Assignment-2.R

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2021-02-10

```
#Assignment 2
setwd("C:/R")
#install.packages("quantmod")
#install.packages("fBasics")
#install.packages("sn")
#install.packages("PerformanceAnalytics")
#install.packages("car")
#install.packages("tseries")
#install.packages("forecast")
library(quantmod)
```

```
## Loading required package: xts
```

```
## Loading required package: zoo
```

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

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

```
## Loading required package: TTR
```

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

```
library(fBasics)
```

```
## Loading required package: timeDate
```

```
## Loading required package: timeSeries
```

```
##
## Attaching package: 'timeSeries'
```

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

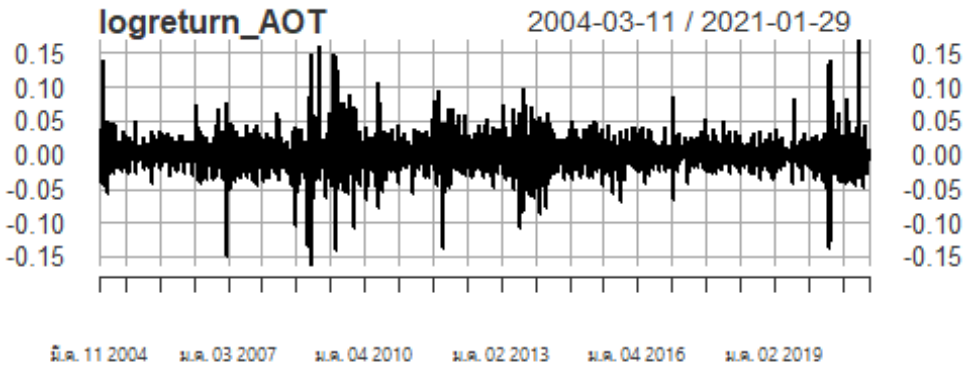
```
##
## Attaching package: 'fBasics'
```

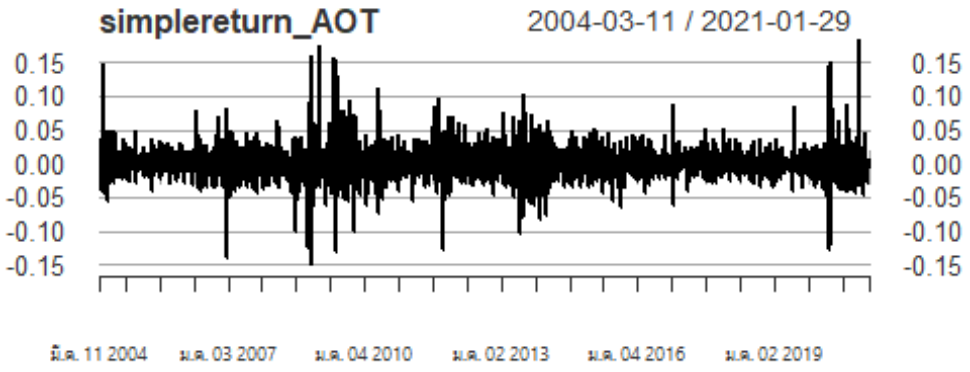
```
## The following object is masked from 'package:TTR':
##
##     volatility

library(sn)

## Loading required package: stats4

##
## Attaching package: 'sn'

## The following object is masked from 'package:fBasics':
##
##     vech

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

library(PerformanceAnalytics)

##
## Attaching package: 'PerformanceAnalytics'

## The following objects are masked from 'package:timeDate':
##
##     kurtosis, skewness

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

library(car)

## Loading required package: carData

##
## Attaching package: 'car'

## The following object is masked from 'package:fBasics':
##
##     densityPlot

library(tseries)
library(forecast)

getSymbols("AOT.BK",from="2000-01-03",to="2021-01-31")

## 'getSymbols' currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## 'loadSymbols' to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.
```

```
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.

## [1] "AOT.BK"

getSymbols("CAT",from="2000-01-03",to="2021-01-31")

## [1] "CAT"

price_AOT = AOT.BK[,6]
price_CAT = CAT[,6]
logprice_AOT = log(price_AOT)
logprice_CAT = log(price_CAT)
logreturn_AOT = diff(logprice_AOT)
logreturn_CAT = diff(logprice_CAT)
simplereturn_AOT <- exp(logreturn_AOT)-1
simplereturn_CAT <- exp(logreturn_CAT)-1
```

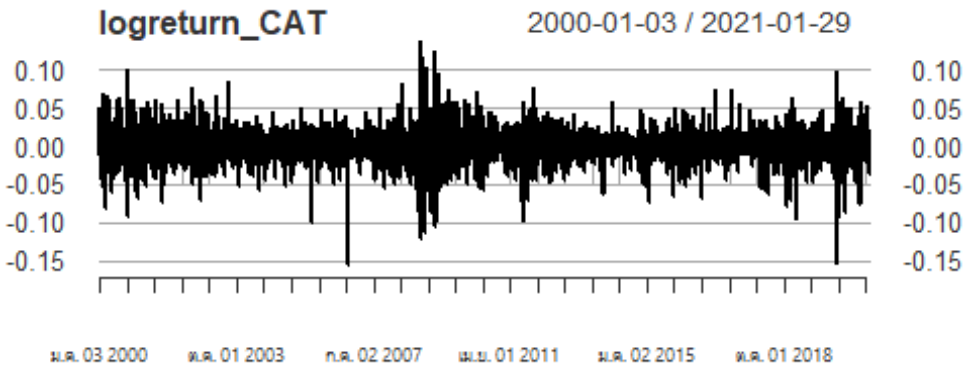
a) Calculate and plot log return and simple return

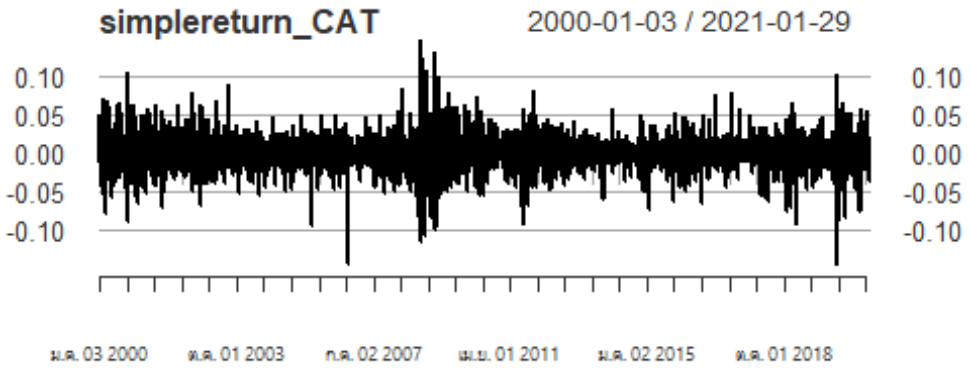
```
#a) plot AOT Return
par(mfrow=c(2,1))
plot(logreturn_AOT,type='l')
plot(simplereturn_AOT,type='l')
```






```
#a) plot CAT Return
par(mfrow=c(2,1))
plot(logreturn_CAT,type='l')
plot(simplereturn_CAT,type='l')
```






```
#b) sample statistics for simple return
table.Stats(simplereturn_AOT)

##                  AOT.BK.Adjusted
## Observations          4158.0000
## NAs                      1.0000
## Minimum                 -0.1505
## Quartile 1              -0.0093
## Median                   0.0000
## Arithmetic Mean          0.0010
## Geometric Mean           0.0007
## Quartile 3               0.0103
## Maximum                  0.1834
## SE Mean                  0.0003
## LCL Mean (0.95)          0.0003
## UCL Mean (0.95)          0.0016
## Variance                 0.0005
## Stdev                    0.0213
## Skewness                 0.5443
## Kurtosis                10.0827

table.Stats(simplereturn_CAT)

##                  CAT.Adjusted
## Observations       5302.0000
## NAs                   1.0000
## Minimum              -0.1452
```

b)

AOT stock's simple return

Sample mean: 0.0010
Standard deviation: 0.0213
Skewness: 0.5443
Excess kurtosis: 10.0827
Minimum: -0.1505
Maximum: 0.1834

CAT stock's simple return

Sample mean: 0.0007
Standard deviation: 0.0205
Skewness: 0.0197
Excess kurtosis: 4.5480
Minimum: -0.1452
Maximum: 0.1472

```
## Quartile 1           -0.0095
## Median                0.0005
## Arithmetic Mean       0.0007
## Geometric Mean        0.0005
## Quartile 3            0.0110
## Maximum               0.1472
## SE Mean               0.0003
## LCL Mean (0.95)       0.0001
## UCL Mean (0.95)       0.0013
## Variance              0.0004
## Stdev                 0.0205
## Skewness              0.0197
## Kurtosis              4.5480
```

```
#new return
nlogreturn_AOT = logreturn_AOT[2:nrow(logreturn_AOT)]
nlogreturn_CAT = logreturn_CAT[2:nrow(logreturn_CAT)]
nsimplereturn_AOT = simplereturn_AOT[2:nrow(logreturn_AOT)]
nsimplereturn_CAT = simplereturn_CAT[2:nrow(logreturn_CAT)]

#c) test for normal distribution
jarque.bera.test(nsimplereturn_CAT)
```

```
##
##  Jarque Bera Test
##
## data:  nsimplereturn_CAT
## X-squared = 4569.9, df = 2, p-value < 2.2e-16
```

c) The simple return of Caterpillar stock is not normally distributed.

JB test
H0: Simple return is normally distributed.
H1: Simple return is not normally distributed.

According to Jarque-Bera test, we need to reject H0 since the calculated p-value that is close to 0 is less than 0.05. Therefore, the simple return of CAT is not normally distributed with 95% level of significance.

```
#d) sample statistics for log return
table.Stats(logreturn_AOT)
```

```
##                  AOT.BK.Adjusted
## Observations          4158.0000
## NAs                      1.0000
## Minimum                 -0.1632
## Quartile 1              -0.0093
## Median                   0.0000
## Arithmetic Mean          0.0007
## Geometric Mean           0.0005
## Quartile 3               0.0102
## Maximum                  0.1684
## SE Mean                  0.0003
## LCL Mean (0.95)          0.0001
## UCL Mean (0.95)          0.0014
## Variance                 0.0004
## Stdev                    0.0212
## Skewness                 0.1746
## Kurtosis                 9.6096
```

d) Log return

AOT's log return

Sample mean: 0.0007
Standard deviation: 0.0212
Skewness: 0.1746
Excess kurtosis: 9.6096
Minimum: -0.1632
Maximum: 0.1684

CAT's log return

Sample mean: 0.0005
Standard deviation: 0.0205
Skewness: -0.1836
Excess kurtosis: 4.6982
Minimum: -0.1569
Maximum: 0.1373

```
table.Stats(logreturn_CAT)
```

```
##                  CAT.Adjusted
## Observations       5302.0000
## NAs                   1.0000
## Minimum              -0.1569
## Quartile 1           -0.0095
## Median                0.0005
## Arithmetic Mean       0.0005
## Geometric Mean        0.0003
## Quartile 3            0.0110
## Maximum               0.1373
## SE Mean               0.0003
## LCL Mean (0.95)      -0.0001
## UCL Mean (0.95)       0.0010
## Variance              0.0004
## Stdev                 0.0205
## Skewness             -0.1836
## Kurtosis              4.6982
```

```
#e) hypotesis testing Test mean = 0
t.test(nlogreturn_CAT)
```

```
## Warning in tstat + c(-cint, cint): Recycling array of length 1 in array-ve
ctor arithmetic is deprecated.
##   Use c() or as.vector() instead.

## Warning in cint * stderr: Recycling array of length 1 in vector-array arit
hmetic is deprecated.
##   Use c() or as.vector() instead.
```

```
##
##  One Sample t-test
##
## data:  nlogreturn_CAT
## t = 1.7296, df = 5301, p-value = 0.08377
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -6.513168e-05  1.041069e-03
## sample estimates:
##    mean of x
## 0.0004879685
```

e) Caterpillar stock

H0: Mean of log return of CAT is equal to zero.
H1: Mean of log return is not equal to zero.
Since the p-value (p-value = 0.08377) is higher than 0.05, we cannot reject the null hypothesis in this case. Therefore, the mean of log return of CAT stock is equal to zero with 95% level of significance.

```
t.test(nlogreturn_AOT)
```

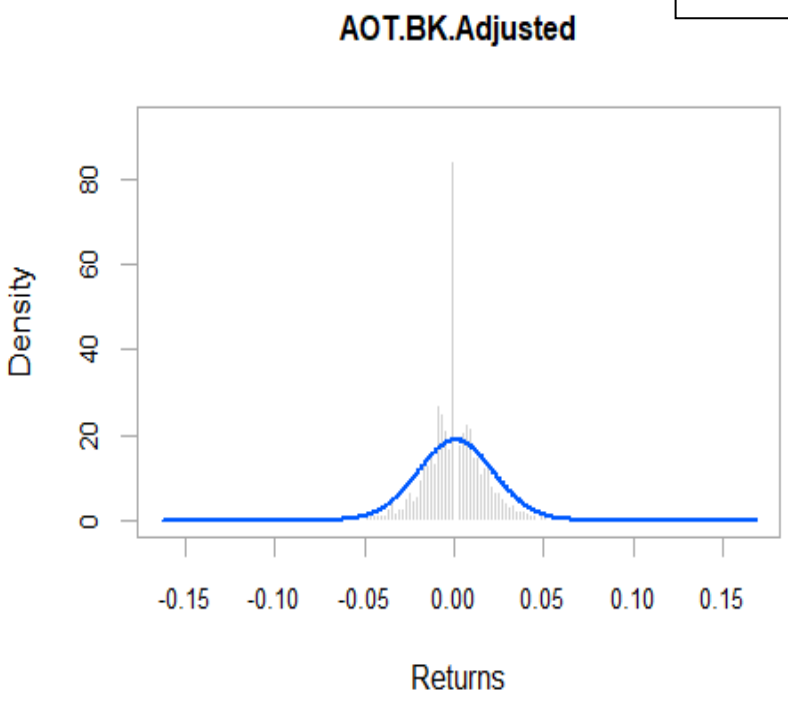
```
## Warning in tstat + c(-cint, cint): Recycling array of length 1 in array-ve
ctor arithmetic is deprecated.
##   Use c() or as.vector() instead.

## Warning in tstat + c(-cint, cint): Recycling array of length 1 in vector-a
rray arithmetic is deprecated.
##   Use c() or as.vector() instead.

##
##  One Sample t-test
##
## data:  nlogreturn_AOT
## t = 2.2696, df = 4157, p-value = 0.02328
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.0001016629 0.0013915769
## sample estimates:
##    mean of x
## 0.0007466199
```

e) AOT stock

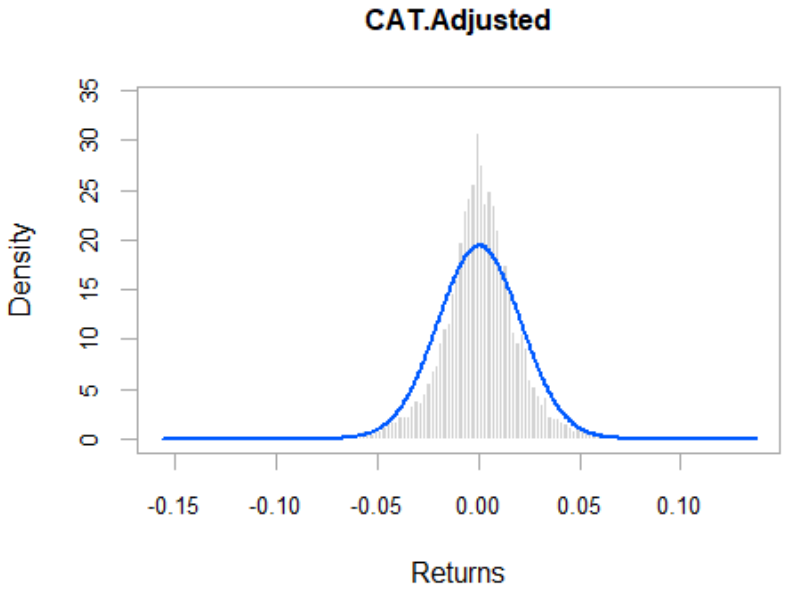
H0: Mean of log return of AOT is equal to zero.
H1: Mean of log return is not equal to zero.
Since p-value (p-value = 0.02328) is less than 0.05, we reject the null hypothesis in this case. Therefore, the mean of log return of AOT stock is not equal to zero with 95% level of significance.

```
#f) density plot of daily log return
par(mfrow=c(1,1))
chart.Histogram(logreturn_AOT, methods = c("add.normal"))
```

f) Plot the density of daily log return




```
chart.Histogram(logreturn_CAT, methods = c("add.normal"))
```



```
#g) 95% confidence interval for daily log return of CAT stock
t.test(nlogreturn_CAT)

## Warning in tstat + c(-cint, cint): Recycling array of length 1 in array-ve
ctor arithmetic is deprecated.
##   Use c() or as.vector() instead.

## Warning in tstat + c(-cint, cint): Recycling array of length 1 in vector-a
rray arithmetic is deprecated.
##   Use c() or as.vector() instead.

##
##  One Sample t-test
##
## data:  nlogreturn_CAT
## t = 1.7296, df = 5301, p-value = 0.08377
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -6.513168e-05  1.041069e-03
## sample estimates:
##    mean of x
## 0.0004879685
```

g) 95 percent confidence interval for daily log return of CAT stock is between -6.513168e-05 and 1.041069e-03

```
#h) Test skewness = 0
T=length(nlogreturn_AOT)
m3 = skewness(nlogreturn_AOT)
tst = m3/sqrt(6/T)
tst
```

h) Test skewness = 0

H0: log return of AOT is symmetry; m3 = 0
H1: log return of AOT is not symmetry; m3 ≠ 0
Since the calculated S* is exceeding the critical value of 1.96, we reject the null hypothesis and conclude that AOT log return is not symmetry.

```
#i) Test excess kurtosis = 0
K=kurtosis(nlogreturn_AOT)
K

## [1] 9.609572

tst_K = K/sqrt(24/T)
tst_K

## [1] 126.4855
```

h) Test excess kurtosis = 0

H0: $K(r_t)$ -3 = 0
H1: $K(r_t)$ – 3 ≠ 0
Since the calculated K* is exceeding the critical value of 1.96, we reject the null hypothesis and conclude that the excess kurtosis of AOT log return is not equal to zero.

```
# test skewness and kurtosis of CAT stock
T_CAT=length(nlogreturn_CAT)
m3_CAT=skewness(nlogreturn_CAT)
tst_CAT = m3_CAT/sqrt(6/T_CAT)
tst_CAT
```

```
## [1] -5.458812
```

```
K_CAT=kurtosis(nlogreturn_CAT)
tst_K_CAT = K_CAT/sqrt(24/T_CAT)
tst_K_CAT
```

```
## [1] 69.83078
```