Practice 2 from Analysis of Financial Time Series

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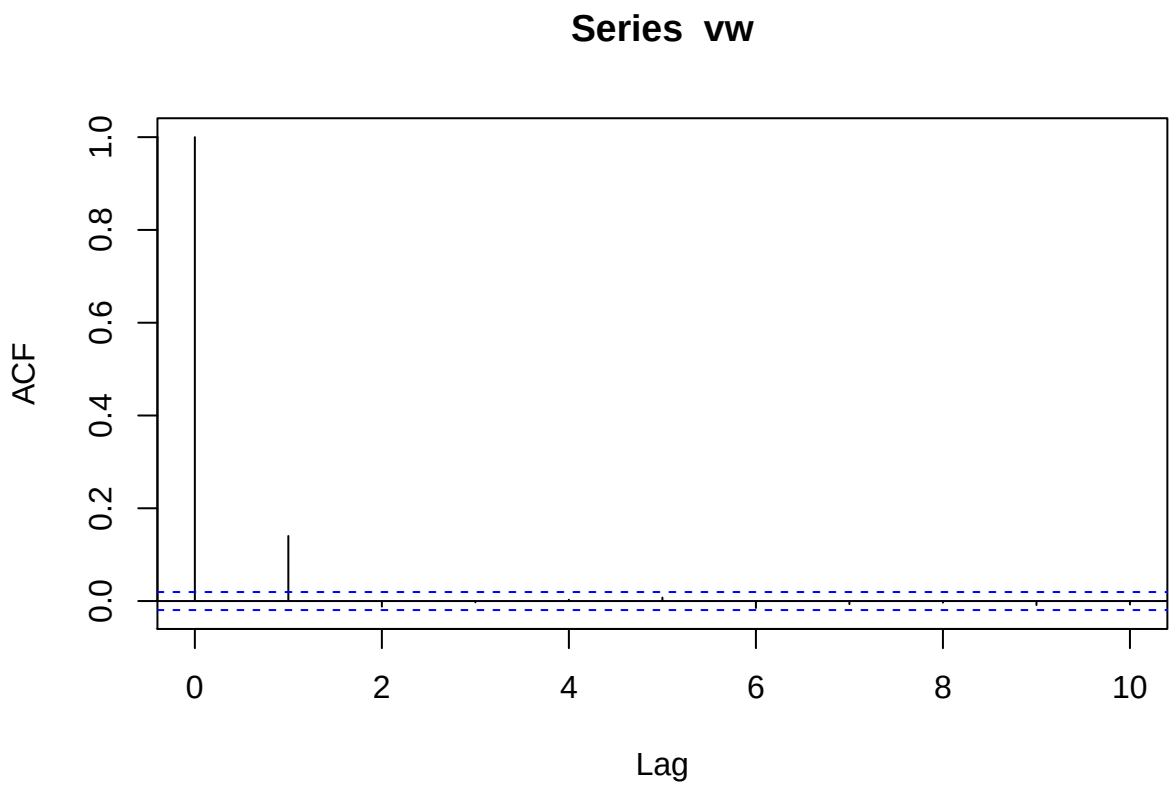
This paper is a practice from the book called Analysis of Financial Time Series by Ruey S. Tsay. All R codes and comments below are belonged to the book and author.

Example 1: MA(1)

```
setwd("~/Desktop/Chicago")
suppressPackageStartupMessages(require(fBasics))
data=read.table("d-ibmvwew6202.txt",header=TRUE)
vw=log(1+data[,3])*100 # Compute percentage log returns of the vw index.
acf(vw,lag.max=10)
```

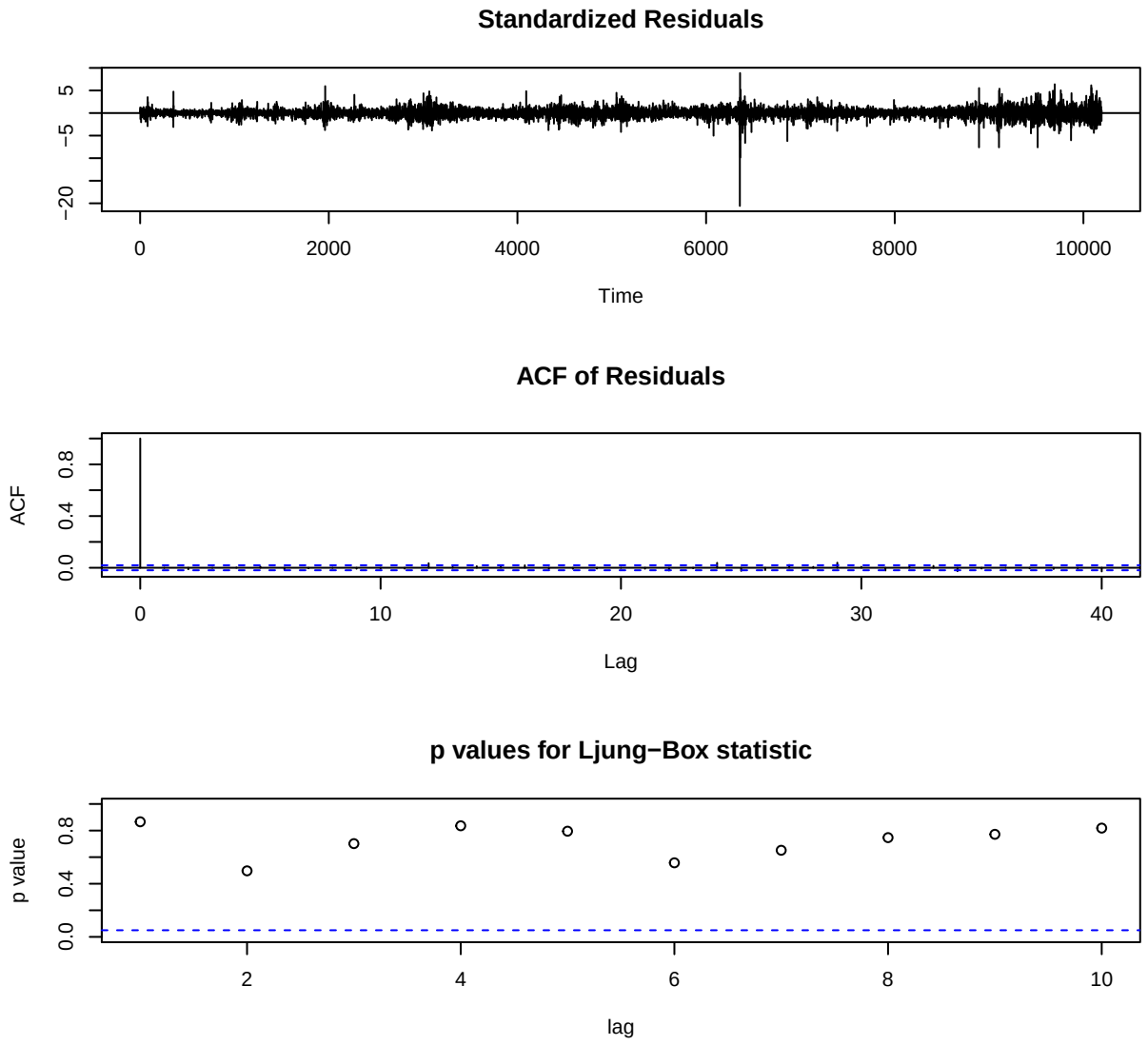



```
m1=arima(vw,order=c(0,0,1)) # fits an MA(1) model
m1 #The model is vw(t) = 0.0396+a(t)+0.1465*a(t-1).
```

```
##
```

```
## Call:
## arima(x = vw, order = c(0, 0, 1))
##
## Coefficients:
##          ma1  intercept
##       0.1465     0.0396
## s.e.  0.0099     0.0100
##
## sigma^2 estimated as 0.7785:  log likelihood = -13188.48,  aic = 26382.96
```

```
tsdiag(m1)
```




```
predict(m1,5)
```

```
## $pred
## Time Series:
```

```
## Start = 10195
## End = 10199
## Frequency = 1
## [1] 0.05036298 0.03960887 0.03960887 0.03960887 0.03960887
##
## $se
## Time Series:
## Start = 10195
## End = 10199
## Frequency = 1
## [1] 0.8823290 0.8917523 0.8917523 0.8917523 0.8917523
```

Example 2: Test for Unit Root

```
suppressPackageStartupMessages(require(fUnitRoots))
da=read.table('q-gdpc96.txt',header=T)
gdp=log(da[,4])
adfTest(gdp,lag=4,type=c("c"))
```

```
##
## Title:
##  Augmented Dickey-Fuller Test
##
## Test Results:
##   PARAMETER:
##     Lag Order: 4
##   STATISTIC:
##     Dickey-Fuller: -1.8568
##   P VALUE:
##     0.3654
##
## Description:
##  Sun Aug 30 22:16:48 2015 by user:
```

```
# cannot reject the null hypothesis of a unit root.
x=diff(gdp)
ord=ar(x) # identify an AR model for the differenced series.
ord
```

```
##
## Call:
## ar(x = x)
##
## Coefficients:
##       1        2        3
##  0.3457   0.1283  -0.1207
##
## Order selected 3  sigma^2 estimated as  8.401e-05
```

```r
# An AR(3) for the differenced data is confirmed.
# Our previous analysis is justified.
```

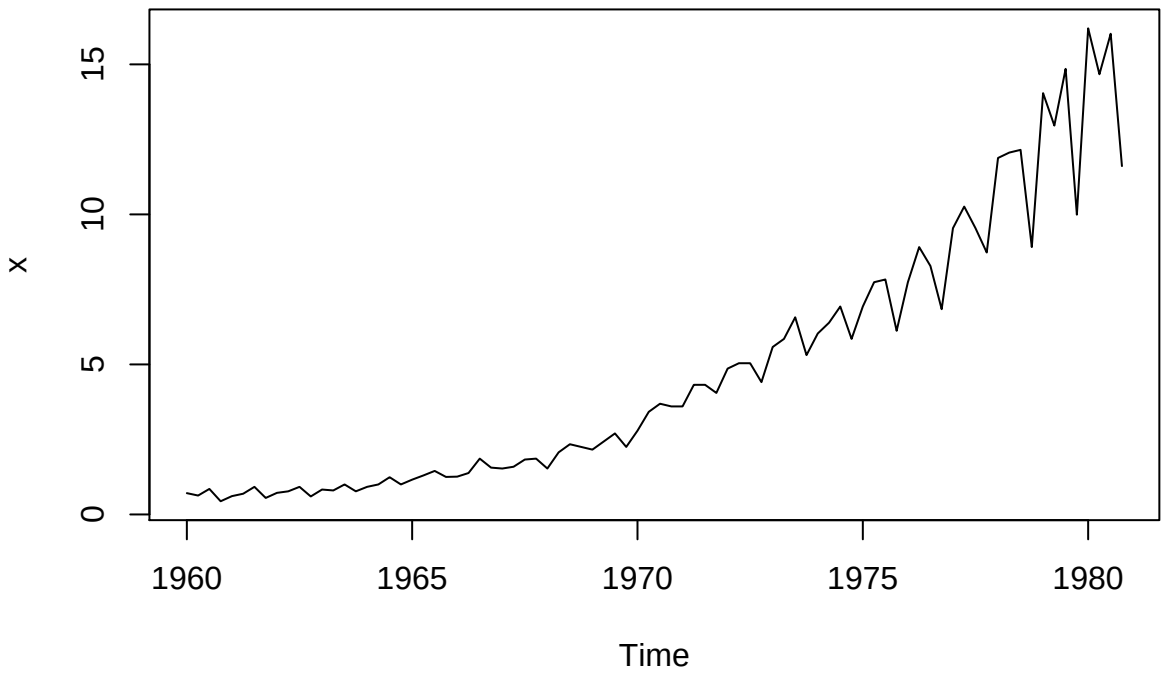
```r
www<-"http://faculty.chicagobooth.edu/ruey.tsay/teaching/fts3/q-gdp4708.txt"
library(fUnitRoots)
da=read.table(www,header=T)
gdp=log(da[,4])
m1=ar(diff(gdp),method='mle')
m1$order
```

```
## [1] 10
```

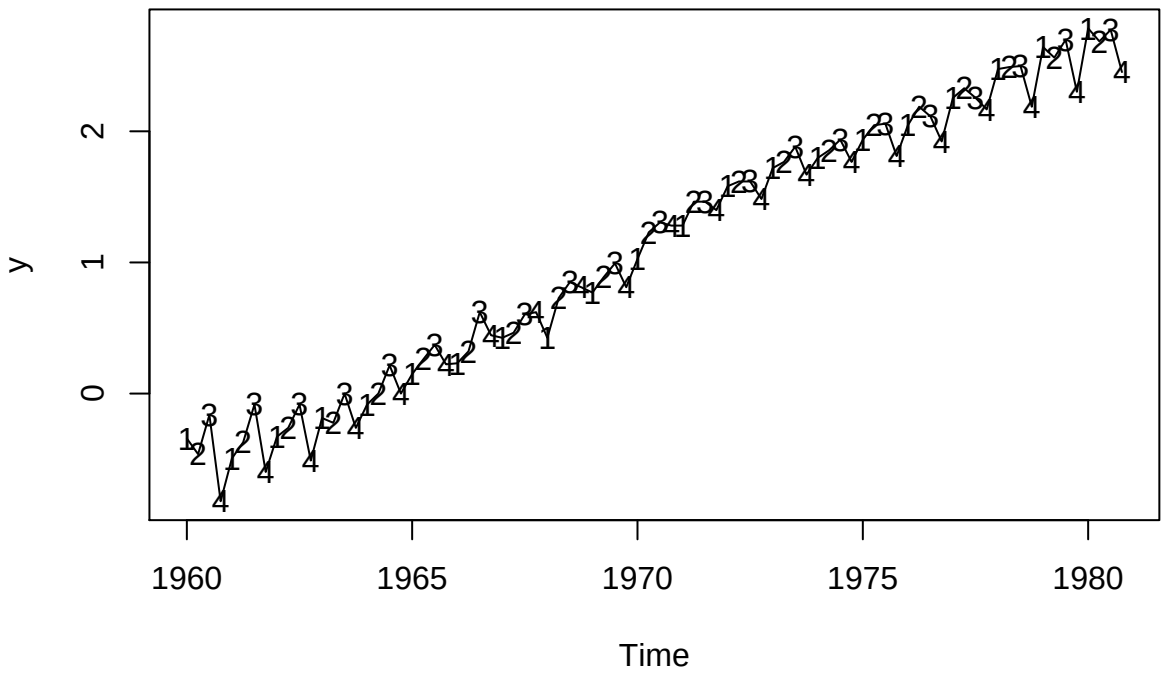
```r
adfTest(gdp,lags=10,type=c("c"))
```

```
##
## Title:
##  Augmented Dickey-Fuller Test
##
## Test Results:
##   PARAMETER:
##     Lag Order: 10
##   STATISTIC:
##     Dickey-Fuller: -1.6109
##   P VALUE:
##     0.4569
##
## Description:
##  Sun Aug 30 22:16:48 2015 by user:
```

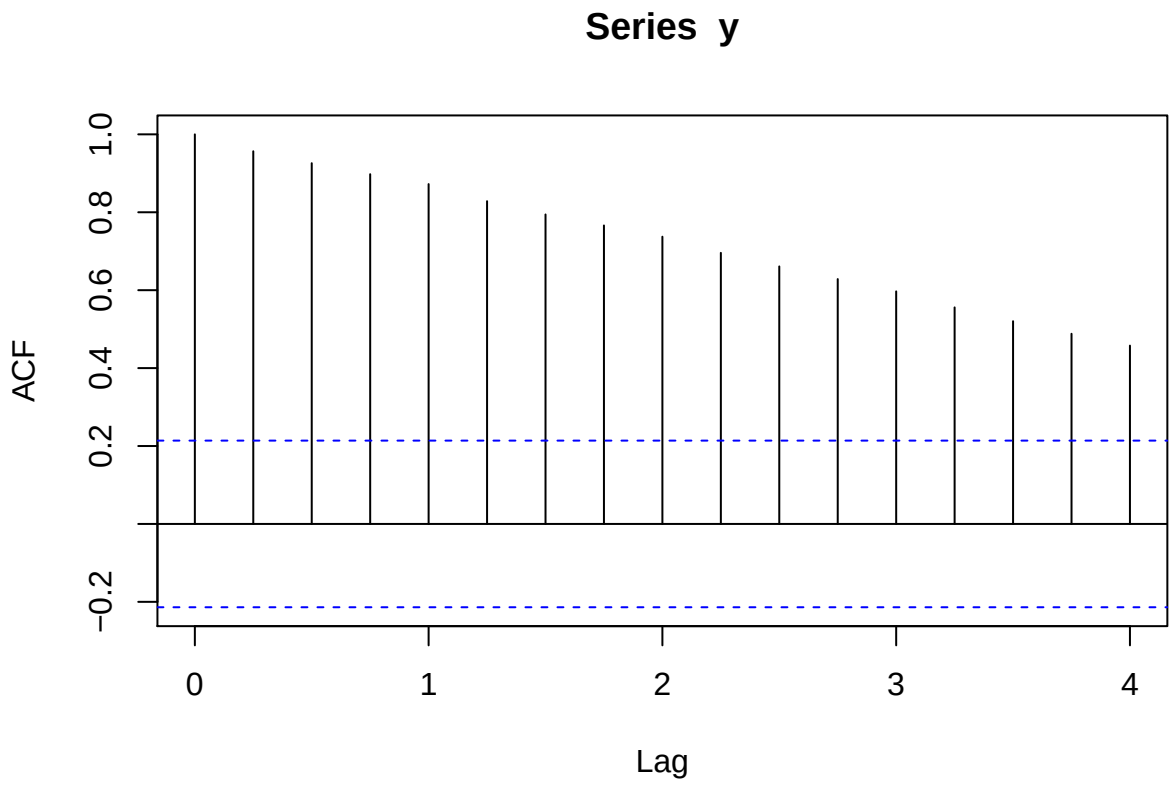
```r
x=ts(scan("q-earn-jnj.txt"),frequency=4,start=c(1960,1))
plot(x)
```



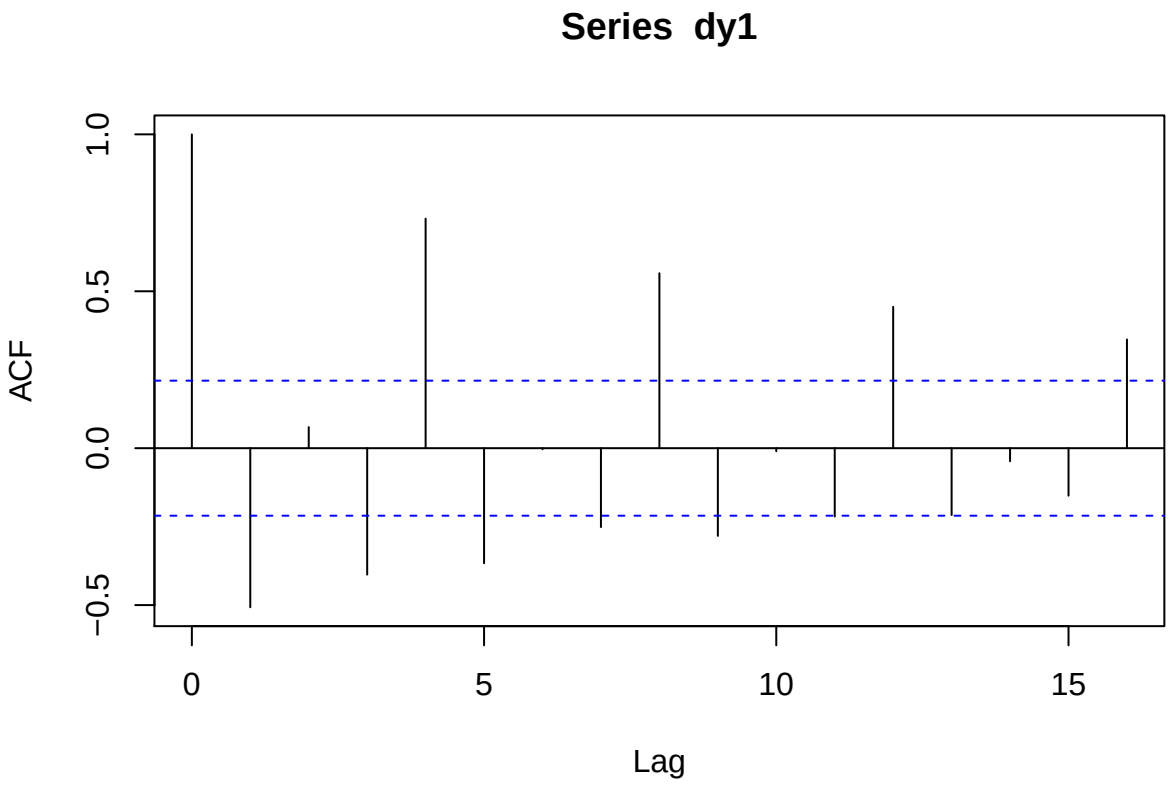

```
y=log(x)
plot(y)
c1=paste(c(1:4))
points(y,pch=c1) # put circles on data points.
```



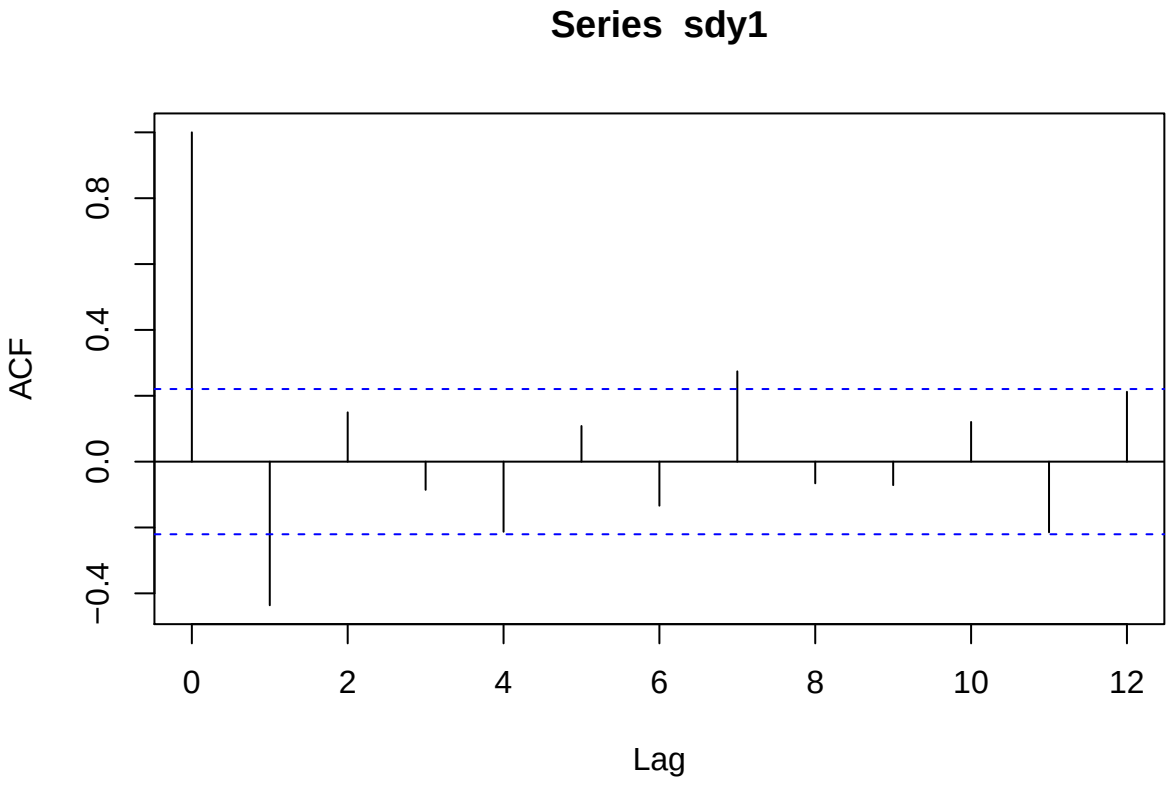

```
acf(y,lag.max=16)
```




```
y1=as.vector(y) # Creates a sequence of data in R
dy1=diff(y1) # regular difference
acf(dy1,lag.max=16)
```



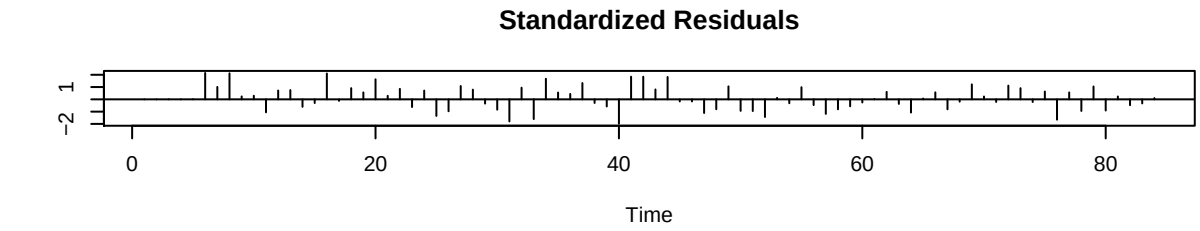

```
sdy1=diff(dy1,4) # seasonal difference
acf(sdy1,lag.max=12)
```

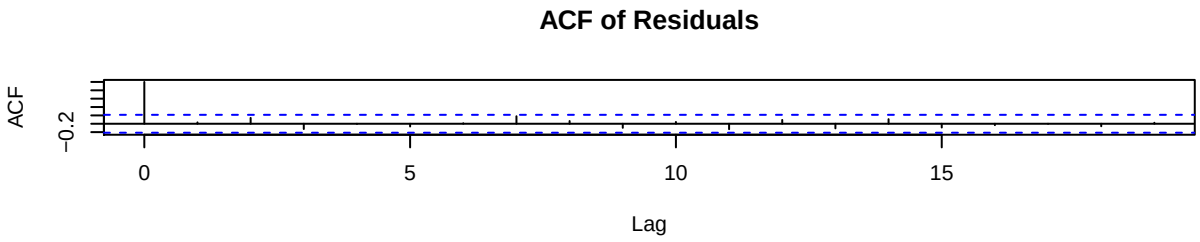


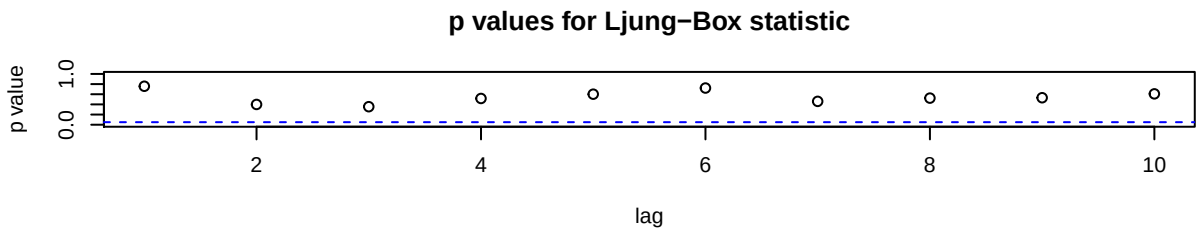

```
m1=arima(y1,order=c(0,1,1),seasonal=list(order=c(0,1,1),period=4))
m1
```

```
##
## Call:
## arima(x = y1, order = c(0, 1, 1), seasonal = list(order = c(0, 1, 1), period = 4))
##
## Coefficients:
##           ma1     sma1
##       -0.6809  -0.3146
## s.e.   0.0982   0.1070
##
## sigma^2 estimated as 0.007931:  log likelihood = 78.38,  aic = -150.75
```

```
tsdiag(m1) # Model checking
```



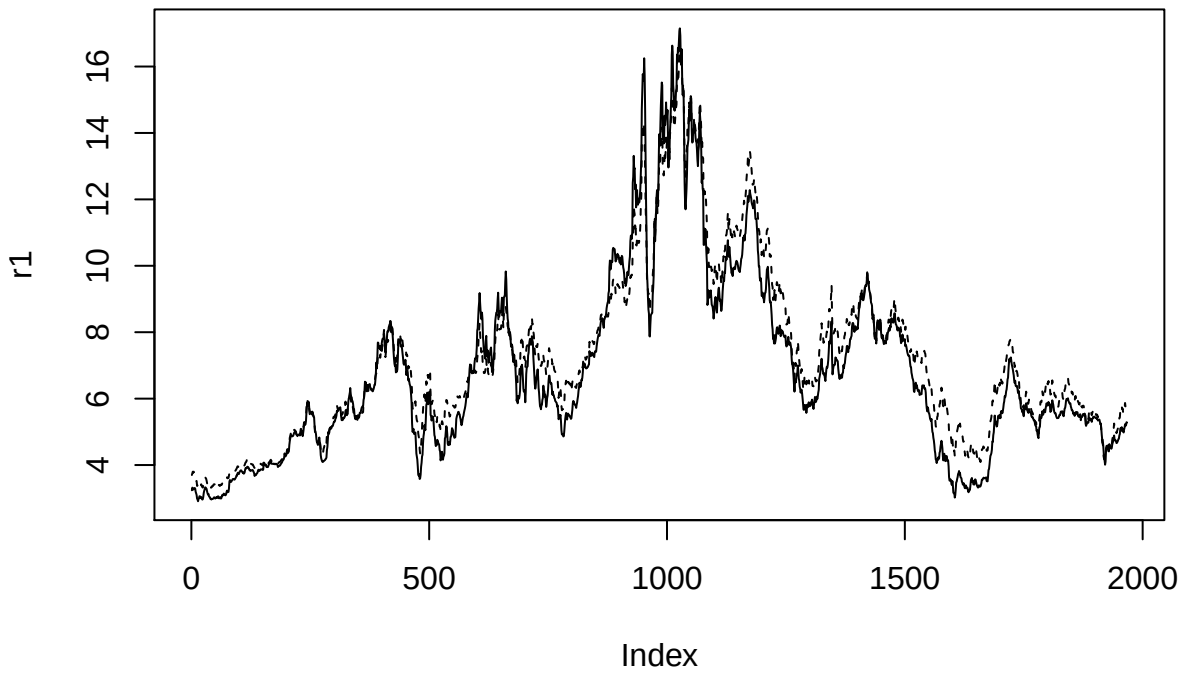




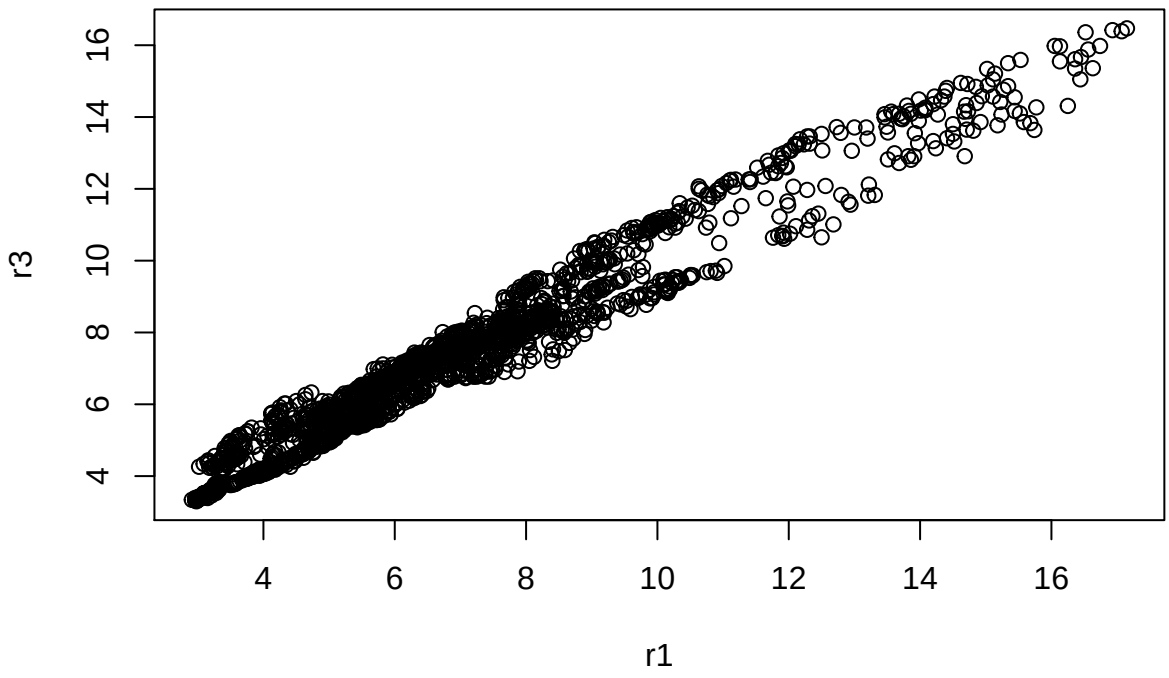

```
f1=predict(m1,8) # prediction
f1
```

```
## $pred
## Time Series:
## Start = 85
## End = 92
## Frequency = 1
## [1] 2.905343 2.823891 2.912148 2.581085 3.036450 2.954999 3.043255 2.712193
##
## $se
## Time Series:
## Start = 85
## End = 92
## Frequency = 1
## [1] 0.08905414 0.09347899 0.09770366 0.10175307 0.13548771 0.14370561
## [7] 0.15147833 0.15887123
```

```
da=read.table("w-gs1n36299.txt",header=TRUE)
r1=da[,1] # 1-year rate
r3=da[,2] # 3-year rate
plot(r1,type='l')
lines(1:1967,r3,lty=2)
```



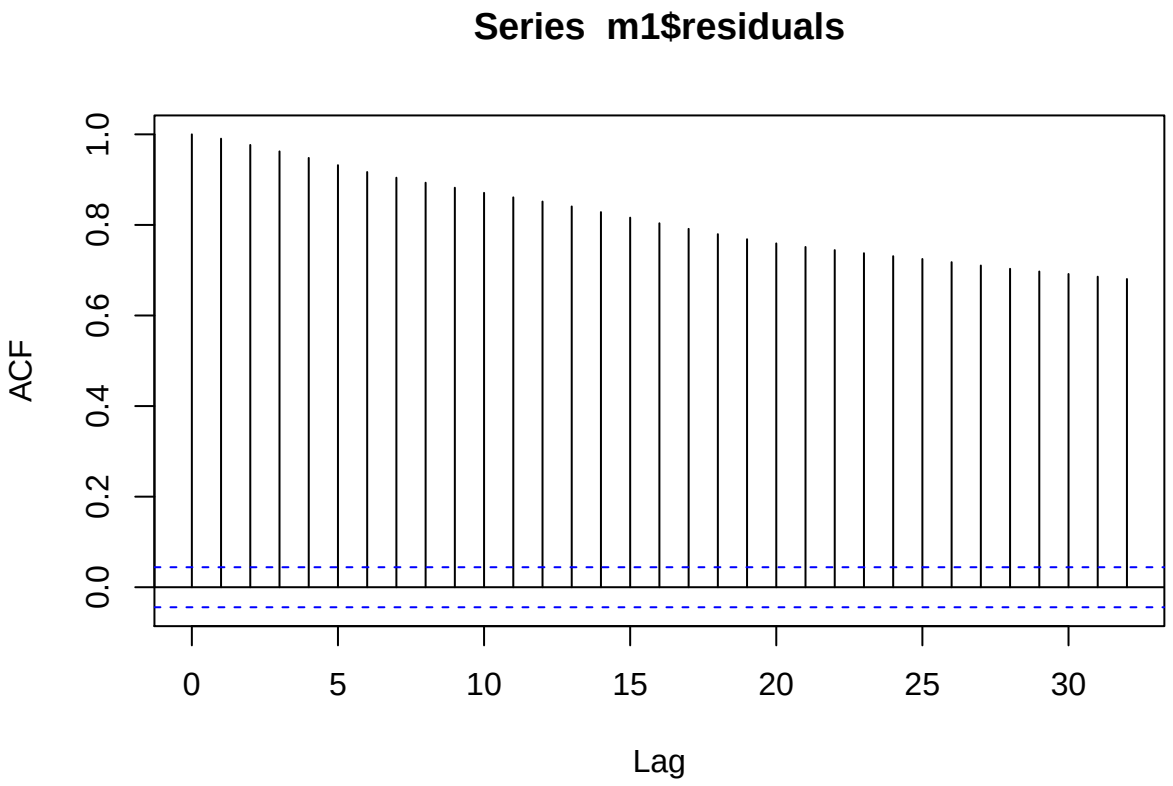

```
plot(r1,r3) # scatter plot of the two series
```



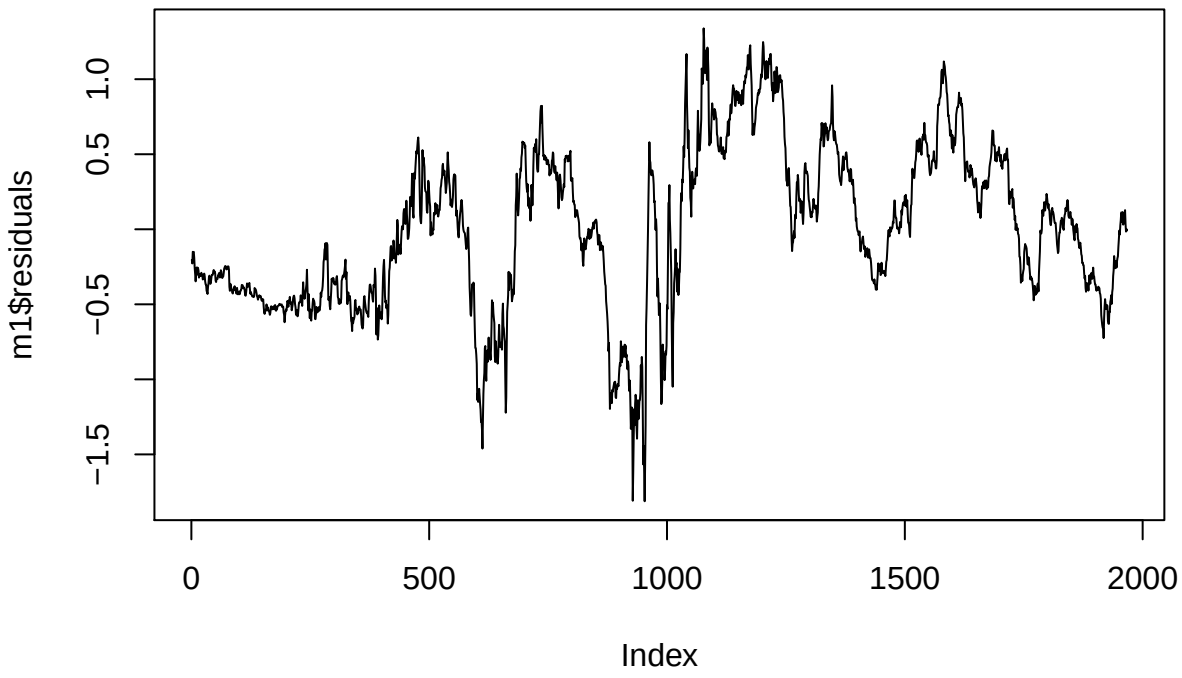

```r
m1=lm(r3~r1) # Fit a regression model with likelihood method.
summary(m1)
```

```
##
## Call:
## lm(formula = r3 ~ r1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.8121 -0.4023  0.0031  0.4026  1.3388
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.910687   0.032250   28.24   <2e-16 ***
## r1          0.923854   0.004389  210.51   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.538 on 1965 degrees of freedom
## Multiple R-squared:  0.9575, Adjusted R-squared:  0.9575
## F-statistic: 4.431e+04 on 1 and 1965 DF,  p-value: < 2.2e-16
```

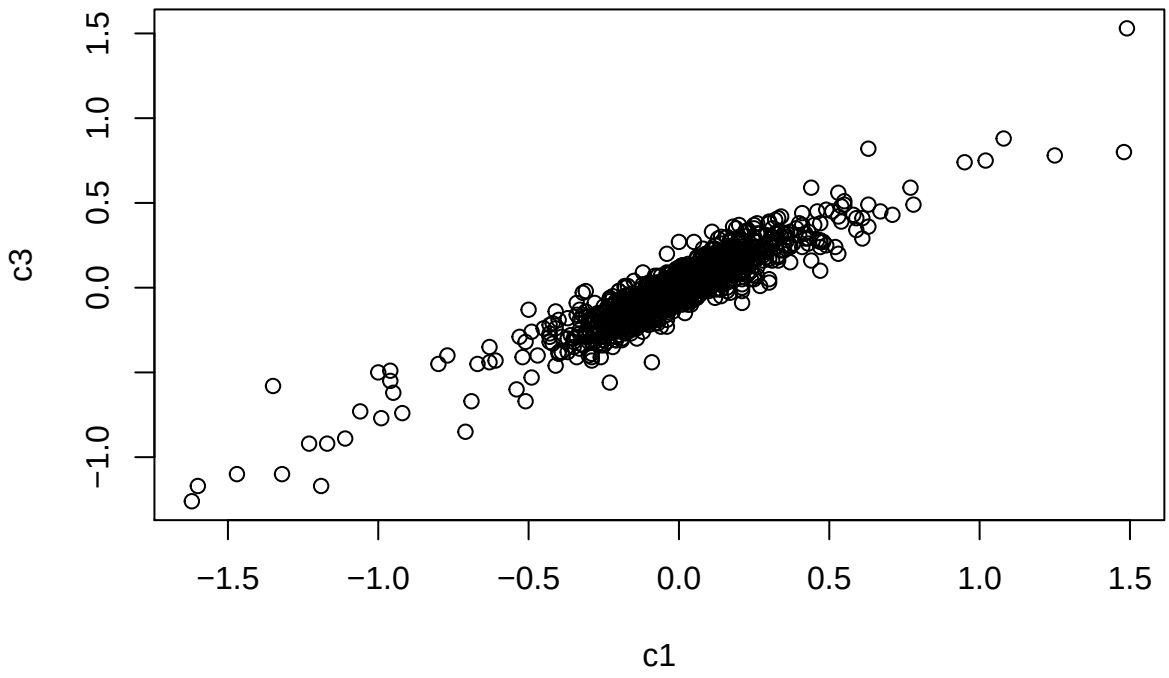
```r
acf(m1$residuals)
```




```
plot(m1$residuals,type="l")
```



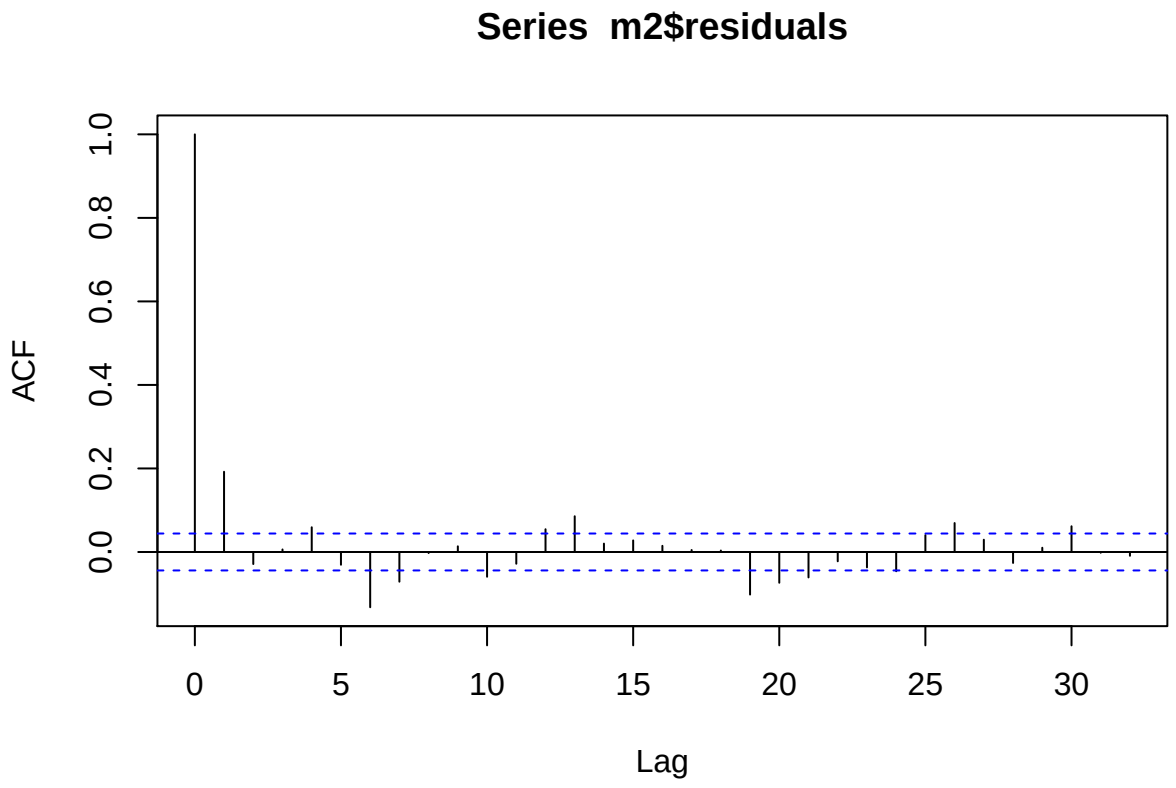

```
c3=diff(r3)
c1=diff(r1)
plot(c1,c3)
```



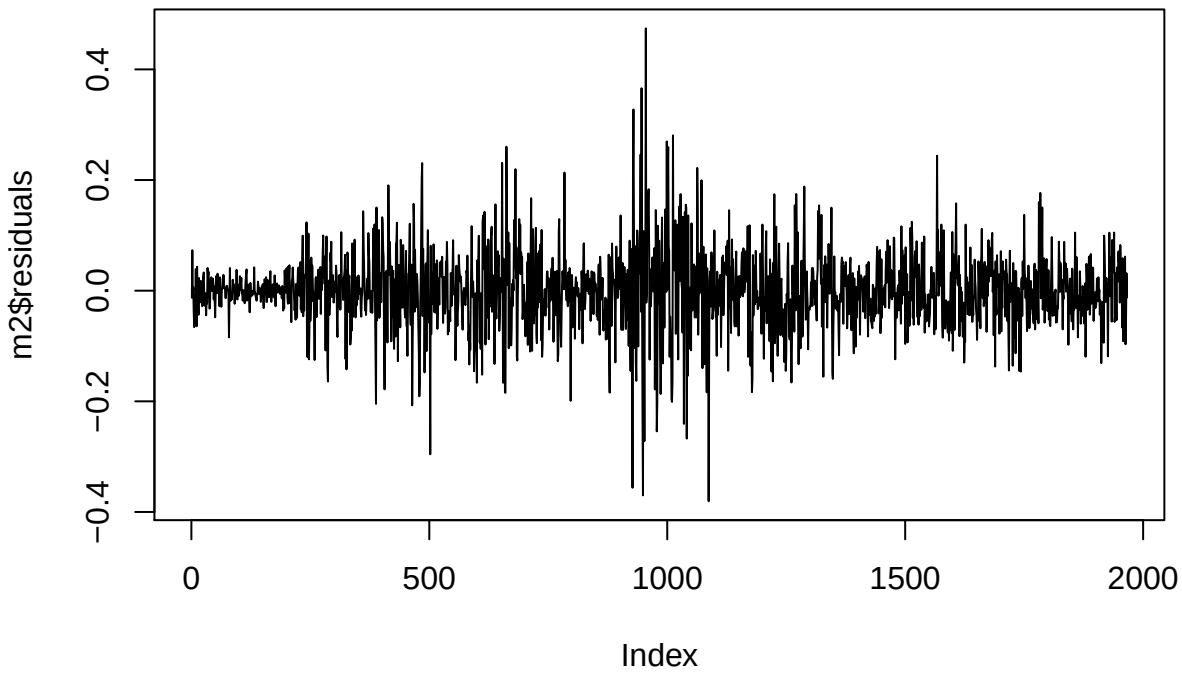

```
m2=lm(c3~c1) # Fit a regression with likelihood method.
summary(m2)
```

```
##
## Call:
## lm(formula = c3 ~ c1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.38060 -0.03338 -0.00054  0.03437  0.47418
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.0002475  0.0015380   0.161    0.872
## c1          0.7810590  0.0074651 104.628   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.06819 on 1964 degrees of freedom
## Multiple R-squared:  0.8479, Adjusted R-squared:  0.8478
## F-statistic: 1.095e+04 on 1 and 1964 DF,  p-value: < 2.2e-16
```

```
acf(m2$residuals)
```



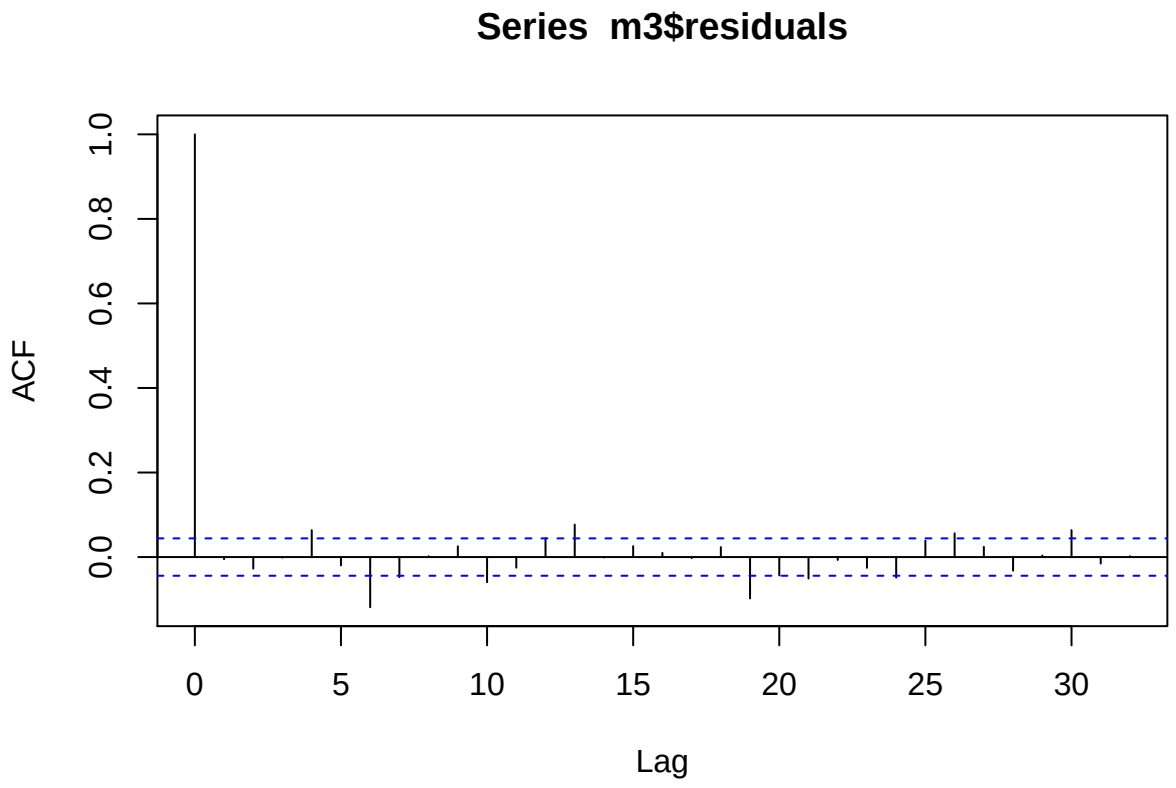

```
plot(m2$residuals,type='l')
```



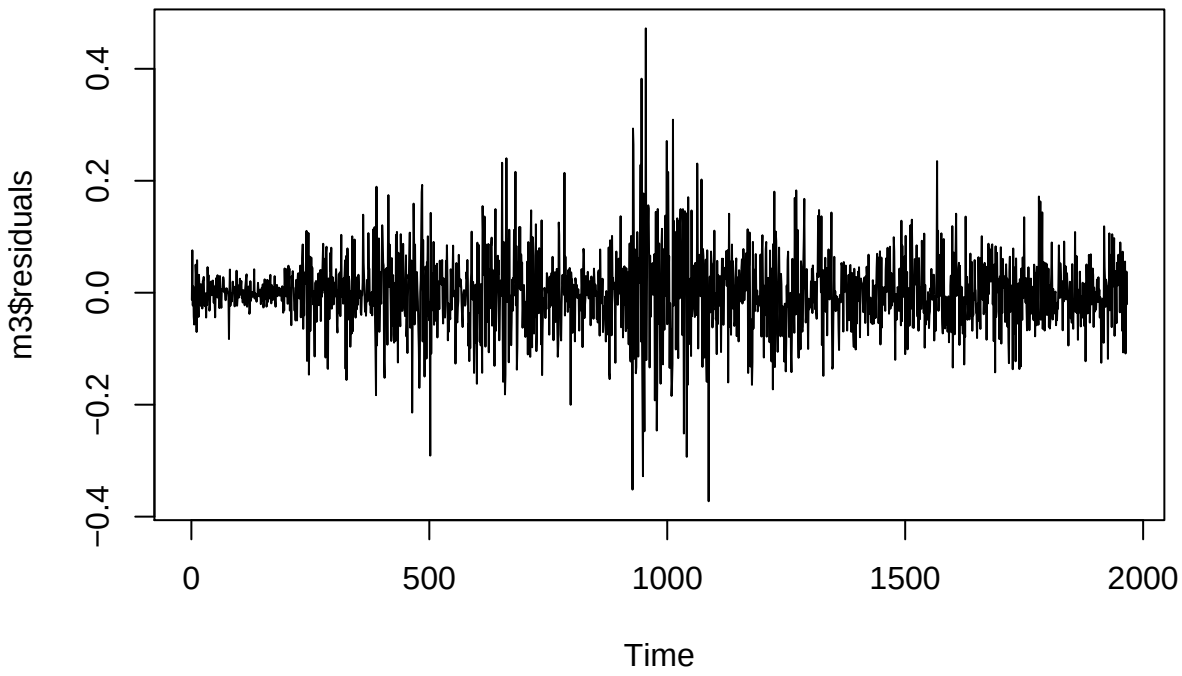

```
m3=arima(c3,xreg=c1,order=c(0,0,1)) # Residuals follow an MA(1) model
m3
```

```
##
## Call:
## arima(x = c3, order = c(0, 0, 1), xreg = c1)
##
## Coefficients:
##          ma1  intercept      c1
##       0.2115     0.0002  0.7824
## s.e.  0.0224     0.0018  0.0077
##
## sigma^2 estimated as 0.004456:  log likelihood = 2531.84,  aic = -5055.69
```

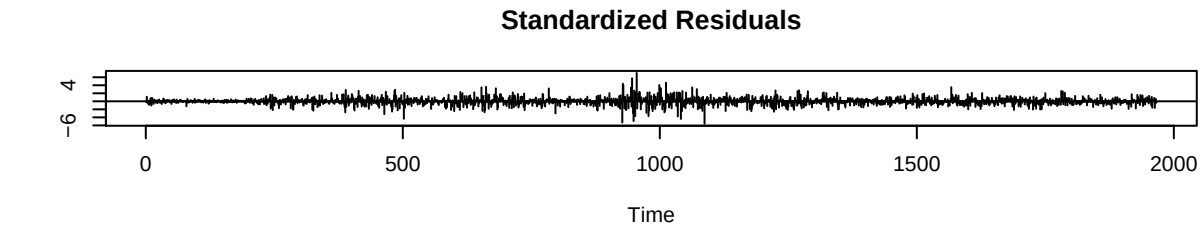
```
acf(m3$residuals)
```

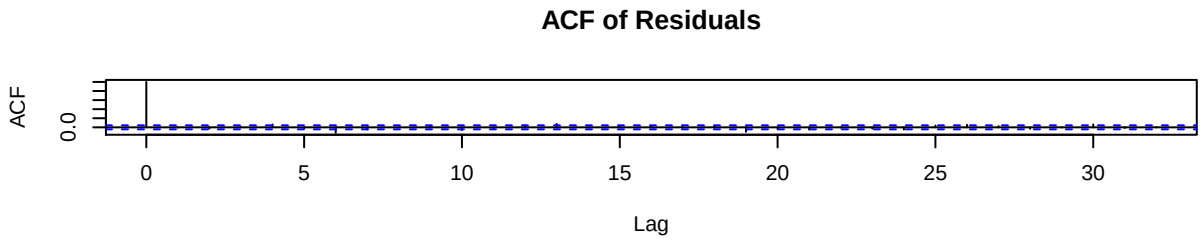


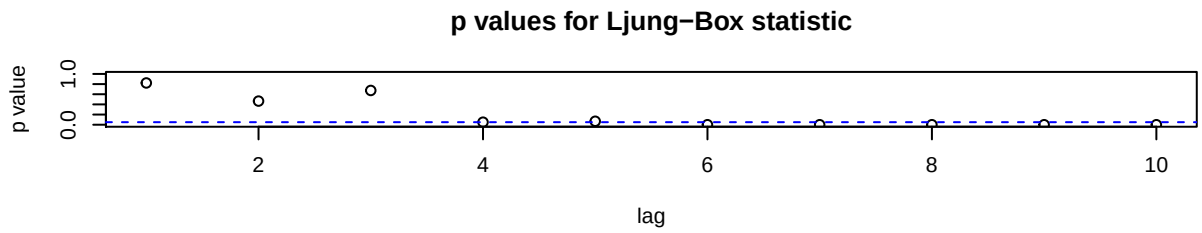

```
plot(m3$residuals,type='l')
```




```
tsdiag(m3)
```



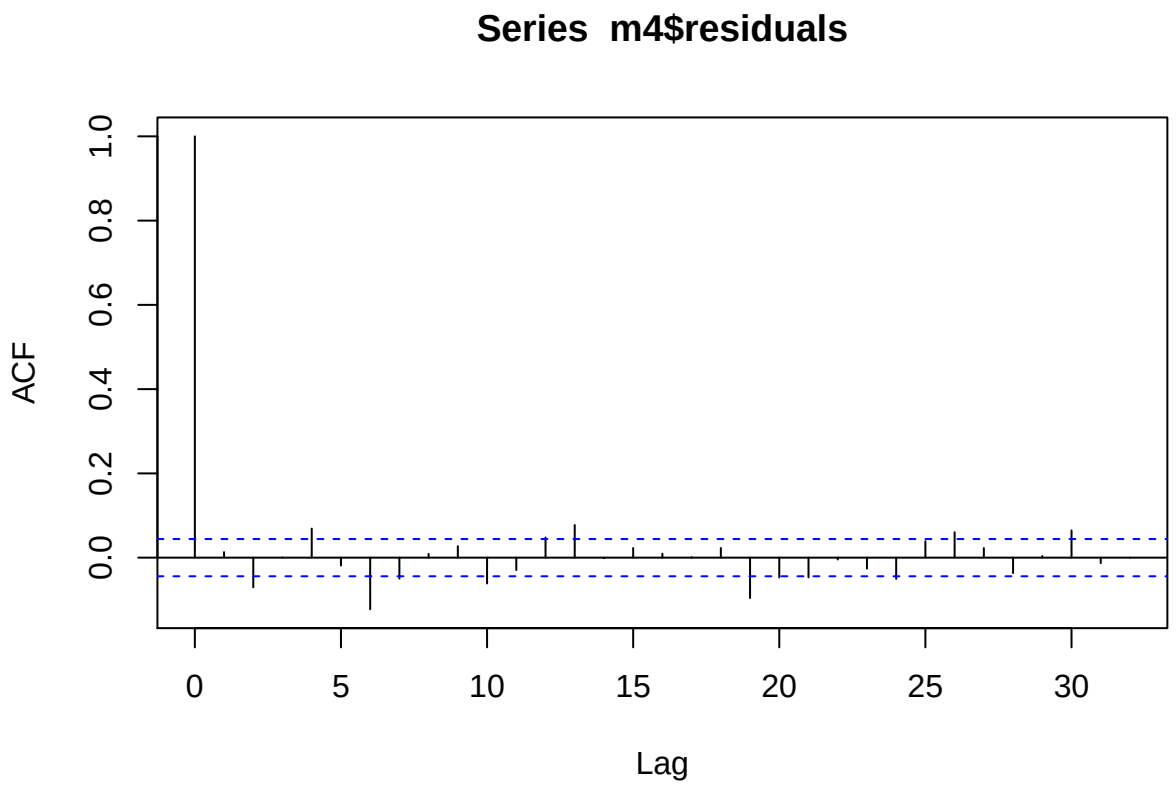




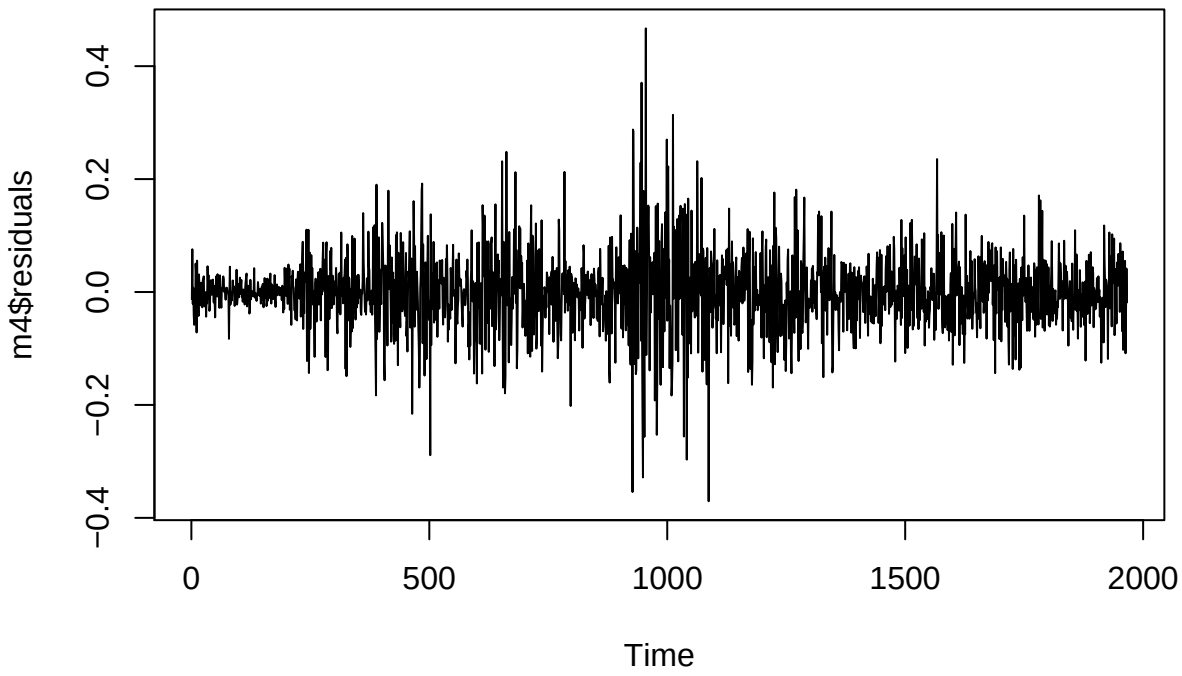

```
m4=arima(c3,xreg=c1,order=c(1,0,0)) # Residuals follow an AR(1) model.
m4
```

```
##
## Call:
## arima(x = c3, order = c(1, 0, 0), xreg = c1)
##
## Coefficients:
##          ar1  intercept      c1
##       0.1922     0.0003  0.7829
## s.e.  0.0221     0.0019  0.0077
##
## sigma^2 estimated as 0.004474:  log likelihood = 2527.86,  aic = -5047.72
```

```
acf(m4$residuals)
```




```
plot(m4$residuals,type='l')
```



Reference:

Tsay, Ruey S. Analysis of financial time series. Vol. 543. John Wiley & Sons, 2005.