STAT4870 Chapter 4 (4)

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Section 3

```
library(astsa)
rec.yw <- ar.yw(rec, order=2)
rec.yw$x.mean
```

```
## [1] 62.26278
```

```
rec.yw$ar
```

```
## [1]  1.3315874 -0.4445447
```

```
sqrt(diag(rec.yw$asy.var.coef))
```

```
## [1] 0.04222637 0.04222637
```

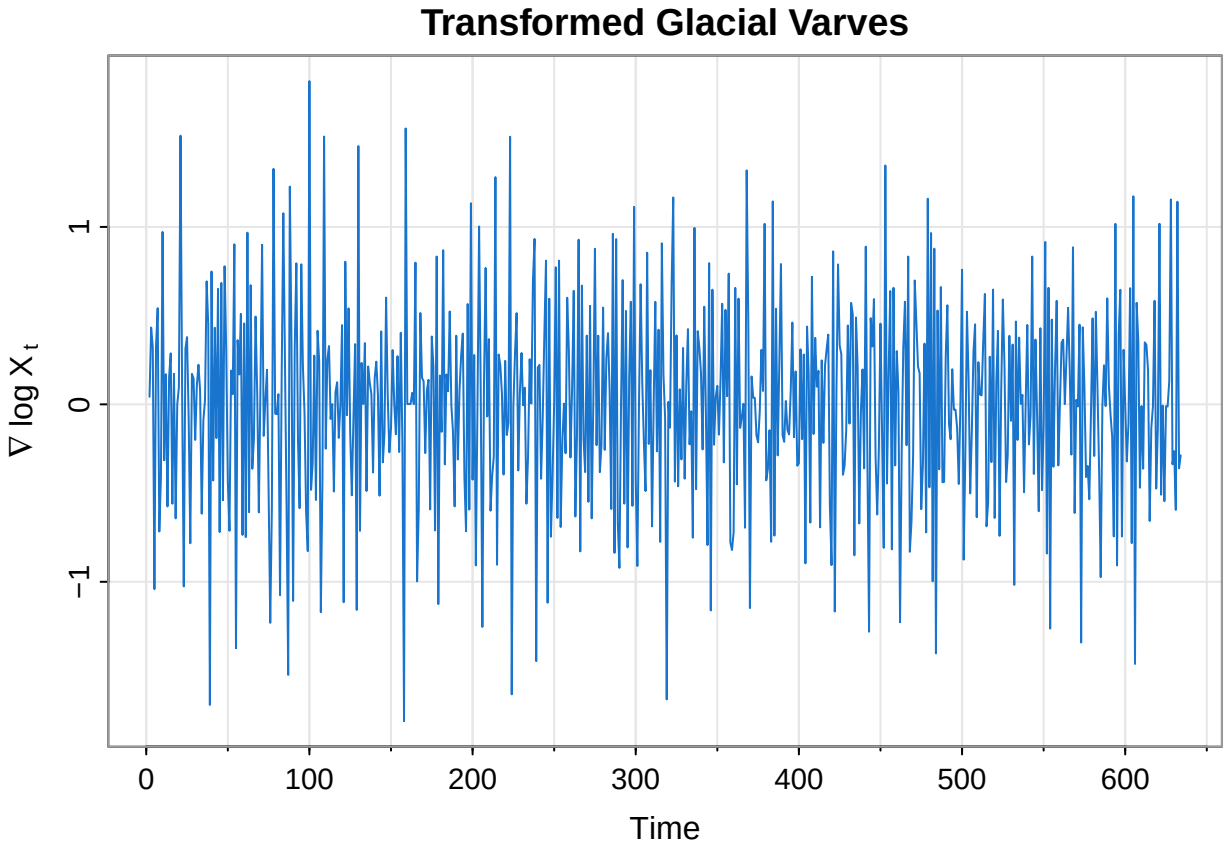
```
rec.yw$var.pred
```

```
## [1] 94.79912
```

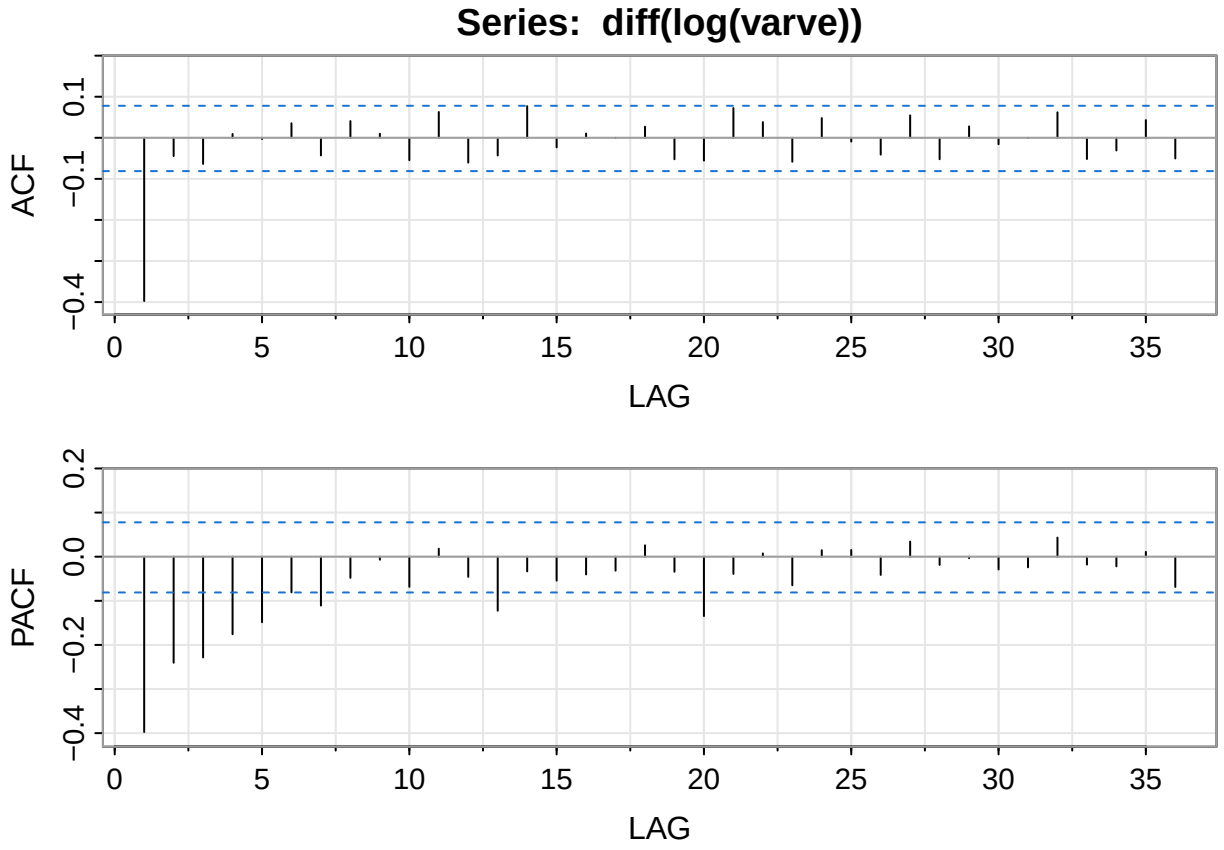
```
set.seed(2)
ma1 <- arima.sim(list(order=c(0,0,1),ma = 0.9), n = 50)
acf1(ma1, plot=FALSE)[1]
```

```
## [1] 0.5066599
```

```
tsplot(diff(log(varve)), col=4, ylab=expression(nabla~log~X[~t]), main="Transformed Glacial Varves")
```




```
acf2(diff(log(varve)))
```

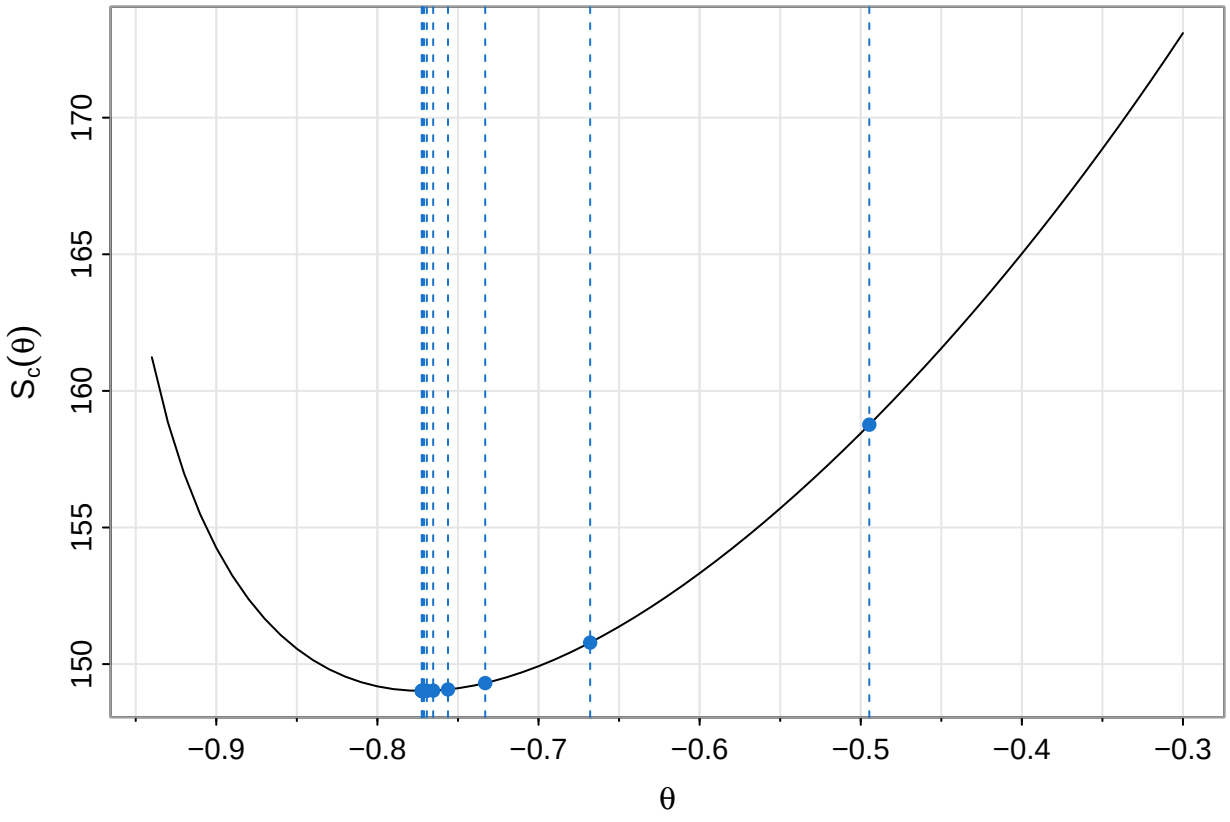



```
##      [,1]  [,2]  [,3]  [,4]  [,5]  [,6]  [,7]  [,8]  [,9] [,10] [,11] [,12]
## ACF  -0.4 -0.04 -0.06  0.01  0.00  0.04 -0.04  0.04  0.01 -0.05  0.06 -0.06
## PACF -0.4 -0.24 -0.23 -0.18 -0.15 -0.08 -0.11 -0.05 -0.01 -0.07  0.02 -0.05
##      [,13] [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24]
## ACF  -0.04  0.08 -0.02  0.01  0.00  0.03 -0.05 -0.06  0.07  0.04 -0.06  0.05
## PACF -0.12 -0.03 -0.05 -0.04 -0.03  0.03 -0.03 -0.13 -0.04  0.01 -0.06  0.01
##      [,25] [,26] [,27] [,28] [,29] [,30] [,31] [,32] [,33] [,34] [,35] [,36]
## ACF  -0.01 -0.04  0.05 -0.05  0.03 -0.02  0.00  0.06 -0.05 -0.03  0.04 -0.05
## PACF  0.02 -0.04  0.03 -0.02  0.00 -0.03 -0.02  0.04 -0.02 -0.02  0.01 -0.07
```

```
x <- diff(log(varve))
r <- acf1(x, 1, plot=FALSE)
c(0) -> z -> Sc -> Sz -> Szw -> para
c(x[1]) -> w
num <- length(x)
para[1] <- (1-sqrt(1-4*(r^2)))/(2*r)
niter <- 12
for (j in 1:niter){
for (t in 2:num){ w[t] <- x[t] - para[j]*w[t-1]
z[t] <- w[t-1] - para[j]*z[t-1]
}
Sc[j] <- sum(w^2)
Sz[j] <- sum(z^2)
Szw[j] <- sum(z*w)
para[j+1] <- para[j] + Szw[j]/Sz[j]
}
cbind(iteration=1:niter-1, thetahat=para[1:niter], Sc, Sz)
```

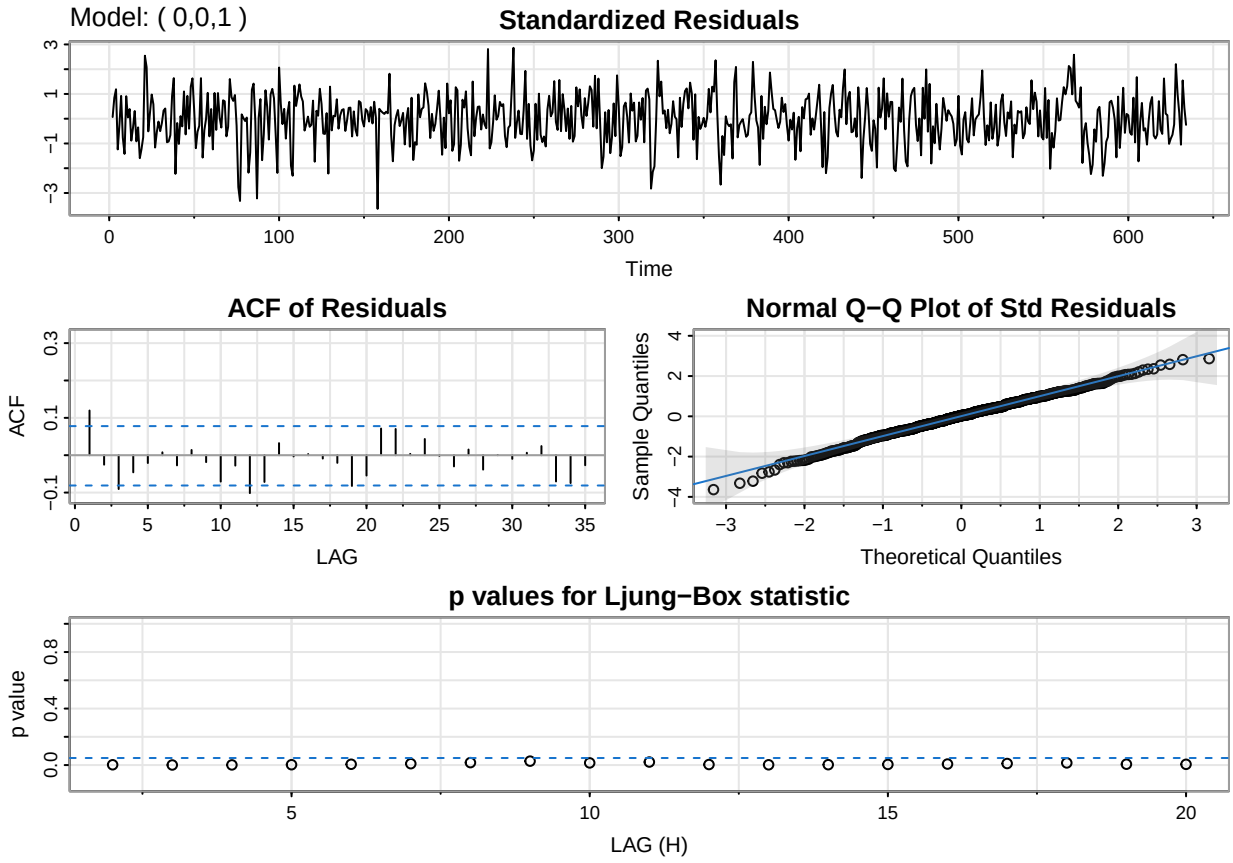
```
##       iteration   thetahat       Sc       Sz
##  [1,]         0 -0.4946886 158.7633 171.3054
##  [2,]         1 -0.6679576 150.7873 235.2448
##  [3,]         2 -0.7330737 149.3056 300.4055
##  [4,]         3 -0.7561828 149.0713 336.6459
##  [5,]         4 -0.7653883 149.0298 354.0188
##  [6,]         5 -0.7693145 149.0219 362.0390
##  [7,]         6 -0.7710421 149.0203 365.6933
##  [8,]         7 -0.7718130 149.0200 367.3494
##  [9,]         8 -0.7721591 149.0199 368.0982
## [10,]         9 -0.7723150 149.0199 368.4365
## [11,]        10 -0.7723853 149.0199 368.5892
## [12,]        11 -0.7724170 149.0199 368.6581
```

```
c(0) -> cSS
th <- -seq(.3, .94, .01)
for (p in 1:length(th)){
for (t in 2:num){ w[t] <- x[t] - th[p]*w[t-1]
}
cSS[p] <- sum(w^2)
}
tsplot(th, cSS, ylab=expression(S[c](theta)), xlab=expression(theta))
abline(v=para[1:12], lty=2, col=4)
points(para[1:12], Sc[1:12], pch=16, col=4)
```



```
sarima(diff(log(varve)), p=0, d=0, q=1, no.constant=TRUE)
```

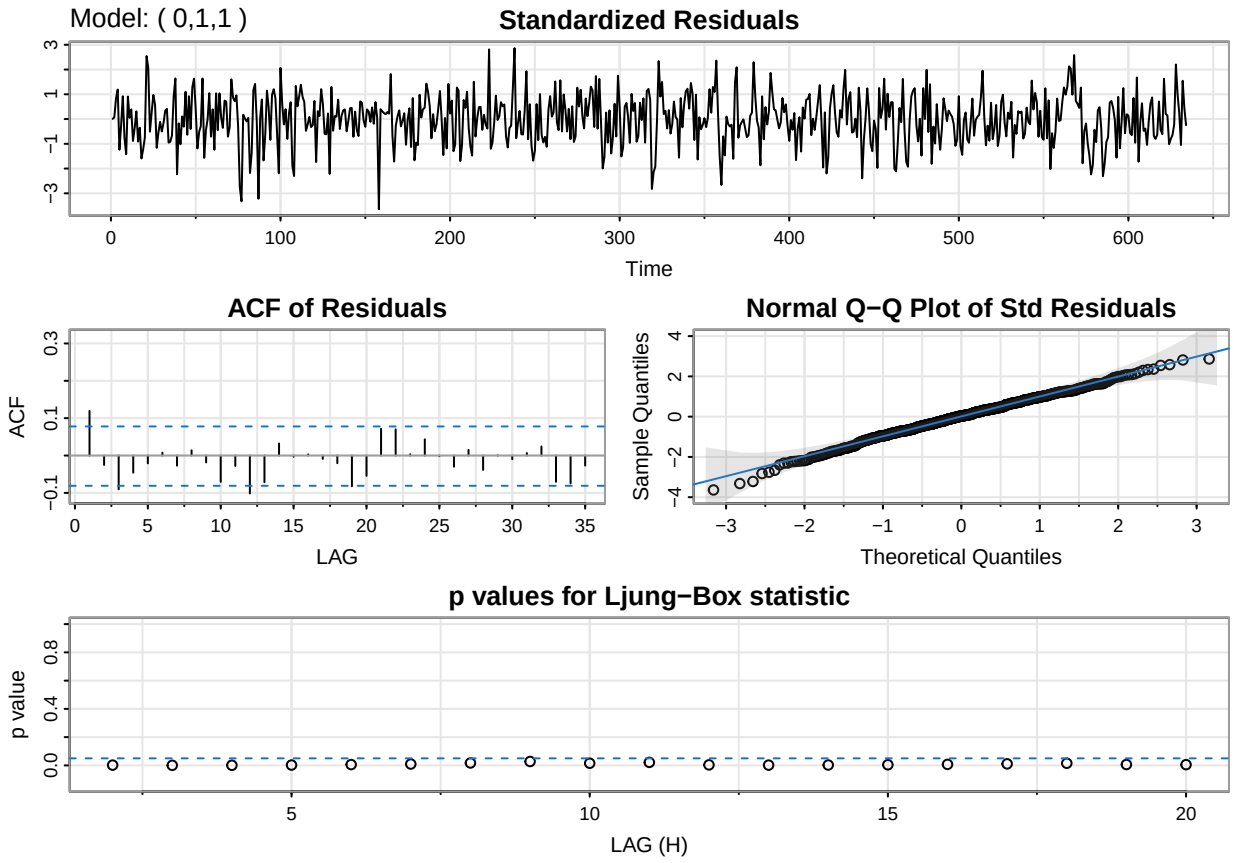
```
## initial  value -0.551778
## iter   2 value -0.671626
## iter   3 value -0.705973
## iter   4 value -0.707314
## iter   5 value -0.722372
## iter   6 value -0.722738
## iter   7 value -0.723187
## iter   8 value -0.723194
## iter   9 value -0.723195
## iter   9 value -0.723195
## iter   9 value -0.723195
## final  value -0.723195
## converged
## initial  value -0.722700
## iter   2 value -0.722702
## iter   3 value -0.722702
## iter   3 value -0.722702
## iter   3 value -0.722702
## final  value -0.722702
## converged
## <><><><><><><><><><><><><><>
##
## Coefficients:
##     Estimate     SE  t.value p.value
## ma1  -0.7705 0.0341 -22.6161       0
##
## sigma^2 estimated as 0.2353156 on 632 degrees of freedom
##
## AIC = 1.398791  AICc = 1.398802  BIC = 1.412853
##
```




```
sarima(log(varve), p=0, d=1, q=1, no.constant=TRUE)
```

```
## initial  value -0.551778
## iter   2 value -0.671626
## iter   3 value -0.705973
## iter   4 value -0.707314
## iter   5 value -0.722372
## iter   6 value -0.722738
## iter   7 value -0.723187
## iter   8 value -0.723194
## iter   9 value -0.723195
## iter   9 value -0.723195
## iter   9 value -0.723195
## final  value -0.723195
## converged
## initial  value -0.722700
## iter   2 value -0.722702
## iter   3 value -0.722702
## iter   3 value -0.722702
## iter   3 value -0.722702
## final  value -0.722702
## converged
## <><><><><><><><><><><><><><>
##
## Coefficients:
##     Estimate     SE  t.value p.value
```

```
## ma1  -0.7705 0.0341 -22.6161       0
##
## sigma^2 estimated as 0.2353156 on 632 degrees of freedom
##
## AIC = 1.398792  AICc = 1.398802  BIC = 1.412853
##
```

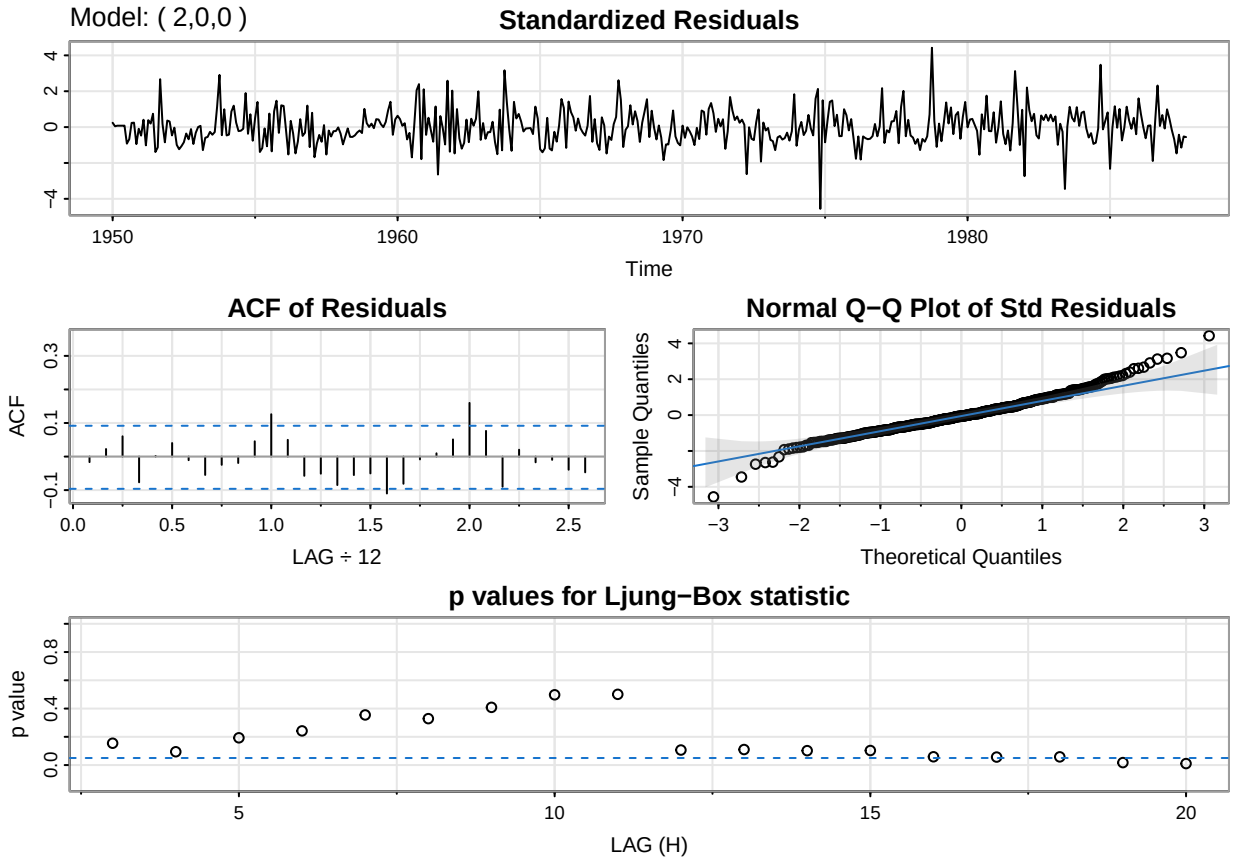


Section 4

```
library(astsa)
sarima(rec, p=2, d=0, q=0)
```

```
## initial  value 3.332380
## iter   2 value 3.251366
## iter   3 value 2.564654
## iter   4 value 2.430141
## iter   5 value 2.258212
## iter   6 value 2.253343
## iter   7 value 2.248346
## iter   8 value 2.248345
## iter   9 value 2.248345
## iter  10 value 2.248341
## iter  11 value 2.248332
## iter  12 value 2.248331
```

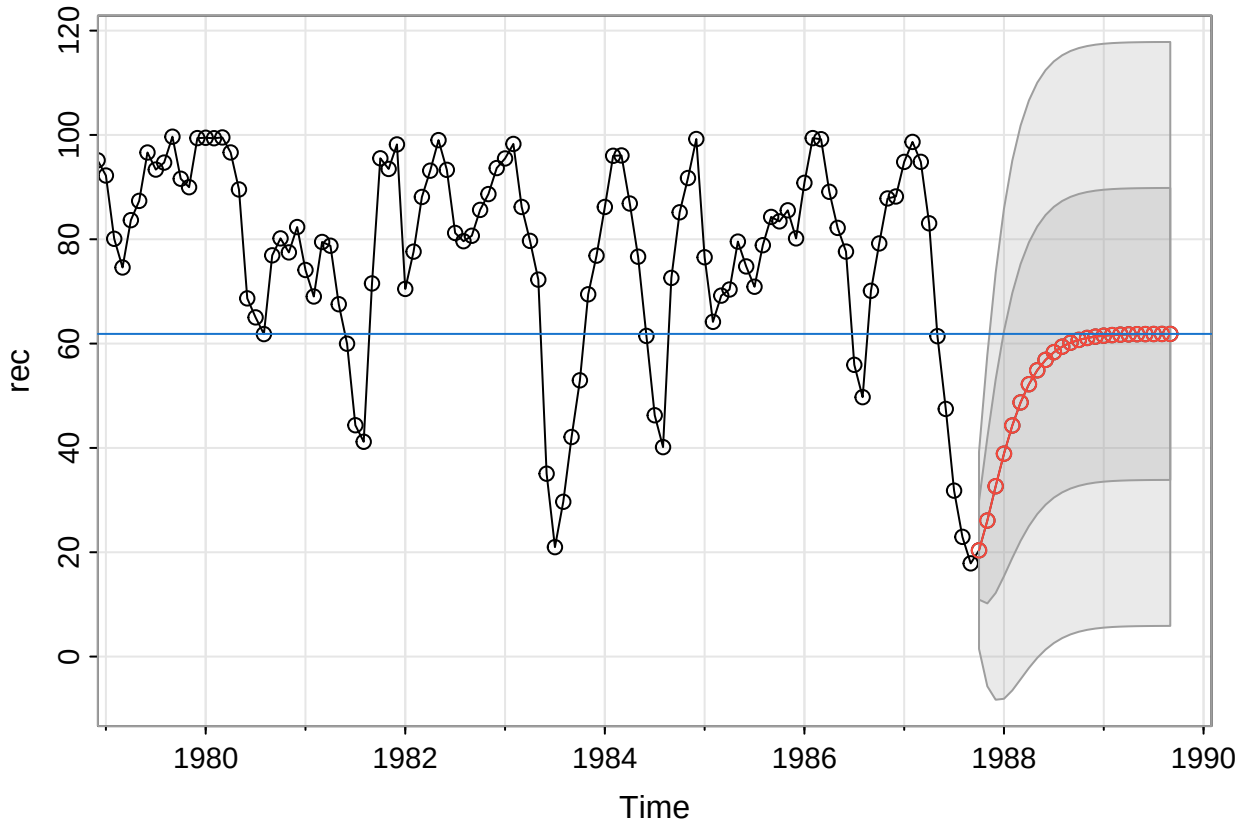
```
## iter  13 value 2.248330
## iter  13 value 2.248330
## iter  13 value 2.248330
## final  value 2.248330
## converged
## initial  value 2.248862
## iter   2 value 2.248857
## iter   3 value 2.248855
## iter   4 value 2.248855
## iter   5 value 2.248854
## iter   6 value 2.248854
## iter   7 value 2.248854
## iter   8 value 2.248854
## iter   9 value 2.248853
## iter  10 value 2.248853
## iter  10 value 2.248853
## iter  10 value 2.248853
## final  value 2.248853
## converged
## <><><><><><><><><><><><><><><>
##
## Coefficients:
##       Estimate     SE  t.value p.value
## ar1     1.3512 0.0416  32.4933       0
## ar2    -0.4612 0.0417 -11.0687       0
## xmean  61.8585 4.0039  15.4494       0
##
## sigma^2 estimated as 89.33436 on 450 degrees of freedom
##
## AIC = 7.353244  AICc = 7.353362  BIC = 7.389587
##
```




```
sarima.for(rec, n.ahead=24, p=2, d=0, q=0)
```

```
## $pred
##           Jan      Feb      Mar      Apr      May      Jun      Jul      Aug
## 1987
## 1988 38.89474 44.30006 48.72437 52.20958 54.87831 56.87693 58.34666 59.41079
## 1989 61.51504 61.63405 61.71363 61.76626 61.80068 61.82291 61.83707 61.84596
##           Sep      Oct      Nov      Dec
## 1987          20.36547 26.08036 32.65148
## 1988 60.17081 60.70697 61.08091 61.33890
## 1989 61.85143
##
## $se
##            Jan       Feb       Mar       Apr       May       Jun       Jul
## 1987
## 1988 23.492457 25.393693 26.537088 27.199368 27.570234 27.771616 27.877923
## 1989 27.984413 27.985045 27.985323 27.985444 27.985495 27.985515 27.985524
##            Aug       Sep       Oct       Nov       Dec
## 1987                      9.451686 15.888378 20.464325
## 1988 27.932597 27.960042 27.973508 27.979974 27.983014
## 1989 27.985527 27.985528
```

```
abline(h=61.8585, col=4)
```


rec
0
20
40
60
80
100
120
1980
1982
1984
1986
1988
1990
Time