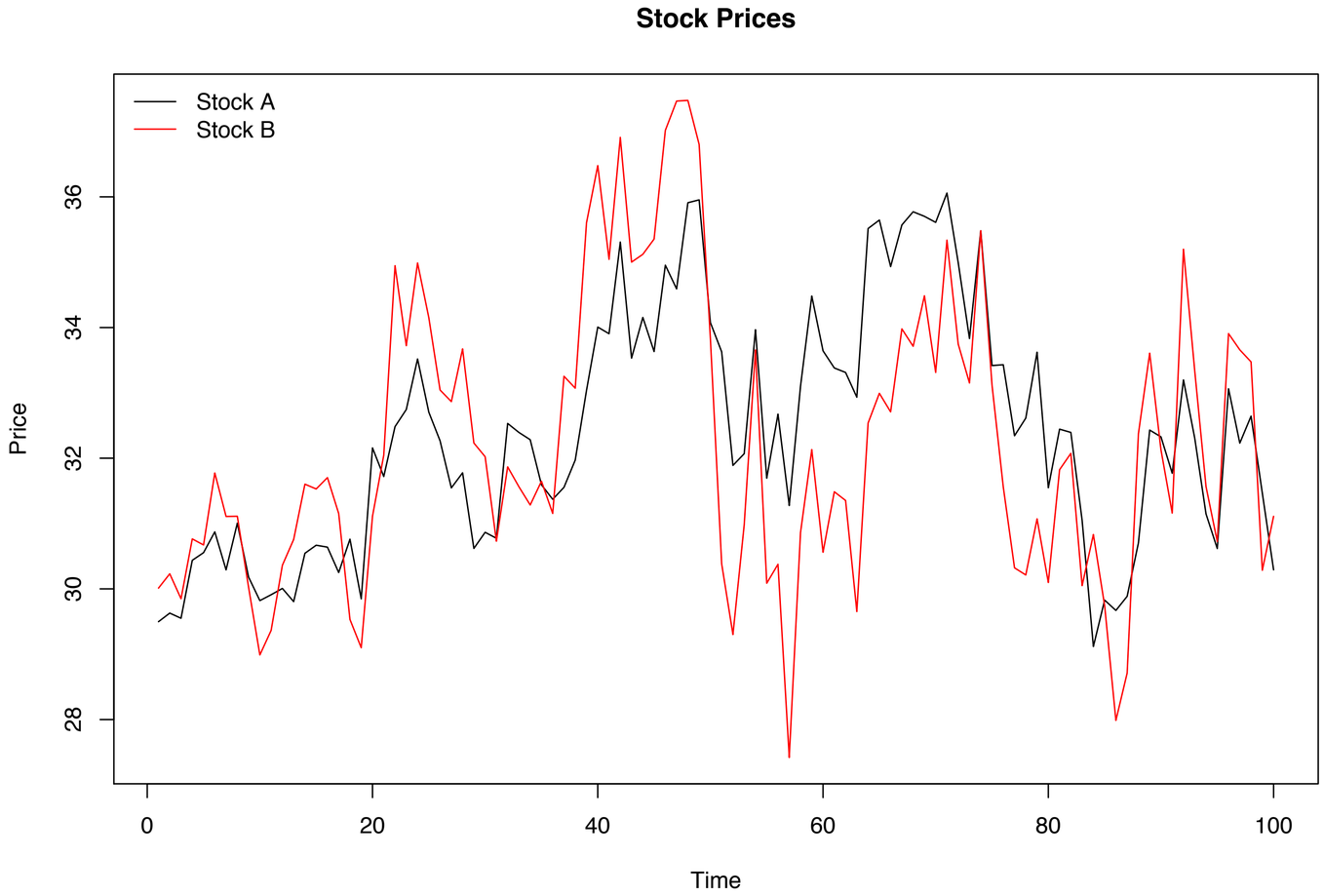
INTRODUCTION TO TIME SERIES ANALYSIS

Scatterplots

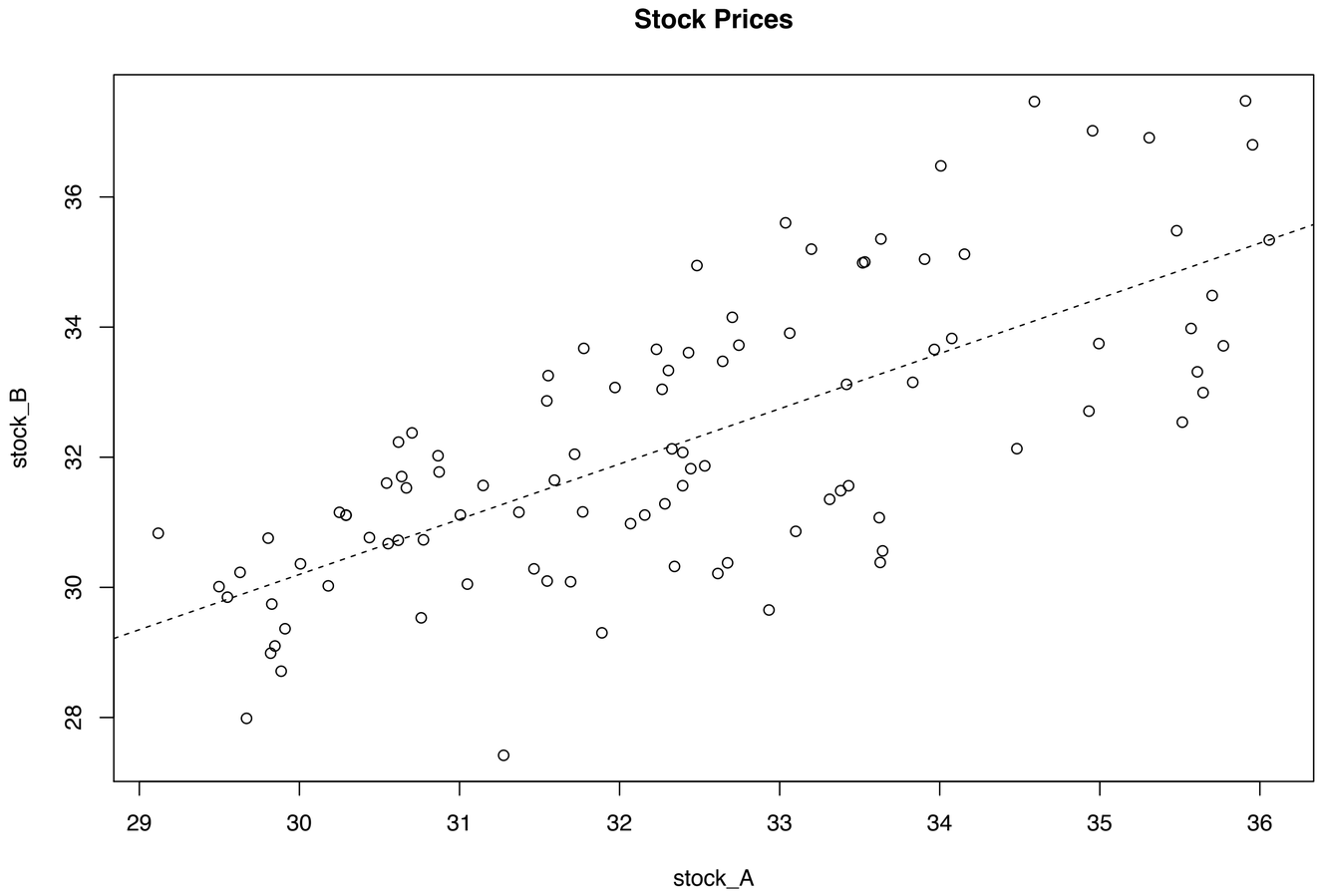
Stock Prices: Stock A and B over time

```
> ts.plot(cbind(stock_A, stock_B))
```



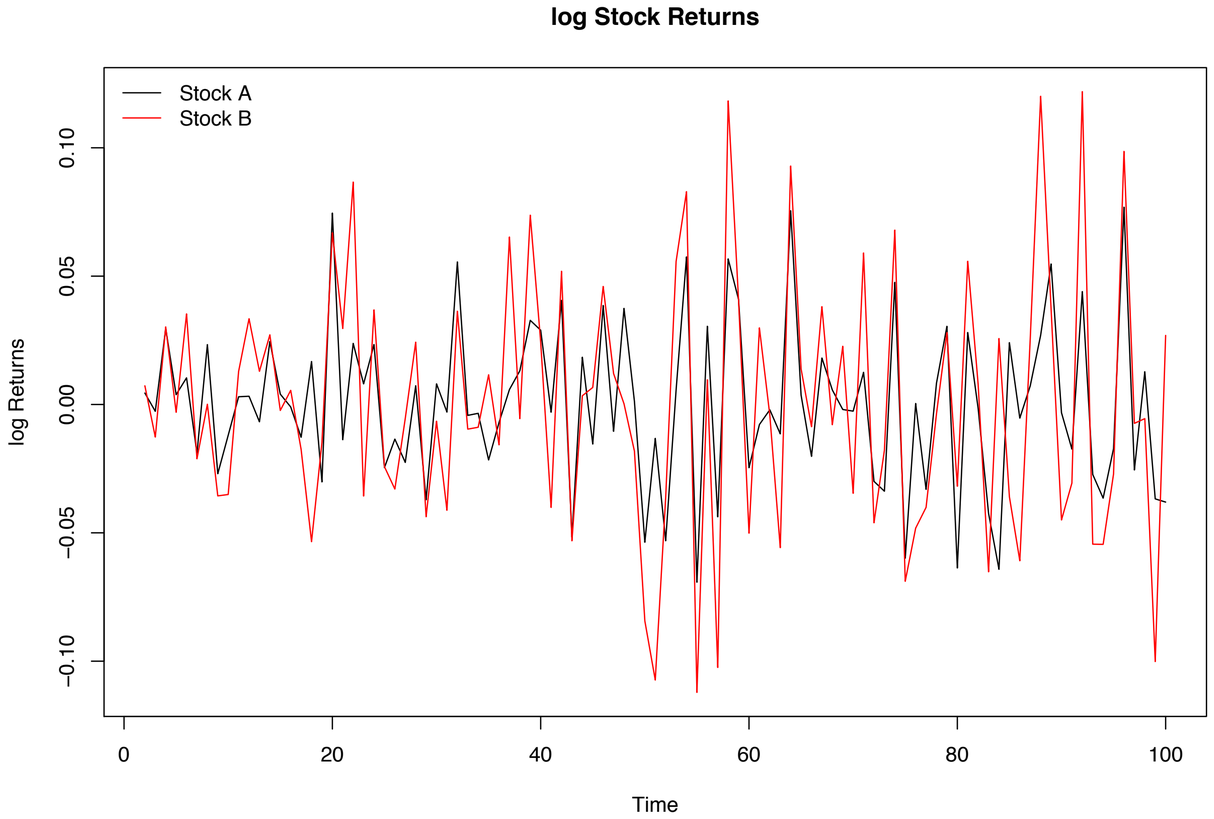
Stock Prices: Scatterplot of Stock B vs. A

```
> plot(stock_A, stock_B)
```



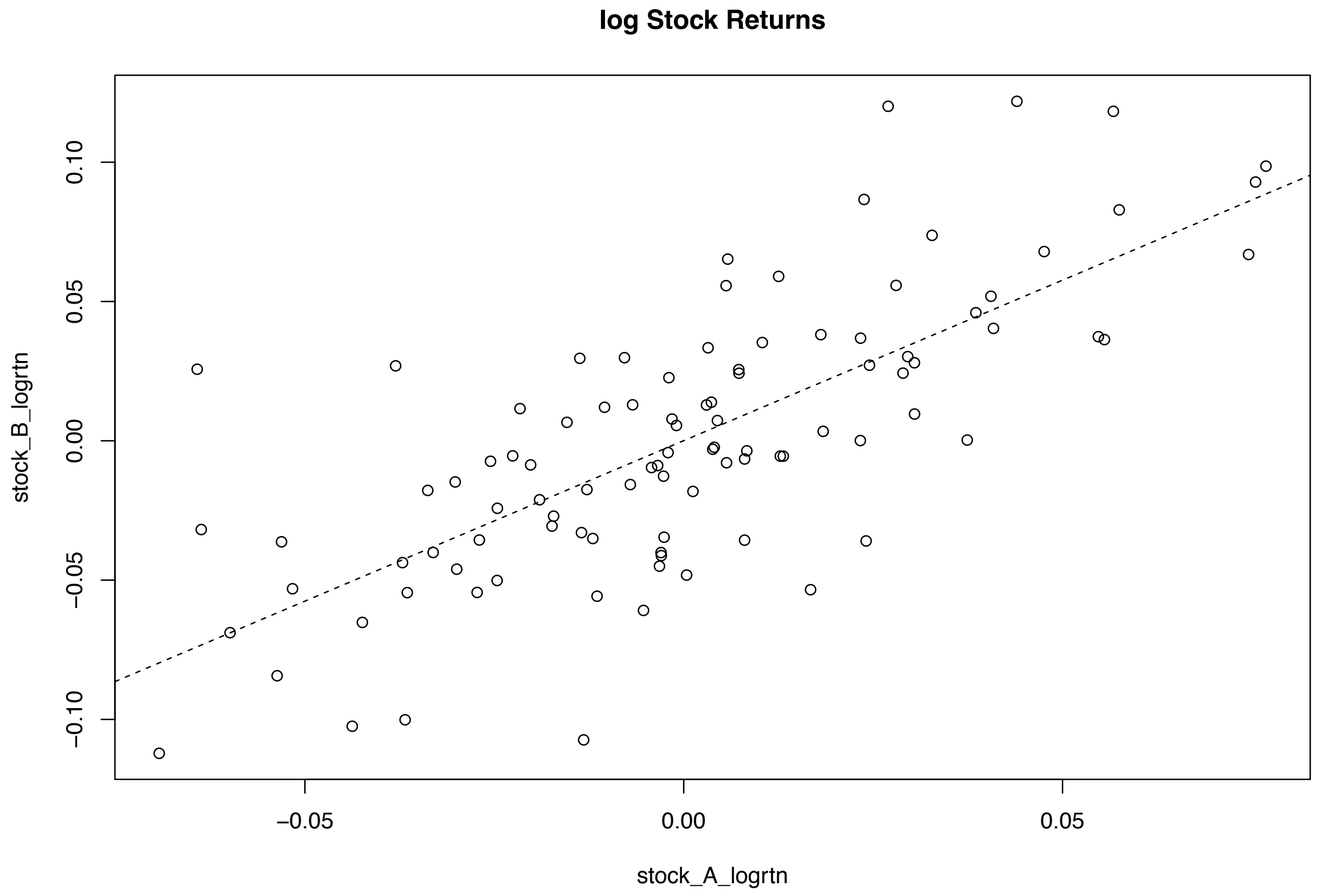
Log returns for Stock A and B

```
> stock_A_logreturn = diff(log(stock_A))
> stock_B_logreturn = diff(log(stock_B))
> ts.plot(cbind(stock_A_logreturn, stock_B_logreturn))
```



Scatterplot of Stock B vs A Log Returns

```
> plot(stock_A_logreturn, stock_B_logreturn)
```



INTRODUCTION TO TIME SERIES ANALYSIS

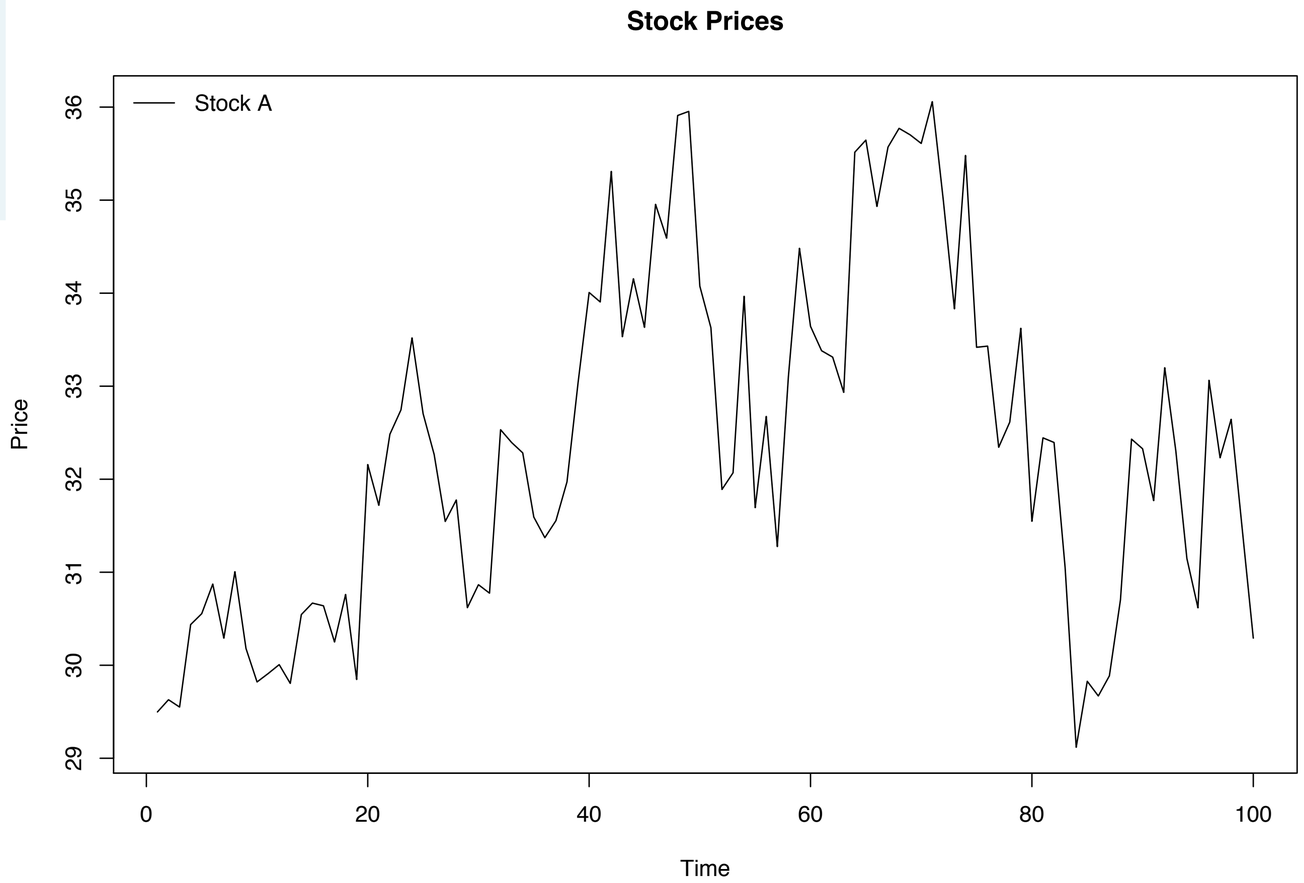
Let’s practice!

INTRODUCTION TO TIME SERIES ANALYSIS

Covariance and Correlation

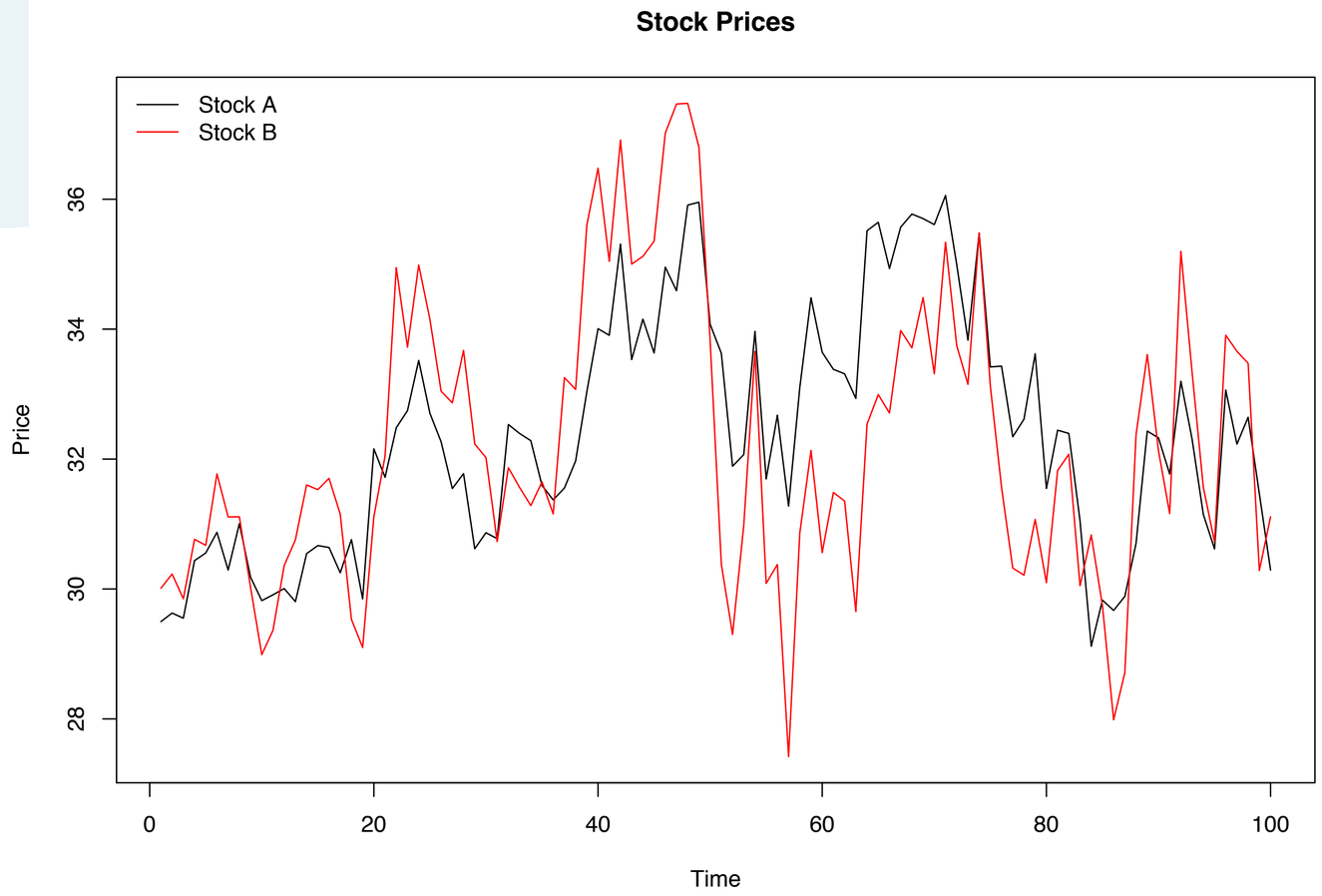
Stock Prices for stock A

```
> mean(stock_A)
[1] 32.36
> sd(stock_A)
[1] 1.83
```



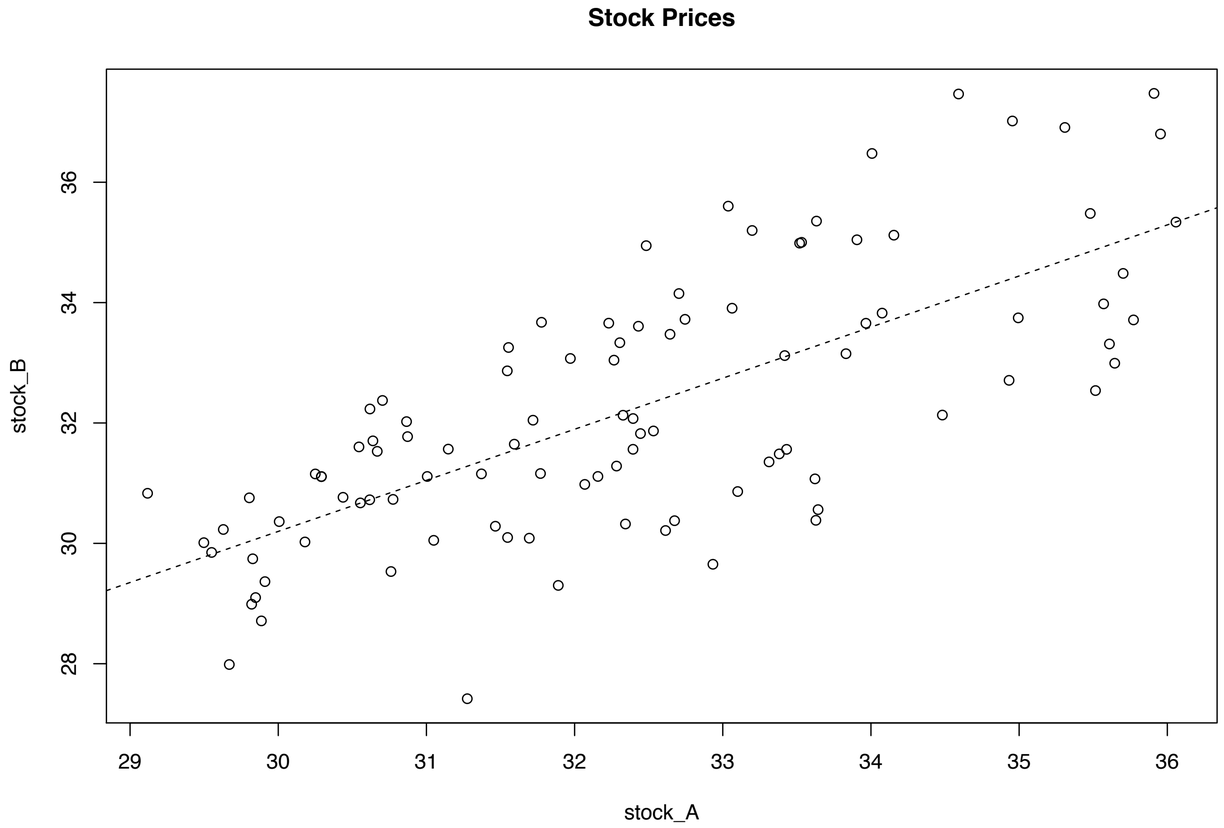
Stock Prices for Stock B

```
> mean(stock_B)
[1] 32.30
> sd(stock_B)
[1] 2.17
```



Covariance of Stock A and B

```
> cov(stock_A, stock_B)
[1] 2.86
```

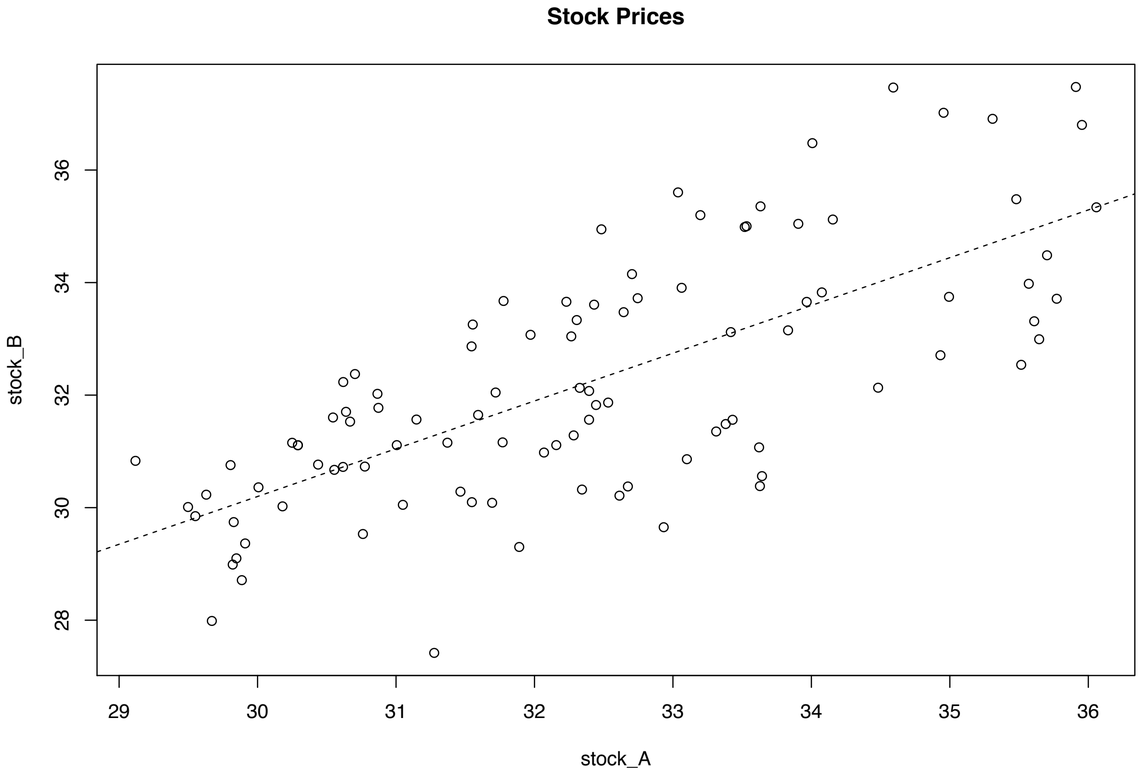


Correlations

- Standardized version of covariance
- **+1**: perfectly positive linear relationship
- **-1**: perfectly negative linear relationship
- **0**: no linear association

Correlation of Stock A and B

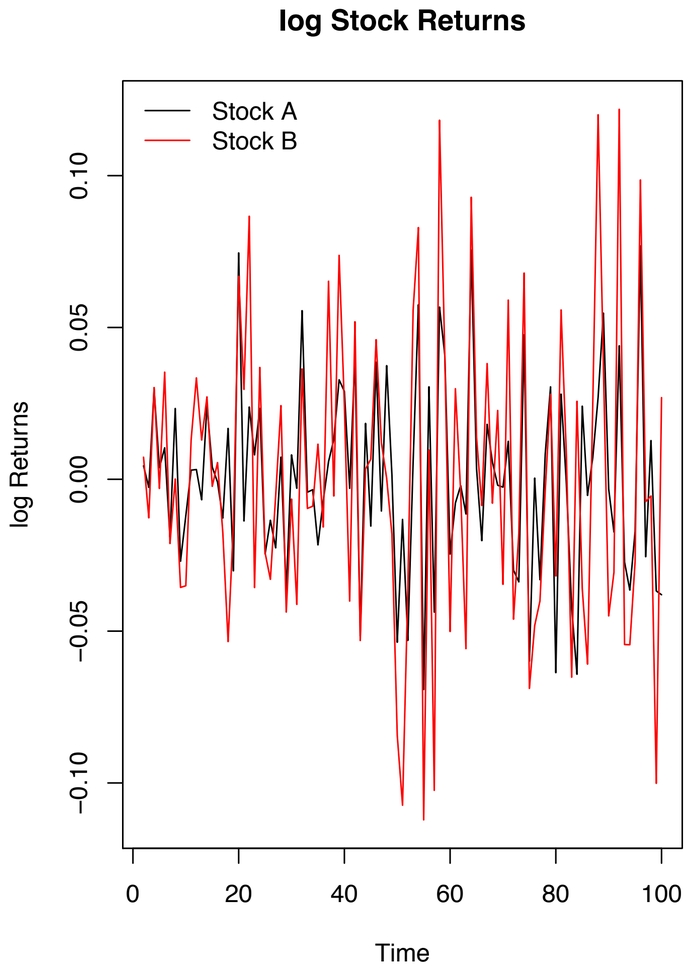
```
> cor(stock_A, stock_B)
[1] 0.71
> cov(stock_A, stock_B) / (sd(stock_A) * sd(stock_B))
[1] 0.71
```

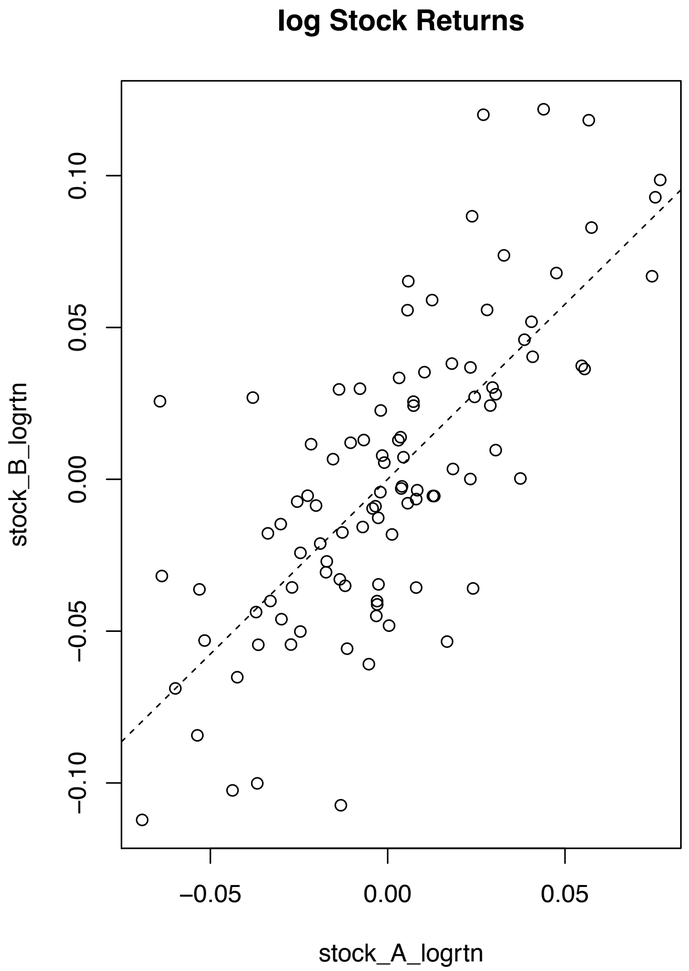


Covariance and Correlation: log returns

```
> cov(stock_A_logreturn, stock_B_logreturn)
[1] 0.001
> cor(stock_A_logreturn, stock_B_logreturn)
[1] 0.74
```

Covariance and Correlation: log returns





INTRODUCTION TO TIME SERIES ANALYSIS

Let’s practice!

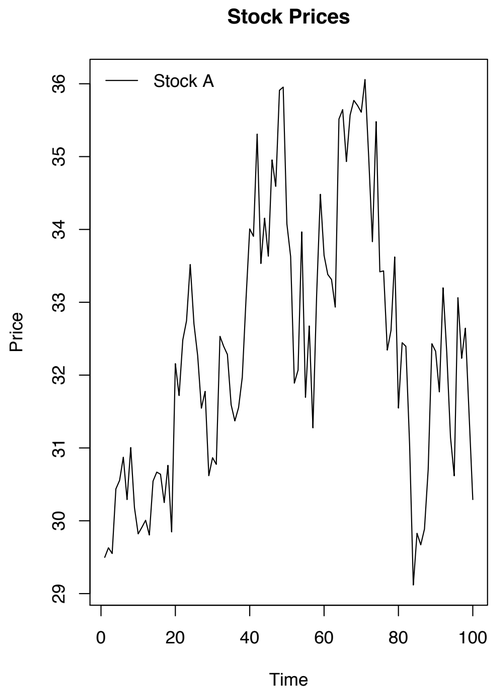
INTRODUCTION TO TIME SERIES ANALYSIS

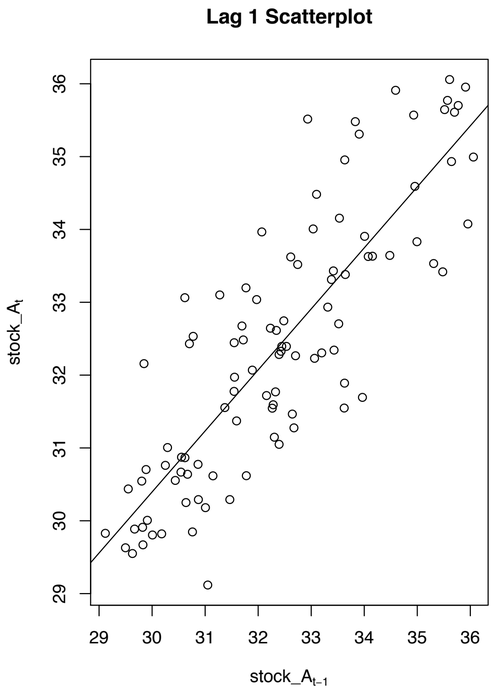
Autocorrelation

Autocorrelation - I

```
# Lag 1 Autocorrelation:
# Correlation of Stock A “today” and stock A “yesterday”

> cor(stock_A[-100],stock_A[-1])
[1] 0.84
```

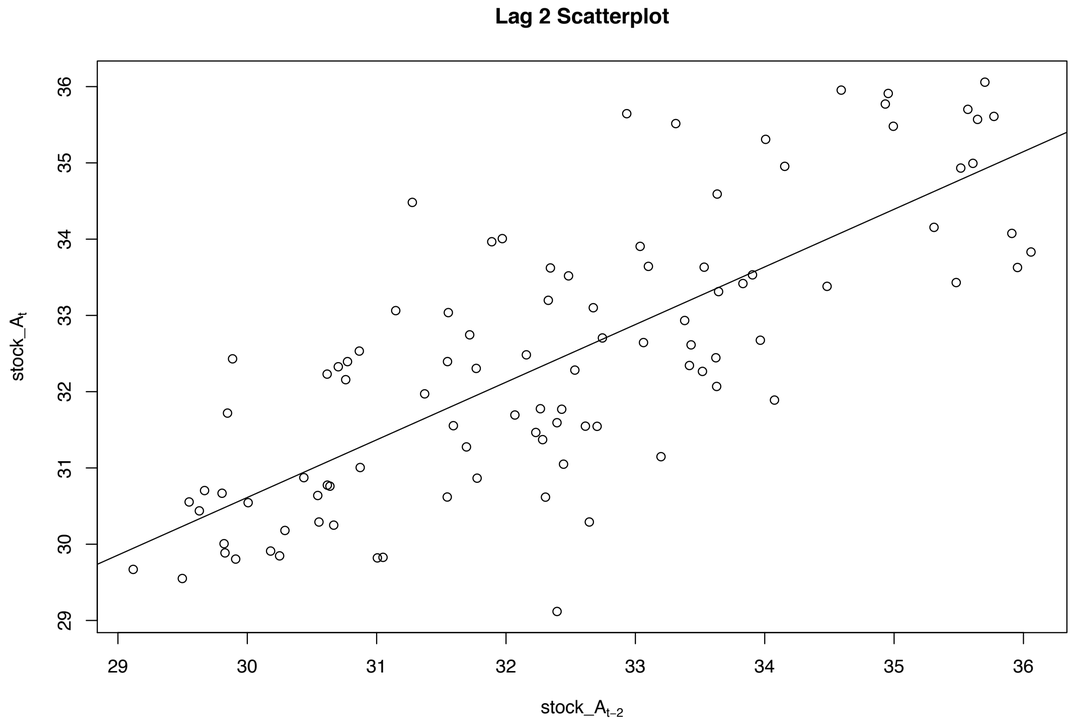




Autocorrelation - II

```
# Lag 2 Autocorrelation:
# Correlation of Stock A “today” and stock A “Two Days Earlier”

> cor(stock_A[-(99:100)],stock_A[-(1:2)])
[1] 0.76
```



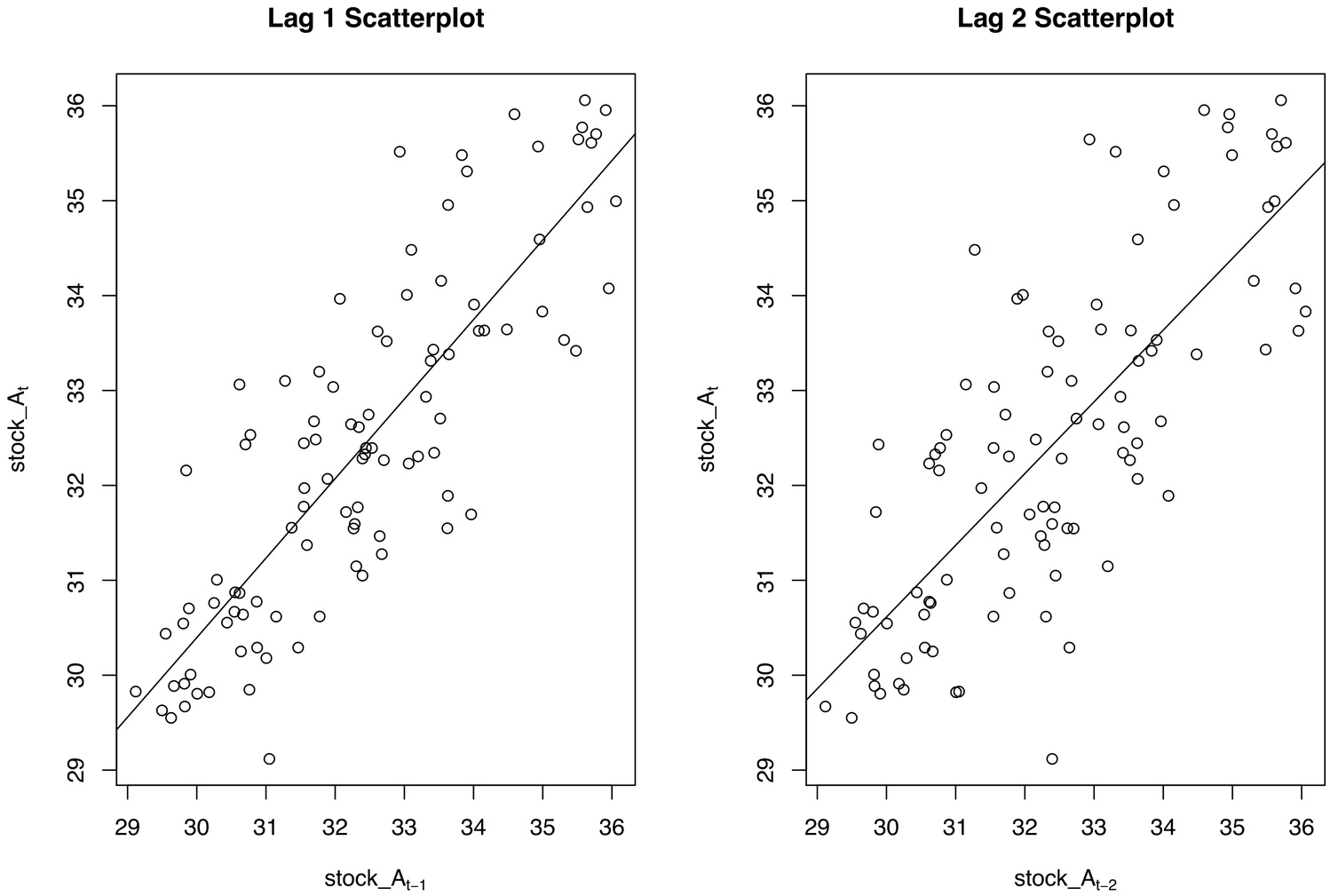
Autocorrelations at lag 1 and 2 - I

```
> cor(stock_A[-100],stock_A[-1])
[1] 0.84

> cor(stock_A[-(99:100)],stock_A[-(1:2)])
[1] 0.76

> acf(stock_A, lag.max = 2, plot = FALSE)
Autocorrelations of series ‘stock_A’, by lag
  1    2
0.84  0.76
```

Autocorrelations at lag 1 and 2 - II



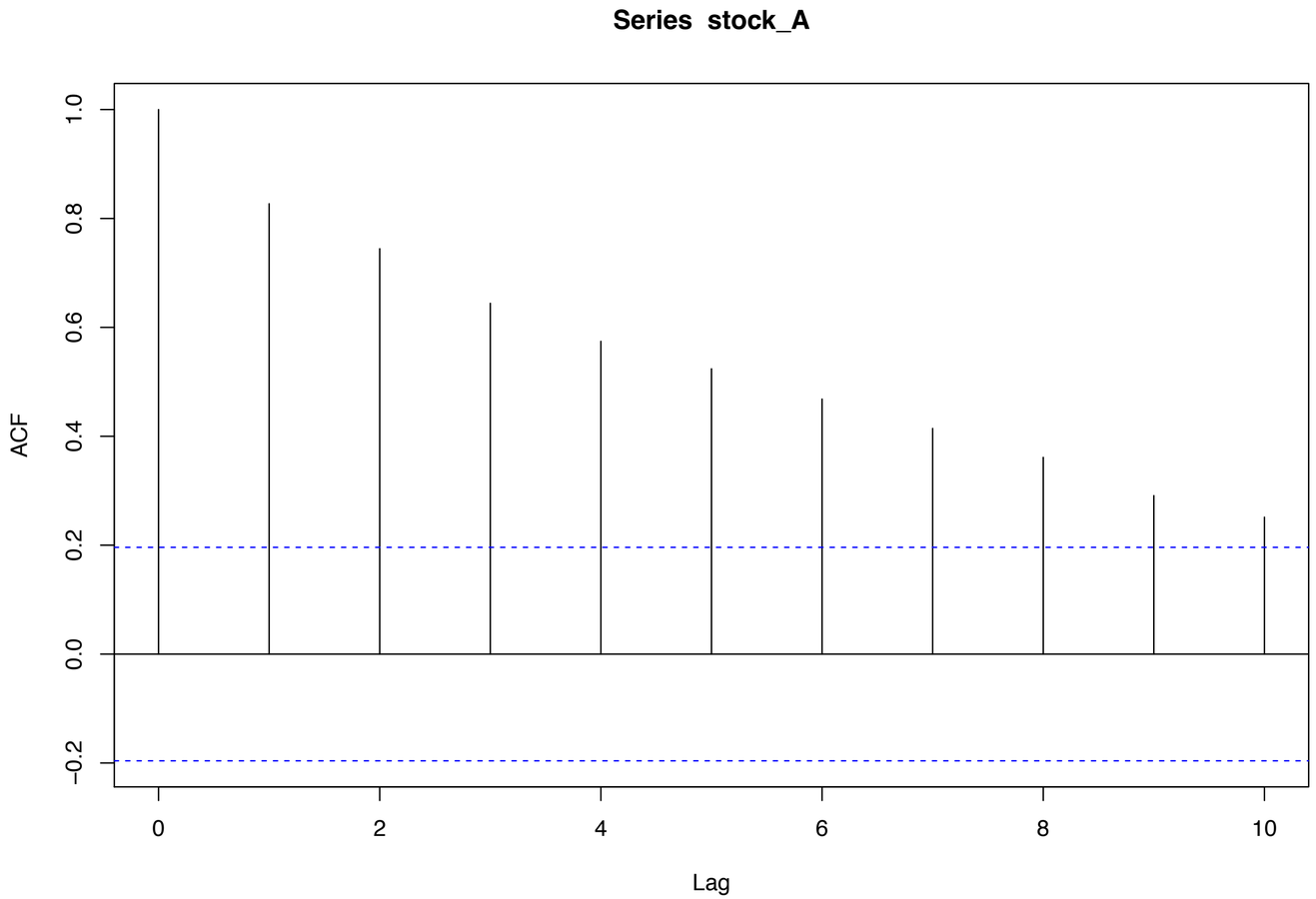
The Autocorrelation Function - I

```
# Autocorrelation by lag: “The Autocorrelation Function” (ACF)

> acf(stock_A, plot = FALSE)
Autocorrelations of series ‘stock_A’, by lag
  1     2     3     4     5     6     7     8     9    10
0.84  0.76  0.64  0.57  0.52  0.46  0.41  0.36  0.29  0.25
```

The Autocorrelation Function - II

```
> acf(stock_A, plot = TRUE)
```



INTRODUCTION TO TIME SERIES ANALYSIS

Let’s practice!