

STAT4870 Chapter 2

Anton Yang

2024-08-30

Section 2.2

```
library("astsa")  
library("xts")
```

```
## Loading required package: zoo
```

```
##
```

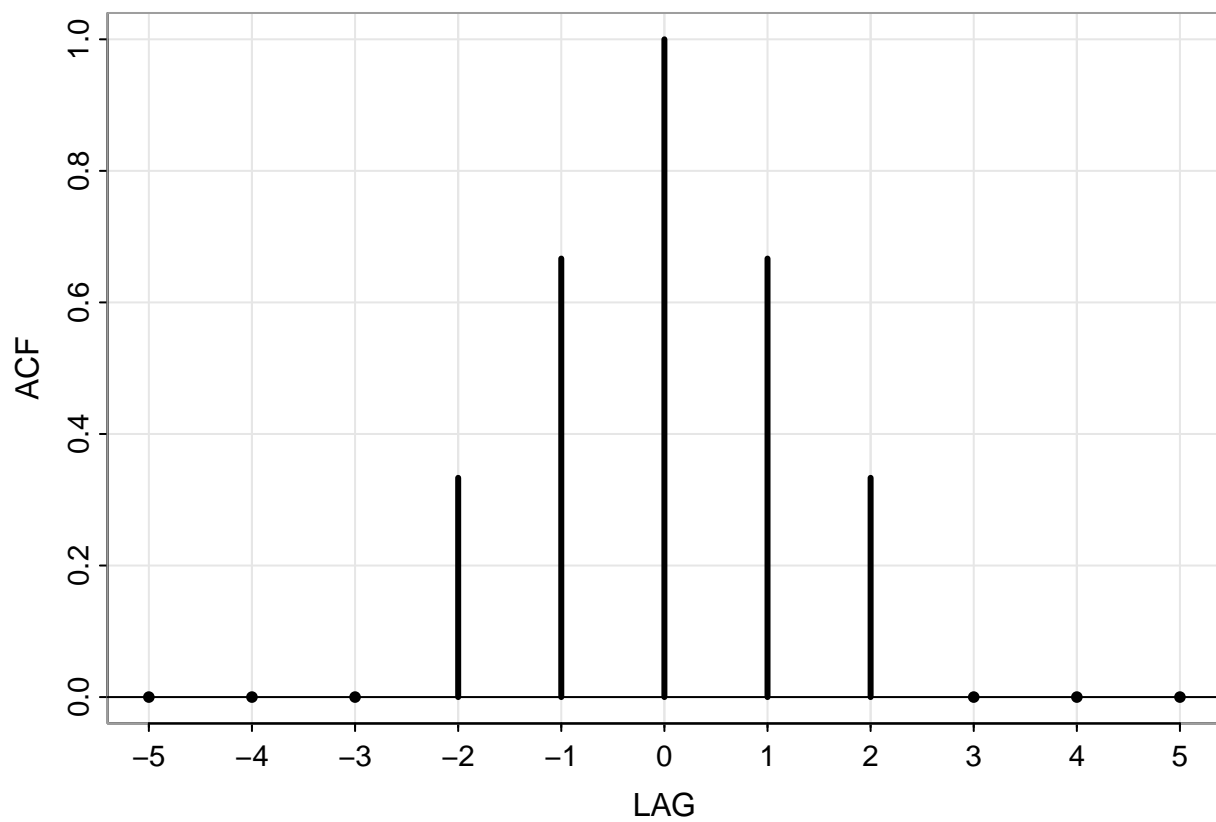
```
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
```

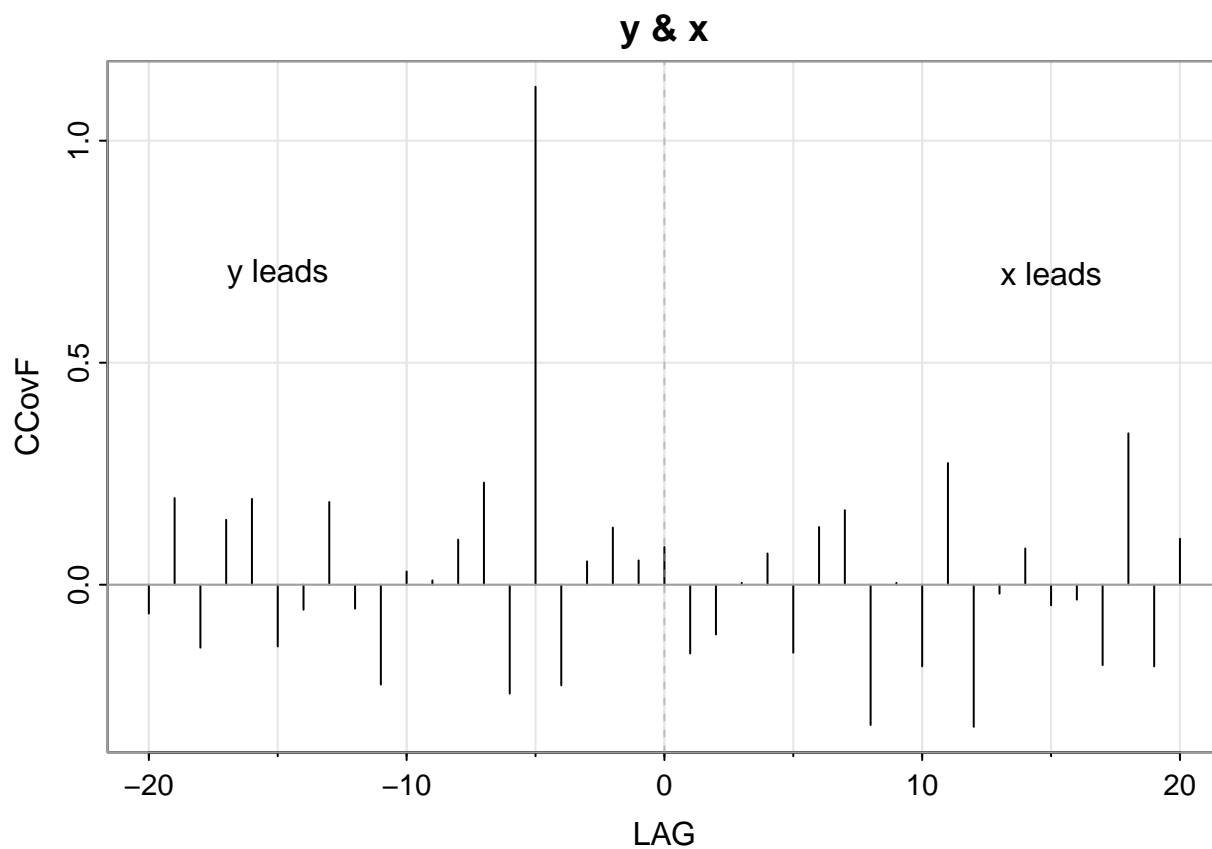
```
##
```

```
##      as.Date, as.Date.numeric
```

```
ACF<-c(0,0,0,1,2,3,2,1,0,0,0)/3  
LAG<--5:5  
tsplot(LAG, ACF, type = "h", lwd = 3, xlab = "LAG")  
abline(h=0)  
points(LAG[-(4:8)], ACF[-(4:8)], pch = 20)  
axis(1, at = seq(-5, 5, by = 2))
```



```
x<-rnorm(100)
y<-lag(x,5)+rnorm(100)
ccf2(y, x, ylab = "CCovF", type = "covariance")
text(c(-15,15), 0.7, c("y leads", "x leads"))
```

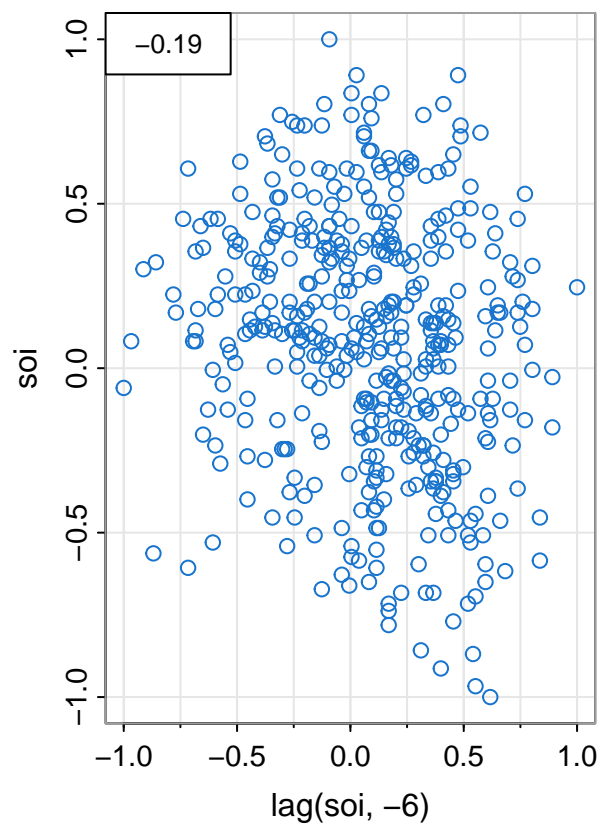
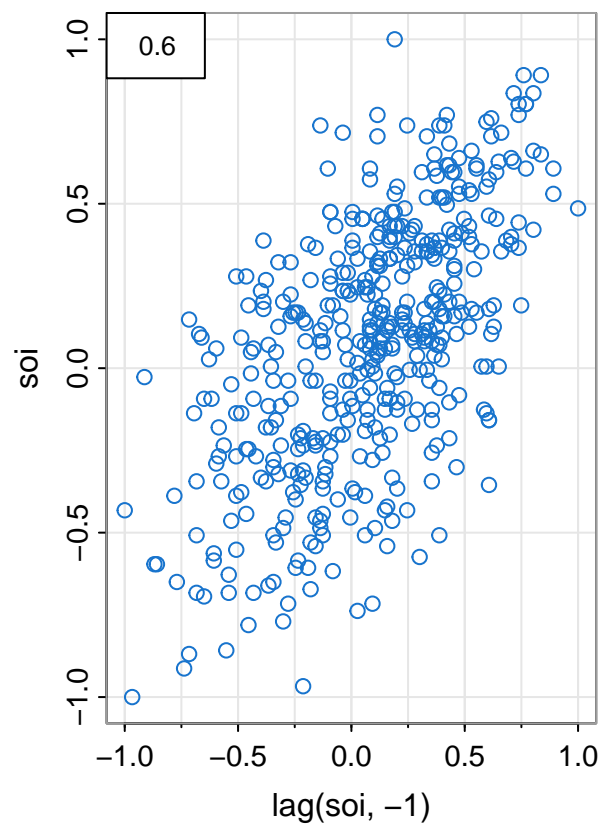


Section 2.3

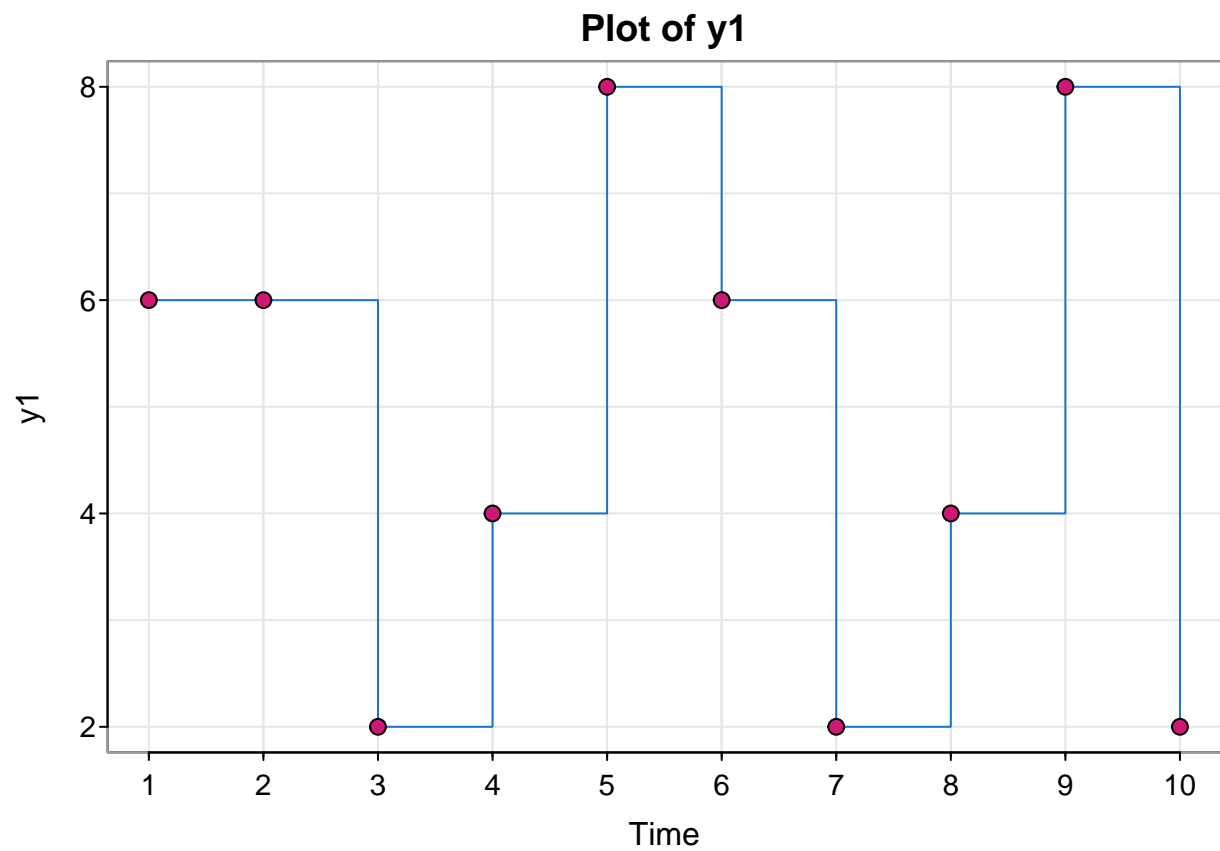
```
(r <- round( acf1(soi, 6, plot = FALSE), 2))
```

```
## [1] 0.60 0.37 0.21 0.05 -0.11 -0.19
```

```
par(mfrow = c(1,2))
tsplot(lag(soi, -1), soi, col = 4, type = "p", xlab = "lag(soi, -1)")
legend("topleft", legend = r[1], bg = "white", adj = 0.45, cex = 0.85)
tsplot(lag(soi, -6), soi, col = 4, type = "p", xlab = "lag(soi, -6)")
legend("topleft", legend = r[6], bg = "white", adj = 0.25, cex = 0.8)
```



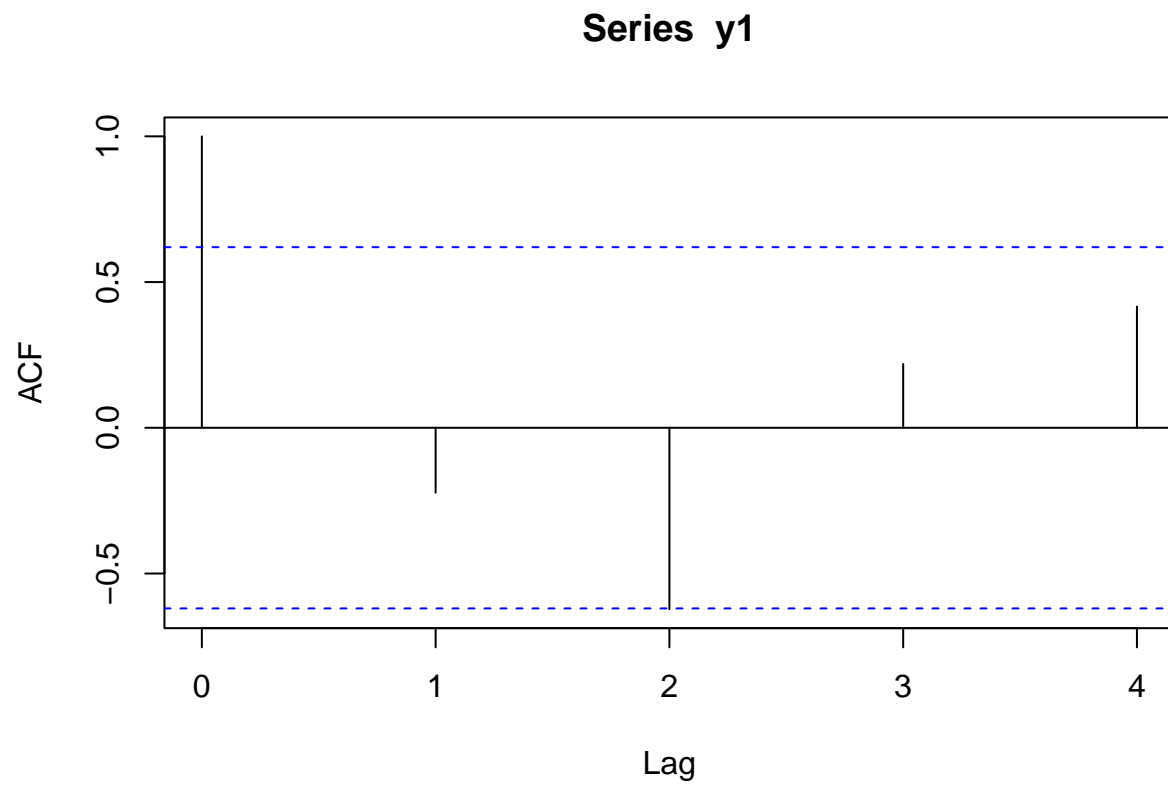
```
set.seed(101011)
x1<-sample(c(-2,2), 11, replace = TRUE)
y1<-5 + filter(x1, sides = 1, filter = c(1,-0.5))[-1]
tsplot(y1, type = "s", col = 4, xaxt = "n", yaxt = "n", main = "Plot of y1")
axis(1, 1:10); axis(2,seq(2,8,2), las = 1)
points(y1, pch = 21, cex = 1.1, bg = 6)
```



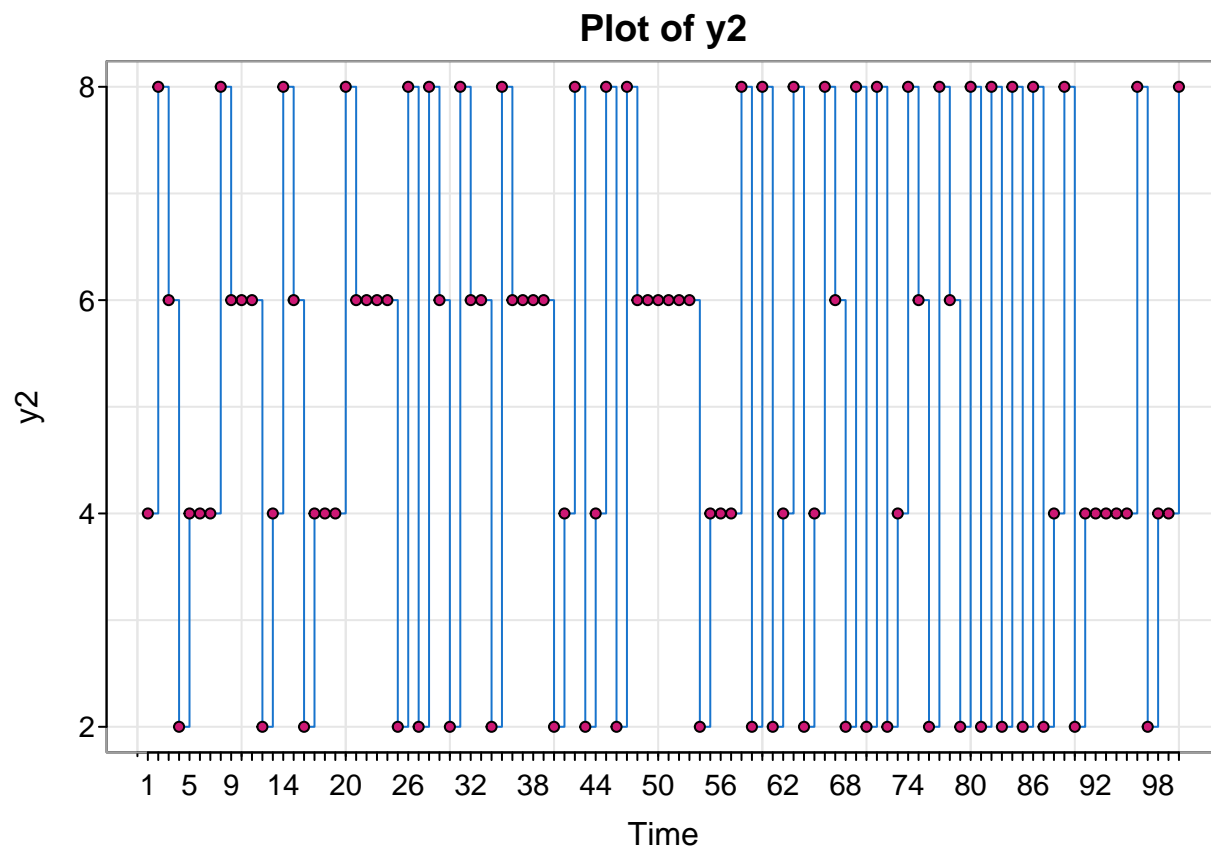
```
acf(y1, lag.max = 4, plot = FALSE)
```

```
##  
## Autocorrelations of series 'y1', by lag  
##  
##      0      1      2      3      4  
## 1.000 -0.223 -0.623  0.219  0.416
```

```
acf(y1, lag.max = 4)
```



```
x2 <- sample(c(-2,2), 101, replace=TRUE)
y2 <- 5 + filter(x2, sides=1, filter=c(1,-.5))[-1]
tsplot(y2, type="s", col=4, xaxt="n", yaxt="n", main="Plot of y2")
axis(1, 1:100); axis(2, seq(2,8,2), las=1)
points(y2, pch=21, cex=0.7, bg=6)
```

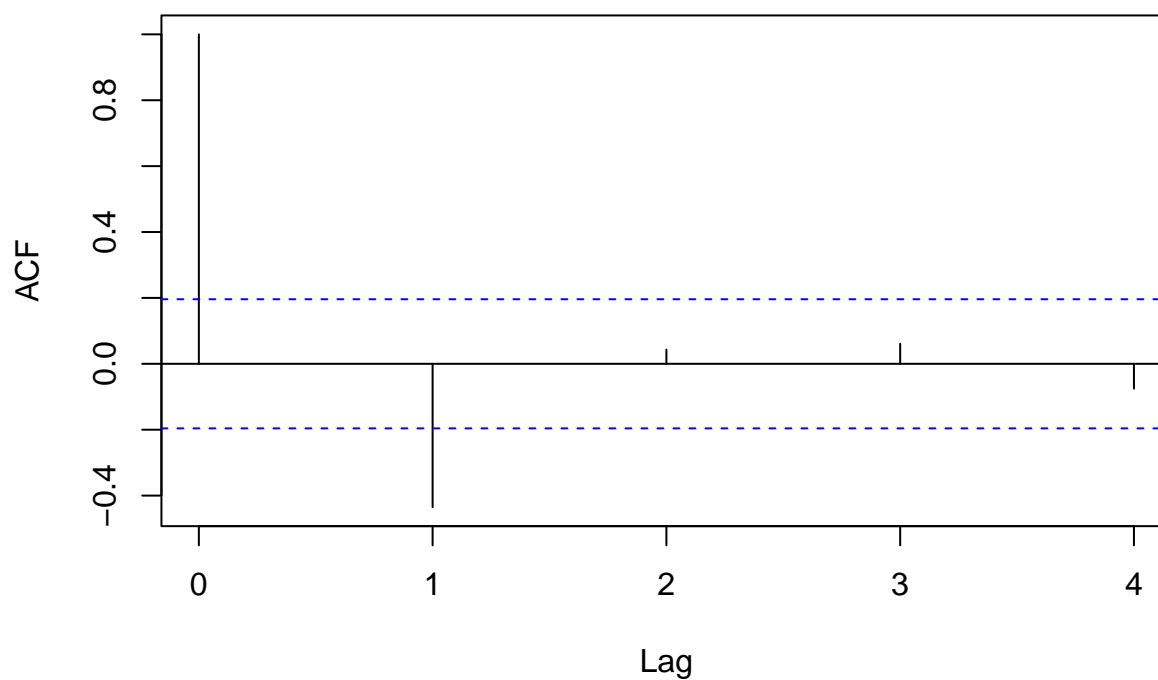


```
acf(y2, lag.max=4, plot=FALSE)
```

```
##
## Autocorrelations of series 'y2', by lag
##
##      0      1      2      3      4
## 1.000 -0.435  0.043  0.061 -0.075
```

```
acf(y2, lag.max=4)
```

Series y2



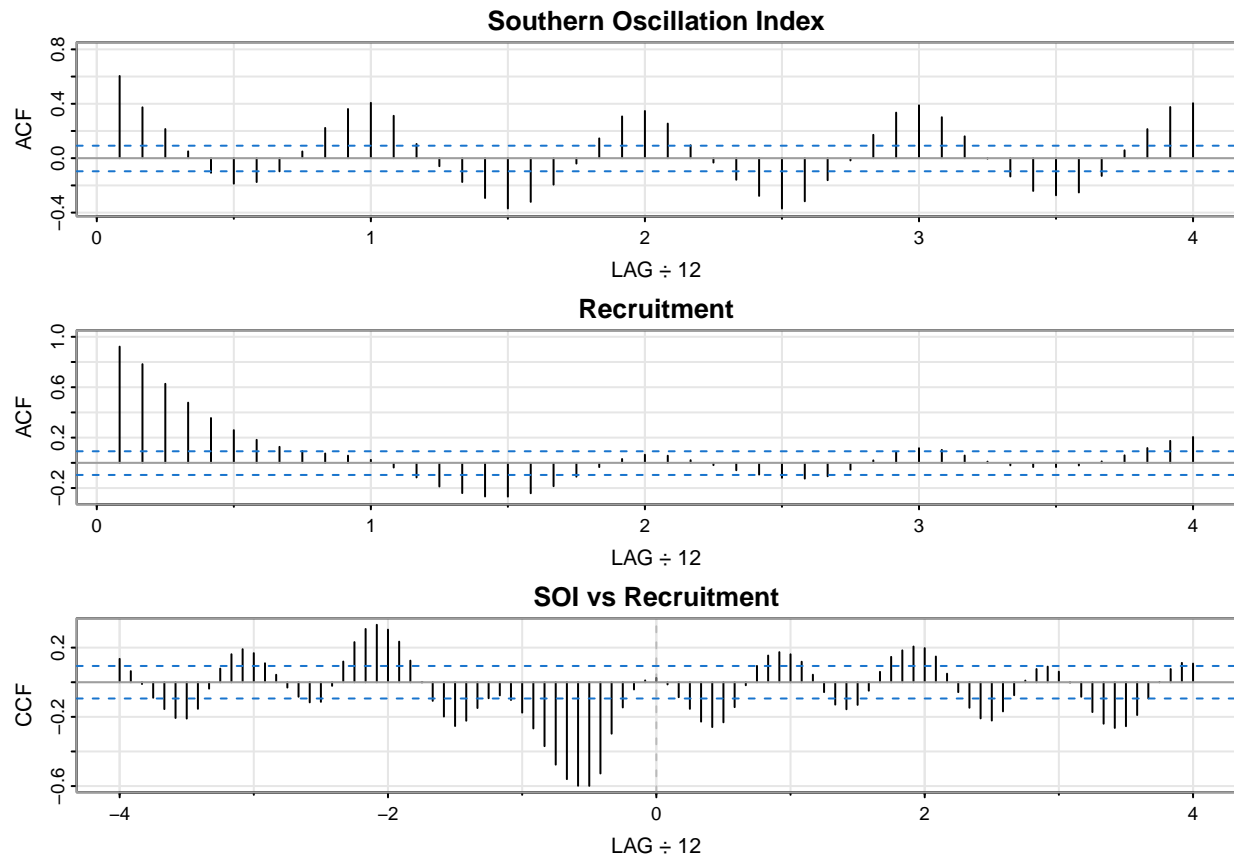
```
op<-par(mfrow=c(3,1))
acf1(soi, 48, main="Southern Oscillation Index")
```

```
## [1] 0.60 0.37 0.21 0.05 -0.11 -0.19 -0.18 -0.10 0.05 0.22 0.36 0.41
## [13] 0.31 0.10 -0.06 -0.17 -0.29 -0.37 -0.32 -0.19 -0.04 0.15 0.31 0.35
## [25] 0.25 0.10 -0.03 -0.16 -0.28 -0.37 -0.32 -0.16 -0.02 0.17 0.33 0.39
## [37] 0.30 0.16 0.00 -0.13 -0.24 -0.27 -0.25 -0.13 0.06 0.21 0.38 0.40
```

```
acf1(rec, 48, main="Recruitment")
```

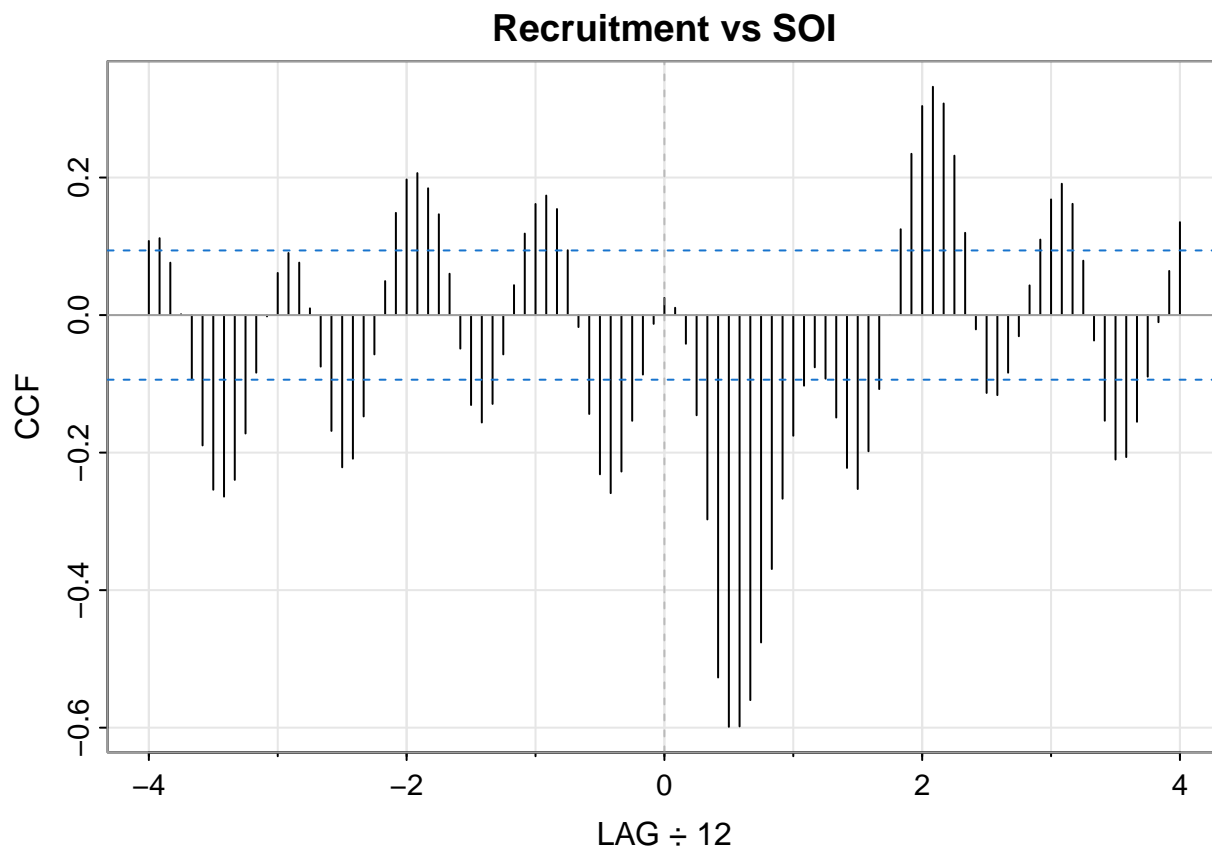
```
## [1] 0.92 0.78 0.63 0.48 0.36 0.26 0.18 0.13 0.09 0.07 0.06 0.02
## [13] -0.04 -0.12 -0.19 -0.24 -0.27 -0.27 -0.24 -0.19 -0.11 -0.03 0.03 0.06
## [25] 0.06 0.02 -0.02 -0.06 -0.09 -0.12 -0.13 -0.11 -0.05 0.02 0.08 0.12
## [37] 0.10 0.06 0.01 -0.02 -0.03 -0.03 -0.02 0.01 0.06 0.12 0.17 0.20
```

```
ccf2(soi, rec, 48, main="SOI vs Recruitment")
```

```
par(op)
```

```
ccf2(rec,soi, 48, main="Recruitment vs SOI")
```



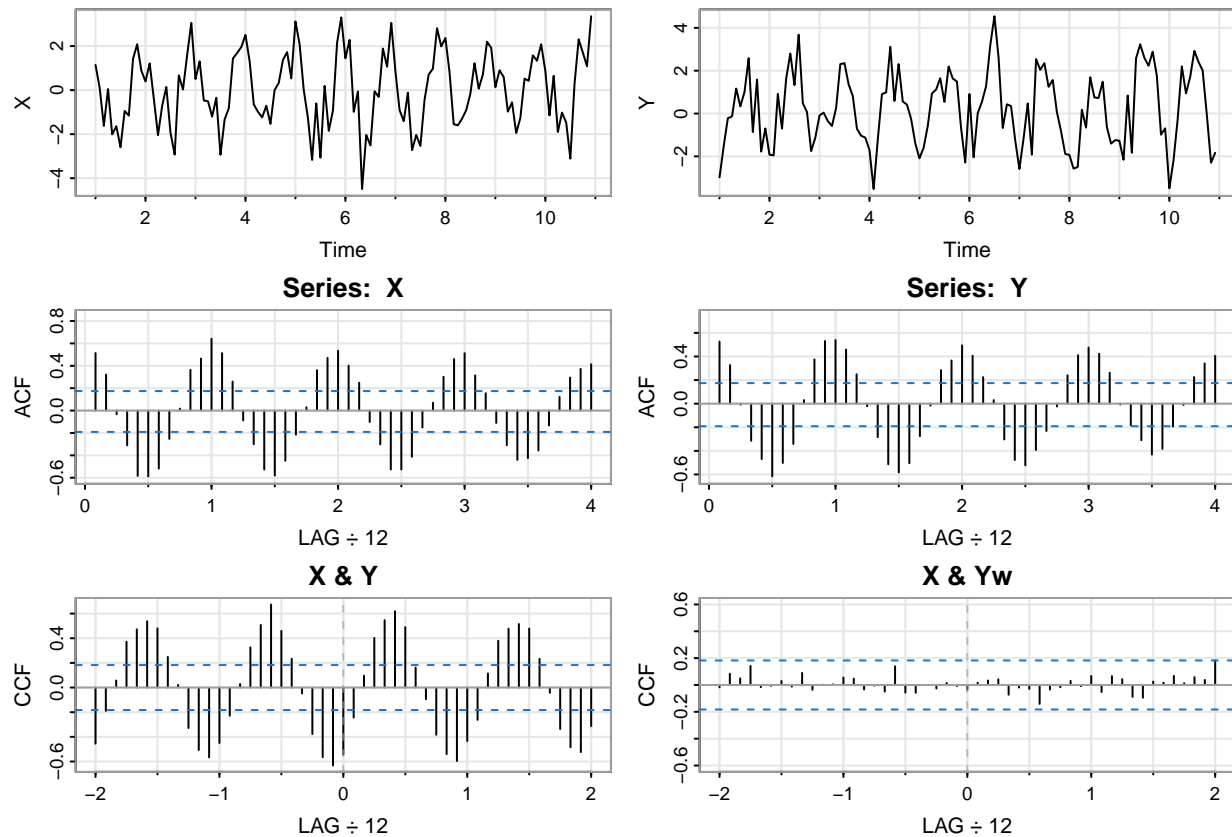
```
set.seed(1492)
num <- 120
t <- 1:num
X <- ts( 2*cos(2*pi*t/12) + rnorm(num), freq=12 )
Y <- ts( 2*cos(2*pi*(t+5)/12) + rnorm(num), freq=12 )
Yw <- resid(lm(Y~ cos(2*pi*t/12) + sin(2*pi*t/12), na.action=NULL))
op<-par(mfrow=c(3,2))
tsplot(X)
tsplot(Y)
acf1(X, 48)
```

```
## [1] 0.51 0.32 -0.03 -0.31 -0.58 -0.59 -0.52 -0.25 0.02 0.36 0.46 0.64
## [13] 0.51 0.26 -0.09 -0.30 -0.53 -0.58 -0.45 -0.21 0.03 0.36 0.47 0.53
## [25] 0.40 0.25 -0.10 -0.30 -0.53 -0.53 -0.41 -0.15 0.07 0.30 0.46 0.51
## [37] 0.31 0.16 -0.11 -0.31 -0.44 -0.42 -0.36 -0.13 0.12 0.30 0.37 0.41
```

```
acf1(Y, 48)
```

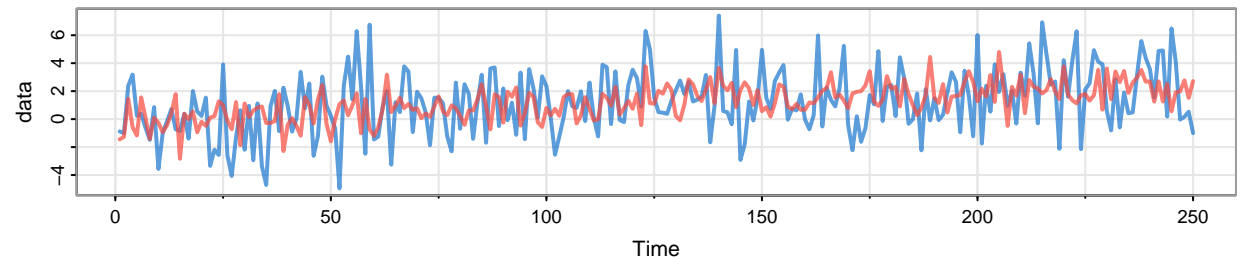
```
## [1] 0.53 0.33 -0.01 -0.31 -0.47 -0.62 -0.50 -0.34 0.03 0.38 0.53 0.54
## [13] 0.46 0.25 -0.02 -0.28 -0.51 -0.58 -0.50 -0.27 -0.02 0.28 0.37 0.49
## [25] 0.41 0.22 0.03 -0.30 -0.48 -0.52 -0.39 -0.23 -0.02 0.24 0.41 0.48
## [37] 0.42 0.26 -0.01 -0.18 -0.31 -0.43 -0.38 -0.19 -0.01 0.23 0.34 0.40
```

```
ccf2(X, Y, 24)
ccf2(X, Yw, 24, ylim=c(-.6,.6))
```

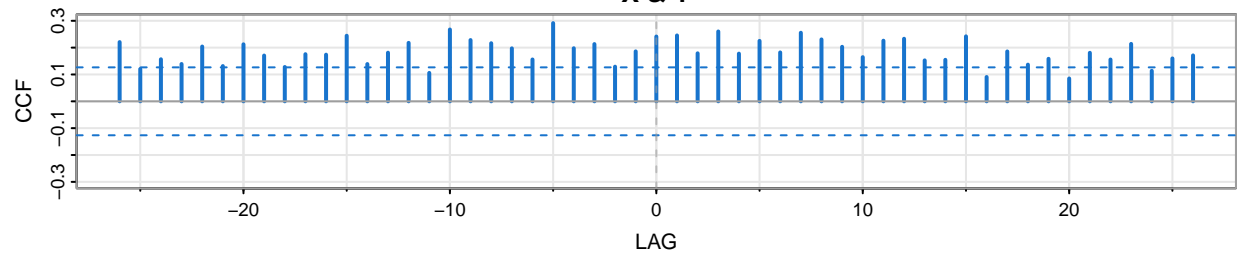


```
par(op)
```

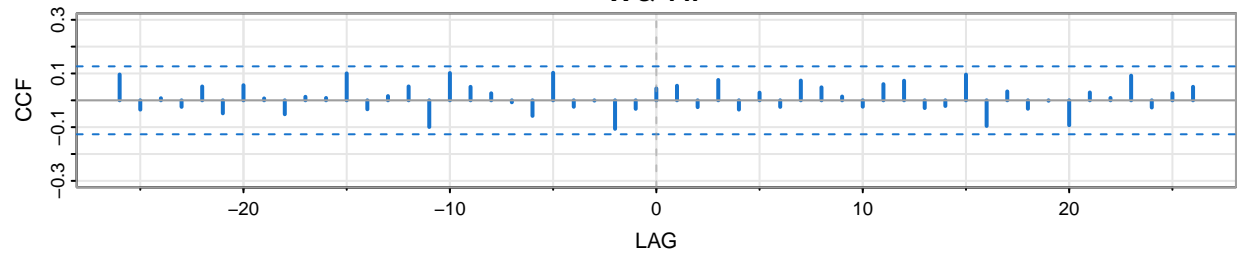
```
set.seed(90210)
num <- 250
t <- 1:num
X <- .01*t + rnorm(num,0,2)
Y <- .01*t + rnorm(num) # x and y are uncorrelated!
op<-par(mfrow=c(3,1))
tsplot(cbind(X,Y), spag=TRUE, col=astsa.col(c(4,2),.7), lwd=2, ylab='data')
ccf2(X, Y, ylim=c(-.3,.3), col=4, lwd=2)
Yw <- resid(lm(Y~t)) # whiten Y by removing trend
ccf2(X, Yw, ylim=c(-.3,.3), col=4, lwd=2)
```



X & Y



X & Yw



```
par(op)
```