6104640542
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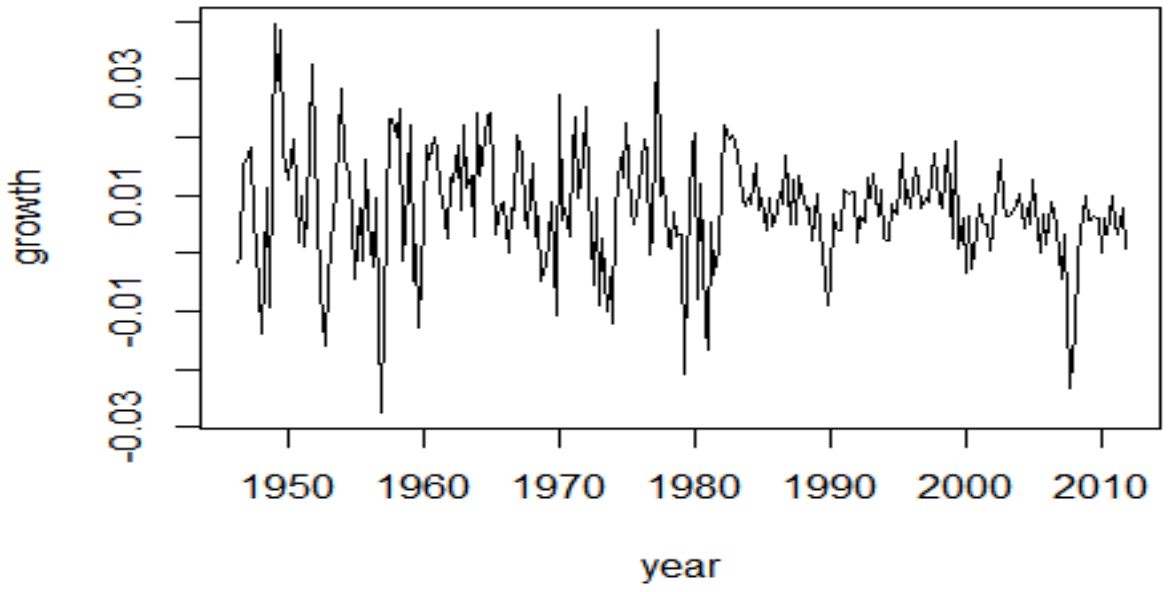
EE435-HW3-6104640542

Q1.a)

```
q.gdpmc1 <- read.csv("~/EE 435/q-gdpmc1.txt", sep="")
View(q.gdpmc1)
gdp=q.gdpmc1[,4]
loggdp=log(gdp)
growth=diff(loggdp)
length(growth)
```

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

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



Q1.b)

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

```
##
##  Box-Ljung test
##
```

```
## data:  growth
## X-squared = 64.259, df = 12, p-value = 3.737e-09
```

Ans.

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

$H_a: \exists \rho_i \neq 0 \; for \; i \in [1,12]$

The computed p-value < 0.05; Ho: Zero Serial Correlation for 12 lags is rejected at 0.05 level of significance. That is, at least one of the Serial Correlation is not equal to 0 (Market inefficiency) with 95% Confidence Interval; mean variation of past information can explain variation of current GDP growth.

Q1.c)

```
t.test(growth)
```

```
##  One Sample t-test
##
## data:  growth
## 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
```

Ans.

$H_0: \mu = 0$

$H_a: \mu \neq 0$

The computed p-value < 0.05. Ho: $\mu = 0$ is rejected at 0.05 level of significance. That is, mean of GDP growth is not equal to 0 with 95% CI

Q2.a)

```
rm(q.gdpmc1,gdp,growth,loggdp,tdx)

d.amzn3dx <- read.csv("~/EE 435/d-amzn3dx.txt", sep="")
View(d.amzn3dx)
amzn=d.amzn3dx[,2]
vwrtn=d.amzn3dx[,3]
ewrtn=d.amzn3dx[,4]
sprtn=d.amzn3dx[,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(vwrtn) #Simple return of CRSP value-weighted index
```

```
##                    vwrtn
## 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
```

```
basicStats(ewrtn) #Simple return of CRSP equal-weighted index
```

```
##                    ewrtn
## 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
```

```
basicStats(sprtn) #Simple return of S&P composite index
```

```
##                    sprtn
## 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
```

Q2.b)

```
#Transforming to log return
logamzn=log(1+amzn) #Log return of Amazon Stock
logvwrtn=log(1+vwrtn) #Log return of CRSP value-weighted index
logewrtn=log(1+ewrtn) #Log return of CRSP equal-weighted index
logsprtn=log(1+sprtn) #Log return of S&P composite index


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
```

```
basicStats(logvwrtn) #Log return of CRSP value-weighted index
```

```
##                 logvwrtn
## 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
```

```
basicStats(logewrtn) #Log return of CRSP equal-weighted index
```

```
##                 logewrtn
## 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
```

```
basicStats(logsprtn) #Log return of S&P composite index
```

```
##                 logsprtn
## 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
```

Q2.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
```

Ans.

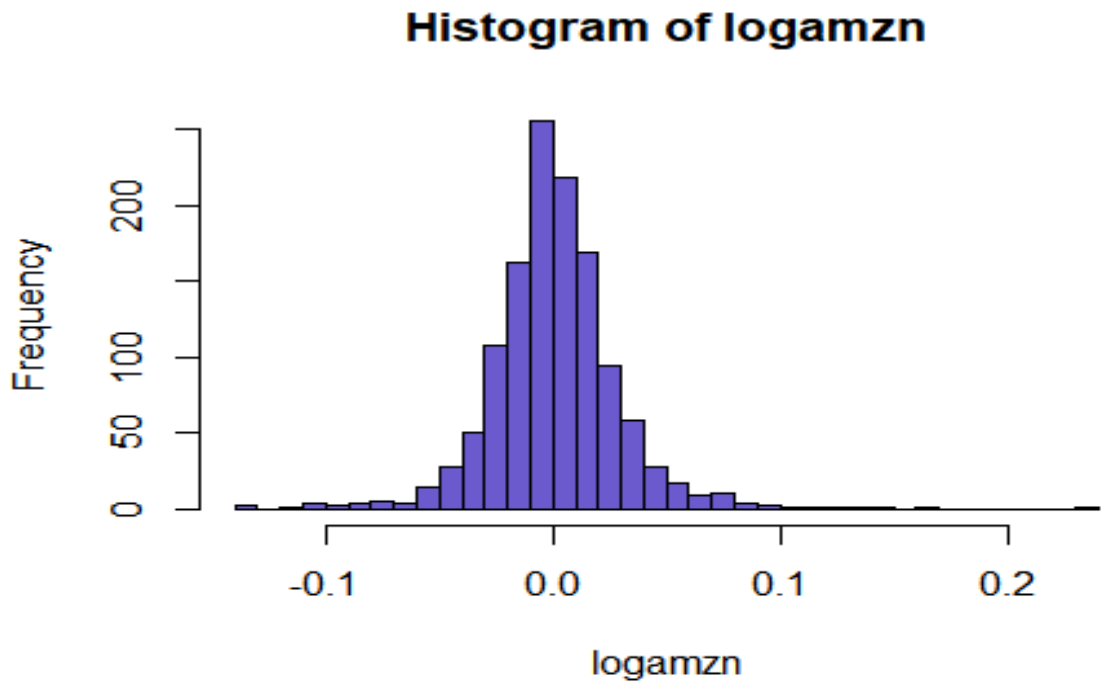
$H_0: \mu = 0$

$H_a: \mu \neq 0$

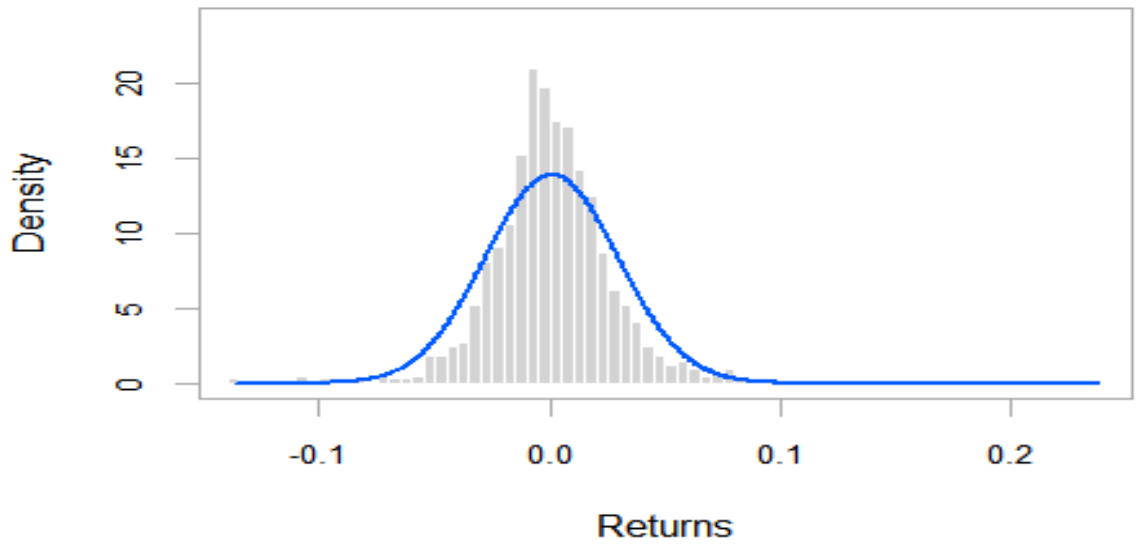
The computed p-value > 0.05. Ho: $\mu = 0$ is not rejected at 0.05 level of significance. That is, mea n of Amazon Stock log return is equal to 0 with 95% CI

Q2.d)

```
hist(logamzn, breaks=40, col="slateblue")
```




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



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Q3.a)

```
m.abt3dx <- read.csv("~/EE 435/m-abt3dx.txt", sep="")
View(m.abt3dx)
ret=m.abt3dx[,2]
vwretd=m.abt3dx[,3]
ewretd=m.abt3dx[,4]
sprtrn=m.abt3dx[,5]
basicStats(ret) #Monthly return of Abbot Laboratories
```

```
##                     ret
## 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(vwretd) #Monthly return of CRSP value-weighted index
```

```
##                   vwretd
## 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(ewretd) #Monthly return of CRSP equal-weighted index
```

```
##                 ewretd
## 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(sprtrn) #Monthly return of S&P composite index
```

```
##                 sprtrn
## 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
```

Q3.b)

```
#Transforming to log return
logret=log(1+ret) #Log return of Abbot Laboratories
logvwretd=log(1+vwretd) #Log return of CRSP value-weighted index
logewretd=log(1+ewretd) #Log return of CRSP equal-weighted index
logsprtrn=log(1+sprtrn) #Log return of S&P composite index


basicStats(logret) #Log return of Abbot Laboratories
```

```
##                 logret
## 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
```

```
basicStats(logvwretd) #Log return of CRSP value-weighted index
```

```
##              logvwretd
## 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
```

```
basicStats(logewretd) #Log return of CRSP equal-weighted index
##              logewretd
## 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
```

```
basicStats(logsprtrn) #Log return of S&P composite index
```

```
##              logsprtrn
## 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
```

Q3.c)

```
t.test(logret)
```

```
##
##  One Sample t-test
##
## data:  logret
## 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
```

Ans.

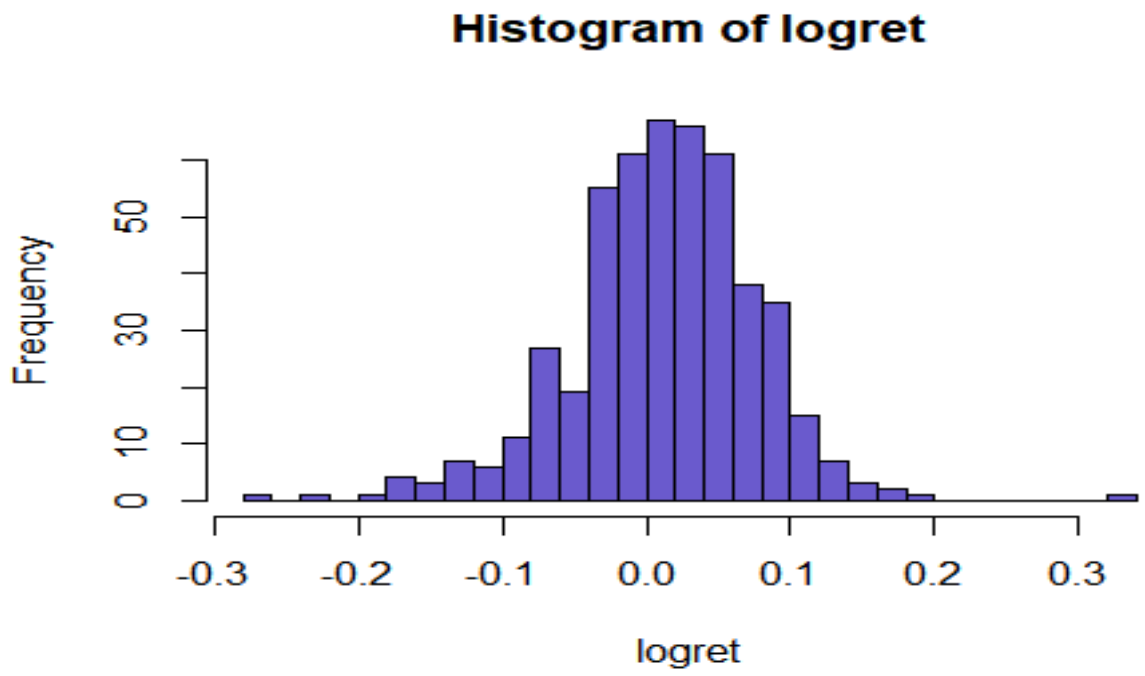
$H_0: \mu = 0$

$H_a: \mu \neq 0$

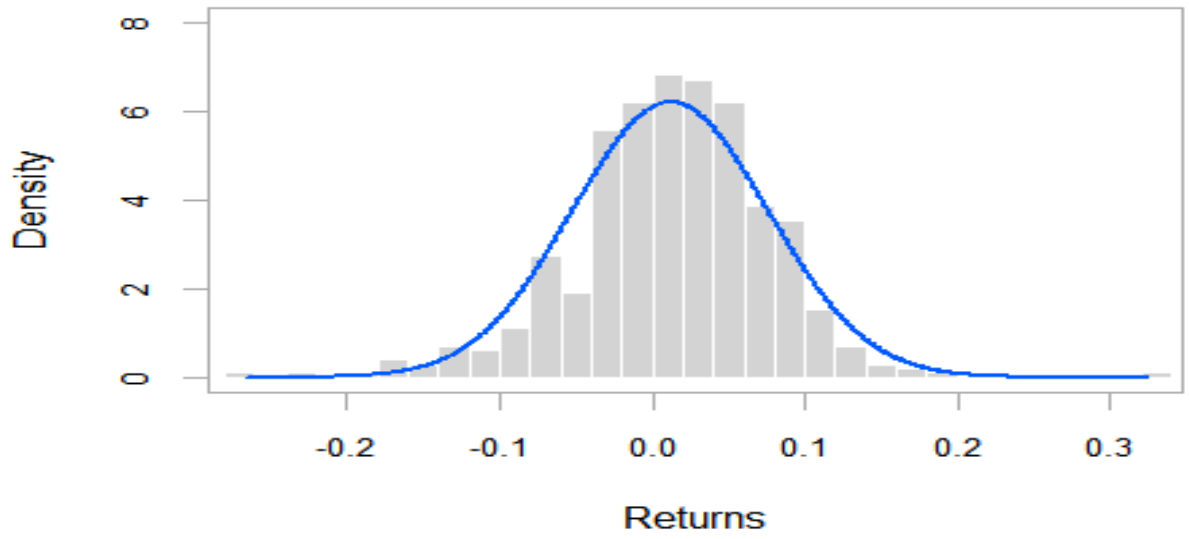
The computed p-value < 0.05. Ho: $\mu = 0$ is rejected at 0.05 level of significance. That is, mean of Abbot Laboratories Stock log return is not equal to 0 with 95% CI

Q3.d)

```
hist(logret, breaks=40, col="slateblue")
```




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



Q4

```
m.abt3dx <- read.csv("~/EE 435/m-abt3dx.txt", sep="")

View(m.abt3dx)
ret=m.abt3dx[,2]
vwretd=m.abt3dx[,3] #Monthly return of CRSP value-weighted index
ewretd=m.abt3dx[,4]
sprtrn=m.abt3dx[,5]
```

Q4.a)

```
t.test(vwretd)
```

```
##
##  One Sample t-test
##
## data:  vwretd
## 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
```

Ans.

$H_0: \mu = 0$

$H_a: \mu \neq 0$

The computed p-value < 0.05. Ho: $\mu = 0$ is rejected at 0.05 level of significance. That is, mean of Monthly return of CRSP value-weighted index is not equal to 0 with 95% CI

Q4.b)

```
m3=skewness(vwretd)
T=length(vwretd)
tst=m3/sqrt(6/T)
tst
```

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

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

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

Ans

$H_0: Skewness\ (m3) = 0$

H_a: $Skewness \neq 0$

The computed p-value < 0.05. Ho: skewness $= 0$ is rejected at 0.05 level of significance. That is, Skewness of Monthly return of CRSP value-weighted index is not equal to 0 with 95% CI

Q4.c)

```
k4=kurtosis(vwretd) #Excess kurtosis
m4=k4+3 #Kurtosis
T=length(vwretd)
tst=(m4-3)/sqrt(24/T)
tst
```

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

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

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

Ans

H_0: $Kurtosis\ (m4) = 3$

H_a: $Kurtosis \neq 3$

The computed p-value < 0.05. Ho: Kutosis $= 3$ is rejected at 0.05 level of significance. That is, kurtosis of Monthly return of CRSP value-weighted index is not equal to 3 with 95% CI

Q5.a)

```
rm(list = ls())

d.amzn3dx <- read.csv("~/EE 435/d-amzn3dx.txt", sep="")
View(d.amzn3dx)

amzn=d.amzn3dx[,2] #Amazon Stock Return
#Transforming to log return
logamzn=log(1+amzn) #Log return of Amazon Stock

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

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

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

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

Ans

H_0: *Skewness* $(m3) = 0$ */ Log return of Amazon Stock is symmetric*

H_a: *Skewness* $\neq 0$

The computed p-value < 0.05. Ho: skewness $= 0$ *is rejected at 0.05 level of significance. That is, Skewness of* `Log return of Amazon Stock` *is not equal to 0 with 95% CI, making the distributi on non-symmetric.*

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

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

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

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

Ans

H_0: *Excess Kurtosis* $(m4) = 0$

H_a: *Excess Kurtosis* $\neq 0$

The computed p-value < 0.05. Ho: Excess Kutosis $= 0$ *is rejected at 0.05 level of significance. T hat is, excess kurtosis of* `Log return of Amazon Stock` *is not equal to 0 with 95% CI*

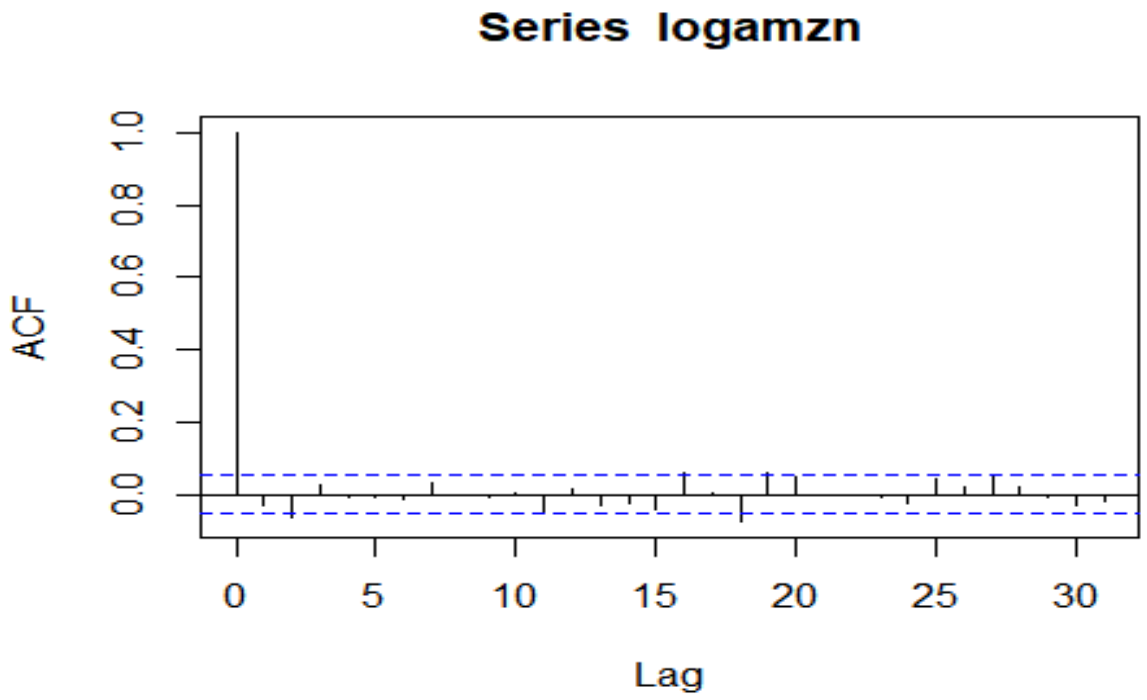
```
t.test(logamzn)
```

```
##
##  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
```

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

Q5.b)

```
m1=acf(logamzn)
```

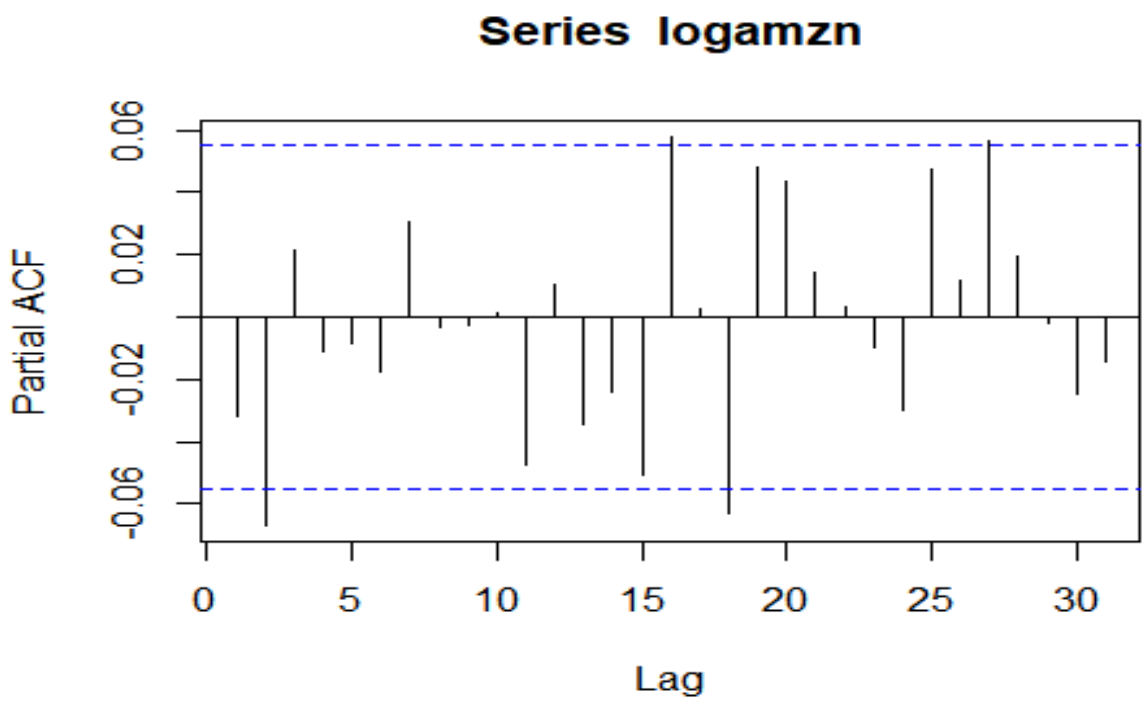



```
m1$acf
```

```
## , , 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
```

Ans

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

$H_a: \exists \rho_i \neq 0 \; for \; i \in [1,12]$

The computed p-value > 0.05; Ho: Zero Serial Correlation for 12 lags is not rejected at 0.05 level of significance. That is, All Serial Correlation is equal to 0 (Market efficiency) with 95% Confidenc e Interval; mean variation of past information cannot explain variation of current log return.

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Q6.a)

```
library(tseries)
library(forecast)
rm(list = ls())
d.exuseu <- read.csv("~/EE 435/d-exuseu.txt", sep="")
View(d.exuseu)

rate=d.exuseu[,4]

lograte=log(rate)
logreturn=diff(lograte)
logreturn
```

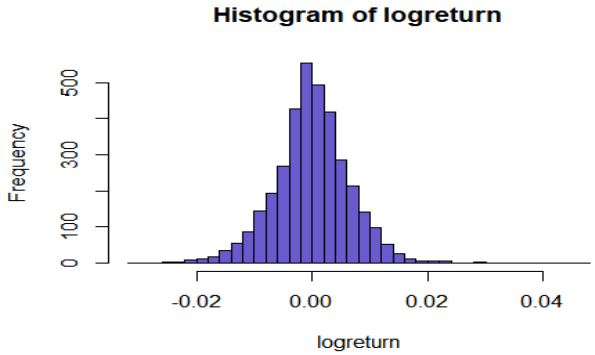
Q6.b)

```
basicStats(logreturn)
```

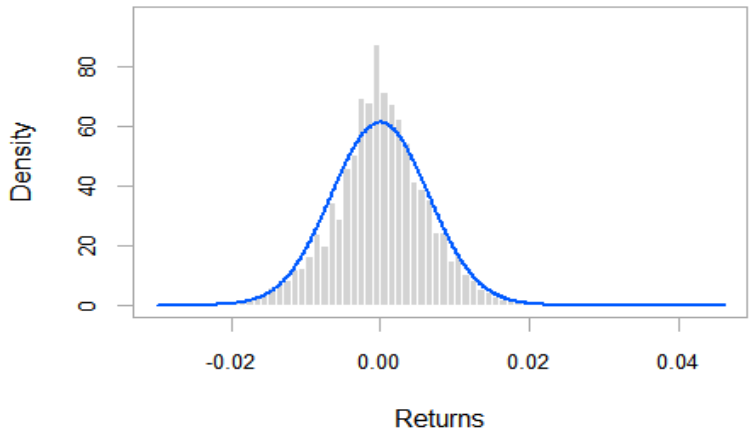
```
##                logreturn
## nobs        3566.000000
## NAs            0.000000
## Minimum       -0.030031
## Maximum        0.046208
## 1. Quartile   -0.003585
## 3. Quartile    0.003767
## Mean           0.000027
## Median         0.000000
## Sum            0.095218
## SE Mean        0.000109
## LCL Mean      -0.000187
## UCL Mean       0.000240
## Variance       0.000042
## Stdev          0.006511
## Skewness       0.116750
## Kurtosis       2.058184
```

Q6.c)

```
hist(logreturn, breaks=40, col="slateblue")
```



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



Q6.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. Ho: $\mu = 0$ is not rejected at 0.05 level of significance. That is, mea n of `log return` is equal to 0 with 95% CI