STAT4870 Chapter 4 (2)

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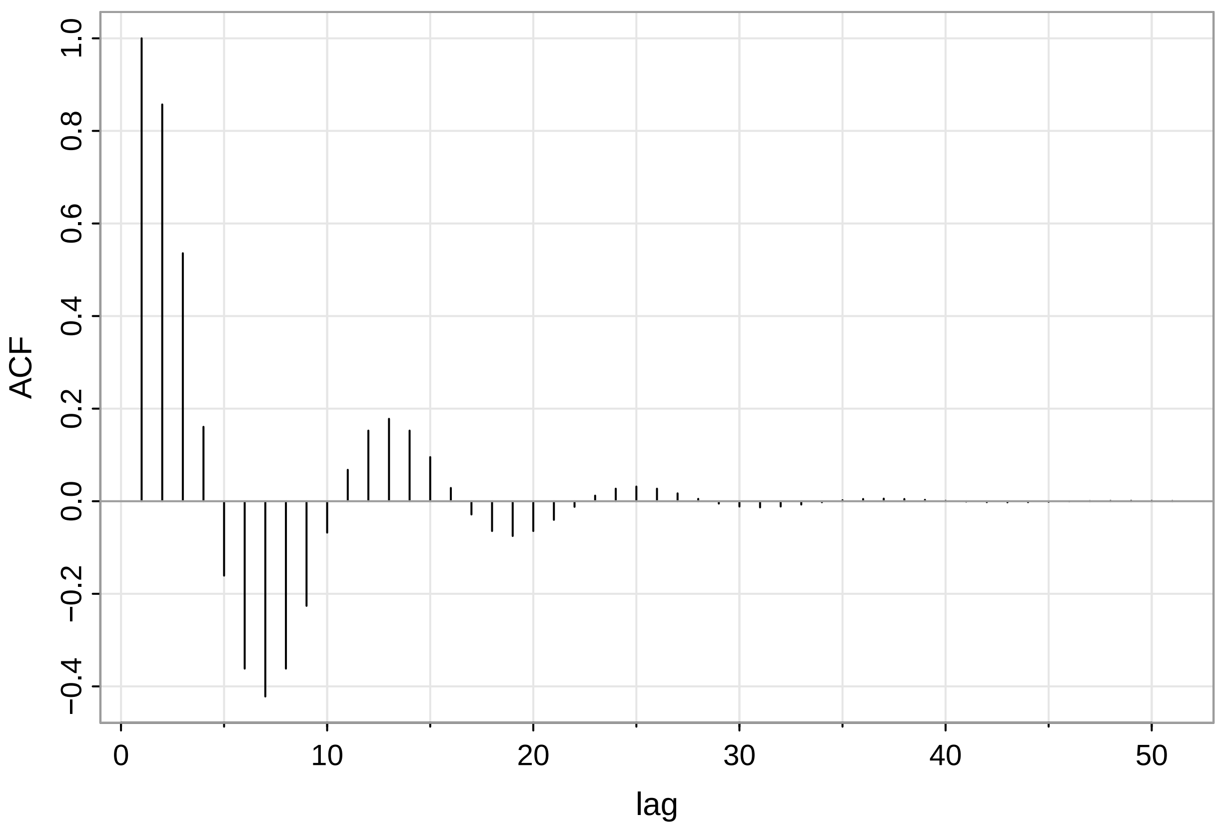
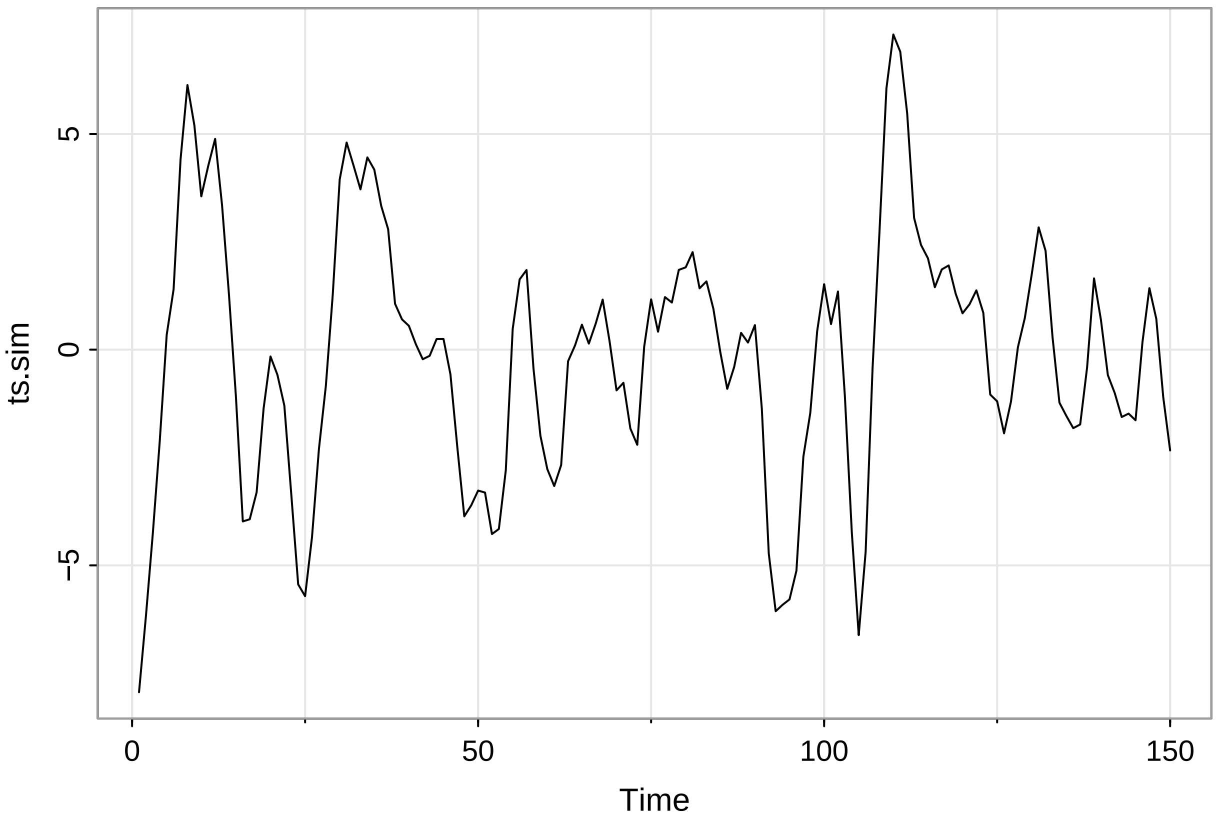
Section 2

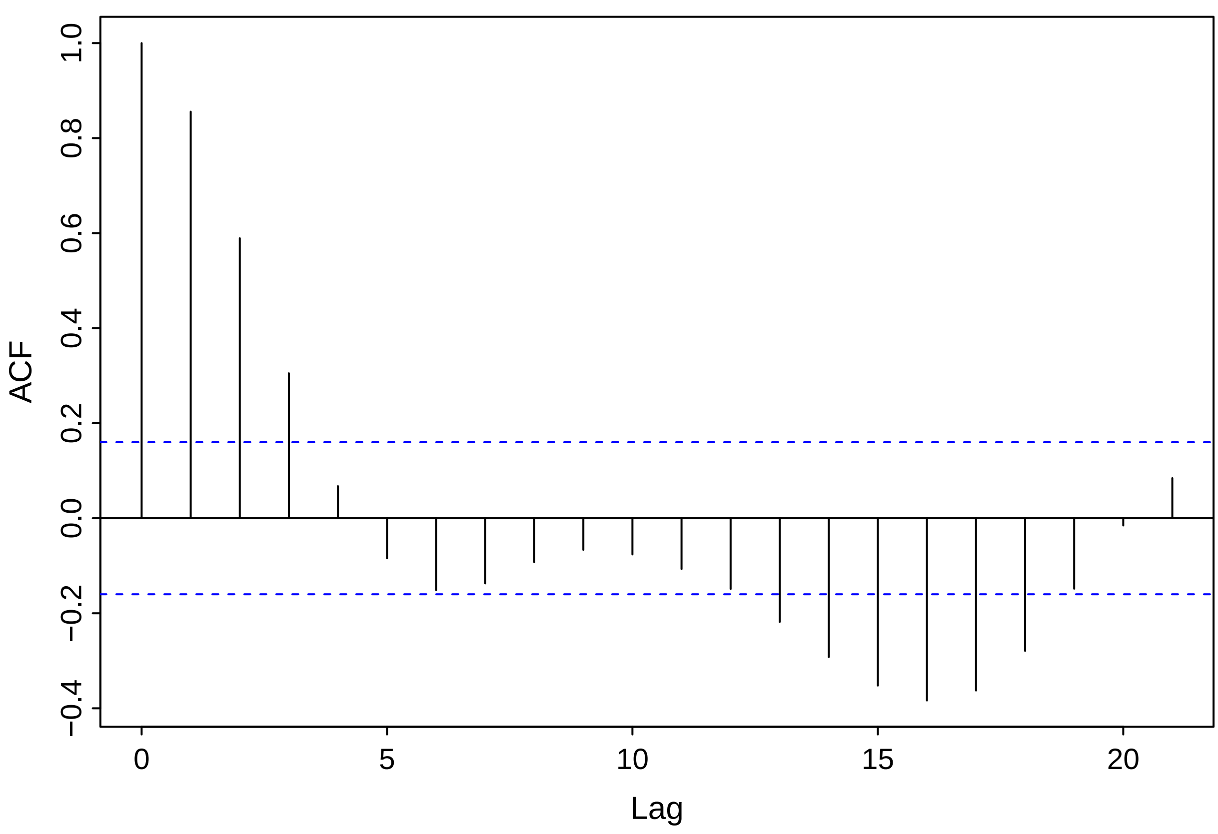
```
library(astsa)
ACF <- ARMAacf(ar=c(1.5,-.75), ma=0, 50)
tsplot(ACF, type="h", xlab="lag")
abline(h=0, col=8)
```



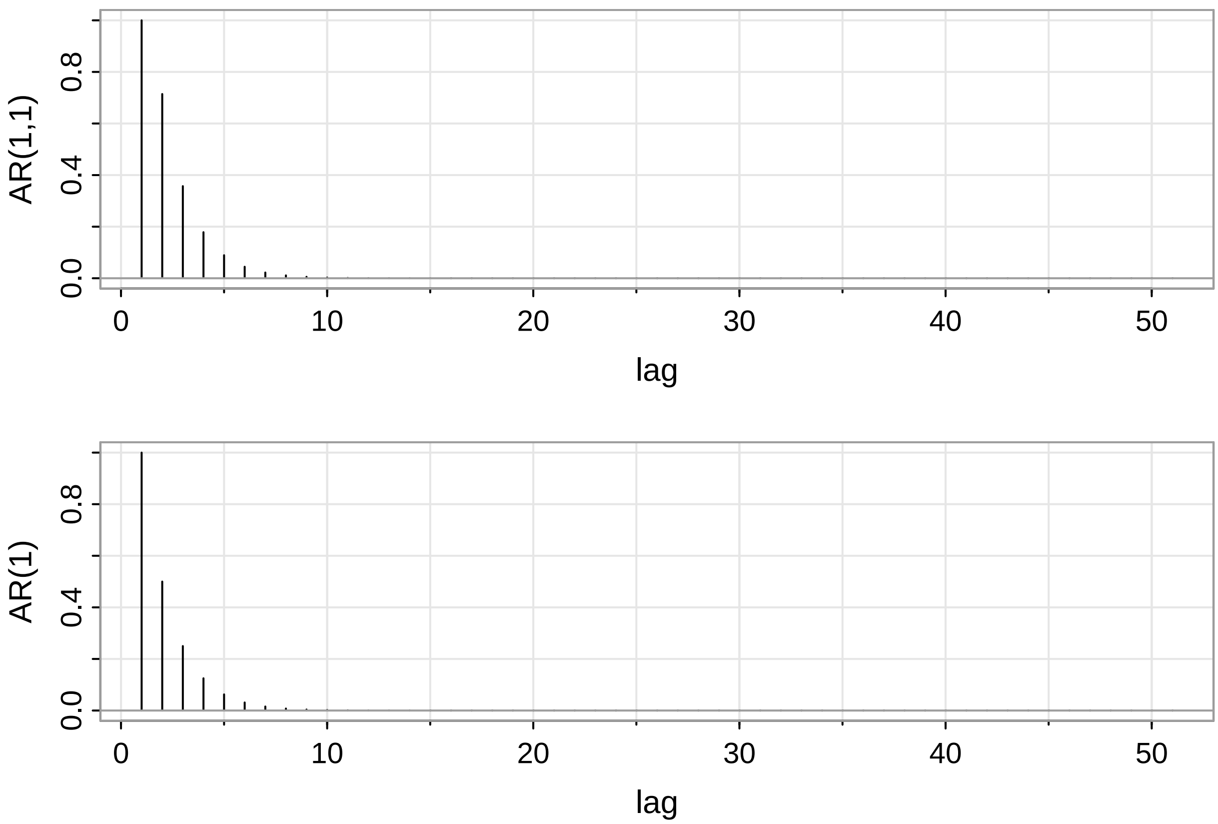

```
ts.sim <- arima.sim(list(order = c(2,0,0), ar = c(1.5,-.75)), n = 150)
tsplot(ts.sim)
```


ts.sim
5
0
−5
0
50
100
150
Time

```
acf(ts.sim)
```

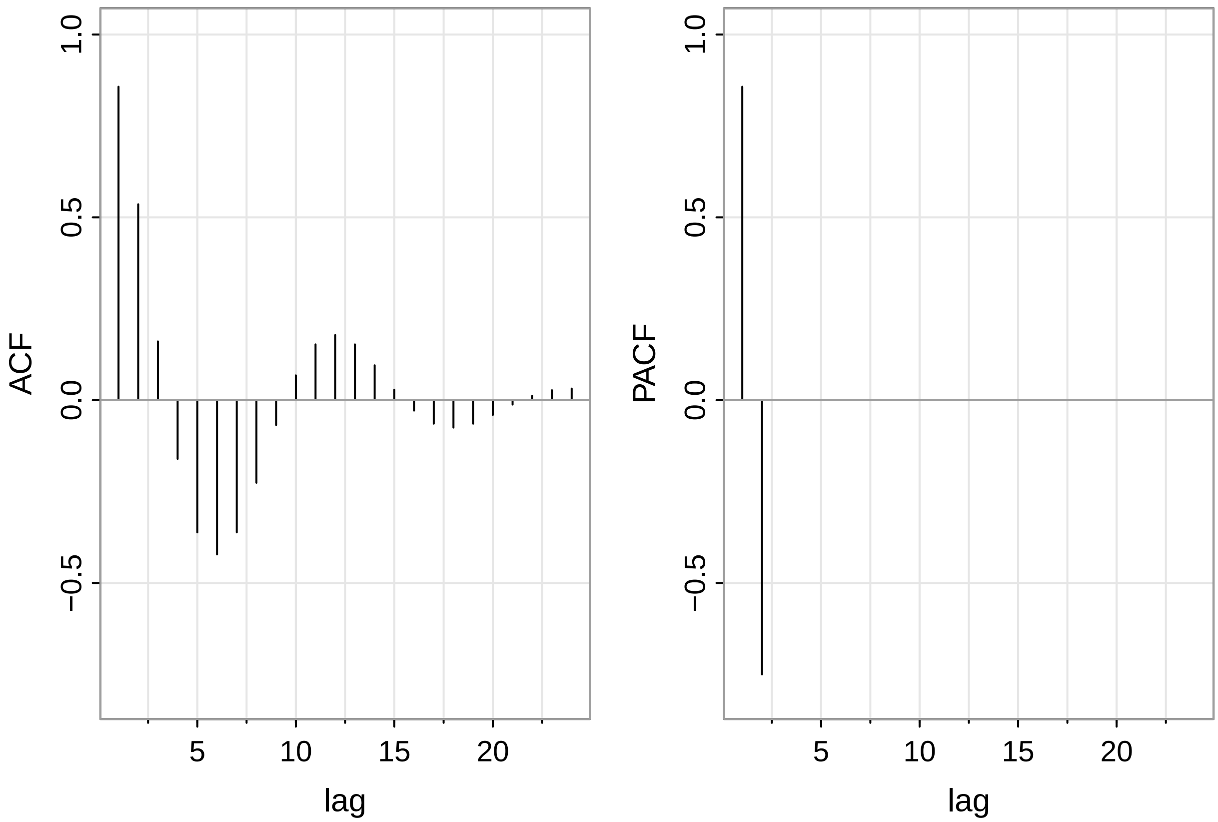

ACF
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
0
5
10
15
20
Lag

```
ACF.arma11 <- ARMAacf(ar=0.5, ma=0.5, 50)
ACF.arma10 <- ARMAacf(ar=0.5, ma=0, 50)
op<-par(mfrow=c(2,1))
tsplot(ACF.arma11, type="h", xlab="lag", ylab="AR(1,1)")
abline(h=0, col=8)
tsplot(ACF.arma10, type="h", xlab="lag", ylab="AR(1)")
abline(h=0, col=8)
```




```
par(op)

ACF <- ARMAacf(ar=c(1.5,-.75), ma=0, 24)
ACF <- ARMAacf(ar=c(1.5,-.75), ma=0, 24)[-1]
PACF <- ARMAacf(ar=c(1.5,-.75), ma=0, 24, pacf=TRUE)
op<-par(mfrow=1:2)
tsplot(ACF, type="h", xlab="lag", ylim=c(-.8,1))
abline(h=0, col=8)
tsplot(PACF, type="h", xlab="lag", ylim=c(-.8,1))
abline(h=0, col=8)
```




```
par(op)

(regr <- ar.ols(rec, order = 2, demean=FALSE, intercept=TRUE))
```

```
##
## Call:
## ar.ols(x = rec, order.max = 2, demean = FALSE, intercept = TRUE)
##
## Coefficients:
##       1        2
##  1.3541  -0.4632
##
## Intercept: 6.737 (1.111)
##
## Order selected 2  sigma^2 estimated as  89.72
```

```
regr$asy.se.coef
```

```
## $x.mean
## [1] 1.110599
##
## $ar
## [1] 0.04178901 0.04187942
```

```r
(regr <- ar.ols(rec, order=2, demean=TRUE, intercept=FALSE))
```

```
##
## Call:
## ar.ols(x = rec, order.max = 2, demean = TRUE, intercept = FALSE)
##
## Coefficients:
##       1        2
##  1.3541  -0.4632
##
## Order selected 2  sigma^2 estimated as  89.72
```

```r
regr$asy.se.coef
```

```
## $x.mean
## [1] 0
##
## $ar
## [1] 0.04178834 0.04187802
```

```r
mean(rec)
```

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

Section 3

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

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

```r
rec.yw$ar
```

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

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

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

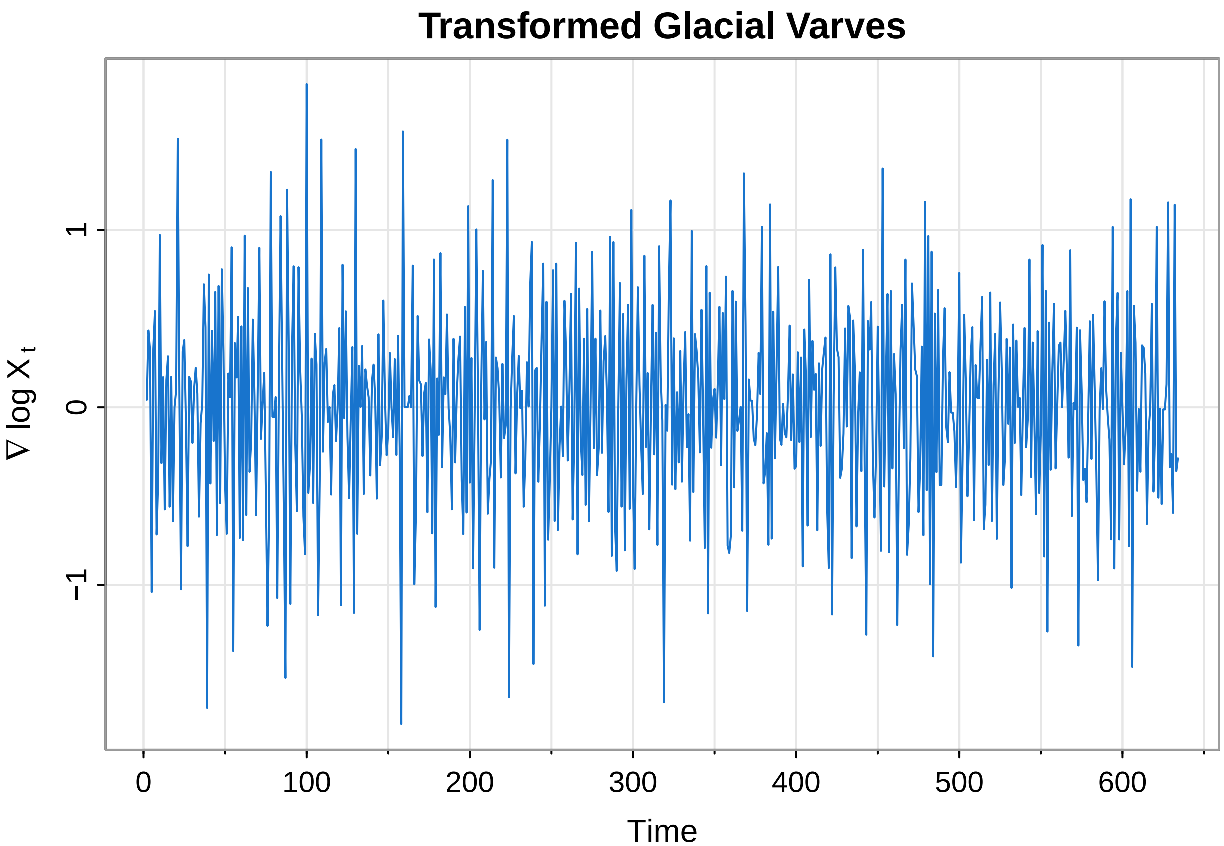
```r
rec.yw$var.pred
```

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

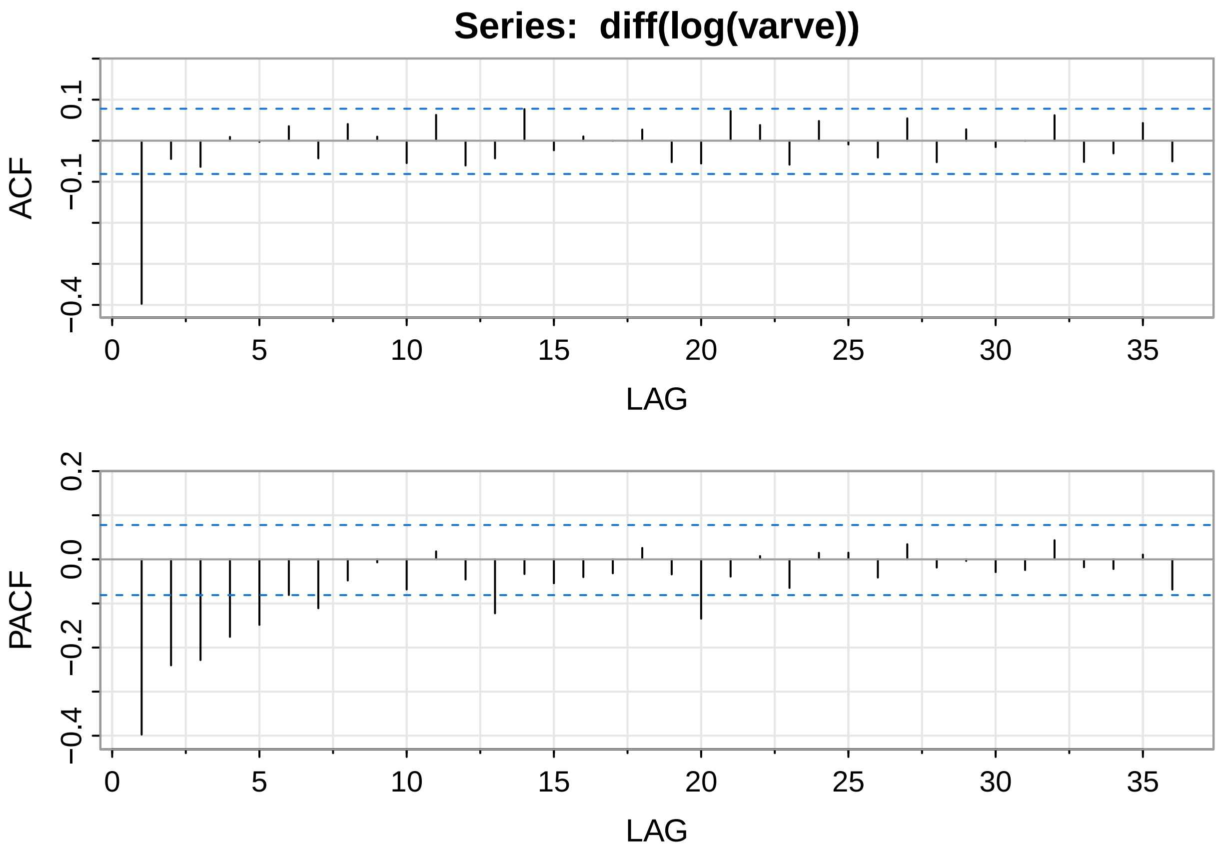
```r
set.seed(2)
ma1 <- arima.sim(list(order=c(0,0,1),ma = 0.9), n = 50)
acf1(ma1, plot=FALSE)[1]
```

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

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




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

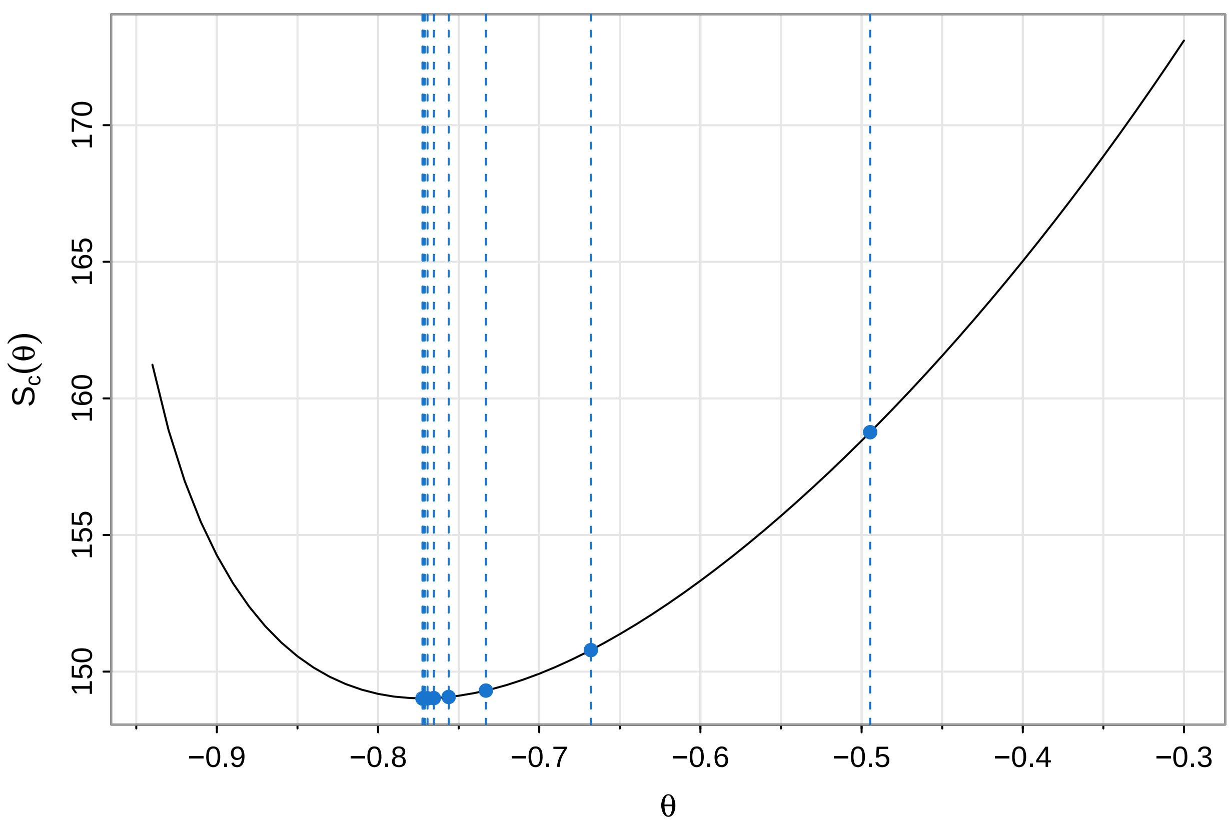



```
##      [,1]  [,2]  [,3]  [,4]  [,5]  [,6]  [,7]  [,8]  [,9] [,10] [,11] [,12]
## ACF  -0.4 -0.04 -0.06  0.01  0.00  0.04 -0.04  0.04  0.01 -0.05  0.06 -0.06
## PACF -0.4 -0.24 -0.23 -0.18 -0.15 -0.08 -0.11 -0.05 -0.01 -0.07  0.02 -0.05
##      [,13] [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,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
```

```r
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)
```

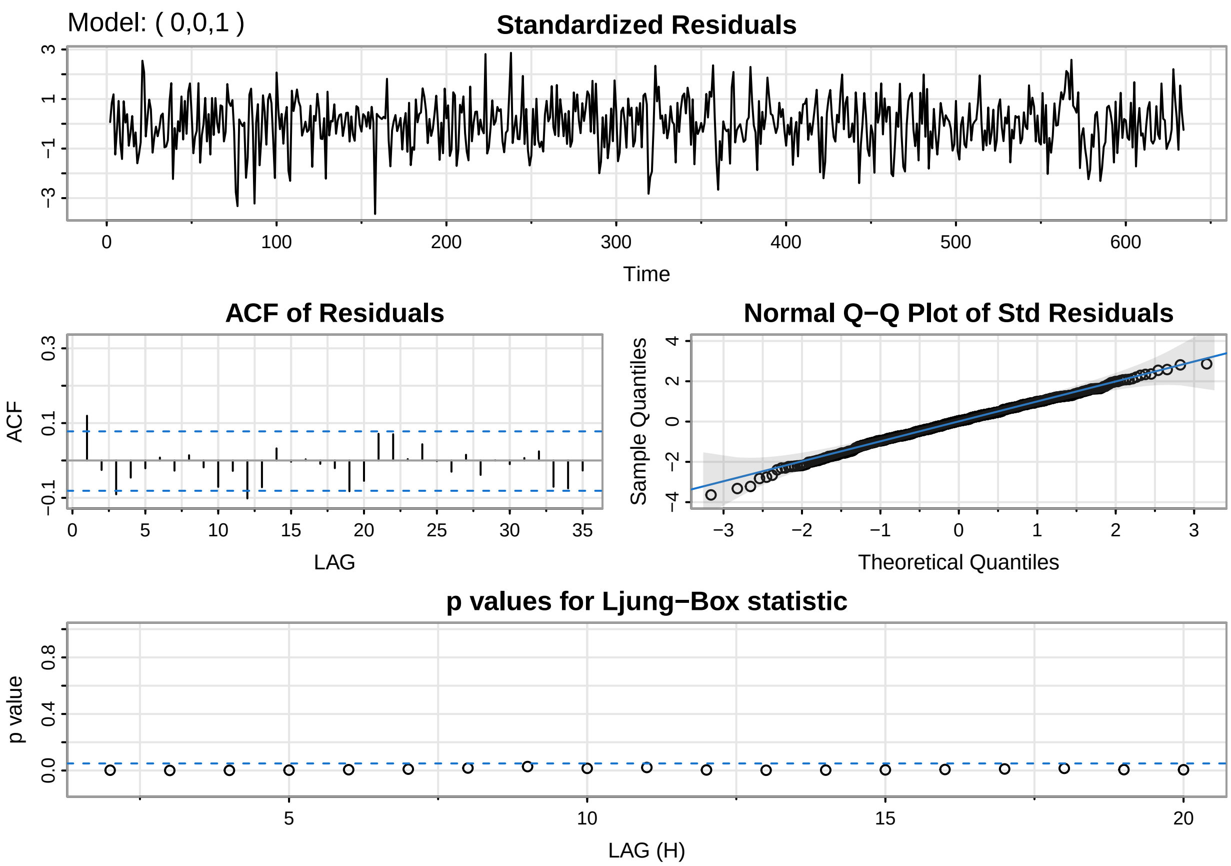
```
##        iteration   thetahat       Sc       Sz
##  [1,]          0 -0.4946886 158.7633 171.3054
##  [2,]          1 -0.6679576 150.7873 235.2448
##  [3,]          2 -0.7330737 149.3056 300.4055
##  [4,]          3 -0.7561828 149.0713 336.6459
##  [5,]          4 -0.7653883 149.0298 354.0188
##  [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)
```



```r
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
##
```




```r
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
##
```