03
## Lag[2*(p+q)+(p+q)-1][5]     8.080 6.508e-09
## Lag[4*(p+q)+(p+q)-1][9]    11.788 1.461e-03
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## -------------------------------------
##                         statistic p-value
## Lag[1]                      1.340 0.24711
## Lag[2*(p+q)+(p+q)-1][2]     3.725 0.08938
## Lag[4*(p+q)+(p+q)-1][5]     8.817 0.01840
## d.o.f=1
##
## Weighted ARCH LM Tests
## -------------------------------------
##             Statistic Shape Scale  P-Value
## ARCH Lag[2]     4.755 0.500 2.000 0.029210
## ARCH Lag[4]     6.854 1.397 1.611 0.030793
## ARCH Lag[6]    12.211 2.222 1.500 0.003911
##
## Nyblom stability test
## -------------------------------------
## Joint Statistic:  2.3994
## Individual Statistics:
## mu     0.04506
## ar1    0.24247
## ar2    0.12968
## omega  2.07656
## alpha1 0.68663
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          1.28 1.47 1.88
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## -------------------------------------
##                    t-value   prob sig
## Sign Bias          0.70799 0.4791
## Negative Sign Bias 0.62262 0.5337
## Positive Sign Bias 0.09456 0.9247
## Joint Effect       2.50266 0.4748
```

```
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     76.62    7.052e-09
## 2    30     85.09    2.033e-07
## 3    40    110.01    1.092e-08
## 4    50    126.98    7.658e-09
##
##
## Elapsed time : 1.408998
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(0,1)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
```

```
## Warning in .sgarchfit(spec = spec, data = data, out.sample = out.sample, :
## ugarchfit-->warning: solver failer to converge.
```

```
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(0,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : norm
##
## Convergence Problem:
## Solver Message:
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(1,1)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(1,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : norm
##
## Optimal Parameters
## -----------------------------------
```

```
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000208    0.000707 -0.29352 0.769126
## ar1     0.123607    0.035026  3.52903 0.000417
## ar2     0.013337    0.033688  0.39589 0.692185
## omega   0.000078    0.000022  3.59444 0.000325
## alpha1  0.213087    0.046150  4.61726 0.000004
## beta1   0.671378    0.065037 10.32295 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000208    0.000754 -0.27547 0.782957
## ar1     0.123607    0.036893  3.35038 0.000807
## ar2     0.013337    0.037072  0.35975 0.719035
## omega   0.000078    0.000054  1.44523 0.148392
## alpha1  0.213087    0.105195  2.02564 0.042801
## beta1   0.671378    0.163649  4.10256 0.000041
##
## LogLikelihood : 2744.247
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.7130
## Bayes        -4.6869
## Shibata      -4.7130
## Hannan-Quinn -4.7031
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                    0.03531  0.8509
## Lag[2*(p+q)+(p+q)-1][5]   1.09856  1.0000
## Lag[4*(p+q)+(p+q)-1][9]   3.13894  0.8685
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                    0.08554  0.7699
## Lag[2*(p+q)+(p+q)-1][5]   0.98291  0.8635
## Lag[4*(p+q)+(p+q)-1][9]   2.12238  0.8899
## d.o.f=2
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[3]     1.010 0.500 2.000  0.3149
## ARCH Lag[5]     1.582 1.440 1.667  0.5710
## ARCH Lag[7]     2.297 2.315 1.543  0.6546
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  1.853
```

```
## Individual Statistics:
## mu     0.10073
## ar1    0.02566
## ar2    0.34435
## omega  0.78639
## alpha1 0.43137
## beta1  1.00276
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          1.49 1.68 2.12
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value   prob sig
## Sign Bias           1.1344 0.2569
## Negative Sign Bias  0.2763 0.7824
## Positive Sign Bias  0.4670 0.6406
## Joint Effect        4.5402 0.2087
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     80.03    1.837e-09
## 2    30     86.69    1.165e-07
## 3    40    115.31    1.802e-09
## 4    50    114.51    3.670e-07
##
##
## Elapsed time : 0.5360031
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(2,0)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(2,0)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : norm
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000315    0.000726 -0.43344 0.664692
## ar1     0.138711    0.036971  3.75189 0.000176
## ar2    -0.021820    0.036859 -0.59198 0.553865
## omega   0.000327    0.000025 13.21483 0.000000
```

```
## alpha1  0.317587    0.063200  5.02508 0.000001
## alpha2  0.202697    0.042679  4.74931 0.000002
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000315    0.000832 -0.37818 0.705297
## ar1     0.138711    0.047397  2.92661 0.003427
## ar2    -0.021820    0.048987 -0.44542 0.656015
## omega   0.000327    0.000052  6.29498 0.000000
## alpha1  0.317587    0.095833  3.31397 0.000920
## alpha2  0.202697    0.071993  2.81552 0.004870
##
## LogLikelihood : 2730.524
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.6894
## Bayes        -4.6633
## Shibata      -4.6894
## Hannan-Quinn -4.6795
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                   0.002088  0.9636
## Lag[2*(p+q)+(p+q)-1][5]  2.002887  0.9576
## Lag[4*(p+q)+(p+q)-1][9]  4.502216  0.5707
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.4471  0.5037
## Lag[2*(p+q)+(p+q)-1][5]    2.1364  0.5866
## Lag[4*(p+q)+(p+q)-1][9]    4.6363  0.4847
## d.o.f=2
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[3]    0.1928 0.500 2.000  0.6606
## ARCH Lag[5]    3.0114 1.440 1.667  0.2881
## ARCH Lag[7]    3.6300 2.315 1.543  0.4031
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.4972
## Individual Statistics:
## mu     0.17356
## ar1    0.07915
## ar2    0.39591
## omega  1.63435
```

```
## alpha1 0.26121
## alpha2 0.46357
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          1.49 1.68 2.12
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## -----------------------------------
##                    t-value   prob sig
## Sign Bias          0.83450 0.4042
## Negative Sign Bias 0.48532 0.6275
## Positive Sign Bias 0.04583 0.9635
## Joint Effect       2.47073 0.4806
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## -----------------------------------
##   group statistic p-value(g-1)
## 1    20     81.79    9.133e-10
## 2    30     98.77    1.535e-09
## 3    40    111.25    7.191e-09
## 4    50    138.26    1.928e-10
##
##
## Elapsed time : 0.831995
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(0,2)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(0,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : norm
##
## Optimal Parameters
## -----------------------------------
##        Estimate  Std. Error     t value Pr(>|t|)
## mu    -0.000521    0.000838 -6.2196e-01 0.533971
## ar1    0.066661    0.029319  2.2736e+00 0.022989
## ar2    0.069013    0.029268  2.3580e+00 0.018374
## omega  0.000001    0.000000  4.0416e+01 0.000000
## beta1  0.008567    0.000158  5.4202e+01 0.000000
## beta2  0.990432    0.000007  1.4013e+05 0.000000
##
## Robust Standard Errors:
##        Estimate  Std. Error    t value Pr(>|t|)
```

```
## mu    -0.000521    0.000759   -0.68622  0.49257
## ar1    0.066661    0.031841    2.09355  0.03630
## ar2    0.069013    0.056297    1.22587  0.22025
## omega  0.000001    0.000000   21.31539  0.00000
## beta1  0.008567    0.000458   18.69106  0.00000
## beta2  0.990432    0.000139 7104.05896  0.00000
##
## LogLikelihood : 2648.158
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.5476
## Bayes        -4.5215
## Shibata      -4.5477
## Hannan-Quinn -4.5378
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                   0.003352  0.9538
## Lag[2*(p+q)+(p+q)-1][5]  0.748254  1.0000
## Lag[4*(p+q)+(p+q)-1][9]  7.018428  0.1263
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic   p-value
## Lag[1]                      50.34 1.296e-12
## Lag[2*(p+q)+(p+q)-1][5]    151.33 0.000e+00
## Lag[4*(p+q)+(p+q)-1][9]    208.08 0.000e+00
## d.o.f=2
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale   P-Value
## ARCH Lag[3]     28.60 0.500 2.000 8.904e-08
## ARCH Lag[5]     82.42 1.440 1.667 0.000e+00
## ARCH Lag[7]    107.86 2.315 1.543 0.000e+00
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  255.3408
## Individual Statistics:
## mu     0.04007
## ar1    0.02046
## ar2    0.17201
## omega 17.52412
## beta1  1.68632
## beta2  1.68622
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          1.49 1.68 2.12
```

```
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value      prob sig
## Sign Bias            1.187 2.354e-01
## Negative Sign Bias   4.639 3.903e-06 ***
## Positive Sign Bias   5.595 2.752e-08 ***
## Joint Effect        58.406 1.288e-12 ***
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     171.2    1.641e-26
## 2    30     193.2    3.567e-26
## 3    40     205.0    2.158e-24
## 4    50     230.1    2.924e-25
##
##
## Elapsed time : 0.5899942
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(2,2)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(2,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : norm
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000401    0.000713 -0.561558 0.574417
## ar1     0.128469    0.035774  3.591097 0.000329
## ar2     0.017758    0.033033  0.537584 0.590864
## omega   0.000079    0.000028  2.845042 0.004441
## alpha1  0.242764    0.048473  5.008193 0.000001
## alpha2  0.000000    0.098912  0.000001 0.999999
## beta1   0.457404    0.312711  1.462705 0.143548
## beta2   0.187848    0.170820  1.099686 0.271469
##
## Robust Standard Errors:
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000401    0.000760 -0.526974 0.598212
## ar1     0.128469    0.038226  3.360787 0.000777
## ar2     0.017758    0.036172  0.490937 0.623471
```

```
## omega   0.000079    0.000042  1.864531 0.062247
## alpha1  0.242764    0.089444  2.714133 0.006645
## alpha2  0.000000    0.124861  0.000001 0.999999
## beta1   0.457404    0.538412  0.849543 0.395579
## beta2   0.187848    0.410890  0.457173 0.647547
##
## LogLikelihood : 2745.45
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.7116
## Bayes        -4.6768
## Shibata      -4.7117
## Hannan-Quinn -4.6985
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                   0.007585  0.9306
## Lag[2*(p+q)+(p+q)-1][5]  1.034330  1.0000
## Lag[4*(p+q)+(p+q)-1][9]  3.106121  0.8739
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                     0.01532  0.9015
## Lag[2*(p+q)+(p+q)-1][11]   2.39767  0.9306
## Lag[4*(p+q)+(p+q)-1][19]   5.12067  0.9330
## d.o.f=4
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[5]    0.5185 0.500 2.000  0.4715
## ARCH Lag[7]    1.6265 1.473 1.746  0.5911
## ARCH Lag[9]    2.1883 2.402 1.619  0.7217
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  3.4259
## Individual Statistics:
## mu     0.07627
## ar1    0.03043
## ar2    0.31682
## omega  0.68589
## alpha1 0.41981
## alpha2 0.66662
## beta1  0.89904
## beta2  0.93477
##
## 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           1.1334 0.2573
## Negative Sign Bias  0.4319 0.6659
## Positive Sign Bias  0.2863 0.7747
## Joint Effect        4.4268 0.2189
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     76.28    8.072e-09
## 2    30     86.33    1.322e-07
## 3    40    103.61    9.110e-08
## 4    50    114.85    3.309e-07
##
##
## Elapsed time : 0.582
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(1,2)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(1,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : norm
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000401    0.000720 -0.55677 0.577682
## ar1     0.128471    0.035807  3.58789 0.000333
## ar2     0.017758    0.033087  0.53671 0.591468
## omega   0.000079    0.000019  4.23600 0.000023
## alpha1  0.242768    0.049606  4.89391 0.000001
## beta1   0.457387    0.134279  3.40624 0.000659
## beta2   0.187860    0.112715  1.66668 0.095577
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000401    0.000775 -0.51681 0.605290
## ar1     0.128471    0.038047  3.37663 0.000734
## ar2     0.017758    0.035932  0.49422 0.621148
```

```
## omega   0.000079    0.000038  2.06587 0.038841
## alpha1  0.242768    0.083013  2.92444 0.003451
## beta1   0.457387    0.168913  2.70782 0.006773
## beta2   0.187860    0.173119  1.08516 0.277853
##
## LogLikelihood : 2745.45
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.7133
## Bayes        -4.6829
## Shibata      -4.7134
## Hannan-Quinn -4.7018
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                   0.007579  0.9306
## Lag[2*(p+q)+(p+q)-1][5]  1.034314  1.0000
## Lag[4*(p+q)+(p+q)-1][9]  3.106105  0.8739
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                     0.01531  0.9015
## Lag[2*(p+q)+(p+q)-1][8]    1.68477  0.9042
## Lag[4*(p+q)+(p+q)-1][14]   3.05926  0.9522
## d.o.f=3
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[4]    0.3127 0.500 2.000  0.5760
## ARCH Lag[6]    1.2435 1.461 1.711  0.6792
## ARCH Lag[8]    1.8727 2.368 1.583  0.7672
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  1.8603
## Individual Statistics:
## mu     0.07626
## ar1    0.03043
## ar2    0.31682
## omega  0.68587
## alpha1 0.41980
## beta1  0.89901
## beta2  0.93475
##
## 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           1.1334 0.2573
## Negative Sign Bias  0.4319 0.6659
## Positive Sign Bias  0.2862 0.7747
## Joint Effect        4.4268 0.2189
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     76.28    8.072e-09
## 2    30     86.33    1.322e-07
## 3    40    103.61    9.110e-08
## 4    50    114.85    3.309e-07
##
##
## Elapsed time : 0.5650022
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(2,1)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(2,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : norm
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000207    0.000997 -0.20814 0.835117
## ar1     0.123605    0.035750  3.45748 0.000545
## ar2     0.013335    0.043229  0.30848 0.757717
## omega   0.000078    0.000152  0.51427 0.607061
## alpha1  0.212999    0.052390  4.06562 0.000048
## alpha2  0.000000    0.304144  0.00000 1.000000
## beta1   0.671535    0.498623  1.34678 0.178052
##
## Robust Standard Errors:
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000207    0.009901 -0.020955  0.98328
## ar1     0.123605    0.101136  1.222161  0.22165
## ar2     0.013335    0.387002  0.034457  0.97251
## omega   0.000078    0.002177  0.035975  0.97130
## alpha1  0.212999    0.275636  0.772754  0.43967
```

```
## alpha2  0.000000    4.309833  0.000000  1.00000
## beta1   0.671535    7.140674  0.094044  0.92507
##
## LogLikelihood : 2744.247
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.7113
## Bayes        -4.6808
## Shibata      -4.7113
## Hannan-Quinn -4.6998
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                    0.03531  0.8510
## Lag[2*(p+q)+(p+q)-1][5]   1.09868  1.0000
## Lag[4*(p+q)+(p+q)-1][9]   3.13909  0.8684
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                     0.08608  0.7692
## Lag[2*(p+q)+(p+q)-1][8]    1.81784  0.8859
## Lag[4*(p+q)+(p+q)-1][14]   3.36233  0.9330
## d.o.f=3
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[4]    0.3649 0.500 2.000  0.5458
## ARCH Lag[6]    1.2357 1.461 1.711  0.6813
## ARCH Lag[8]    1.8350 2.368 1.583  0.7747
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.789
## Individual Statistics:
## mu     0.10071
## ar1    0.02567
## ar2    0.34434
## omega  0.78543
## alpha1 0.43101
## alpha2 1.01209
## beta1  1.00210
##
## 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           1.1345 0.2568
## Negative Sign Bias  0.2759 0.7827
## Positive Sign Bias  0.4677 0.6401
## Joint Effect        4.5417 0.2086
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     80.03    1.837e-09
## 2    30     86.69    1.165e-07
## 3    40    115.31    1.802e-09
## 4    50    114.51    3.670e-07
##
##
## Elapsed time : 0.553992
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(0,1)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(0,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## -----------------------------------
##        Estimate  Std. Error     t value Pr(>|t|)
## mu    -0.000623    0.000803    -0.77613 0.437671
## ar1    0.053852    0.027949     1.92676 0.054009
## ar2    0.034824    0.028053     1.24136 0.214474
## omega  0.000001    0.000000     5.83664 0.000000
## beta1  0.999000    0.000054 18429.36549 0.000000
## skew   1.040120    0.039989    26.00990 0.000000
## shape  2.891545    0.108471    26.65728 0.000000
##
## Robust Standard Errors:
##        Estimate  Std. Error    t value Pr(>|t|)
## mu    -0.000623    0.000875   -0.71247  0.47618
## ar1    0.053852    0.033471    1.60890  0.10764
## ar2    0.034824    0.037630    0.92545  0.35473
## omega  0.000001    0.000000    9.17262  0.00000
## beta1  0.999000    0.000520 1919.57966  0.00000
## skew   1.040120    0.041543   25.03748  0.00000
## shape  2.891545    0.118234   24.45614  0.00000
```

```
##
## LogLikelihood : 2767.922
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.7520
## Bayes        -4.7215
## Shibata      -4.7521
## Hannan-Quinn -4.7405
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.2876 0.59177
## Lag[2*(p+q)+(p+q)-1][5]    2.3354 0.85739
## Lag[4*(p+q)+(p+q)-1][9]    8.1449 0.05101
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic   p-value
## Lag[1]                      46.57 8.852e-12
## Lag[2*(p+q)+(p+q)-1][2]     85.45 0.000e+00
## Lag[4*(p+q)+(p+q)-1][5]    145.86 0.000e+00
## d.o.f=1
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[2]     77.49 0.500 2.000       0
## ARCH Lag[4]    108.99 1.397 1.611       0
## ARCH Lag[6]    145.34 2.222 1.500       0
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  266.1433
## Individual Statistics:
## mu     0.06899
## ar1    0.02323
## ar2    0.59426
## omega 23.36184
## beta1  1.86606
## skew   0.12515
## shape  1.21033
##
## 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            1.187 2.356e-01
## Negative Sign Bias   4.484 8.045e-06 ***
## Positive Sign Bias   5.551 3.523e-08 ***
## Joint Effect        56.056 4.086e-12 ***
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     17.72       0.5409
## 2    30     36.97       0.1471
## 3    40     51.98       0.0799
## 4    50     74.32       0.0113
##
##
## Elapsed time : 1.265992
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(1,0)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(1,0)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000903    0.000744  -1.2131 0.225093
## ar1     0.104451    0.033662   3.1029 0.001916
## ar2     0.039264    0.027742   1.4153 0.156975
## omega   0.000432    0.000053   8.1338 0.000000
## alpha1  0.448756    0.100990   4.4436 0.000009
## skew    1.041164    0.040348  25.8048 0.000000
## shape   3.507401    0.384558   9.1206 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000903    0.000828  -1.0904 0.275529
## ar1     0.104451    0.032503   3.2135 0.001311
## ar2     0.039264    0.035558   1.1042 0.269501
## omega   0.000432    0.000059   7.2571 0.000000
## alpha1  0.448756    0.126693   3.5421 0.000397
## skew    1.041164    0.045150  23.0599 0.000000
## shape   3.507401    0.419368   8.3635 0.000000
##
## LogLikelihood : 2797.696
```

```
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8033
## Bayes        -4.7728
## Shibata      -4.8033
## Hannan-Quinn -4.7918
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.2485  0.6181
## Lag[2*(p+q)+(p+q)-1][5]    1.1722  0.9999
## Lag[4*(p+q)+(p+q)-1][9]    5.1856  0.4124
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic   p-value
## Lag[1]                      1.136 0.2864444
## Lag[2*(p+q)+(p+q)-1][2]     6.780 0.0136372
## Lag[4*(p+q)+(p+q)-1][5]    14.090 0.0007787
## d.o.f=1
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale   P-Value
## ARCH Lag[2]     11.25 0.500 2.000 7.967e-04
## ARCH Lag[4]     12.88 1.397 1.611 9.091e-04
## ARCH Lag[6]     19.65 2.222 1.500 4.655e-05
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  3.8953
## Individual Statistics:
## mu     0.06619
## ar1    0.02076
## ar2    0.71895
## omega  2.16566
## alpha1 0.36385
## skew   0.18341
## shape  0.98990
##
## 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           1.4111 0.1585
## Negative Sign Bias  0.4458 0.6559
```

```
## Positive Sign Bias  0.5460 0.5852
## Joint Effect        3.9992 0.2616
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     10.94       0.9257
## 2    30     23.65       0.7462
## 3    40     30.50       0.8331
## 4    50     33.44       0.9563
##
##
## Elapsed time : 1.258989
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(1,1)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(1,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000227    0.000663 -0.34236 0.732084
## ar1     0.087690    0.030492  2.87583 0.004030
## ar2     0.019683    0.030098  0.65397 0.513132
## omega   0.000052    0.000018  2.83995 0.004512
## alpha1  0.230749    0.058190  3.96541 0.000073
## beta1   0.721067    0.059159 12.18873 0.000000
## skew    1.082562    0.043405 24.94098 0.000000
## shape   3.913314    0.461727  8.47538 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000227    0.000716 -0.31699 0.751250
## ar1     0.087690    0.027837  3.15015 0.001632
## ar2     0.019683    0.032134  0.61254 0.540178
## omega   0.000052    0.000024  2.19479 0.028178
## alpha1  0.230749    0.067048  3.44156 0.000578
## beta1   0.721067    0.072046 10.00846 0.000000
## skew    1.082562    0.046978 23.04395 0.000000
## shape   3.913314    0.474569  8.24603 0.000000
##
## LogLikelihood : 2828.134
```

```
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8539
## Bayes        -4.8191
## Shibata      -4.8540
## Hannan-Quinn -4.8408
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.690  0.1936
## Lag[2*(p+q)+(p+q)-1][5]     2.716  0.6531
## Lag[4*(p+q)+(p+q)-1][9]     4.668  0.5310
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.1542  0.6946
## Lag[2*(p+q)+(p+q)-1][5]    1.6976  0.6913
## Lag[4*(p+q)+(p+q)-1][9]    3.3462  0.7007
## d.o.f=2
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[3]     1.514 0.500 2.000  0.2185
## ARCH Lag[5]     2.582 1.440 1.667  0.3564
## ARCH Lag[7]     3.772 2.315 1.543  0.3807
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.4726
## Individual Statistics:
## mu     0.10264
## ar1    0.03065
## ar2    0.68188
## omega  0.71223
## alpha1 0.30981
## beta1  0.70931
## skew   0.15159
## shape  0.32396
##
## 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           1.2281 0.2197
```

```
## Negative Sign Bias  0.4263 0.6700
## Positive Sign Bias  0.1513 0.8797
## Joint Effect        4.4994 0.2123
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     16.69       0.6107
## 2    30     32.32       0.3060
## 3    40     42.75       0.3132
## 4    50     48.24       0.5038
##
##
## Elapsed time : 0.914001
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(2,0)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(2,0)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000240    0.000704 -0.34100 0.733104
## ar1     0.097267    0.032071  3.03284 0.002423
## ar2     0.017395    0.031520  0.55186 0.581042
## omega   0.000332    0.000042  7.86574 0.000000
## alpha1  0.347349    0.086239  4.02774 0.000056
## alpha2  0.262619    0.074615  3.51966 0.000432
## skew    1.073025    0.042658 25.15432 0.000000
## shape   3.711021    0.427629  8.67813 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000240    0.000772 -0.31087 0.755899
## ar1     0.097267    0.030332  3.20681 0.001342
## ar2     0.017395    0.034947  0.49775 0.618659
## omega   0.000332    0.000049  6.78461 0.000000
## alpha1  0.347349    0.080847  4.29637 0.000017
## alpha2  0.262619    0.088395  2.97097 0.002969
## skew    1.073025    0.044239 24.25517 0.000000
## shape   3.711021    0.440058  8.43302 0.000000
##
```

```
## LogLikelihood : 2813.89
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8294
## Bayes        -4.7946
## Shibata      -4.8295
## Hannan-Quinn -4.8163
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.044  0.3069
## Lag[2*(p+q)+(p+q)-1][5]     2.058  0.9463
## Lag[4*(p+q)+(p+q)-1][9]     4.487  0.5744
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.5175  0.4719
## Lag[2*(p+q)+(p+q)-1][5]    2.6992  0.4647
## Lag[4*(p+q)+(p+q)-1][9]    4.6586  0.4812
## d.o.f=2
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[3]   0.06999 0.500 2.000  0.7913
## ARCH Lag[5]   2.32194 1.440 1.667  0.4044
## ARCH Lag[7]   2.72669 2.315 1.543  0.5666
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  3.4153
## Individual Statistics:
## mu     0.12656
## ar1    0.02985
## ar2    0.89282
## omega  1.49292
## alpha1 0.14060
## alpha2 0.44228
## skew   0.13147
## shape  0.63635
##
## 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           1.1234 0.2615
## Negative Sign Bias  0.5099 0.6102
## Positive Sign Bias  0.3738 0.7086
## Joint Effect        3.0576 0.3828
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     21.61      0.30386
## 2    30     22.77      0.78707
## 3    40     47.50      0.16487
## 4    50     66.74      0.04665
##
##
## Elapsed time : 1.427992
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(0,2)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(0,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##        Estimate  Std. Error    t value Pr(>|t|)
## mu    -0.000615    0.000808   -0.76125 0.446507
## ar1    0.053751    0.028023    1.91812 0.055096
## ar2    0.035677    0.028139    1.26791 0.204831
## omega  0.000001    0.000000    3.71830 0.000201
## beta1  0.000000    0.000510    0.00001 0.999992
## beta2  0.999000    0.000116 8582.56112 0.000000
## skew   1.040483    0.040220   25.86959 0.000000
## shape  2.857489    0.178353   16.02157 0.000000
##
## Robust Standard Errors:
##        Estimate  Std. Error     t value Pr(>|t|)
## mu    -0.000615    0.000882   -0.697438 0.485529
## ar1    0.053751    0.033726    1.593782 0.110985
## ar2    0.035677    0.038224    0.933372 0.350628
## omega  0.000001    0.000000    2.886224 0.003899
## beta1  0.000000    0.000918    0.000006 0.999995
## beta2  0.999000    0.000986 1013.083589 0.000000
## skew   1.040483    0.042153   24.683345 0.000000
## shape  2.857489    0.402499    7.099362 0.000000
```

```
##
## LogLikelihood : 2769.065
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.7523
## Bayes        -4.7174
## Shibata      -4.7524
## Hannan-Quinn -4.7391
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.2985 0.58480
## Lag[2*(p+q)+(p+q)-1][5]    2.3022 0.87096
## Lag[4*(p+q)+(p+q)-1][9]    7.9484 0.06024
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic   p-value
## Lag[1]                      45.96 1.204e-11
## Lag[2*(p+q)+(p+q)-1][5]    139.20 0.000e+00
## Lag[4*(p+q)+(p+q)-1][9]    189.53 0.000e+00
## d.o.f=2
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale   P-Value
## ARCH Lag[3]     26.64 0.500 2.000 2.453e-07
## ARCH Lag[5]     74.98 1.440 1.667 0.000e+00
## ARCH Lag[7]     97.06 2.315 1.543 0.000e+00
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  212.1912
## Individual Statistics:
## mu     0.07052
## ar1    0.02354
## ar2    0.60443
## omega 18.21304
## beta1  1.64474
## beta2  1.64408
## skew   0.12421
## shape  1.11482
##
## 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             1.176 2.397e-01
## Negative Sign Bias    4.445 9.619e-06 ***
## Positive Sign Bias    5.570 3.167e-08 ***
## Joint Effect         56.016 4.168e-12 ***
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     15.07     0.717882
## 2    30     36.04     0.172464
## 3    40     47.02     0.177057
## 4    50     78.02     0.005234
##
##
## Elapsed time : 1.044998
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(2,2)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(2,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000282    0.000655 -0.429896  0.66727
## ar1     0.088915    0.030685  2.897659  0.00376
## ar2     0.020973    0.029662  0.707071  0.47952
## omega   0.000056    0.000064  0.874887  0.38164
## alpha1  0.254308    0.049542  5.133168  0.00000
## alpha2  0.000000    0.326242  0.000001  1.00000
## beta1   0.549861    1.007384  0.545831  0.58518
## beta2   0.144428    0.668590  0.216019  0.82897
## skew    1.079855    0.042984 25.122433  0.00000
## shape   3.939012    0.445478  8.842216  0.00000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000282    0.000732 -0.38503 0.700219
## ar1     0.088915    0.027764  3.20249 0.001362
## ar2     0.020973    0.032918  0.63713 0.524038
## omega   0.000056    0.000106  0.52836 0.597246
## alpha1  0.254308    0.102799  2.47384 0.013367
```

```
## alpha2  0.000000    0.515832  0.00000 1.000000
## beta1   0.549861    1.724290  0.31889 0.749809
## beta2   0.144428    1.197266  0.12063 0.903983
## skew    1.079855    0.047617 22.67813 0.000000
## shape   3.939012    0.521182  7.55784 0.000000
##
## LogLikelihood : 2828.491
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8511
## Bayes        -4.8076
## Shibata      -4.8513
## Hannan-Quinn -4.8347
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.596  0.2064
## Lag[2*(p+q)+(p+q)-1][5]     2.653  0.6917
## Lag[4*(p+q)+(p+q)-1][9]     4.646  0.5361
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                     0.05203  0.8196
## Lag[2*(p+q)+(p+q)-1][11]   3.29703  0.8318
## Lag[4*(p+q)+(p+q)-1][19]   5.97825  0.8755
## d.o.f=4
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[5]    0.8456 0.500 2.000  0.3578
## ARCH Lag[7]    2.4611 1.473 1.746  0.4107
## ARCH Lag[9]    2.6837 2.402 1.619  0.6251
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.7982
## Individual Statistics:
## mu     0.09746
## ar1    0.02846
## ar2    0.68781
## omega  0.68270
## alpha1 0.31640
## alpha2 0.47120
## beta1  0.68531
## beta2  0.70386
## skew   0.15922
## shape  0.31838
```

```
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.29 2.54 3.05
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                     t-value   prob sig
## Sign Bias          1.266262 0.2057
## Negative Sign Bias 0.517195 0.6051
## Positive Sign Bias 0.002504 0.9980
## Joint Effect       4.599743 0.2036
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     13.25       0.8256
## 2    30     28.50       0.4914
## 3    40     34.83       0.6604
## 4    50     43.85       0.6813
##
##
## Elapsed time : 1.075992
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(1,2)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(1,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000282    0.000667 -0.42256 0.672613
## ar1     0.088926    0.030761  2.89093 0.003841
## ar2     0.020975    0.029857  0.70254 0.482342
## omega   0.000056    0.000019  2.87599 0.004028
## alpha1  0.254260    0.066066  3.84858 0.000119
## beta1   0.549953    0.196479  2.79904 0.005125
## beta2   0.144392    0.163437  0.88347 0.376980
## skew    1.079823    0.043400 24.88064 0.000000
## shape   3.939146    0.467873  8.41926 0.000000
##
## Robust Standard Errors:
```

```
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000282    0.000716 -0.39365 0.693839
## ar1     0.088926    0.027741  3.20562 0.001348
## ar2     0.020975    0.032055  0.65436 0.512882
## omega   0.000056    0.000023  2.39728 0.016517
## alpha1  0.254260    0.064894  3.91808 0.000089
## beta1   0.549953    0.142419  3.86152 0.000113
## beta2   0.144392    0.131273  1.09994 0.271360
## skew    1.079823    0.046443 23.25031 0.000000
## shape   3.939146    0.480384  8.19999 0.000000
##
## LogLikelihood : 2828.491
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8528
## Bayes        -4.8137
## Shibata      -4.8529
## Hannan-Quinn -4.8380
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.596  0.2065
## Lag[2*(p+q)+(p+q)-1][5]     2.652  0.6922
## Lag[4*(p+q)+(p+q)-1][9]     4.646  0.5363
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                     0.05222  0.8192
## Lag[2*(p+q)+(p+q)-1][8]    2.50089  0.7757
## Lag[4*(p+q)+(p+q)-1][14]   4.03725  0.8767
## d.o.f=3
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[4]    0.5092 0.500 2.000  0.4755
## ARCH Lag[6]    1.7865 1.461 1.711  0.5396
## ARCH Lag[8]    2.6886 2.368 1.583  0.6032
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.4583
## Individual Statistics:
## mu     0.09743
## ar1    0.02842
## ar2    0.68764
## omega  0.68214
## alpha1 0.31617
```

```
## beta1  0.68495
## beta2  0.70349
## skew   0.15934
## shape  0.31826
##
## 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          1.266263 0.2057
## Negative Sign Bias 0.517029 0.6052
## Positive Sign Bias 0.002271 0.9982
## Joint Effect       4.599753 0.2036
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     13.25       0.8256
## 2    30     28.50       0.4914
## 3    40     34.70       0.6665
## 4    50     44.28       0.6645
##
##
## Elapsed time : 1.029002
```

```
spec_of_garch_idfc<- ugarchspec(variance.model = list(garchOrder=c(2,1)),mean.model =list(armaOrder=c(2
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : sGARCH(2,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000227    0.000671 -0.338526 0.734967
## ar1     0.087690    0.030528  2.872442 0.004073
## ar2     0.019681    0.030210  0.651474 0.514741
## omega   0.000052    0.000024  2.168304 0.030136
## alpha1  0.230754    0.065796  3.507123 0.000453
## alpha2  0.000000    0.086315  0.000001 0.999999
## beta1   0.721059    0.087057  8.282607 0.000000
```

```
## skew    1.082558    0.043660 24.794919 0.000000
## shape   3.913325    0.475612  8.227984 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000227    0.000725 -0.312982 0.754294
## ar1     0.087690    0.027882  3.145006 0.001661
## ar2     0.019681    0.031996  0.615104 0.538486
## omega   0.000052    0.000035  1.508170 0.131511
## alpha1  0.230754    0.059277  3.892814 0.000099
## alpha2  0.000000    0.106144  0.000001 0.999999
## beta1   0.721059    0.128097  5.628994 0.000000
## skew    1.082558    0.046738 23.162177 0.000000
## shape   3.913325    0.506922  7.719785 0.000000
##
## LogLikelihood : 2828.134
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8522
## Bayes        -4.8130
## Shibata      -4.8523
## Hannan-Quinn -4.8374
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.690  0.1936
## Lag[2*(p+q)+(p+q)-1][5]     2.716  0.6531
## Lag[4*(p+q)+(p+q)-1][9]     4.668  0.5310
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                      0.1541  0.6946
## Lag[2*(p+q)+(p+q)-1][8]     3.0280  0.6804
## Lag[4*(p+q)+(p+q)-1][14]    4.6591  0.8104
## d.o.f=3
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[4]    0.6265 0.500 2.000  0.4287
## ARCH Lag[6]    2.0077 1.461 1.711  0.4891
## ARCH Lag[8]    2.9268 2.368 1.583  0.5572
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.9019
## Individual Statistics:
## mu     0.10264
```

```
## ar1    0.03065
## ar2    0.68192
## omega  0.71222
## alpha1 0.30980
## alpha2 0.59891
## beta1  0.70928
## skew   0.15160
## shape  0.32396
##
## 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           1.2281 0.2197
## Negative Sign Bias  0.4263 0.6699
## Positive Sign Bias  0.1513 0.8798
## Joint Effect        4.4994 0.2123
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     16.69       0.6107
## 2    30     32.32       0.3060
## 3    40     42.75       0.3132
## 4    50     48.24       0.5038
##
##
## Elapsed time : 0.9089971
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="eGARCH",garchOrder=c(1,1)),mean.model = list
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : eGARCH(1,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000510    0.000658 -0.77438 0.438709
## ar1     0.085456    0.030431  2.80816 0.004983
## ar2     0.012778    0.029558  0.43231 0.665519
```

```
## omega  -0.647639    0.211827 -3.05740 0.002233
## alpha1 -0.038340    0.031034 -1.23542 0.216672
## beta1   0.914066    0.028004 32.64015 0.000000
## gamma1  0.382003    0.067833  5.63149 0.000000
## skew    1.070119    0.043111 24.82259 0.000000
## shape   3.916815    0.462232  8.47369 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000510    0.000772 -0.66027 0.509080
## ar1     0.085456    0.029550  2.89193 0.003829
## ar2     0.012778    0.032044  0.39877 0.690063
## omega  -0.647639    0.257117 -2.51885 0.011774
## alpha1 -0.038340    0.033134 -1.15714 0.247216
## beta1   0.914066    0.034052 26.84331 0.000000
## gamma1  0.382003    0.081621  4.68018 0.000003
## skew    1.070119    0.047917 22.33271 0.000000
## shape   3.916815    0.465925  8.40654 0.000000
##
## LogLikelihood : 2831.514
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8580
## Bayes        -4.8189
## Shibata      -4.8581
## Hannan-Quinn -4.8432
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      2.496  0.1141
## Lag[2*(p+q)+(p+q)-1][5]     3.656  0.1492
## Lag[4*(p+q)+(p+q)-1][9]     6.078  0.2440
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.902  0.1678
## Lag[2*(p+q)+(p+q)-1][5]     2.985  0.4098
## Lag[4*(p+q)+(p+q)-1][9]     4.287  0.5409
## d.o.f=2
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[3]     1.167 0.500 2.000  0.2800
## ARCH Lag[5]     1.623 1.440 1.667  0.5605
## ARCH Lag[7]     2.769 2.315 1.543  0.5582
##
## Nyblom stability test
```

```
## ------------------------------------
## Joint Statistic:  2.4746
## Individual Statistics:
## mu     0.13061
## ar1    0.02137
## ar2    0.58626
## omega  0.61837
## alpha1 0.06003
## beta1  0.57978
## gamma1 0.30061
## skew   0.16893
## shape  0.25744
##
## 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           1.1671 0.24339
## Negative Sign Bias  0.5057 0.61318
## Positive Sign Bias  0.8950 0.37098
## Joint Effect        7.4943 0.05771   *
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     20.82      0.34668
## 2    30     32.94      0.28018
## 3    40     40.89      0.38741
## 4    50     63.73      0.07686
##
##
## Elapsed time : 1.044005
```

this model is rejected since gamma is not negative.

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(1,1)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## ------------------------------------
## GARCH Model  : gjrGARCH(1,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
```

```
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000386    0.000661 -0.58461 0.558808
## ar1     0.079335    0.030629  2.59018 0.009592
## ar2     0.019549    0.029588  0.66070 0.508807
## omega   0.000049    0.000017  2.81950 0.004810
## alpha1  0.179866    0.055276  3.25394 0.001138
## beta1   0.729735    0.057357 12.72267 0.000000
## gamma1  0.100806    0.065849  1.53088 0.125799
## skew    1.080763    0.043248 24.99004 0.000000
## shape   3.909701    0.461420  8.47319 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000386    0.000741 -0.52160 0.601947
## ar1     0.079335    0.029015  2.73433 0.006251
## ar2     0.019549    0.031326  0.62404 0.532600
## omega   0.000049    0.000022  2.25405 0.024193
## alpha1  0.179866    0.062361  2.88425 0.003923
## beta1   0.729735    0.068665 10.62741 0.000000
## gamma1  0.100806    0.071373  1.41239 0.157835
## skew    1.080763    0.046685 23.15014 0.000000
## shape   3.909701    0.472399  8.27628 0.000000
##
## LogLikelihood : 2829.397
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8544
## Bayes        -4.8152
## Shibata      -4.8545
## Hannan-Quinn -4.8396
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      2.721 0.09902
## Lag[2*(p+q)+(p+q)-1][5]     3.791 0.11060
## Lag[4*(p+q)+(p+q)-1][9]     5.802 0.29016
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.4176  0.5181
## Lag[2*(p+q)+(p+q)-1][5]    2.1733  0.5781
## Lag[4*(p+q)+(p+q)-1][9]    4.0169  0.5860
## d.o.f=2
##
## Weighted ARCH LM Tests
```

```
## -----------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[3]     1.467 0.500 2.000  0.2259
## ARCH Lag[5]     2.447 1.440 1.667  0.3807
## ARCH Lag[7]     3.916 2.315 1.543  0.3588
##
## Nyblom stability test
## -----------------------------------
## Joint Statistic:  2.5571
## Individual Statistics:
## mu     0.11942
## ar1    0.02744
## ar2    0.73136
## omega  0.66969
## alpha1 0.27669
## beta1  0.69005
## gamma1 0.30419
## skew   0.14552
## shape  0.32537
##
## 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           1.2187 0.22321
## Negative Sign Bias  0.6214 0.53443
## Positive Sign Bias  0.5749 0.56545
## Joint Effect        6.8330 0.07741   *
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     23.40     0.219996
## 2    30     47.55     0.016348
## 3    40     63.68     0.007555
## 4    50     48.15     0.507323
##
##
## Elapsed time : 2.124001
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(1,0)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
```

```
## ------------------------------------
## GARCH Model  : gjrGARCH(1,0)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000778    0.000762 -1.02132 0.307103
## ar1     0.109197    0.034286  3.18492 0.001448
## ar2     0.037865    0.027968  1.35389 0.175771
## omega   0.000430    0.000053  8.18607 0.000000
## alpha1  0.510865    0.139820  3.65372 0.000258
## gamma1 -0.126420    0.165047 -0.76596 0.443699
## skew    1.043905    0.040565 25.73433 0.000000
## shape   3.531461    0.390615  9.04076 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000778    0.000840 -0.92689 0.353985
## ar1     0.109197    0.033986  3.21296 0.001314
## ar2     0.037865    0.036381  1.04080 0.297966
## omega   0.000430    0.000059  7.29194 0.000000
## alpha1  0.510865    0.158044  3.23242 0.001227
## gamma1 -0.126420    0.146469 -0.86312 0.388073
## skew    1.043905    0.045061 23.16653 0.000000
## shape   3.531461    0.424452  8.32005 0.000000
##
## LogLikelihood : 2797.993
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8021
## Bayes        -4.7672
## Shibata      -4.8021
## Hannan-Quinn -4.7889
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.1204  0.7286
## Lag[2*(p+q)+(p+q)-1][5]    1.0203  1.0000
## Lag[4*(p+q)+(p+q)-1][9]    4.9720  0.4600
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic   p-value
## Lag[1]                      1.152 0.2832063
## Lag[2*(p+q)+(p+q)-1][2]     7.446 0.0090736
## Lag[4*(p+q)+(p+q)-1][5]    15.607 0.0003051
## d.o.f=1
```

```
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale   P-Value
## ARCH Lag[2]     12.55 0.500 2.000 3.971e-04
## ARCH Lag[4]     14.33 1.397 1.611 3.823e-04
## ARCH Lag[6]     21.96 2.222 1.500 1.131e-05
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  3.9839
## Individual Statistics:
## mu     0.06549
## ar1    0.02043
## ar2    0.70399
## omega  2.18428
## alpha1 0.36564
## gamma1 0.25805
## skew   0.19830
## shape  0.96806
##
## 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           1.4252 0.1544
## Negative Sign Bias  0.2369 0.8128
## Positive Sign Bias  0.7676 0.4429
## Joint Effect        3.2059 0.3610
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     14.80       0.7353
## 2    30     19.20       0.9159
## 3    40     39.10       0.4653
## 4    50     46.86       0.5601
##
##
## Elapsed time : 3.004993
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(0,1)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
```

```
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(0,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## -----------------------------------
##        Estimate  Std. Error     t value Pr(>|t|)
## mu    -0.000623    0.000803    -0.77613 0.437671
## ar1    0.053852    0.027949     1.92676 0.054009
## ar2    0.034824    0.028053     1.24136 0.214474
## omega  0.000001    0.000000     5.83664 0.000000
## beta1  0.999000    0.000054 18429.36549 0.000000
## skew   1.040120    0.039989    26.00990 0.000000
## shape  2.891545    0.108471    26.65728 0.000000
##
## Robust Standard Errors:
##        Estimate  Std. Error    t value Pr(>|t|)
## mu    -0.000623    0.000875   -0.71247  0.47618
## ar1    0.053852    0.033471    1.60890  0.10764
## ar2    0.034824    0.037630    0.92545  0.35473
## omega  0.000001    0.000000    9.17262  0.00000
## beta1  0.999000    0.000520 1919.57966  0.00000
## skew   1.040120    0.041543   25.03748  0.00000
## shape  2.891545    0.118234   24.45614  0.00000
##
## LogLikelihood : 2767.922
##
## Information Criteria
## -----------------------------------
##
## Akaike       -4.7520
## Bayes        -4.7215
## Shibata      -4.7521
## Hannan-Quinn -4.7405
##
## Weighted Ljung-Box Test on Standardized Residuals
## -----------------------------------
##                         statistic p-value
## Lag[1]                     0.2876 0.59177
## Lag[2*(p+q)+(p+q)-1][5]    2.3354 0.85739
## Lag[4*(p+q)+(p+q)-1][9]    8.1449 0.05101
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## -----------------------------------
##                         statistic   p-value
## Lag[1]                      46.57 8.852e-12
## Lag[2*(p+q)+(p+q)-1][2]     85.45 0.000e+00
## Lag[4*(p+q)+(p+q)-1][5]    145.86 0.000e+00
## d.o.f=1
##
```

```
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[2]     77.49 0.500 2.000       0
## ARCH Lag[4]    108.99 1.397 1.611       0
## ARCH Lag[6]    145.34 2.222 1.500       0
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  266.1433
## Individual Statistics:
## mu     0.06899
## ar1    0.02323
## ar2    0.59426
## omega 23.36184
## beta1  1.86606
## skew   0.12515
## shape  1.21033
##
## 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            1.187 2.356e-01
## Negative Sign Bias   4.484 8.045e-06 ***
## Positive Sign Bias   5.551 3.523e-08 ***
## Joint Effect        56.056 4.086e-12 ***
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     17.72       0.5409
## 2    30     36.97       0.1471
## 3    40     51.98       0.0799
## 4    50     74.32       0.0113
##
##
## Elapsed time : 2.613995
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(1,2)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## ------------------------------------
```

```
## GARCH Model  : gjrGARCH(1,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000414    0.000663 -0.62344 0.532995
## ar1     0.080250    0.030897  2.59735 0.009395
## ar2     0.020643    0.029509  0.69956 0.484204
## omega   0.000051    0.000018  2.81730 0.004843
## alpha1  0.195548    0.064013  3.05482 0.002252
## beta1   0.610028    0.199335  3.06032 0.002211
## beta2   0.101022    0.164463  0.61425 0.539048
## gamma1  0.102453    0.070312  1.45712 0.145084
## skew    1.079095    0.043282 24.93178 0.000000
## shape   3.928928    0.466232  8.42699 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000414    0.000738 -0.56065 0.575037
## ar1     0.080250    0.029198  2.74844 0.005988
## ar2     0.020643    0.031311  0.65930 0.509703
## omega   0.000051    0.000021  2.39649 0.016553
## alpha1  0.195548    0.068176  2.86827 0.004127
## beta1   0.610028    0.149336  4.08495 0.000044
## beta2   0.101022    0.132201  0.76416 0.444773
## gamma1  0.102453    0.076077  1.34670 0.178077
## skew    1.079095    0.046314 23.29977 0.000000
## shape   3.928928    0.476817  8.23990 0.000000
##
## LogLikelihood : 2829.575
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8530
## Bayes        -4.8094
## Shibata      -4.8531
## Hannan-Quinn -4.8365
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      2.613  0.1060
## Lag[2*(p+q)+(p+q)-1][5]     3.692  0.1381
## Lag[4*(p+q)+(p+q)-1][9]     5.725  0.3041
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                      0.2584  0.6112
```

```
## Lag[2*(p+q)+(p+q)-1][8]     3.1518  0.6576
## Lag[4*(p+q)+(p+q)-1][14]    4.8499  0.7878
## d.o.f=3
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[4]    0.4177 0.500 2.000  0.5181
## ARCH Lag[6]    1.8817 1.461 1.711  0.5174
## ARCH Lag[8]    3.0389 2.368 1.583  0.5362
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.5796
## Individual Statistics:
## mu     0.11492
## ar1    0.02664
## ar2    0.73468
## omega  0.64773
## alpha1 0.27966
## beta1  0.67337
## beta2  0.69789
## gamma1 0.31700
## skew   0.15097
## shape  0.32126
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.29 2.54 3.05
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value    prob sig
## Sign Bias           1.2668 0.20549
## Negative Sign Bias  0.6720 0.50169
## Positive Sign Bias  0.4276 0.66902
## Joint Effect        6.7585 0.08001   *
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     24.09      0.19261
## 2    30     48.90      0.01185
## 3    40     59.20      0.02000
## 4    50     49.96      0.43492
##
##
## Elapsed time : 2.546003
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(2,1)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(2,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000319    0.000664 -0.47959 0.631517
## ar1     0.085640    0.030375  2.81940 0.004811
## ar2     0.015834    0.030096  0.52613 0.598796
## omega   0.000069    0.000036  1.89766 0.057740
## alpha1  0.226558    0.076610  2.95729 0.003104
## alpha2  0.000000    0.099769  0.00000 1.000000
## beta1   0.647418    0.127403  5.08163 0.000000
## gamma1 -0.068053    0.105348 -0.64599 0.518288
## gamma2  0.205439    0.112733  1.82235 0.068402
## skew    1.083861    0.043278 25.04423 0.000000
## shape   3.919209    0.502920  7.79291 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000319    0.000752 -0.42366 0.671813
## ar1     0.085640    0.028986  2.95449 0.003132
## ar2     0.015834    0.031844  0.49725 0.619014
## omega   0.000069    0.000064  1.07194 0.283746
## alpha1  0.226558    0.074642  3.03525 0.002403
## alpha2  0.000000    0.137634  0.00000 1.000000
## beta1   0.647418    0.228040  2.83905 0.004525
## gamma1 -0.068053    0.111460 -0.61056 0.541489
## gamma2  0.205439    0.129337  1.58840 0.112197
## skew    1.083861    0.046239 23.44065 0.000000
## shape   3.919209    0.576409  6.79936 0.000000
##
## LogLikelihood : 2831.254
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8541
## Bayes        -4.8063
## Shibata      -4.8543
## Hannan-Quinn -4.8361
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      2.224  0.1359
```

```
## Lag[2*(p+q)+(p+q)-1][5]     3.191  0.3574
## Lag[4*(p+q)+(p+q)-1][9]     5.095  0.4322
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                      0.3091  0.5782
## Lag[2*(p+q)+(p+q)-1][8]     4.6010  0.4100
## Lag[4*(p+q)+(p+q)-1][14]    6.5060  0.5708
## d.o.f=3
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[4]    0.7215 0.500 2.000  0.3956
## ARCH Lag[6]    2.1411 1.461 1.711  0.4605
## ARCH Lag[8]    3.2276 2.368 1.583  0.5018
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  4.1666
## Individual Statistics:
## mu     0.13749
## ar1    0.03597
## ar2    0.72448
## omega  0.81146
## alpha1 0.20720
## alpha2 0.78627
## beta1  0.73186
## gamma1 0.19703
## gamma2 0.30796
## skew   0.14248
## shape  0.32083
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.49 2.75 3.27
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value   prob sig
## Sign Bias           1.0696 0.2850
## Negative Sign Bias  0.2020 0.8400
## Positive Sign Bias  0.2002 0.8414
## Joint Effect        3.1034 0.3760
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     24.30      0.18491
## 2    30     47.60      0.01615
```

```
## 3    40     50.53      0.10218
## 4    50     53.06      0.32050
##
##
## Elapsed time : 3.465003
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(2,2)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(2,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000358    0.000657 -0.54516 0.585644
## ar1     0.089069    0.030548  2.91574 0.003548
## ar2     0.011747    0.029112  0.40349 0.686584
## omega   0.000082    0.000029  2.77055 0.005596
## alpha1  0.299045    0.087695  3.41005 0.000650
## alpha2  0.000000    0.072746  0.00000 1.000000
## beta1   0.218930    0.140166  1.56193 0.118304
## beta2   0.333435    0.105770  3.15244 0.001619
## gamma1 -0.145416    0.103893 -1.39968 0.161611
## gamma2  0.302461    0.103090  2.93395 0.003347
## skew    1.079636    0.043032 25.08907 0.000000
## shape   4.051720    0.504155  8.03665 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000358    0.000733 -0.48850 0.625197
## ar1     0.089069    0.028887  3.08339 0.002047
## ar2     0.011747    0.031325  0.37499 0.707665
## omega   0.000082    0.000037  2.19366 0.028260
## alpha1  0.299045    0.087010  3.43691 0.000588
## alpha2  0.000000    0.065492  0.00000 1.000000
## beta1   0.218930    0.094160  2.32509 0.020067
## beta2   0.333435    0.075564  4.41262 0.000010
## gamma1 -0.145416    0.107893 -1.34778 0.177729
## gamma2  0.302461    0.099939  3.02647 0.002474
## skew    1.079636    0.044948 24.01977 0.000000
## shape   4.051720    0.515547  7.85907 0.000000
##
## LogLikelihood : 2834.941
##
```

```
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8588
## Bayes        -4.8065
## Shibata      -4.8590
## Hannan-Quinn -4.8391
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.976  0.1598
## Lag[2*(p+q)+(p+q)-1][5]     2.985  0.4814
## Lag[4*(p+q)+(p+q)-1][9]     5.007  0.4521
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                     0.08917  0.7652
## Lag[2*(p+q)+(p+q)-1][11]   4.52055  0.6539
## Lag[4*(p+q)+(p+q)-1][19]   7.94778  0.6816
## d.o.f=4
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[5]    0.9817 0.500 2.000  0.3218
## ARCH Lag[7]    2.6679 1.473 1.746  0.3738
## ARCH Lag[9]    2.8685 2.402 1.619  0.5899
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  3.0483
## Individual Statistics:
## mu     0.12801
## ar1    0.03458
## ar2    0.81378
## omega  0.76069
## alpha1 0.21835
## alpha2 0.43747
## beta1  0.71373
## beta2  0.73632
## gamma1 0.20910
## gamma2 0.27857
## skew   0.15969
## shape  0.30839
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.69 2.96 3.51
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
```

```
## ------------------------------------
##                    t-value   prob sig
## Sign Bias           0.9986 0.3182
## Negative Sign Bias  0.1498 0.8810
## Positive Sign Bias  0.2625 0.7930
## Joint Effect        1.7703 0.6214
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     21.44       0.3129
## 2    30     38.41       0.1134
## 3    40     44.20       0.2615
## 4    50     68.21       0.0361
##
##
## Elapsed time : 4.079001
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(1,3)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## ------------------------------------
## GARCH Model  : gjrGARCH(1,3)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000486    0.000696 -0.698428 0.484910
## ar1     0.082802    0.039133  2.115923 0.034351
## ar2     0.024299    0.059913  0.405578 0.685053
## omega   0.000057    0.000095  0.598743 0.549345
## alpha1  0.234695    0.349387  0.671734 0.501753
## beta1   0.443513    0.359968  1.232092 0.217915
## beta2   0.000001    4.685584  0.000000 1.000000
## beta3   0.217538    3.749200  0.058023 0.953731
## gamma1  0.110960    0.422218  0.262802 0.792703
## skew    1.076032    0.069369 15.511698 0.000000
## shape   4.016451    0.729225  5.507837 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000486    0.005308 -0.091611  0.92701
## ar1     0.082802    0.613026  0.135071  0.89256
## ar2     0.024299    1.400716  0.017348  0.98616
```

```
## omega   0.000057    0.002490  0.022866  0.98176
## alpha1  0.234695    9.142727  0.025670  0.97952
## beta1   0.443513    8.852442  0.050101  0.96004
## beta2   0.000001  125.106461  0.000000  1.00000
## beta3   0.217538  100.111689  0.002173  0.99827
## gamma1  0.110960   11.085305  0.010010  0.99201
## skew    1.076032    1.445331  0.744488  0.45658
## shape   4.016451   14.608890  0.274932  0.78337
##
## LogLikelihood : 2830.38
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8526
## Bayes        -4.8048
## Shibata      -4.8528
## Hannan-Quinn -4.8346
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      2.214  0.1368
## Lag[2*(p+q)+(p+q)-1][5]     3.334  0.2812
## Lag[4*(p+q)+(p+q)-1][9]     5.429  0.3613
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                     0.05237  0.8190
## Lag[2*(p+q)+(p+q)-1][11]   2.52902  0.9188
## Lag[4*(p+q)+(p+q)-1][19]   5.05884  0.9364
## d.o.f=4
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[5]    0.7606 0.500 2.000  0.3831
## ARCH Lag[7]    2.5712 1.473 1.746  0.3907
## ARCH Lag[9]    2.6962 2.402 1.619  0.6227
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  3.0109
## Individual Statistics:
## mu     0.11499
## ar1    0.02066
## ar2    0.76849
## omega  0.58608
## alpha1 0.28336
## beta1  0.65297
## beta2  0.70146
```

```
## beta3  0.66190
## gamma1 0.37233
## skew   0.15701
## shape  0.31134
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.49 2.75 3.27
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## -----------------------------------
##                    t-value    prob sig
## Sign Bias           1.3156 0.18858
## Negative Sign Bias  0.7779 0.43679
## Positive Sign Bias  0.1249 0.90065
## Joint Effect        6.4305 0.09244   *
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     18.03       0.5201
## 2    30     33.46       0.2597
## 3    40     36.90       0.5661
## 4    50     35.85       0.9194
##
##
## Elapsed time : 2.357999
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(3,1)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(3,1)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000374    0.000660 -0.567051 0.570680
## ar1     0.082594    0.030169  2.737659 0.006188
## ar2     0.010070    0.030410  0.331152 0.740529
## omega   0.000051    0.000031  1.633180 0.102431
## alpha1  0.184054    0.064763  2.841941 0.004484
## alpha2  0.000000    0.112539  0.000000 1.000000
## alpha3  0.000000    0.084763  0.000001 0.999999
```

```
## beta1   0.722467    0.124948  5.782154 0.000000
## gamma1 -0.027809    0.094955 -0.292868 0.769623
## gamma2  0.310559    0.152147  2.041179 0.041233
## gamma3 -0.183860    0.114471 -1.606174 0.108236
## skew    1.080418    0.042988 25.133113 0.000000
## shape   4.012332    0.553024  7.255260 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000374    0.000754 -0.496466 0.619566
## ar1     0.082594    0.029331  2.815922 0.004864
## ar2     0.010070    0.031803  0.316649 0.751510
## omega   0.000051    0.000052  0.978651 0.327752
## alpha1  0.184054    0.063897  2.880472 0.003971
## alpha2  0.000000    0.142671  0.000000 1.000000
## alpha3  0.000000    0.086931  0.000001 0.999999
## beta1   0.722467    0.209154  3.454238 0.000552
## gamma1 -0.027809    0.099137 -0.280514 0.779083
## gamma2  0.310559    0.140761  2.206289 0.027364
## gamma3 -0.183860    0.104243 -1.763772 0.077770
## skew    1.080418    0.045461 23.765657 0.000000
## shape   4.012332    0.697070  5.755998 0.000000
##
## LogLikelihood : 2832.393
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8527
## Bayes        -4.7961
## Shibata      -4.8529
## Hannan-Quinn -4.8313
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      2.403  0.1211
## Lag[2*(p+q)+(p+q)-1][5]     3.524  0.1966
## Lag[4*(p+q)+(p+q)-1][9]     5.556  0.3361
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                       0.966  0.3257
## Lag[2*(p+q)+(p+q)-1][11]     6.159  0.4146
## Lag[4*(p+q)+(p+q)-1][19]     9.345  0.5226
## d.o.f=4
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[5]    0.8804 0.500 2.000  0.3481
```

```
## ARCH Lag[7]    2.5636 1.473 1.746  0.3920
## ARCH Lag[9]    2.7179 2.402 1.619  0.6185
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  5.5862
## Individual Statistics:
## mu     0.13668
## ar1    0.02852
## ar2    0.80677
## omega  0.70298
## alpha1 0.24794
## alpha2 0.86774
## alpha3 0.53427
## beta1  0.69207
## gamma1 0.25998
## gamma2 0.34963
## gamma3 0.31898
## skew   0.14403
## shape  0.33767
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.89 3.15 3.69
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value   prob sig
## Sign Bias          0.95110 0.3418
## Negative Sign Bias 0.08049 0.9359
## Positive Sign Bias 0.62643 0.5312
## Joint Effect       3.55584 0.3136
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     22.30       0.2694
## 2    30     38.62       0.1092
## 3    40     45.64       0.2154
## 4    50     54.44       0.2753
##
##
## Elapsed time : 4.796999
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(2,3)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
```

```
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(2,3)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000428    0.000658 -0.65135 0.514818
## ar1     0.091401    0.030912  2.95682 0.003108
## ar2     0.014075    0.027968  0.50326 0.614782
## omega   0.000082    0.000026  3.16040 0.001576
## alpha1  0.319412    0.087580  3.64708 0.000265
## alpha2  0.000000    0.064470  0.00000 1.000000
## beta1   0.220082    0.060619  3.63056 0.000283
## beta2   0.000000    0.216804  0.00000 1.000000
## beta3   0.297809    0.115010  2.58941 0.009614
## gamma1 -0.124749    0.099060 -1.25933 0.207911
## gamma2  0.319978    0.095524  3.34973 0.000809
## skew    1.076818    0.043065 25.00439 0.000000
## shape   4.115613    0.508936  8.08671 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000428    0.000736 -0.58229 0.560369
## ar1     0.091401    0.029670  3.08055 0.002066
## ar2     0.014075    0.032608  0.43165 0.665998
## omega   0.000082    0.000041  2.00078 0.045416
## alpha1  0.319412    0.094405  3.38342 0.000716
## alpha2  0.000000    0.068217  0.00000 1.000000
## beta1   0.220082    0.299993  0.73362 0.463179
## beta2   0.000000    0.460781  0.00000 1.000000
## beta3   0.297809    0.279205  1.06663 0.286139
## gamma1 -0.124749    0.130804 -0.95371 0.340232
## gamma2  0.319978    0.140163  2.28290 0.022436
## skew    1.076818    0.044796 24.03828 0.000000
## shape   4.115613    0.523478  7.86205 0.000000
##
## LogLikelihood : 2836.943
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8605
## Bayes        -4.8039
## Shibata      -4.8607
## Hannan-Quinn -4.8391
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.828  0.1763
## Lag[2*(p+q)+(p+q)-1][5]     2.859  0.5617
```

```
## Lag[4*(p+q)+(p+q)-1][9]     4.938  0.4677
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                    0.003728  0.9513
## Lag[2*(p+q)+(p+q)-1][14]  4.067972  0.8737
## Lag[4*(p+q)+(p+q)-1][24]  8.634465  0.8271
## d.o.f=5
##
## Weighted ARCH LM Tests
## ------------------------------------
##              Statistic Shape Scale P-Value
## ARCH Lag[6]     0.2676 0.500 2.000  0.6050
## ARCH Lag[8]     1.7837 1.480 1.774  0.5625
## ARCH Lag[10]    2.1346 2.424 1.650  0.7455
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  3.4175
## Individual Statistics:
## mu     0.15232
## ar1    0.01708
## ar2    0.89443
## omega  0.61080
## alpha1 0.14876
## alpha2 0.45157
## beta1  0.62158
## beta2  0.56192
## beta3  0.72867
## gamma1 0.15584
## gamma2 0.46235
## skew   0.16789
## shape  0.29833
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.89 3.15 3.69
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value   prob sig
## Sign Bias           1.0899 0.2760
## Negative Sign Bias  0.2953 0.7678
## Positive Sign Bias  0.4390 0.6607
## Joint Effect        2.2305 0.5260
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     25.40       0.1478
```

```
## 2    30     34.33       0.2272
## 3    40     41.86       0.3479
## 4    50     57.62       0.1865
##
##
## Elapsed time : 3.972005
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(3,2)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(3,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000382    0.000658 -0.58072 0.561426
## ar1     0.085998    0.030749  2.79680 0.005161
## ar2     0.009416    0.029711  0.31691 0.751315
## omega   0.000069    0.000038  1.78576 0.074138
## alpha1  0.257592    0.084267  3.05687 0.002237
## alpha2  0.000000    0.102390  0.00000 1.000000
## alpha3  0.000000    0.083243  0.00000 1.000000
## beta1   0.311065    0.240487  1.29348 0.195845
## beta2   0.302271    0.139531  2.16634 0.030285
## gamma1 -0.077355    0.110445 -0.70039 0.483681
## gamma2  0.338017    0.142433  2.37317 0.017636
## gamma3 -0.124443    0.162871 -0.76406 0.444833
## skew    1.080208    0.043035 25.10048 0.000000
## shape   4.109539    0.552985  7.43156 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.000382    0.000755 -0.50582 0.612985
## ar1     0.085998    0.029329  2.93216 0.003366
## ar2     0.009416    0.031667  0.29734 0.766210
## omega   0.000069    0.000058  1.18751 0.235028
## alpha1  0.257592    0.086296  2.98498 0.002836
## alpha2  0.000000    0.130520  0.00000 1.000000
## alpha3  0.000000    0.089354  0.00000 1.000000
## beta1   0.311065    0.287091  1.08351 0.278584
## beta2   0.302271    0.111682  2.70654 0.006799
## gamma1 -0.077355    0.124642 -0.62062 0.534852
## gamma2  0.338017    0.146372  2.30930 0.020927
## gamma3 -0.124443    0.193444 -0.64330 0.520027
```

```
## skew    1.080208    0.045009 23.99994 0.000000
## shape   4.109539    0.642570  6.39547 0.000000
##
## LogLikelihood : 2835.124
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8556
## Bayes        -4.7947
## Shibata      -4.8559
## Hannan-Quinn -4.8326
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      2.137  0.1438
## Lag[2*(p+q)+(p+q)-1][5]     3.231  0.3352
## Lag[4*(p+q)+(p+q)-1][9]     5.291  0.3899
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                      0.2431  0.6220
## Lag[2*(p+q)+(p+q)-1][14]    5.3885  0.7201
## Lag[4*(p+q)+(p+q)-1][24]    9.6904  0.7349
## d.o.f=5
##
## Weighted ARCH LM Tests
## ------------------------------------
##              Statistic Shape Scale P-Value
## ARCH Lag[6]      0.568 0.500 2.000  0.4510
## ARCH Lag[8]      1.921 1.480 1.774  0.5311
## ARCH Lag[10]     2.194 2.424 1.650  0.7342
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  4.3131
## Individual Statistics:
## mu     0.13029
## ar1    0.02691
## ar2    0.83795
## omega  0.72574
## alpha1 0.25585
## alpha2 0.75685
## alpha3 0.71712
## beta1  0.75430
## beta2  0.73310
## gamma1 0.26669
## gamma2 0.37198
## gamma3 0.40333
## skew   0.15211
```

```
## shape  0.32163
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          3.08 3.34 3.9
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## -----------------------------------
##                    t-value   prob sig
## Sign Bias          0.99470 0.3201
## Negative Sign Bias 0.17435 0.8616
## Positive Sign Bias 0.00857 0.9932
## Joint Effect       2.24759 0.5226
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## -----------------------------------
##   group statistic p-value(g-1)
## 1    20     20.27       0.3784
## 2    30     38.52       0.1113
## 3    40     37.52       0.5375
## 4    50     45.40       0.6198
##
##
## Elapsed time : 5.850994
```

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(3,3)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(3,3)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## -----------------------------------
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000397    0.000655  -0.60591 0.544578
## ar1     0.090841    0.030094   3.01855 0.002540
## ar2     0.005718    0.028674   0.19942 0.841931
## omega   0.000083    0.000023   3.60329 0.000314
## alpha1  0.295849    0.059394   4.98116 0.000001
## alpha2  0.000000    0.040579   0.00000 1.000000
## alpha3  0.000000    0.021625   0.00000 1.000000
## beta1   0.166285    0.023095   7.19997 0.000000
## beta2   0.166221    0.095352   1.74324 0.081292
## beta3   0.213916    0.061941   3.45354 0.000553
```

```
## gamma1 -0.086331    0.064048  -1.34792 0.177684
## gamma2  0.383233    0.051707   7.41157 0.000000
## gamma3 -0.142634    0.003665 -38.92032 0.000000
## skew    1.080378    0.042899  25.18395 0.000000
## shape   4.238235    0.513477   8.25399 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000397    0.000732  -0.54248 0.587489
## ar1     0.090841    0.028445   3.19360 0.001405
## ar2     0.005718    0.030632   0.18668 0.851914
## omega   0.000083    0.000030   2.77635 0.005497
## alpha1  0.295849    0.063726   4.64253 0.000003
## alpha2  0.000000    0.036492   0.00000 1.000000
## alpha3  0.000000    0.023318   0.00000 1.000000
## beta1   0.166285    0.019592   8.48747 0.000000
## beta2   0.166221    0.089237   1.86269 0.062506
## beta3   0.213916    0.050597   4.22787 0.000024
## gamma1 -0.086331    0.068860  -1.25372 0.209944
## gamma2  0.383233    0.064487   5.94281 0.000000
## gamma3 -0.142634    0.002669 -53.44291 0.000000
## skew    1.080378    0.042897  25.18532 0.000000
## shape   4.238235    0.531733   7.97060 0.000000
##
## LogLikelihood : 2836.746
##
## Information Criteria
## ------------------------------------
##
## Akaike       -4.8567
## Bayes        -4.7914
## Shibata      -4.8570
## Hannan-Quinn -4.8321
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.669  0.1964
## Lag[2*(p+q)+(p+q)-1][5]     2.932  0.5154
## Lag[4*(p+q)+(p+q)-1][9]     5.096  0.4322
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                           statistic p-value
## Lag[1]                      0.02202  0.8820
## Lag[2*(p+q)+(p+q)-1][17]    5.14089  0.8802
## Lag[4*(p+q)+(p+q)-1][29]    9.89969  0.8828
## d.o.f=6
##
## Weighted ARCH LM Tests
## ------------------------------------
##              Statistic Shape Scale P-Value
```

```
## ARCH Lag[7]      1.850 0.500 2.000  0.1737
## ARCH Lag[9]      1.886 1.485 1.796  0.5462
## ARCH Lag[11]     2.424 2.440 1.677  0.7016
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  4.5196
## Individual Statistics:
## mu     0.14082
## ar1    0.02223
## ar2    0.99442
## omega  0.67426
## alpha1 0.16137
## alpha2 0.47710
## alpha3 0.18211
## beta1  0.47508
## beta2  0.55237
## beta3  0.80376
## gamma1 0.11599
## gamma2 0.27895
## gamma3 0.05595
## skew   0.13779
## shape  0.34178
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          3.26 3.54 4.07
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value   prob sig
## Sign Bias          1.18627 0.2358
## Negative Sign Bias 0.09613 0.9234
## Positive Sign Bias 0.33534 0.7374
## Joint Effect       2.27854 0.5166
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     20.00       0.3948
## 2    30     30.72       0.3788
## 3    40     28.71       0.8869
## 4    50     48.84       0.4794
##
##
## Elapsed time : 7.116999
```

going further is not leading any good results

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(1,2)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc,out.sample = 500)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(1,2)
## Mean Model   : ARFIMA(2,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.001042    0.000830 -1.25626 0.209022
## ar1     0.092618    0.042845  2.16171 0.030640
## ar2     0.079095    0.041371  1.91185 0.055895
## omega   0.000058    0.000021  2.73963 0.006151
## alpha1  0.281191    0.102029  2.75598 0.005852
## beta1   0.595880    0.260732  2.28542 0.022288
## beta2   0.000000    0.197145  0.00000 1.000000
## gamma1  0.086064    0.117546  0.73218 0.464061
## skew    1.093587    0.059868 18.26655 0.000000
## shape   4.350751    0.743212  5.85399 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error  t value Pr(>|t|)
## mu     -0.001042    0.000938 -1.11049 0.266788
## ar1     0.092618    0.041615  2.22559 0.026042
## ar2     0.079095    0.047253  1.67387 0.094157
## omega   0.000058    0.000027  2.14364 0.032062
## alpha1  0.281191    0.107093  2.62567 0.008648
## beta1   0.595880    0.250408  2.37964 0.017330
## beta2   0.000000    0.192231  0.00000 1.000000
## gamma1  0.086064    0.126316  0.68134 0.495657
## skew    1.093587    0.060362 18.11718 0.000000
## shape   4.350751    0.740936  5.87196 0.000000
##
## LogLikelihood : 1713.02
##
## Information Criteria
## ------------------------------------
##
## Akaike       -5.1451
## Bayes        -5.0772
## Shibata      -5.1455
## Hannan-Quinn -5.1188
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      2.031  0.1542
## Lag[2*(p+q)+(p+q)-1][5]     3.385  0.2565
## Lag[4*(p+q)+(p+q)-1][9]     4.509  0.5691
```

```
## d.o.f=2
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                     0.5477  0.4593
## Lag[2*(p+q)+(p+q)-1][8]    2.1375  0.8372
## Lag[4*(p+q)+(p+q)-1][14]   3.7567  0.9023
## d.o.f=3
##
## Weighted ARCH LM Tests
## ------------------------------------
##             Statistic Shape Scale P-Value
## ARCH Lag[4] 0.0000924 0.500 2.000  0.9923
## ARCH Lag[6] 0.3939753 1.461 1.711  0.9210
## ARCH Lag[8] 1.4248295 2.368 1.583  0.8536
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.6092
## Individual Statistics:
## mu     0.31399
## ar1    0.06015
## ar2    0.53480
## omega  0.17767
## alpha1 0.40277
## beta1  0.51991
## beta2  0.55646
## gamma1 0.53269
## skew   0.15370
## shape  0.71955
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.29 2.54 3.05
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
## ------------------------------------
##                    t-value   prob sig
## Sign Bias           0.8371 0.4028
## Negative Sign Bias  0.5776 0.5638
## Positive Sign Bias  0.2394 0.8109
## Joint Effect        3.5586 0.3132
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## ------------------------------------
##   group statistic p-value(g-1)
## 1    20     22.89       0.2420
## 2    30     32.08       0.3164
## 3    40     41.08       0.3795
## 4    50     47.97       0.5149
##
```

```
##
## Elapsed time : 1.823005
```

ARIMA(2,0,0)<- (1,0,0)<-(0,0,1)<-c(0,0,2)

```
spec_of_garch_idfc<-ugarchspec(variance.model =list(model="gjrGARCH",garchOrder=c(2,3)),mean.model = lis
my_model_idfc<-ugarchfit(spec=spec_of_garch_idfc,data=ret_idfc,out.sample = 500)
my_model_idfc
```

```
##
## *---------------------------------*
## *          GARCH Model Fit        *
## *---------------------------------*
##
## Conditional Variance Dynamics
## -----------------------------------
## GARCH Model  : gjrGARCH(2,3)
## Mean Model   : ARFIMA(1,0,0)
## Distribution : sstd
##
## Optimal Parameters
## ------------------------------------
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000992    0.000779 -1.273670 0.202780
## ar1     0.111156    0.042987  2.585798 0.009715
## omega   0.000092    0.000041  2.258492 0.023915
## alpha1  0.413918    0.132658  3.120199 0.001807
## alpha2  0.071966    0.134004  0.537042 0.591239
## beta1   0.000000    0.293662  0.000001 0.999999
## beta2   0.208915    0.130879  1.596249 0.110433
## beta3   0.108688    0.108653  1.000318 0.317157
## gamma1 -0.223305    0.163848 -1.362876 0.172921
## gamma2  0.347912    0.145134  2.397181 0.016522
## skew    1.093518    0.059734 18.306382 0.000000
## shape   4.815993    0.905881  5.316364 0.000000
##
## Robust Standard Errors:
##         Estimate  Std. Error   t value Pr(>|t|)
## mu     -0.000992    0.000918 -1.080817 0.279779
## ar1     0.111156    0.042993  2.585448 0.009725
## omega   0.000092    0.000060  1.528489 0.126391
## alpha1  0.413918    0.144395  2.866574 0.004149
## alpha2  0.071966    0.173660  0.414407 0.678576
## beta1   0.000000    0.401626  0.000001 1.000000
## beta2   0.208915    0.134772  1.550140 0.121108
## beta3   0.108688    0.114717  0.947441 0.343414
## gamma1 -0.223305    0.203219 -1.098838 0.271839
## gamma2  0.347912    0.147264  2.362516 0.018151
## skew    1.093518    0.057200 19.117468 0.000000
## shape   4.815993    0.937427  5.137459 0.000000
##
## LogLikelihood : 1715.913
##
```

```
## Information Criteria
## ------------------------------------
##
## Akaike       -5.1478
## Bayes        -5.0663
## Shibata      -5.1484
## Hannan-Quinn -5.1162
##
## Weighted Ljung-Box Test on Standardized Residuals
## ------------------------------------
##                         statistic p-value
## Lag[1]                      1.185 0.27637
## Lag[2*(p+q)+(p+q)-1][2]     2.284 0.13329
## Lag[4*(p+q)+(p+q)-1][5]     5.140 0.09505
## d.o.f=1
## H0 : No serial correlation
##
## Weighted Ljung-Box Test on Standardized Squared Residuals
## ------------------------------------
##                          statistic p-value
## Lag[1]                      0.3639  0.5464
## Lag[2*(p+q)+(p+q)-1][14]    3.1050  0.9496
## Lag[4*(p+q)+(p+q)-1][24]    6.7654  0.9421
## d.o.f=5
##
## Weighted ARCH LM Tests
## ------------------------------------
##              Statistic Shape Scale P-Value
## ARCH Lag[6]   0.006627 0.500 2.000  0.9351
## ARCH Lag[8]   1.650796 1.480 1.774  0.5941
## ARCH Lag[10]  2.484617 2.424 1.650  0.6787
##
## Nyblom stability test
## ------------------------------------
## Joint Statistic:  2.5295
## Individual Statistics:
## mu     0.43080
## ar1    0.05904
## omega  0.19566
## alpha1 0.30268
## alpha2 0.42289
## beta1  0.39602
## beta2  0.50488
## beta3  0.46642
## gamma1 0.34854
## gamma2 0.41366
## skew   0.12312
## shape  0.85731
##
## Asymptotic Critical Values (10% 5% 1%)
## Joint Statistic:          2.69 2.96 3.51
## Individual Statistic:     0.35 0.47 0.75
##
## Sign Bias Test
```

```
## -------------------------------------
##                     t-value   prob sig
## Sign Bias           0.41670 0.6770
## Negative Sign Bias 0.13875 0.8897
## Positive Sign Bias 0.07094 0.9435
## Joint Effect       0.45761 0.9281
##
##
## Adjusted Pearson Goodness-of-Fit Test:
## -------------------------------------
##   group statistic p-value(g-1)
## 1    20     18.24       0.5064
## 2    30     22.83       0.7841
## 3    40     36.97       0.5627
## 4    50     47.67       0.5272
##
##
## Elapsed time : 3.315998
```

```
back_testing<-ugarchroll(spec_of_garch_idfc,ret_idfc,n.ahead=1,n.start = 1000,refit.every =30,refit.wi
```

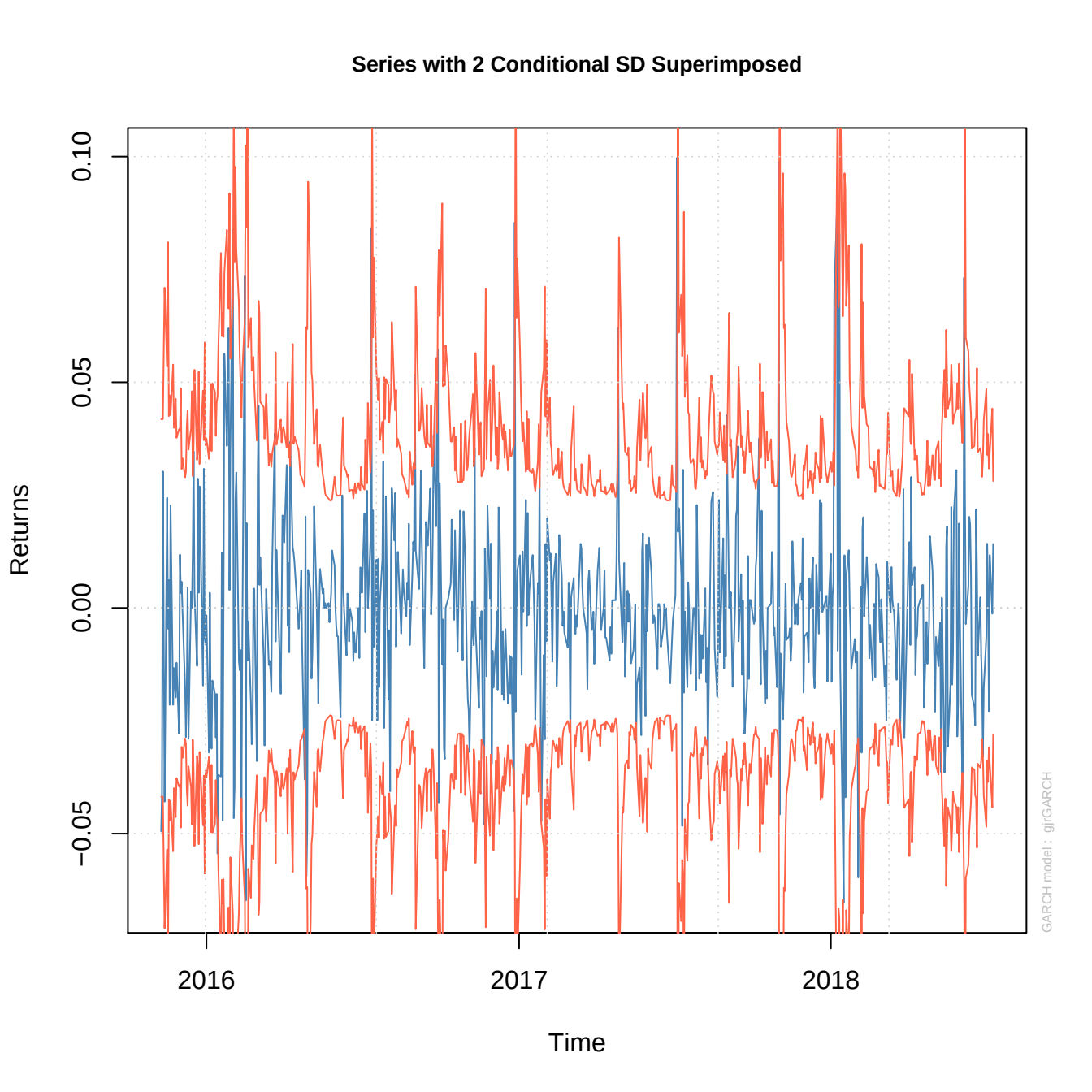
```
##
## Iter: 1 fn: -2513.7073    Pars:  -0.00052565921  0.10521341862  0.00013307048  0.40579174436  0.0416
## Iter: 2 fn: -2513.7073    Pars:  -0.00052564092  0.10521287697  0.00013306970  0.40579373497  0.0416
## solnp--> Completed in 2 iterations
##
## Iter: 1 fn: -2517.4930    Pars:  -0.00022872945  0.10643067221  0.00012540150  0.39961853408  0.0135
## Iter: 2 fn: -2517.4930    Pars:  -0.0002287396950  0.1064296257263  0.0001254064625  0.3996125168690
## Iter: 3 fn: -2517.4930    Pars:  -0.0002287396950  0.1064296257263  0.0001254064625  0.3996125168690
## solnp--> Completed in 3 iterations
##
## Iter: 1 fn: -2534.1943    Pars:  -0.0002397170563  0.0986840969094  0.0001678239183  0.3745696096846
## Iter: 2 fn: -2534.1943    Pars:  -0.0002397235256  0.0986823774262  0.0001678257482  0.3745656202735
## Iter: 3 fn: -2534.1943    Pars:  -0.0002397235256  0.0986823774262  0.0001678257482  0.3745656202735
## solnp--> Completed in 3 iterations
##
## Iter: 1 fn: -2510.2630    Pars:  -0.00045358701  0.08817633430  0.00015541447  0.36360392183  0.0572
## Iter: 2 fn: -2510.2630    Pars:  -0.00045358507  0.08817723821  0.00015541296  0.36360132015  0.0572
## Iter: 3 fn: -2510.2630    Pars:  -0.00045358186  0.08817736784  0.00015541264  0.36359960203  0.0572
## solnp--> Completed in 3 iterations
##
## Iter: 1 fn: -2491.2381    Pars:  -0.00048540851  0.08139001638  0.00011603587  0.36915127357  0.0494
## Iter: 2 fn: -2491.2381    Pars:  -0.00048540801  0.08139001965  0.00011603567  0.36915070806  0.0494
## solnp--> Completed in 2 iterations
##
## Iter: 1 fn: -2448.5377    Pars:  -0.00014359051  0.08215203058  0.00010539953  0.33503868625  0.0016
## Iter: 2 fn: -2448.5377    Pars:  -0.000143556777  0.082149415215  0.000105405190  0.335030002219  0.0
## Iter: 3 fn: -2448.5377    Pars:  -0.000143556777  0.082149415215  0.000105405190  0.335030002219  0.0
## solnp--> Completed in 3 iterations
```

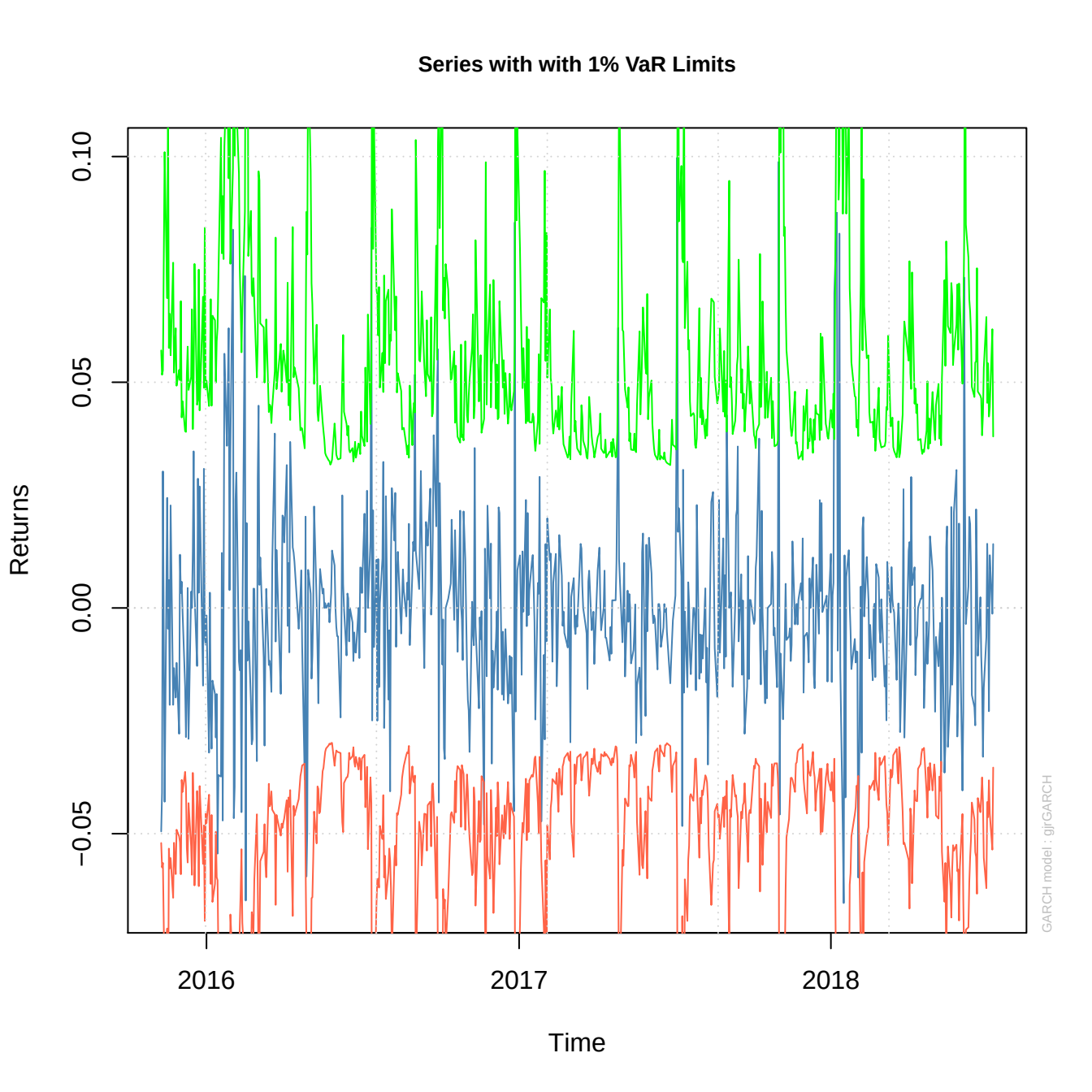
```
report(back_testing)
```

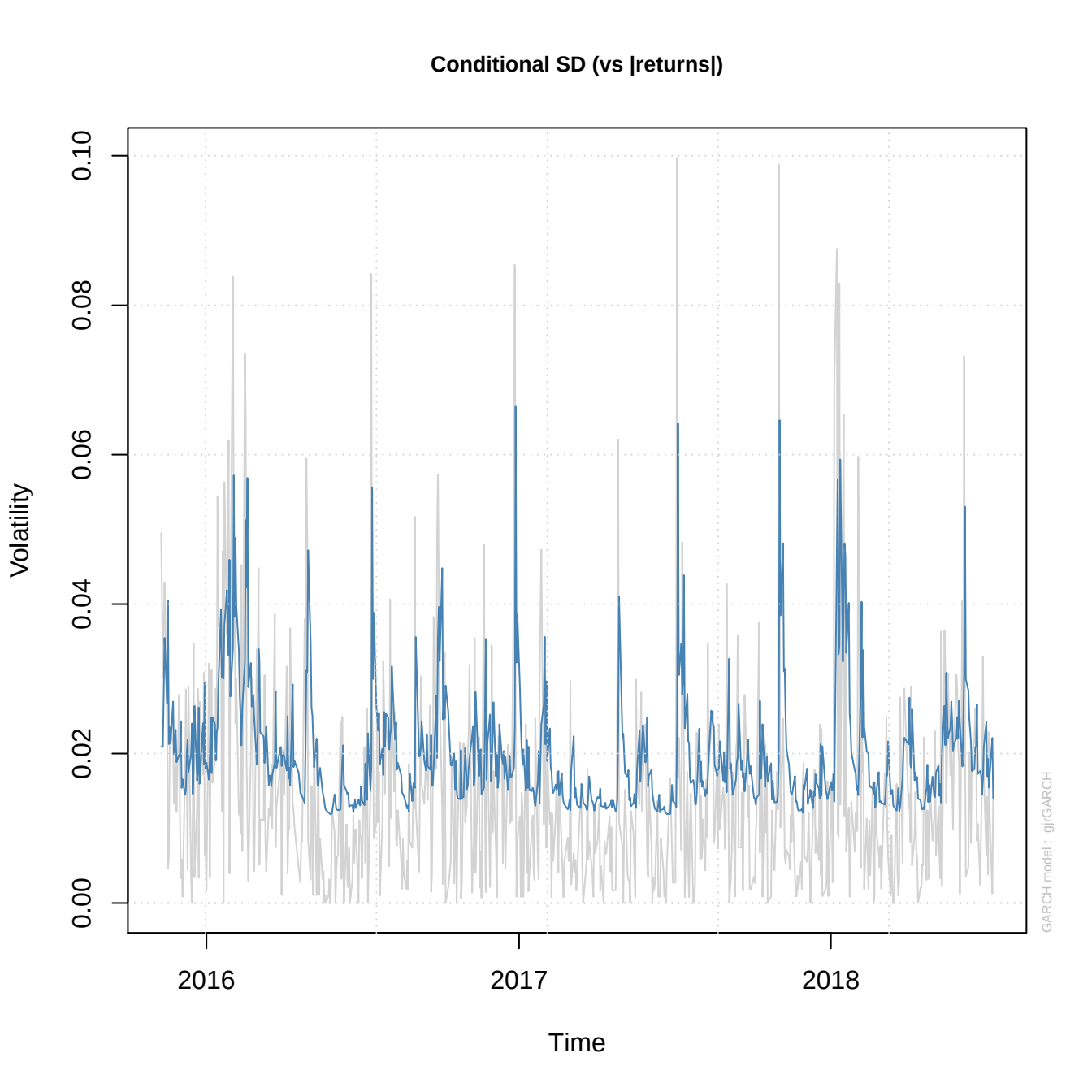
```
## VaR Backtest Report
```

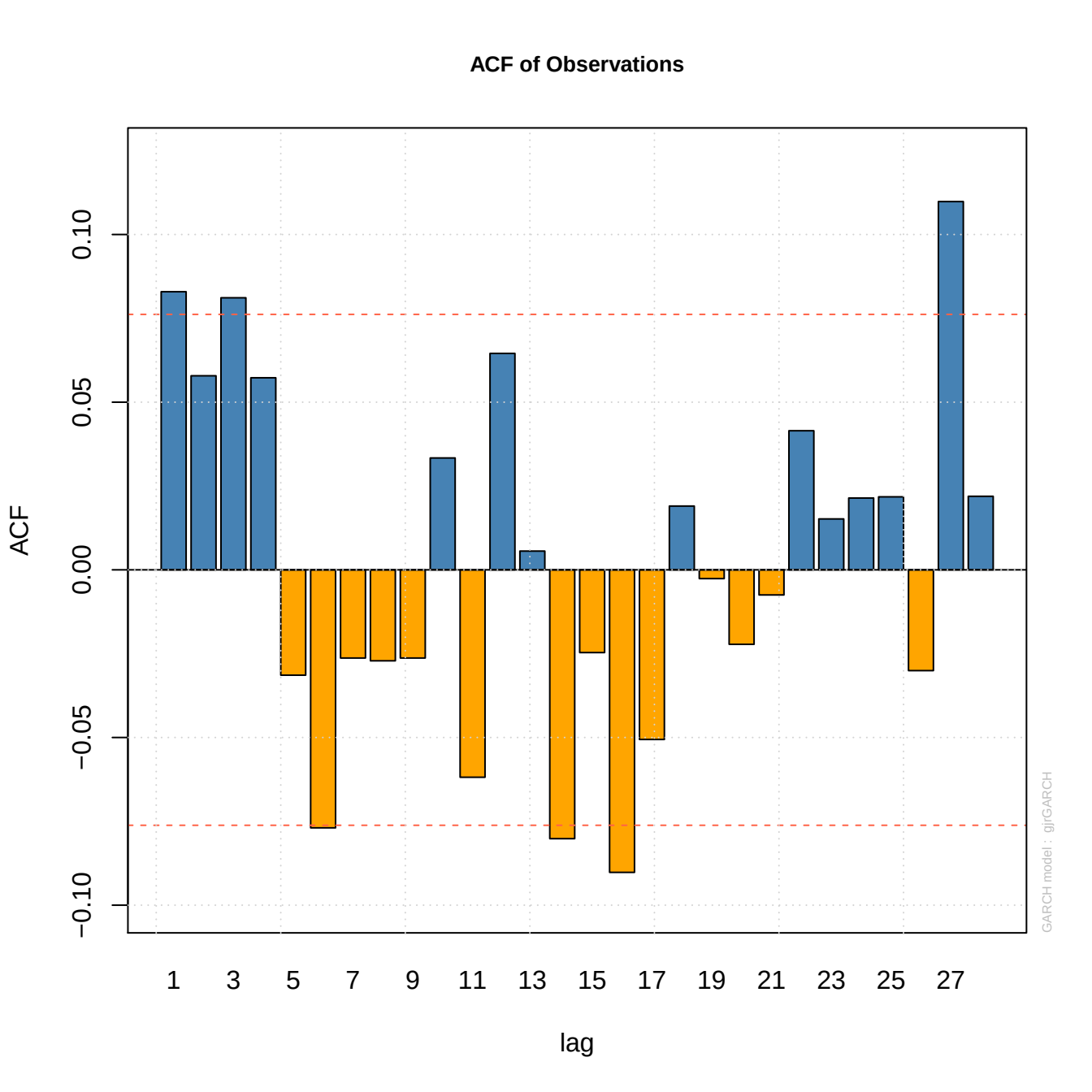
```
## ========================================
## Model:               gjrGARCH-sstd
## Backtest Length: 162
## Data:
##
## ========================================
## alpha:               1%
## Expected Exceed: 1.6
## Actual VaR Exceed:   3
## Actual %:            1.9%
##
## Unconditional Coverage (Kupiec)
## Null-Hypothesis: Correct Exceedances
## LR.uc Statistic: 0.949
## LR.uc Critical:      3.841
## LR.uc p-value:       0.33
## Reject Null:     NO
##
## Conditional Coverage (Christoffersen)
## Null-Hypothesis: Correct Exceedances and
##                  Independence of Failures
## LR.cc Statistic: 1.063
## LR.cc Critical:      5.991
## LR.cc p-value:       0.588
## Reject Null:     NO
```

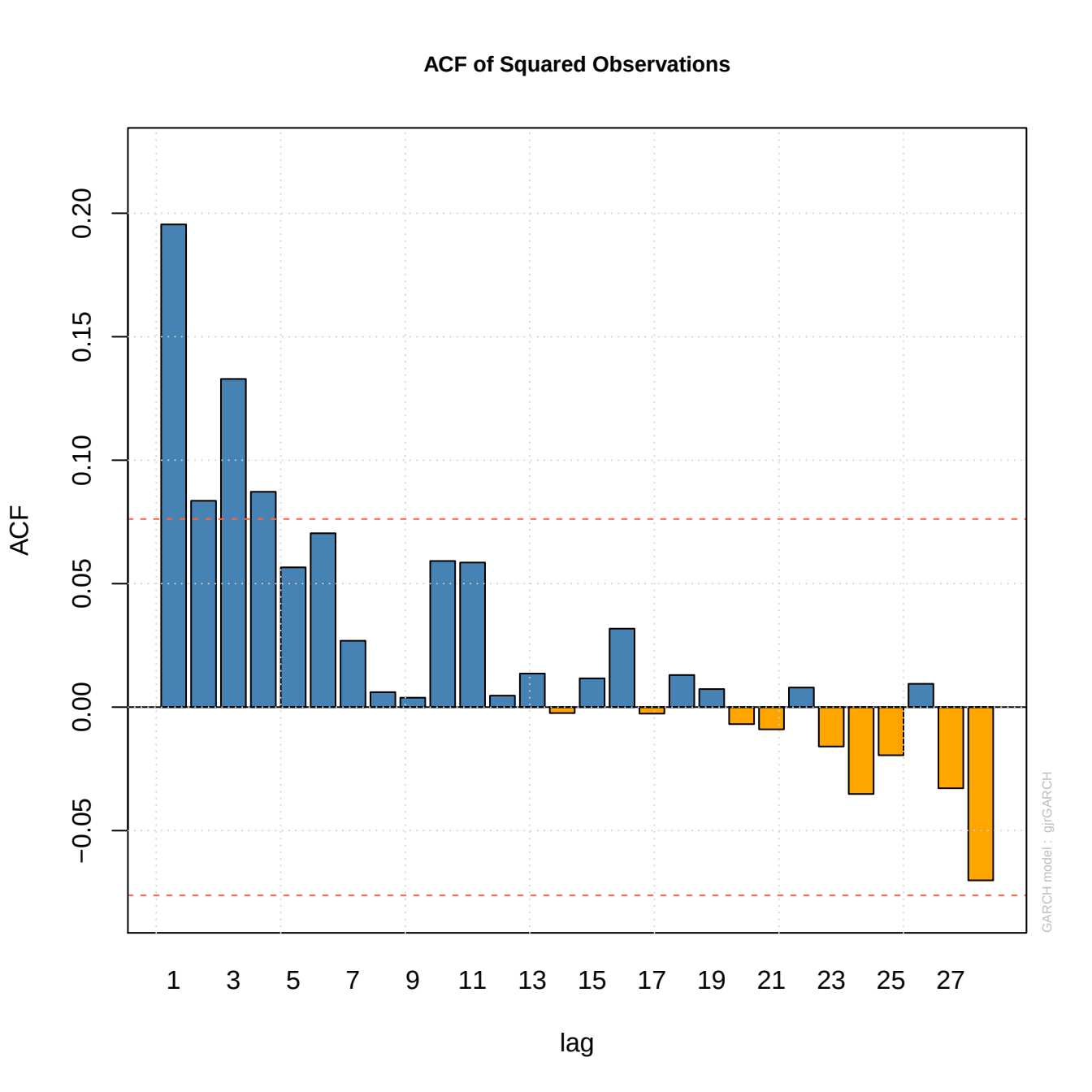
```
forecast<- ugarchforecast(my_model_idfc,data=ret_idfc,n.ahead =100,n.roll = 100)
```

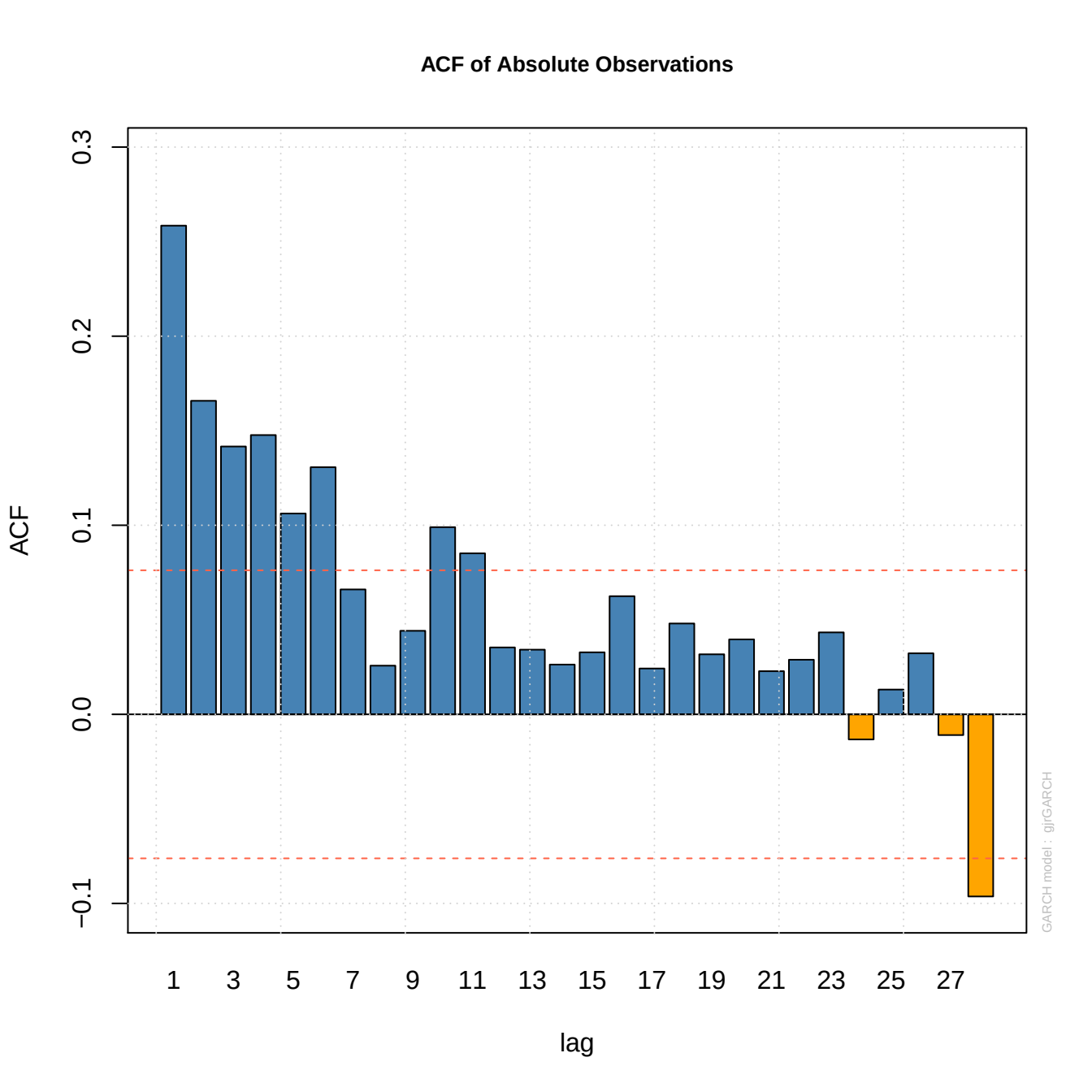

Series with 2 Conditional SD Superimposed
Returns
0.10
0.05
0.00
−0.05
2016
2017
2018
Time
GARCH model : gjrGARCH

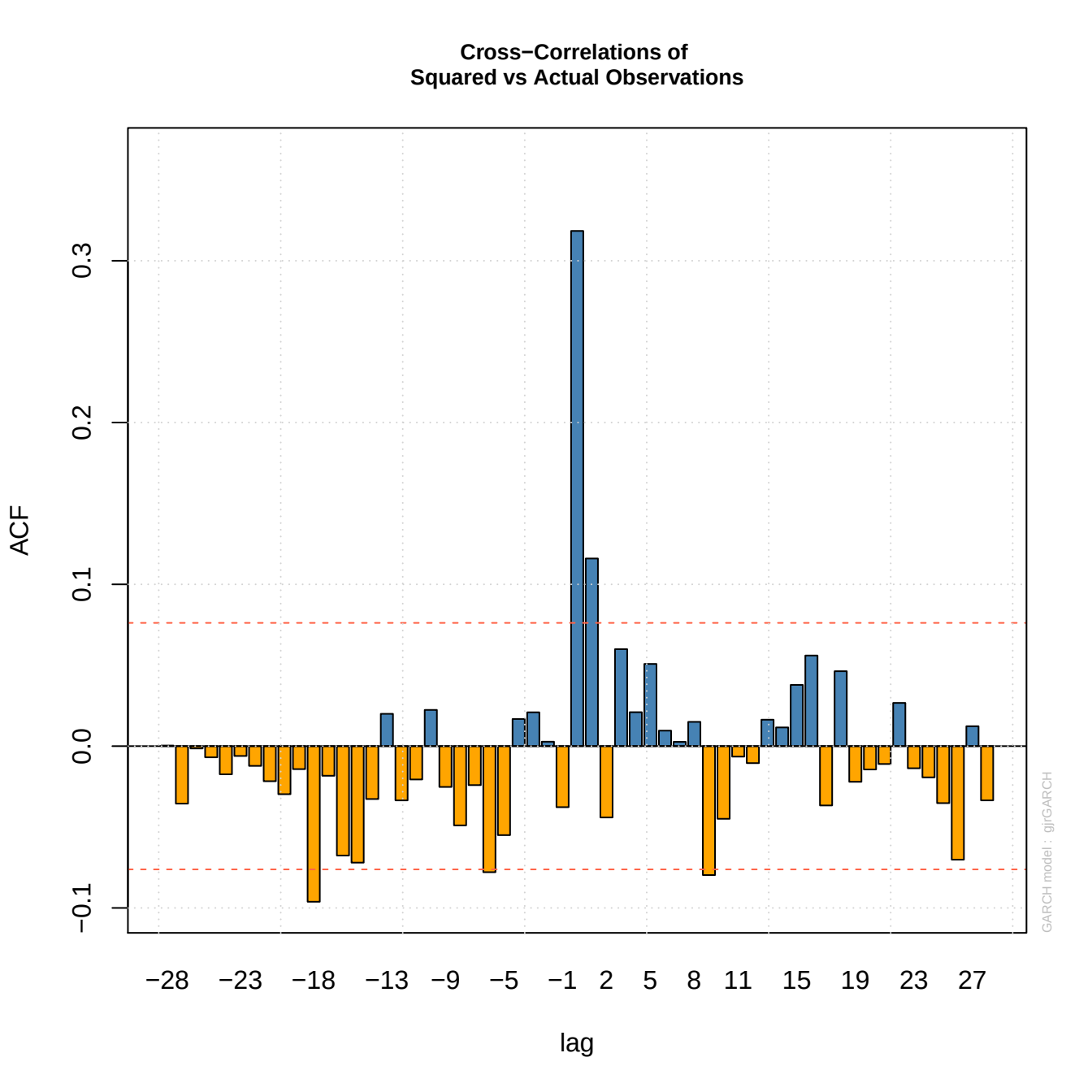

Series with with 1% VaR Limits
Returns
0.10
0.05
0.00
−0.05
2016
2017
2018
Time
GARCH model : gjrGARCH

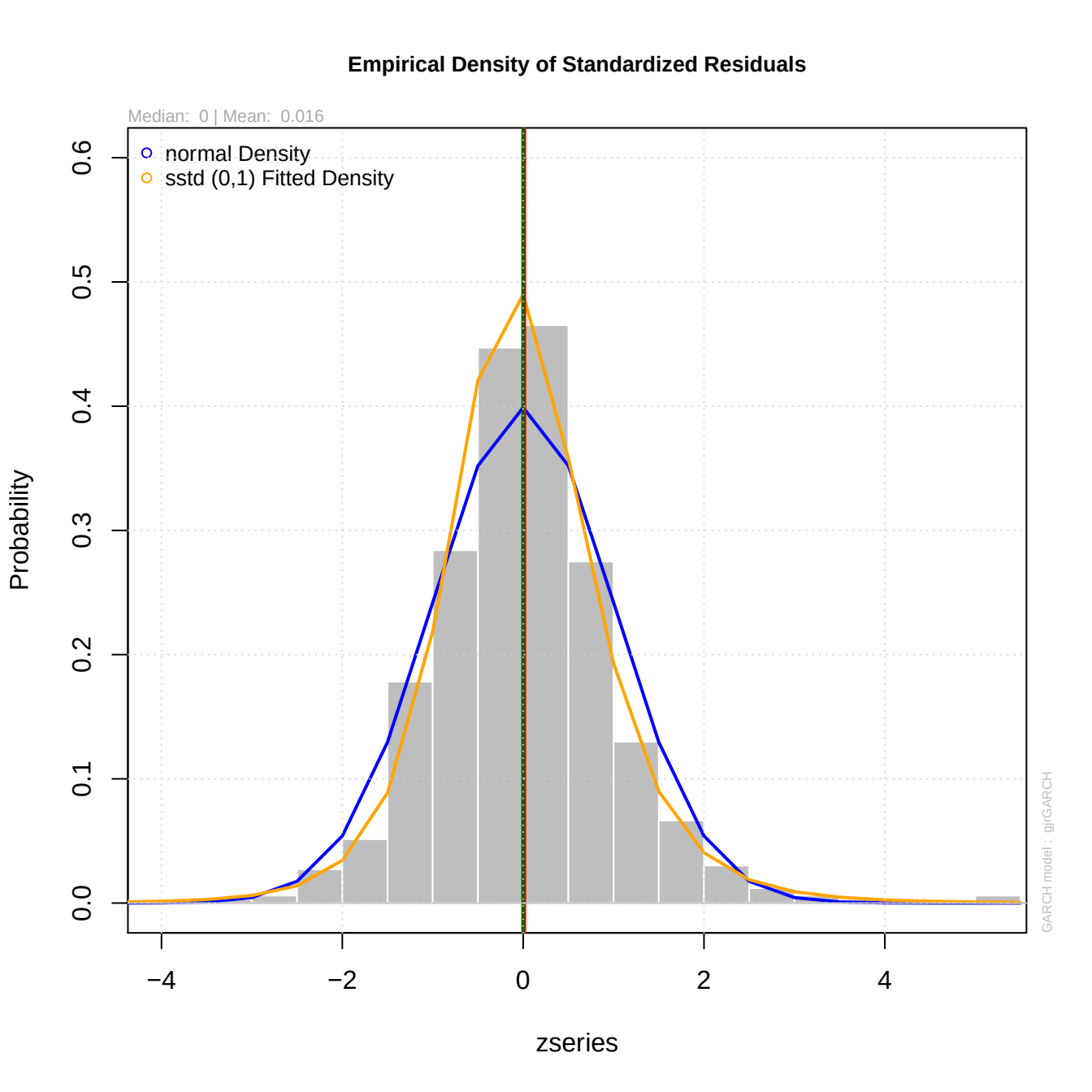

Conditional SD (vs |returns|)
Volatility
0.00
0.02
0.04
0.06
0.08
0.10
2016
2017
2018
Time
GARCH model : gjrGARCH

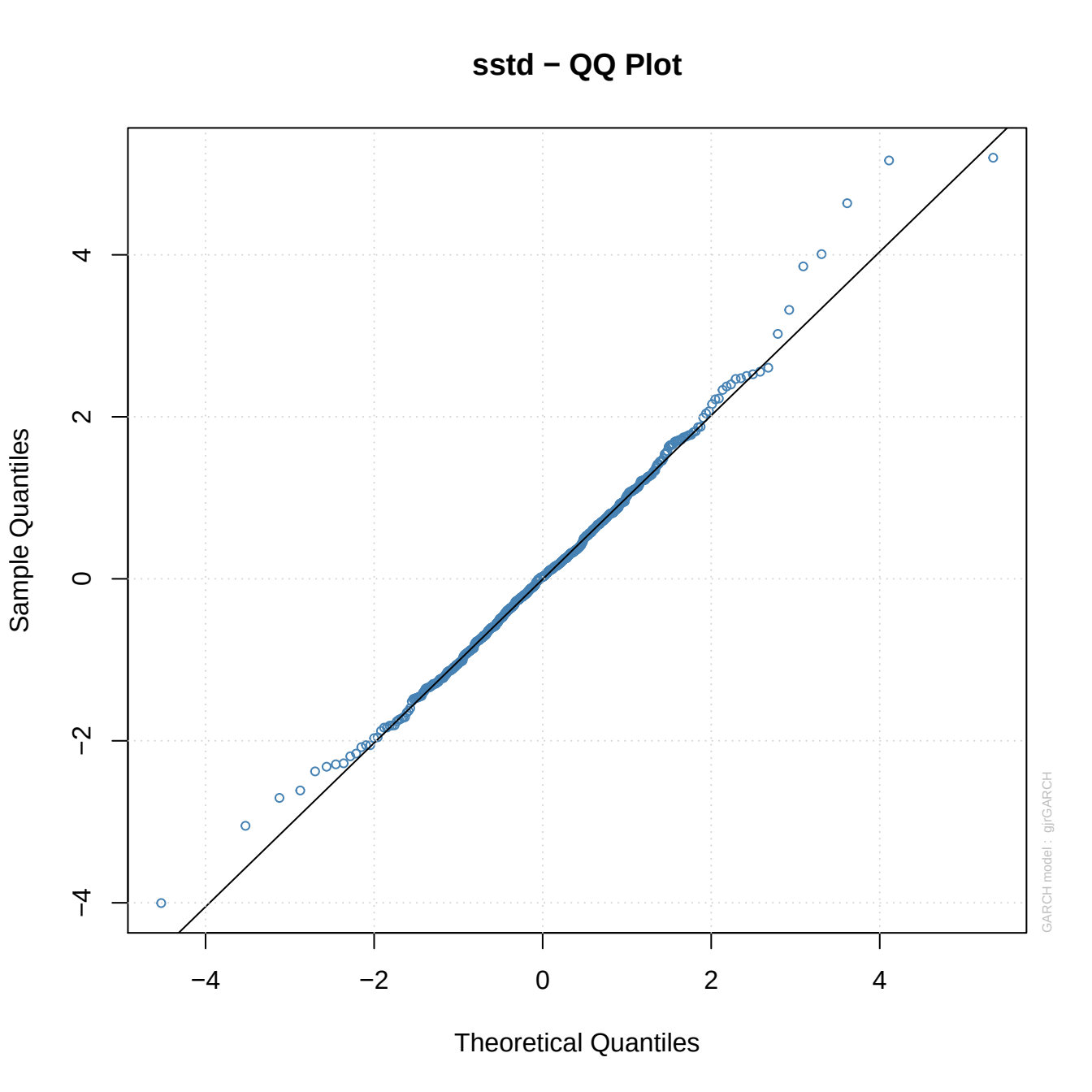

ACF of Observations
ACF
0.10
0.05
0.00
−0.05
−0.10
1
3
5
7
9
11
13
15
17
19
21
23
25
27
lag
GARCH model : gjrGARCH

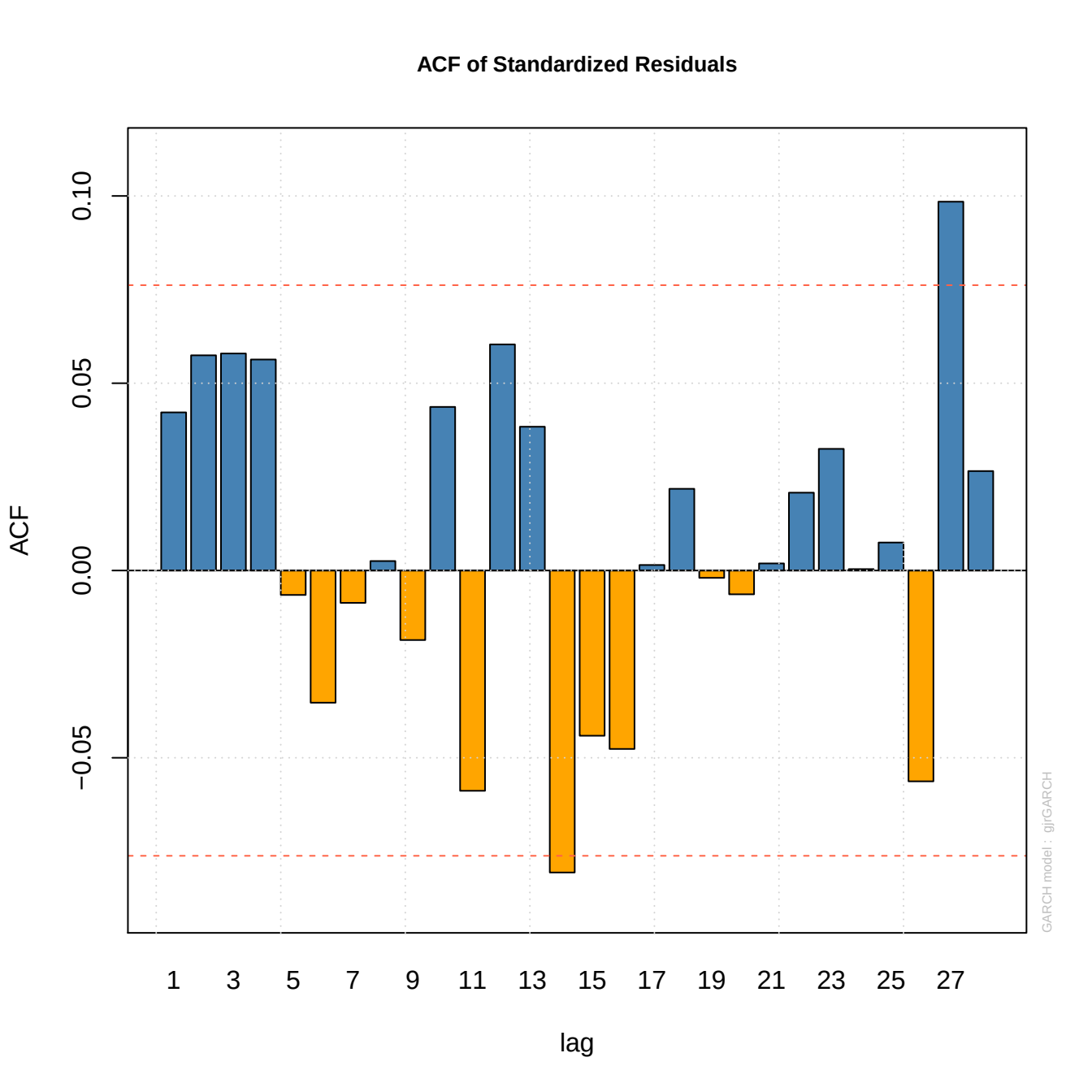

ACF of Squared Observations
ACF
0.20
0.15
0.10
0.05
0.00
−0.05
1
3
5
7
9
11
13
15
17
19
21
23
25
27
lag
GARCH model : gjrGARCH

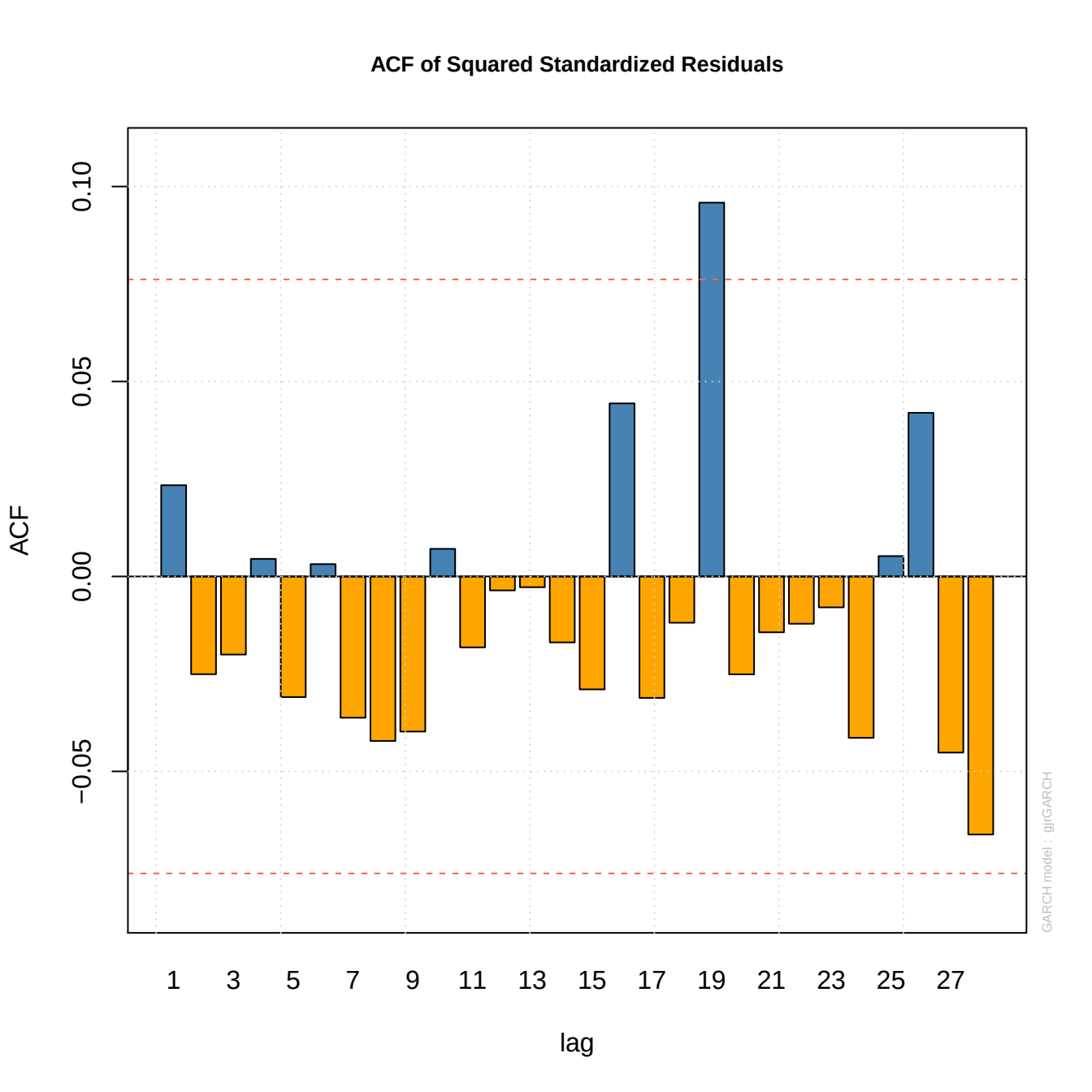

ACF of Absolute Observations
ACF
0.3
0.2
0.1
0.0
−0.1
1
3
5
7
9
11
13
15
17
19
21
23
25
27
lag
GARCH model : gjrGARCH

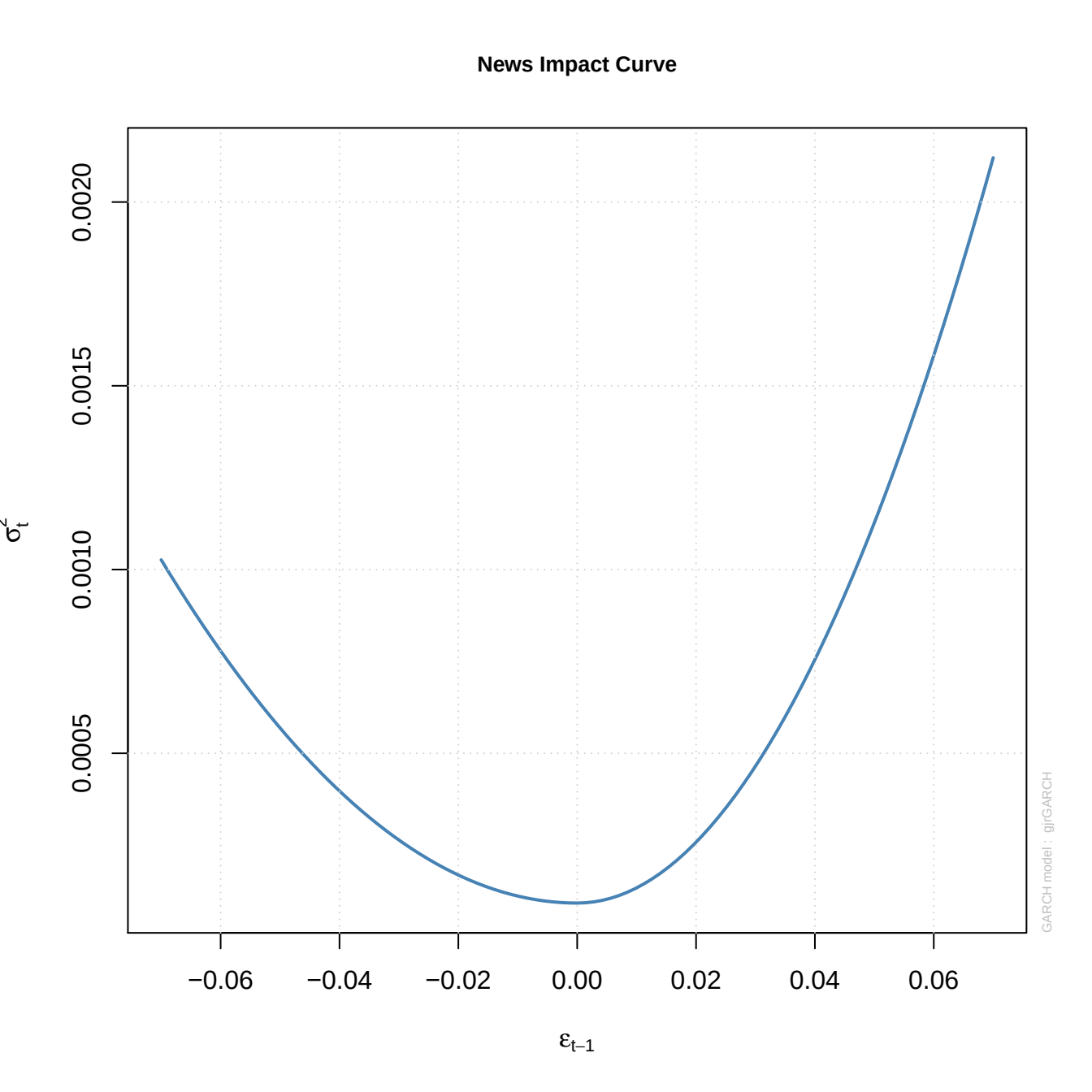

Cross−Correlations of
Squared vs Actual Observations
ACF
0.3
0.2
0.1
0.0
−0.1
−28
−23
−18
−13
−9
−5
−1
2
5
8
11
15
19
23
27
lag
GARCH model : gjrGARCH

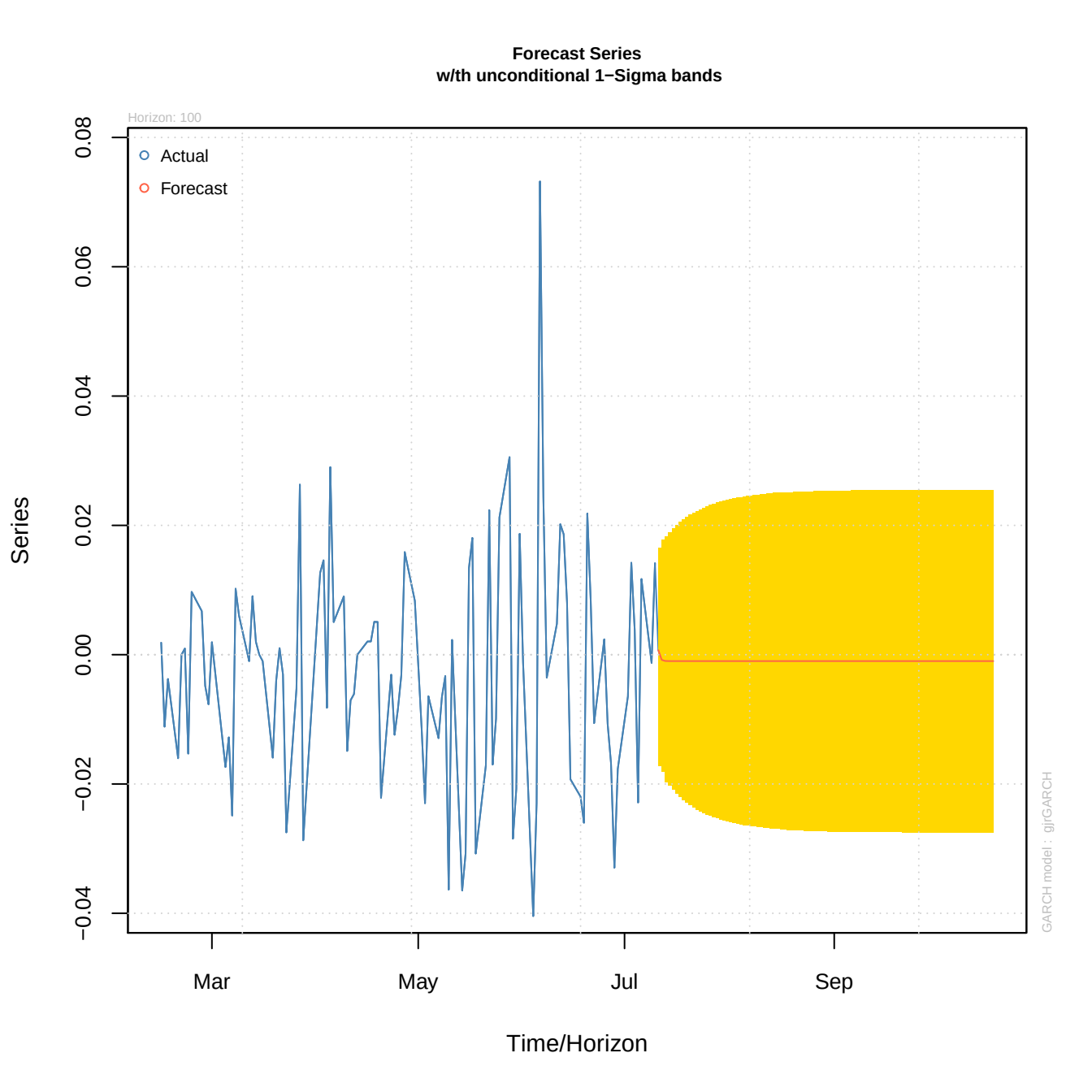

Empirical Density of Standardized Residuals
Median: 0 | Mean: 0.016
normal Density
sstd (0,1) Fitted Density
Probability
0.0
0.1
0.2
0.3
0.4
0.5
0.6
−4
−2
0
2
4
zseries
GARCH model : gjrGARCH

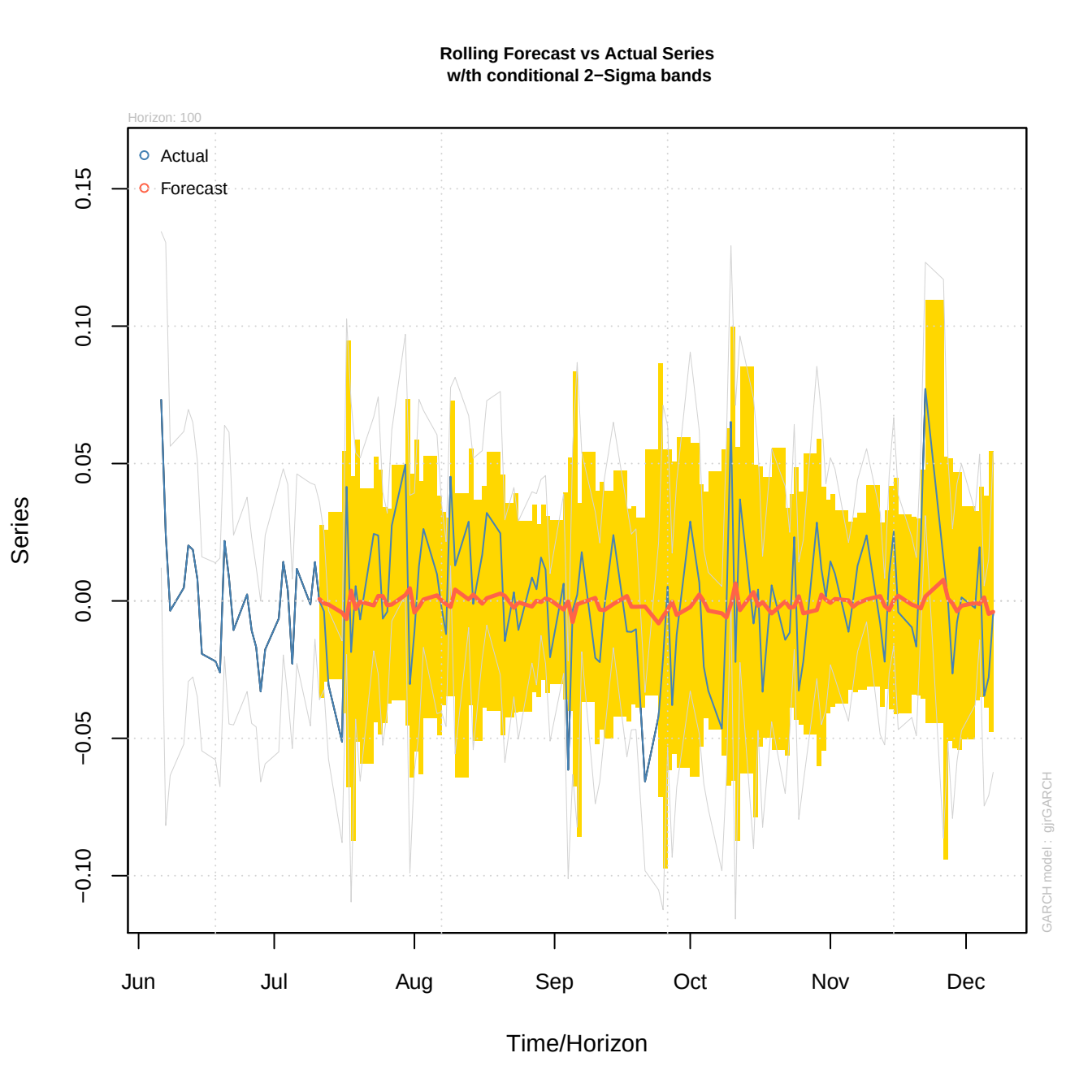

sstd − QQ Plot
Sample Quantiles
Theoretical Quantiles
−4
−2
0
2
4
GARCH model : gjrGARCH

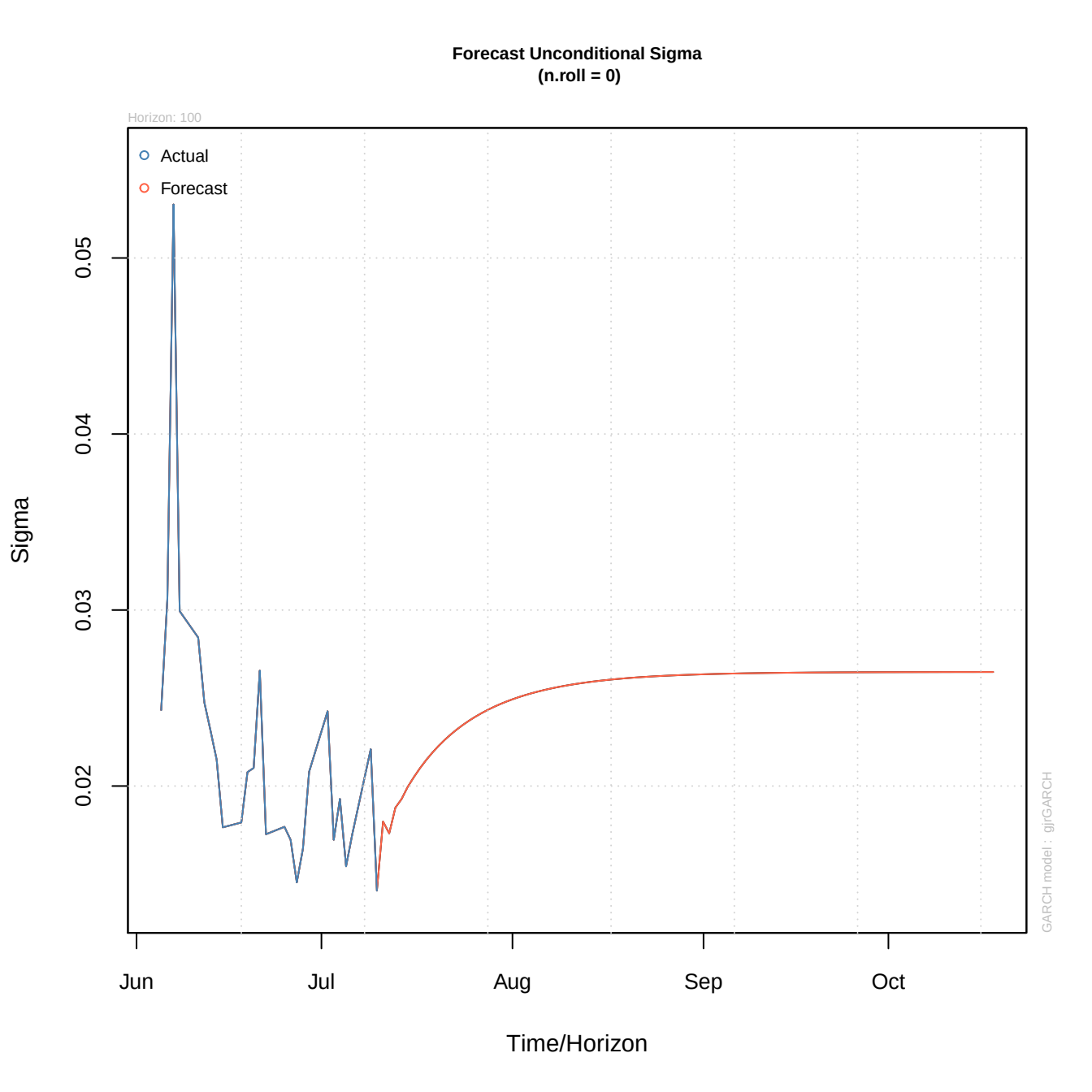

ACF of Standardized Residuals
ACF
0.10
0.05
0.00
−0.05
1
3
5
7
9
11
13
15
17
19
21
23
25
27
lag
GARCH model : gjrGARCH

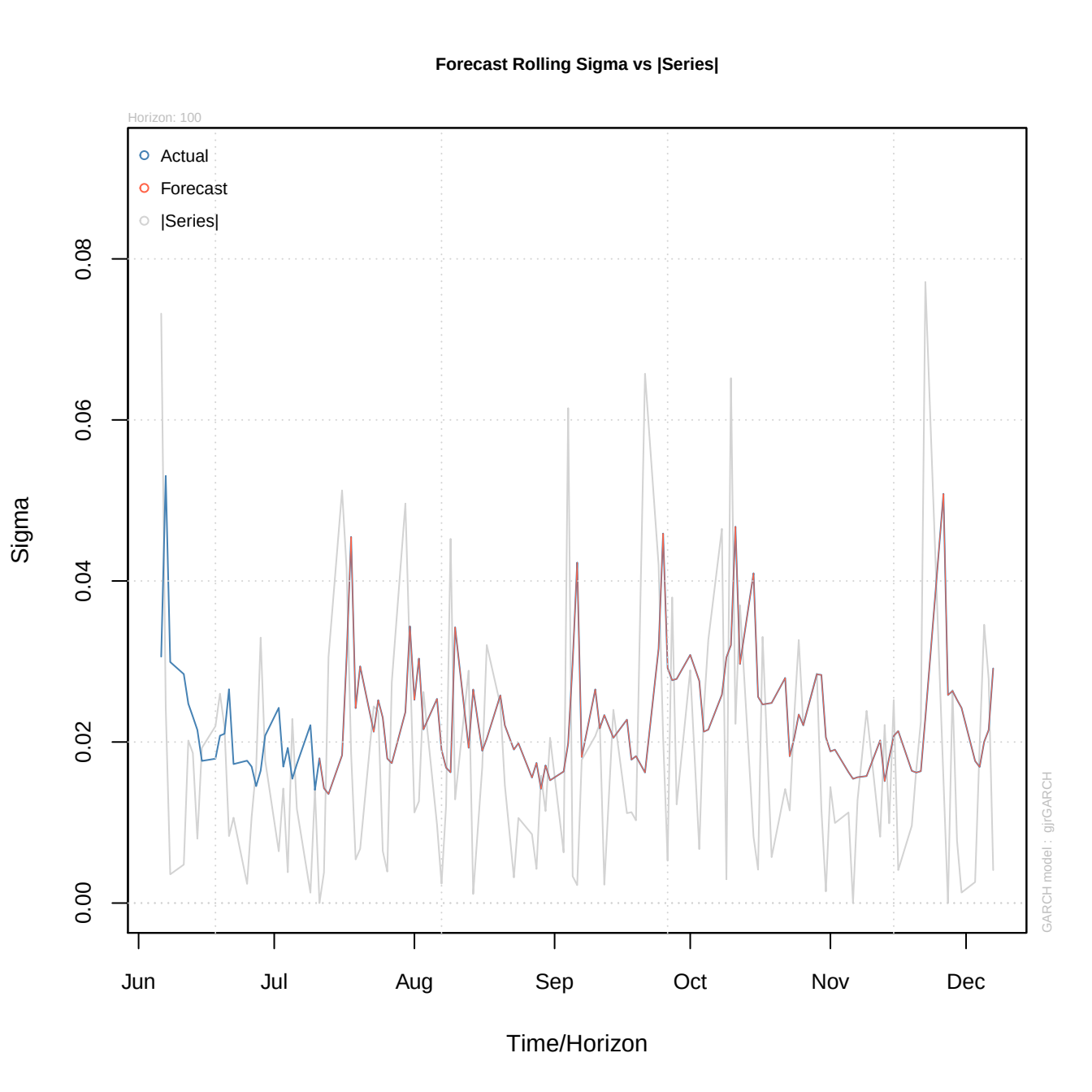

ACF of Squared Standardized Residuals
ACF
0.10
0.05
0.00
−0.05
1
3
5
7
9
11
13
15
17
19
21
23
25
27
lag
GARCH model : gjrGARCH


News Impact Curve
0.0020
0.0015
0.0010
0.0005
σ_t^2
−0.06
−0.04
−0.02
0.00
0.02
0.04
0.06
ε_{t-1}
GARCH model : gjrGARCH


Forecast Series
w/th unconditional 1−Sigma bands
Horizon: 100
Actual
Forecast
Series
0.08
0.06
0.04
0.02
0.00
−0.02
−0.04
Mar
May
Jul
Sep
Time/Horizon
GARCH model : gjrGARCH


Rolling Forecast vs Actual Series
w/th conditional 2−Sigma bands
Horizon: 100
Actual
Forecast
0.15
0.10
0.05
0.00
−0.05
−0.10
Series
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Time/Horizon
GARCH model : gjrGARCH


Forecast Unconditional Sigma
(n.roll = 0)
Horizon: 100
Actual
Forecast
Sigma
0.02
0.03
0.04
0.05
Jun
Jul
Aug
Sep
Oct
Time/Horizon
GARCH model : gjrGARCH


Forecast Rolling Sigma vs |Series|
Horizon: 100
Actual
Forecast
|Series|
Sigma
0.00
0.02
0.04
0.06
0.08
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Time/Horizon
GARCH model : gjrGARCH