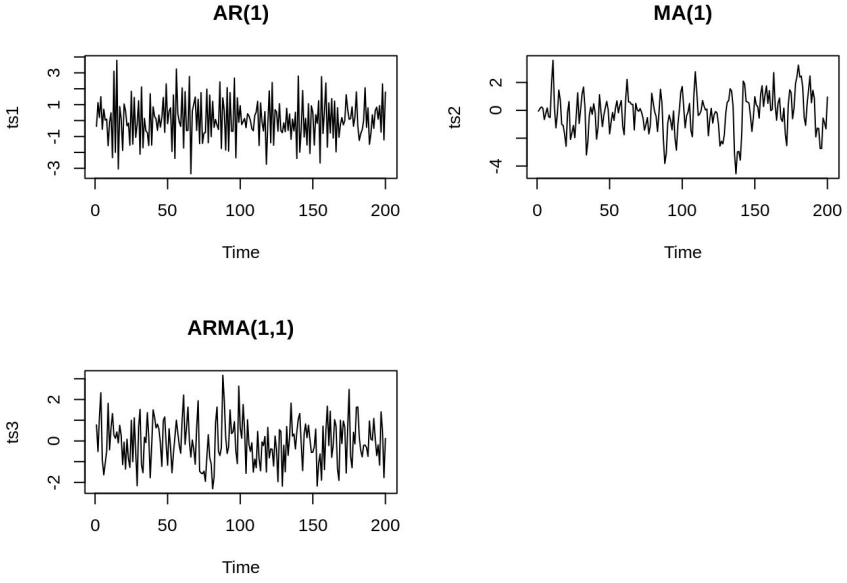
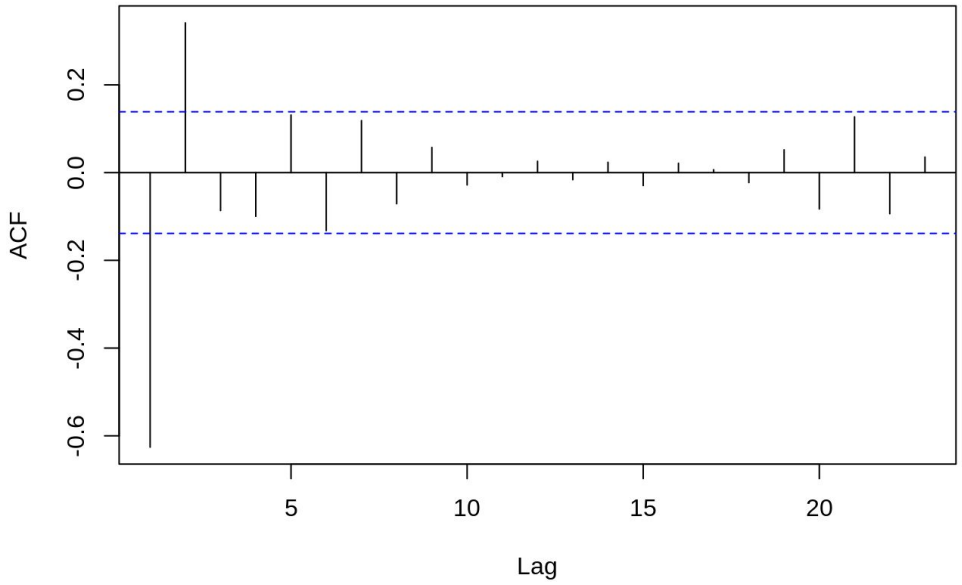
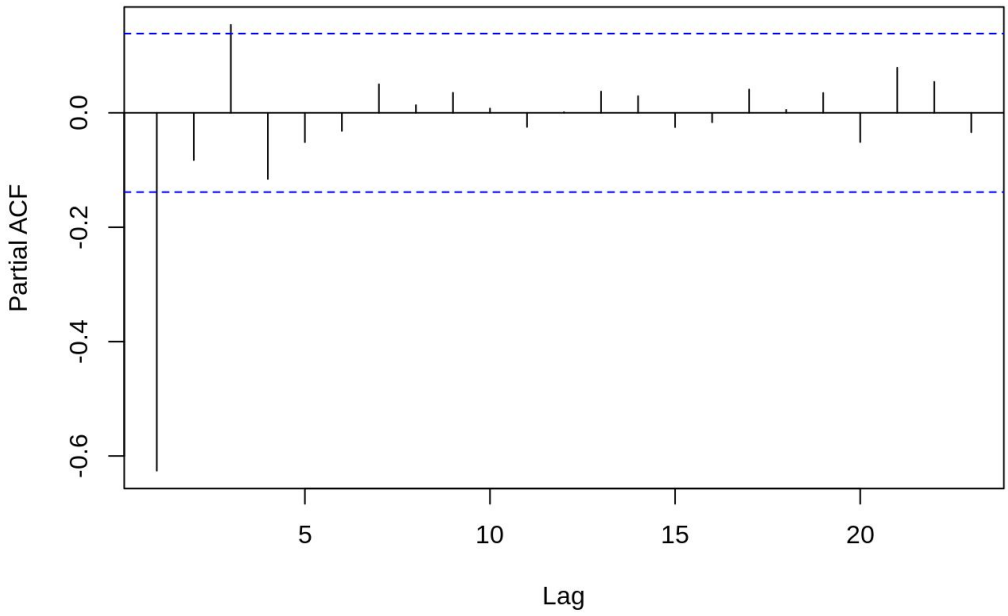
Problem 3

```
library(TSA)

library(tseries)

ts_1 = arima.sim(model=list(ar=-.6), n=200)
ts_2 = arima.sim(model=list(ma=.8), n=200)
ts_3 = arima.sim(model=list(ar=-.6, ma=.8), n=200)
ts_1 = ts(ts_1, start=1, end=200, frequency=1)
ts_2 = ts(ts_2, start=1, end=200, frequency=1)
ts_3 = ts(ts_3, start=1, end=200, frequency=1)
par(mfrow=c(2,2))
plot(ts_1, main = "AR(1)")
plot(ts_2, main = "MA(1)")
plot(ts_3, main = "ARMA(1,1)")
par(mfrow=c(1,1))

acf(ts_1)
```



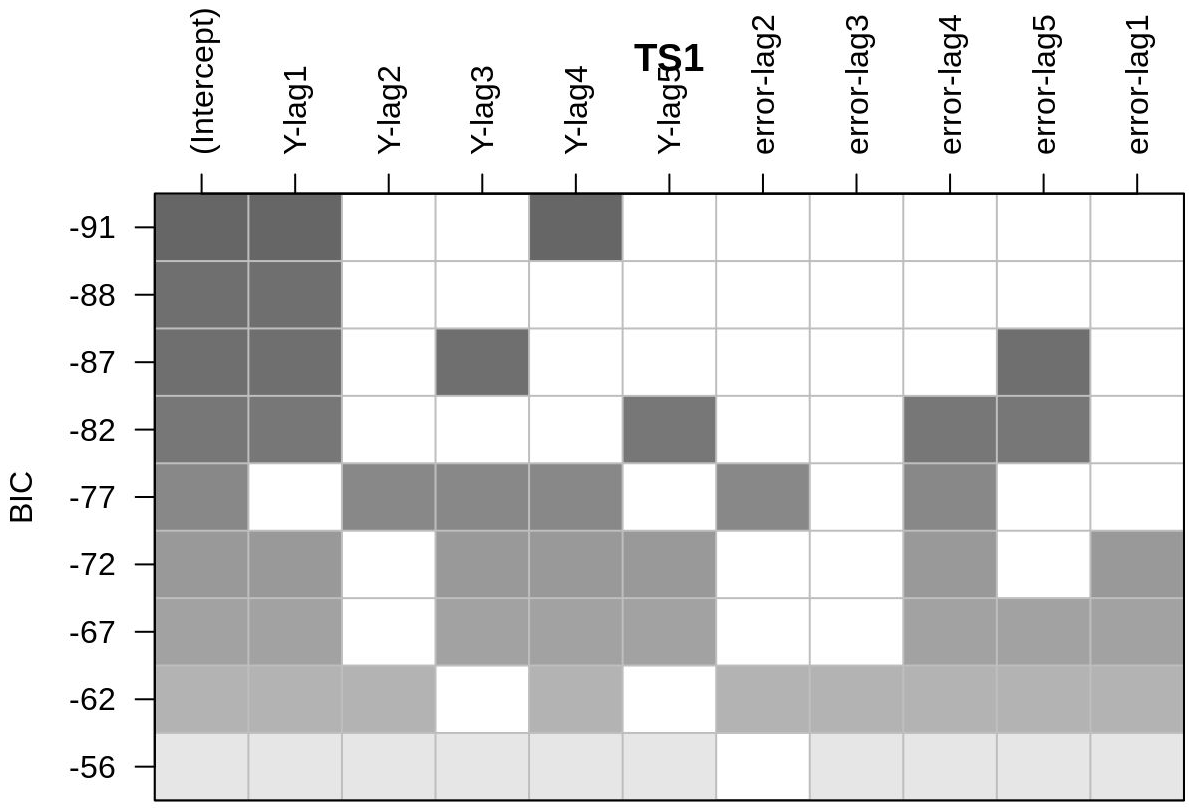

ACF
0.2
0.0
-0.2
-0.4
-0.6
5
10
15
20
Lag

```
pacf(ts_1)
```

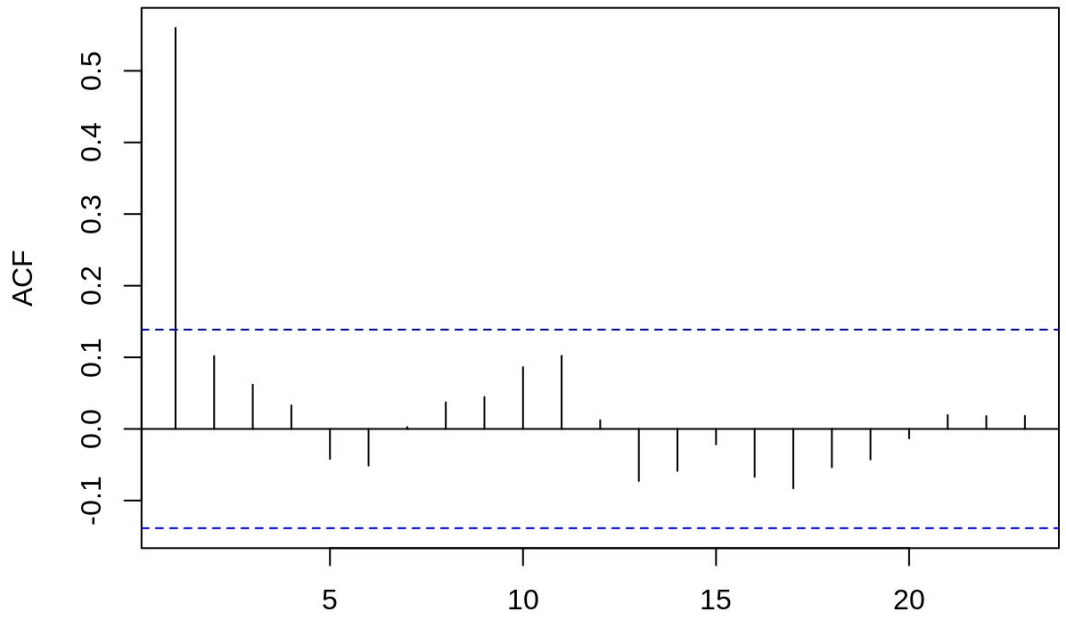

Partial ACF
0.0
-0.2
-0.4
-0.6
5
10
15
20
Lag

```
eacf(ts_1)

AR/MA
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 x x o o o o o o o o o  o  o  o
1 o x o x o o o o o o o  o  o  o
2 x o x x o o o o o o o  o  o  o
3 x x x x o o o o o o o  o  o  o
4 x o x o o o o o o o o  o  o  o
5 x o x o o o o o o o o  o  o  o
6 x x x o x o o o o o o  o  o  o
7 o x x x o x o o o o o  o  o  o
```

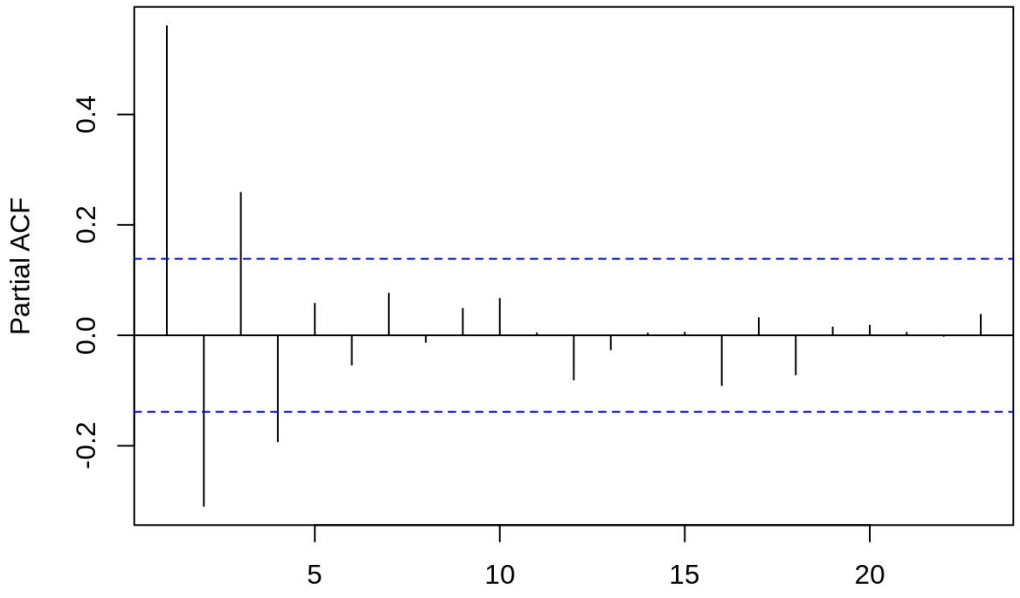
```
plot(armasubsets(ts_1, 5, 5), main = "TS1")
```



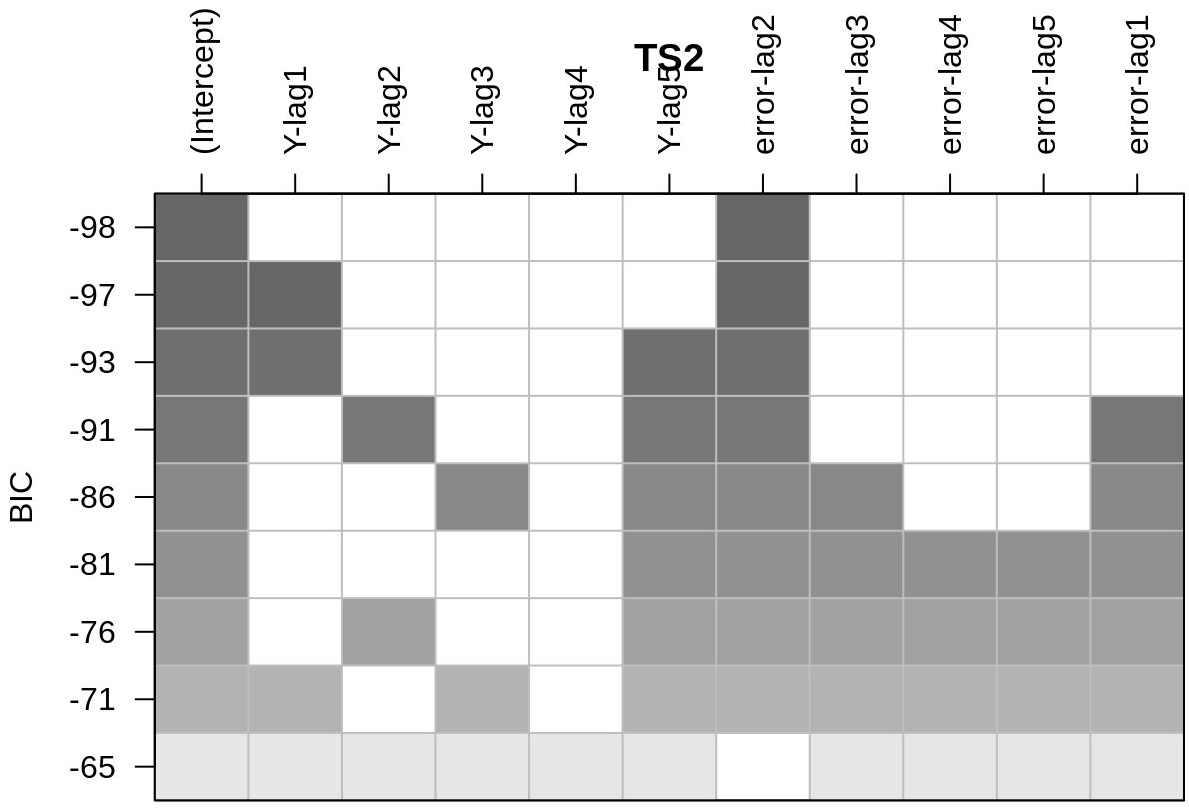
```
acf(ts_2)
```



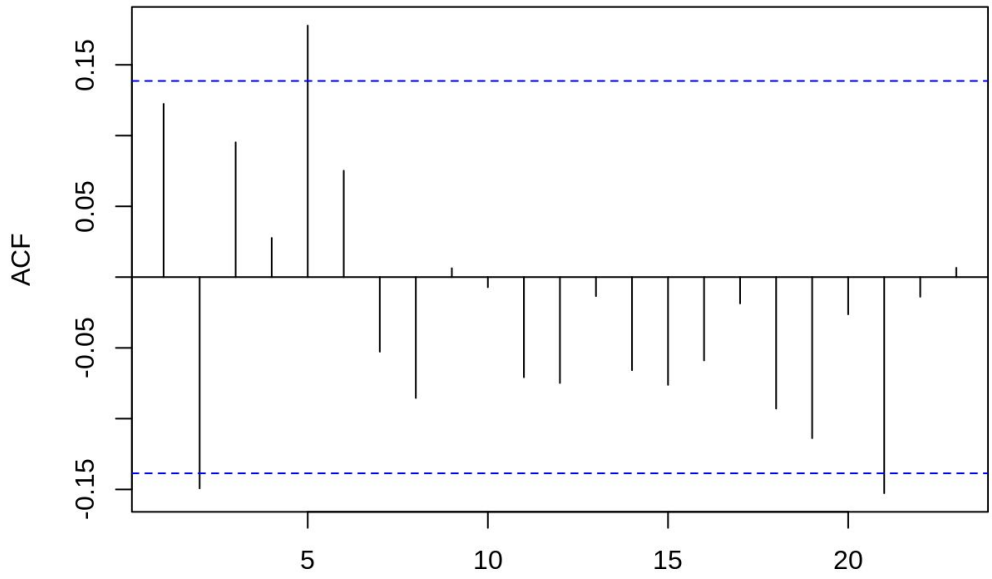

```
pacf(ts_2)
```



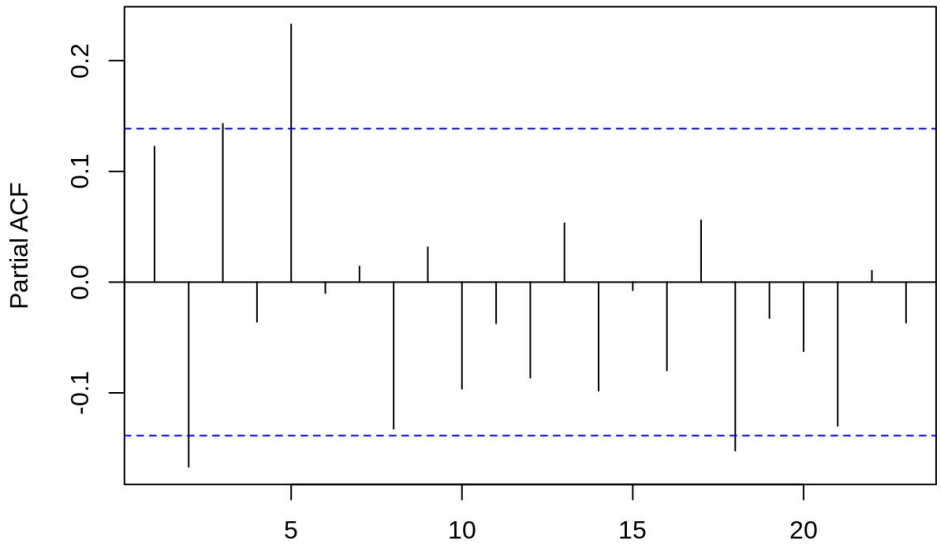
```
eacf(ts_2)

AR/MA
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 x o o o o o o o o o o  o  o  o
1 x x o o o o o o o o o  o  o  o
2 x x o o o o o o o o o  o  o  o
3 x o x x o o o o o o o  o  o  o
4 x x x o o o o o o o o  o  o  o
5 x o x o o o o o o o o  o  o  o
6 x x x o o x x o o o o  o  o  o
7 x x x o x x x o o o o  o  o  o

plot(armasubsets(ts_2, 5, 5), main = "TS2")
```



```
acf(ts_3)
```

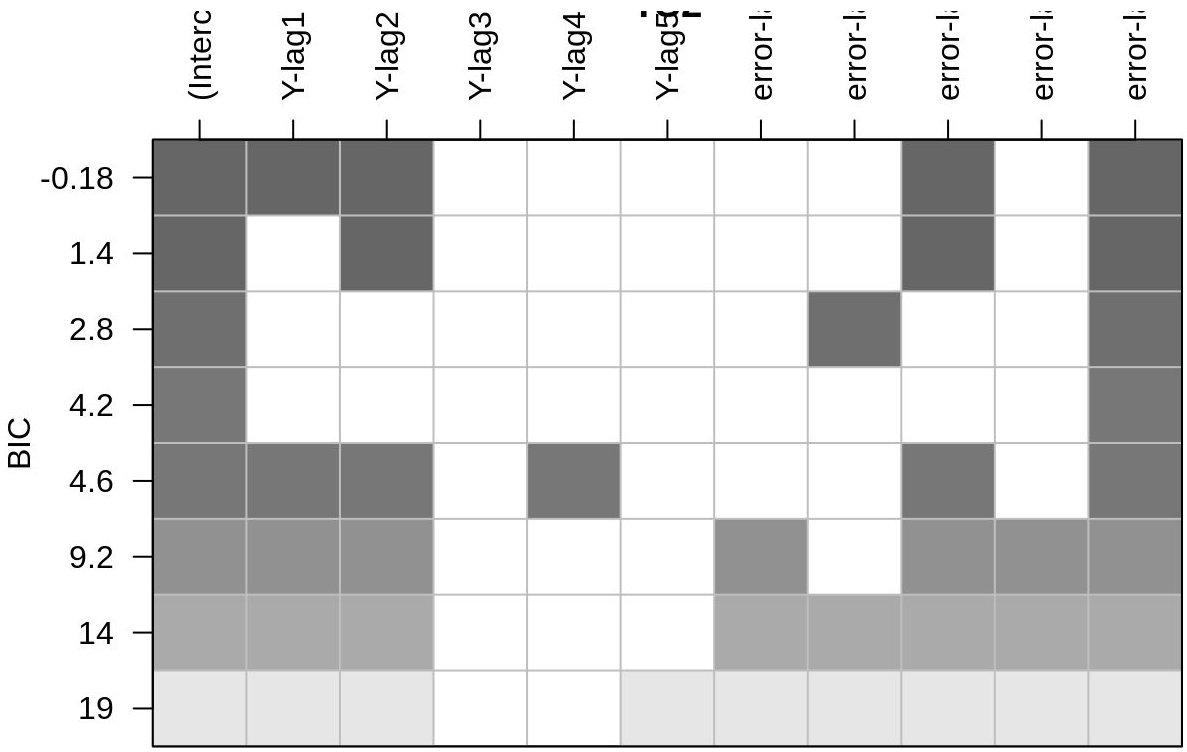



```
pacf(ts_3)
```



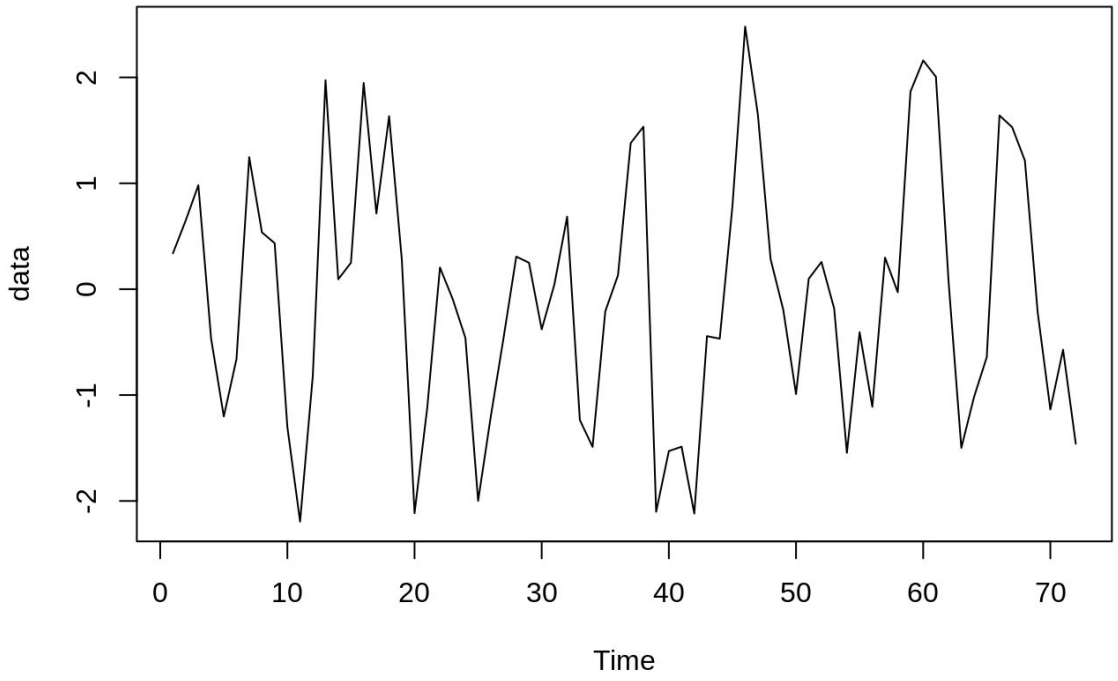
```
eacf(ts_3)

AR/MA
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 o x o o x o o o o o o  o  o  o
1 x o o o x o o o o o o  o  o  o
2 x x o o x o o o o o o  o  o  o
3 x x x o x o o o o o o  o  o  o
4 o x x o o o o o o o o  o  o  o
5 o o x x x o o o o o o  o  o  o
6 x o x x x x o o o o o  o  o  o
7 o o x x x o o o o o o  o  o  o
```

```
plot(armasubsets(ts_3, 5, 5))
```

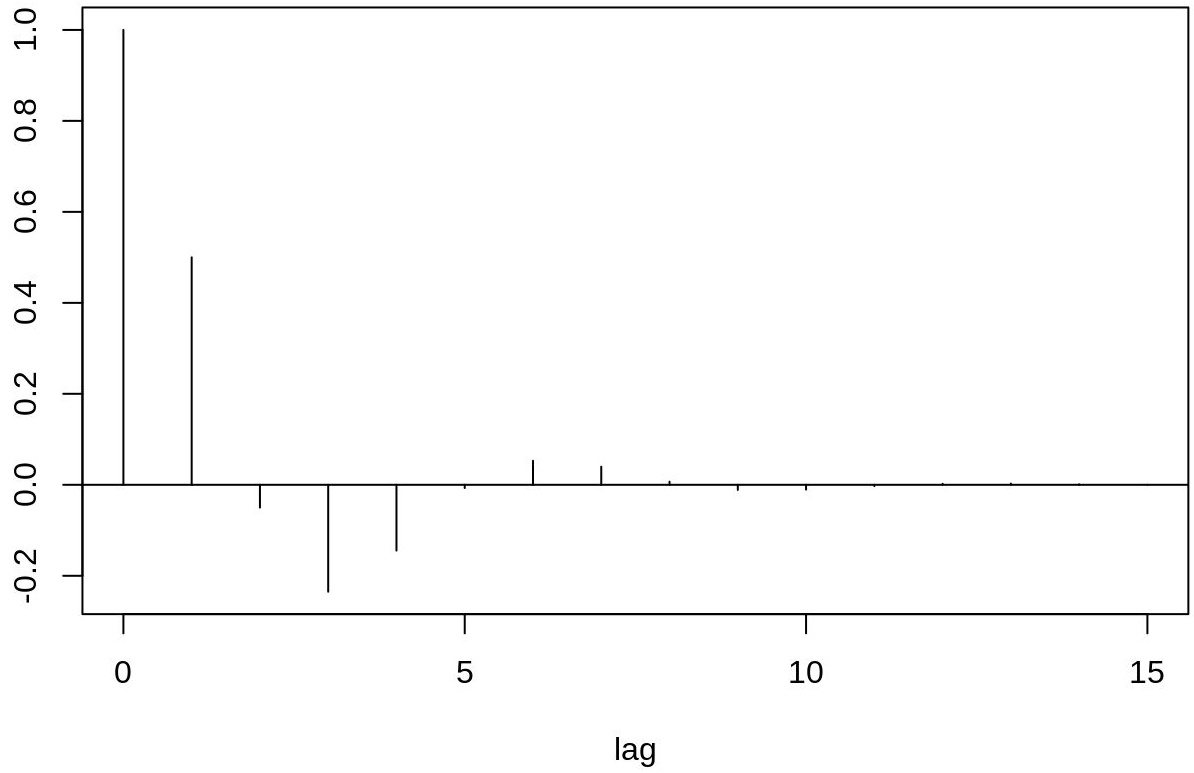


Problem 6.27

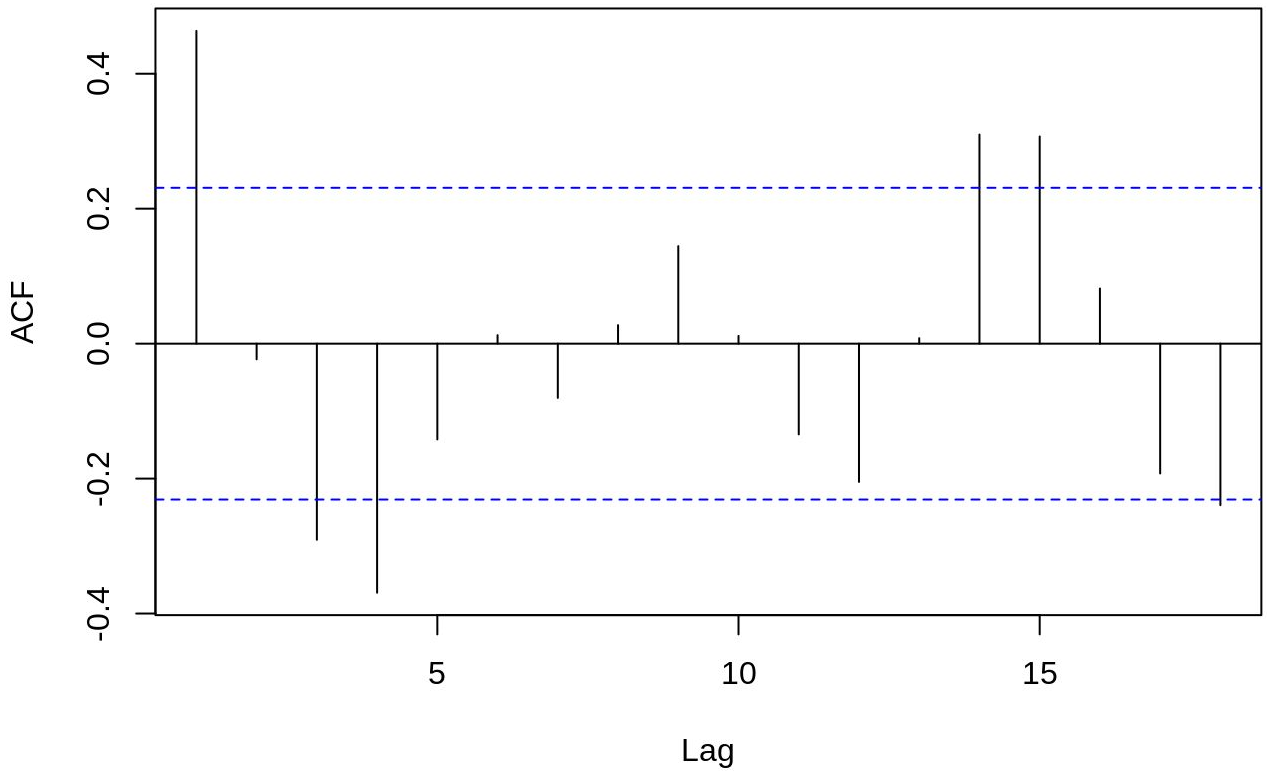
```
data = arima.sim(model=list(ar=c(.7,-0.4)), n=72)
data = ts(data, start=1, end=72, frequency=1)
plot(data)
```




```
t_acf = ARMAacf(ar = c(.7,-0.4), lag.max=15)

plot(c(0:15), t_acf, xlab = "lag", type = "h")
abline(0,0)
```

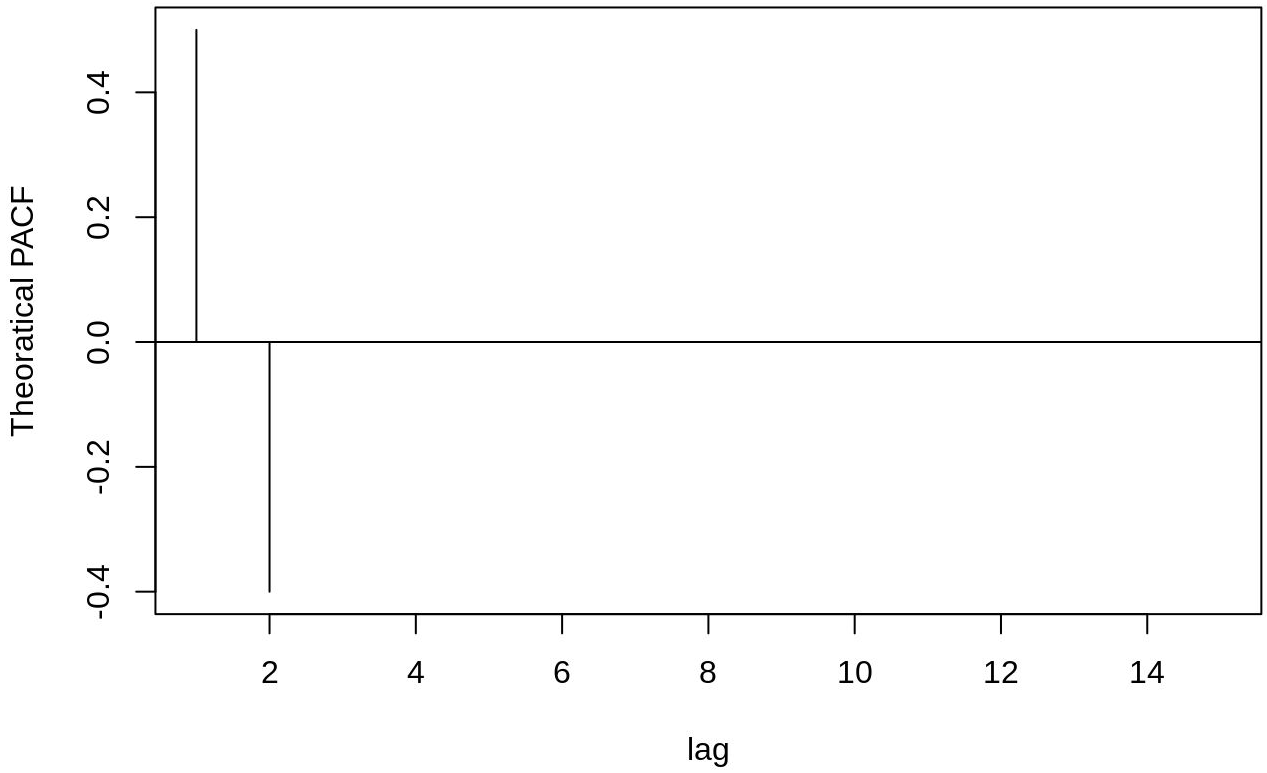



```
acf(data, main = "Auto Correlation Function")
```

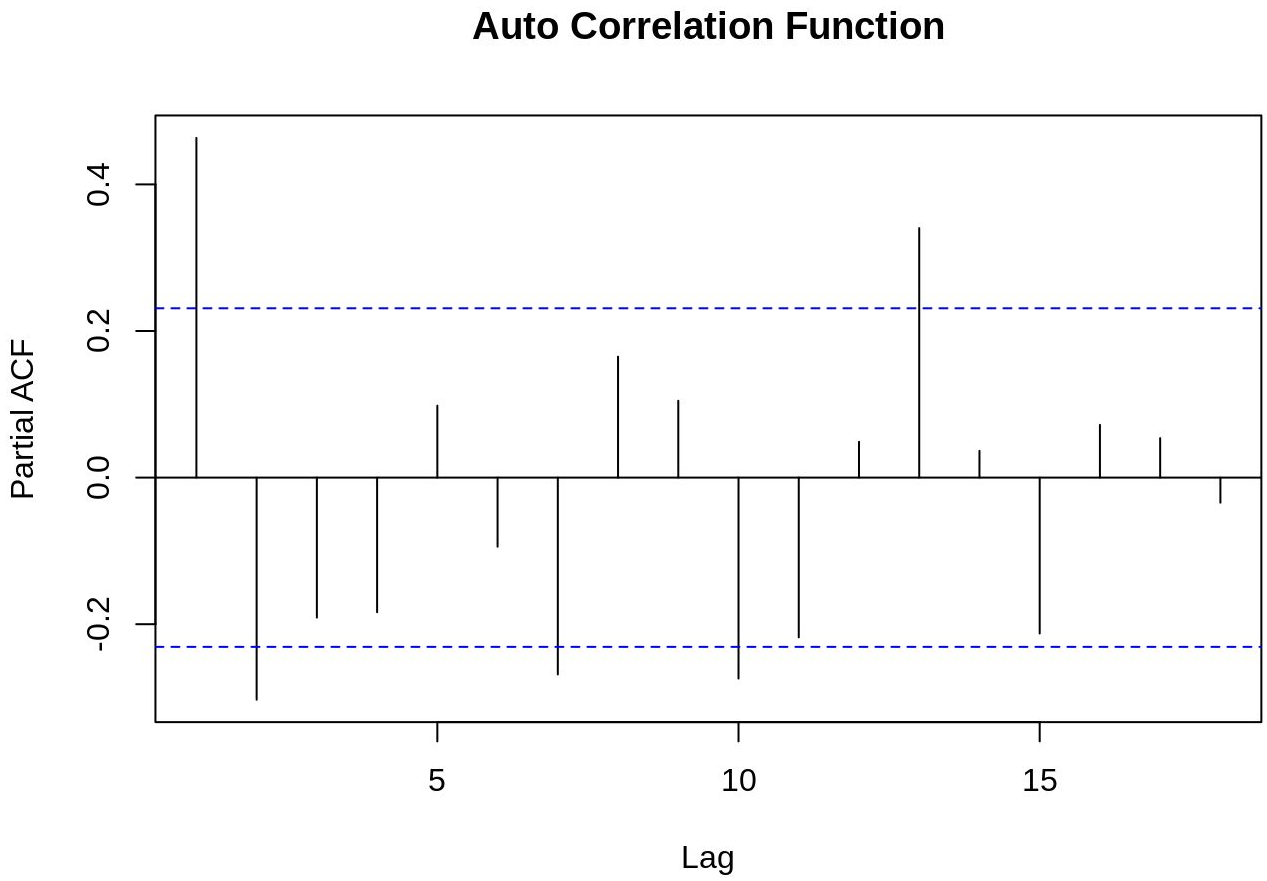


Comment: Sample and Theoretical ACFs are somewhat close

```
theo_pacf <- ARMAacf(ar = c(.7,-0.4),
                     lag.max = 15,
                     pacf = TRUE) #Theoratical PACF
plot(c(1:15),
     theo_pacf,
     xlab = "lag",
     ylab = "Theoratical PACF",
     type = "h")
abline(0,0)
```



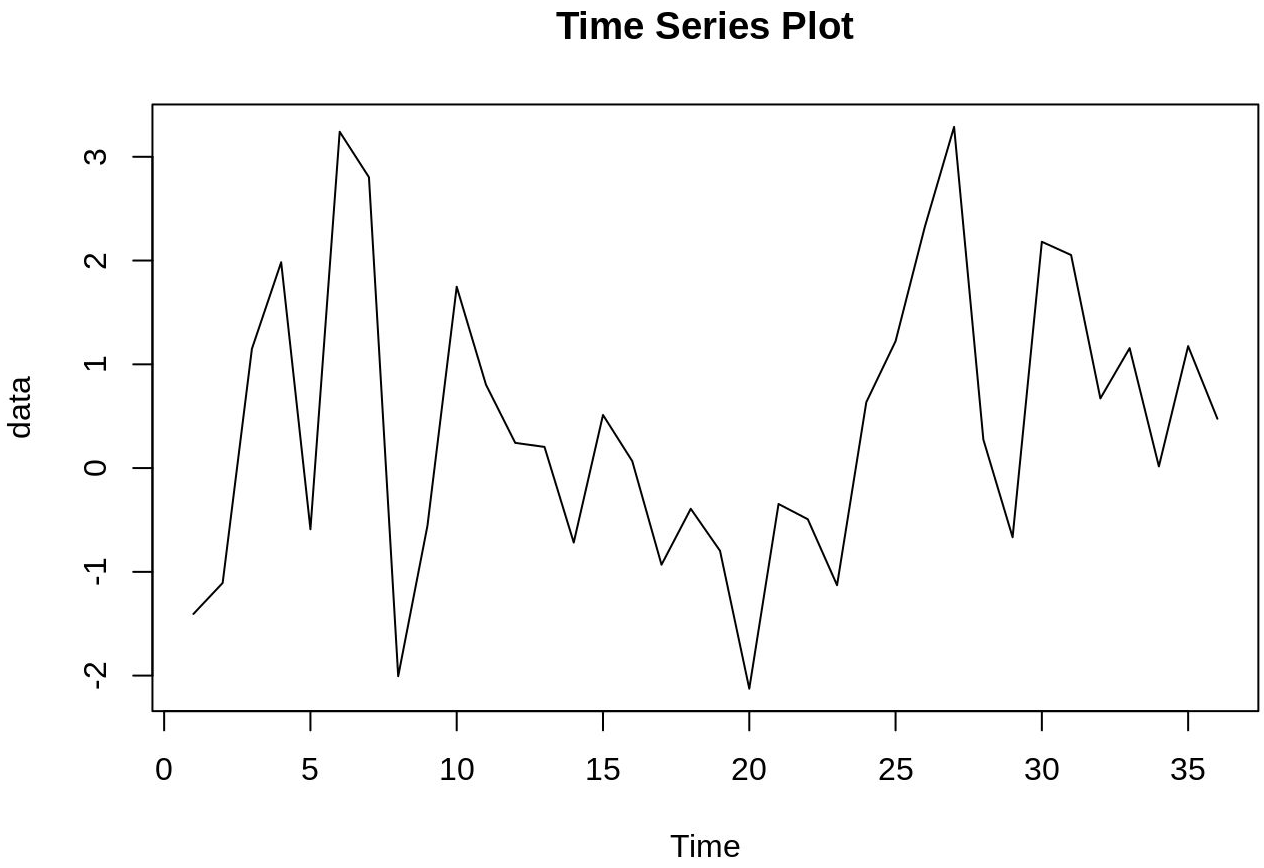

```
pacf(data, main = "Auto Correlation Function") #Sample ACF
```



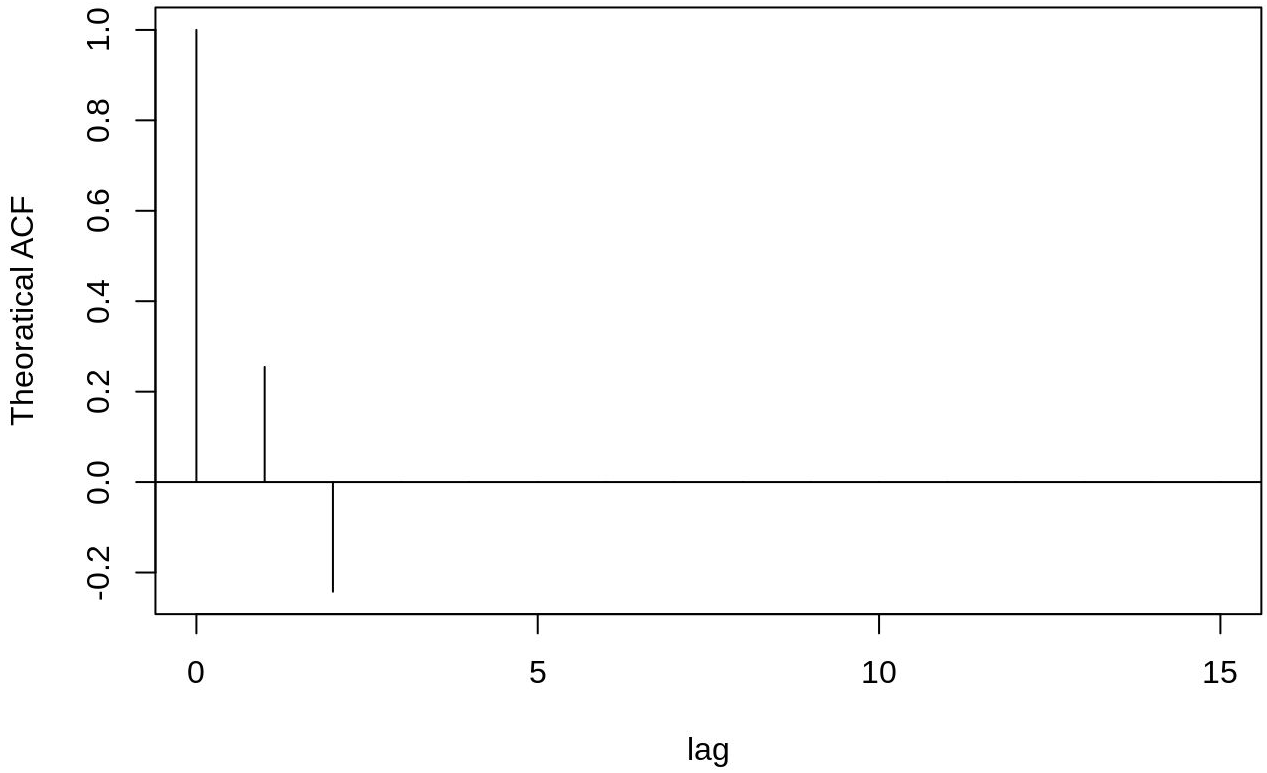
Comment: Value and pattern from the sample PACF accurately matches value and pattern from theoratical PACF

*Problem 6.28

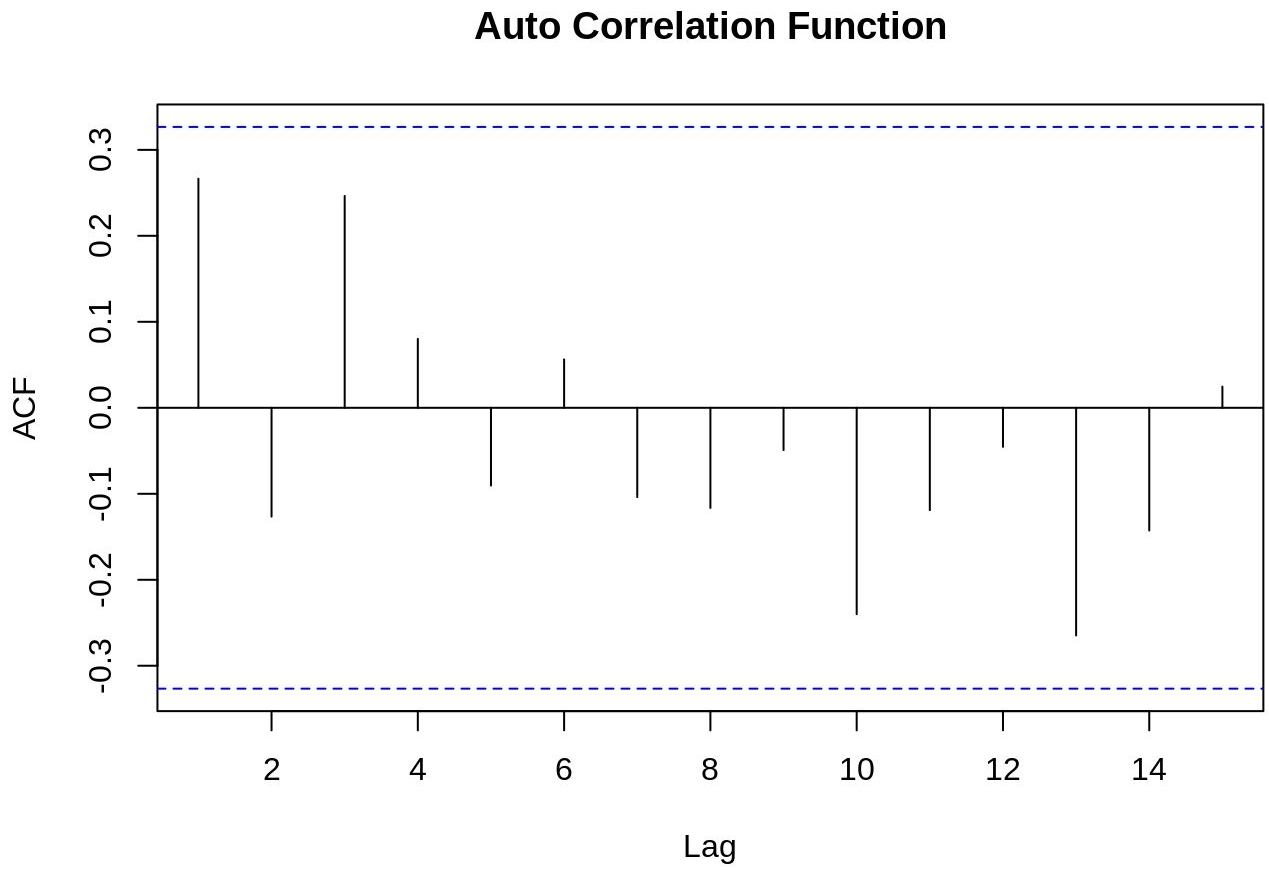
```
library(TSA)
data <- arima.sim(model=list(ma=c(.7,-0.4)),n=36)
data <- ts(data,
           start = 1,
           end = 36,
           frequency = 1)
plot(data, main = "Time Series Plot")
```




```
theo_acf <- ARMAacf(ma = c(.7,-0.4), lag.max = 15) #Theoratical ACF
plot(c(0:15),
     theo_acf,
     xlab = "lag",
     ylab = "Theoratical ACF",
     type = "h")
abline(0,0)
```

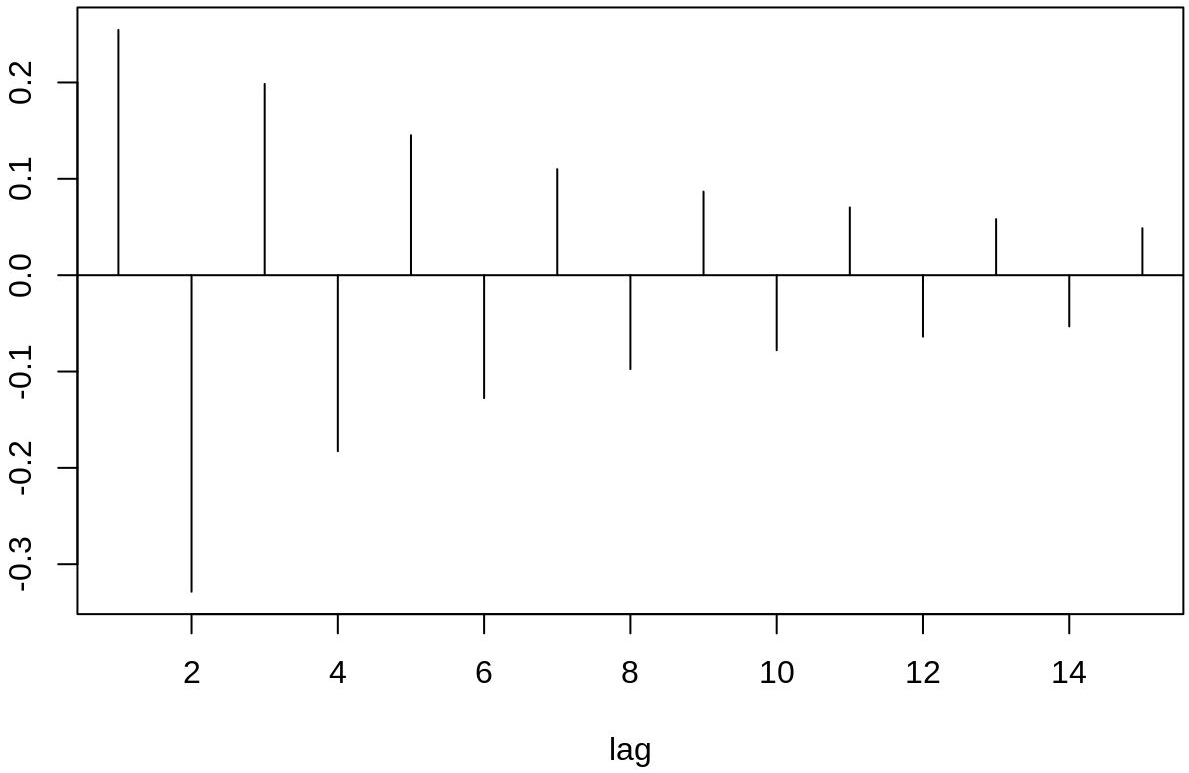



```
acf(data, main = "Auto Correlation Function") #Sample ACF
```

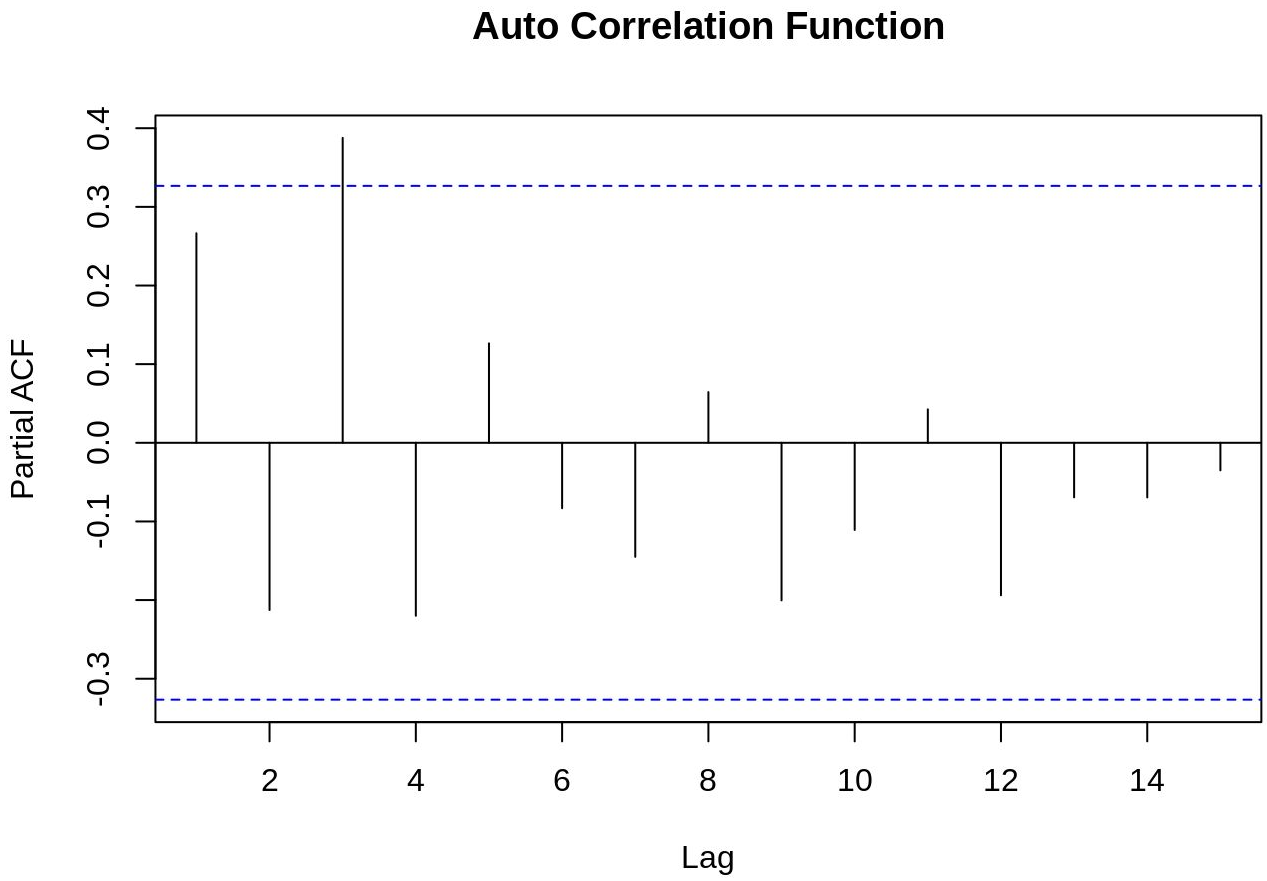


Comment: Sample and Theoretical ACFs are somewhat close

```
theo_pacf <- ARMAacf(ma = c(.7,-0.4),
                     lag.max = 15,
                     pacf = TRUE) #Theoretical PACF
plot(c(1:15),
     theo_pacf,
     xlab = "lag",
     type = "h")
abline(0,0)
```



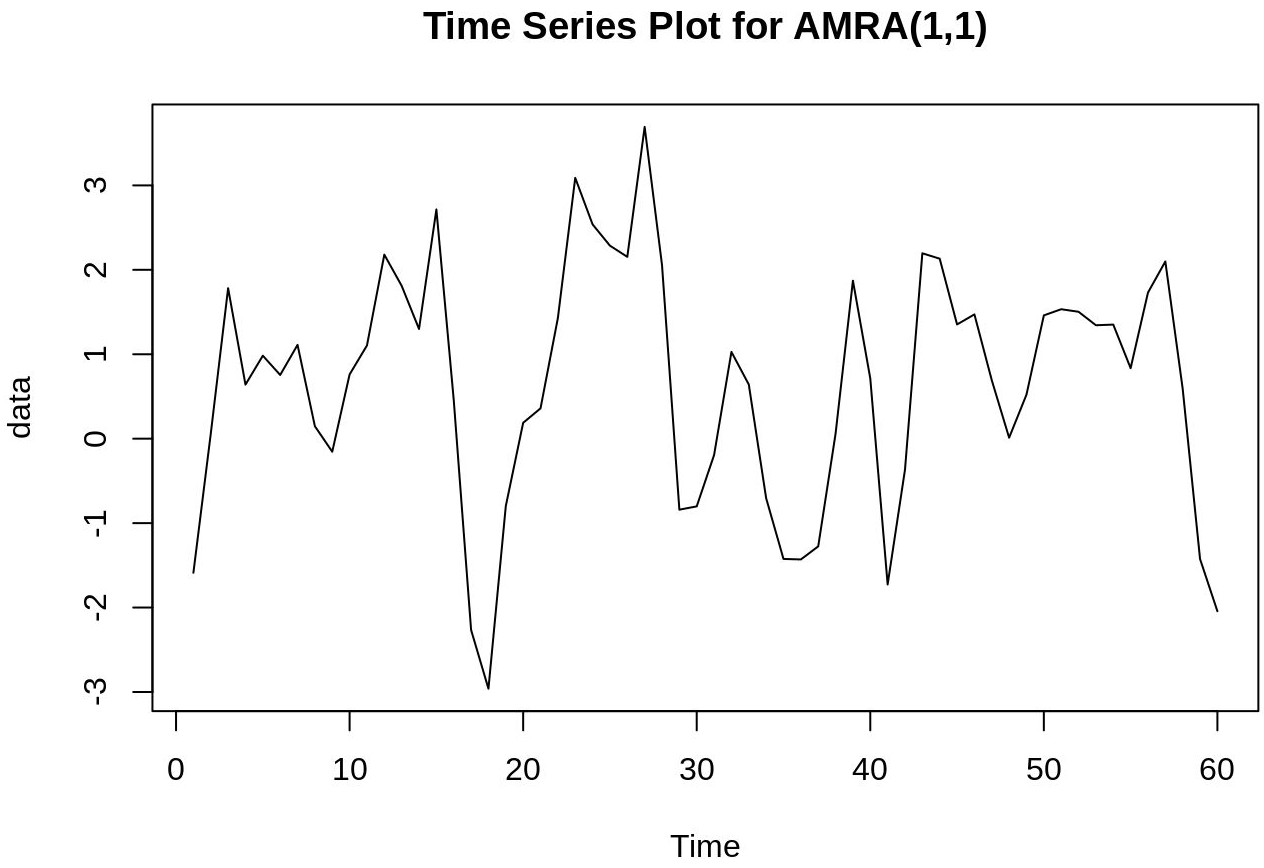

```
pacf(data, main = "Auto Correlation Function") #Sample ACF
```



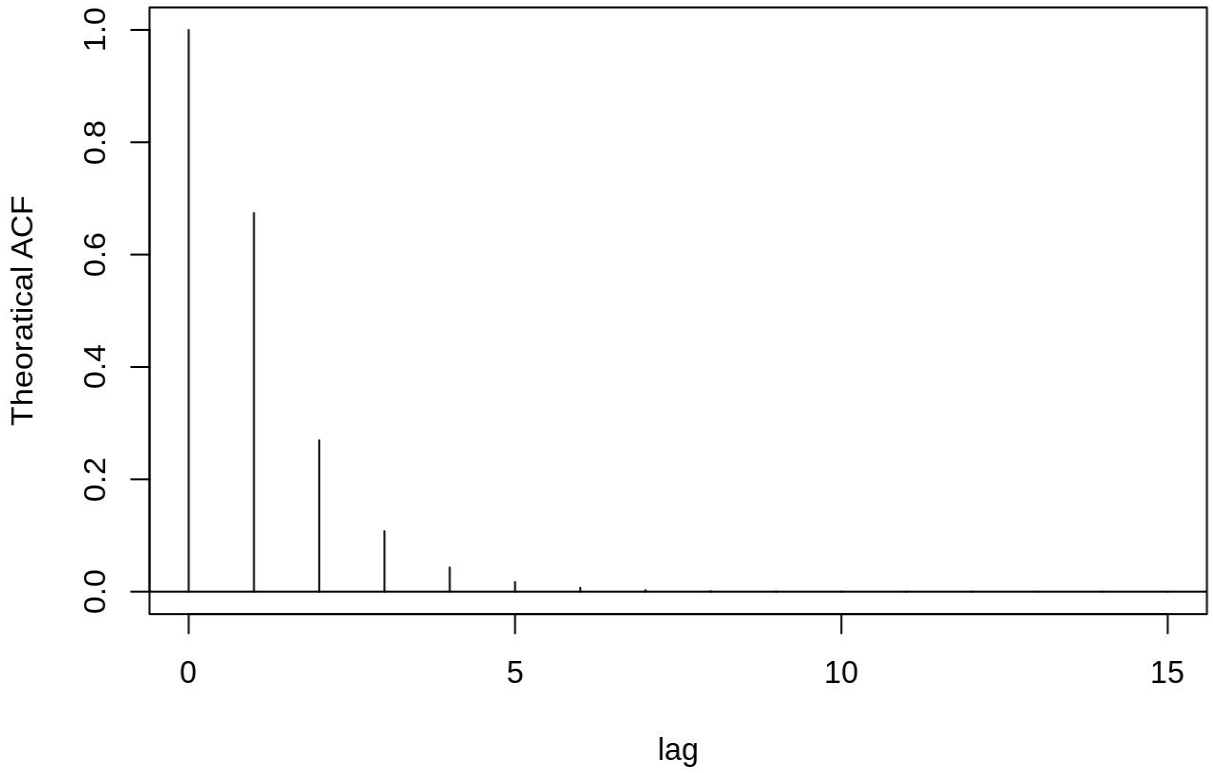
Comment: Sample and Theoretical ACFs are somewhat close

Problem 6.29

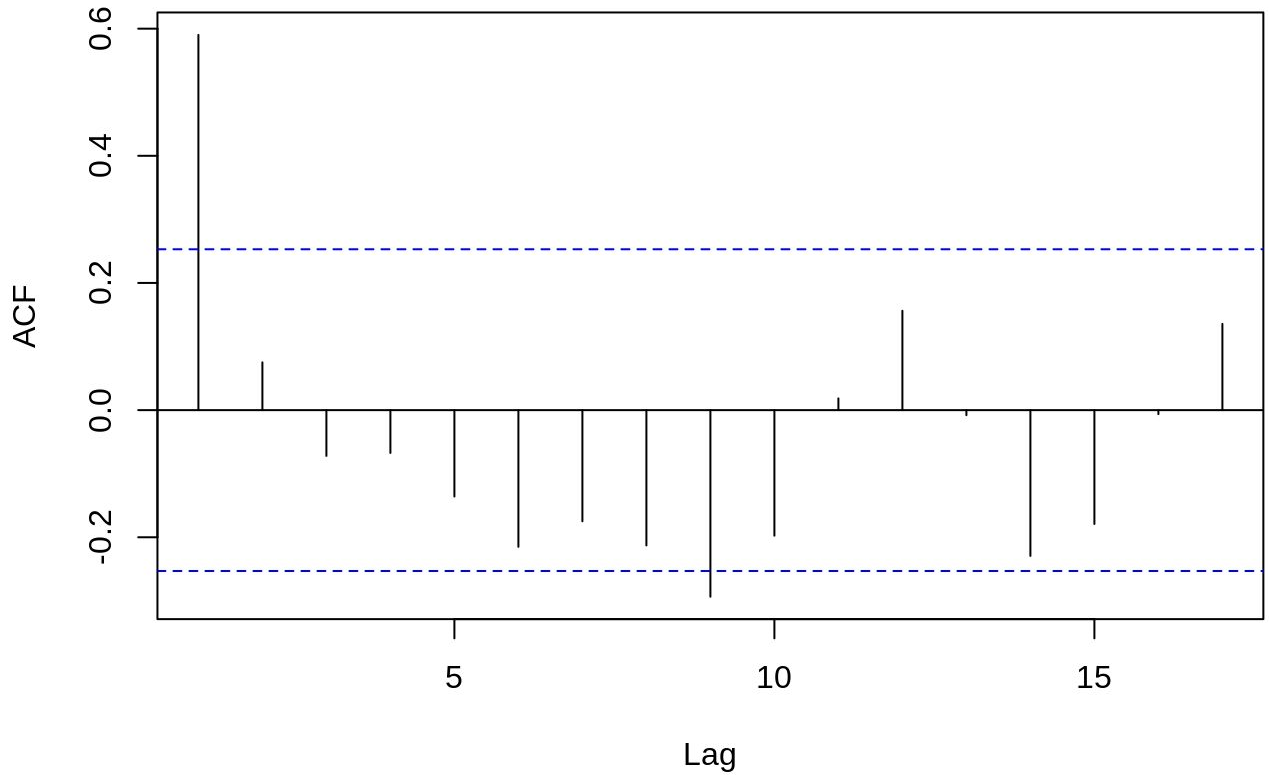
```
data = arima.sim(model=list(ar=c(.4), ma=c(.6)), n=60)
data = ts(data,
          start = 1,
          end = 60,
          frequency = 1)
plot(data, main = "Time Series Plot for AMRA(1,1)")
```




```
theo_acf <- ARMAacf(ar = c(.4),
                    ma = c(.6),
                    lag.max = 15
plot(c(0:15),
     theo_acf,
     xlab = "lag",     type = "h")
abline(0,0)
```




```
acf(data) #Sample ACF
```



Comment: Sample and Theoretical ACFs are somewhat close

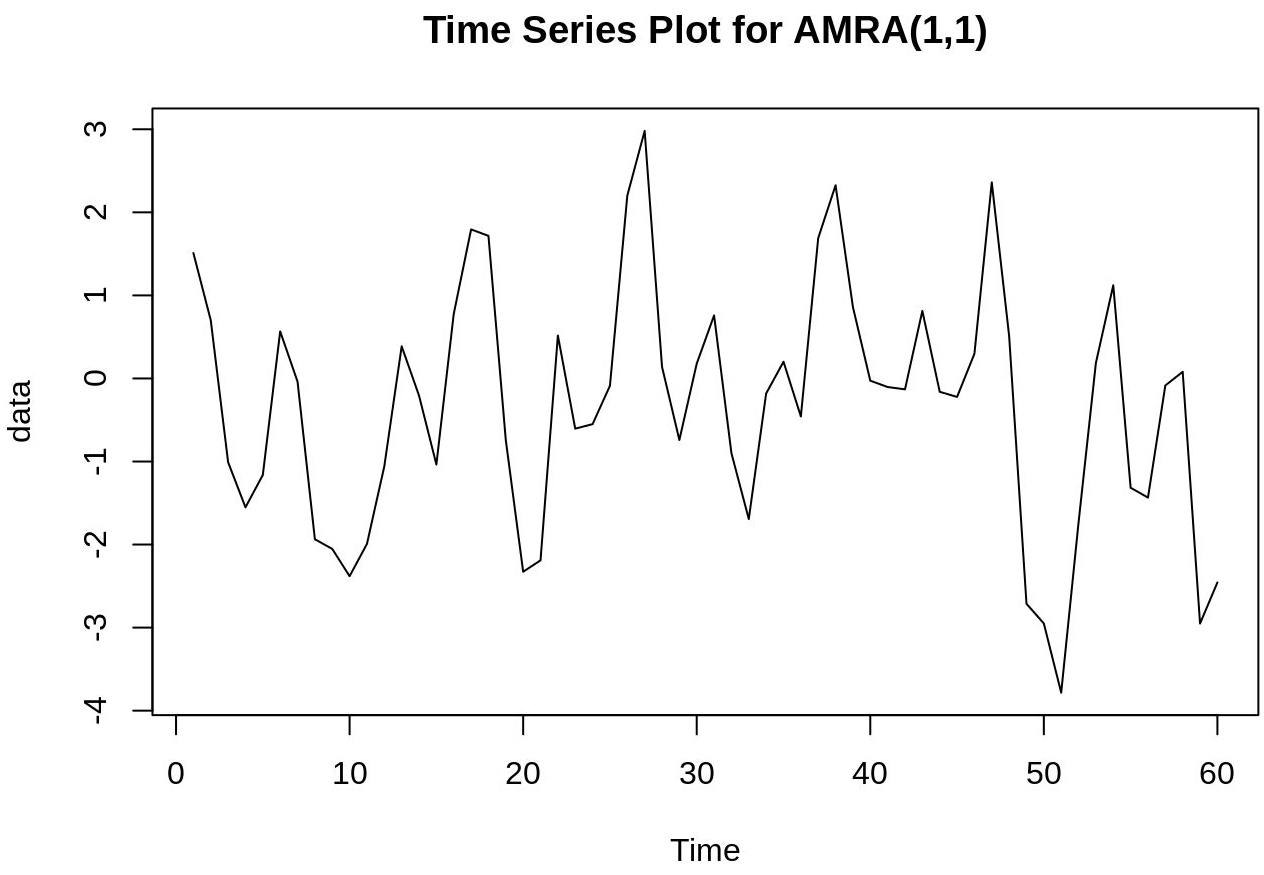
```
eacf(data, ar.max = 7, ma.max = 13)
```

```
## AR/MA
##   0 1 2 3 4 5 6 7 8 9 10 11 12 13
## 0 x o o o o o o o x o o  o  o  o
## 1 x o o o o o o o o o o  o  o  x
## 2 x x o o o o o o o o o  o  o  o
## 3 x o o o o o o o o o o  o  o  o
## 4 x o o o o o o o o o o  o  o  o
## 5 o x o o o o o o o o o  o  o  o
## 6 o o o o o o o o o o o  o  o  o
## 7 o o o x x o o o o o o  o  o  o
```

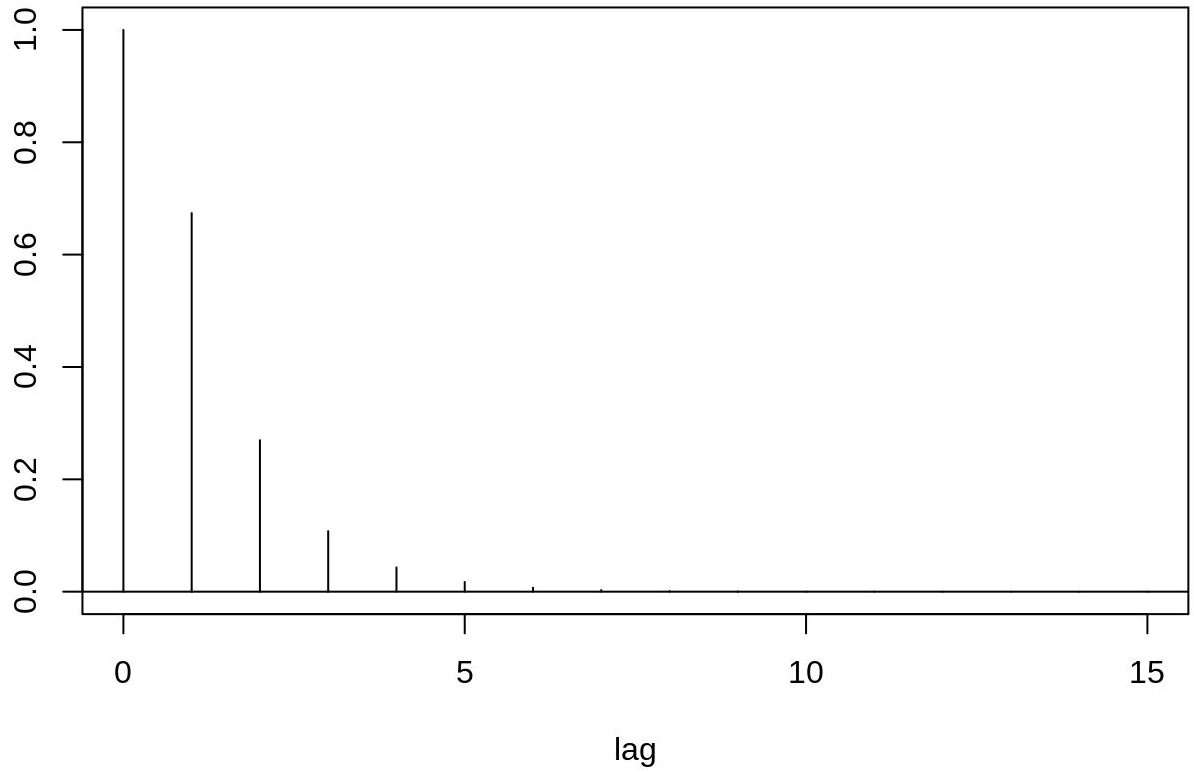
REPEATED SIMULATION

```
data <- arima.sim(model=list(ar=c(.4), ma=c(.6)), n=60)
```

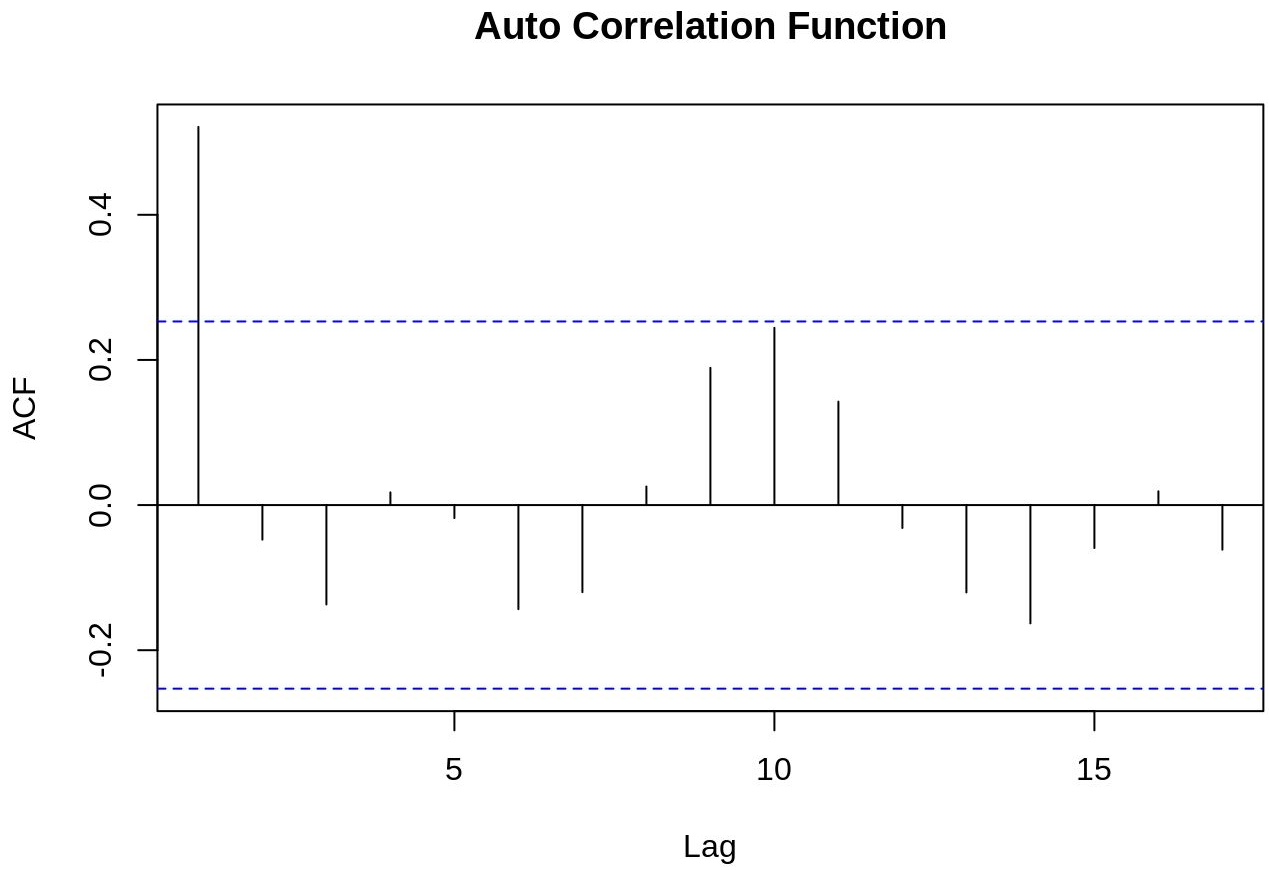
```
data <- ts(data,
           start = 1,
           end = 60,
           frequency = 1)
plot(data, main = "Time Series Plot for AMRA(1,1)")
```




```
theo_acf <- ARMAacf(ar = c(.4),
                    ma = c(.6),
                    lag.max = 15) #Theoratical ACF
plot(c(0:15),
     theo_acf,
     xlab = "lag",
     type = "h")
abline(0,0)
```




```
acf(data, main = "Auto Correlation Function") #Sample ACF
```

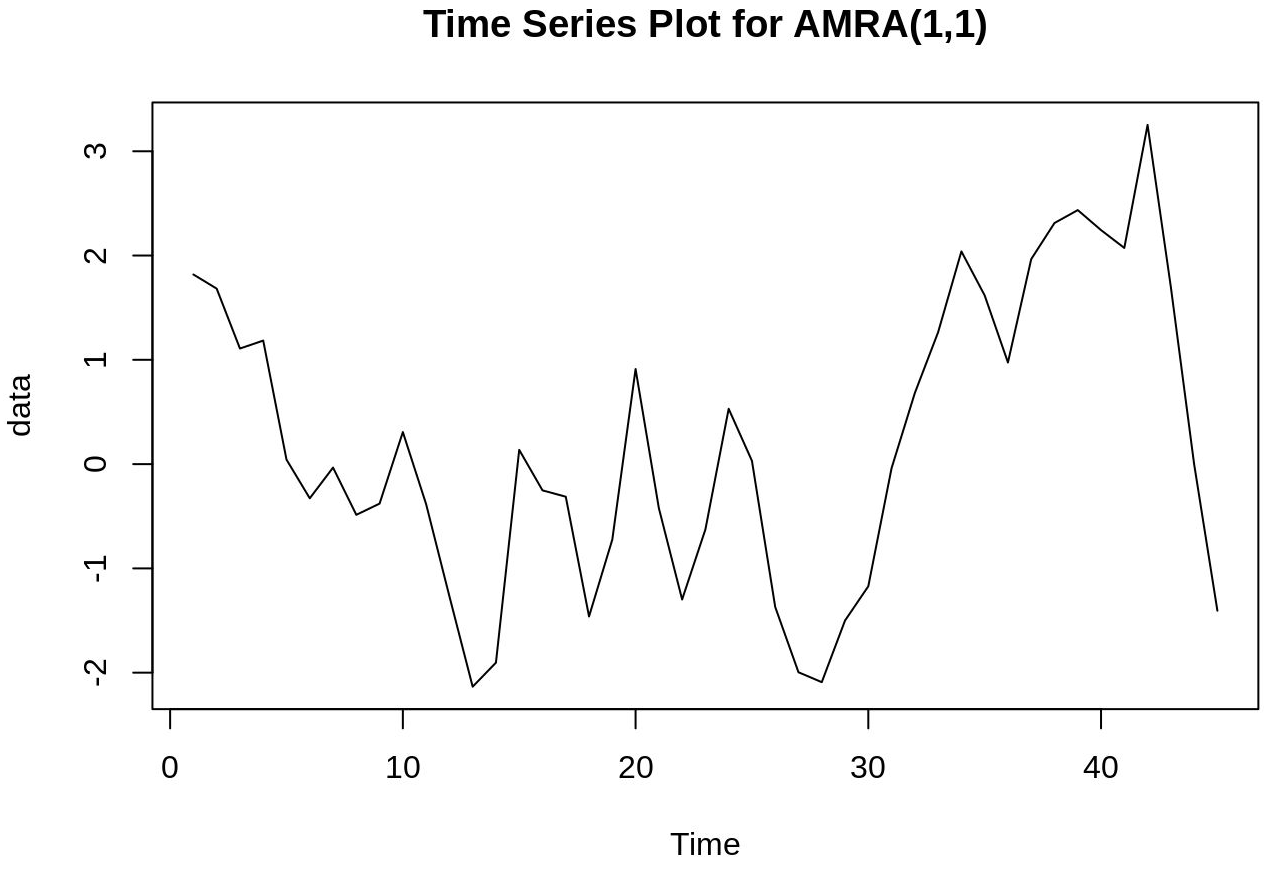


Comment: Sample and Theoretical ACFs are somewhat close

```
eacf(data, ar.max = 7, ma.max = 13)

## AR/MA
##   0 1 2 3 4 5 6 7 8 9 10 11 12 13
## 0 x o o o o o o o o o o  o  o  o
## 1 x o o o o o o o o o o  o  o  o
## 2 x o o o o o o o o o o  o  o  o
## 3 o o o o o o o o o o o  o  o  o
## 4 o x x o o o o o o o o  o  o  o
## 5 o o o o o o o o o o o  o  o  o
## 6 o o o x o o o o o o o  o  o  o
## 7 o o o x o o o o o o o  o  o  o
```

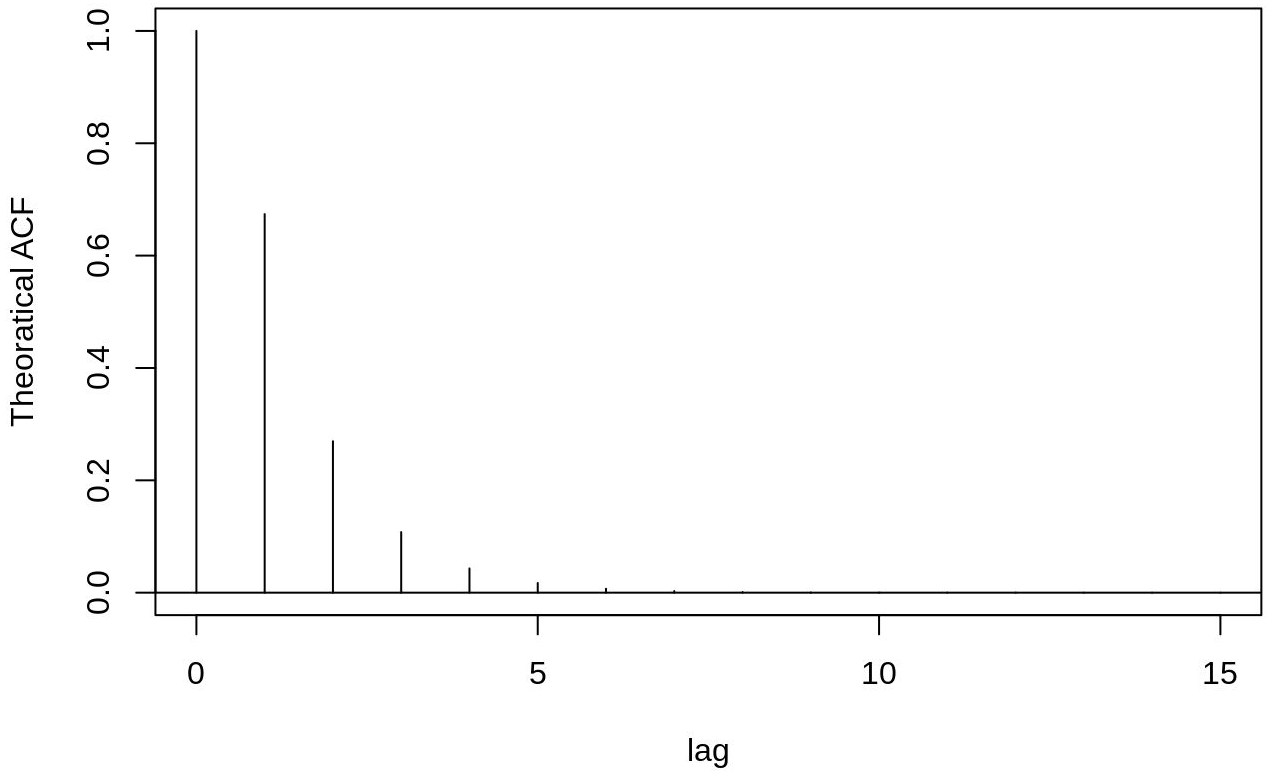
Comment: *BLANK*

```
REPEATED SIMULATION with n = 45

 data <- arima.sim(model=list(ar=c(.4), ma=c(.6)), n=45)
 data <- ts(data,
            start = 1,
            end = 45,
            frequency = 1)
 plot(data, main = "Time Series Plot for AMRA(1,1)")
```

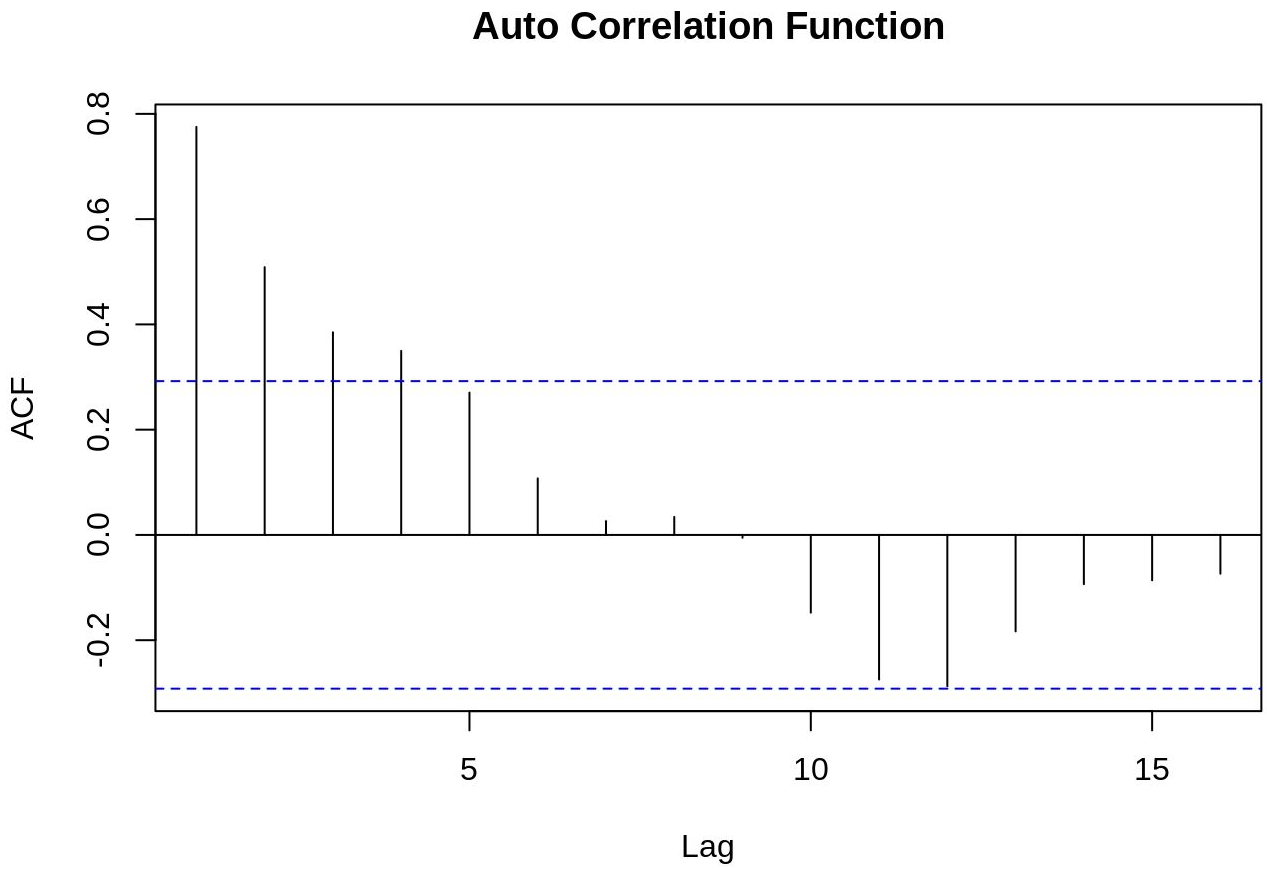



```
 theo_acf <- ARMAacf(ar = c(.4),
                     ma = c(.6),
                     lag.max = 15) #Theoratical ACF
 plot(c(0:15),
      theo_acf,
      xlab = "lag",
      ylab = "Theoratical ACF",
```

```
     type = "h")
abline(0,0)
```




```
acf(data, main = "Auto Correlation Function") #Sample ACF
```

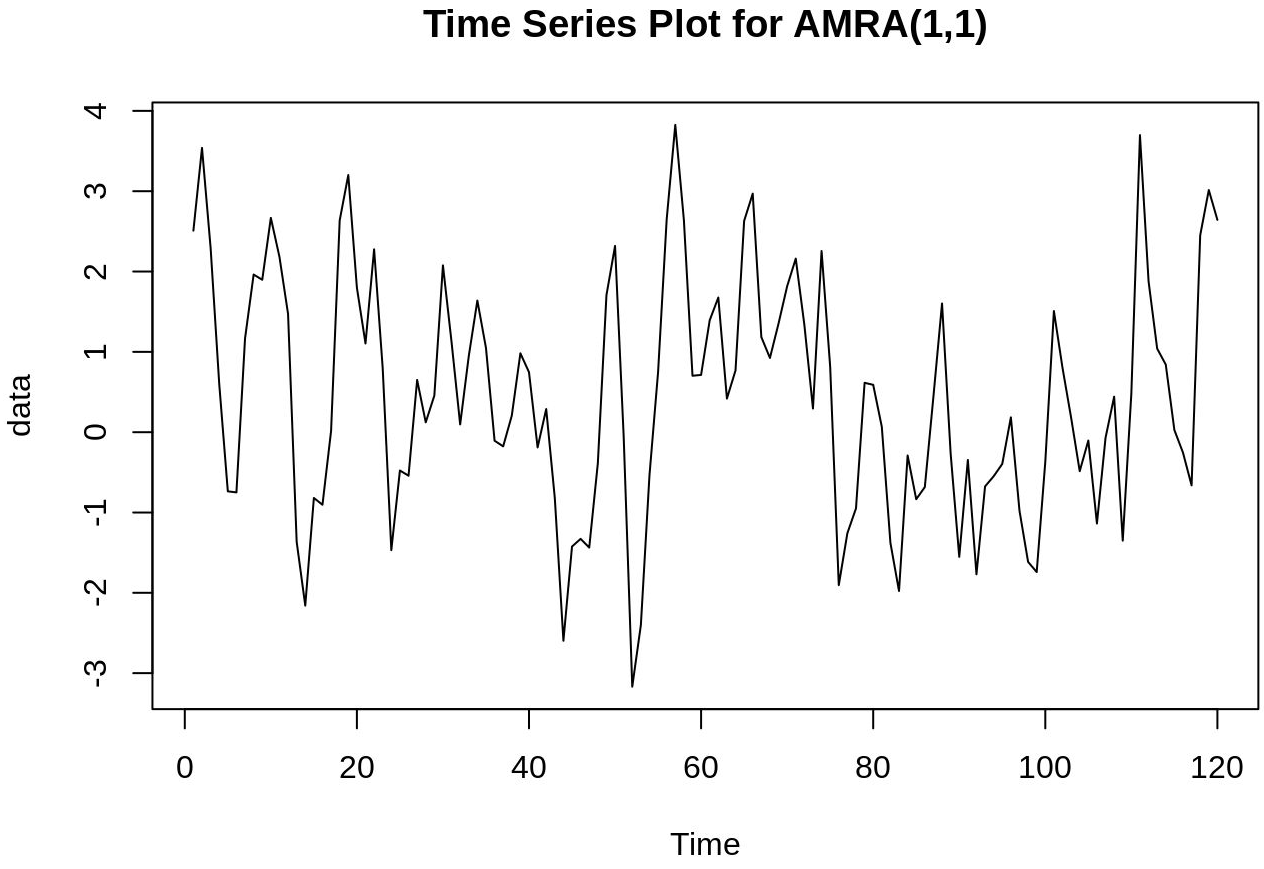


Comment: Sample and Theoretical ACFs are somewhat close

```
 eacf(data, ar.max = 7, ma.max = 13)

 ## AR/MA
 ##   0 1 2 3 4 5 6 7 8 9 10 11 12 13
 ## 0 x x x x o o o o o o o  o  o  o
 ## 1 x o o o o o o o o o o  o  o  o
 ## 2 x o o o x o o o o o o  o  o  o
 ## 3 o o o o x o o o o o o  o  o  o
 ## 4 o o o o x o o o o o o  o  o  o
 ## 5 x o x x o o o o o o o  o  o  o
 ## 6 x o o x o o o o o o o  o  o  o
 ## 7 x o o o o o o o o o o  o  o  o
```

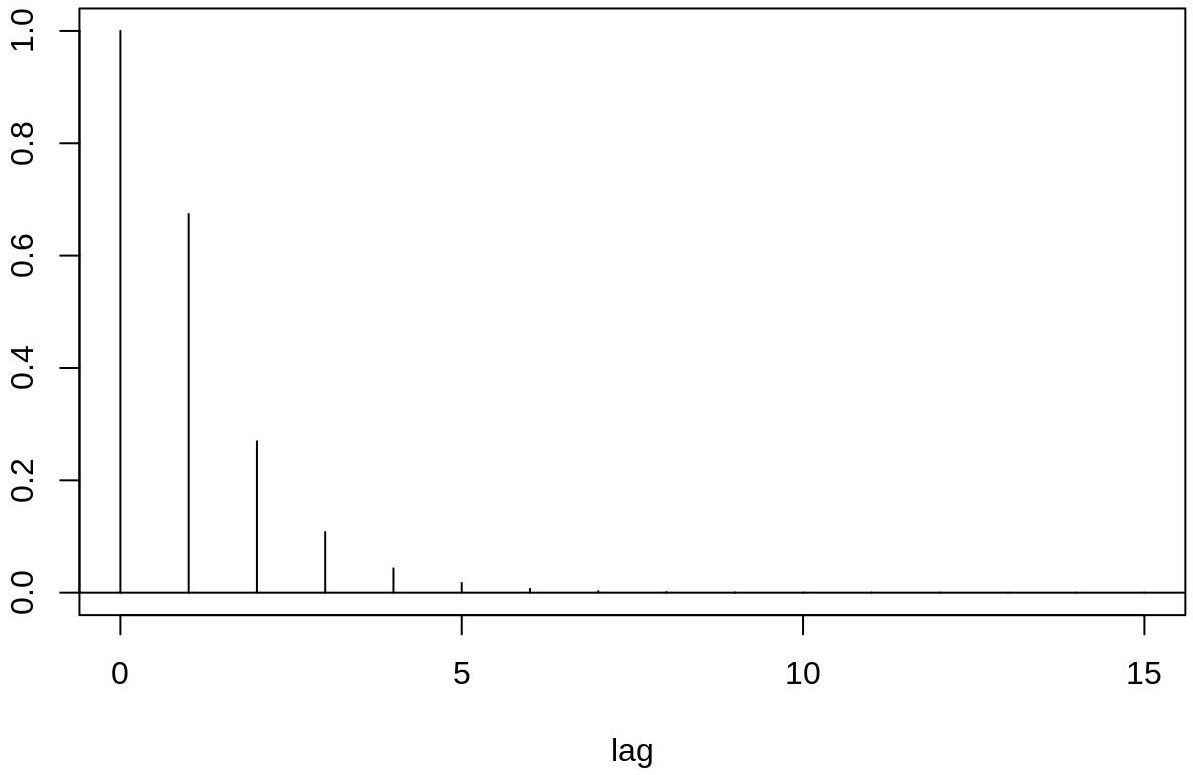
Comment: *BLANK*

```
REPEATED SIMULATION with n = 120

 data = arima.sim(model=list(ar=c(.4), ma=c(.6)), n=120)
 data = ts(data,
           start = 1,
           end = 120,
           frequency = 1)
 plot(data, main = "Time Series Plot for AMRA(1,1)")
```

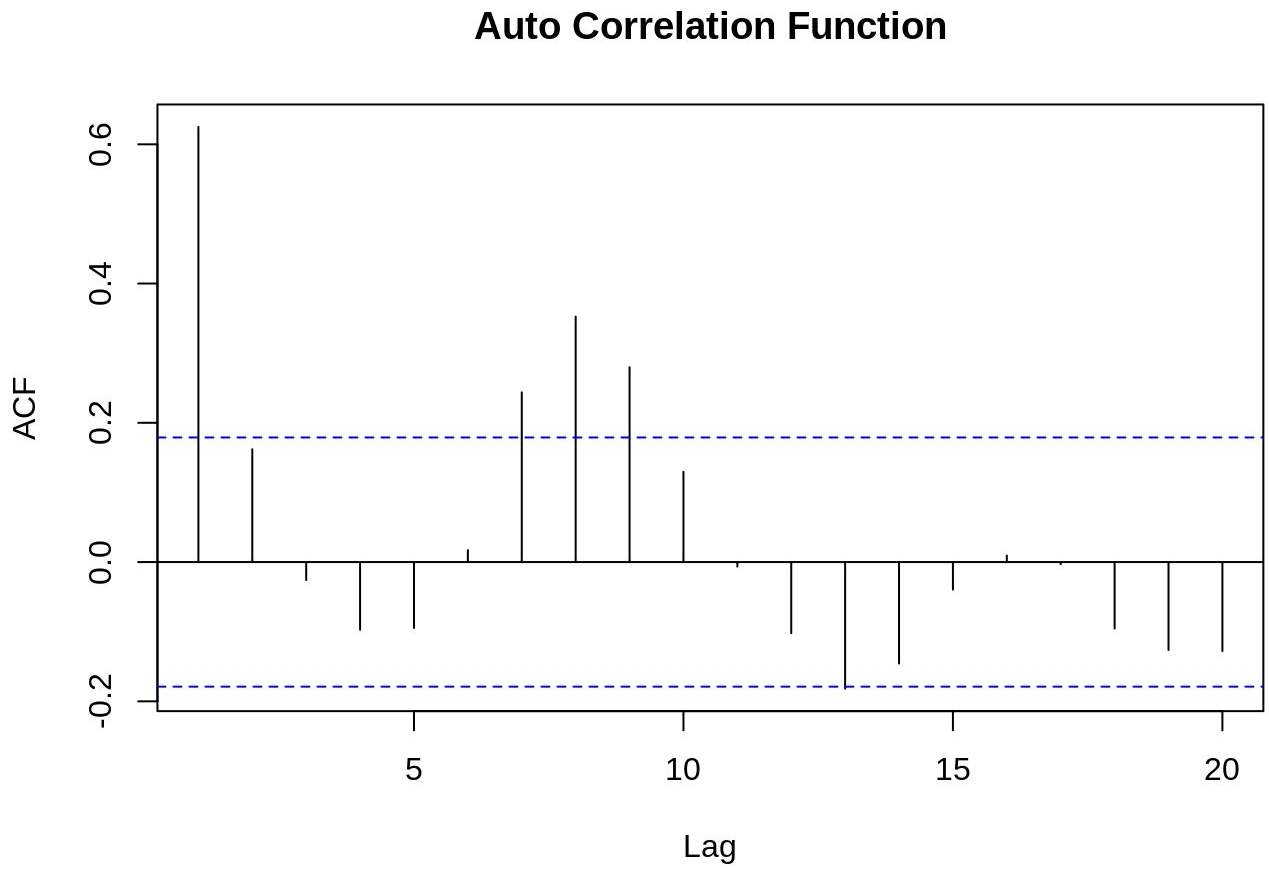



```
 theo_acf <- ARMAacf(ar = c(.4),
                     ma = c(.6),
                     lag.max = 15)

 plot(c(0:15),
      theo_acf,
      xlab = "lag",
```

```
     type = "h")
abline(0,0)
```




```
acf(data, main = "Auto Correlation Function") #Sample ACF
```

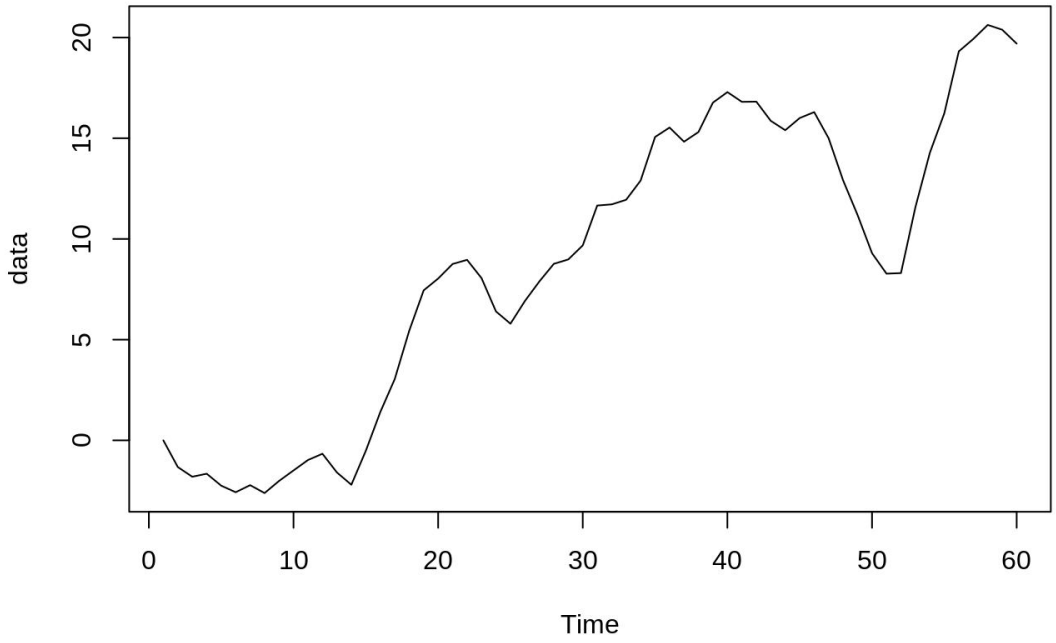


Comment: Sample ACP somewhat corresponds to theoretical ACF

```
 eacf(data, ar.max = 7, ma.max = 13)

 AR/MA
 0 1 2 3 4 5 6 7 8 9 10 11 12 13
 0 x o o o o o x x x o o  o  o  o
 1 x o o o o o o x o o o  o  o  o
 2 x x x o o o o o o o o  o  o  o
 3 x x x o o o o x o o o  o  o  o
 4 x x x o o o o o o o o  o  o  o
 5 x o x o o x o o o o o  o  o  o
 6 x o x x x x x o o o o  o  o  o
 7 o x o x o x o o o o o  o  o  o
```

Problem 6.31

```
data = arima.sim(list(order = c(0,1,1), ma = 0.8), n = 60)
data =  ts(data,  start=1, end=60,  frequency=1)
plot(data)
```




```
adf.test(data, k= 0)

##
##  Augmented Dickey-Fuller Test
##
## data:  data
## Dickey-Fuller = -1.5376, Lag order = 0, p-value = 0.7617
## alternative hypothesis: stationary
```

Comment: P-value > 0.05, so we fail to reject the Null hypothesis, the time series is non-stationary.

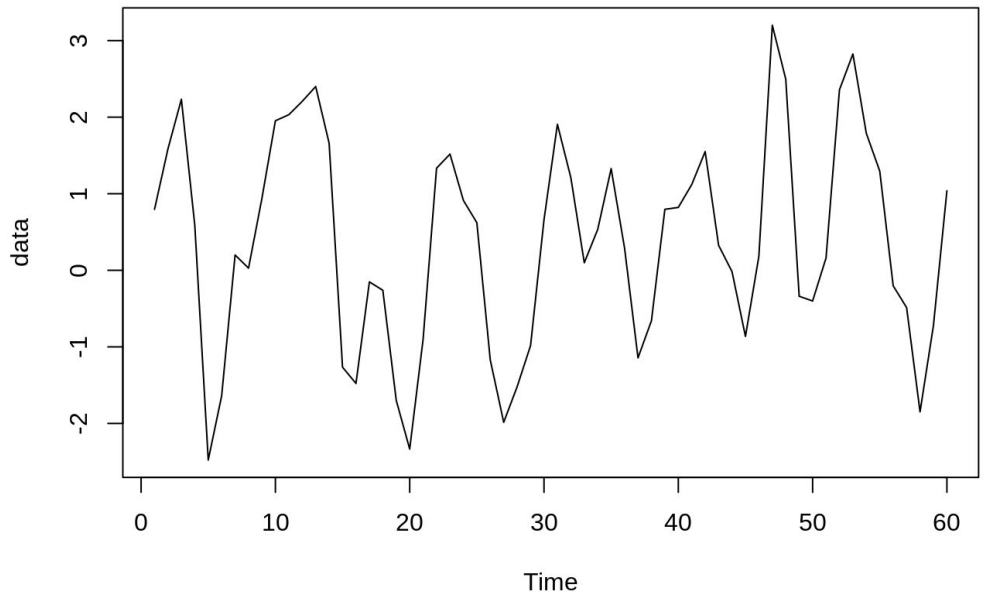
```
adf.test(data)

##
```

```
##  Augmented Dickey-Fuller Test
##
## data:  data
## Dickey-Fuller = -2.9207, Lag order = 3, p-value = 0.2026
## alternative hypothesis: stationary
```

Comment: P-value > 0.05, so we fail to reject the Null hypothesis, the time series is non-stationary.

*REPEATED SIMULATION WITH STATIONARY SERIES

```
set.seed(1)
data = arima.sim(list(order = c(1,0,1), ar = 0.4, ma = 0.8), n = 60)
data = ts(data, start=1, end=60, frequency=1)
plot(data)
```




```
adf.test(data, k=0)

##
##  Augmented Dickey-Fuller Test
##
## data:  data
```

```
## Dickey-Fuller = -3.8133, Lag order = 0, p-value = 0.02387
## alternative hypothesis: stationary
```

Comment: P-value < 0.05, so we reject the Null hypothesis, the time series is stationary.

```
adf.test(data)
```

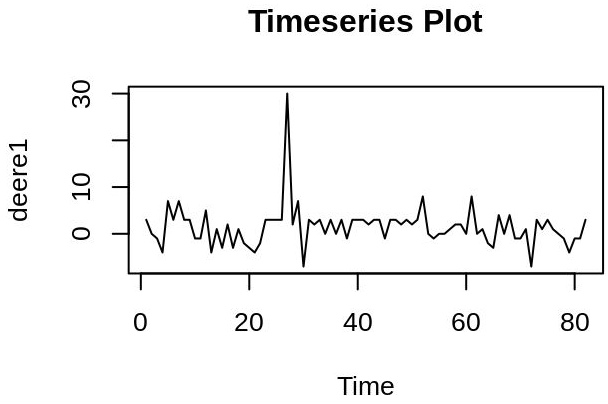
```
##  Augmented Dickey-Fuller Test
##
## data:  data
## Dickey-Fuller = -4.5771, Lag order = 3, p-value = 0.01
## alternative hypothesis: stationary
```

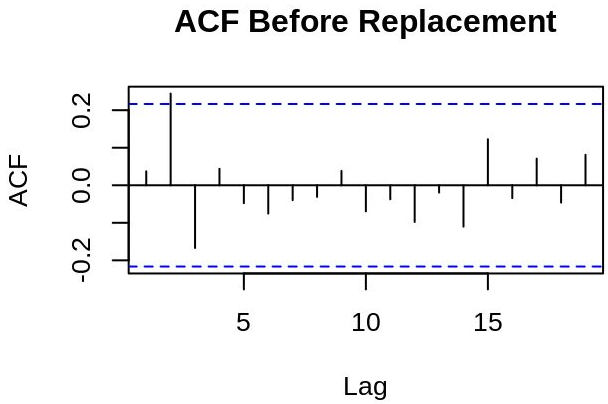
Comment: P-value < 0.05, so we reject the Null hypothesis, the time series is stationary.

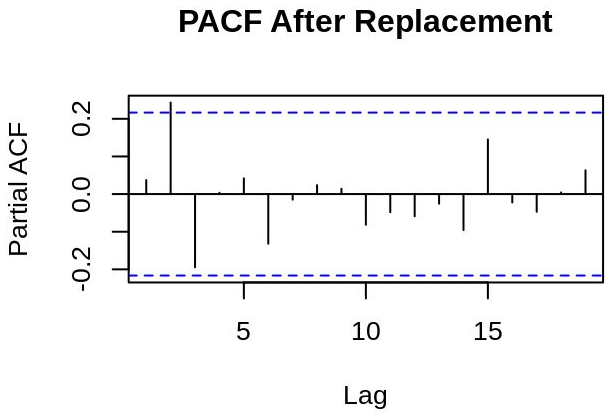
Problem 6.33

```
wd = '../HW5 Data'
setwd(wd)
library('TSA')
library('tseries')
```

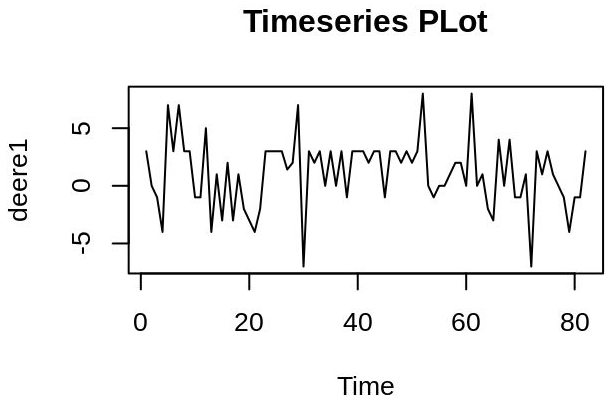
```
timeseries <- read.table('deere1.txt', header = T)
ts = ts(timeseries, start = 1, end = 82)
par(mfrow=c(2,2))
plot(ts, main = "Timeseries Plot")

acf(ts, main = "ACF Before Replacement")
pacf(ts, main = "PACF After Replacement")
par(mfrow=c(1,1))
```

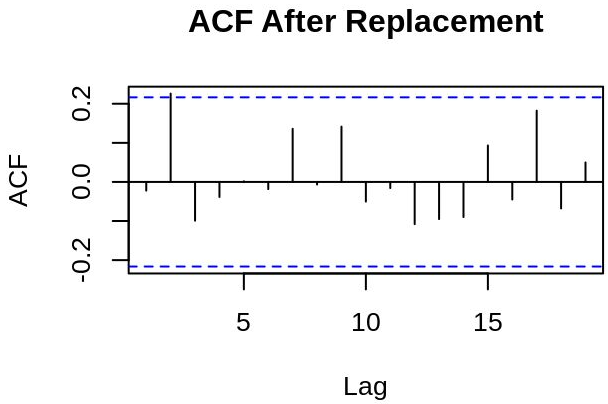


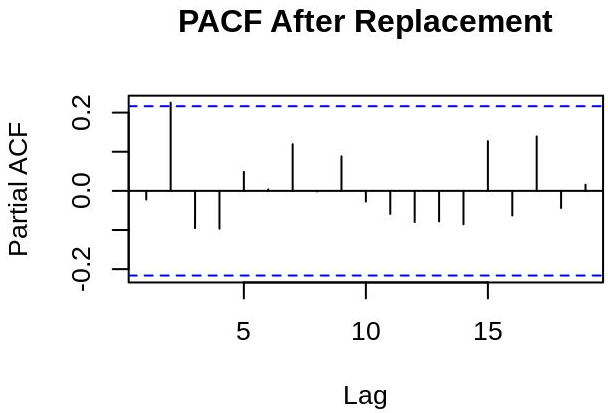




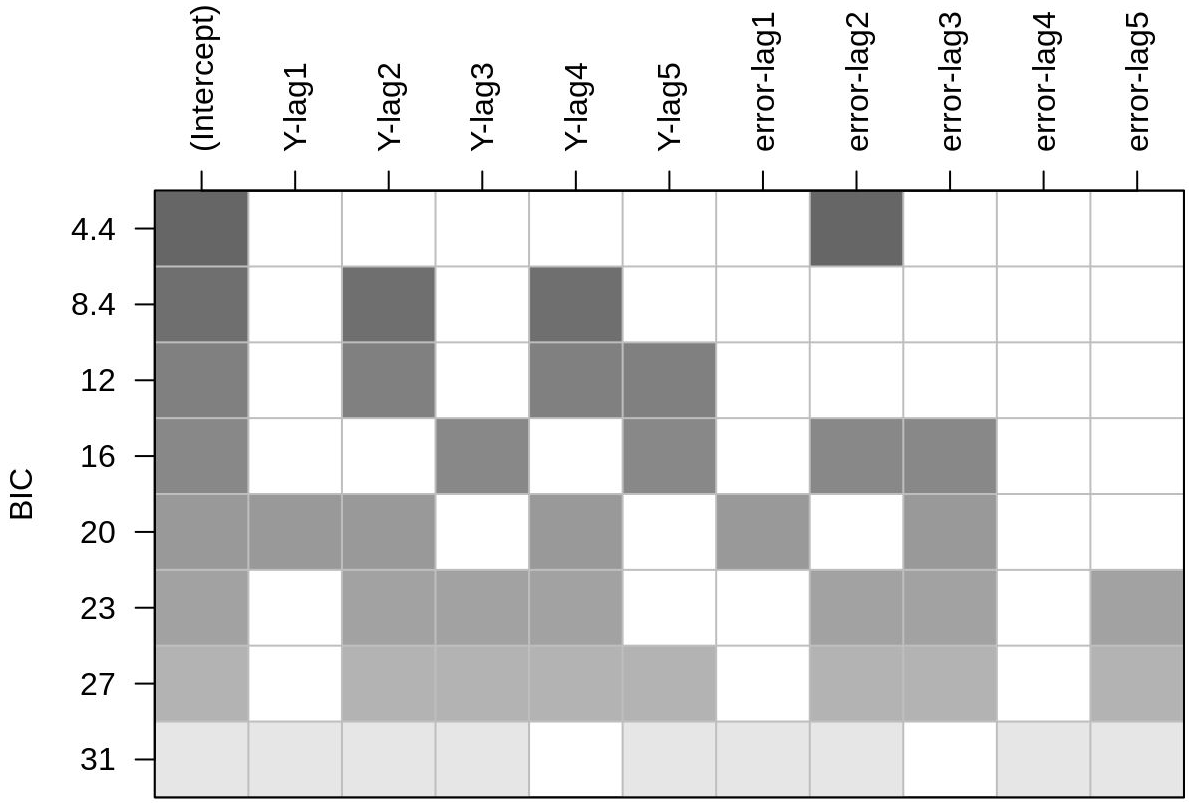

```
ts[27] <- mean(ts) #replace outlier with mean
par(mfrow=c(2,2))
plot(ts, main= "Timeseries PLot")

acf(ts, main = "ACF After Replacement")
pacf(ts, main = "PACF After Replacement")
par(mfrow=c(1,1))
```





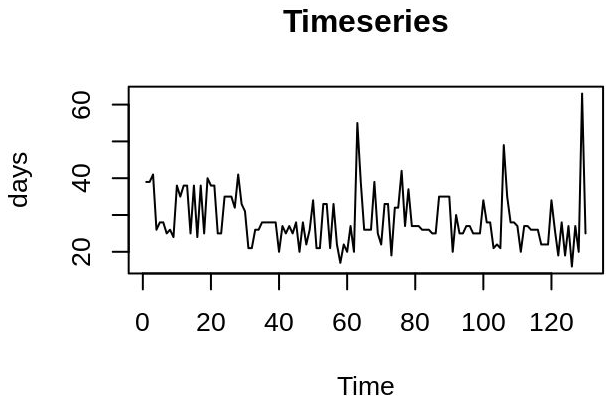


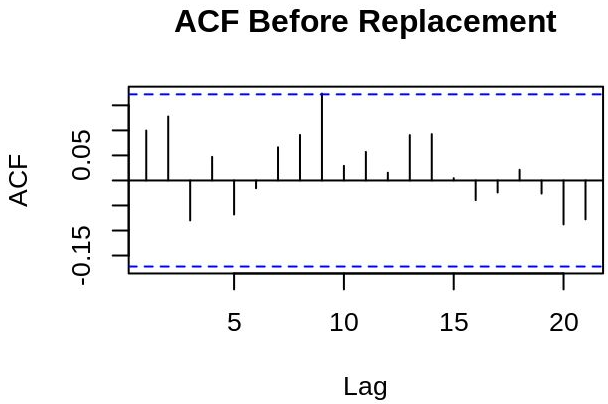

```
plot(armasubsets(ts, 5, 5))
```

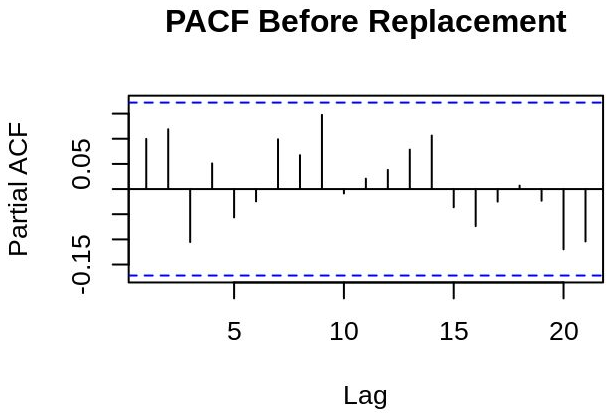


Problem 6.39

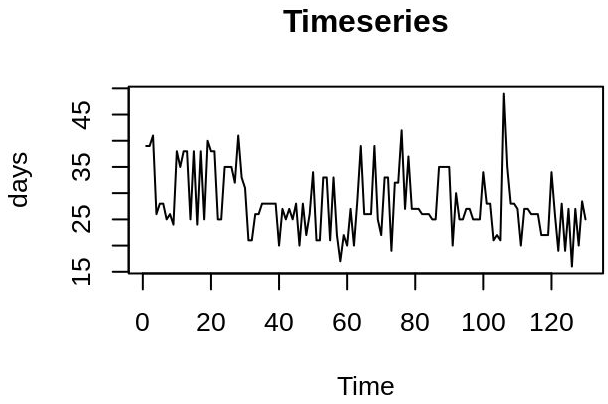
```
timeseries2 <- read.table('days.txt', header = TRUE)
ts2 <- ts(timeseries2, start = 1, end = nrow(timeseries2))
par(mfrow=c(2,2))
plot(ts2, main = "Timeseries")
acf(ts2, main = "ACF Before Replacement")
pacf(ts2, main = "PACF Before Replacement")
par(mfrow=c(1,1))
```

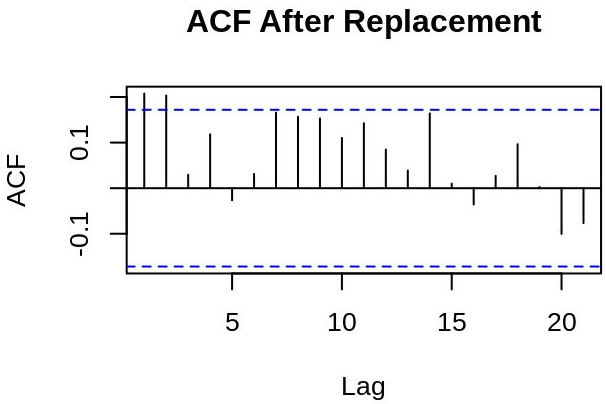


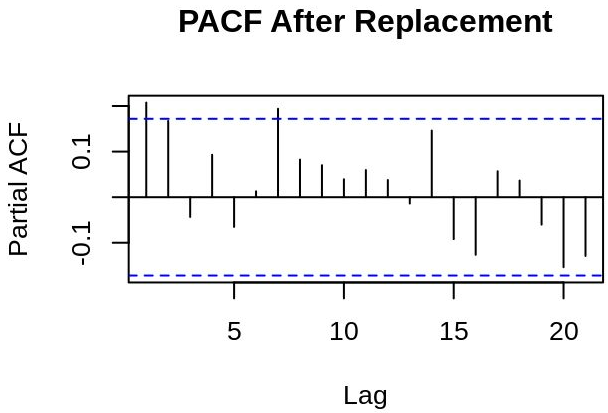




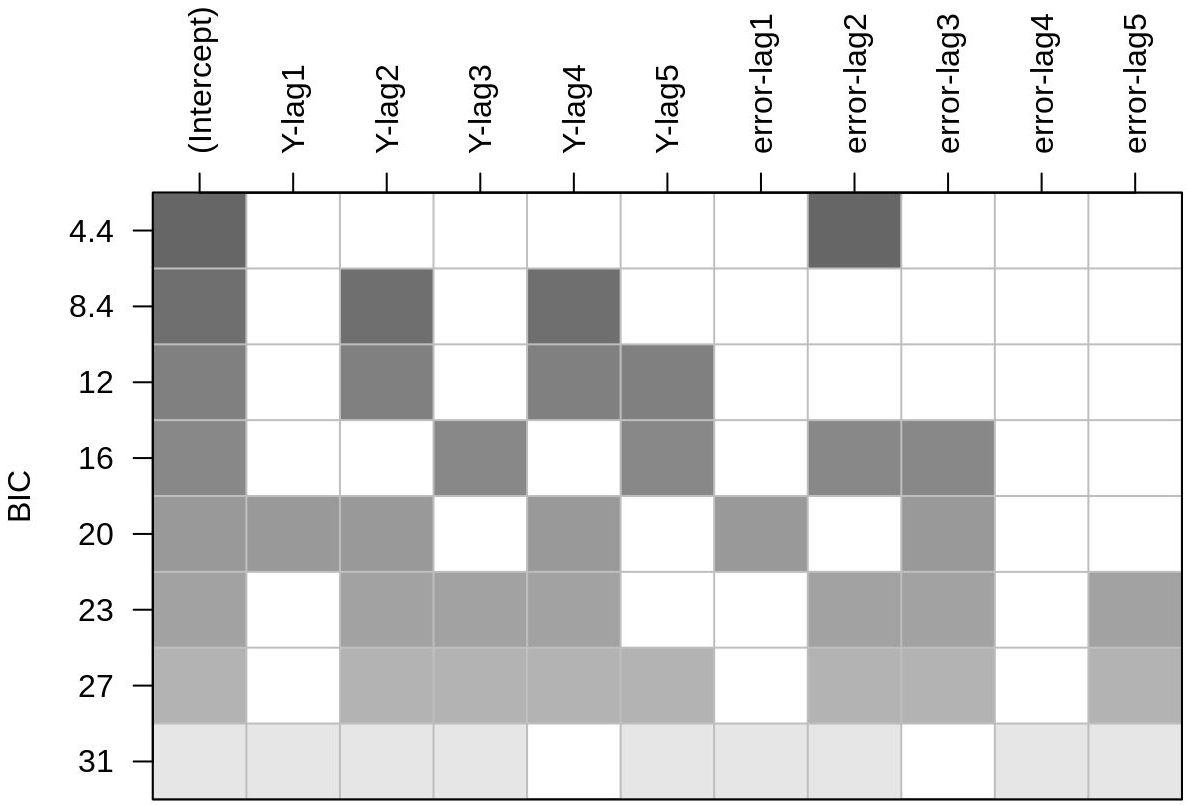

```
ts2[63] = mean(ts2)

ts2[129] = mean(ts2)

par(mfrow=c(2,2))
plot(ts2, main = "Timeseries")
acf(ts2, main = "ACF After Replacement")
pacf(ts2, main = "PACF After Replacement")
par(mfrow=c(1,1))
```








```
plot(armasubsets(ts, 5, 5))
```


(Intercept)
Y-lag1
Y-lag2
Y-lag3
Y-lag4
Y-lag5
error-lag1
error-lag2
error-lag3
error-lag4
error-lag5
BIC
4.4
8.4
12
16
20
23
27
31