Final Exam for Big Data and Internet Finance

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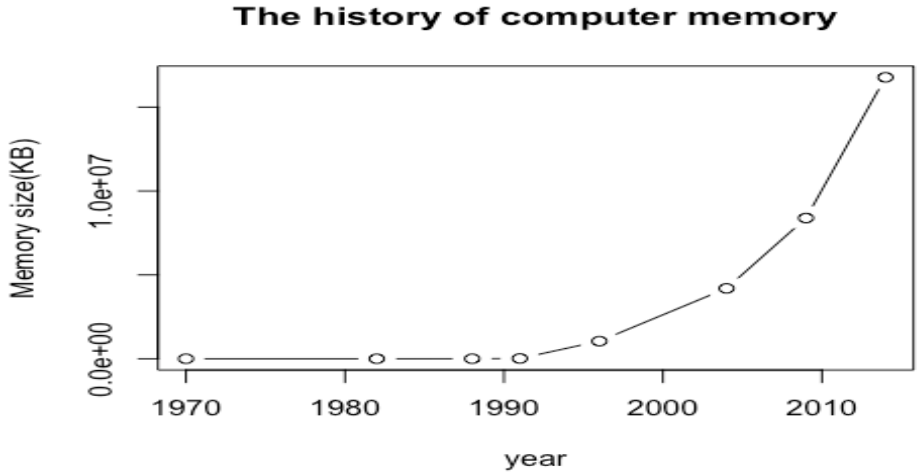
HM Unit 1

Q1. Find the data of PC memory and plot it.

Year	Memory	Type
1970	256KB	DIP
1982	256KB	SIMM
1988	2MB	FPM DRAM
1991	16MB	EDO
1996	1GB	DDR SDRAM
2004	4GB	DDR2
2009	8GB	DDR3
2014	16GB	DDR4



Q2. Learn and introduce logistic regression.

Logistic regression is a regression model where the dependent variable is categorical.

It was developed by statistician David Cox in 1958. It allows one to say that the presence of a risk factor increases the odds of a given outcome by a specific factor.

For example, if we want to calculate the probability of passing an exam versus hours of study, we can choose a group of 20 students spend between 0 and 6 hours studying for an exam. How does the number of hours spent studying affect the probability that the student

will pass the exam?

In this regression, the dependent variable pass/fail represented by "1" and "0" are not cardinal numbers.

Q3. Create your own github account.

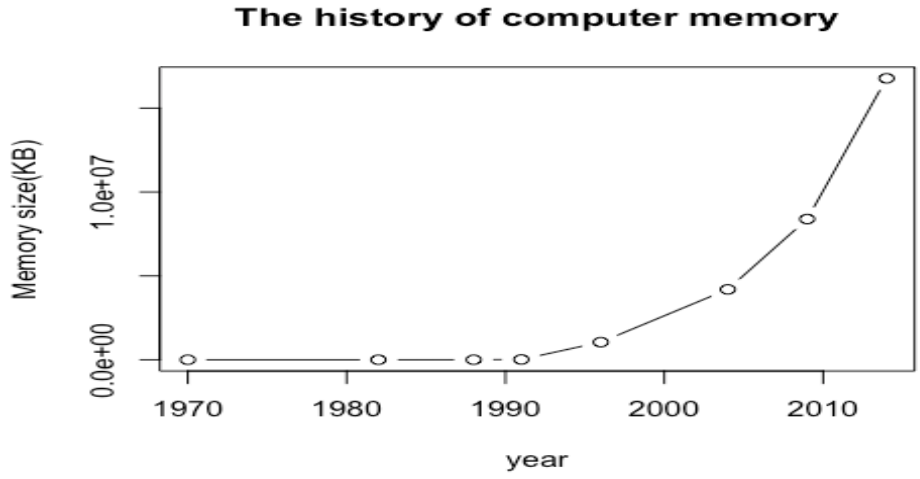
My github account name is RanCheng019.

HM Unit 2

Q1. Make an R quantlet to solve HW #1 from unit 1 with R and show it on Github (GH). hint: use the CMB Qs for this work

Codes:

```
year<-c(1970,1982,1988,1991,1996,2004,2009,2014)
memory_size<-
c(256,256,2*1024,16*1024,1*1024*1024,4*1024*1024,8*1024*1024,16*1024*1024)
plot(year,memory_size,type = "b", col="black",main = "The history of computer memory",
     xlab = "year",ylab = "Memory size(KB)")
barplot(memory_size, xlab = "year",ylab ="The number of memory ")
```



Q2. Suppose you observe that in n=1000 mails (in 1 week) you have about 2 scams. Use the LvB /Possion pdf to calculate that you have 6 scam emails in 2 weeks. In Scammy land you have 5 scams on average, what is the probability to have no scam mail.

Codes:

```
lambda=2
x=seq(0:6)
P<-data.frame(dpois(x,lambda))
lambda=5
x=0
dpois(x,lambda)
```

HM Unit 3

Q1. Make an R quantlet on GH to produce hash code for the 2 sentences: „I learn a lot from this class when I am proper listening to the professor “, „I do not learn a lot from this class when I am absent and playing on my Iphone “. Compare the 2 hash sequences.

Codes:

```
#install.packages("digest")
library(digest)
digest("I learn a lot from this class when I am proper listening to the professor","sha1")
digest("I do not learn a lot from this class when I am absent and playing on my Iphone",
"sha512")
```

Q2. Make 3-5 slides (in PPTX) on the DSA (Digital Signature Algorithms).

Digital Signature Algorithms is a Federal Information Processing Standard for digital signatures. It is a variant of the ElGamal signature scheme.

In August 1991, the National Institute of Standards and Technology (NIST) proposed DSA for use in their Digital Signature Standard (DSS) and adopted it as FIPS 186 in 1993. There are four revisions to the initial specification to DSA: FIPS 186-1 in 1996, FIPS 186-2 in 2000, FIPS 186-3 in 2009, FIPS 186-4 in 2013.

The key generation of DSA has two phases: The first phase is a choice of algorithm parameters which may be shared between different users of the system. The second phase computes public and private keys for a single user.

Q3. Make slides with R code where you create a JSON data set that you save and read again.

1. Create a JSON data set

Codes:

```
library(rjsonio)
Num <- [1:5]
Name <- c( “a” , ” b” , ” c” , “d” , “e” )
data <- as.matrix(data.frame(Num,Name))
cat(toJSON(data))
# Note: JSON data is a key-value pairs list.
```

2. Read the JSON data set

Codes:

```
library("rjson")
json_data = fromJSON(file=data)
# We can use function ‘fromJSON’ to read the JSON data set
```

Q4. Download the CRIX data and make a plot of the time series, analyse its properties, i.e. fit ARMA, ARIMA etc. Is there a GARCH effect?

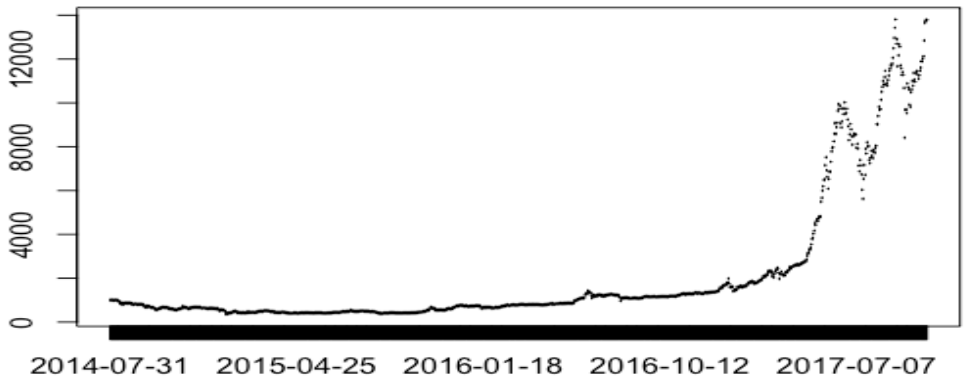


Figure 1: Plot of CRIX Index

Codes:

```
install.packages("rjson", repos="http://cran.us.r-project.org")
library("rjson")
json_file = "http://crix.hu-berlin.de/data/crix.json"
json_data = fromJSON(file=json_file)
crix_data_frame = as.data.frame(json_data)
crix_data_frame1 = as.vector(json_data)
for(i in 1:1174){
```

```
    date[i] = crix_data_frame1[[i]][1]
    price[i] = crix_data_frame1[[i]][2]
}
date1 = as.vector(date)
price1 = as.numeric(price)
data1 = data.frame(date1,price1)
data2 = data.frame(t(as.vector(data1[1:1174])),t(as.vector(data1[-1:-1174])))
names(data2) <- c("date","price")
plot(x = data2$date, y = data2$price)
library(tseries)
adf.test(time_series)
# Since p-value greater than printed p-value,we can't reject the hypothesis#
# the time series(time_series) is not stationary#
```

HM Unit 4

Q1. 1.improve the R quantlets on GH (from CRIX directory on quantlet.de) and make excellent graphics that follow Fig 3,4,5,6 of the ” Econometrics of CRIX “ paper.

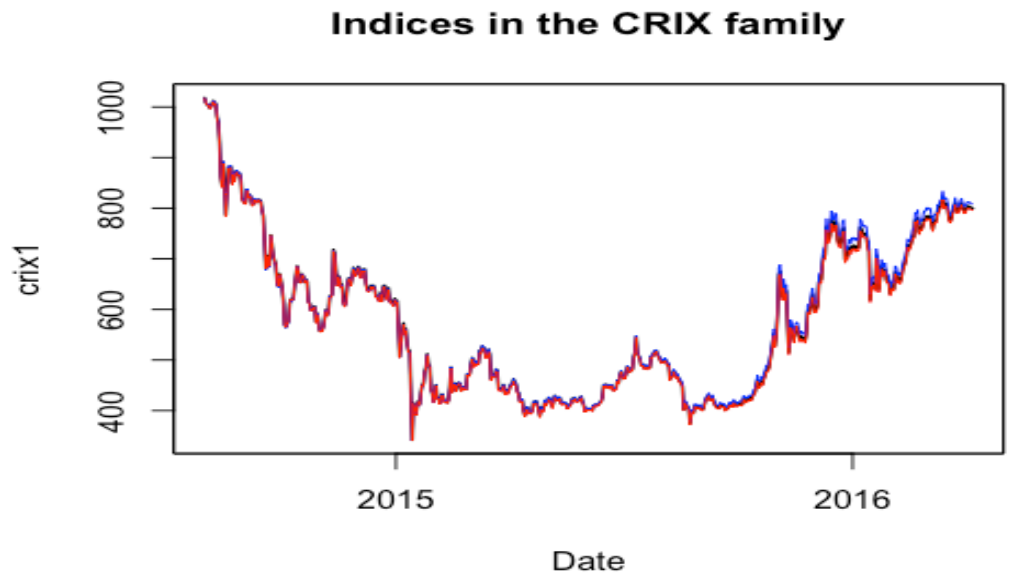


Figure 3: The daily value of indices in the CRIX family

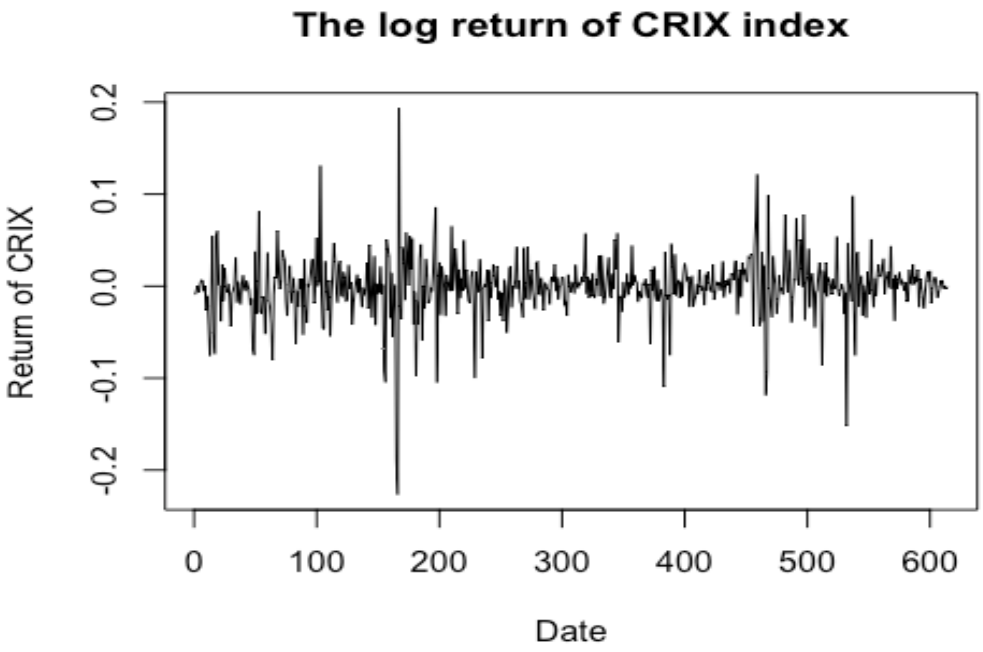


Figure 4: The log returns of CRIX index

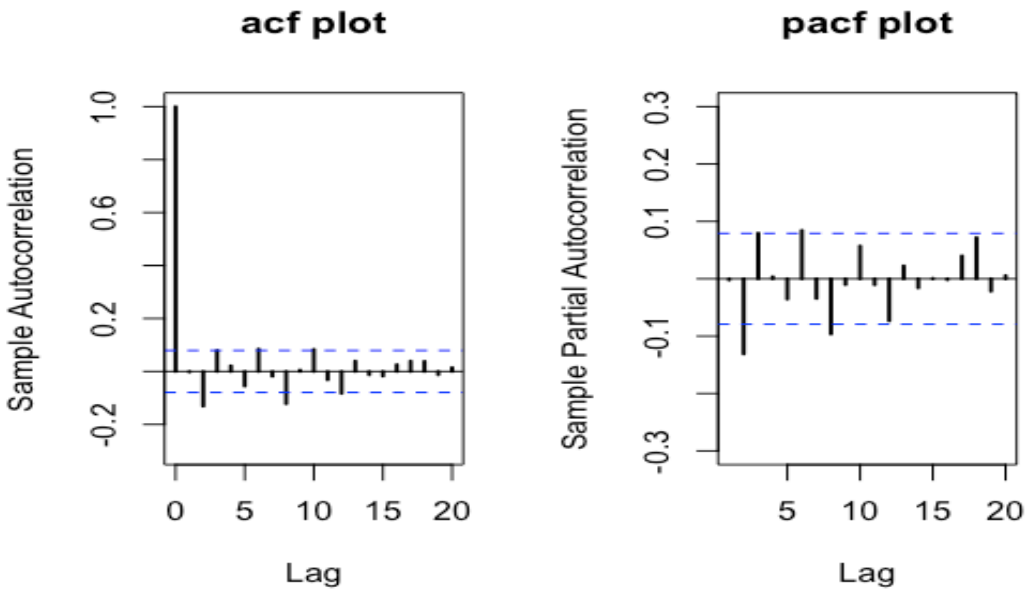


Figure 5: Histogram and QQ plot of CRIX returns

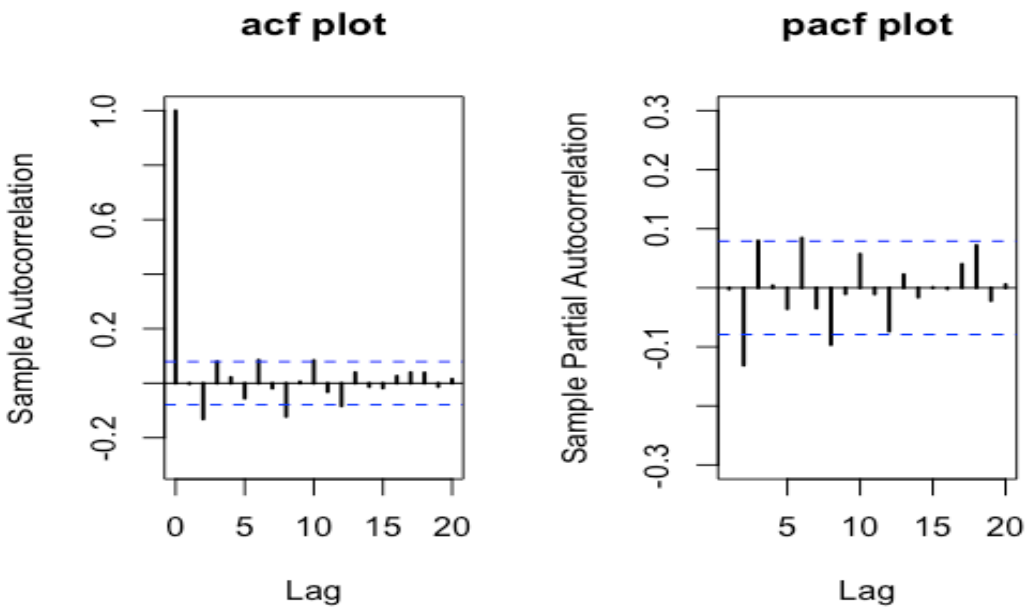


Figure 6: The sample ACF and PACF of CRIX returns

Codes:

```
rm(list = ls(all = TRUE))
graphics.off()

# install and load packages
libraries = c("zoo", "tseries", "xts","ccgarch")
lapply(libraries, function(x) if (!(x %in% installed.packages())) {
    install.packages(x)
})
lapply(libraries, library, quietly = TRUE, character.only = TRUE)

# load dataset
load(file.choose())
load(file.choose())
load(file.choose())

# three indices return
ecrix1 = zoo(ecrix, order.by = index(crix1))
efcrix1 = zoo(efcrix, order.by = index(crix1))
```

```
# plot with different x-axis scales with zoo
my.panel <- function(x, ...) {
  lines(x, ...)
  lines(ecrix1, col = "blue")
  lines(efcrix1, col = "red")
}
plot.zoo(crix1, plot.type = "multiple", type = "l", lwd = 1.5, panel = my.panel,
         main = "Indices in the CRIX family", xlab = "Date")

# plot of crix
# plot(as.xts(crix), type="l", auto.grid=FALSE, main = NA)
plot(crix1, ylab = "Price of CRIX", xlab = "Date")

# plot of crix return
ret    = diff(log(crix1))
# plot(as.xts(ret), type="l", auto.grid=FALSE, main = NA)
plot(ret, ylab = "Return of CRIX", xlab = "Date")

# stationary test
adf.test(ret, alternative = "stationary")
kpss.test(ret, null = "Trend")

par(mfrow = c(1, 2))
# histogram of returns
hist(ret, col = "grey", breaks = 20, freq = FALSE, ylim = c(0, 25), xlab = "Return of CRIX")
lines(density(ret), lwd = 2)
mu = mean(ret)
sigma = sd(ret)
x = seq(-4, 4, length = 100)
curve(dnorm(x, mean = mean(ret), sd = sd(ret)), add = TRUE, col = "red",
      lwd = 2)
# qq-plot
qqnorm(ret)
```

```
qqline(ret, col = "blue", lwd = 3)

# acf plot
autocorr = acf(ret, lag.max = 20, ylab = "Sample Autocorrelation", main = "acf plot",
               lwd = 2, ylim = c(-0.3, 1))

# pacf plot
autopcorr = pacf(ret, lag.max = 20, ylab = "Sample Partial Autocorrelation",
                 main = "pacf plot", ylim = c(-0.3, 0.3), lwd = 2)
```

Q2. make your R code perfect as in the R examples on quantlet.de i.e. make sure that the code is " time independent " by using actual dimensions of the data that you are collecting from crix.hu-berlin.de Recreate Fig 7 from " Econometrics of CRIX ".

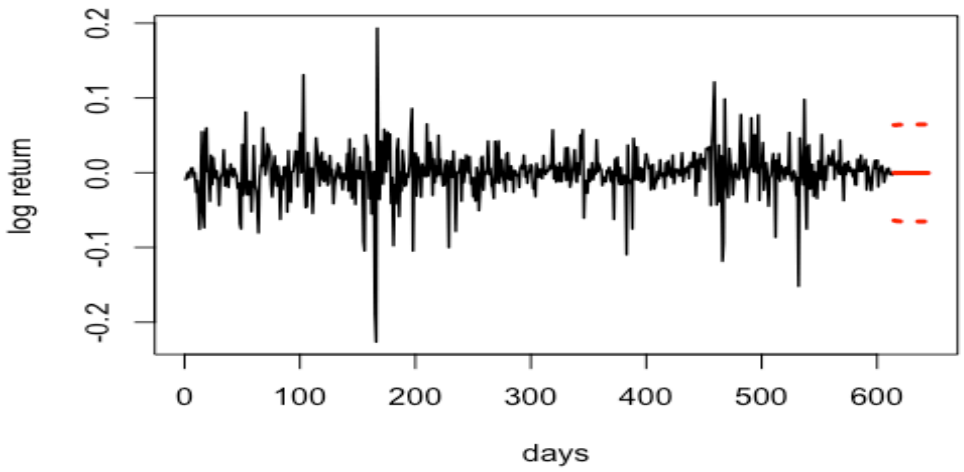


Figure 7: CRIX returns and predicted values.

Codes:

```
# arima model
par(mfrow = c(1, 1))
fit1 = arima(ret, order = c(1, 0, 1))
tsdiag(fit1)
Box.test(fit1$residuals, lag = 1)

# aic
```

```
aic = matrix(NA, 6, 6)
for (p in 0:4) {
   for (q in 0:3) {
      a.p.q = arima(ret, order = c(p, 0, q))
      aic.p.q = a.p.q$aic
      aic[p + 1, q + 1] = aic.p.q
   }
}
aic

# bic
bic = matrix(NA, 6, 6)
for (p in 0:4) {
   for (q in 0:3) {
      b.p.q = arima(ret, order = c(p, 0, q))
      bic.p.q = AIC(b.p.q, k = log(length(ret)))
      bic[p + 1, q + 1] = bic.p.q
   }
}
bic

# select p and q order of ARIMA model
fit4 = arima(ret, order = c(2, 0, 3))
tsdiag(fit4)
Box.test(fit4$residuals, lag = 1)

fitr4 = arima(ret, order = c(2, 1, 3))
tsdiag(fitr4)
Box.test(fitr4$residuals, lag = 1)

# to conclude, 202 is better than 213
fit202 = arima(ret, order = c(2, 0, 2))
```

```
AIC(fit202, k = log(length(ret)))
AIC(fit4, k = log(length(ret)))
AIC(fitr4, k = log(length(ret)))
fit202$aic
fit4$aic
fitr4$aic

# arima202 predict
predict_num = 30
fit202 = arima(ret, order = c(2, 0, 2))
crpre = predict(fit202, n.ahead = predict_num)

dates = seq(as.Date("02/08/2014", format = "%d/%m/%Y"), by = "days", length = length(ret))

plot(ret, type = "l", xlim = c(0, length(ret)+predict_num), ylab = "log return", xlab = "days",
     lwd = 1.5, col = "black")
lines(crpre$pred, col = "red", lwd = 3)
lines(crpre$pred + 2 * crpre$se, col = "red", lty = 3, lwd = 3)
lines(crpre$pred - 2 * crpre$se, col = "red", lty = 3, lwd = 3)
```

Q3. Redo as many figures as you can.

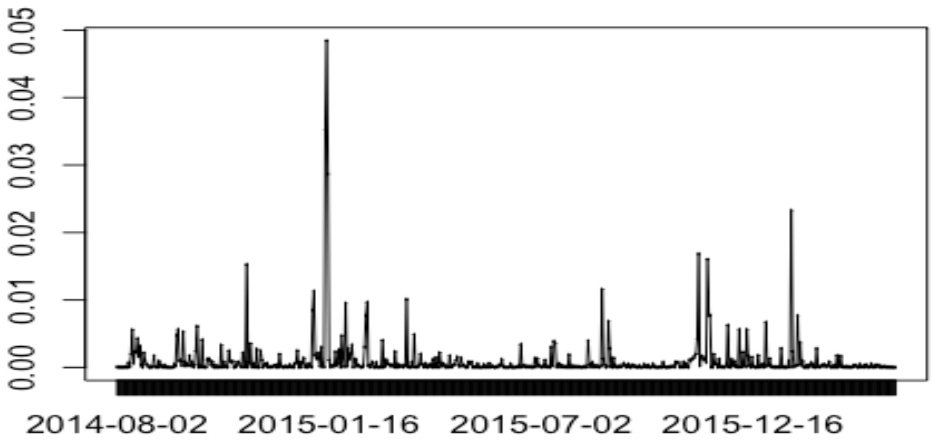


Figure 8: The squared ARIMA(2,0,2) residuals of CRIX returns.

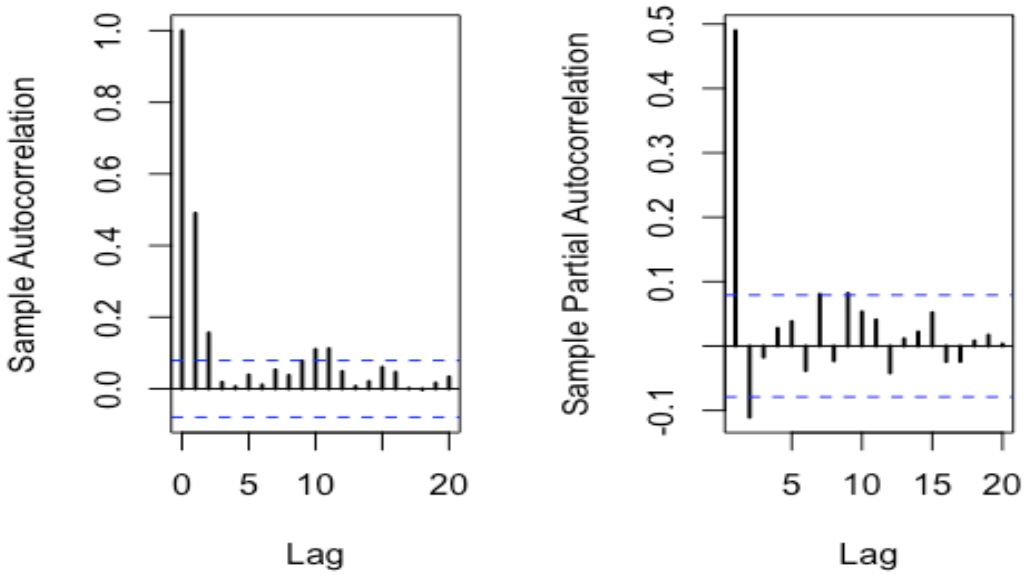
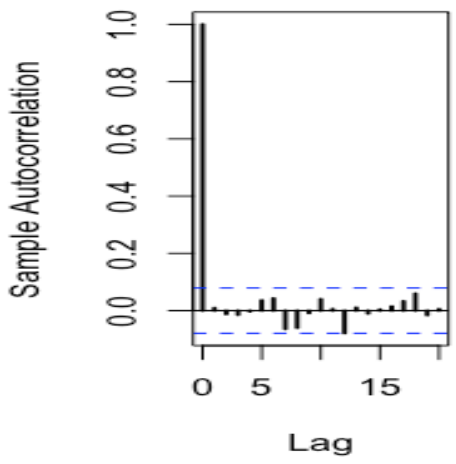


Figure 9: The ACF and PACF of squared ARIMA(2,0,2) residuals

Code:

```
rm(list = ls(all = TRUE))
graphics.off()

# install and load packages
libraries = c("tseries")
lapply(libraries, function(x) if (!(x %in% installed.packages())) {
    install.packages(x)
})
lapply(libraries, library, quietly = TRUE, character.only = TRUE)

# please change your working directory
setwd()

load(file.choose())
Pr = as.numeric(crix)
Da = factor(date1)
crx = data.frame(Da, Pr)
```

```
# plot of crix return
ret = diff(log(crx$Pr))
Dare = factor(date1[-1])
retts = data.frame(Dare, ret)

# arima202 predict
fit202 = arima(ret, order = c(2, 0, 2))

# vola cluster
par(mfrow = c(1, 1))
res = fit202$residuals
res2 = fit202$residuals^2
tsres202 = data.frame(Dare, res2)
plot(tsres202$Dare, tsres202$res2, type = "o", ylab = NA)
lines(tsres202$res2)

# plot(res2, ylab='Squared residuals', main=NA)
par(mfrow = c(1, 2))
acfres2 = acf(res2, main = NA, lag.max = 20, ylab = "Sample Autocorrelation", lwd = 2)
pacfres2 = pacf(res2, lag.max = 20, ylab = "Sample Partial Autocorrelation", lwd = 2, main =
NA)
```



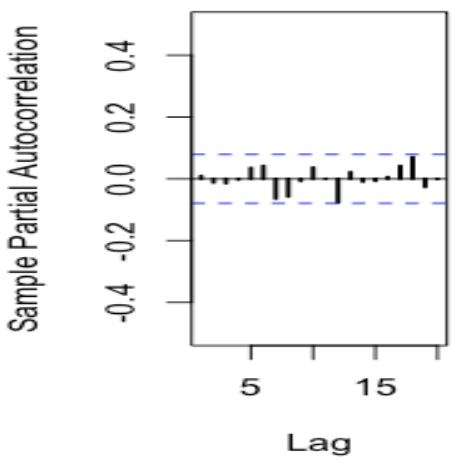


Figure 10: The ACF and PACF of squared ARIMA(2,0,2) residuals

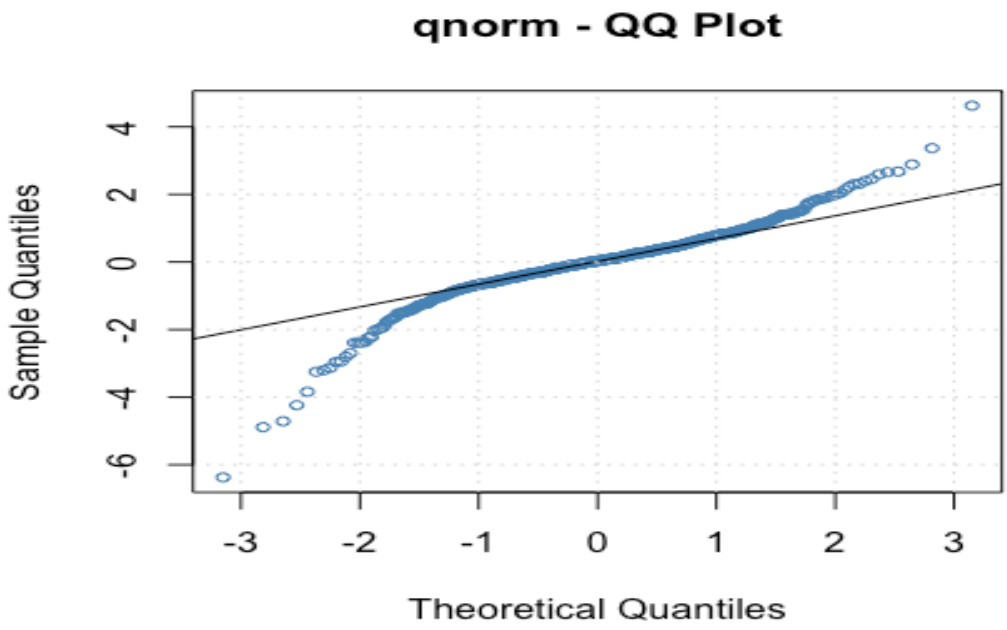


Figure 11: The QQ plots of model residuals of ARIMA-GARCH process.

Codes:

```
rm(list = ls(all = TRUE))
graphics.off()

# install and load packages
libraries = c("forecast", "fGarch")
lapply(libraries, function(x) if (!(x %in% installed.packages())) {
    install.packages(x)
})
lapply(libraries, library, quietly = TRUE, character.only = TRUE)

# load dataset
load(file.choose())
ret = diff(log(crix1))

# vol cluster
fit202 = arima(ret, order = c(2, 0, 2))
```

```
par(mfrow = c(1, 1))
res = fit202$residuals
res2 = fit202$residuals^2

# different garch model
fg11 = garchFit(data = res, data ~ garch(1, 1))
summary(fg11)
fg12 = garchFit(data = res, data ~ garch(1, 2))
summary(fg12)
fg21 = garchFit(data = res, data ~ garch(2, 1))
summary(fg21)
fg22 = garchFit(data = res, data ~ garch(2, 2))
summary(fg22)

# residual plot
reszo = zoo(fg11@residuals, order.by = index(crix1))
plot(reszo, ylab = NA, lwd = 2)

par(mfrow = c(1, 2))
fg11res2 = fg11@residuals
acfres2    = acf(fg11res2, lag.max = 20, ylab = "Sample Autocorrelation",
                 main = NA, lwd = 2)
pacfres2 = pacf(fg11res2, lag.max = 20, ylab = "Sample Partial Autocorrelation",
                  main = NA, lwd = 2, ylim = c(-0.5, 0.5))

fg12res2 = fg12@residuals
acfres2    = acf(fg12res2, lag.max = 20, ylab = "Sample Autocorrelation",
                 main = NA, lwd = 2)
pacfres2 = pacf(fg12res2, lag.max = 20, ylab = "Sample Partial Autocorrelation",
                  main = NA, lwd = 2, ylim = c(-0.5, 0.5))

# qq plot
par(mfrow = c(1, 1))
```

plot(fg11, which = 13) #9,10,11,13

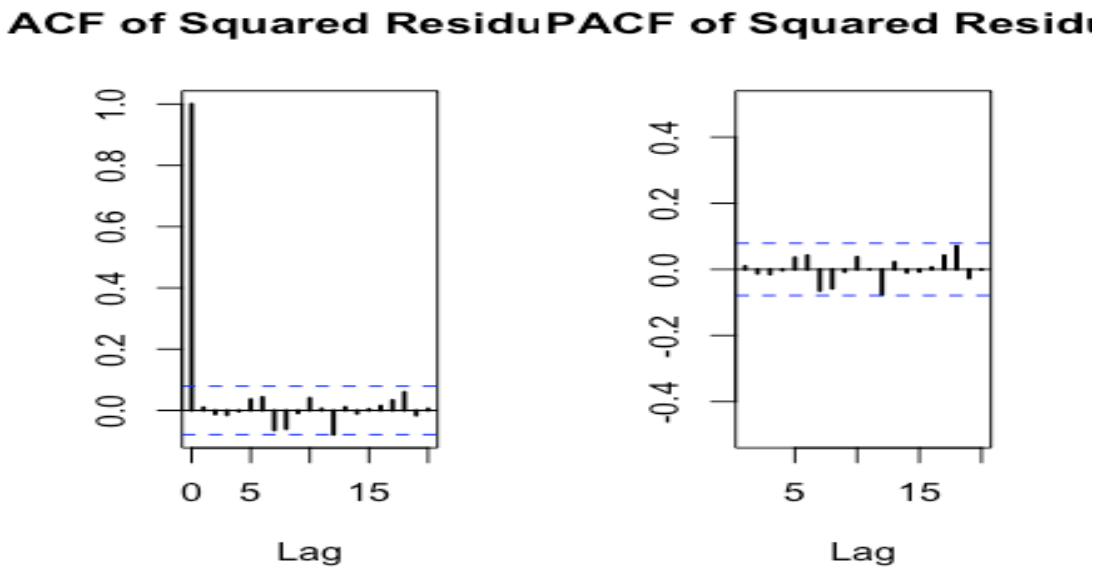


Figure 12: The ACF and PACF plots for model residuals of ARIMA(2,0,2)- t-GARCH(1,1) process.

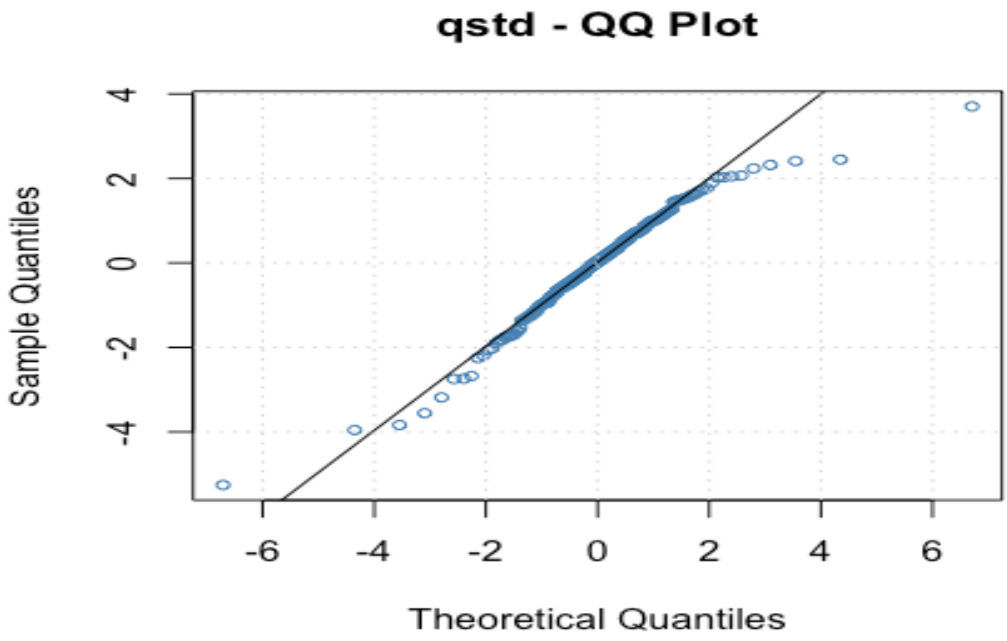


Figure 13: The QQ plots of model residuals of ARIMA-t-GARCH process.

Codes:

fg11stu = garchFit(data = res, data ~ garch(1, 1), cond.dist = "std")

```
# different forecast with t-garch
# fg11stufore = predict(fg11stu, n.ahead = 30, plot=TRUE, mse='uncond', auto.grid=FALSE)
fg11stufore = predict(fg11stu, n.ahead = 30, plot = TRUE, cond.dist = "QMLE",
                      auto.grid = FALSE)

par(mfrow = c(1, 2))
stu.fg11res2 = fg11stu@residuals

# acf and pacf for t-garch
stu.acfres2 = acf(stu.fg11res2, ylab = NA, lag.max = 20, main = "ACF of Squared Residuals",
                  lwd = 2)
stu.pacfres2 = pacf(stu.fg11res2, lag.max = 20, main = "PACF of Squared Residuals",
                    lwd = 2, ylab = NA, ylim = c(-0.5, 0.5))

# ARIMA-t-GARCH qq plot
par(mfrow = c(1, 1))
plot(fg11stu, which = 13)
```