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Assignment-3

1. By taking the 2nd Column for the Starbuck Stock and the following are the tasks done:

a) Serial correlations in log returns of the Starbucks stock:
Yes, $Q(10, r_t) = 19.441$ with a p-value of 0.03501. The first lag in particular is significant

b) ARCH effect:
Yes, By subtracting the mean of the column, we get $Q(10, \hat{a}^2_t) = 50.989$, with a p-value near zero.

c) Fit a GARCH(1,1) model for the percentage log return of Starbucks stock using Gaussian distribution for the innovations. Perform model checking and write down the fitted model:

$$r_t = 0.123 - 0.075r_t{-}1 + a_t$$
$$a_t = \sigma_t \in_t , \ \in_t \sim N(0, 1)$$
$$\sigma_t = 0.015 + 0.019a^2_{t-1} + 0.978\sigma^2_{t-1}$$

2. Considering the Log returns of S&P 500 Index:

a) Serial Correlations:
No, $Q(10, r_t) = 12.565$ with a p-value of 0.249.

b) ARCH effect:
Similarly like the first problem, finding the mean and finding $Q(10,r^2_t)=830.35$, p-value= 2.2e-16 which is closer to zero. So, Yes there is an ARCH effect.

c) Fit an IGARCH(1,1) model for the log return series of the index using normal distribution for the innovations:

$$r_t = 0.039 + a_t$$

$$a_t = \sigma_t \in_t , \in_t \sim N(0, 1)$$
$$\sigma_t = 0.028 + 0.063a^2_{t-1} + 0.937\sigma^2_{t-1}$$

d) Computing 1-4 step ahead forecasts:
Forecasts for the daily percentage log return are constant, 0.039, and for the volatility 0.500, 0.502, 0.505, 0.508.

3. Considering the log returns of the starbuck stocks:

a) Fit a GARCH(1,1)-M model for the series with normal distribution:

$$r_t = 0.126\text{-}0.065r_{t-1}\text{-}0.019\sigma^2_t + a_t$$
$$a_t = \sigma_t \in_t , \in_t \sim N(0, 1)$$
$$\sigma_t = 0.027 + 0.028a^2_{t-1} + 0.966\sigma^2_{t-1}$$

b) ARCH Effect:
No, t-stat value is -0.76 with a p-value of 0.45

c) Fitting a GJR(1,1) Model to the log return of the series, Fitting the model as follow:

$$r_t = 0.126\text{-}0.086r_{t-1} + a_t$$
$$a_t = \sigma_t \in_t , \in_t \sim N(0, 1)$$
$$\sigma_t = 0.028 + (0+0.04N_{t-1})a^2_{t-1} + 0.975\sigma^2_{t-1}$$

From the Model, We can assume $N_{t-1} = I(a_{t-1}<0)$, Therefore $Q(10,\hat{a}_t)=4.43$ with a p-value of 0.88 and $Q(10,\hat{a}^2_t)=3.81$ with a p-value=0.87, The Normality assumption may not be valid since the J-B statistics has a p-value near to zero.

d) "Leverage" factor is significant as t-stat value is 3.76 with p-value = 0.0002. The Arch parameter is not significant though.

4. The Data of monthly simple returns of PG Stock is given, below are the tasks:

a) Serial correlation in the stock:
No, $Q(10,r_t)=8.651$, p-value = 0.565

b) Fit a GARCH(1,1) model to the monthly percentage log returns of PG stock using generalized error distribution for the innovations.

$r_t = 1.104 + a_t$

$a_t = \sigma_t \in_t$, $\in_t \sim GED_{1.43}(0, 1)$

$\sigma_t = 0.7925 + 0.1067a^2_{t-1} + 0.86\sigma^2_{t-1}$

c) Predicting the next 5 steps:
Forecasts for the daily percentage log return are constant, 1.104, and for the volatility 2.90, 3.00, 3.08, 3.17, 3.24.

5. By taking the file of daily exchange rate between U.S. Dollars and Euro from January 1999 to March 20,2007. Compute the percentage log returns of the exchange rate.

a) Serial correlation in log return series:
No, $Q(10,r_t)$=11.921, with p-value=0.2904

b) ARCH effect:
Yes, $Q(10,r^2_t)$=29.121, with p-value = 0.001191

c) Fitting a IGARCH Model:

$r_t = 0.011 + a_t$

$a_t = \sigma_t \in_t$, $\in_t \sim N(0, 1)$

$\sigma_t = 0.016a^2_{t-1} + 0.985\sigma^2_{t-1}$

From the output we find Q(10, ˆt) = 9.61, with a p-value of 0.48, and Q(10, ∈ˆ2t) = 11.83, with a p-value of 0.16. However, Q(20, ∈ˆ2t) = 29.55, with a p-value of 0.042

d) Predicting the next 5 steps:
Forecasts for the daily percentage log return are constant, 0.011, and constant for the volatility 0.3753.

Appendix:R-Output-

```r
#setwd=("/Users/gardasnagarjun/Documents/2019FTS/assignment")
library(forecast)
library(fGarch)
ta=read.table("/Users/gardasnagarjun/Documents/2019FTS/assignment/d-sbuxsp0106.txt",header =F,sep="")
ta
#logta=log(ta$V2)*100
#logta
Box.test(ta$V2,lag = 10,type = "Ljung")

at=ta$V2-mean(ta$V2)
at
acf(at^2,20,main="",col="red",ylim=c(-0.2,0.4))


Box.test(at^2,lag=10,type="Ljung")

gam1=garchFit(intc~garch(1,1),data=at,trace=F)
gam1
summary(gam1)

```

```r
#2nd Question
tb=ta$V3
tb
Box.test(ta$V3,lag=10,type="Ljung")
atb=ta$V3-mean(ta$V3)
acf(atb^2,20,main="",col="green",ylim=c(-0.2,0.4))
Box.test(atb,lag=10,type="Ljung")
Box.test(atb^2,lag=10,type="Ljung")

library(rugarch)

spec1=ugarchspec(variance.model=list(model="iGARCH"),
                 mean.model=list(armaOrder=c(1,1),include.mean = FALSE) )


mm=ugarchfit(spec=spec1,data=atb)
mm  ### see output

predict(mm,5) #predict

res=residuals(mm,standardize=T)
```

```r
res=residuals(mm,standardize=T)

Box.test(res,10,type="Ljung")


#3rd Question:
spec2=ugarchspec(variance.model=list(model="sGARCH"),
                 mean.model=list(armaOrder=c(0,0),include.mean = TRUE) )
gm=ugarchfit(spec=spec2,data=at)
gm

spec3=ugarchspec(variance.model=list(model="gjrGARCH"),
                 mean.model=list(armaOrder=c(0,0),include.mean = TRUE) )
gjm=ugarchfit(spec=spec2,data=at)
gjm


#4th Question
tc=read.table("/Users/gardasnagarjun/Documents/2019FTS/assignment/m-pg5606.txt",header =F,sep="")
tc
```

```r
#ltc=diff(log(tc$V2),lag=5)
Box.test(tc$V2,lag = 10,type = "Ljung")
#Box.test(ltc,lag = 10,type = "Ljung")

atc=tc$V2-mean(tc$V2)
atc
acf(atc^2,20,main="",col="red",ylim=c(-0.2,0.4))


Box.test(atc^2,lag=10,type="Ljung")

#spec4=ugarchspec(variance.model=list(model="sGARCH"),
                 #mean.model=list(armaOrder=c(0,0),include.mean = TRUE) )
#gmc=ugarchfit(spec=spec4,data=atc)
#gmc
m4=garchFit(intc~garch(1,1),data=atc,trace=F)
summary(m4)
predict(m4,5)
```

```r

#5th Question:
tc=read.table("/Users/gardasnagarjun/Documents/2019FTS/assignment/d-exuseu.txt",header =F,sep="")
tc
ltc=diff(log(tc$V4))*100
ltc
Box.test(ltc,lag=10,type="Ljung")

atd=ltc-mean(ltc)
atd
acf(atd^2,20,main="",col="red",ylim=c(-0.2,0.4))
Box.test(atd^2,lag=10,type="Ljung")

spec5=ugarchspec(variance.model=list(model="iGARCH"),
                 mean.model=list(armaOrder=c(0,0),include.mean = FALSE) )

mm5=ugarchfit(spec=spec5,data=atd)
mm5  ### see output

predict(m5,5)
```