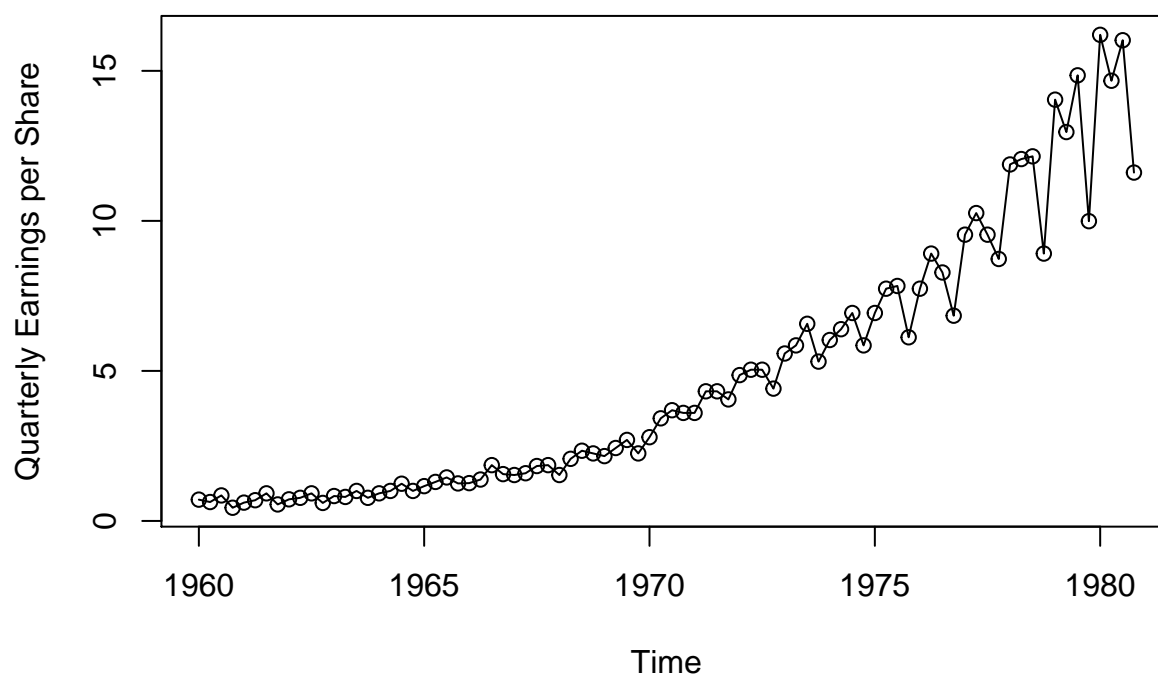# Chapter 1 Characteristisc of Time Series

Jieli Zhou

1/4/2018

```
# Install astsa package
# install.packages("devtools")
# devtools::install_github("nickpoison/astsa")
```
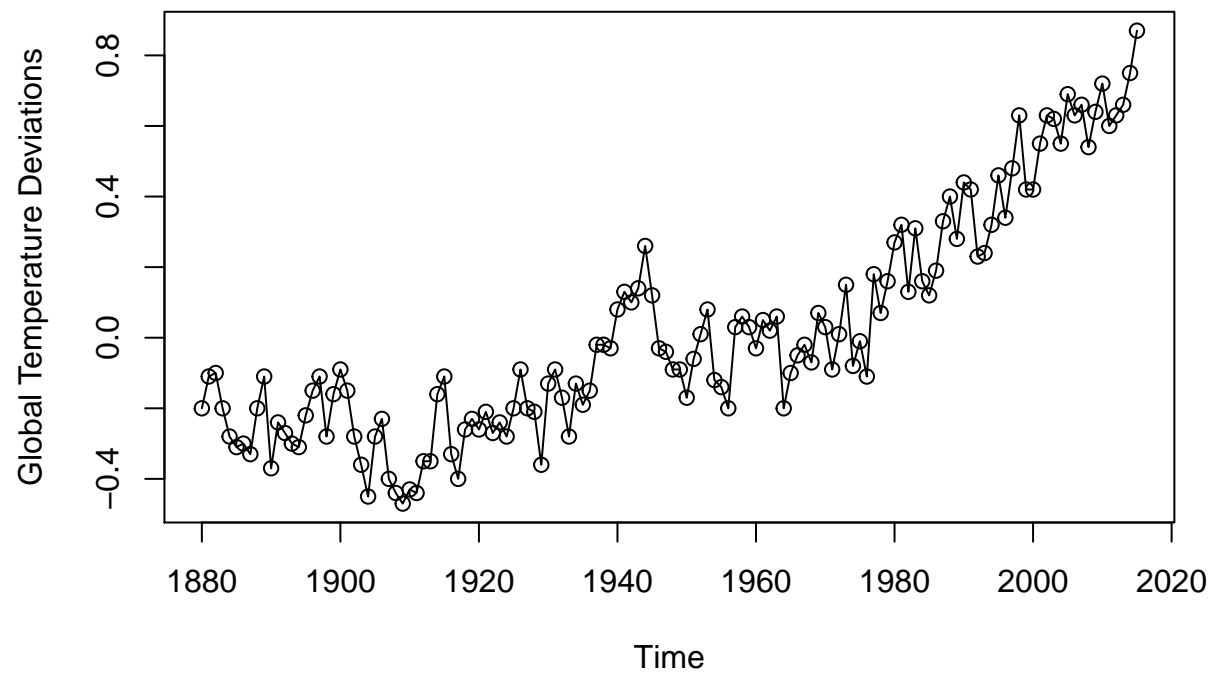
Johnson & Johnson Quarterly Earnings

```
library(astsa)
plot(jj, type="o", ylab="Quarterly Earnings per Share")
```
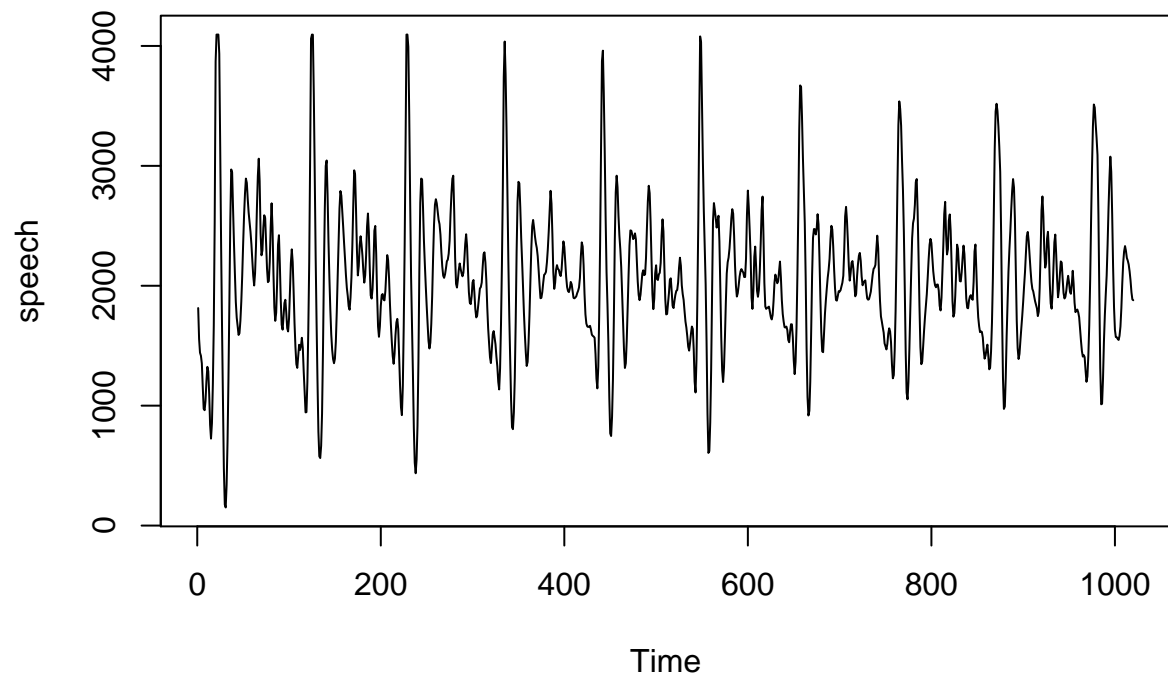

Global Warming

```
plot(globtemp, type="o", ylab="Global Temperature Deviations")
```
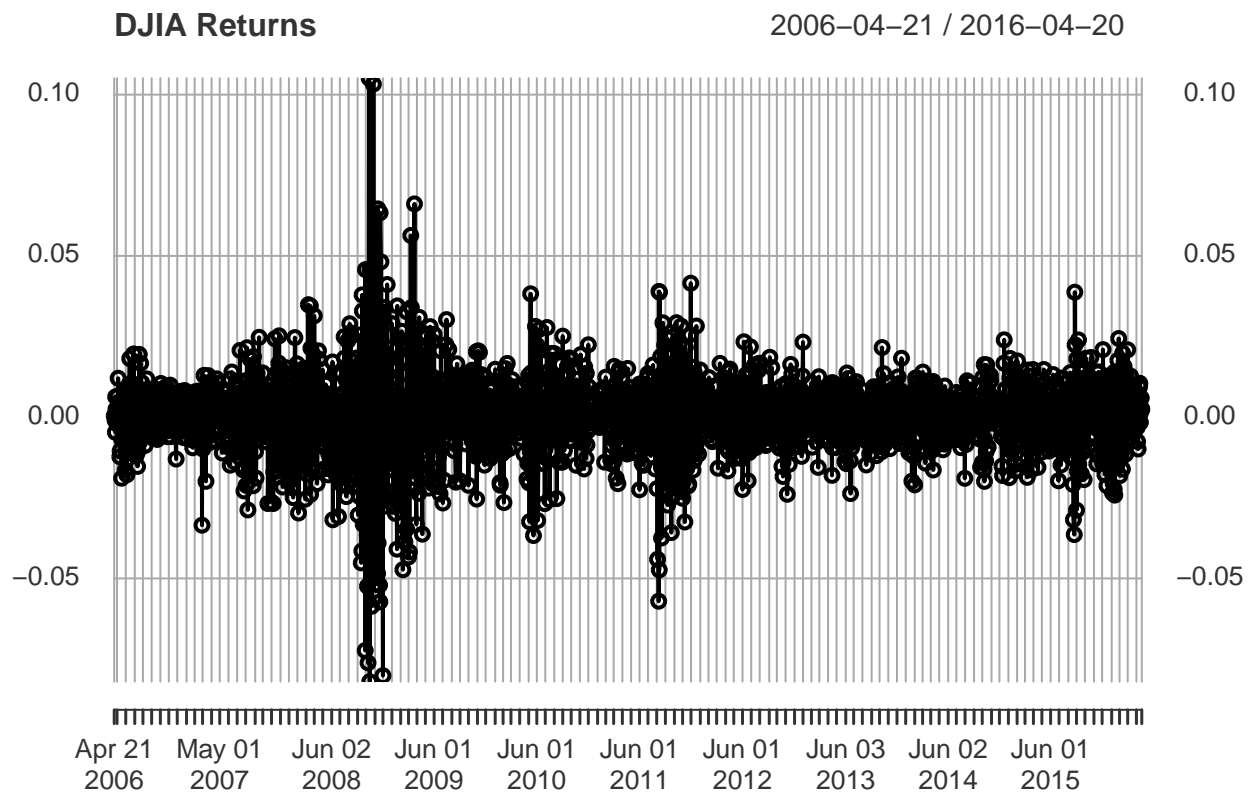
Speech Data

```r
plot(speech)
```

Dow Jones Industrial Average (2006-04-20 to 2016-04-20)

```r
library(xts)
```

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

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

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

```r
djiar = diff(log(djia$Close))[-1]
plot(djiar, main = "DJIA Returns", type = "o")
```


2017 DJIA (2017-01-01 to 2017-12-31)

```r
# install.packages("TTR");
library(TTR)
djia2017 = getYahooData("^DJI", start=20170101, end=20171231, freq="daily")
```

```
## Warning: TTR::getYahooData is deprecated and will be removed in a future release.
## Please use quantmod::getSymbols instead.
```

```r
# library(quantmod)
# djia2017 = getSymbols("^DJI", start=20170101, end=20171231, freq="daily")
```
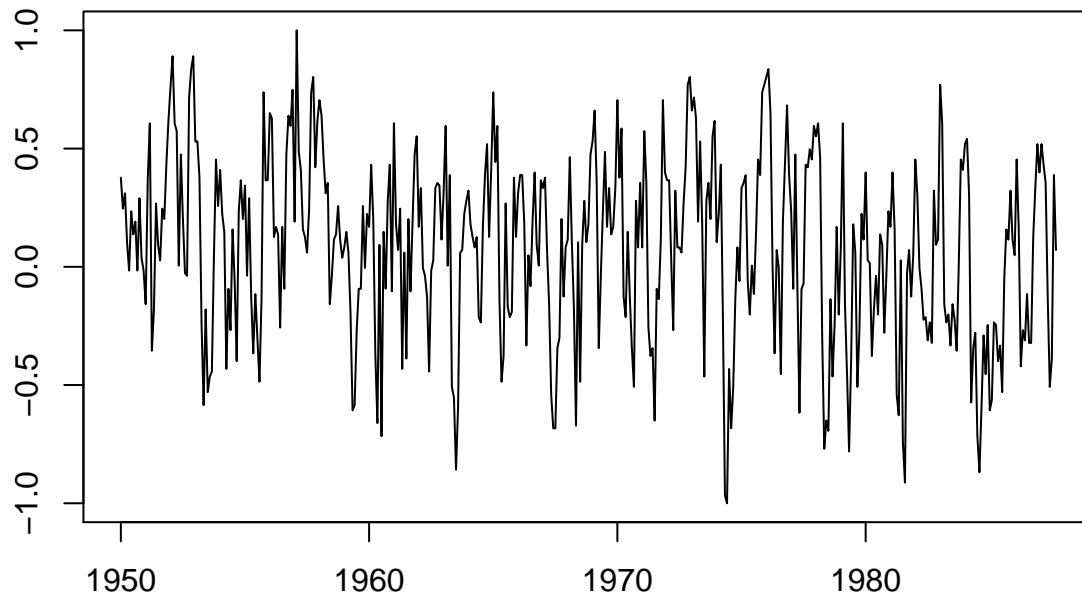
```
djiar2017 = diff(log(djia2017$Close))[-1]
plot(djiar2017, main = "DJIA Returns in 2017", type="o")
```

DJIA Returns in 2017   2017−01−04 / 2017−12−29
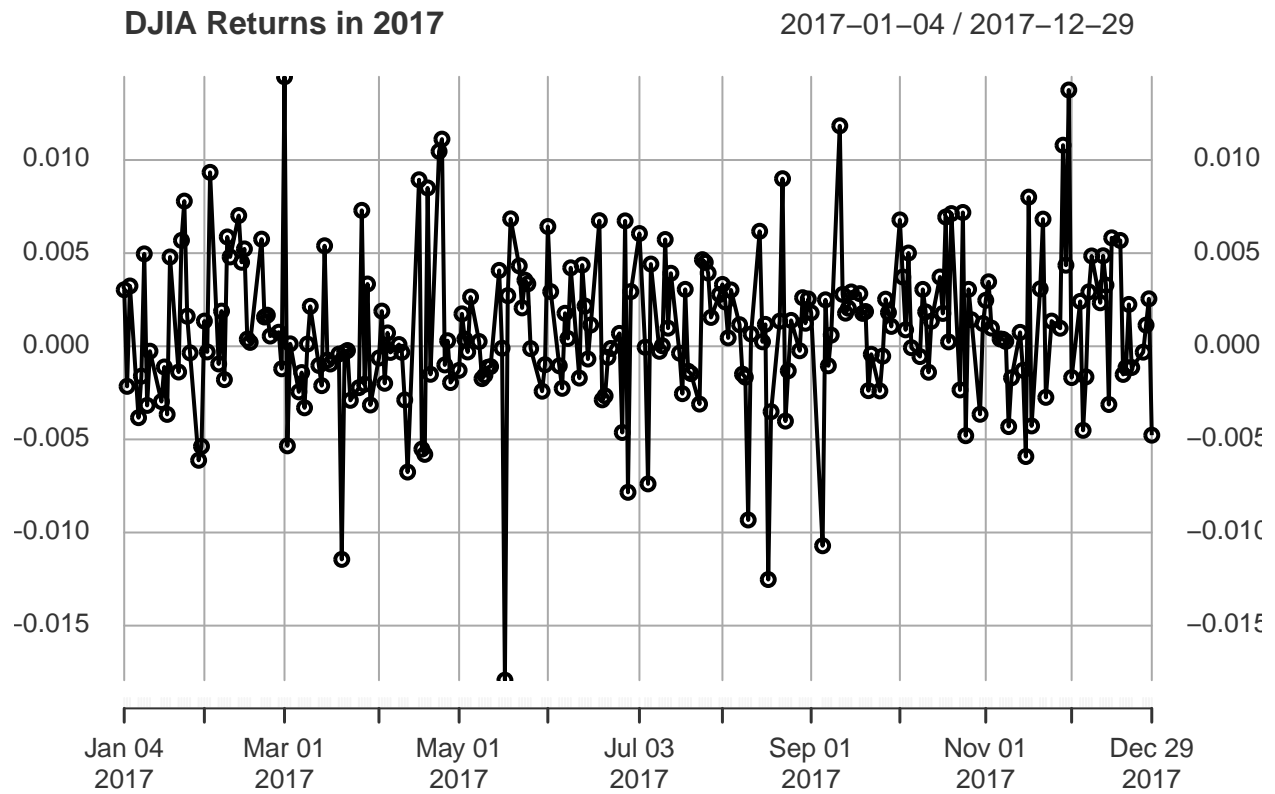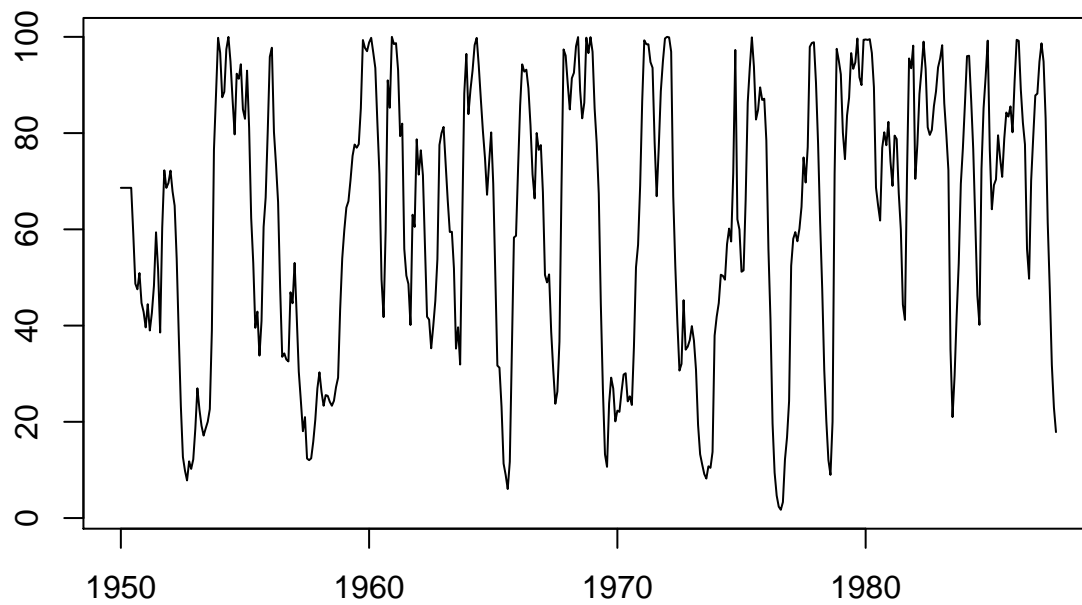

EI Nino and Fish Population

```
plot(soi, ylab = "", xlab = "", main="Southern Oscillation Index")
```

Southern Oscillation Index


```
plot(rec, ylab = "", xlab = "", main="Recruitment")
```
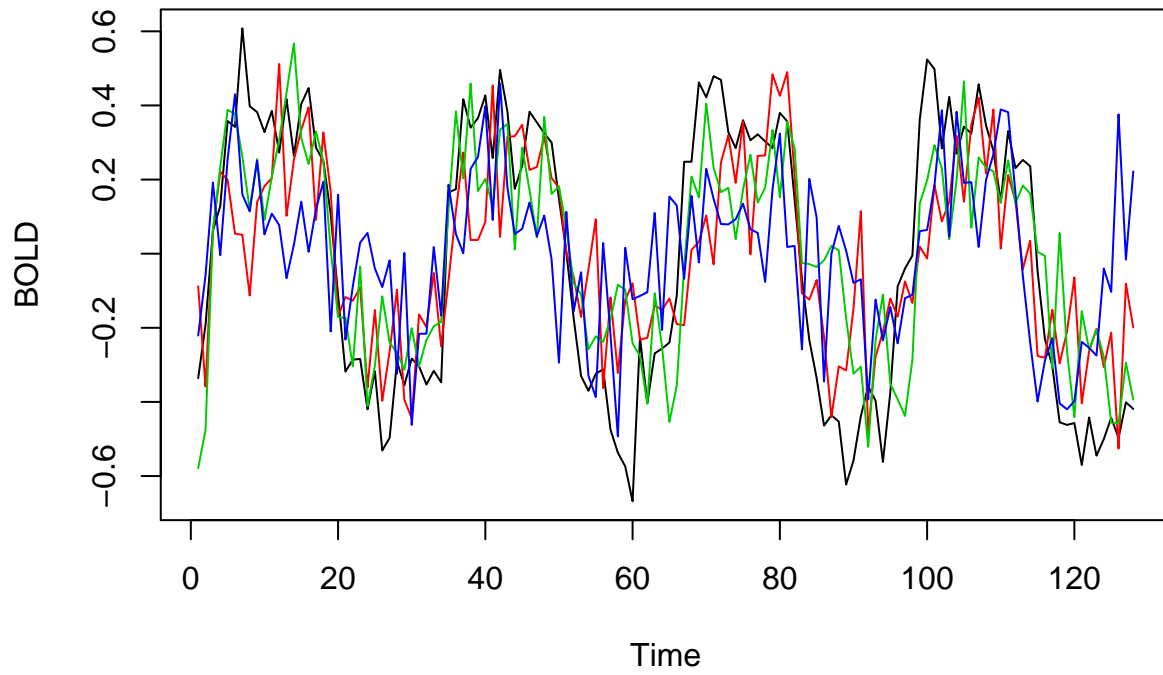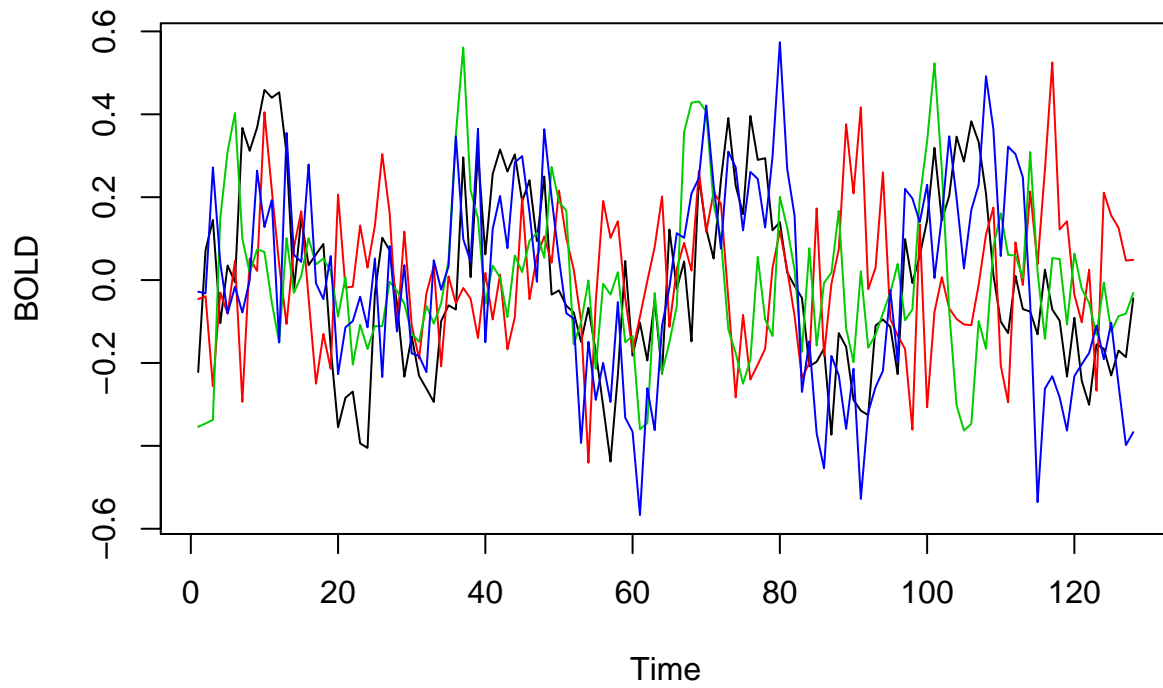
Recruitment

fMRI Imaging

```
ts.plot(fmri1[,2:5], col=1:4, ylab = "BOLD", main="Cortex")
```
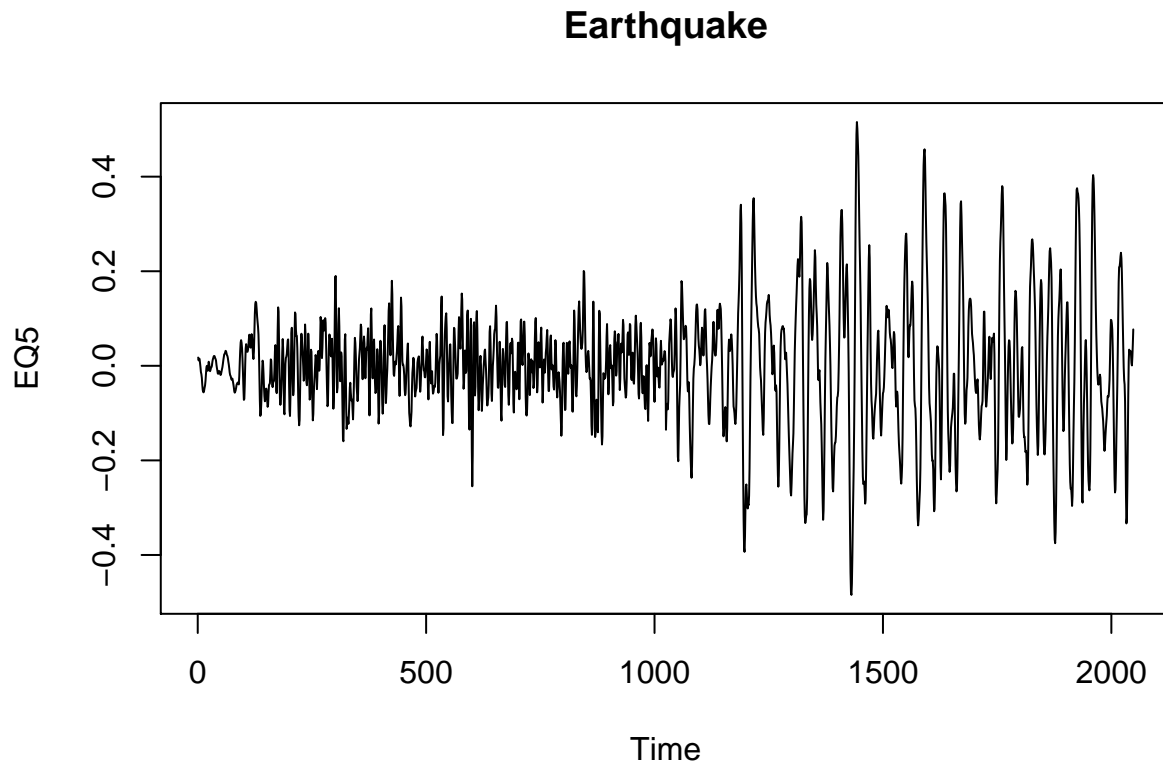
Cortex


```
ts.plot(fmri1[,6:9], col=1:4, ylab = "BOLD", main="Thalamus & Cerebellum")
```
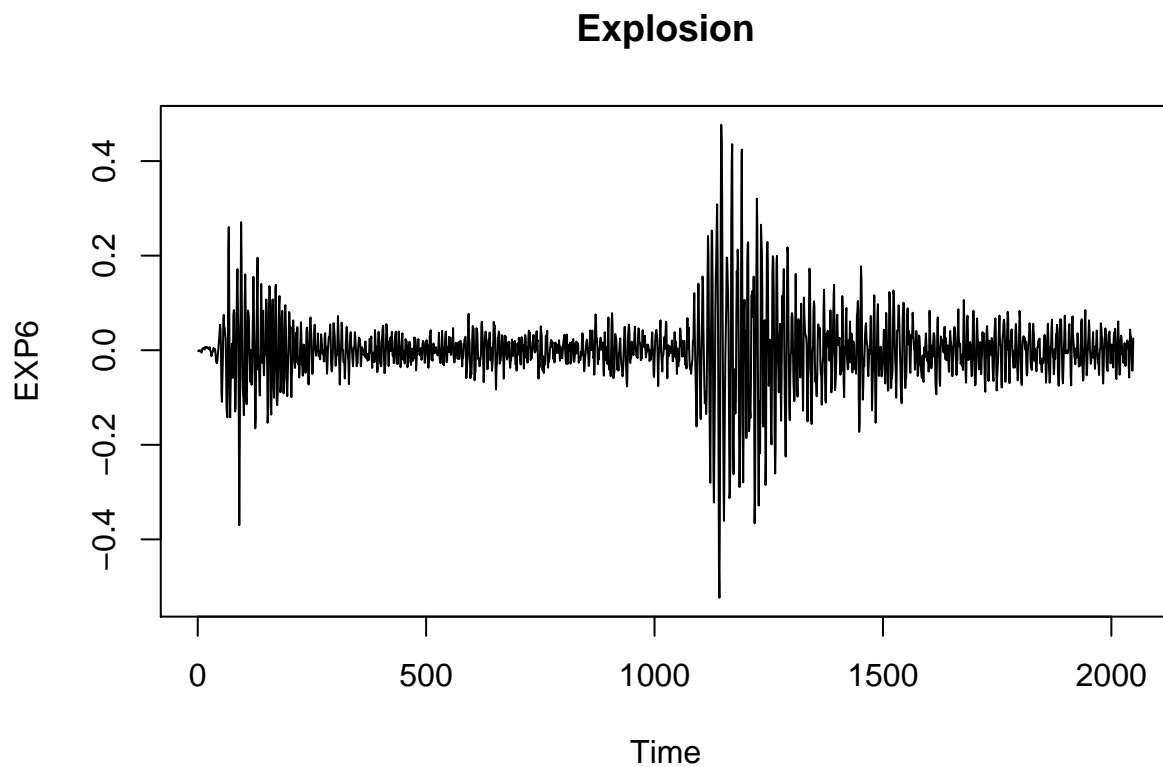
Thalamus & Cerebellum

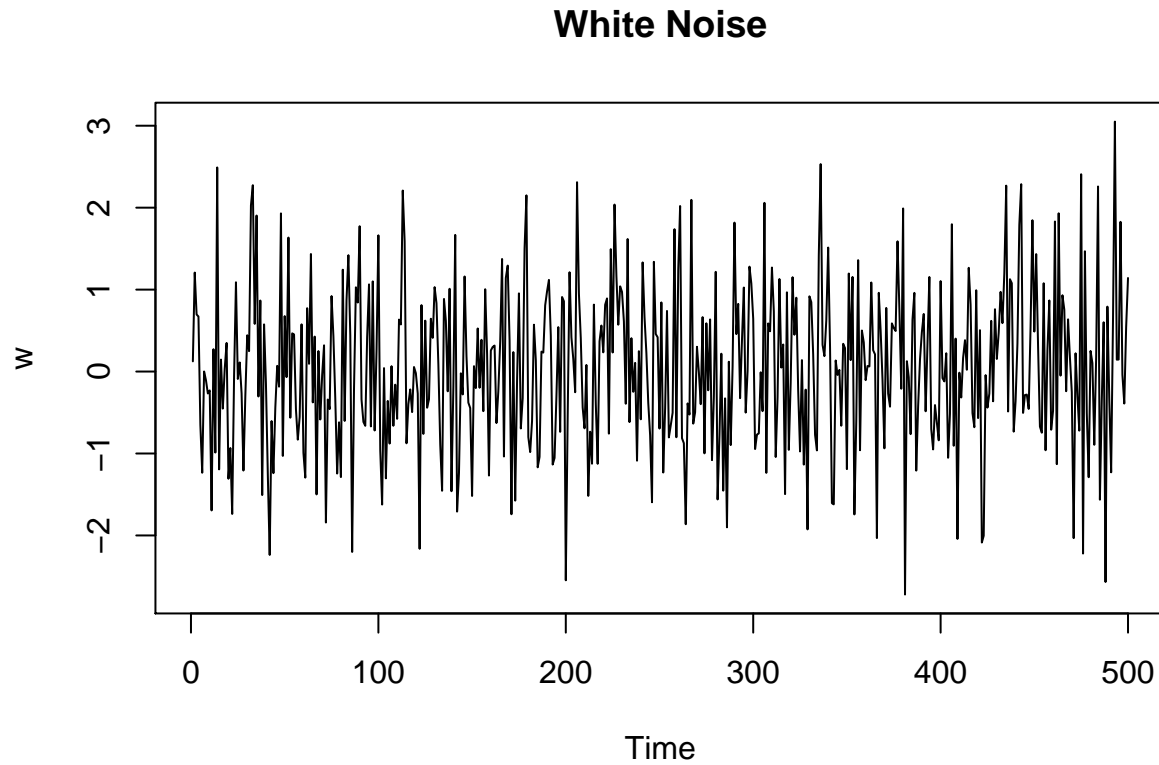# Earthquakes and Explosions

```r
plot(EQ5, main = "Earthquake")
```

Earthquake


```r
plot(EXP6, main = "Explosion")
```

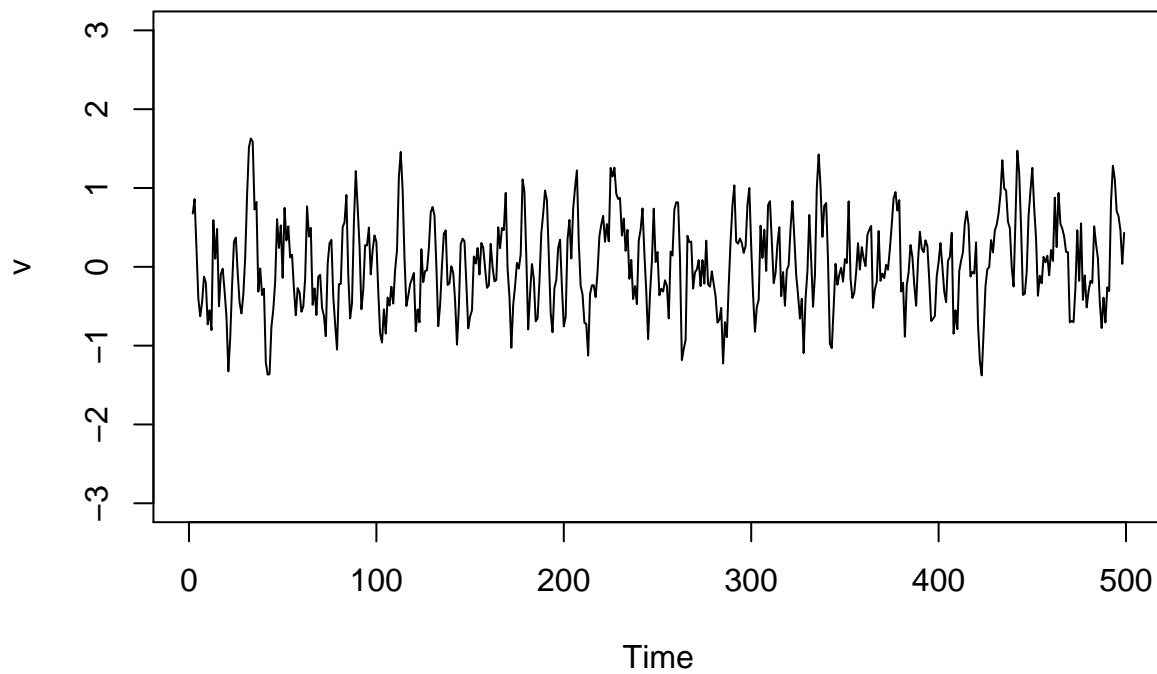## Explosion

White Noise, Moving Average, and Filter

```
w = rnorm(500, 0, 1)
v = filter(w, sides = 2, filter = rep(1/3, 3))
plot.ts(w, main = "White Noise")
```

White Noise


```
plot.ts(v, ylim = c(-3, 3), main = "Moving Average")
```
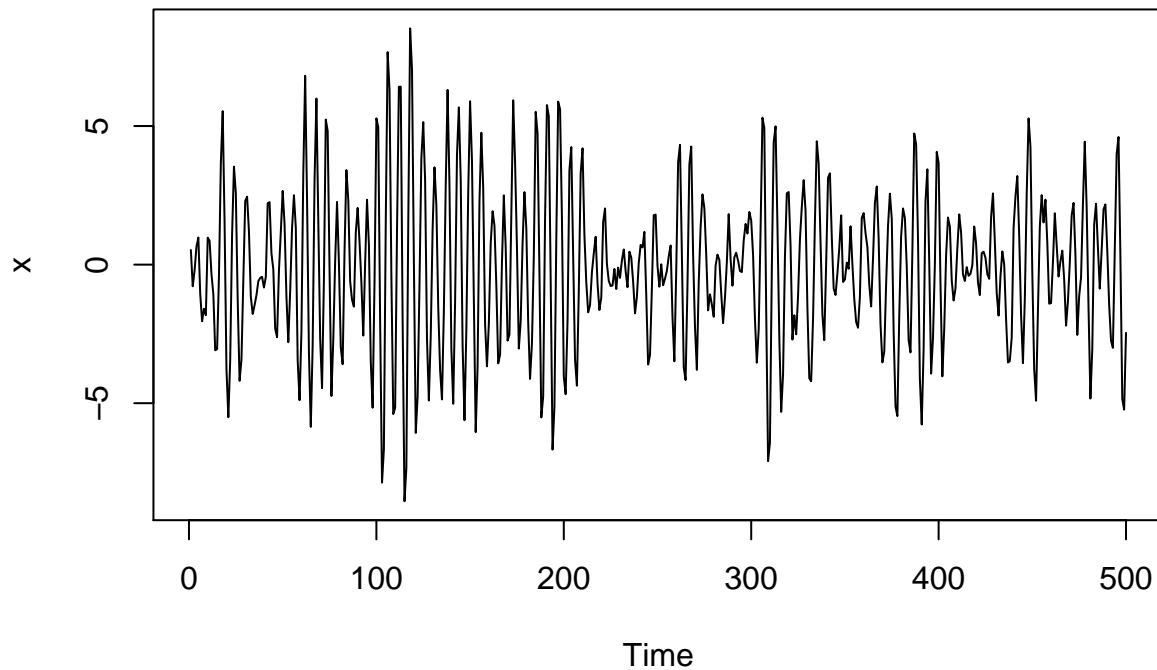
Moving Average

Autoregression

```r
w = rnorm(550,0,1) # 50 extra to avoid startup problems
x = filter(w, filter=c(1,-.9), method="recursive")[-(1:50)] # remove first 50
plot.ts(x, main="autoregression")
```

autoregression

Time

Random Walk with Drift

```
set.seed(154)
w = rnorm(200)
x = cumsum(w)
wd = w + .2
xd = cumsum(wd)
plot.ts(xd, ylim=c(-5, 55), main = "Random Walk", ylab = "")
lines(x, col = 4);
abline(h = 0, col = 4, lty = 2)
abline(a = 0, b = .2, lty = 2)
```

Random Walk

Time