

R Code for Lecture 8

```
library(ggplot2)
library(TSA)
library(vars)
library(readr)
library(dplyr)
```

1. Daily Data of S&P 500, S&P 400 (MidCap) and S&P 600 (SmallCap)

```
# setwd("/Users/ouyangfu/Dropbox/Teaching/financial econometrics/2018/data")
setwd("C:/Users/dell/Dropbox/Teaching/financial econometrics/2018/data")
rm(list = ls())

data.prepare <- function(data.name) {
  data <- read_csv(data.name, col_names = T, na = "null") %>%
    rename(index = `Adj Close`) %>%
    mutate(lindex = lag(index, n = 1L), ret = (index-lindex)/lindex) %>%
    select(Date, ret, index)

  if (data.name == "sp500day.csv") {
    data$Date <- as.Date(strptime(as.character(data$Date), "%m/%d/%Y"))
  } else {
    data$Date <- as.Date(strptime(as.character(data$Date), "%Y-%m-%d"))
  }

  data <- arrange(data, Date)
  data <- filter(data, (Date >= as.Date("2011-01-01")) & (Date <= as.Date("2014-12-31")))
}

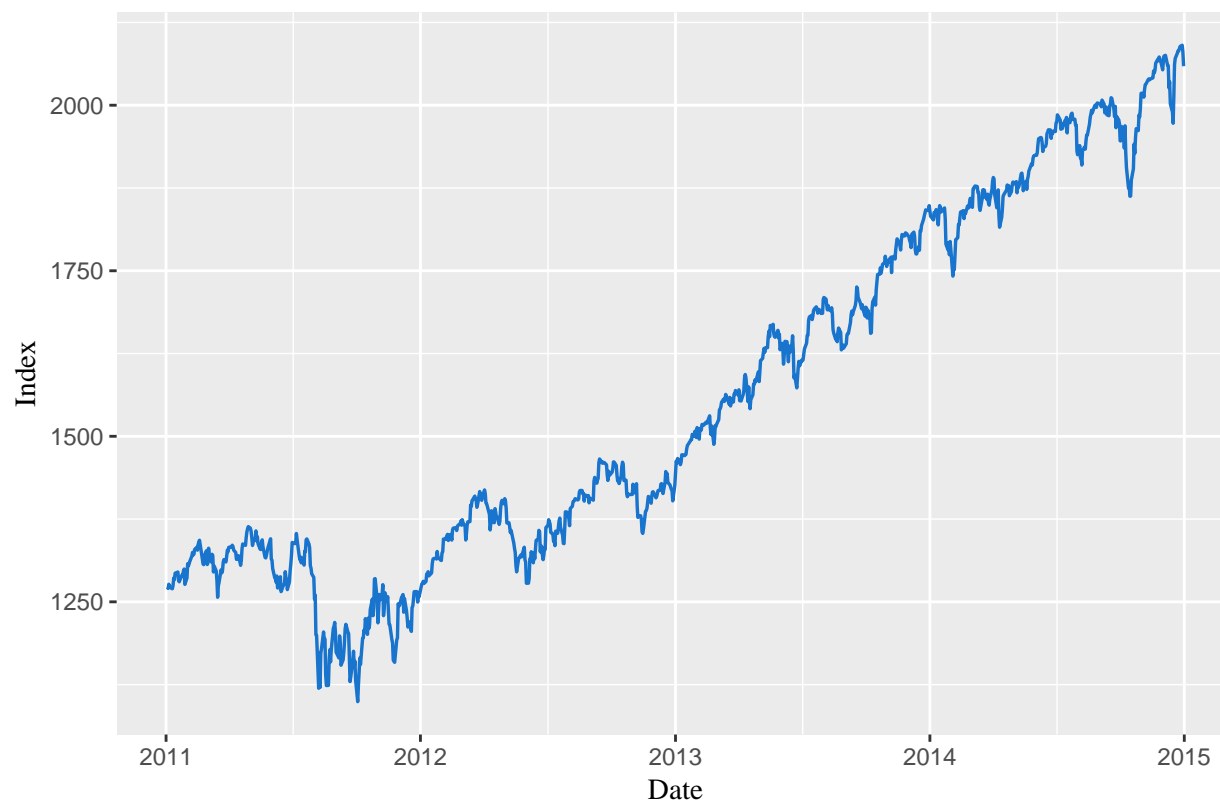
sp500 <- data.prepare("sp500day.csv"); sp500 <- rename(sp500, R_LC = ret)
sp400 <- data.prepare("sp400day.csv"); sp400 <- rename(sp400, R_MC = ret)
sp600 <- data.prepare("sp600day.csv"); sp600 <- rename(sp600, R_SC = ret)
```

2. Time Series of Daily Returns of S&P 500, S&P 400 (MidCap) and S&P 600 (SmallCap)

2.1 S&P 500

```
fig11 <- ggplot(sp500, aes(Date)) +
  geom_line(aes(y = index), size = 0.6, color = "dodgerblue3") +
  labs(title = "Time Series of Daily Returns of S&P 500 Index (2011-2015)",
       x = "Date", y = "Index") +
  theme(axis.title = element_text(family = "serif"),
        plot.title = element_text(hjust = 0.5, family = "serif", face = "bold"))
fig11
```

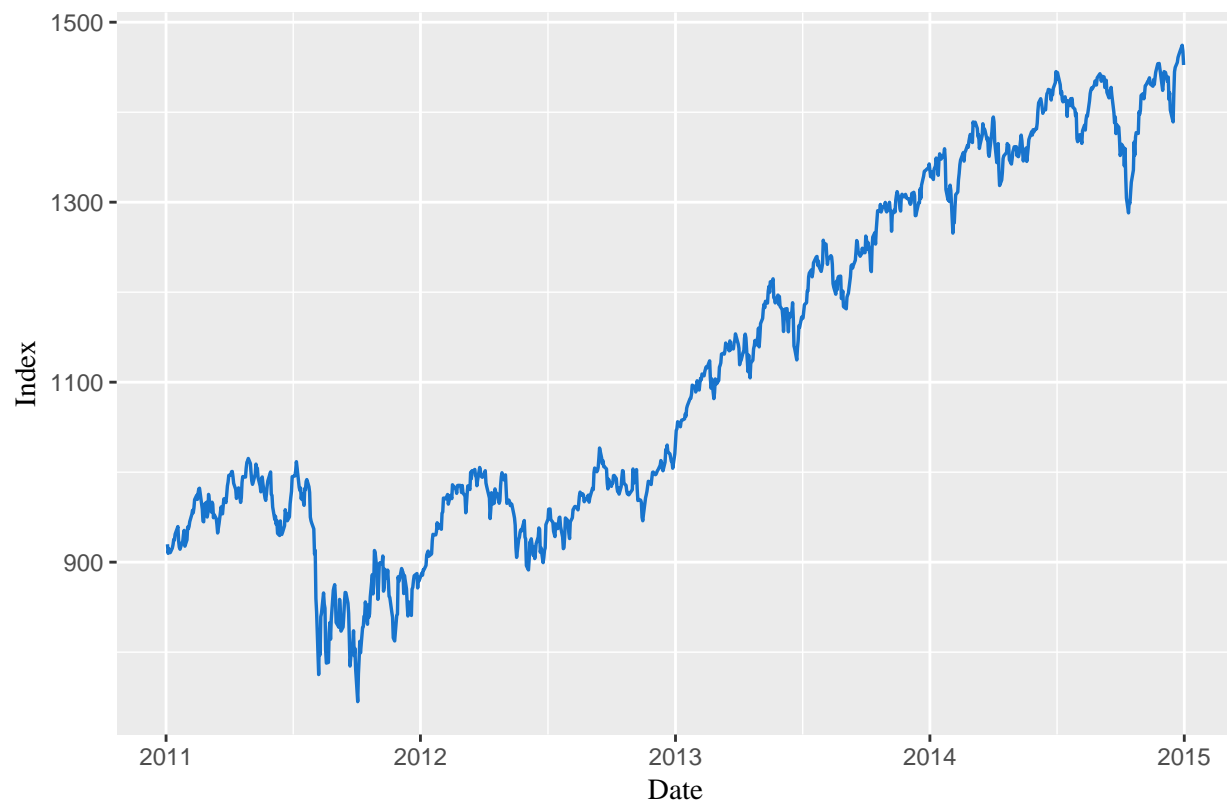
Time Series of Daily Returns of S&P 500 Index (2011–2015)



2.2 S&P 400

```
fig12 <- ggplot(sp400, aes(Date)) +  
  geom_line(aes(y = index), size = 0.6, color = "dodgerblue3") +  
  labs(title = "Time Series of Daily Returns of S&P 400 MidCap Index (2011-2015)",  
        x = "Date", y = "Index") +  
  theme(axis.title = element_text(family = "serif"),  
        plot.title = element_text(hjust = 0.5, family = "serif", face = "bold"))  
fig12
```

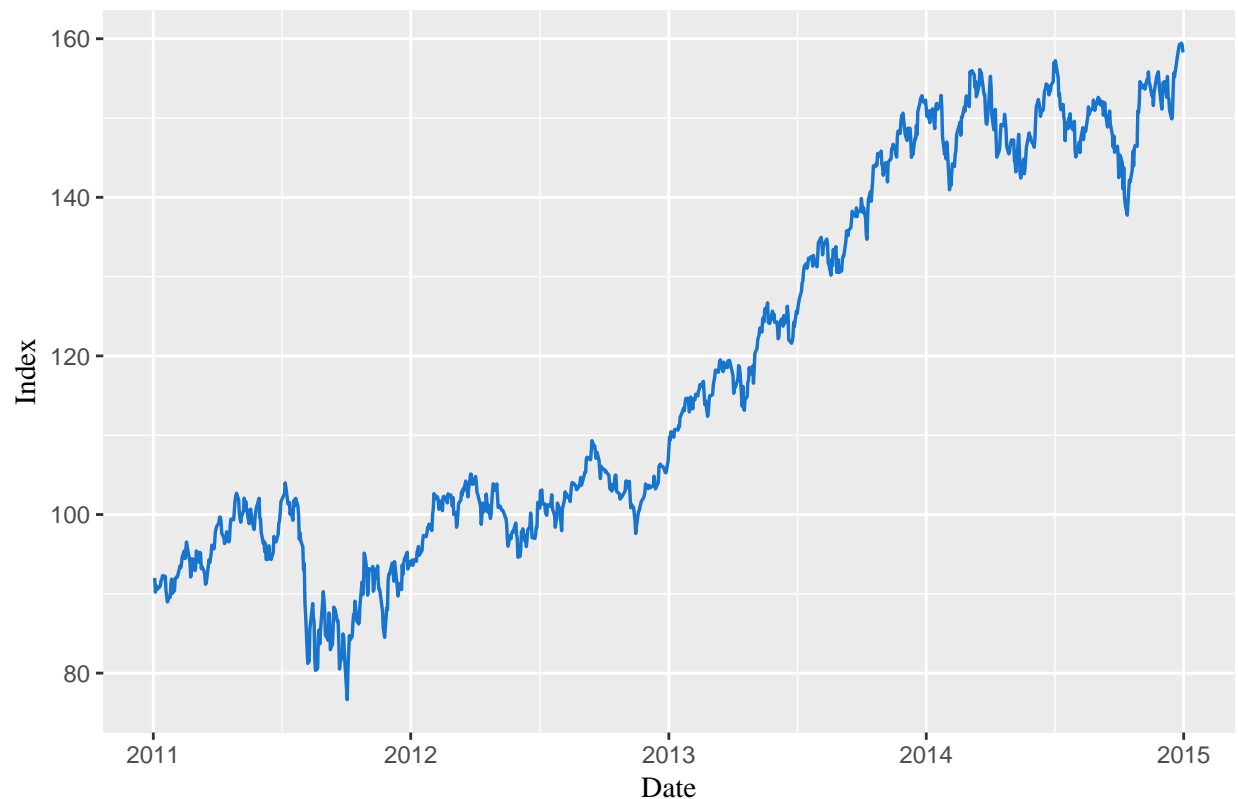
Time Series of Daily Returns of S&P 400 MidCap Index (2011–2015)



2.3 S&P 600

```
fig13 <- ggplot(sp600, aes(Date)) +  
  geom_line(aes(y = index), size = 0.6, color = "dodgerblue3") +  
  labs(title = "Time Series of Daily Returns of S&P 600 SmallCap Index (2011-2015)",  
       x = "Date", y = "Index") +  
  theme(axis.title = element_text(family = "serif"),  
        plot.title = element_text(hjust = 0.5, family = "serif", face = "bold"))  
fig13
```

Time Series of Daily Returns of S&P 600 SmallCap Index (2011–2015)



3. Auto-Correlation and Cross Correlation Functions

```
data <- inner_join(inner_join(sp500, sp400, by = "Date"), sp600, by = "Date")
data <- select(data, starts_with("R"))
ACF <- acf(data, na.action = na.pass, plot = F)
ACF
```

```
##
## Autocorrelations of series 'data', by lag
##
## , , R_LC
##
##   R_LC      R_MC      R_SC
## -0.069 ( 1) -0.953 (-1) -0.852 (-1)
##  0.074 ( 2)  0.050 (-2) -0.023 (-2)
## -0.105 ( 3) -0.039 (-3) -0.002 (-3)
##  0.032 ( 4)  0.128 (-4)  0.120 (-4)
## -0.142 ( 5) -0.024 (-5) -0.003 (-5)
##  0.029 ( 6)  0.135 (-6)  0.089 (-6)
## -0.025 ( 7) -0.029 (-7) -0.015 (-7)
##  0.032 ( 8)  0.032 (-8)  0.029 (-8)
## -0.053 ( 9) -0.040 (-9) -0.033 (-9)
##  0.087 (10)  0.041 (-10)  0.019 (-10)
## -0.004 (11) -0.091 (-11) -0.079 (-11)
## -0.029 (12)  0.004 (-12) -0.005 (-12)
```

```

## 0.000 ( 13) 0.030 (-13) 0.039 (-13)
## -0.046 ( 14) 0.001 (-14) 0.027 (-14)
## -0.006 ( 15) 0.037 (-15) 0.014 (-15)
## 0.028 ( 16) 0.015 (-16) 0.015 (-16)
## 0.044 ( 17) -0.011 (-17) 0.005 (-17)
## -0.076 ( 18) -0.045 (-18) -0.031 (-18)
## -0.035 ( 19) 0.073 (-19) 0.080 (-19)
## 0.012 ( 20) 0.035 (-20) 0.018 (-20)
## -0.033 ( 21) -0.023 (-21) -0.024 (-21)
## -0.043 ( 22) 0.041 (-22) 0.025 (-22)
## 0.050 ( 23) 0.050 (-23) 0.050 (-23)
## 0.018 ( 24) -0.026 (-24) 0.013 (-24)
## -0.096 ( 25) -0.011 (-25) -0.033 (-25)
##
## , , R_MC
##
## R_MC
## R_MC R_SC
## -0.090 ( 1) -0.030 ( 1) 0.048 ( -1)
## 0.098 ( 2) 0.051 ( 2) 0.020 ( -2)
## -0.020 ( 3) -0.123 ( 3) -0.119 ( -3)
## 0.148 ( 4) 0.010 ( 4) -0.011 ( -4)
## -0.014 ( 5) -0.141 ( 5) -0.097 ( -5)
## 0.014 ( 6) 0.011 ( 6) -0.007 ( -6)
## -0.034 ( 7) -0.020 ( 7) -0.016 ( -7)
## 0.031 ( 8) 0.043 ( 8) 0.034 ( -8)
## -0.104 ( 9) -0.013 ( 9) 0.009 ( -9)
## -0.007 ( 10) 0.107 ( 10) 0.097 (-10)
## 0.037 ( 11) 0.002 ( 11) 0.013 (-11)
## 0.003 ( 12) -0.036 ( 12) -0.048 (-12)
## 0.054 ( 13) 0.002 ( 13) -0.018 (-13)
## 0.000 ( 14) -0.045 ( 14) -0.017 (-14)
## -0.030 ( 15) -0.010 ( 15) -0.013 (-15)
## -0.030 ( 16) 0.006 ( 16) -0.004 (-16)
## 0.083 ( 17) 0.036 ( 17) 0.016 (-17)
## 0.028 ( 18) -0.086 ( 18) -0.094 (-18)
## -0.010 ( 19) -0.031 ( 19) -0.018 (-19)
## 0.031 ( 20) 0.016 ( 20) 0.019 (-20)
## 0.049 ( 21) -0.039 ( 21) -0.023 (-21)
## -0.048 ( 22) -0.054 ( 22) -0.055 (-22)
## -0.033 ( 23) 0.020 ( 23) -0.020 (-23)
## 0.089 ( 24) 0.025 ( 24) 0.051 (-24)
## 0.013 ( 25) -0.079 ( 25) -0.047 (-25)
##
## , , R_SC
##
## R_MC
## R_MC R_SC
## -0.075 ( 1) 0.004 ( 1) 0.016 ( 1)
## 0.114 ( 2) 0.039 ( 2) 0.010 ( 2)
## -0.020 ( 3) -0.142 ( 3) -0.145 ( 3)
## 0.122 ( 4) 0.006 ( 4) -0.025 ( 4)
## -0.001 ( 5) -0.106 ( 5) -0.049 ( 5)
## 0.023 ( 6) -0.003 ( 6) -0.016 ( 6)
## -0.048 ( 7) -0.027 ( 7) -0.029 ( 7)
## 0.028 ( 8) 0.058 ( 8) 0.039 ( 8)

```

```
## -0.094 ( 9) -0.014 ( 9) 0.007 ( 9)
## -0.005 (10) 0.096 (10) 0.100 (10)
## 0.008 (11) 0.001 (11) 0.014 (11)
## 0.019 (12) -0.006 (12) -0.019 (12)
## 0.051 (13) -0.027 (13) -0.047 (13)
## -0.002 (14) -0.044 (14) -0.020 (14)
## -0.046 (15) -0.011 (15) -0.012 (15)
## -0.020 (16) 0.026 (16) 0.016 (16)
## 0.077 (17) 0.027 (17) 0.009 (17)
## 0.012 (18) -0.080 (18) -0.087 (18)
## 0.030 (19) -0.019 (19) -0.008 (19)
## 0.028 (20) -0.028 (20) -0.024 (20)
## 0.002 (21) -0.028 (21) -0.011 (21)
## -0.031 (22) -0.014 (22) -0.018 (22)
## -0.018 (23) 0.009 (23) -0.027 (23)
## 0.088 (24) 0.010 (24) 0.032 (24)
## 0.006 (25) -0.077 (25) -0.054 (25)
```

```
plot(ACF)
```

