STAT4870 HW1

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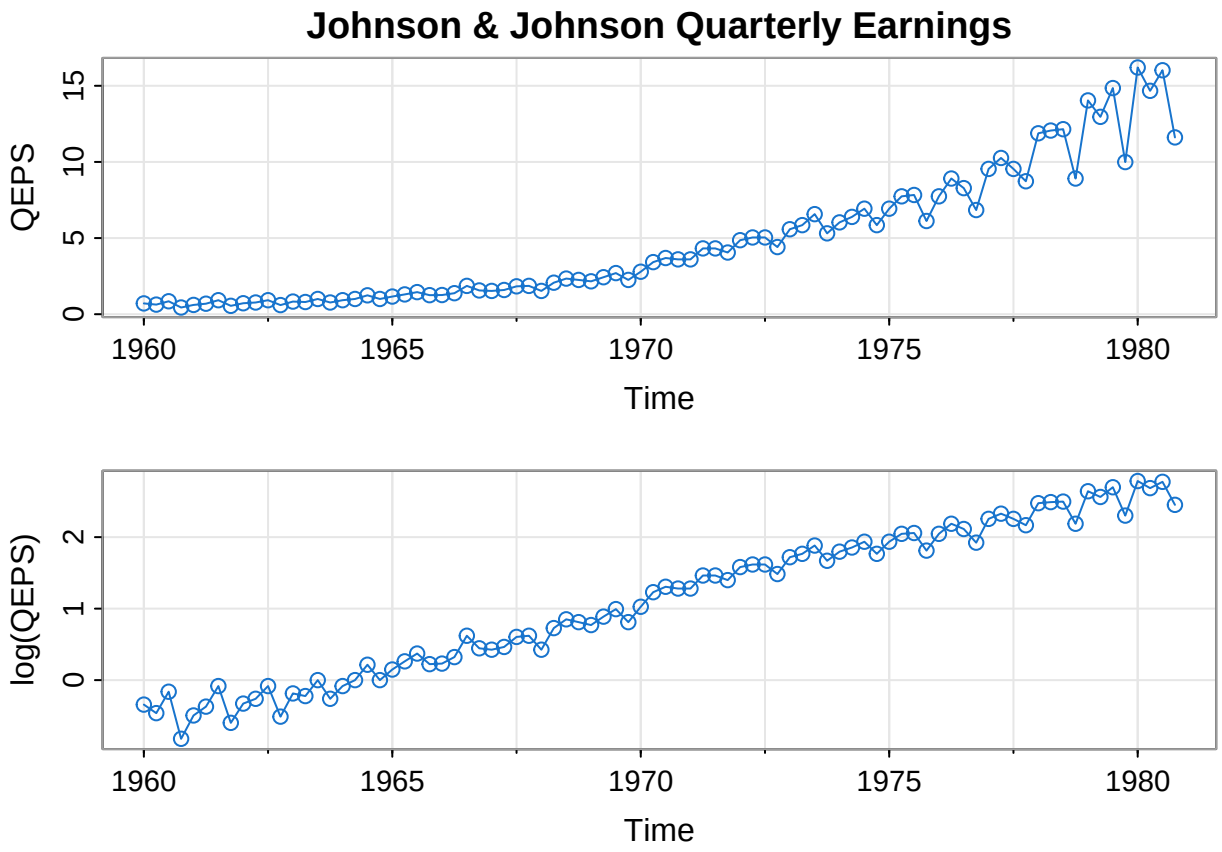
Chapter 1 Section 2

Johnson & Johnson Quarterly Earnings

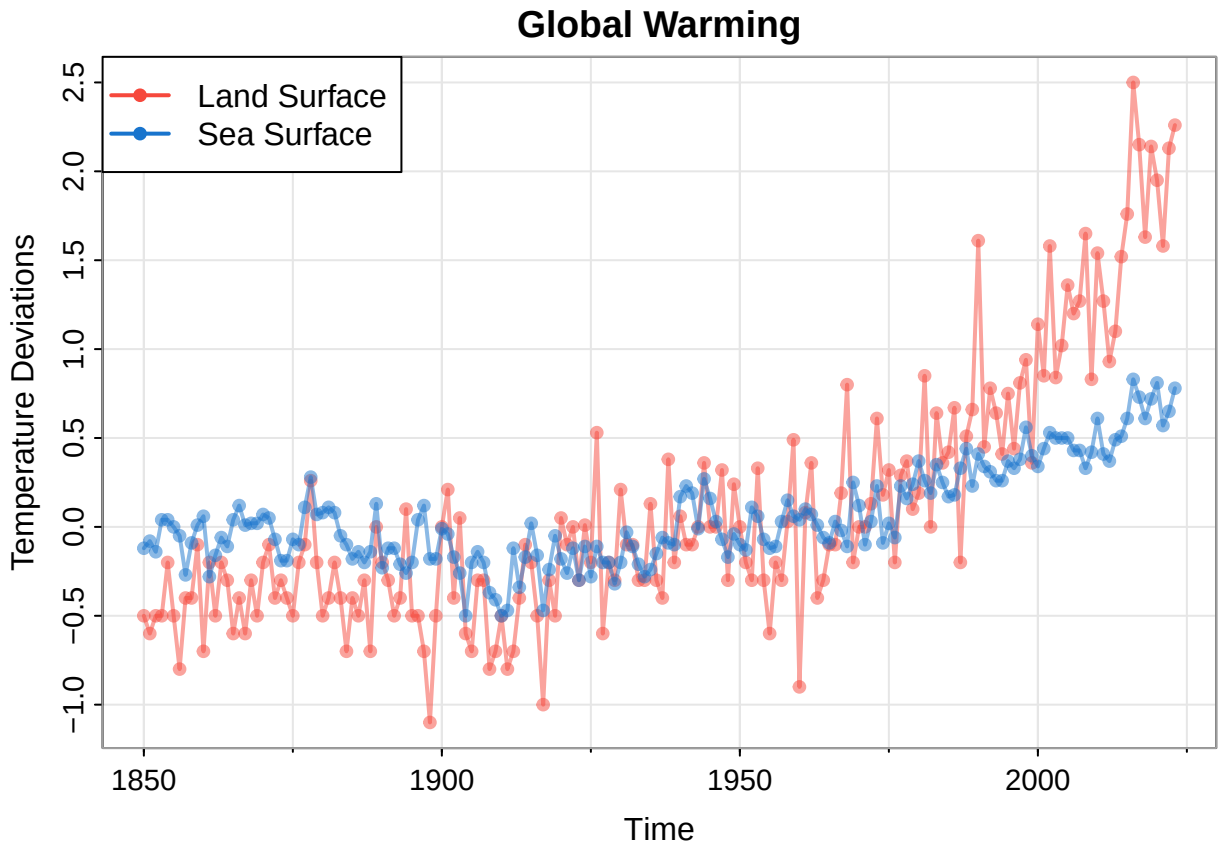
```
library("astsa")
par(mfrow=2:1)
tsplot(jj, ylab="QEPS", type="o", col=4, main="Johnson & Johnson Quarterly Earnings")
tsplot(log(jj), ylab="log(QEPS)", type="o", col=4)
```



Graph 2 is more homogenous and less volatile than Graph 1.

```
tsplot(cbind(gtemp_land,gtemp_ocean), spaghetti=TRUE, col = astsa.col(c(2,4), .5),
lwd=2, type="o", pch=20, ylab="Temperature Deviations", main="Global Warming")
```

```
legend("topleft", col=c(2,4), lty=1, lwd=2, pch=20, bg="white",
legend=c("Land Surface", "Sea Surface"))
```



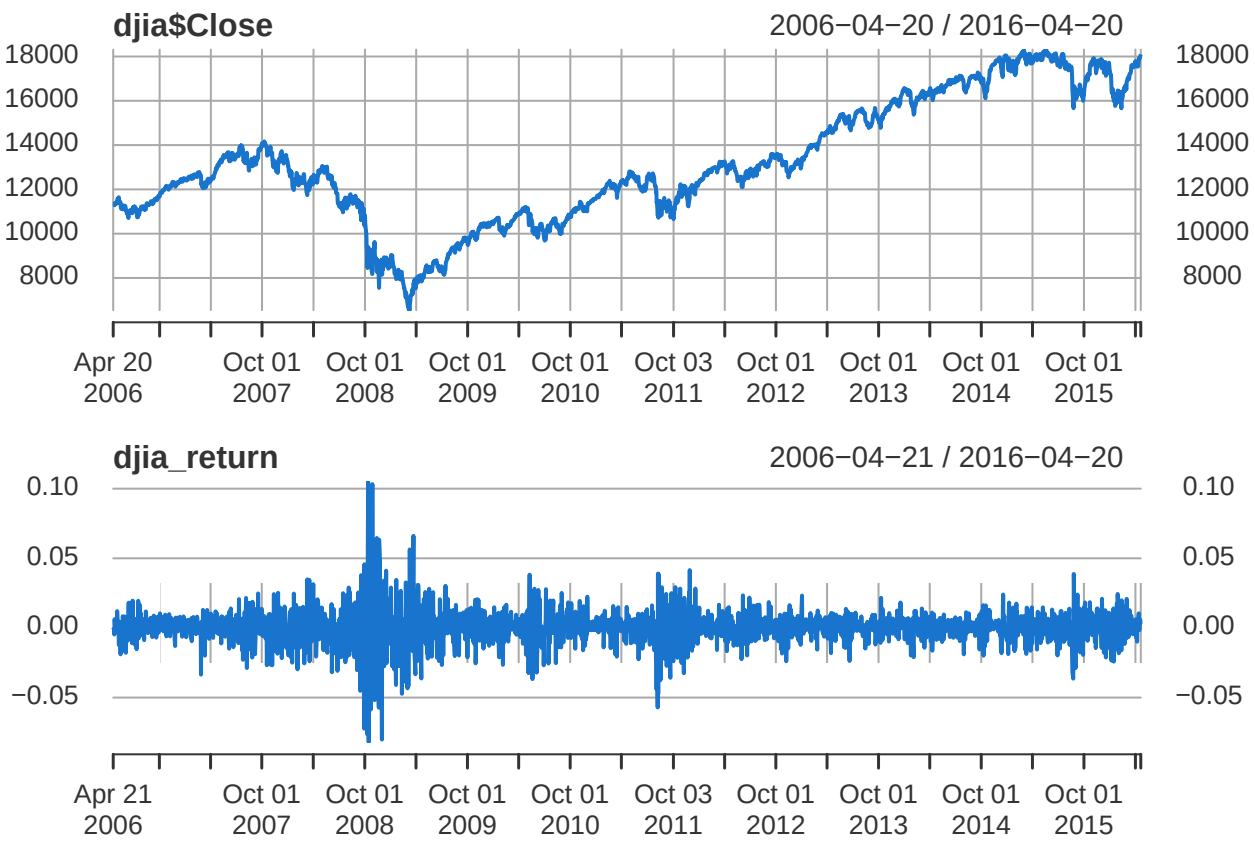

```
library("xts")
```

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

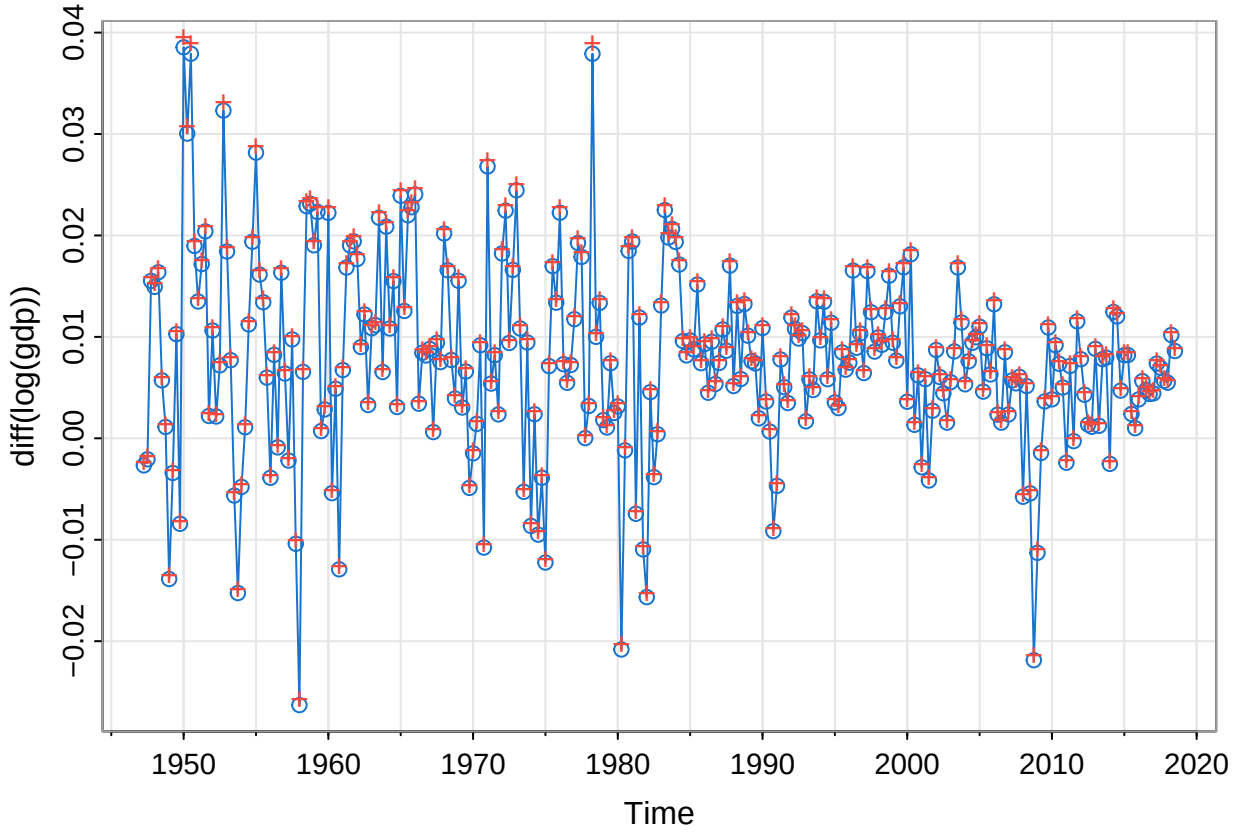
```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
djia_return = diff(log(djia$Close))[-1]
par(mfrow=2:1)
plot(djia$Close, col=4)
plot(djia_return, col=4)
```




```
tsplot(diff(log(gdp)), type="o", col=4)
points(diff(gdp)/lag(gdp,-1), pch="+", col=2)
```




```
ts(1:10, frequency = 4, start = c(1959, 2))
```

```
##      Qtr1 Qtr2 Qtr3 Qtr4
## 1959         1    2    3
## 1960    4    5    6    7
## 1961    8    9   10
```

```
print(ts(1:10, frequency = 7, start = c(12,2)), calendar = TRUE)
```

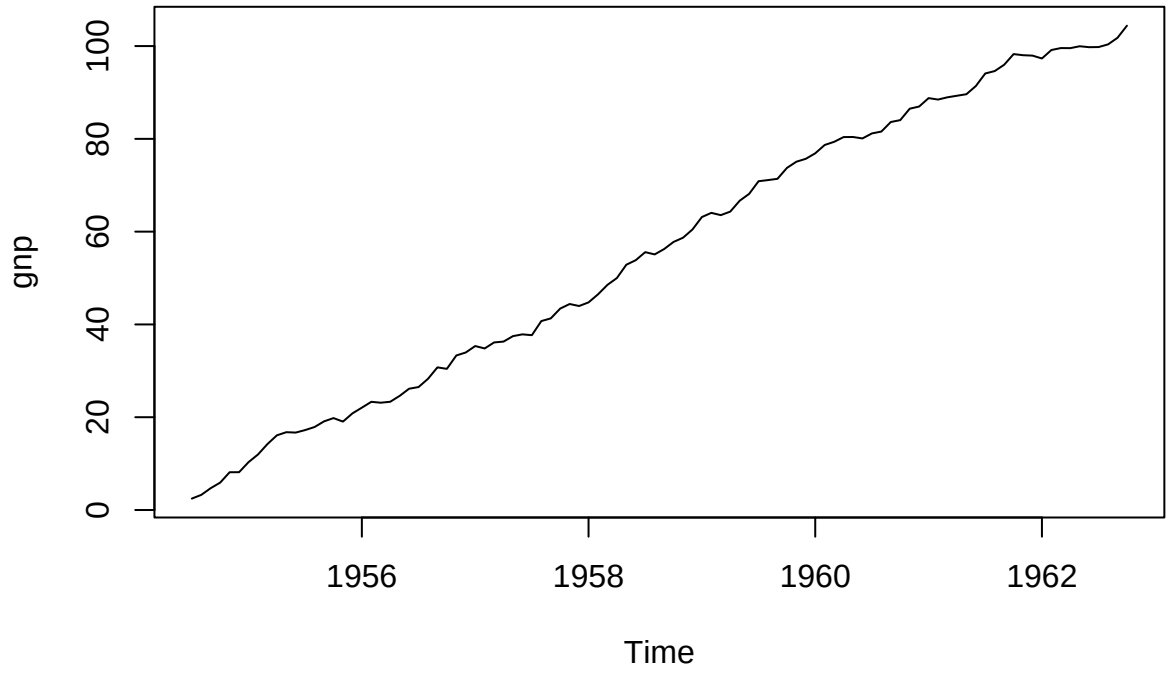
```
##    p1 p2 p3 p4 p5 p6 p7
## 12     1  2  3  4  5  6
## 13  7  8  9 10
```

```
(gnp<-ts(cumsum(1+round(rnorm(100),2)),
         start = c(1954,7), frequency = 12))
```

```
##          Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct
## 1954                                                 2.46   3.26   4.71   5.90
## 1955  10.31  11.96  14.20  16.09  16.77  16.69  17.23  17.89  19.11  19.81
## 1956  22.06  23.32  23.13  23.33  24.60  26.14  26.50  28.27  30.75  30.42
## 1957  35.34  34.82  36.12  36.30  37.48  37.86  37.68  40.72  41.30  43.42
## 1958  44.75  46.49  48.53  50.00  52.87  53.85  55.58  55.09  56.25  57.78
## 1959  63.15  64.05  63.56  64.32  66.66  68.14  70.87  71.11  71.39  73.73
## 1960  76.88  78.68  79.36  80.38  80.40  80.09  81.17  81.57  83.63  84.04
```

```
## 1961  88.78  88.47  88.96  89.29  89.62  91.38  94.09  94.61  95.97  98.27
## 1962  97.32  99.15  99.57  99.55  99.96  99.76  99.79 100.36 101.78 104.39
##         Nov    Dec
## 1954   8.14   8.15
## 1955  19.05  20.82
## 1956  33.31  33.95
## 1957  44.40  43.97
## 1958  58.69  60.46
## 1959  75.07  75.70
## 1960  86.50  86.97
## 1961  98.03  97.94
## 1962
```

```
plot(gnp)
plot.ts(gnp)
```




```
z<-ts(matrix(rnorm(300), 100, 3), start = c(1961,1), frequency = 12)
class(z)
```

```
## [1] "mts"    "ts"     "matrix"
```

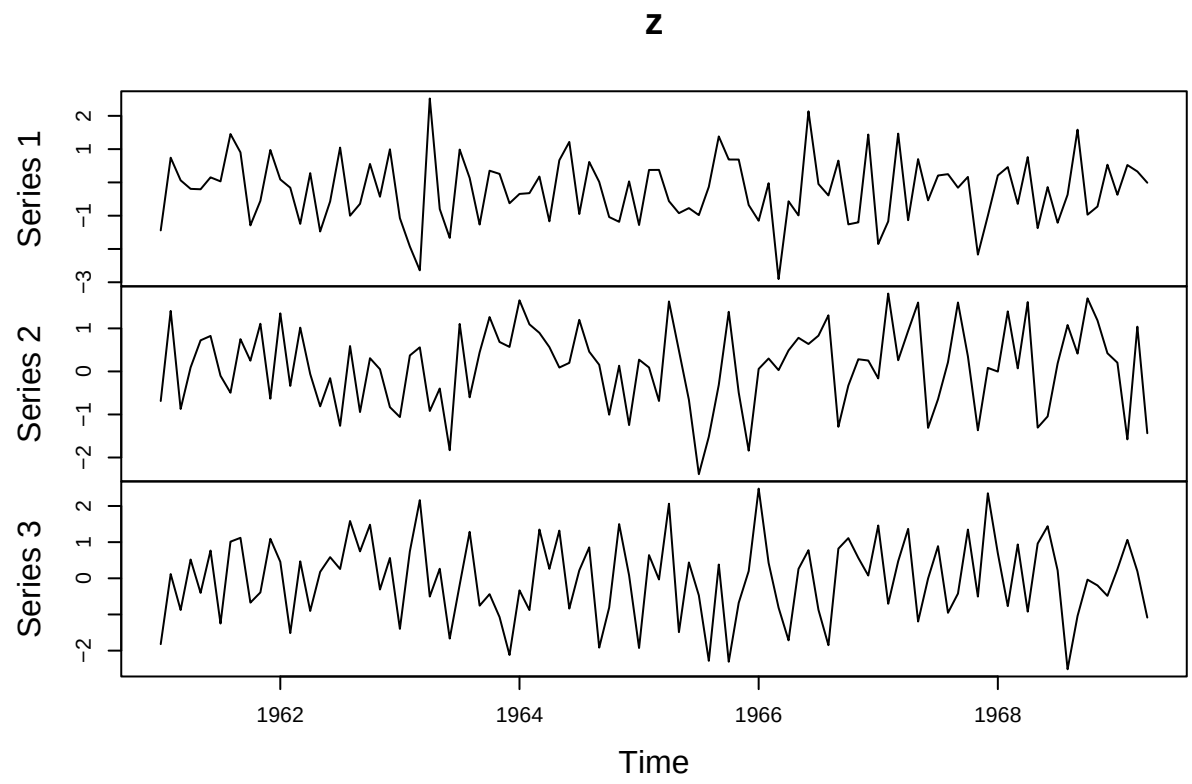
```
is.mts(z)
```

```
## [1] TRUE
```

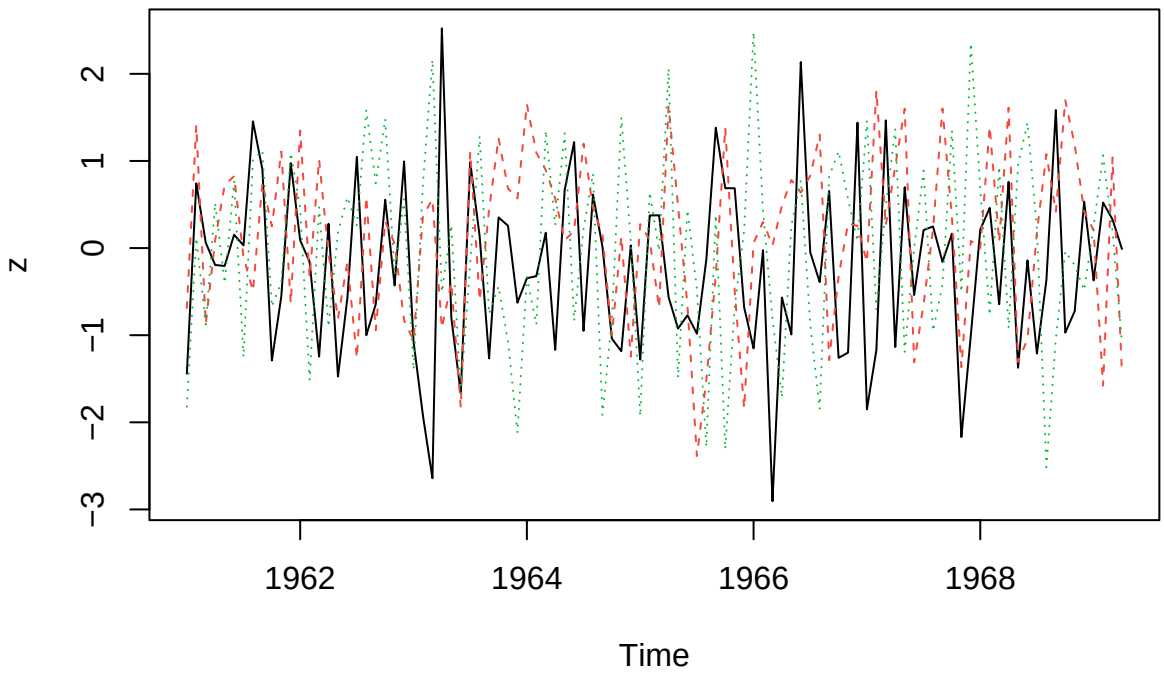
```
head(z)
```

```
##          Series 1    Series 2   Series 3
## [1,] -1.44175651 -0.68730748 -1.8206265
## [2,]  0.74281037  1.40596624  0.1175185
## [3,]  0.06266491 -0.87254282 -0.8769371
## [4,] -0.19425389  0.09272906  0.5189127
## [5,] -0.20557230  0.72238530 -0.4030671
## [6,]  0.15260326  0.82446247  0.7674652
```

```
plot(z)
```




```
plot(z, plot.type = "single", lty = 1:3, col=1:3)
```




```
x<-c(1,3,7,4,9,2)
ts(x)
```

```
## Time Series:
## Start = 1
## End = 6
## Frequency = 1
## [1] 1 3 7 4 9 2
```

```
diff(ts(x))
```

```
## Time Series:
## Start = 2
## End = 6
## Frequency = 1
## [1]  2  4 -3  5 -7
```

```
diff(ts(x), lag = 2)
```

```
## Time Series:
## Start = 3
## End = 6
## Frequency = 1
## [1]  6  1  2 -2
```

```r
diff(ts(x), lag = 3)
```

```
## Time Series:
## Start = 4
## End = 6
## Frequency = 1
## [1]  3  6 -5
```

```r
diff(ts(x), differences = 2)
```

```
## Time Series:
## Start = 3
## End = 6
## Frequency = 1
## [1]   2  -7   8 -12
```

```r
diff(ts(x), lag = 2, differences = 2)
```

```
## Time Series:
## Start = 5
## End = 6
## Frequency = 1
## [1] -4 -3
```

```r
lag(ts(x))
```

```
## Time Series:
## Start = 0
## End = 5
## Frequency = 1
## [1] 1 3 7 4 9 2
```

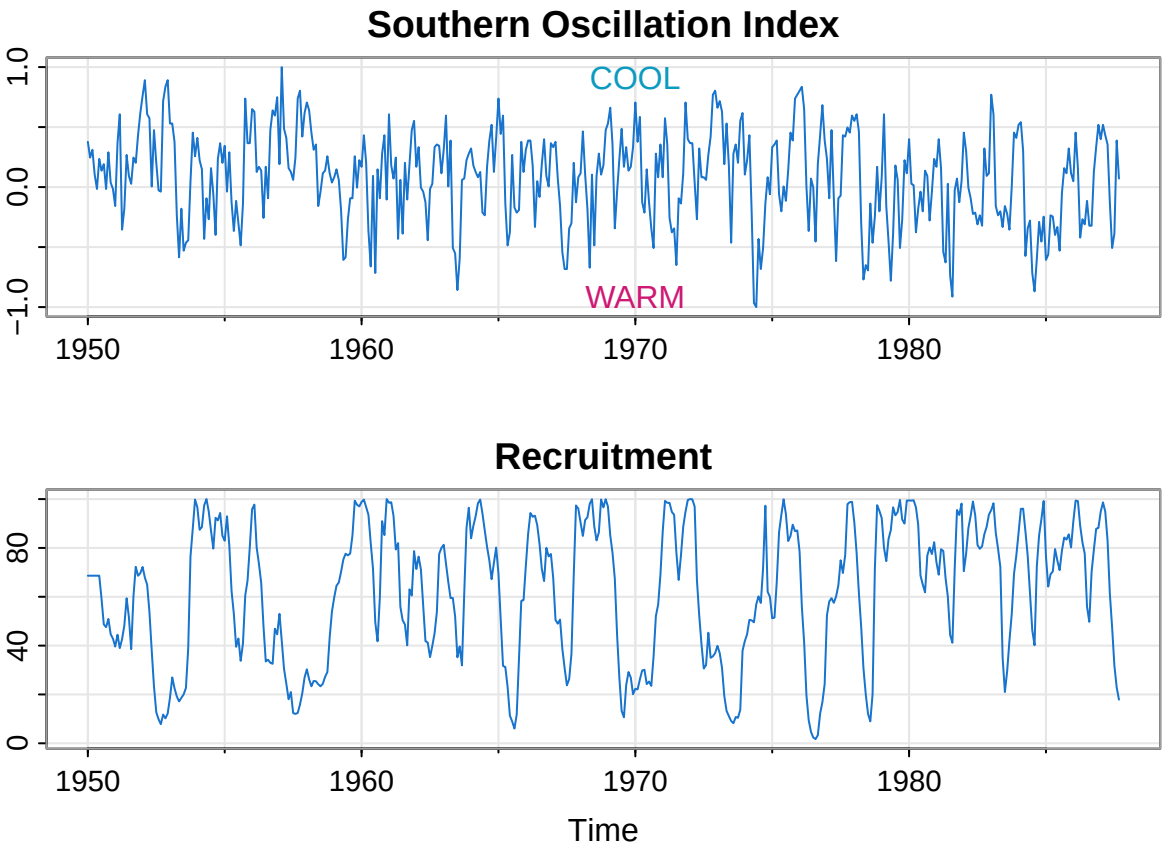
```r
lag(ts(x), k = 2)
```

```
## Time Series:
## Start = -1
## End = 4
## Frequency = 1
## [1] 1 3 7 4 9 2
```

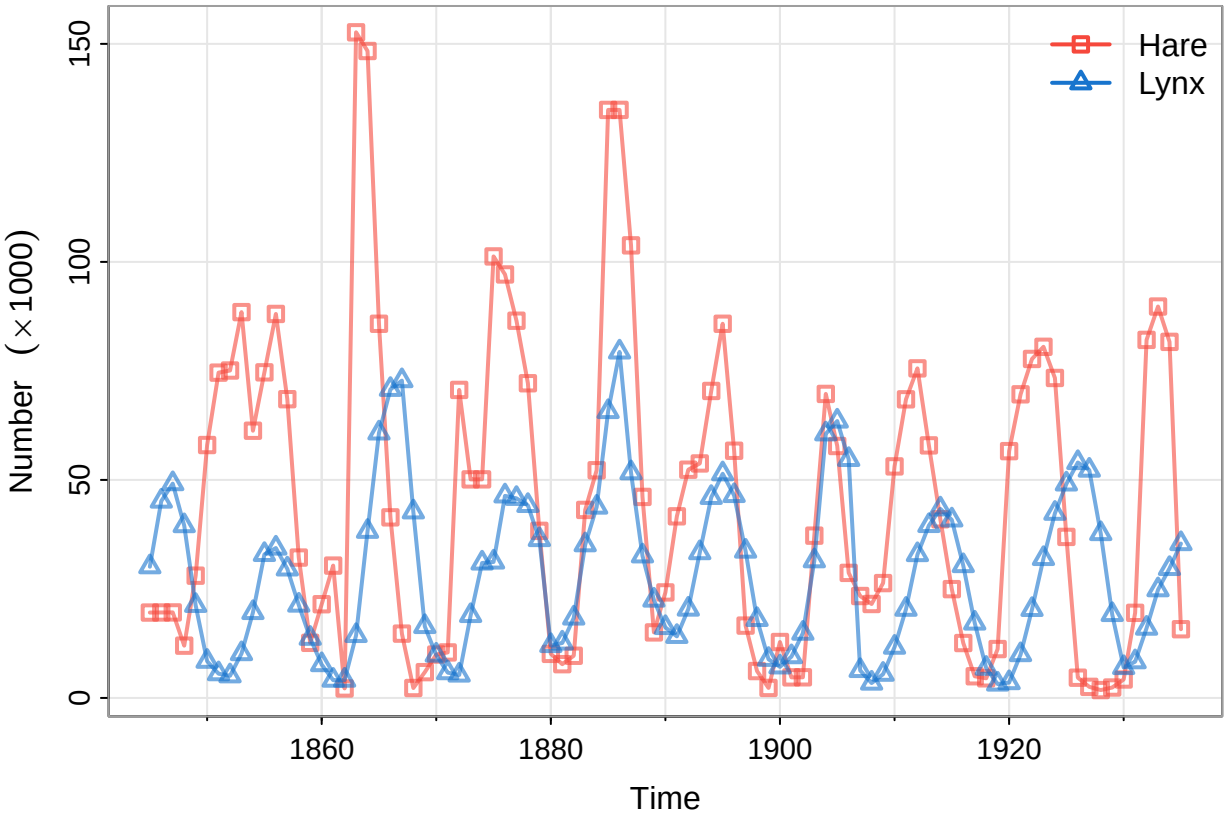
```r
lag(ts(x), k = -1)
```

```
## Time Series:
## Start = 2
## End = 7
## Frequency = 1
## [1] 1 3 7 4 9 2
```

```
par(mfrow = c(2,1))
tsplot(soi, ylab = "", xlab = "", main = "Southern Oscillation Index", col = 4)
text(1970, 0.91, "COOL", col = 5)
text(1970, -0.91, "WARM", col = 6)
tsplot(rec, ylab = "", main = "Recruitment", col = 4)
```

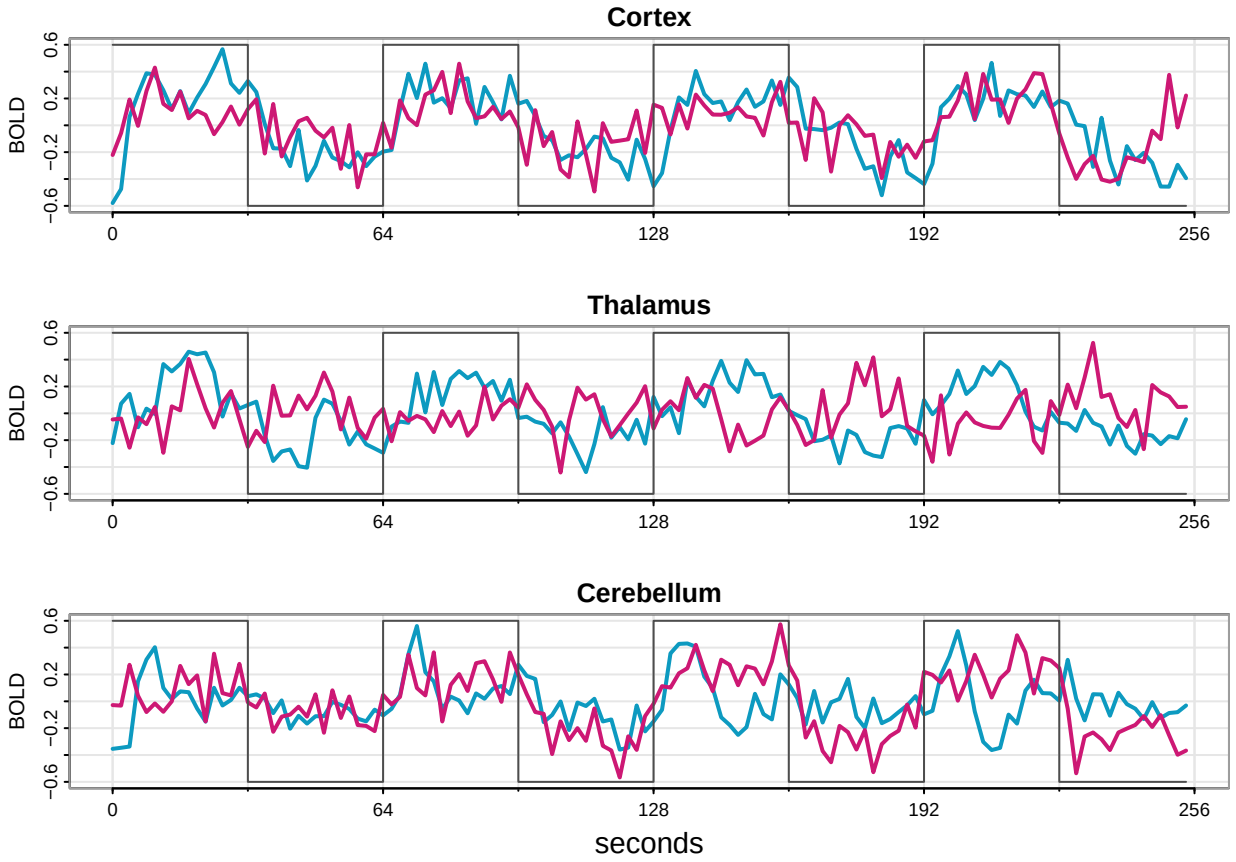



```
tsplot(cbind(Hare, Lynx), col = astsa.col(c(2,4), 0.6), lwd = 2, type = "o", pch = c(0,2), spaghetti = T
legend("topright", col = c(2,4), lty = 1, lwd = 2, pch = c(0,2), legend = c("Hare", "Lynx"), bty = "n")
```



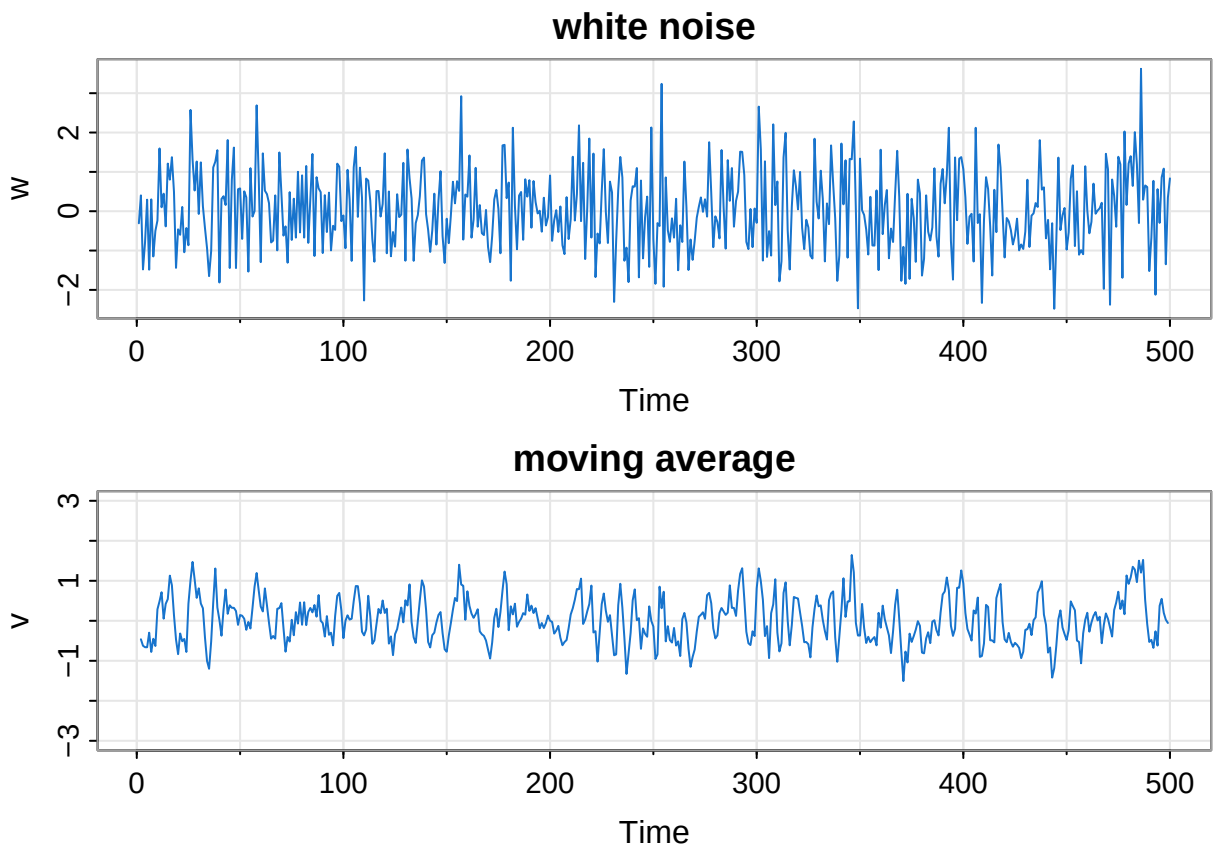

```
par(mfrow = c(3,1))
x = ts(fmri1[,4:9], start = 0, freq = 32)
names = c("Cortex", "Thalamus", "Cerebellum")
u = ts(rep(c(rep(0.6, 16), rep(-0.6, 16)), 4), start = 0, freq = 32)

for (i in 1:3){
j = 2*i-1
tsplot(x[,j:(j+1)], ylab="BOLD", xlab="", main=names[i], col=5:6, ylim=c(-.6,.6),lwd=2, xaxt="n", spagh
axis(seq(0,256,64), side=1, at=0:4)
lines(u, type="s", col=gray(.3))
}
mtext("seconds", side=1, line=1.75, cex=.9)
```

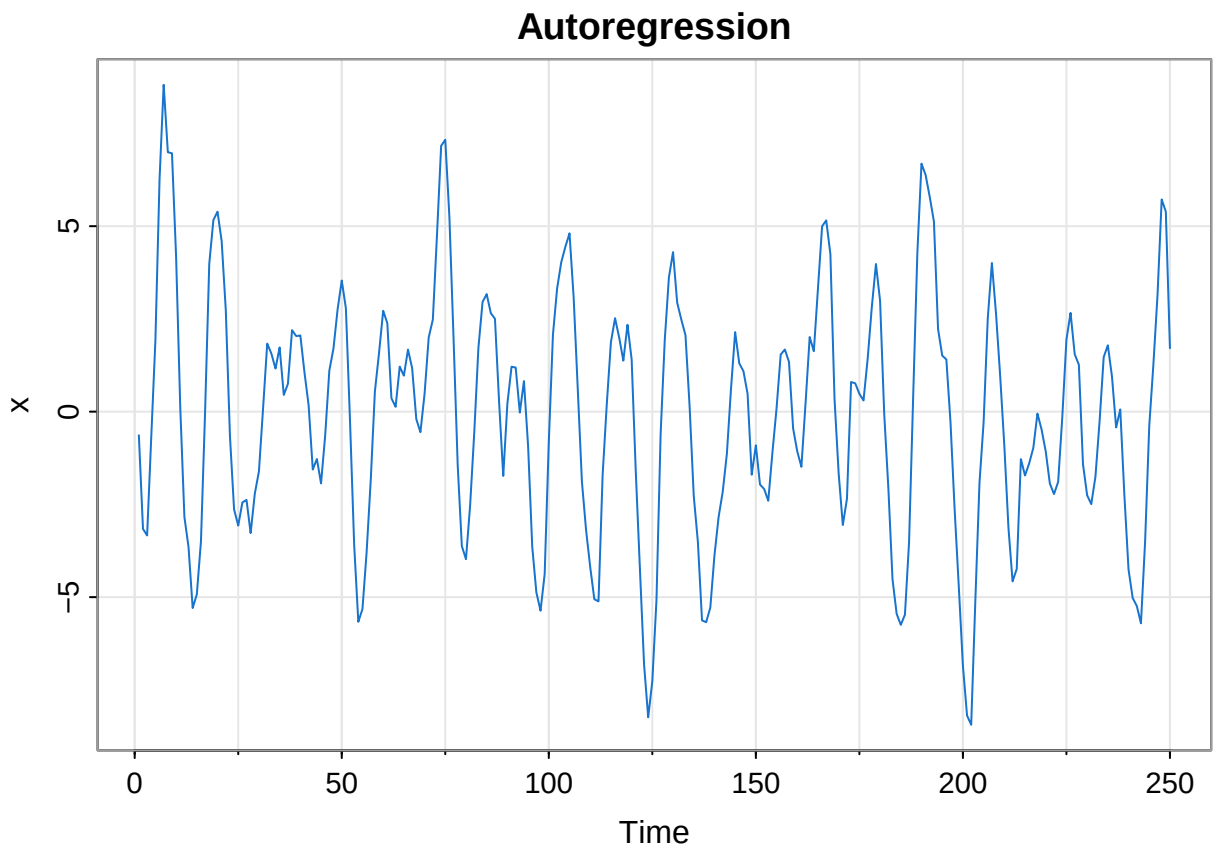


Chapter 1 Section 3

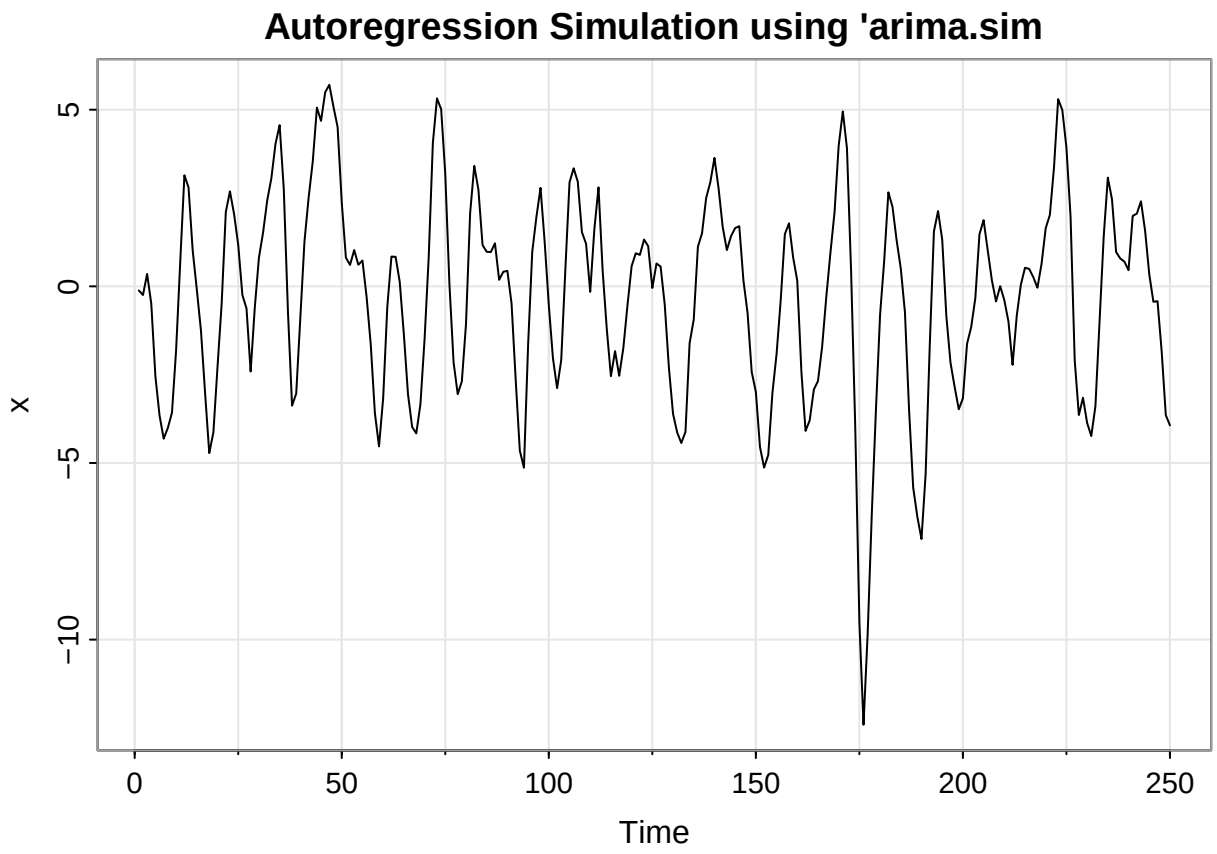
```
par(mfrow = 2:1)
w = rnorm(500)
v = filter(w, sides = 2, filter = rep(1/3, 3))
tsplot(w, col = 4, main = "white noise")
tsplot(v, ylim = c(-3,3), col = 4, main = "moving average")
```



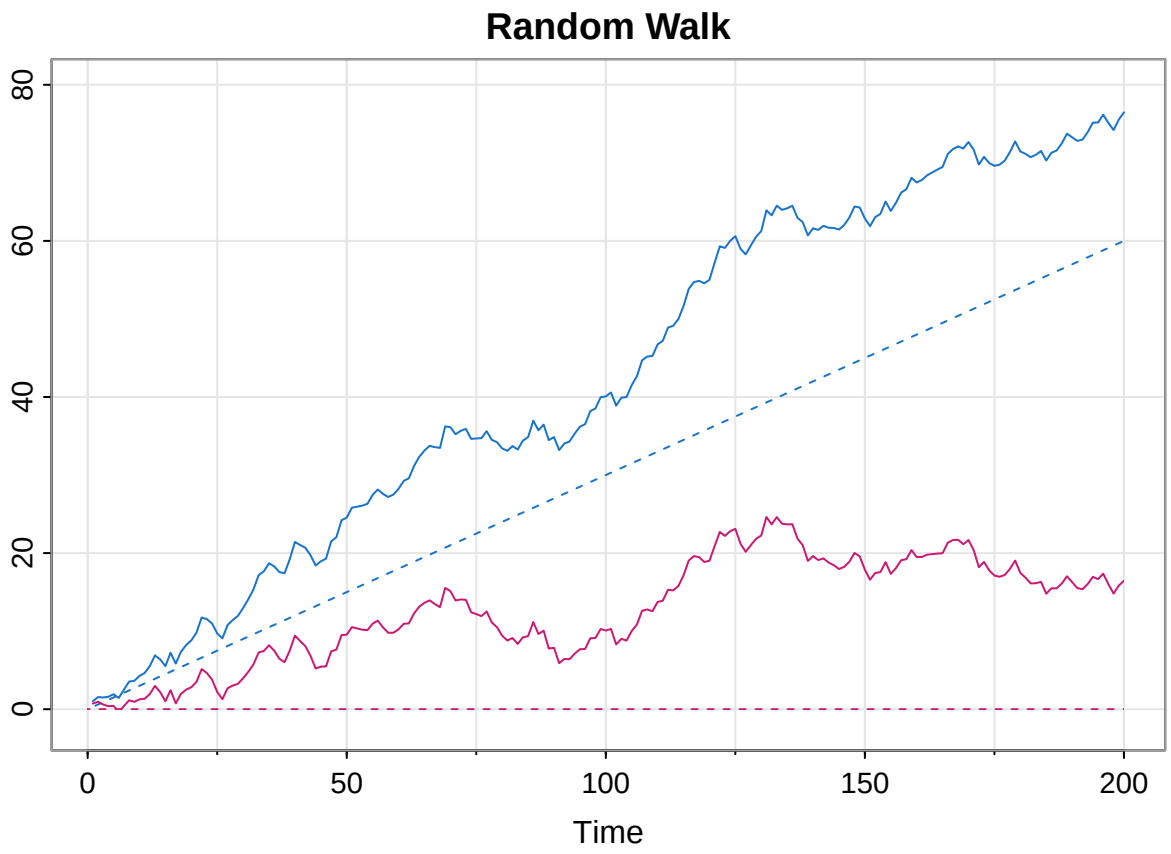

```
set.seed(90210)
w = rnorm(250+50)
x = filter(w, filter = c(1.5, -0.75), method = "recursive")[-(1:50)]
tsplot(x, main = "Autoregression", col = 4)
```




```
tsplot(arima.sim(n = 250, list(ar = c(1.5, -0.75), sd = 1)), ylab = "x", main = "Autoregression Simulati
```

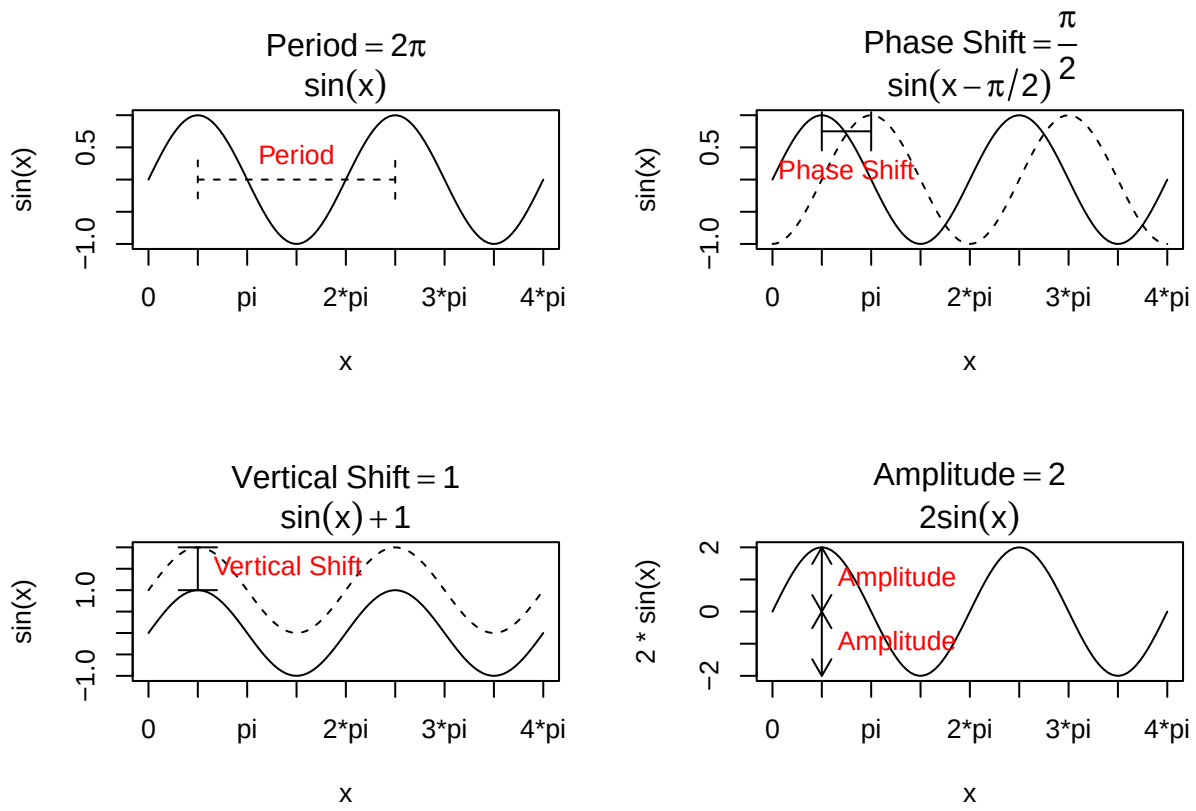



```
set.seed(314159265)
w = rnorm(200)
x = cumsum(w)
wd = w + 0.3
xd = cumsum(wd)
tsplot(xd, ylim = c(-2,80), main = "Random Walk", ylab = "", col = 4)
clip(0,200,0,80)
abline(a = 0, b = 0.3, lty = 2, col = 4)
lines(x, col = 6)
clip(0, 200, 0, 80)
abline(h = 0, col = 6, lty = 2)
```

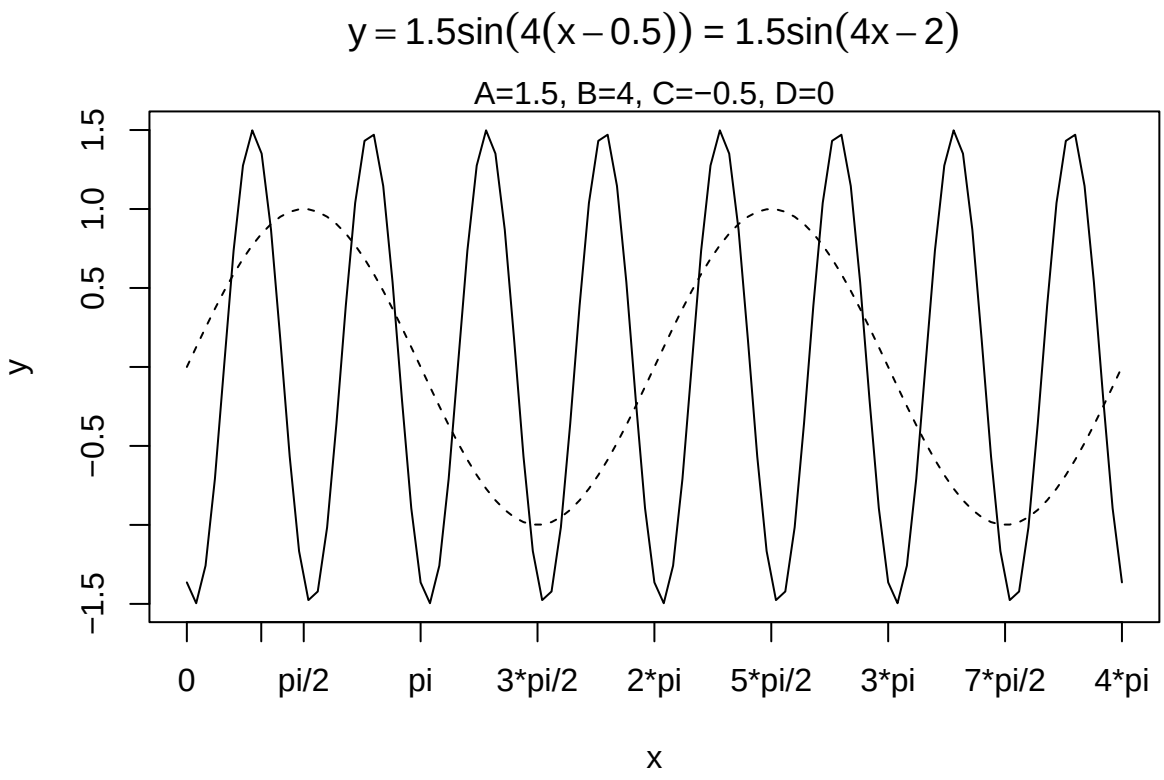



```
par(mfrow=c(2,2))
curve(sin,xlim=c(0,4*pi),xaxt='n',main=expression(Period==2*pi))
axis(1,c(0,pi/2,pi,3*pi/2,2*pi,5*pi/2,3*pi,7*pi/2,4*pi),
c("0","pi/2","pi","3*pi/2","2*pi","5*pi/2","3*pi","7*pi/2","4*pi"))
arrows(pi/2,0,5*pi/2,lty=2,angle=90,code=3,length=.1)
text(3*pi/2,0,"Period",pos=3,col='red')
mtext(expression(sin(x)))
curve(sin(x),xlim=c(0,4*pi),xaxt='n',main=expression(Phase~Shift==frac(pi,2)))
axis(1,c(0,pi/2,pi,3*pi/2,2*pi,5*pi/2,3*pi,7*pi/2,4*pi),
c("0","pi/2","pi","3*pi/2","2*pi","5*pi/2","3*pi","7*pi/2","4*pi"))
curve(sin(x-pi/2),add=TRUE,lty=2)
arrows(pi/2,.75,pi,angle=90,code=3,length=.1)
text(3*pi/4,0.5,"Phase Shift",pos=1,col='red')
mtext(expression(sin(x-pi/2)))
curve(sin(x),xlim=c(0,4*pi),xaxt='n',main=expression(Vertical~Shift==1),ylim=c(-1,2))
axis(1,c(0,pi/2,pi,3*pi/2,2*pi,5*pi/2,3*pi,7*pi/2,4*pi),
c("0","pi/2","pi","3*pi/2","2*pi","5*pi/2","3*pi","7*pi/2","4*pi"))
curve(sin(x)+1,add=TRUE,lty=2)
arrows(pi/2,1,y1=2,angle=90,code=3,length=.1)
text(pi/2,1.5,"Vertical Shift",pos=4,col='red')
mtext(expression(sin(x)+1))
curve(2*sin(x),xlim=c(0,4*pi),xaxt='n',main=expression(Amplitude==2),ylim=c(-2,2))
axis(1,c(0,pi/2,pi,3*pi/2,2*pi,5*pi/2,3*pi,7*pi/2,4*pi),
c("0","pi/2","pi","3*pi/2","2*pi","5*pi/2","3*pi","7*pi/2","4*pi"))
arrows(pi/2,0,y1=2,code=3,length=.1)
arrows(pi/2,0,y1=-2,code=3,length=.1)
```

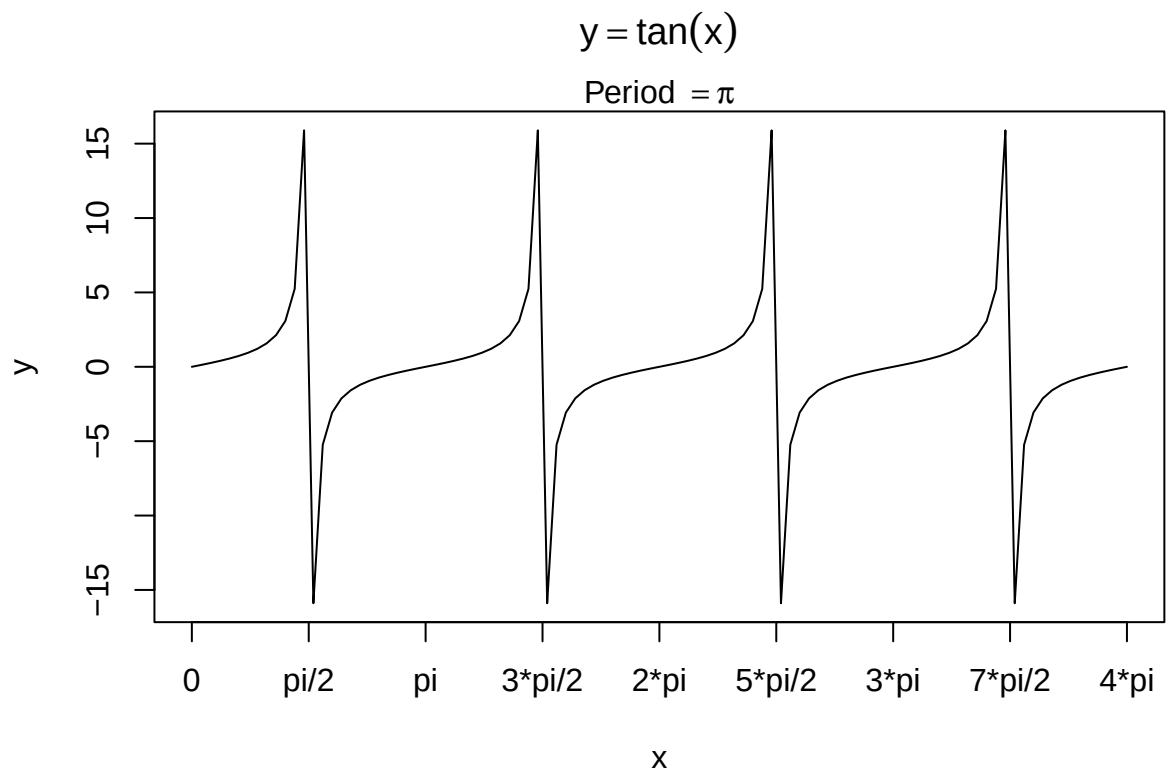
```
text(pi/2,1,"Amplitude",pos=4,col='red')
text(pi/2,-1,"Amplitude",pos=4,col='red')
mtext(expression(2*sin(x)))
```



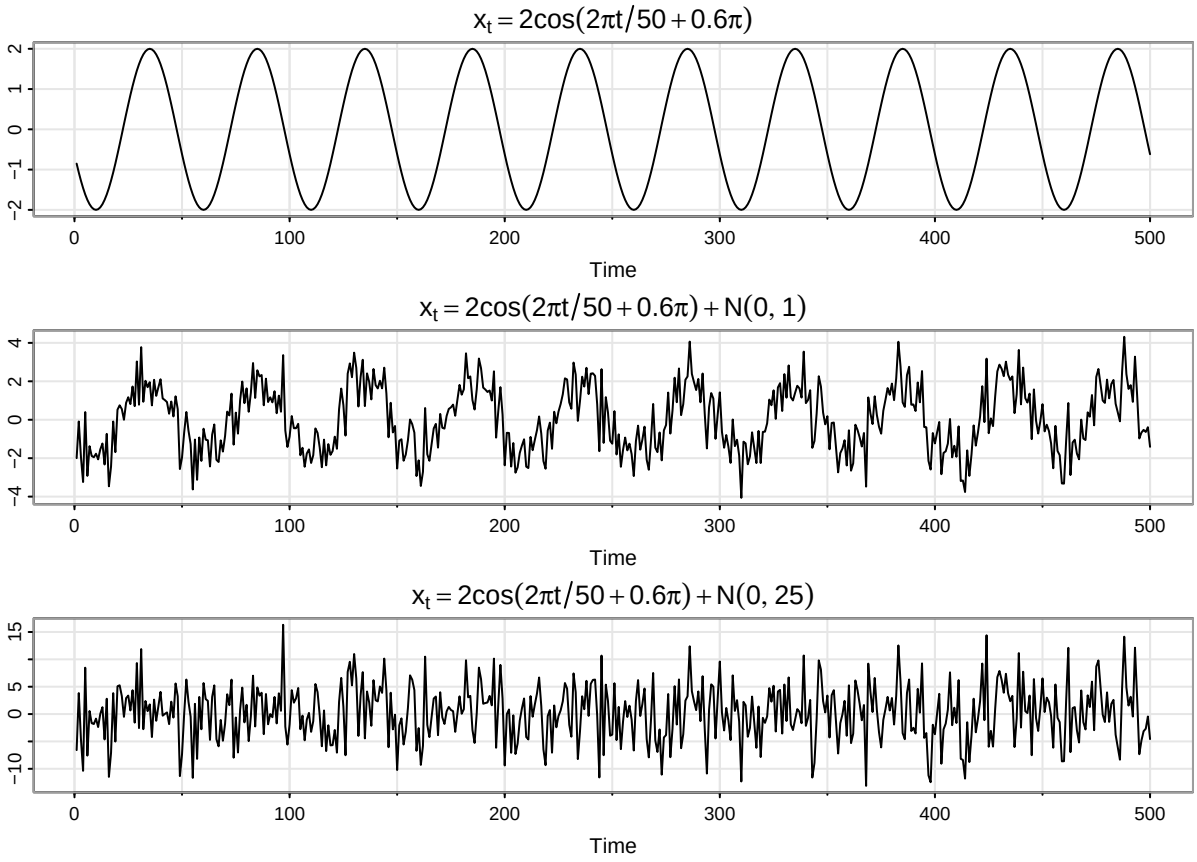

```
curve(1.5*sin(4*(x-.5)),xlim=c(0,4*pi),xaxt='n',
main=expression(y==1.5*sin(4*(x-.5))~"="~1.5*sin(4*x-2)),ylab="y")
axis(1,c(0,pi/2,pi,3*pi/2,2*pi,5*pi/2,3*pi,7*pi/2,4*pi),
c("0","pi/2","pi","3*pi/2","2*pi","5*pi/2","3*pi","7*pi/2","4*pi"))
curve(sin(x),add=TRUE,lty=2)
mtext("A=1.5, B=4, C=-0.5, D=0")
axis(1,1,"")
```




```
curve(tan(x),xlim=c(0,4*pi),xaxt='n',main=expression(y==tan(x)),ylab="y")
axis(1,c(0,pi/2,pi,3*pi/2,2*pi,5*pi/2,3*pi,7*pi/2,4*pi),
c("0","pi/2","pi","3*pi/2","2*pi","5*pi/2","3*pi","7*pi/2","4*pi"))
mtext(expression("Period "== pi))
```




```
# cs = 2*cos(2*pi*(1:500)/50 + .6*pi) # as in the text
cs = 2*cos(2*pi*(1:500+15)/50) # same thing
w = rnorm(500,0,1)
par(mfrow=c(3,1))
tsplot(cs, ylab="", main = expression(x[t]==2*cos(2*pi*t/50+.6*pi)))
tsplot(cs + w, ylab="", main = expression(x[t]==2*cos(2*pi*t/50+.6*pi)+N(0,1)))
tsplot(cs + 5*w, ylab="", main = expression(x[t]==2*cos(2*pi*t/50+.6*pi)+N(0,25)))
```


$x_t = 2\cos(2\pi t/50 + 0.6\pi)$
2
1
0
−1
−2
0
100
200
300
400
500
Time
$x_t = 2\cos(2\pi t/50 + 0.6\pi) + N(0, 1)$
4
2
0
−2
−4
0
100
200
300
400
500
Time
$x_t = 2\cos(2\pi t/50 + 0.6\pi) + N(0, 25)$
15
5
0
−10
0
100
200
300
400
500
Time