Assignment-3.R.

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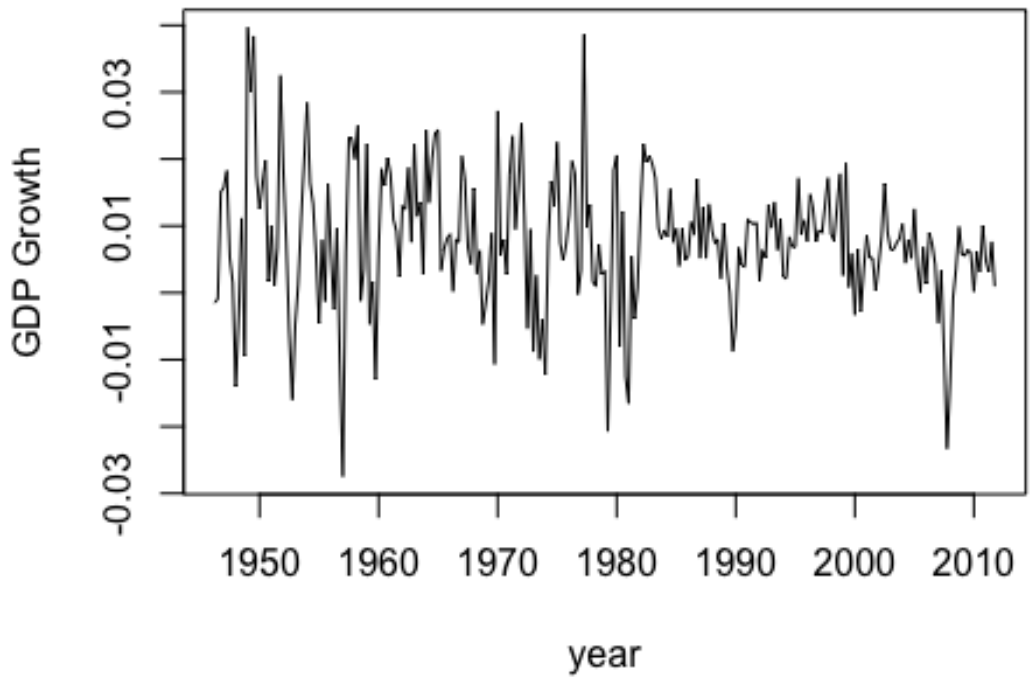
```
setwd("/Users/to_on/Desktop/EE435")
da <- read.table("q-gdpmc1.txt", header = TRUE)

#1.a
GDP=da[,4]
logGDP=log(GDP)
growthGDP=diff(logGDP)
length(growthGDP)
```

```
## [1] 263
```

```
tdx=c(1:263)/4+1946
plot(tdx,growthGDP,xlab="year",ylab="GDP Growth",type='l')
```




```
#1.b
Box.test(growthGDP,lag=12,type='Ljung')
```

```
##
##  Box-Ljung test
##
## data:  growthGDP
## X-squared = 64.259, df = 12, p-value = 3.737e-09
```

$H_0: \rho_1=\rho_2=\rho_3=\ldots=\rho_{12}=0$

$H_a: \exists \rho_I \neq 0$ for $I \in [1,12]$

The computed p-value<0.05. Then,we reject the null hypothesis at 0.05 level of significance. It mean that at least one of the serial correlation is not equal to 0 with 95% CI. meaning variation of the past information cannot explain variation of current GDP growth.

```
#1.c
t.test(growthGDP)

##
##  One Sample t-test
##
## data:  growthGDP
## t = 12.786, df = 262, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.006573382 0.008966545
## sample estimates:
##   mean of x
## 0.007769964
```

$H_0: \mu = 0$

$H_a: \mu \neq 0$

The computed p-value<0.05. Then, we reject the null hypothesis at 0.05 level of significance. It mean that mean of the GDP growth is not equal to 0 with 95% CI.

```
#2.a
da <- read.table("d-amzn3dx.txt",header = TRUE)
amzn=da[,2]
VW=da[,3]
EW=da[,4]
SP=da[,5]
basicStats(amzn) simple return of Amazon Stock

##                     amzn
## nobs        1259.000000
## NAs            0.000000
## Minimum       -0.127820
```

```
## Maximum         0.267951
## 1. Quartile    -0.013195
## 3. Quartile     0.014571
## Mean            0.001207
## Median         -0.000451
## Sum             1.519912
## SE Mean         0.000820
## LCL Mean       -0.000401
## UCL Mean        0.002816
## Variance        0.000846
## Stdev           0.029087
## Skewness        1.031884
## Kurtosis        9.360219 (Excess Kurtosis)

basicStats(VW) simple return of CRSP value-weighted index

##                      VW
## nobs        1259.000000
## NAs            0.000000
## Minimum       -0.089763
## Maximum        0.114895
## 1. Quartile   -0.006328
## 3. Quartile    0.007376
## Mean           0.000210
## Median         0.000818
## Sum            0.264749
## SE Mean        0.000469
## LCL Mean      -0.000710
## UCL Mean       0.001130
## Variance       0.000277
## Stdev          0.016641
## Skewness      -0.113083
## Kurtosis       6.298940 (Excess Kurtosis)

basicStats(EW) simple return of CRSP equal-weighted index

##                      EW
## nobs        1259.000000
## NAs            0.000000
## Minimum       -0.078240
## Maximum        0.107422
## 1. Quartile   -0.006365
## 3. Quartile    0.007780
## Mean           0.000517
## Median         0.001210
## Sum            0.651089
## SE Mean        0.000434
## LCL Mean      -0.000334
## UCL Mean       0.001368
## Variance       0.000237
## Stdev          0.015395
```

```
## Skewness       -0.168185
## Kurtosis        5.275824 (Excess Kurtosis)
```

```
basicStats(SP) simple return of S&P composite index
```

```
##                      SP
## nobs        1259.000000
## NAs            0.000000
## Minimum       -0.090350
## Maximum        0.115800
## 1. Quartile   -0.006301
## 3. Quartile    0.006978
## Mean           0.000114
## Median         0.000685
## Sum            0.143876
## SE Mean        0.000467
## LCL Mean      -0.000802
## UCL Mean       0.001031
## Variance       0.000275
## Stdev          0.016573
## Skewness      -0.018307
## Kurtosis       7.154386 (Excess Kurtosis)
```

```
#2.b
logamzn=log(1+amzn)
basicStats(logamzn) Log return of Amazon Stock
```

```
##                 logamzn
## nobs        1259.000000
## NAs            0.000000
## Minimum       -0.136759
## Maximum        0.237402
## 1. Quartile   -0.013283
## 3. Quartile    0.014466
## Mean           0.000791
## Median        -0.000451
## Sum            0.996211
## SE Mean        0.000810
## LCL Mean      -0.000798
## UCL Mean       0.002380
## Variance       0.000826
## Stdev          0.028736
## Skewness       0.627148
## Kurtosis       7.249289
```

```
logVW=log(1+VW)
basicStats(logVW) Log return of CRSP value-weighted index
```

```
##                    logVW
## nobs         1259.000000
## NAs             0.000000
## Minimum        -0.094050
## Maximum         0.108760
## 1. Quartile    -0.006348
## 3. Quartile     0.007348
## Mean            0.000072
## Median          0.000818
## Sum             0.090160
## SE Mean         0.000470
## LCL Mean       -0.000850
## UCL Mean        0.000993
## Variance        0.000278
## Stdev           0.016673
## Skewness       -0.317276
## Kurtosis        6.194861
```

```
logEW=log(1+EW)
basicStats(logEW) log return of CRSP equal-weighted index
```

```
##                    logEW
## nobs         1259.000000
## NAs             0.000000
## Minimum        -0.081470
## Maximum         0.102035
## 1. Quartile    -0.006385
## 3. Quartile     0.007749
## Mean            0.000398
## Median          0.001209
## Sum             0.501599
## SE Mean         0.000435
## LCL Mean       -0.000454
## UCL Mean        0.001251
## Variance        0.000238
## Stdev           0.015420
## Skewness       -0.333442
## Kurtosis        5.193084
```

```
logSP=log(1+SP)
basicStats(logSP) log return of S&P composite index
```

```
##                    logSP
## nobs         1259.000000
## NAs             0.000000
## Minimum        -0.094695
## Maximum         0.109572
## 1. Quartile    -0.006320
## 3. Quartile     0.006954
## Mean           -0.000023
## Median          0.000685
```

```
## Sum           -0.029133
## SE Mean        0.000468
## LCL Mean      -0.000941
## UCL Mean       0.000894
## Variance       0.000275
## Stdev          0.016594
## Skewness      -0.242090
## Kurtosis       6.952089
```

```
#2.c
t.test(logamzn)
```

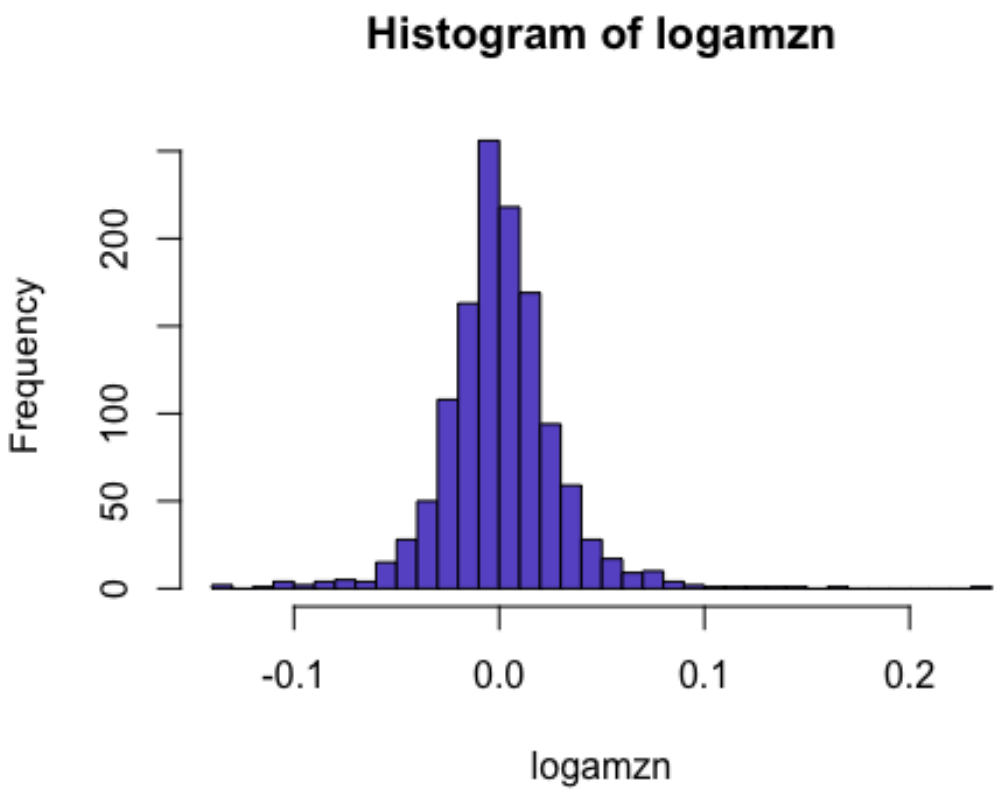
```
##
##  One Sample t-test
##
## data:  logamzn
## t = 0.97705, df = 1258, p-value = 0.3287
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.0007975567  0.0023801007
## sample estimates:
##   mean of x
## 0.000791272
```

$H_0: \mu = 0$

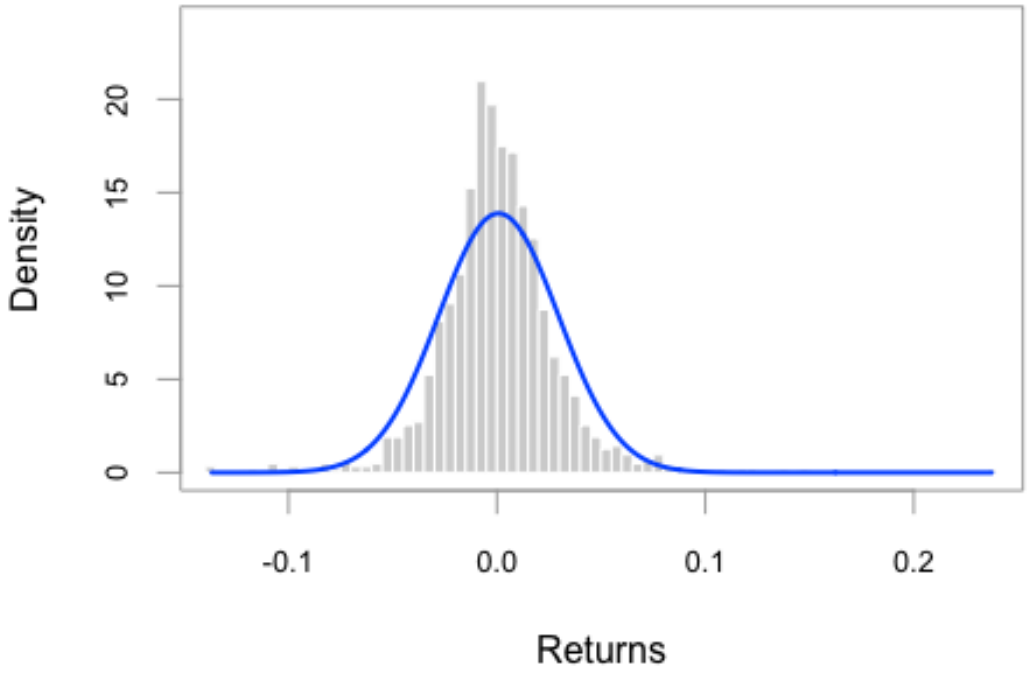
$H_a: \mu \neq 0$

The computed p-value>0.05. Then, we can not reject the null hypothesis at 0.05 level of significance. It mean that mean of the Amazon Stock's log return is equal to 0 with 95% CI.

```
#2.d
hist(logamzn, breaks=40, col="slateblue")
```




```
chart.Histogram(logamzn,method = c("add.normal"))
```




```
#3.a
da <- read.table("m-abt3dx.txt",header = TRUE)
ABT=da[,2]
VW=da[,3]
EW=da[,4]
SP=da[,5]
basicStats(ABT) Monthly return of Abbott Laboratories

##                     ABT
## nobs         492.000000
## NAs            0.000000
## Minimum       -0.234146
## Maximum        0.382326
## 1. Quartile   -0.024230
## 3. Quartile    0.055840
## Mean           0.014073
## Median         0.014083
## Sum            6.923863
## SE Mean        0.002921
## LCL Mean       0.008333
## UCL Mean       0.019812
## Variance       0.004198
## Stdev          0.064795
```

```
## Skewness      0.097058
## Kurtosis      2.469971
```

```
basicStats(VW)  Monthly return of CRSP value-weighted index
```

```
##                     VW
## nobs        492.000000
## NAs           0.000000
## Minimum      -0.225363
## Maximum       0.165585
## 1. Quartile  -0.017196
## 3. Quartile   0.039484
## Mean          0.009020
## Median        0.012626
## Sum           4.437612
## SE Mean       0.002089
## LCL Mean      0.004915
## UCL Mean      0.013124
## Variance      0.002147
## Stdev         0.046341
## Skewness     -0.555341
## Kurtosis      2.073657
```

```
basicStats(EW) Monthly return of CRSP equal-weighted index
```

```
##                     EW
## nobs        492.000000
## NAs           0.000000
## Minimum      -0.272248
## Maximum       0.299260
## 1. Quartile  -0.020694
## 3. Quartile   0.044462
## Mean          0.011583
## Median        0.014379
## Sum           5.699074
## SE Mean       0.002583
## LCL Mean      0.006508
## UCL Mean      0.016659
## Variance      0.003283
## Stdev         0.057299
## Skewness     -0.200025
## Kurtosis      3.288104
```

```
basicStats(SP) Monthly return of S&P composite index
```

```
##                     SP
## nobs        492.000000
## NAs           0.000000
## Minimum      -0.217630
## Maximum       0.163047
## 1. Quartile  -0.018948
```

```
## 3. Quartile   0.035349
## Mean          0.006386
## Median        0.009091
## Sum           3.142113
## SE Mean       0.002019
## LCL Mean      0.002419
## UCL Mean      0.010354
## Variance      0.002006
## Stdev         0.044788
## Skewness     -0.444303
## Kurtosis      1.889777

#3.b
logABT=log(1+ABT)
basicStats(logABT) log return of Abbott Laboratories

##                 logABT
## nobs        492.000000
## NAs           0.000000
## Minimum      -0.266764
## Maximum       0.323768
## 1. Quartile  -0.024528
## 3. Quartile   0.054337
## Mean          0.011924
## Median        0.013985
## Sum           5.866748
## SE Mean       0.002898
## LCL Mean      0.006230
## UCL Mean      0.017619
## Variance      0.004133
## Stdev         0.064287
## Skewness     -0.297125
## Kurtosis      2.005416

logVW=log(1+VW)
basicStats(logVW) log return of CRSP value-weighted index

##                  logVW
## nobs        492.000000
## NAs           0.000000
## Minimum      -0.255361
## Maximum       0.153223
## 1. Quartile  -0.017345
## 3. Quartile   0.038724
## Mean          0.007903
## Median        0.012547
## Sum           3.888033
## SE Mean       0.002107
## LCL Mean      0.003762
## UCL Mean      0.012043
## Variance      0.002185
```

```
## Stdev          0.046745
## Skewness      -0.839542
## Kurtosis       3.003331
```

```
logEW=log(1+EW)
basicStats(logEW) log return of CRSP equal-weighted index
```

```
##                   logEW
## nobs         492.000000
## NAs            0.000000
## Minimum       -0.317795
## Maximum        0.261795
## 1. Quartile   -0.020911
## 3. Quartile    0.043501
## Mean           0.009887
## Median         0.014277
## Sum            4.864341
## SE Mean        0.002592
## LCL Mean       0.004794
## UCL Mean       0.014979
## Variance       0.003305
## Stdev          0.057491
## Skewness      -0.662276
## Kurtosis       3.976081
```

```
logSP=log(1+SP)
basicStats(logSP) log return of S&P composite index
```

```
##                   logSP
## nobs         492.000000
## NAs            0.000000
## Minimum       -0.245428
## Maximum        0.151043
## 1. Quartile   -0.019130
## 3. Quartile    0.034738
## Mean           0.005360
## Median         0.009050
## Sum            2.636920
## SE Mean        0.002035
## LCL Mean       0.001361
## UCL Mean       0.009359
## Variance       0.002038
## Stdev          0.045145
## Skewness      -0.711215
## Kurtosis       2.659018
```

```
#3.c
t.test(logABT)
```

```
##
##  One Sample t-test
```

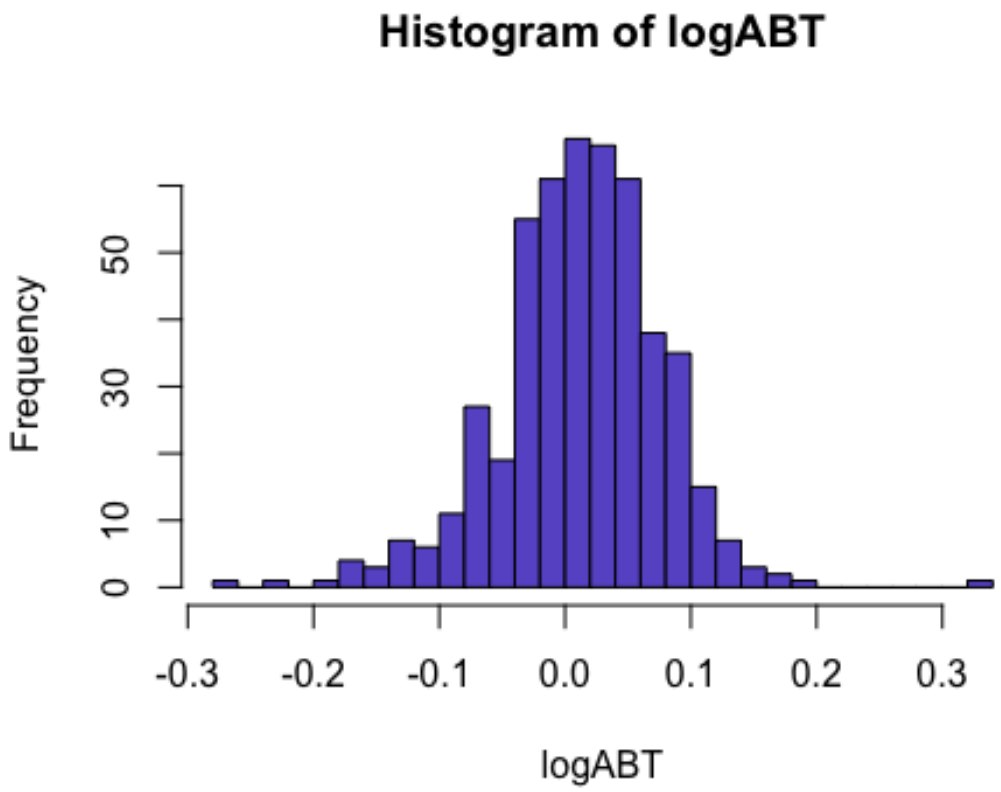
```
##
## data:  logABT
## t = 4.1143, df = 491, p-value = 4.555e-05
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.006229721 0.017618849
## sample estimates:
##  mean of x
## 0.01192429
```

$H_0: \mu = 0$

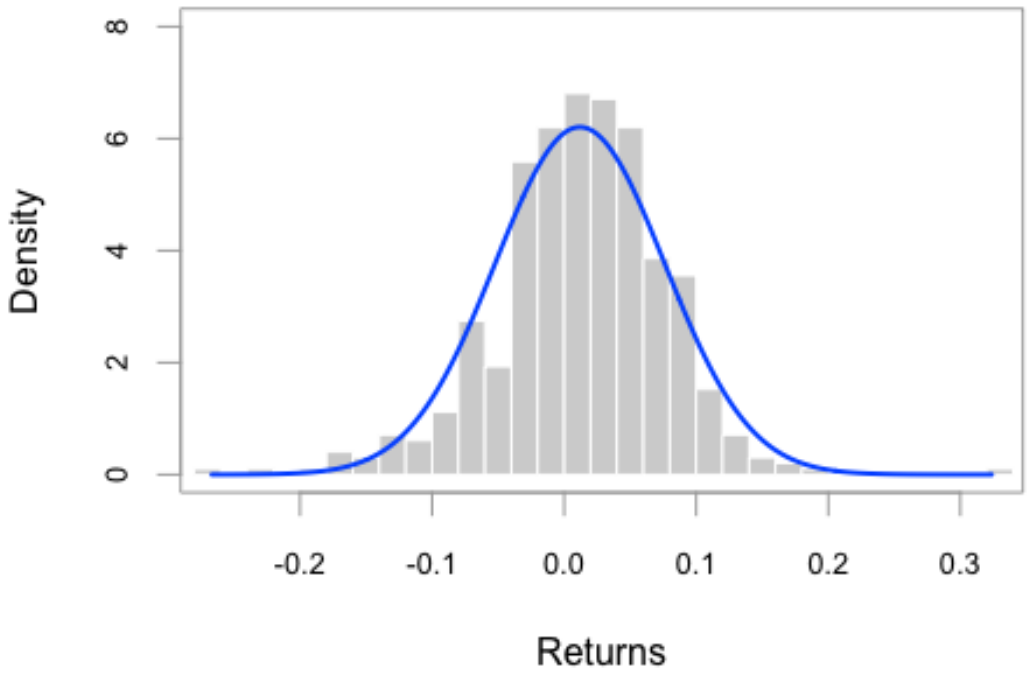
$H_a: \mu \neq 0$

The computed p-value<0.05. Then, we reject the null hypothesis at 0.05 level of significance. It mean that mean of Abbott Laboratories Stock log return is not equal to 0 with 95% CI.

```
#3.d
hist(logABT, breaks=40, col="slateblue")
```




```
chart.Histogram(logABT,method = c("add.normal"))
```




```
#4
da <- read.table("m-abt3dx.txt",header = TRUE)
VW=da[,3]
#4.a
t.test(VW)

##
##  One Sample t-test
##
## data:  VW
## t = 4.3172, df = 491, p-value = 1.912e-05
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.004914667 0.013124406
## sample estimates:
##   mean of x
## 0.009019537
```

$H_0: \mu = 0$

$H_a: \mu \neq 0$

The computed p-value < 0.05. Then, we reject the null hypothesis at 0.05 level of significance. It mean that mean of Monthly return of CRSP value-weighted index is not equal to 0 with 95% CI.

```
#4.b
m3=skewness(VW)
T=length(VW)
tst=m3/sqrt(6/T)
tst
```

```
## [1] -5.044201
```

```
pv=2*pnorm(tst)
pv
```

```
## [1] 4.55421e-07
```

H_0:skewness = 0

H_a:skewness ≠ 0

The computed p-value < 0.05. Then, we reject the null hypothesis at 0.05 level of significance. It mean that the skewness of Monthly return of CRSP value-weighted index is not equal to 0 with 95% CI.

```
#4.c
k4=kurtosis(VW)
tst=k4/sqrt(24/T)
tst
```

```
## [1] 9.482548
```

```
pv=2*(1-pnorm(tst))
pv
```

```
## [1] 0
```

H_0:kurtosis = 3

H_a:kurtosis ≠ 3

The computed p-value < 0.05. Then, we reject the null hypothesis at 0.05 level of significance. It mean that the kurtosis of Monthly return of CRSP value-weighted index is not equal to 3 with 95% CI.

```
#5
da <- read.table("d-amzn3dx.txt",header = TRUE)
amzn=da[,2]
logamzn=log(1+amzn)
```

```r
#(i)
s3=skewness(logamzn)
T=length(logamzn)
tst=s3/sqrt(6/T)
tst
```

```
## [1] 9.095459
```

```r
pv=2*(1-pnorm(tst))
pv
```

```
## [1] 0
```

H_0:skewness = 0

H_a:skewness ≠ 0

The computed p-value < 0.05. Then, we reject the null hypothesis at 0.05 leve
l of significance. It mean that the skewness of log return of amazon stock is
not equal to 0 with 95% CI meaning the distribution is non-symmetric.

```r
#(ii)
k4=kurtosis(logamzn)
T=length(logamzn)
tst=k4/sqrt(24/T)
tst
```

```
## [1] 52.62331
```

```r
pv=2*(1-pnorm(tst))
pv
```

```
## [1] 0
```

H_0:Excess kurtosis = 0

H_a:Excess kurtosis ≠ 0

The computed p-value < 0.05. Then, we reject the null hypothesis at 0.05 leve
l of significance. It mean that the kurtosis of log return of amazon stock is
not equal to 3 with 95% CI.

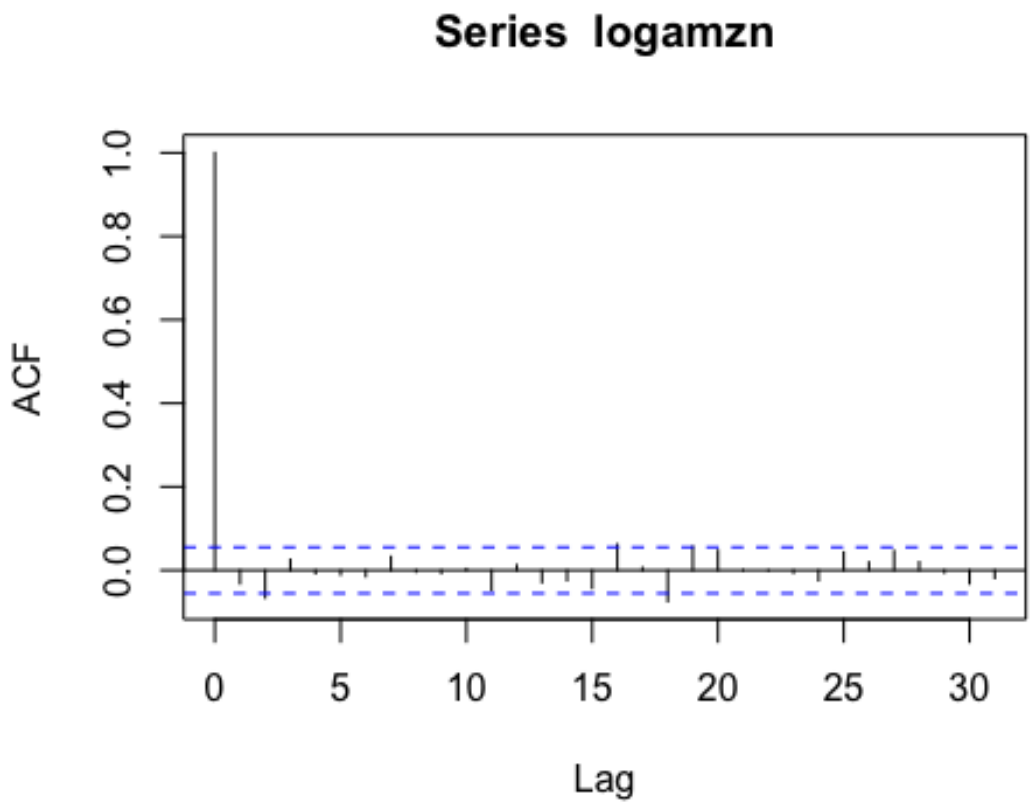
```r
#(iii)
t.test(logamzn)
```

```
##
##  One Sample t-test
##
```

```
## data:  logamzn
## t = 0.97705, df = 1258, p-value = 0.3287
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.0007975567  0.0023801007
## sample estimates:
##   mean of x
## 0.000791272
```

95% confidence interval of expected log return of amazon is [-0.0007975567 ,0.0023801007]

```
#5.b
m1=acf(logamzn)
```

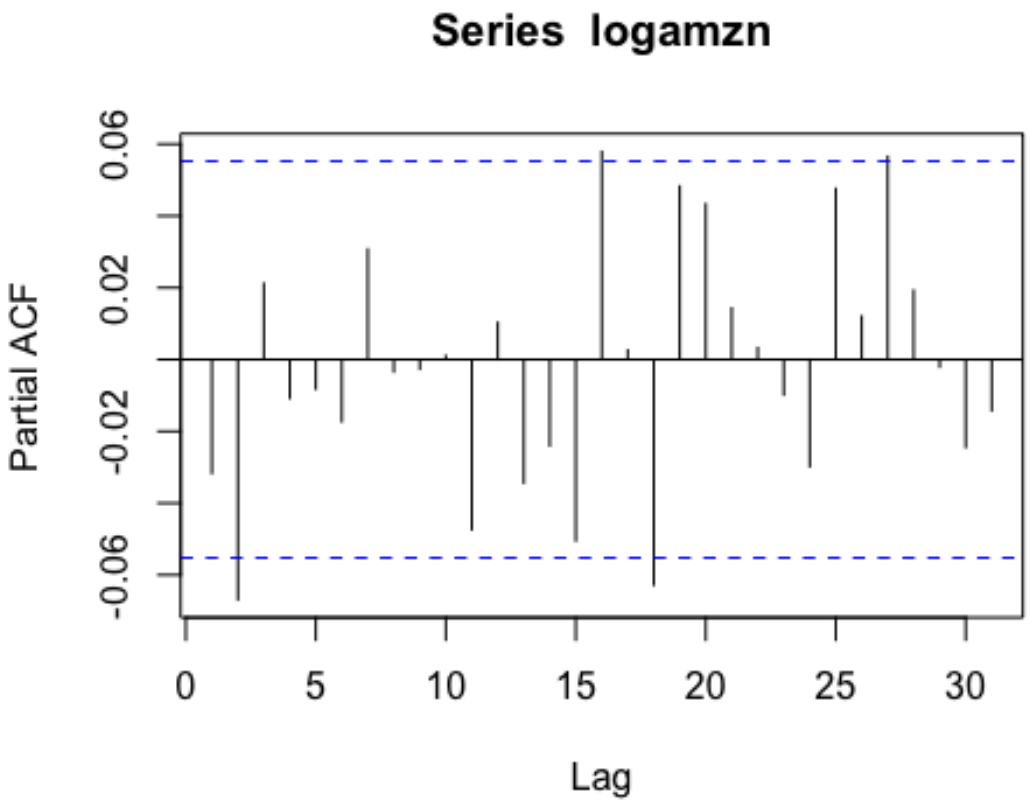



```
m1$acf

## , , 1
##
##                [,1]
##  [1,]  1.0000000000
##  [2,] -0.0316614625
##  [3,] -0.0657963636
```

```
##  [4,]  0.0254218662
##  [5,] -0.0078449975
##  [6,] -0.0106049170
##  [7,] -0.0148006161
##  [8,]  0.0323683041
##  [9,] -0.0036167194
## [10,] -0.0071029841
## [11,]  0.0036460656
## [12,] -0.0470650529
## [13,]  0.0124225728
## [14,] -0.0292344042
## [15,] -0.0243312999
## [16,] -0.0427496969
## [17,]  0.0620802986
## [18,]  0.0061473042
## [19,] -0.0744147656
## [20,]  0.0568749860
## [21,]  0.0471836320
## [22,]  0.0003109035
## [23,] -0.0006986516
## [24,] -0.0062326764
## [25,] -0.0244831099
## [26,]  0.0430134379
## [27,]  0.0192213377
## [28,]  0.0464068477
## [29,]  0.0197592080
## [30,] -0.0055967072
## [31,] -0.0317808897
## [32,] -0.0189335815
```

```
m2=pacf(logamzn)
```




```
m2$acf
```

```
## , , 1
##
##               [,1]
##  [1,] -0.031661462
##  [2,] -0.066865841
##  [3,]  0.021198224
##  [4,] -0.010767266
##  [5,] -0.008175617
##  [6,] -0.017271554
##  [7,]  0.030726846
##  [8,] -0.003403192
##  [9,] -0.002629988
## [10,]  0.001032256
## [11,] -0.047363651
## [12,]  0.010284023
## [13,] -0.034370971
## [14,] -0.024008840
## [15,] -0.050490587
## [16,]  0.057915450
## [17,]  0.002614565
## [18,] -0.062793034
```

```
## [19,]  0.048259706
## [20,]  0.043316077
## [21,]  0.014313942
## [22,]  0.003269419
## [23,] -0.009825781
## [24,] -0.029795895
## [25,]  0.047586551
## [26,]  0.012023445
## [27,]  0.056509305
## [28,]  0.019236094
## [29,] -0.002035994
## [30,] -0.024437113
## [31,] -0.014212519
```

```
Box.test(logamzn,lag=12,type='Ljung')
```

```
##
##  Box-Ljung test
##
## data:  logamzn
## X-squared = 12.488, df = 12, p-value = 0.4073
```

$H_0: \rho_1=\rho_2=\rho_3=\ldots=\rho_{12}=0$

$H_a: \exists \rho_I \neq 0$ for $I \in [1,12]$

The computed p-value > 0.05. Then, we can not reject the null hypothesis at 0.05 level of significance. It mean that all of the serial correlation is equal to 0 with 95% CI meaning variation of the past information cannot explain variation of current log return.

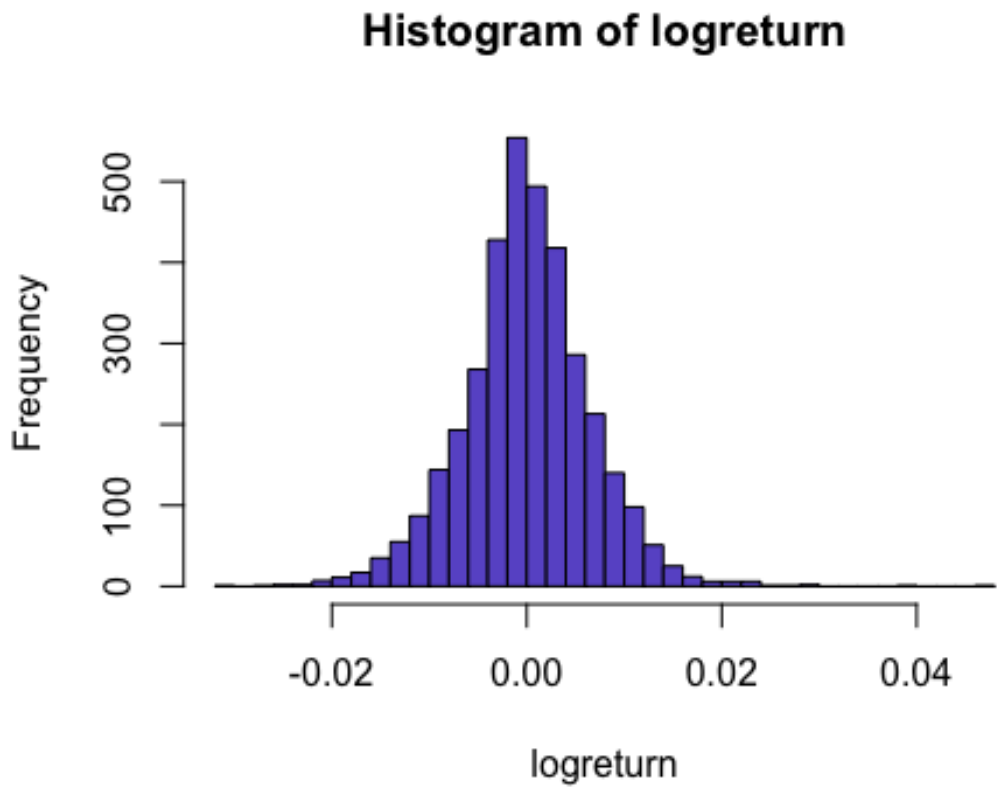
```
#6.a
da <- read.table("d-exuseu.txt",header = TRUE)
rate=da[,4]
lograte=log(rate)
logreturn=diff(lograte)

#6.b
basicStats(logreturn)
```

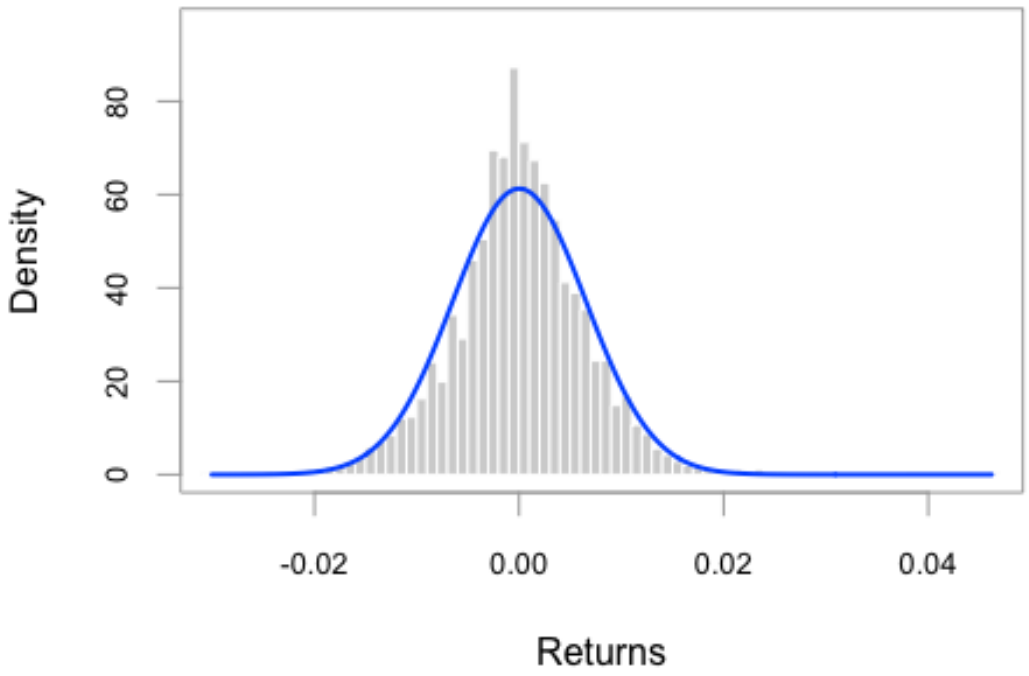
```
##               logreturn
## nobs        3566.000000
## NAs            0.000000
## Minimum       -0.030031
## Maximum        0.046208
## 1. Quartile   -0.003585
## 3. Quartile    0.003767
## Mean           0.000027
## Median         0.000000
```

```
## Sum             0.095218
## SE Mean         0.000109
## LCL Mean       -0.000187
## UCL Mean        0.000240
## Variance        0.000042
## Stdev           0.006511
## Skewness        0.116750
## Kurtosis        2.058184
```

```r
#6.c
hist(logreturn, breaks=40, col="slateblue")
```




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




```
#6.d
t.test(logreturn)

##
##  One Sample t-test
##
## data:  logreturn
## t = 0.24489, df = 3565, p-value = 0.8066
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.0001870737  0.0002404769
## sample estimates:
##    mean of x
## 2.670158e-05
```

$H_0: \mu = 0$

$H_a: \mu \neq 0$

The computed p-value > 0.05. Then, we can not reject the null hypothesis at 0.05 level of significance. It mean that mean of log return is equal to 0 with 95% CI.