Stock Market Analyses - Terend

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R Markdown

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When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
#############################################################################
##########################################
# Script name: SMP.SaeidRezaei.R
# Porpouse   : This script is developed to analyse the stock market for
certain security and
#              provide prediction based on stock price (using time series
method)
# Data source: Data source could be off-line (marketPriceHistory.csv) or
online SP&500
# R Package usagae:
# quantmod
# ggplot2
# forecast
# plotly
# ggfortify
# tseries
# gridExtra
# docstring
# here
#############################################################################
##########################################
#Developer         Date              Version                    Reason
#Saeid Rezaei     2017-12-20           0                      Initial Version
#############################################################################
##########################################

# Start program
print ("Start program - Forcaste Stock Marekt")

## [1] "Start program - Forcaste Stock Marekt"

print ("STEP 1: Merging data into one file and value missing records")
```

```
## [1] "STEP 1: Merging data into one file and value missing records"
```

```r
# If you are using off line market price you would need to execute
# DataClening.pl (Perl) script to merge files and value the secirities
# with missing price, The method is to value the missing price by looking
into
# Previous price, if this is first row price would be Zero (0)
# Note: I'm running from my local drive. You would need to specify the path
# if you are running from other location
# Recomandation setup:
# Create subfolder in your local (C) drive call it CHM136
# Create another sub-directory under CHM136 call id StockPriceHist
# Copy all downloaded price .csv files there

system("perl C:/CHM136/DataCleaning.pl")

print ("STEP 2: Analyse data and train data")
```

```
## [1] "STEP 2: Analyse data and train data"
```

```r
print ("STEP 2.1: Install and Load R Packages")
```

```
## [1] "STEP 2.1: Install and Load R Packages"
```

```r
#install.packages('quantmod')
#install.packages('binhf')
library(quantmod)
```

```
## Warning: package 'quantmod' was built under R version 3.3.3

## Loading required package: xts

## Warning: package 'xts' was built under R version 3.3.3

## Loading required package: zoo

## Warning: package 'zoo' was built under R version 3.3.3

##
## Attaching package: 'zoo'

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

## Loading required package: TTR

## Warning: package 'TTR' was built under R version 3.3.3

## Version 0.4-0 included new data defaults. See ?getSymbols.
```

```r
# Load data into Var.
# Load data from local .csv file into var.
```

```r
#marketPriceHisotry <- read.csv(
"C:/CHM136/StockPriceHist/output/secPriceHistory.csv")
#attach(marketPriceHisotry)

# Since Downloading data is not up-t-date, I used R PACKAGE CALLED quantmod
to get realtime stock price
# I'll use that source in my project going forward

print ("STEP 2.2: Get stock price from Yahoo and analyse data")
```

```
## [1] "STEP 2.2: Get stock price from Yahoo and analyse data"
```

```r
getSymbols('SPY', src='yahoo')
```

```
## 'getSymbols' currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## 'loadSymbols' to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.
```

```
##
## WARNING: There have been significant changes to Yahoo Finance data.
## Please see the Warning section of '?getSymbols.yahoo' for details.
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.yahoo.warning"=FALSE).
```

```
## [1] "SPY"
```

```r
getSymbols('^GSPC', src='yahoo')
```

```
## [1] "GSPC"
```

```r
getSymbols('^IBEX', src='yahoo')
```

```
## Warning: ^IBEX contains missing values. Some functions will not work if
## objects contain missing values in the middle of the series. Consider using
## na.omit(), na.approx(), na.fill(), etc to remove or replace them.
```

```
## [1] "IBEX"
```

```r
getSymbols(c('QQQ'), src='google')
```

```
## [1] "QQQ"
```

```r
head(GSPC)
```

```
##            GSPC.Open GSPC.High GSPC.Low GSPC.Close GSPC.Volume
## 2007-01-03   1418.03   1429.42  1407.86    1416.60  3429160000
## 2007-01-04   1416.60   1421.84  1408.43    1418.34  3004460000
## 2007-01-05   1418.34   1418.34  1405.75    1409.71  2919400000
## 2007-01-08   1409.26   1414.98  1403.97    1412.84  2763340000
## 2007-01-09   1412.84   1415.61  1405.42    1412.11  3038380000
## 2007-01-10   1408.70   1415.99  1405.32    1414.85  2764660000
##            GSPC.Adjusted
## 2007-01-03       1416.60
## 2007-01-04       1418.34
## 2007-01-05       1409.71
## 2007-01-08       1412.84
## 2007-01-09       1412.11
## 2007-01-10       1414.85
```

```
tail(GSPC)
```

```
##            GSPC.Open GSPC.High GSPC.Low GSPC.Close GSPC.Volume
## 2017-12-28   2686.10   2687.66  2682.69    2687.54  2153330000
## 2017-12-29   2689.15   2692.12  2673.61    2673.61  2443490000
## 2018-01-02   2683.73   2695.89  2682.36    2695.81  3357250000
## 2018-01-03   2697.85   2714.37  2697.77    2713.06  3538660000
## 2018-01-04   2719.31   2729.29  2719.07    2723.99  3695260000
## 2018-01-05   2731.33   2743.45  2727.92    2743.15  3236620000
##            GSPC.Adjusted
## 2017-12-28       2687.54
## 2017-12-29       2673.61
## 2018-01-02       2695.81
## 2018-01-03       2713.06
## 2018-01-04       2723.99
## 2018-01-05       2743.15
```

```
head(SPY)
```

```
##            SPY.Open SPY.High SPY.Low SPY.Close SPY.Volume SPY.Adjusted
## 2007-01-03   142.25   142.86  140.57    141.37   94807600     113.1958
## 2007-01-04   141.23   142.05  140.61    141.67   69620600     113.4360
## 2007-01-05   141.33   141.40  140.38    140.54   76645300     112.5312
## 2007-01-08   140.82   141.41  140.25    141.19   71655000     113.0516
## 2007-01-09   141.31   141.60  140.40    141.07   75680100     112.9556
## 2007-01-10   140.58   141.57  140.30    141.54   72428000     113.3318
```

```
tail(SPY)
```

```
##            SPY.Open SPY.High SPY.Low SPY.Close SPY.Volume SPY.Adjusted
## 2017-12-28   267.89   267.92  267.45    267.87   45116100       267.87
## 2017-12-29   268.53   268.55  266.64    266.86   96007400       266.86
## 2018-01-02   267.84   268.81  267.40    268.77   86655700       268.77
## 2018-01-03   268.96   270.64  268.96    270.47   90070400       270.47
## 2018-01-04   271.20   272.16  270.54    271.61   80636400       271.61
## 2018-01-05   272.51   273.56  271.95    273.42   72820100       273.42
```

```
# Remove the null values
QQQ <- QQQ[!(rowSums(is.na(QQQ))),]
```

```
SPY <- SPY[!(rowSums(is.na(SPY))),]

GSPC <- GSPC[!(rowSums(is.na(GSPC))),]
IBEX <- IBEX[!(rowSums(is.na(IBEX))),]



# GSPC and SPY are Time sereies data, Let's find the class
class(GSPC)

## [1] "xts" "zoo"

# Create a vector and put more than one symbol into that
# This VAR will being used to compare more than one symbol
# and analyse the market
basketSymbols <-(c('YELP','AAPL','AMZN'))
getSymbols(basketSymbols, src='yahoo')

## [1] "YELP" "AAPL" "AMZN"

# Analyse the Data
summary(YELP)

##      Index              YELP.Open       YELP.High         YELP.Low
##  Min.   :2012-03-02   Min.   :15.11   Min.   : 15.26   Min.   :14.10
##  1st Qu.:2013-08-19   1st Qu.:25.01   1st Qu.: 25.68   1st Qu.:24.51
##  Median :2015-02-04   Median :35.61   Median : 36.07   Median :35.02
##  Mean   :2015-02-03   Mean   :40.47   Mean   : 41.34   Mean   :39.58
##  3rd Qu.:2016-07-21   3rd Qu.:51.33   3rd Qu.: 52.61   3rd Qu.:50.42
##  Max.   :2018-01-05   Max.   :99.80   Max.   :101.75   Max.   :97.25
##    YELP.Close     YELP.Volume       YELP.Adjusted
##  Min.   :15.22   Min.   :  226800   Min.   :15.22
##  1st Qu.:25.09   1st Qu.: 1273550   1st Qu.:25.09
##  Median :35.43   Median : 2002650   Median :35.43
##  Mean   :40.45   Mean   : 2683634   Mean   :40.45
##  3rd Qu.:51.45   3rd Qu.: 3044850   3rd Qu.:51.45
##  Max.   :98.04   Max.   :47155000   Max.   :98.04

summary(AAPL)

##      Index              AAPL.Open        AAPL.High         AAPL.Low
##  Min.   :2007-01-03   Min.   : 11.34   Min.   : 11.71   Min.   : 11.17
##  1st Qu.:2009-10-02   1st Qu.: 27.25   1st Qu.: 27.55   1st Qu.: 26.96
##  Median :2012-07-03   Median : 65.08   Median : 65.41   Median : 64.21
##  Mean   :2012-07-04   Mean   : 69.75   Mean   : 70.38   Mean   : 69.07
##  3rd Qu.:2015-04-08   3rd Qu.:103.10   3rd Qu.:105.05   3rd Qu.:102.72
##  Max.   :2018-01-05   Max.   :175.11   Max.   :177.20   Max.   :174.86
##    AAPL.Close      AAPL.Volume        AAPL.Adjusted
##  Min.   : 11.17   Min.   : 11475900   Min.   : 10.01
##  1st Qu.: 27.21   1st Qu.: 49739400   1st Qu.: 24.39
##  Median : 64.76   Median : 97645800   Median : 58.87
##  Mean   : 69.75   Mean   :123330073   Mean   : 65.74
##  3rd Qu.:103.30   3rd Qu.:164516100   3rd Qu.: 99.24
##  Max.   :176.42   Max.   :843242400   Max.   :176.42
```

```
summary(AMZN)
```

```
##      Index              AMZN.Open         AMZN.High
##  Min.   :2007-01-03   Min.   :  35.29   Min.   :  37.07
##  1st Qu.:2009-10-02   1st Qu.:  95.00   1st Qu.:  95.90
##  Median :2012-07-03   Median : 227.57   Median : 230.97
##  Mean   :2012-07-04   Mean   : 324.42   Mean   : 327.69
##  3rd Qu.:2015-04-08   3rd Qu.: 398.94   3rd Qu.: 403.49
##  Max.   :2018-01-05   Max.   :1217.51   Max.   :1229.14
##     AMZN.Low         AMZN.Close       AMZN.Volume        AMZN.Adjusted
##  Min.   :  34.68   Min.   :  35.03   Min.   :   984400   Min.   :  35.03
##  1st Qu.:  93.11   1st Qu.:  94.45   1st Qu.:  3034000   1st Qu.:  94.45
##  Median : 225.29   Median : 228.29   Median :  4550700   Median : 228.29
##  Mean   : 320.87   Mean   : 324.48   Mean   :  5815254   Mean   : 324.48
##  3rd Qu.: 394.29   3rd Qu.: 398.79   3rd Qu.:  7077400   3rd Qu.: 398.79
##  Max.   :1210.00   Max.   :1229.14   Max.   :104329200   Max.   :1229.14
```

```
# Merge all there symbol data into one data frame
basket <- data.frame(as.xts(merge(YELP,AAPL,AMZN)))
# N/A respresents when Symbol does not have have price
head(basket)
```

```
##            YELP.Open YELP.High YELP.Low YELP.Close YELP.Volume
## 2007-01-03        NA        NA       NA         NA          NA
## 2007-01-04        NA        NA       NA         NA          NA
## 2007-01-05        NA        NA       NA         NA          NA
## 2007-01-08        NA        NA       NA         NA          NA
## 2007-01-09        NA        NA       NA         NA          NA
## 2007-01-10        NA        NA       NA         NA          NA
##            YELP.Adjusted AAPL.Open AAPL.High AAPL.Low AAPL.Close
## 2007-01-03            NA  12.32714  12.36857 11.70000   11.97143
## 2007-01-04            NA  12.00714  12.27857 11.97429   12.23714
## 2007-01-05            NA  12.25286  12.31428 12.05714   12.15000
## 2007-01-08            NA  12.28000  12.36143 12.18286   12.21000
## 2007-01-09            NA  12.35000  13.28286 12.16429   13.22429
## 2007-01-10            NA  13.53571  13.97143 13.35000   13.85714
##            AAPL.Volume AAPL.Adjusted AMZN.Open AMZN.High AMZN.Low
## 2007-01-03   309579900      10.73159     38.68     39.06    38.05
## 2007-01-04   211815100      10.96978     38.59     39.14    38.26
## 2007-01-05   208685400      10.89166     38.72     38.79    37.60
## 2007-01-08   199276700      10.94545     38.22     38.31    37.17
## 2007-01-09   837324600      11.85469     37.60     38.06    37.34
## 2007-01-10   738220000      12.42201     37.49     37.70    37.07
##            AMZN.Close AMZN.Volume AMZN.Adjusted
## 2007-01-03      38.70    12405100         38.70
## 2007-01-04      38.90     6318400         38.90
## 2007-01-05      38.37     6619700         38.37
## 2007-01-08      37.50     6783000         37.50
## 2007-01-09      37.78     5703000         37.78
## 2007-01-10      37.15     6527500         37.15
```

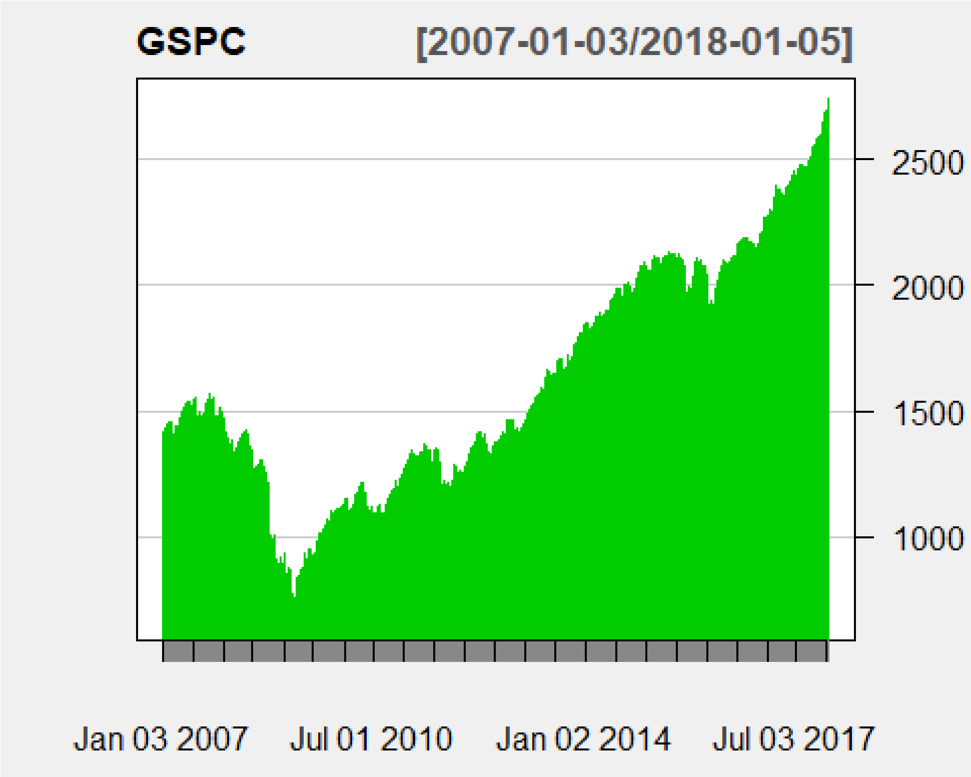
```r
tail(basket)
```

```
##            YELP.Open YELP.High YELP.Low YELP.Close YELP.Volume
## 2017-12-28     42.44     42.74    42.01      42.23      472900
## 2017-12-29     42.23     42.43    41.90      41.96      688800
## 2018-01-02     42.06     43.47    42.06      43.24     1355300
## 2018-01-03     43.35     43.59    42.86      43.12     1347700
## 2018-01-04     43.36     43.53    42.52      42.82      933000
## 2018-01-05     42.95     43.34    42.74      43.17      903600
##            YELP.Adjusted AAPL.Open AAPL.High AAPL.Low AAPL.Close
## 2017-12-28         42.23    171.00    171.85   170.48     171.08
## 2017-12-29         41.96    170.52    170.59   169.22     169.23
## 2018-01-02         43.24    170.16    172.30   169.26     172.26
## 2018-01-03         43.12    172.53    174.55   171.96     172.23
## 2018-01-04         42.82    172.54    173.47   172.08     173.03
## 2018-01-05         43.17    173.44    175.37   173.05     175.00
##            AAPL.Volume AAPL.Adjusted AMZN.Open AMZN.High AMZN.Low
## 2017-12-28    16480200        171.08   1189.00   1190.10  1184.38
## 2017-12-29    25999900        169.23   1182.35   1184.00  1167.50
## 2018-01-02    25555900        172.26   1172.00   1190.00  1170.51
## 2018-01-03    29517900        172.23   1188.30   1205.49  1188.30
## 2018-01-04    22434600        173.03   1205.00   1215.87  1204.66
## 2018-01-05    23329000        175.00   1217.51   1229.14  1210.00
##            AMZN.Close AMZN.Volume AMZN.Adjusted
## 2017-12-28    1186.10     1841700       1186.10
## 2017-12-29    1169.47     2688400       1169.47
## 2018-01-02    1189.01     2694500       1189.01
## 2018-01-03    1204.20     3108800       1204.20
## 2018-01-04    1209.59     3022100       1209.59
## 2018-01-05    1229.14     3452800       1229.14
```

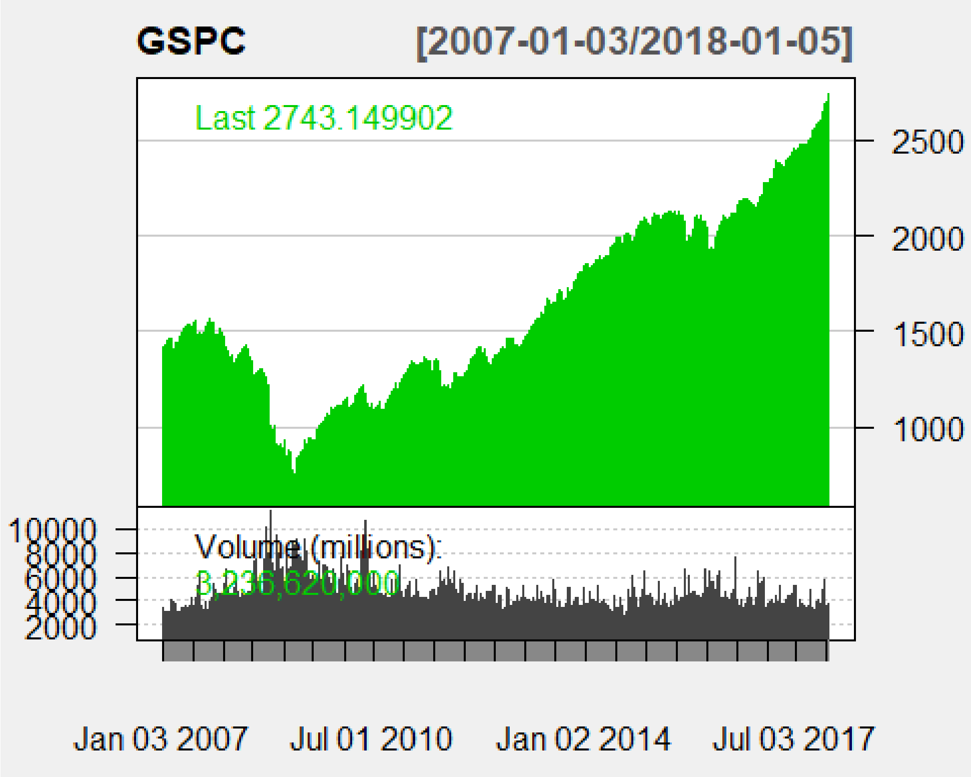
```r
# Draw few charts to do basid analyses
print ("STEP 2.3: Draw few charts and analyse them")
```

```
## [1] "STEP 2.3: Draw few charts and analyse them"
```

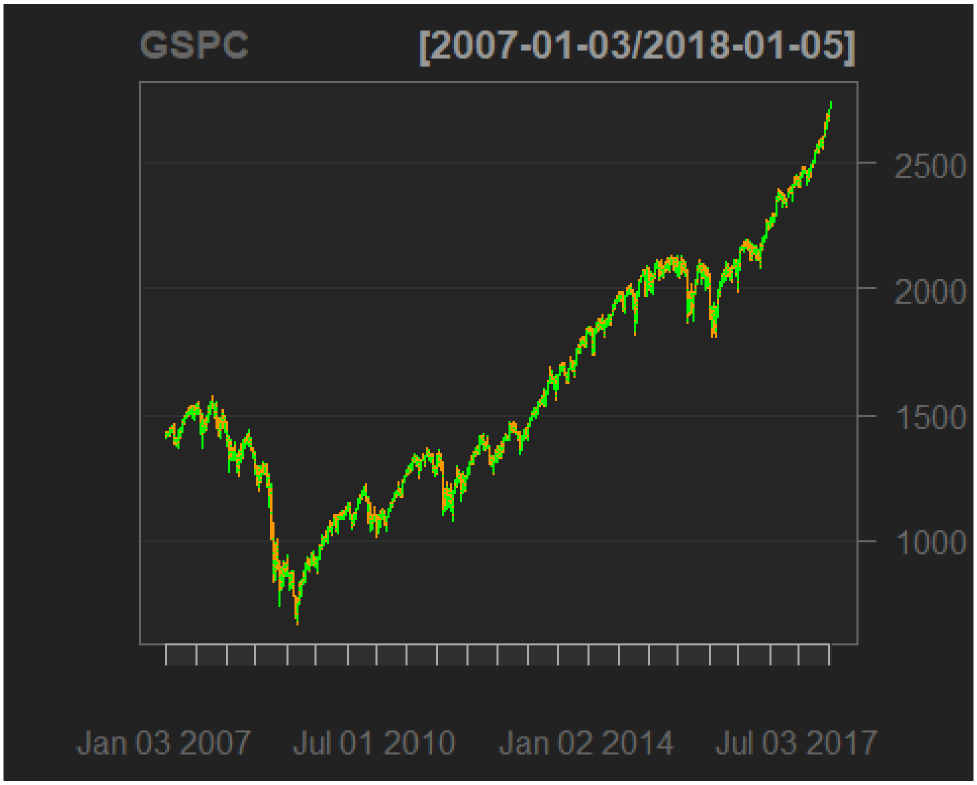
```r
lineChart(GSPC,line.type = 'h',theme = 'white',TA=NULL)
```



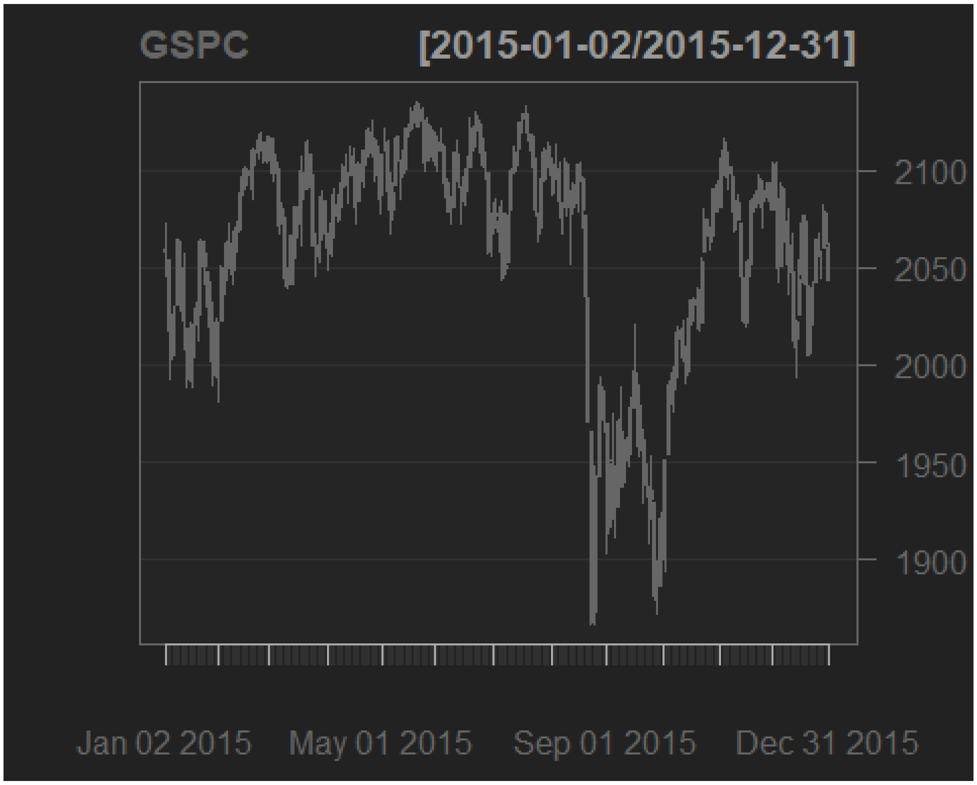
```
# put the volumn
lineChart(GSPC,line.type = 'h',theme = 'white')
```



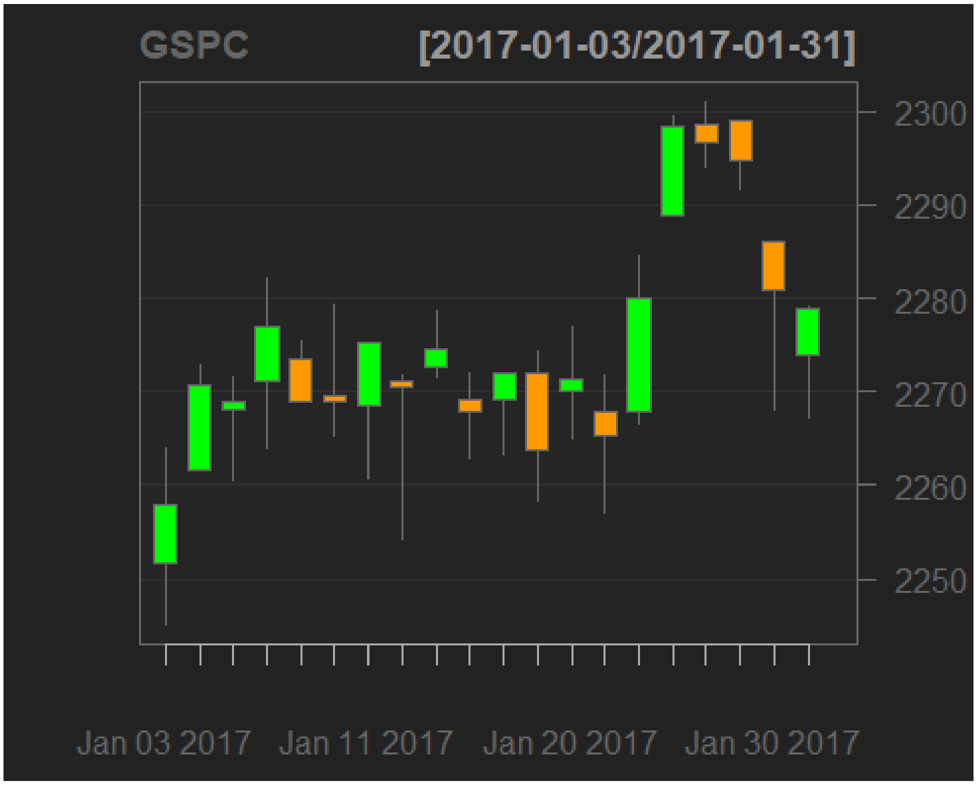
```
barChart(GSPC,bar.type = 'hcl',TA=NULL)
```



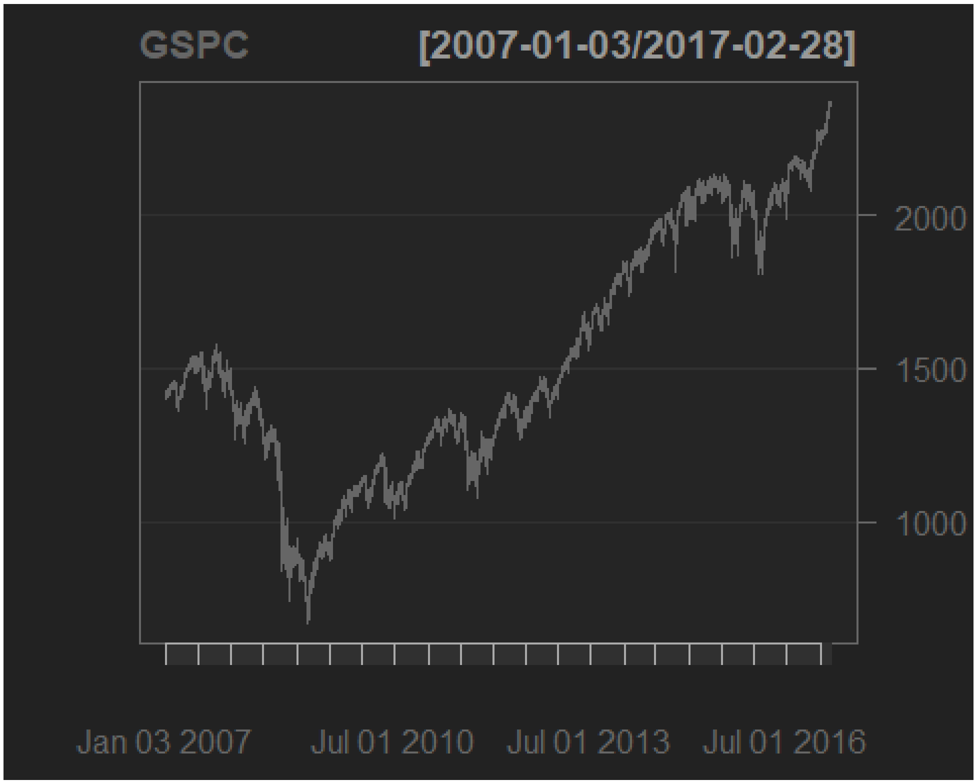
```
candleChart(GSPC,TA=NULL,subset = '2015')
```



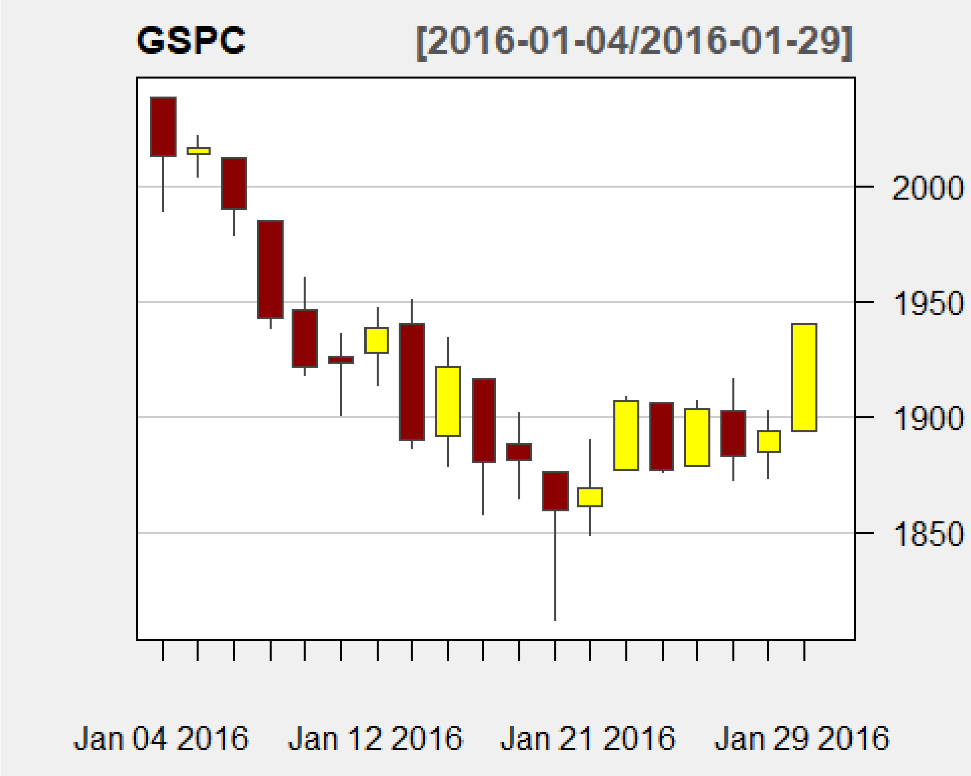
```
# Fucase on Jan 2017
candleChart(GSPC,TA=NULL,subset = '2017-01')
```



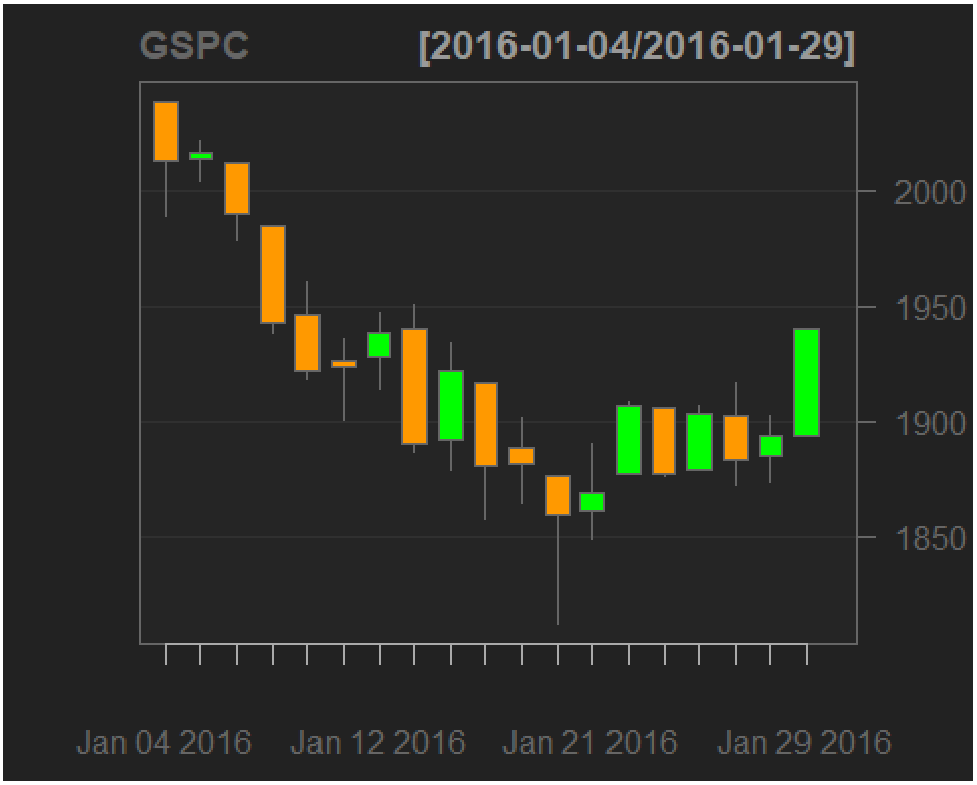
```
# Review the price changes from Feb 2017 and backward to 1st day
candleChart(GSPC,TA=NULL,subset = '::2017-02')
```



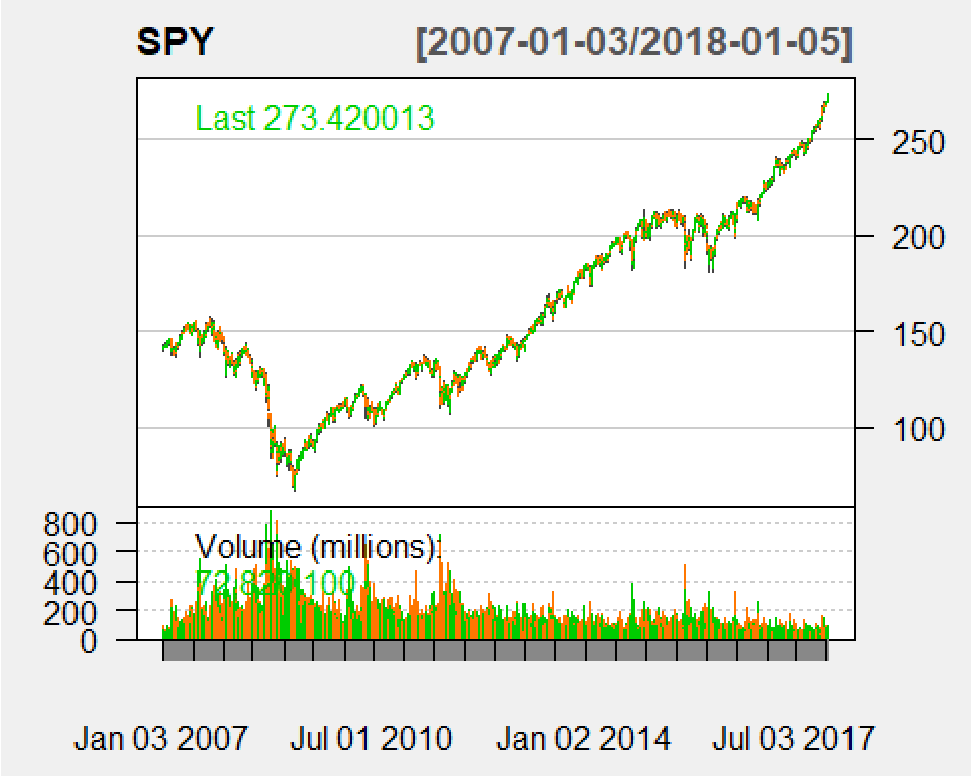
```
candleChart(GSPC,theme =
chartTheme('white',up.col='yellow',dn.col='darkred'),
           TA=NULL,subset = '2016-01')
```



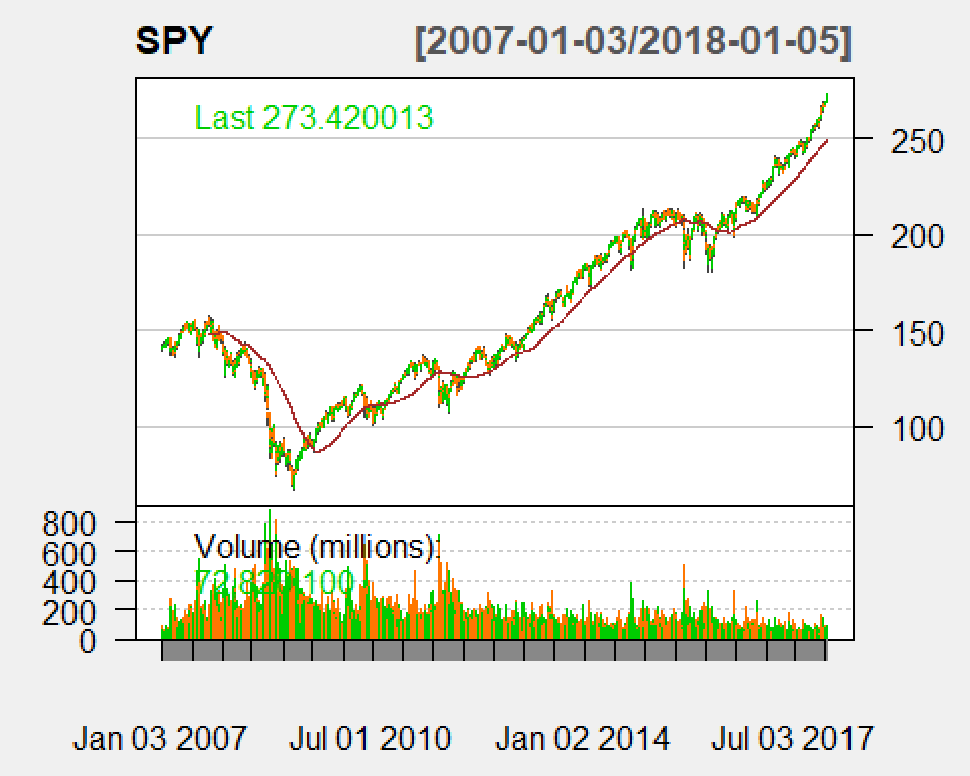
```
chartSeries(GSPC,type =c("candlesticks"),TA=NULL,subset = '2016-01')
```



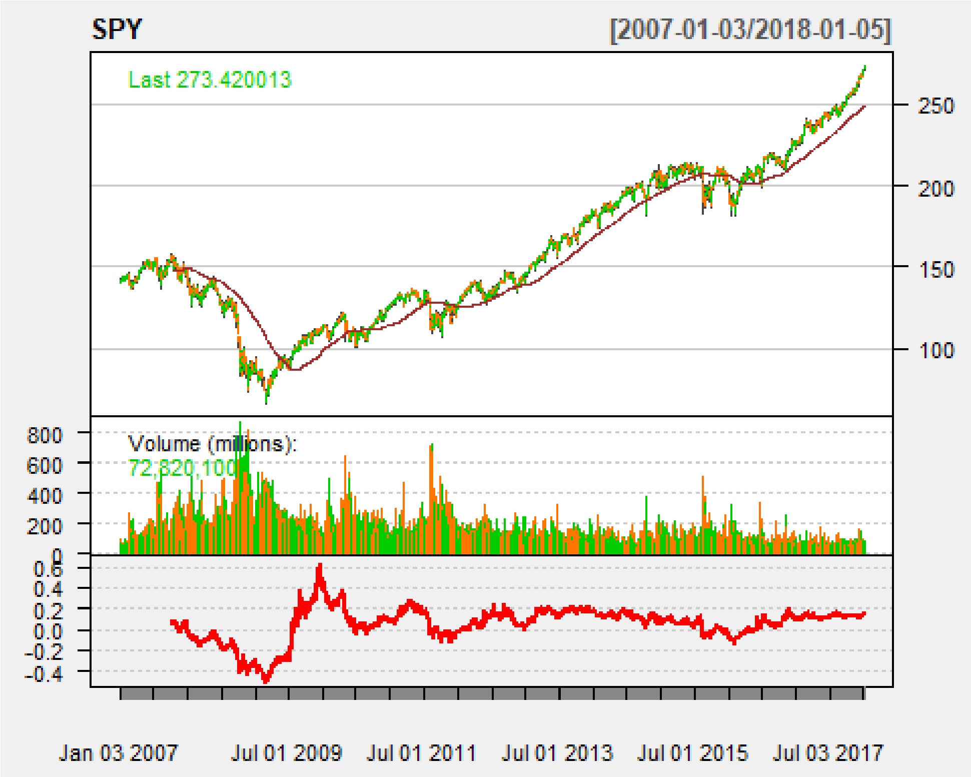
```
chartSeries(SPY, theme='white')
```



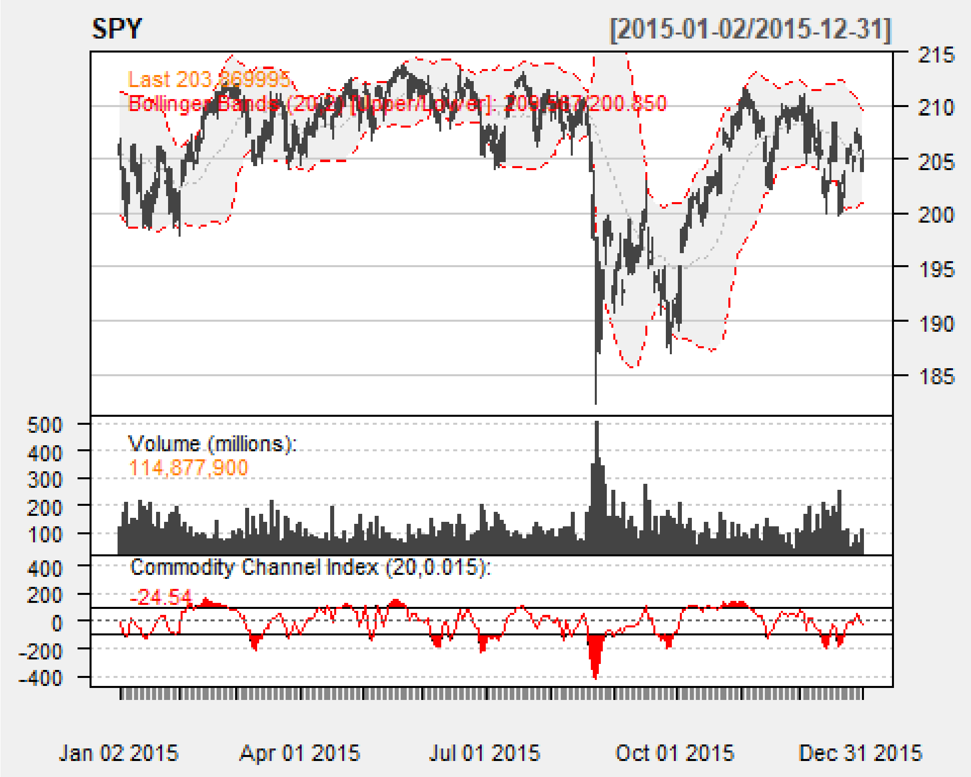
```
# Let's find the Symple moving avarage for period of 200
#{{\mathit  {momentum}} \over N+1}={\mathit  {SMA}}_{{\mathit  {today}}}-
{\mathit  {SMA}}_{{\mathit  {yesterday}}}


addSMA(n=200)
```



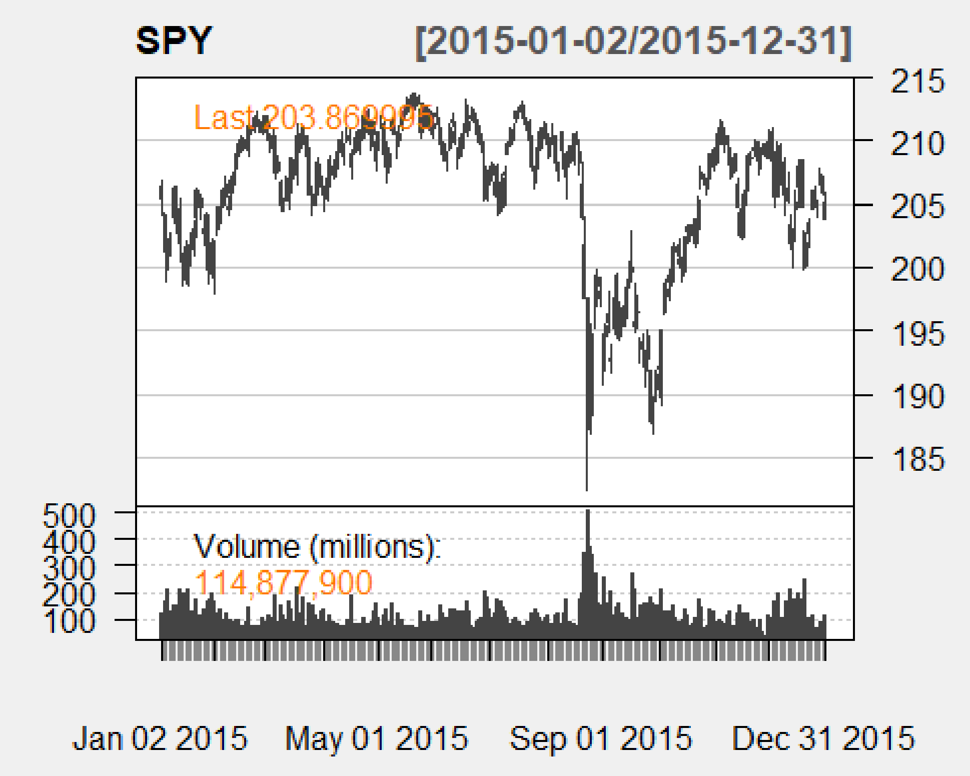
```
#Find the 10 period days of rate of change

addROC(n=200)
```



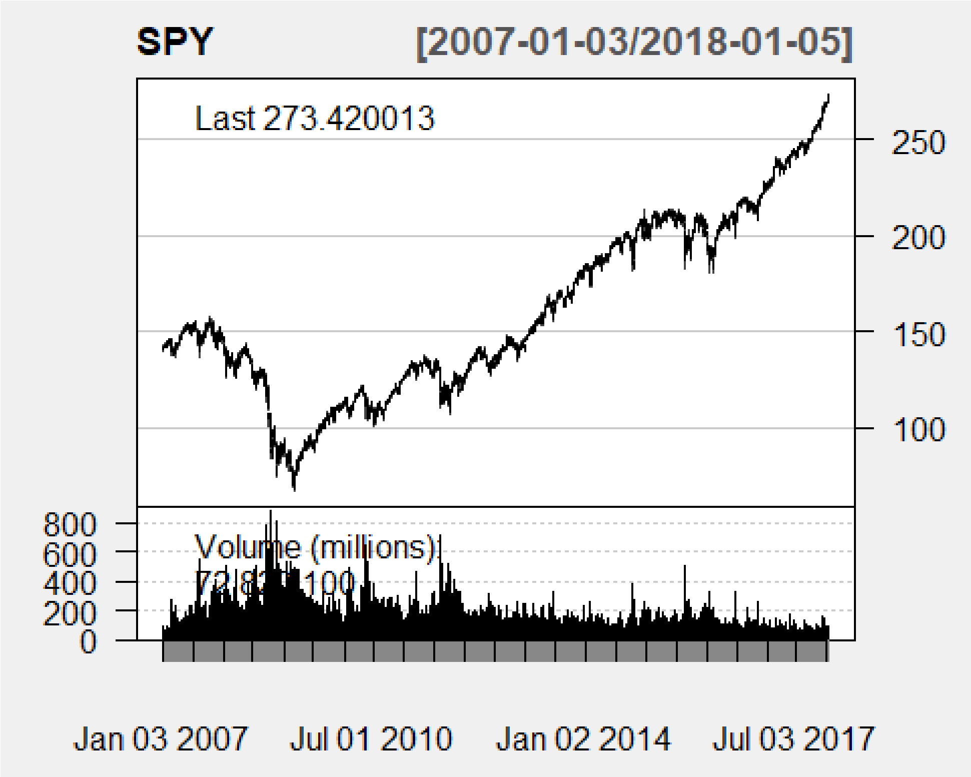
```r
chartSeries(SPY, theme="white",
          TA="addVo();addBBands();addCCI()", subset='2015')
```



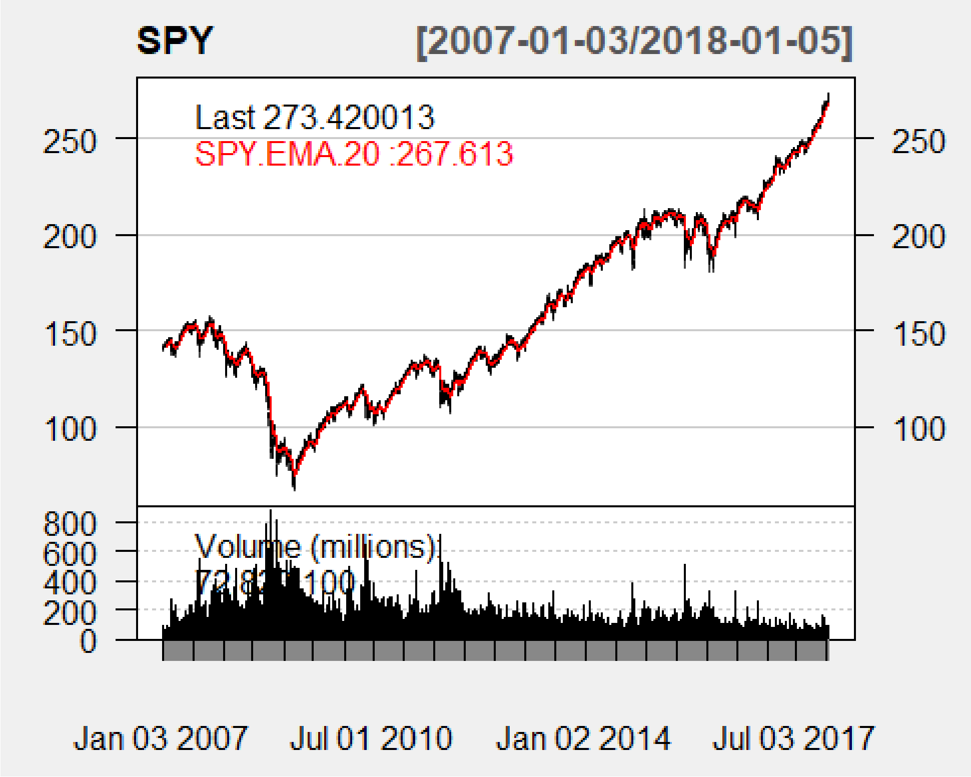
```r
chartSeries(SPY, theme="white", subset='2015')
```



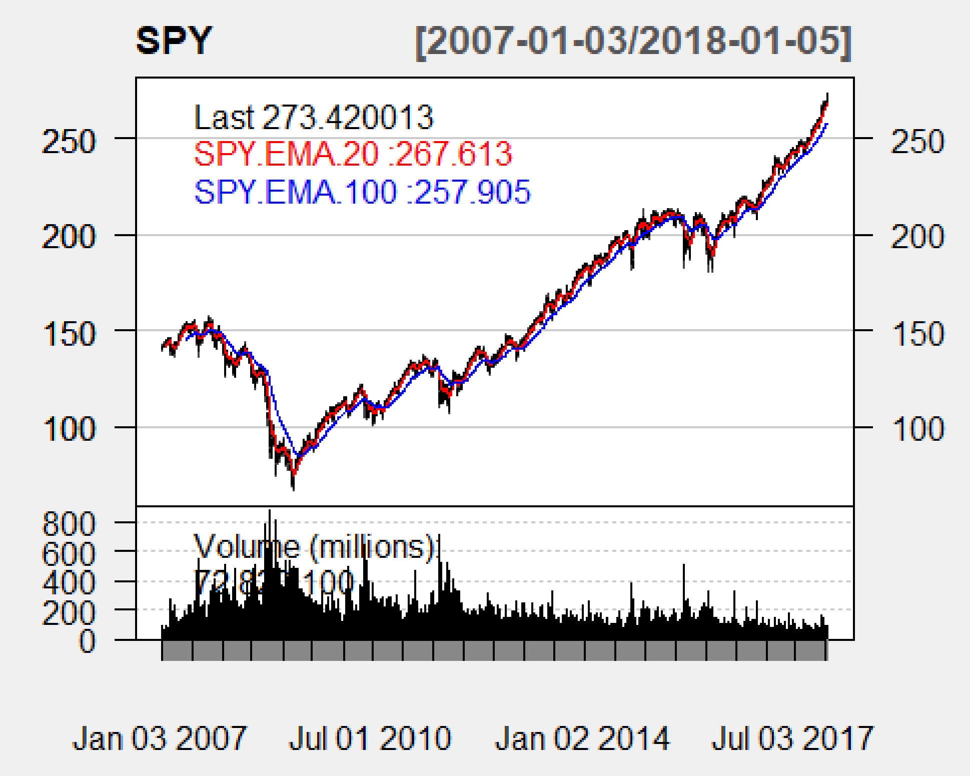
```r
chartSeries(SPY, theme=chartTheme('white'), up.col="black",
            dn.col="black")
```



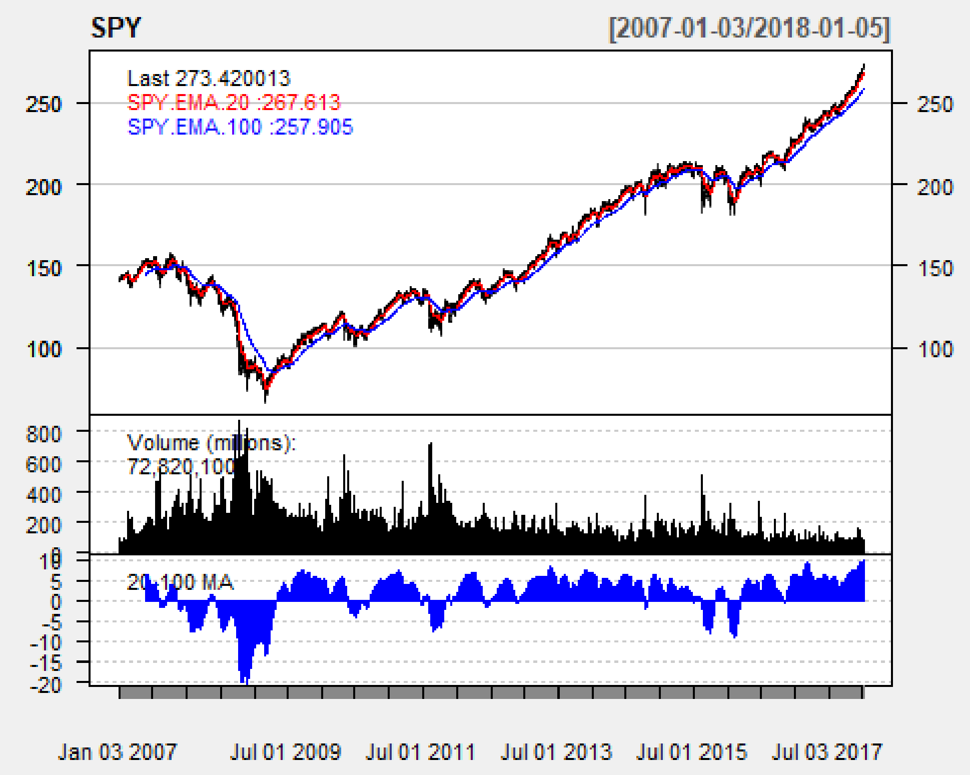
```
SPY.EMA.20<- EMA(SPY$SPY.Close, n=20)
SPY.EMA.100<- EMA(SPY$SPY.Close, n=100)
addTA(SPY.EMA.20, on=1, col = "red")
```



```
addTA(SPY.EMA.100, on=1, col = "blue")
```



```
addTA(SPY.EMA.20 - SPY.EMA.100,col='blue', type='h',legend="20-100 MA")
```



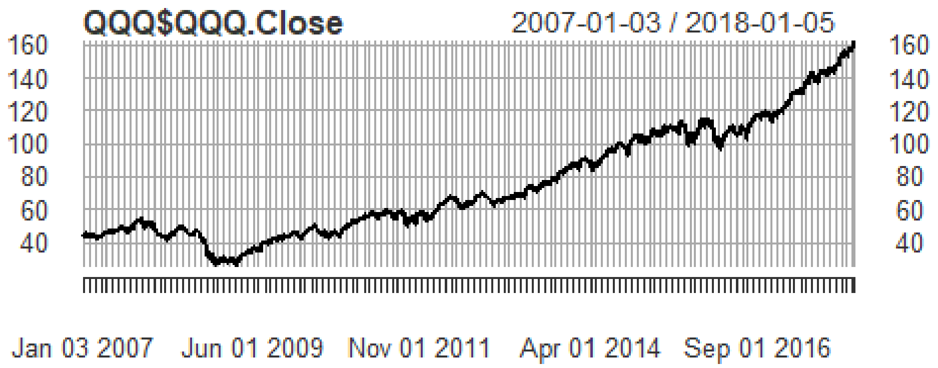
```r
# get more inside about Moving Average price
# In the below lines I'm going to explain the SMA
# function that I have used above
print ("STEP 2.4:Creating Moving Average")
```

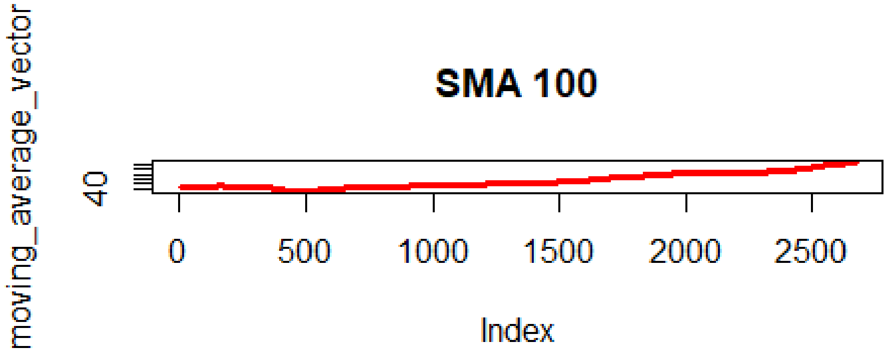
```
## [1] "STEP 2.4:Creating Moving Average"
```

```r
getSymbols(c('QQQ'), src='google')
```

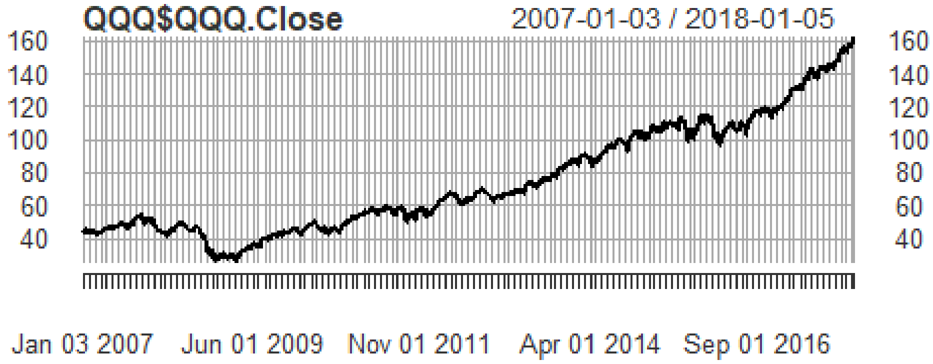
```
## [1] "QQQ"
```

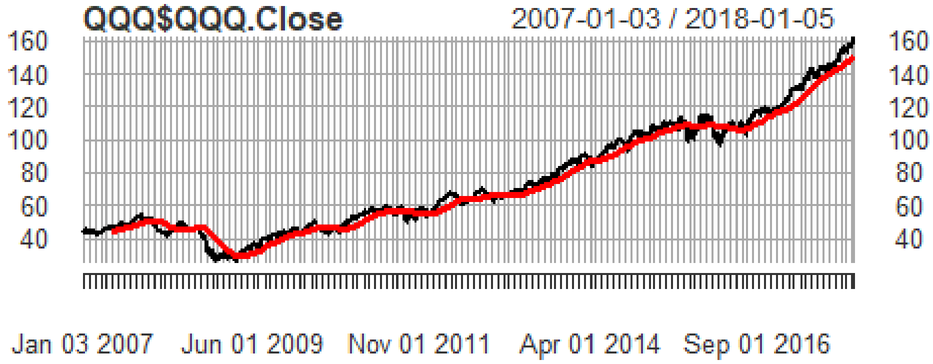
```r
#I�ll focus on the Close of the bar (where it closed for the day). Let�s take
a quick peek at what we have:
plot(QQQ$QQQ.Close)

#I�ll create a simple function to break down the data and average every price
point by x amount of points prior to it.
#In this case I�ll use a 100 day smoothing period.

period <- 100
price_vector <- QQQ$QQQ.Close
moving_average_vector <- c()
for (ind in seq((period+1),(length(price_vector))) ){
       moving_average_vector <- c(moving_average_vector,
mean(price_vector[(ind-period):ind]))
}

par(mfrow=c(2,1))
plot(QQQ$QQQ.Close)
plot(moving_average_vector, type='l', col='red', lwd=3, main = paste('SMA',
period))
```



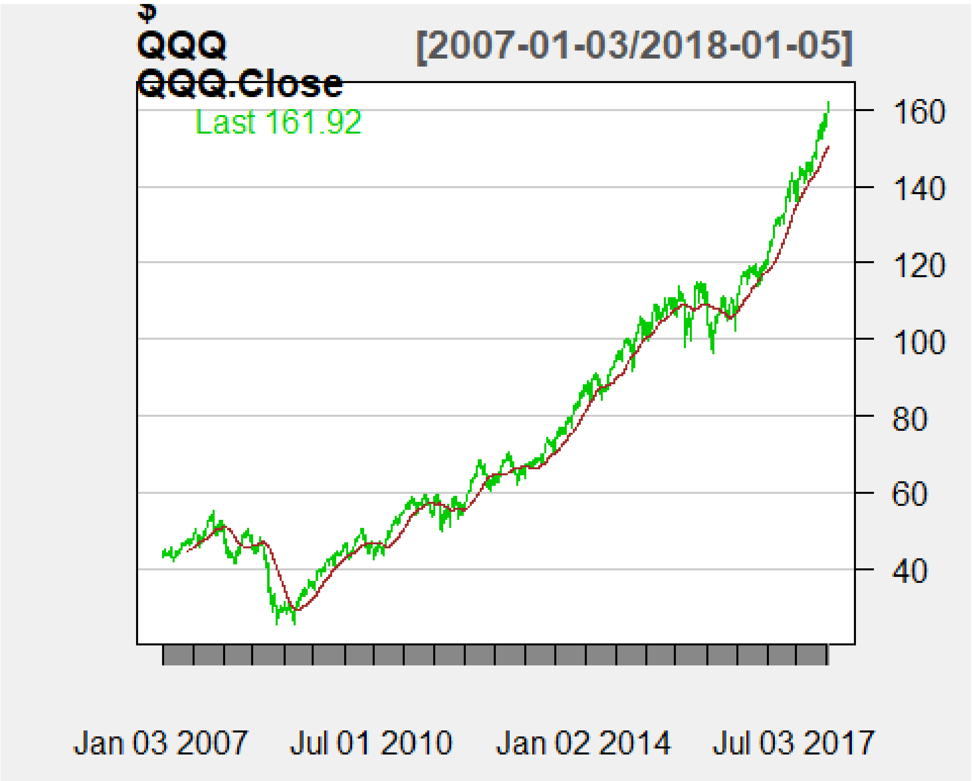


```
#The first plot is the raw QQQ daily closing prices and the second plot, is
our smoothed version. Keep in mind that the first 100 days of price data
#can�t be used as that is the minimum data we need to create a 100 period
average.
#The issue we have is our new SMA vector contains 2065 entries, while our the
QQQ market download, has 2165 entries.
#This should be easy to understand as it takes 100 entries to calculate an
SMA.
#This is going to make it difficult to overlay our SMA onto the raw market
data.
#One way around this is to buffer our SMA with 100 NA�s.

period <- 100
price_vector <- QQQ$QQQ.Close
moving_average_vector <- c(rep(NA, period))
# moving_average_vector <- c(rep(as.numeric(QQQ$QQQ.Close[period]), period))
for (ind in seq((period+1),(length(price_vector))) ){
       moving_average_vector <- c(moving_average_vector,
mean(price_vector[(ind-period):ind]))
}

# pass it back to our time series object
QQQ$QQQ.Close.SMA <- moving_average_vector

plot(QQQ$QQQ.Close)
lines(QQQ$QQQ.Close.SMA, type='l', col='red', lwd=3)
```

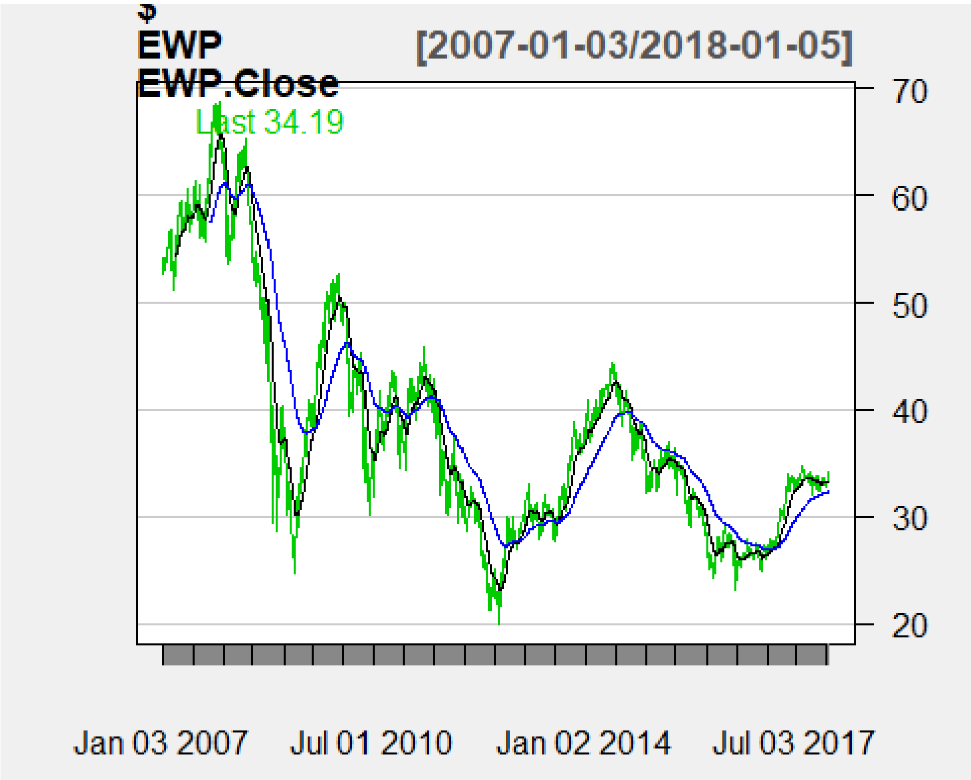




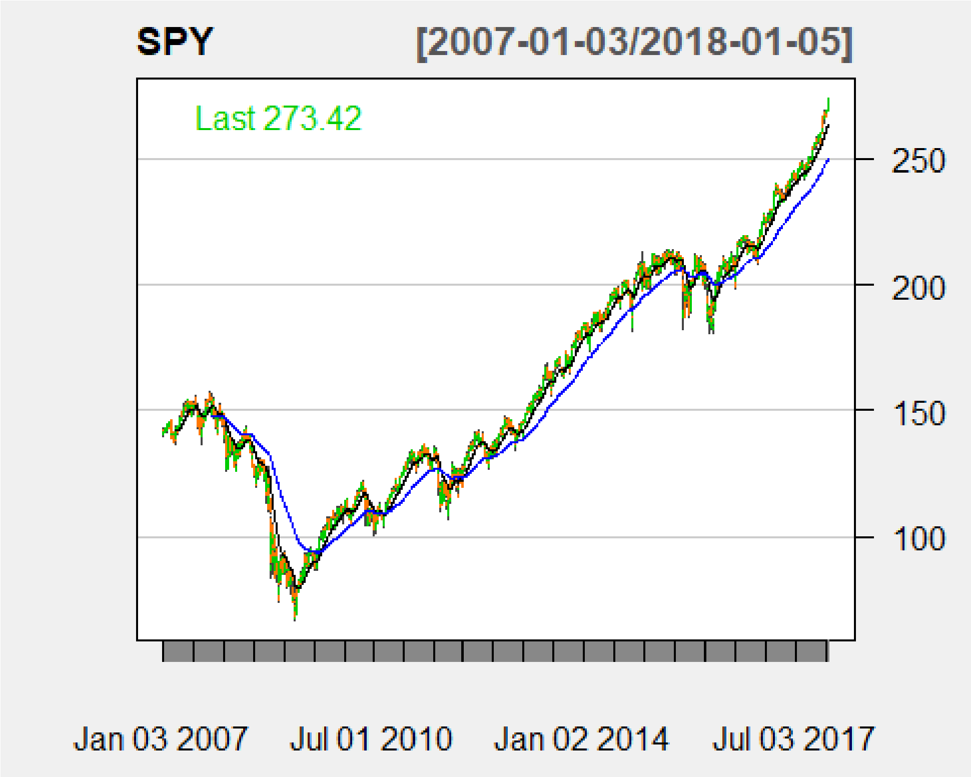
```
# All above action could be simplified by using TTA package same as below:
chartSeries(QQQ$QQQ.Close, theme="white", TA="addSMA(100)")
```



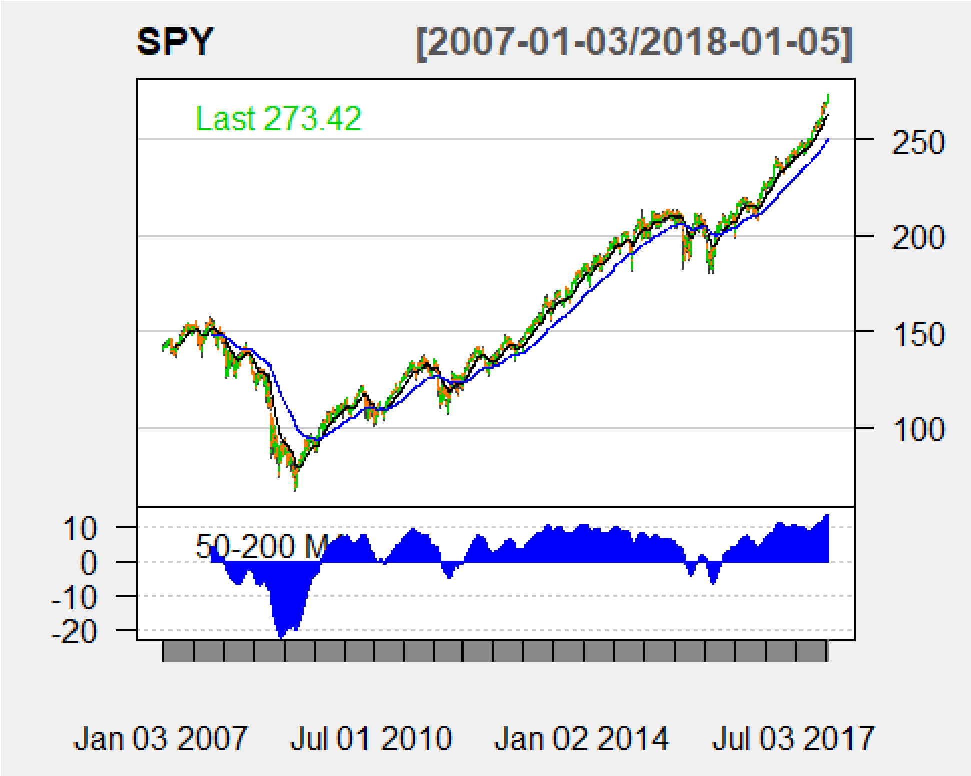
```r
# Following the trend with multiple moving avarge
# Looking at multiple moving averages, the 10, 50 & 200 MAs * Detrending
market action
getSymbols(c('EWP', 'SPY'), src='google')

## [1] "EWP" "SPY"

#Let�s chart the data using a 50 and 200-period moving average.
#These are common periods often used as benchmarks to indicate a
strengthening or weakening stock.
chartSeries(EWP$EWP.Close, theme="white", TA="addEMA(50,
col='black');addEMA(200, col='blue')")
```



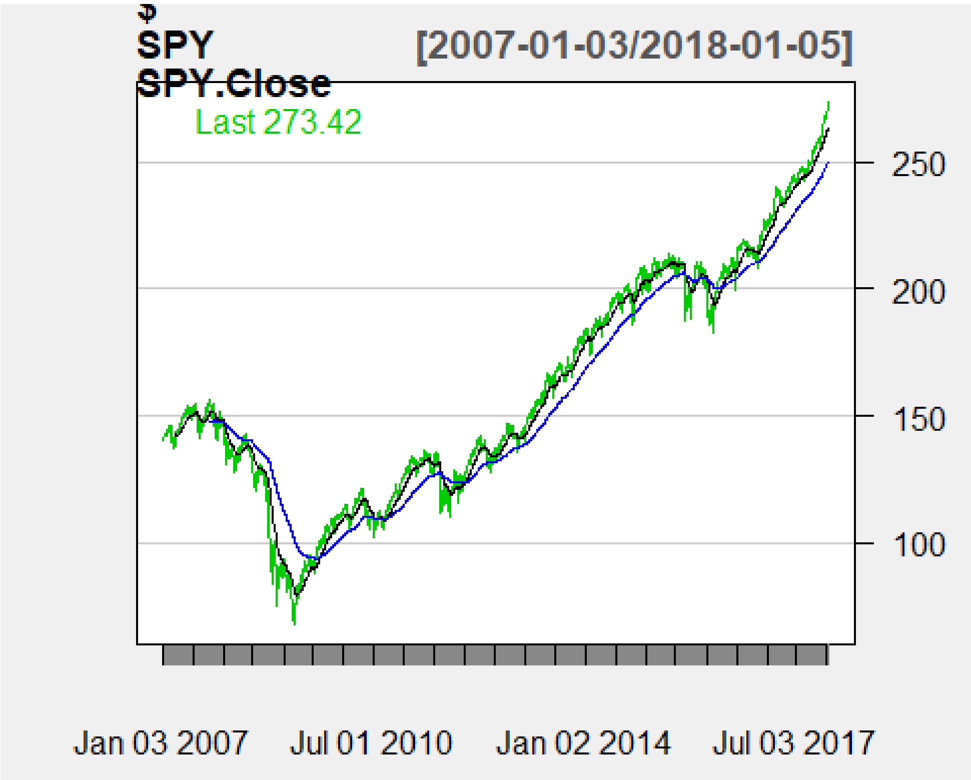
```r
chartSeries(SPY, theme="white", TA="addEMA(50, col='black');addEMA(200,
col='blue')")
```



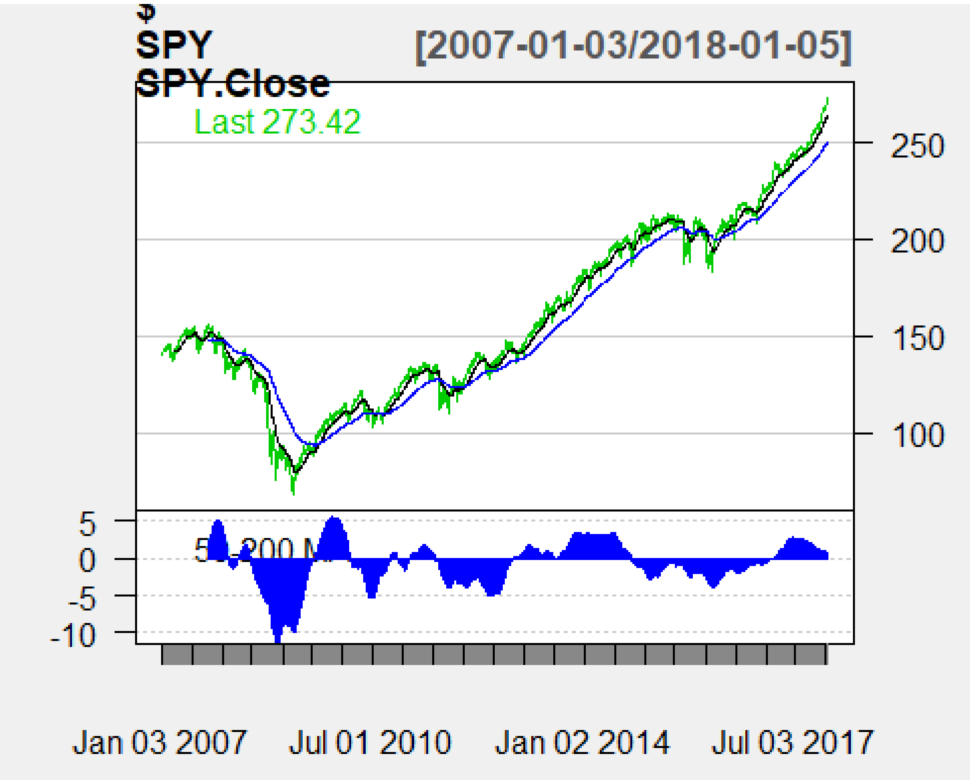
```
#Having two moving averages of different periods removes a lot of the noise.
#When the fast moving average is above the slow one, the market is moving
upwards,
#and when the fast is below the slow, it is going down. Some traders will
look at the
#crossing of these moving averages to take a directional position


SPY.EMA.50<- EMA(SPY$SPY.Close, n=50, )
SPY.EMA.200<- EMA(SPY$SPY.Close, n=200, )
#SPY.EMA.50 fast change
#SPY.EMA.200 slow change
addTA(SPY.EMA.50 - SPY.EMA.200,col='blue', type='h',legend="50-200 MA")
```



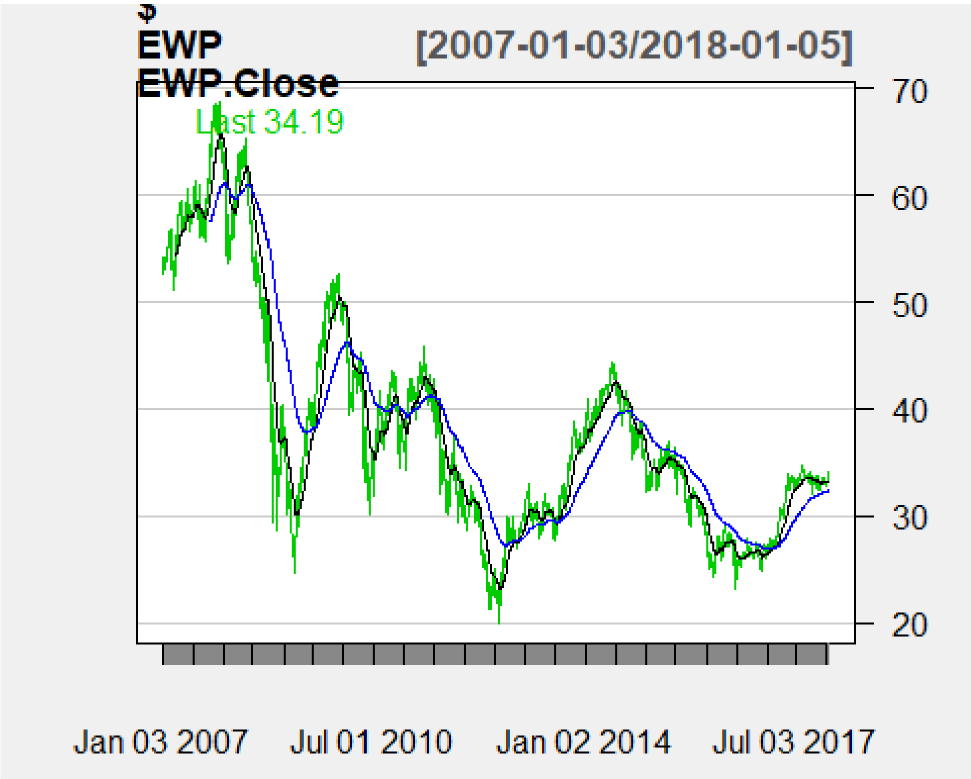
```
chartSeries(SPY$SPY.Close, theme="white", TA="addEMA(50,
col='black');addEMA(200, col='blue')")
```



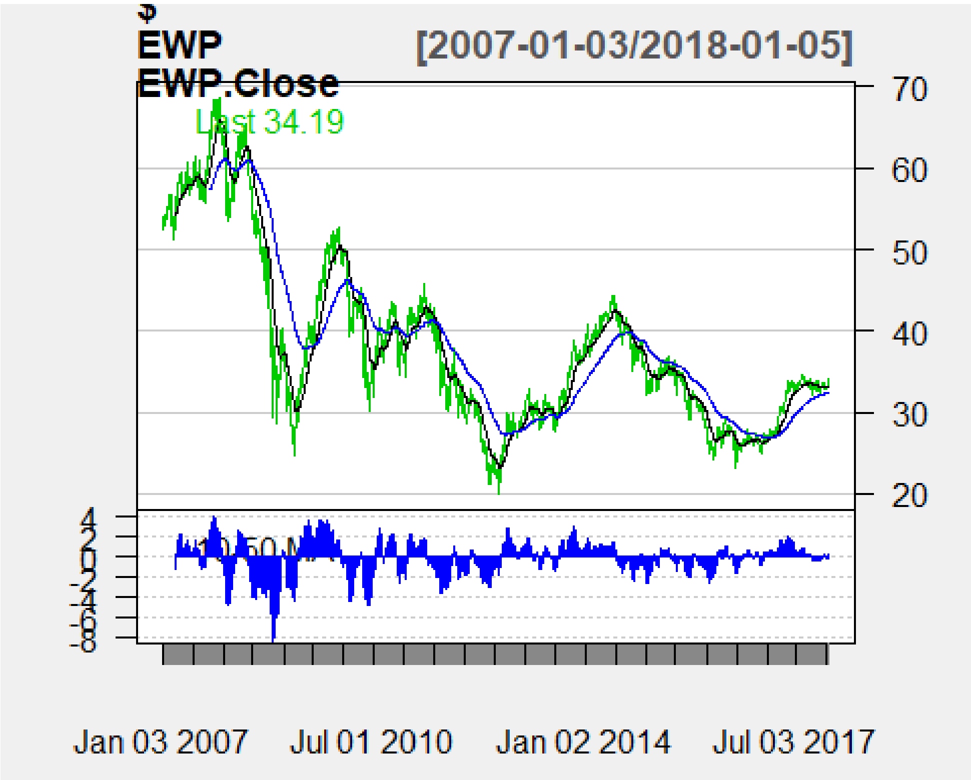
```
EWP.EMA.50 <- EMA(EWP$EWP.Close, n=50, )
EWP.EMA.200 <- EMA(EWP$EWP.Close, n=200, )
addTA(EWP.EMA.50 - EWP.EMA.200, col='blue', type='h',legend="50-200 MA")
```



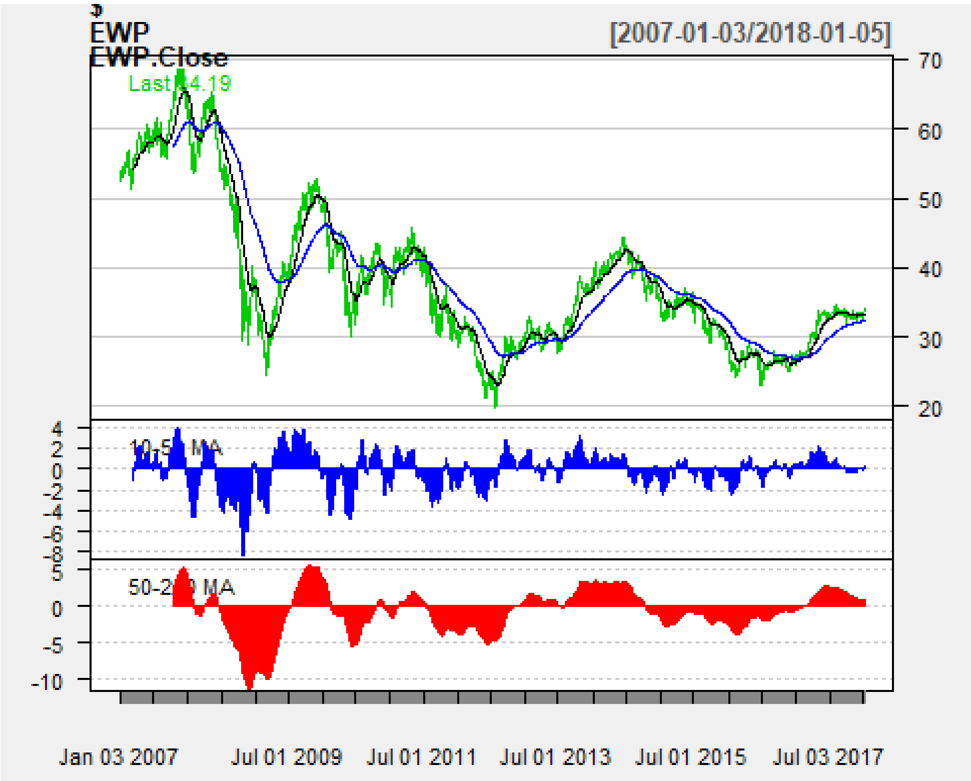
```
chartSeries(EWP$EWP.Close, theme="white", TA="addEMA(50,
col='black');addEMA(200, col='blue')")
```



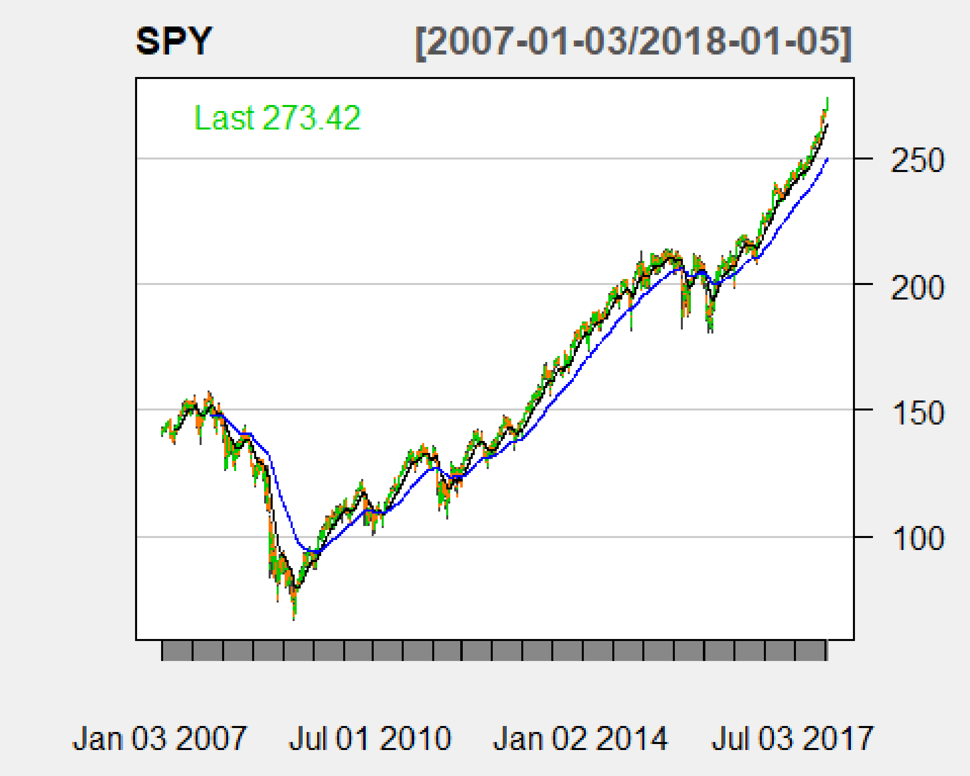
```
# everyting below Zero - You should not be long - and keep the Index ,
Holding
# everything above Zero - You should not be short - and sell the Index ,
Holding
# Let's look into three avarage moving , I'm adding 10 period

EWP.EMA.10 <- EMA(EWP$EWP.Close, n=10, )
EWP.EMA.50 <- EMA(EWP$EWP.Close, n=50, )
EWP.EMA.200 <- EMA(EWP$EWP.Close, n=200, )
Fast.Diff <- EWP.EMA.10 - EWP.EMA.50
Slow.Diff <- EWP.EMA.50 - EWP.EMA.200
addTA(Fast.Diff, col='blue', type='h',legend="10-50 MA")
```



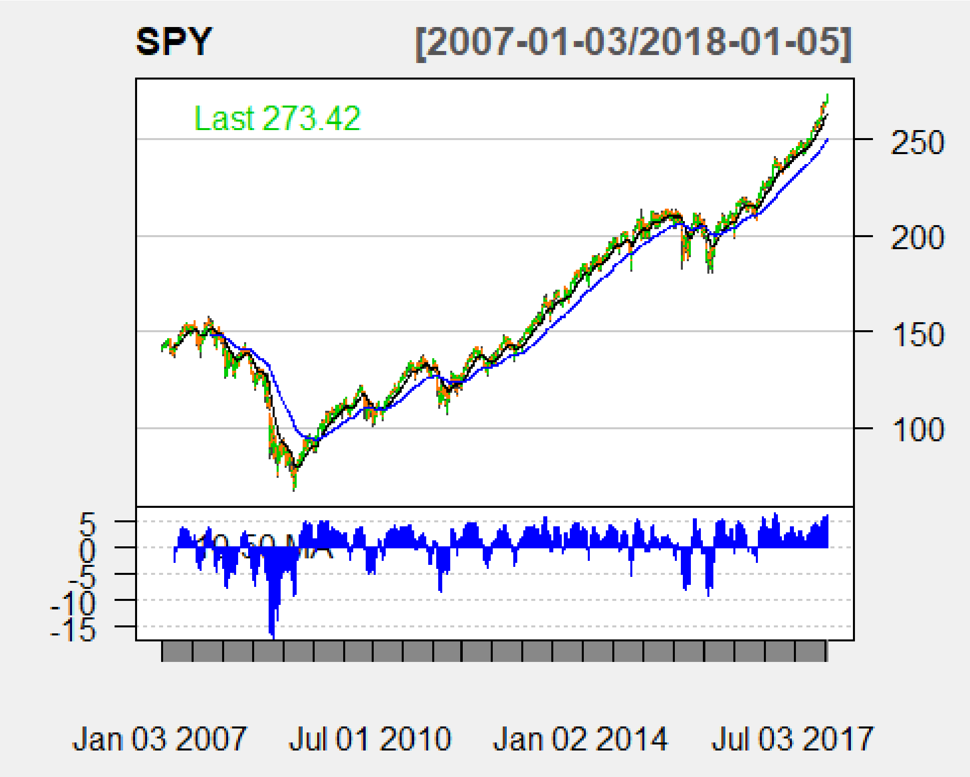
```
addTA(Slow.Diff, col='red', type='h',legend="50-200 MA")
```



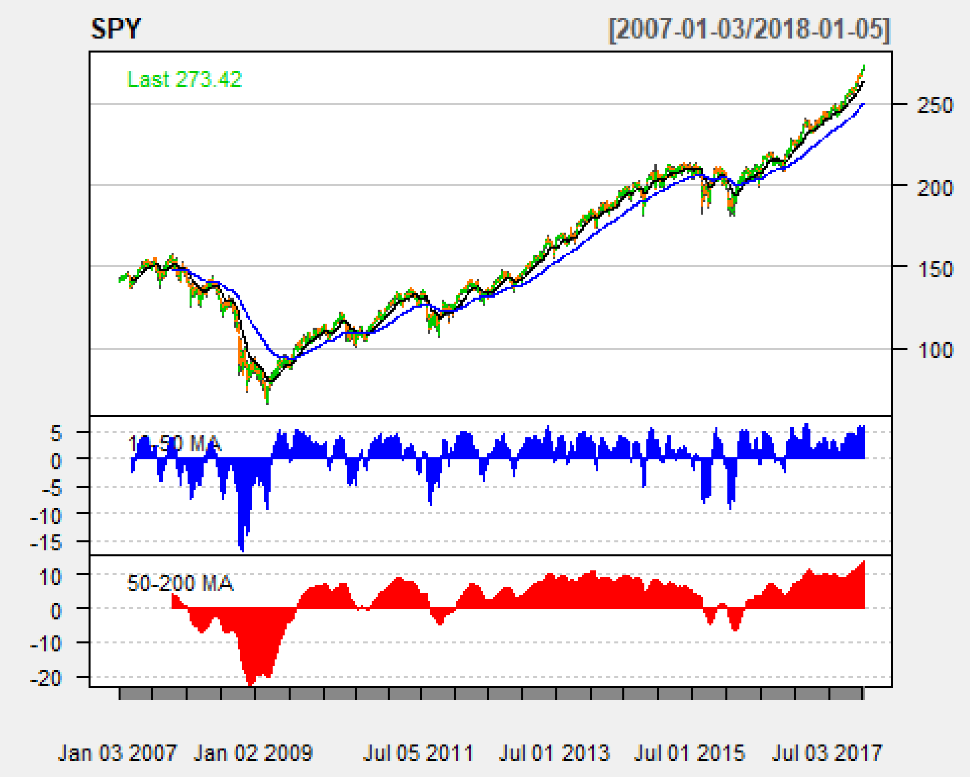
```
chartSeries(SPY, theme="white", TA="addEMA(50, col='black');addEMA(200,
col='blue')")
```



```
SPY.EMA.10 <- EMA(SPY$SPY.Close, n=10, )
SPY.EMA.50 <- EMA(SPY$SPY.Close, n=50, )
SPY.EMA.200 <- EMA(SPY$SPY.Close, n=200, )
Fast.Diff <- SPY.EMA.10 - SPY.EMA.50
Slow.Diff <- SPY.EMA.50 - SPY.EMA.200
addTA(Fast.Diff, col='blue', type='h',legend="10-50 MA")
```



```
addTA(Slow.Diff, col='red', type='h',legend="50-200 MA")
```



```
#Trading With The Trend

#You can only enter in the direction of the red Slow.Diff indicator,
#if its above zero you can take long signals, if its below zero,
#you can take short signals. The Fast.Diff indicator dictates the entries.
#When the blue line goes from negative to positive, its a long trade (and the
slower red Slow.Diff indicator is above zero).
#Same thing for shorts. This is also referred to as a moving average
crossover trading system.

#To run this system, we need to build rules to hunt them down.

#The rules are:

#    if no position: red > 0 and blue-1 < 0 and blue > 0 go long
#    if long: blue < 0 exit long

#    if no position: red < 0 and blue-1 > 0 and blue < 0 go short
#    if short: blue > 0 exit short
# New chalange would to find the blue -1 means, meaning lag of blue, Pre.
price .
print ("STEP 2.5:Trading With The Trend")

## [1] "STEP 2.5:Trading With The Trend"

library(binhf)

## Warning: package 'binhf' was built under R version 3.3.3

## Loading required package: wavethresh

## Warning: package 'wavethresh' was built under R version 3.3.3

## Loading required package: MASS

## WaveThresh: R wavelet software, release 4.6.8, installed

## Copyright Guy Nason and others 1993-2016

## Note: nlevels has been renamed to nlevelsWT

## Loading required package: adlift

## Warning: package 'adlift' was built under R version 3.3.3

## Loading required package: EbayesThresh

## Warning: package 'EbayesThresh' was built under R version 3.3.3

##
##  **********************************************
##  adlift: a package to perform wavelet lifting schemes
```

```
##
##  --- Written by Matt Nunes and Marina Knight ---
##    Current package version:  1.3-3  ( 2017-09-13 )
##
##              -+ packaged by MAN +-
##  **********************************************
##
##  adlift 1.3-3 loaded
```

```
##
## Attaching package: 'adlift'
```

```
## The following object is masked from 'package:EbayesThresh':
##
##     postmean.cauchy
```

```
##
##  **********************************************
##  binhf: Haar-Fisz functions for binomial data
##
##  --- Written by Matt Nunes ---
##    Current package version:  1.0-1  ( 24/04/2014 )
##
##
##  **********************************************
##
##  binhf 1.0-1 loaded
```

```
##
## Attaching package: 'binhf'
```

```
## The following objects are masked from 'package:EbayesThresh':
##
##     negloglik.laplace, wandafromx
```

```
## The following object is masked from 'package:wavethresh':
##
##     madmad
```

```
## The following object is masked from 'package:base':
##
##     norm
```

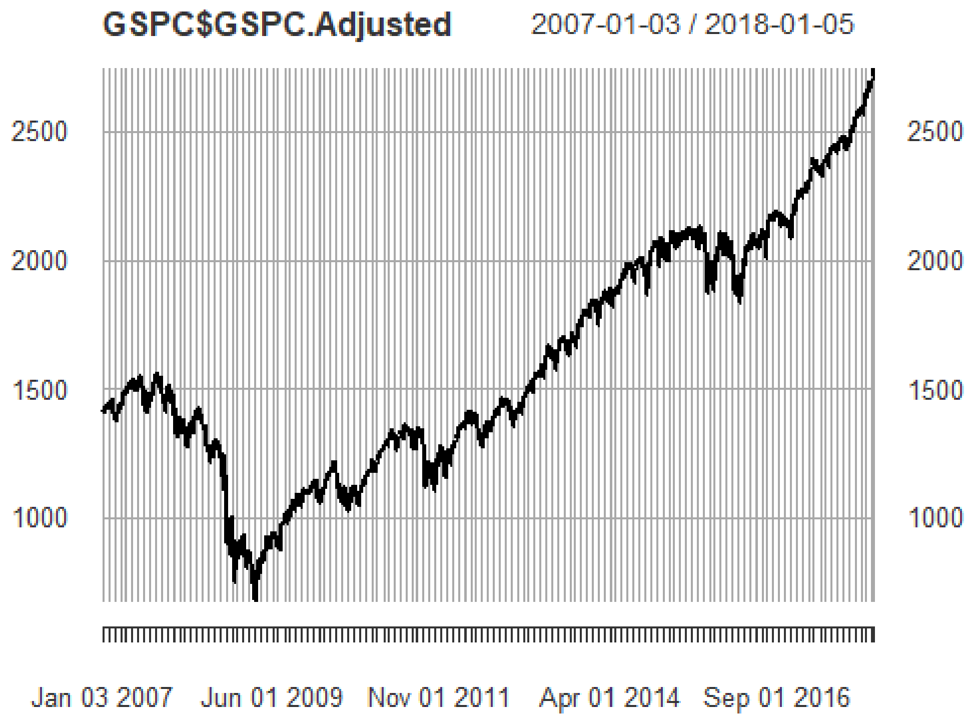
```
tail(as.numeric(Fast.Diff))
```

```
## [1] 5.322173 5.087720 5.139512 5.386004 5.703934 6.171299
```

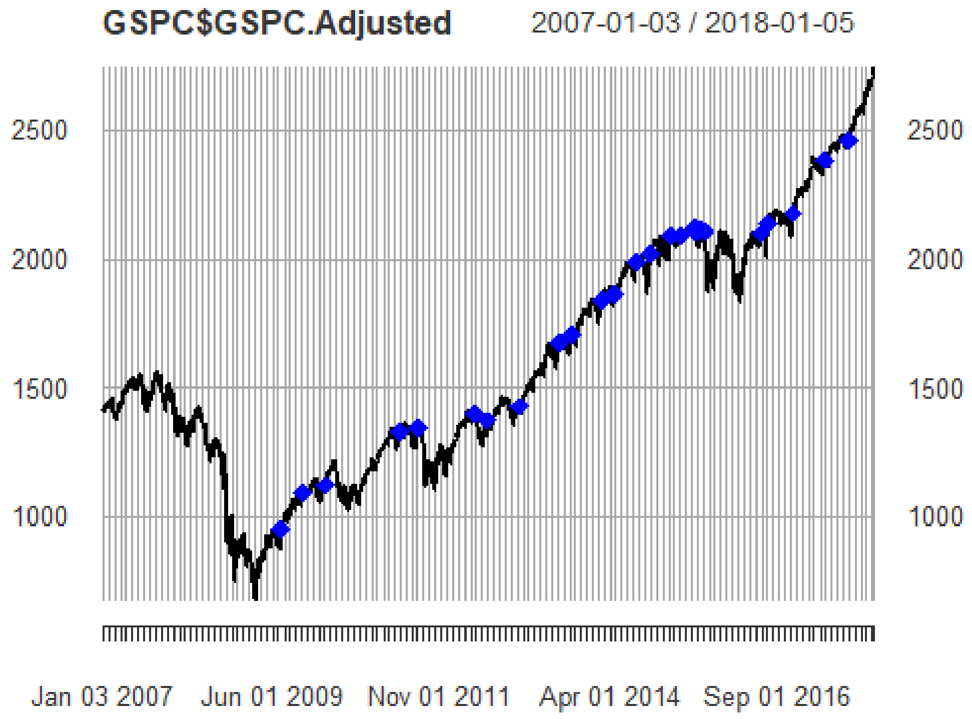
```
# return prev. data
tail(shift(v=as.numeric(Fast.Diff), places=1, dir="right"))
```

```
## [1] 5.388930 5.322173 5.087720 5.139512 5.386004 5.703934
```

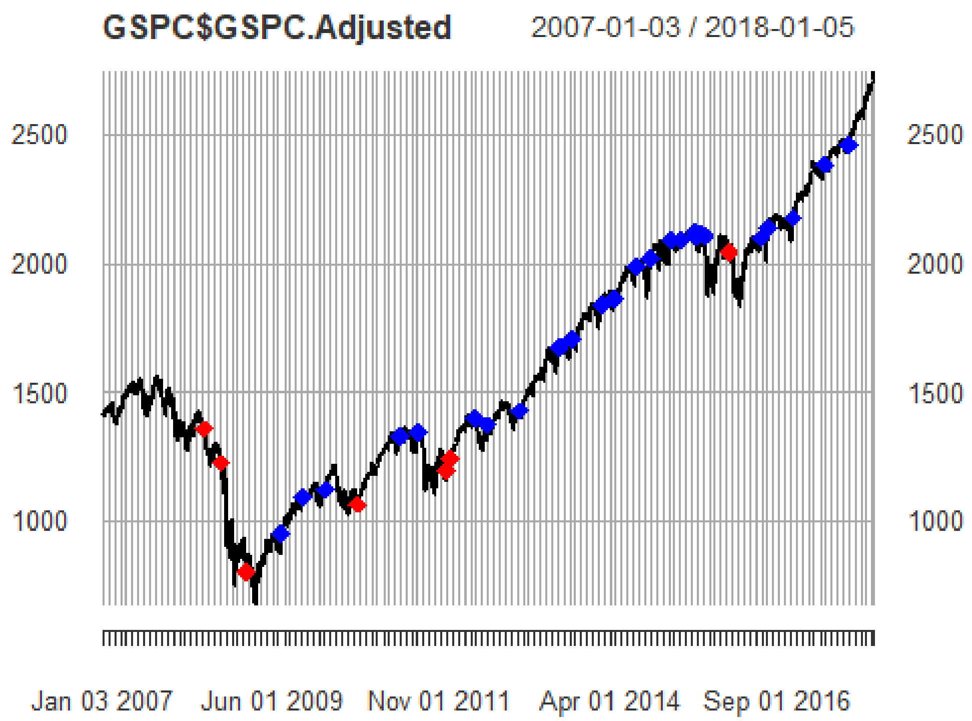
```r
#This allows us to compare the values of two different rows on the same row.
#We still have our indicator value of today, but we now can compare it with
yesterday�s value on the same row.
#Sure, we could have just easily created a loop and run through each value
but by doing it this way we stick to vector comparison in its simplest form.

#Now, let�s translate our trend trading system pseudo code into R code:
#Note: Closing price won't give us best price since compay pays dividend /
interest and this price is not accure ah the end of the
# month, Hence I have used Adjusted price.

GSPC.SMA.10 <- SMA(GSPC$GSPC.Adjusted, n=10, )
GSPC.SMA.50 <- SMA(GSPC$GSPC.Adjusted, n=50, )
GSPC.SMA.200 <- SMA(GSPC$GSPC.Adjusted, n=200, )
Fast.Diff <- GSPC.SMA.10 - GSPC.SMA.50
Slow.Diff <- GSPC.SMA.50 - GSPC.SMA.200

# look for long entries
Long_Trades <- ifelse(
Slow.Diff  > 0 &
Fast.Diff  > 0 &
shift(v=as.numeric(Fast.Diff), places=1, dir="right") < 0,
GSPC$GSPC.Adjusted, NA)

# look for long exits (same thing but inverse signts)
Short_Trades <- ifelse(
Slow.Diff  < 0 &
Fast.Diff  < 0 &
shift(v=as.numeric(Fast.Diff), places=1, dir="right") > 0,
GSPC$GSPC.Adjusted, NA)
plot(GSPC$GSPC.Adjusted)
```



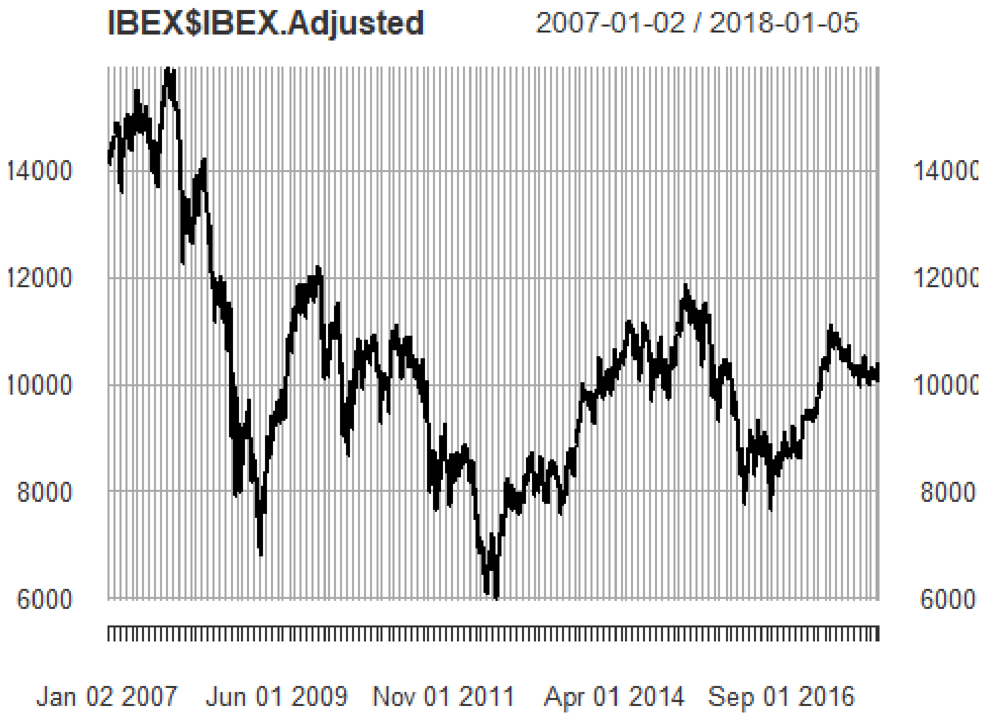
```
## Warning in plot.xts(EWP): only the univariate series will be plotted
points(Long_Trades, col='blue', cex=1.5, pch=18)
```



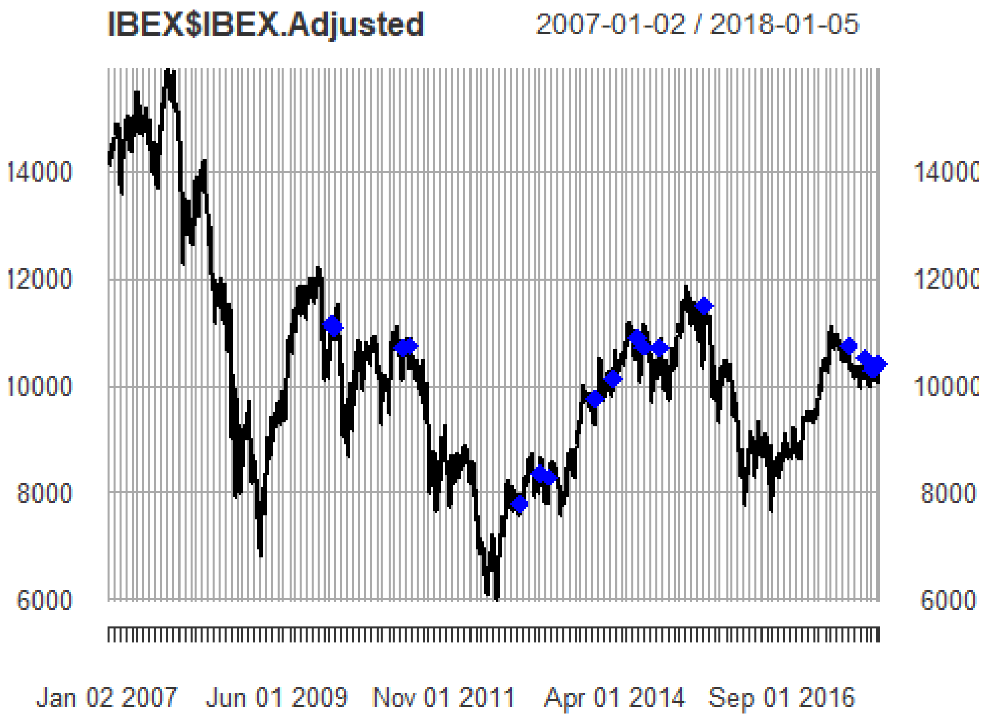
```r
points(Short_Trades, col='red', cex=1.5, pch=18)
```



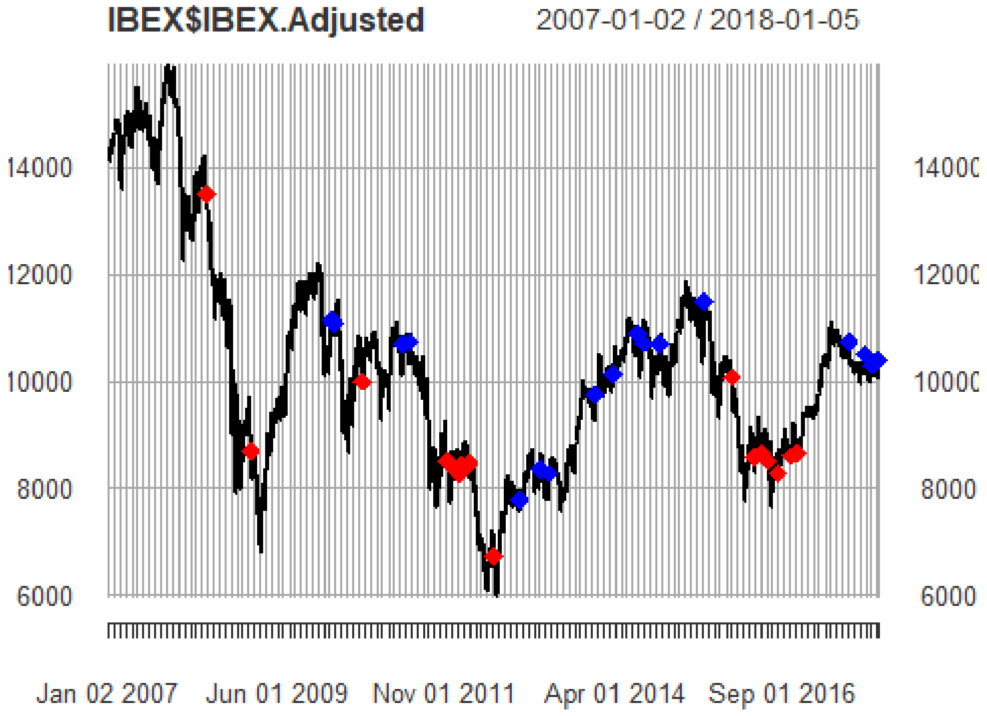
```r
#Mixture of entry points and that is usually how it works on a trading,
bouncing trend.
#Though we aren�t going to design full trending systems here, a stop-loss
exit order is key to any directional
#trading so you don�t lose everything! Let�s see what it does on trending
market:



IBEX.EMA.10 <- EMA(IBEX$IBEX.Adjusted, n=10 )
IBEX.EMA.50 <- EMA(IBEX$IBEX.Adjusted, n=50, )
IBEX.EMA.200 <- EMA(IBEX$IBEX.Adjusted, n=200, )
Fast.Diff <- IBEX.EMA.10 - IBEX.EMA.50
Slow.Diff <- IBEX.EMA.50 - IBEX.EMA.200

# look for long entries
Long_Trades <- ifelse(
  Slow.Diff  > 0 &
    Fast.Diff  > 0 &
    shift(v=as.numeric(Fast.Diff), places=1, dir="right") < 0,
IBEX$IBEX.Adjusted, NA)

# look for long exits (same thing but inverse signts)
Short_Trades <- ifelse(
  Slow.Diff  < 0 &
    Fast.Diff  < 0 &
    shift(v=as.numeric(Fast.Diff), places=1, dir="right") > 0,
IBEX$IBEX.Adjusted, NA)

plot(IBEX$IBEX.Adjusted)
```



```
points(Long_Trades, col='blue', cex=1.5, pch=18)
```

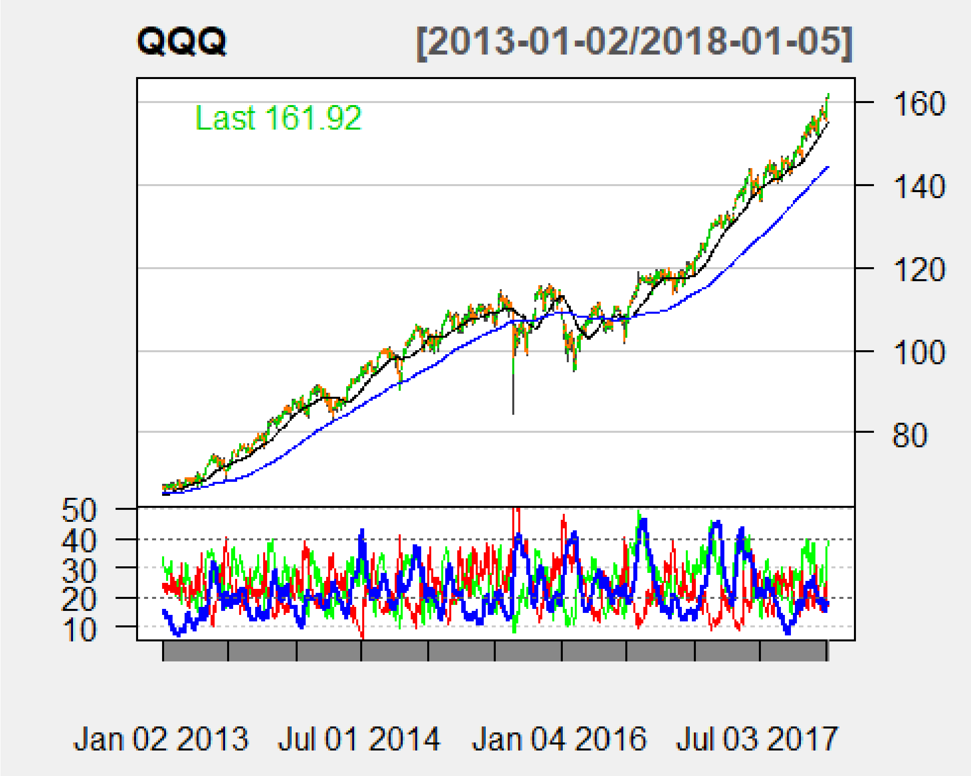


```
points(Short_Trades, col='red', cex=1.5, pch=18)
```

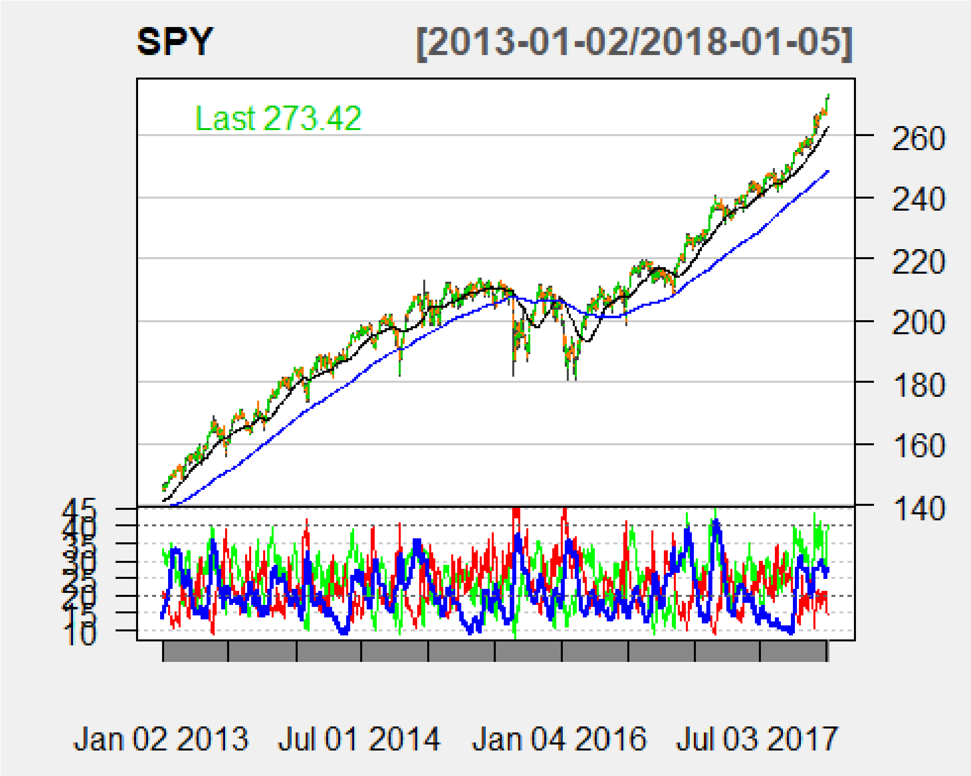


```
print ("STEP 2.6:Volume-based indicators")
```

```
## [1] "STEP 2.6:Volume-based indicators"

library(quantmod)
getSymbols(c('QQQ', 'SPY'), src='google')

## [1] "QQQ" "SPY"

# remove any NAs
QQQ <- QQQ[!(rowSums(is.na(QQQ))),]
SPY <- SPY[!(rowSums(is.na(SPY))),]

library(TTR)

#The ADX is Welles Wilder�s Directional Movement Indicator. It is used by
lots of people to determine if the market is trending or range bound.
# Refrence: https://en.wikipedia.org/wiki/Average_directional_movement_index
chartSeries(QQQ, theme="white", TA="addSMA(50, col='black');addSMA(200,
col='blue');addADX(n = 14, maType='EMA', wilder=TRUE)", subset='2013::')
```

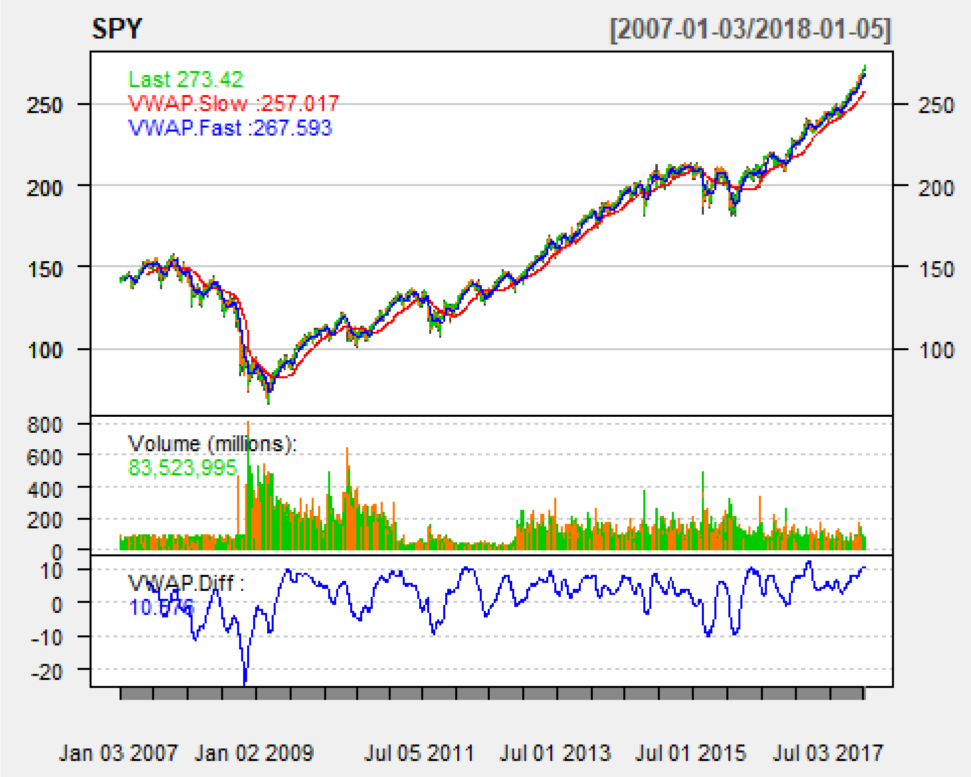


```
# Look into price as of 2013 and onward
chartSeries(SPY, theme="white", TA="addSMA(50, col='black');addSMA(200,
col='blue');addADX(n = 14, maType='EMA', wilder=TRUE)", subset='2013::')
```

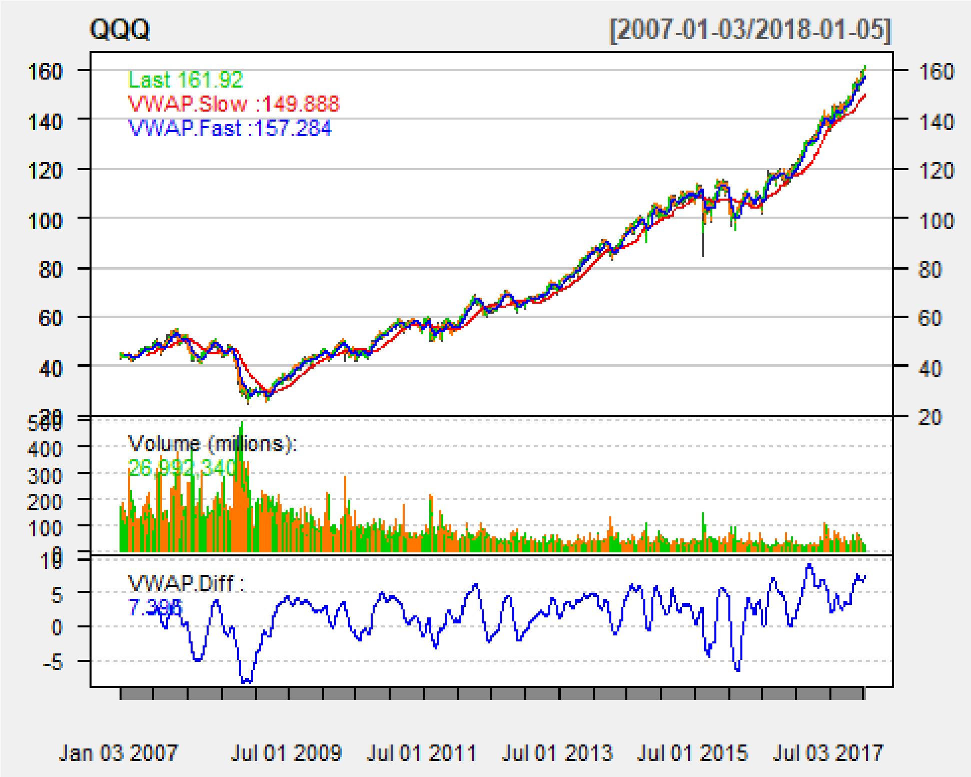


```
#In a nutshell, Welles recommends using the ADX with a 14-day period. When
the main blue line is above 20, it is considered a strong,
#trending market, when it is below, it is considered a weak one.
#Volume

#As this is an introductory course, we�re mostly using the closing price but
it is important to note that there are a lot of other market variables
available.
#You can design systems with the open price, the high or low, the difference
between the open and close, etc. And there is also the volume.

#This an important indicator. A falling stack on rising volume or a rising
stock on falling volume may mean the move is about to
#reverse. Whatever the reason for abnormal volume, it should be a warning to
keep a vigilant eye on the stock.

#There are plenty of indicators that include the volume price such as the
Volume-weighted average price (VWAP).
#The VWAP is a guide more than a trading indicator as to where the market is
trading compared to the volume adjusted price.
#It divides dollars traded by volume (see above link for more details).

VWAP.Slow <- VWAP(price=SPY$SPY.Close, volume=SPY$SPY.Volume, n=100)
VWAP.Fast <- VWAP(price=SPY$SPY.Close, volume=SPY$SPY.Volume, n=20)
VWAP.Diff <- VWAP.Fast- VWAP.Slow
```

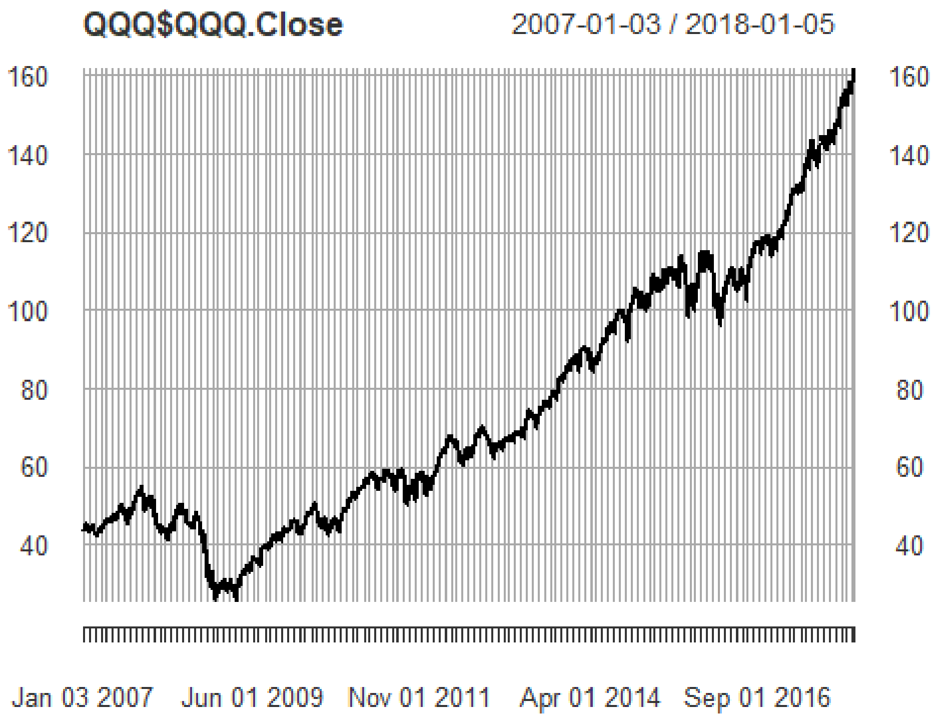
```
chartSeries(SPY, theme="white", TA="addVo();addTA(VWAP.Slow, on=1,
col='red');addTA(VWAP.Fast, on=1, col='blue');addTA(VWAP.Diff, col='blue')")
```



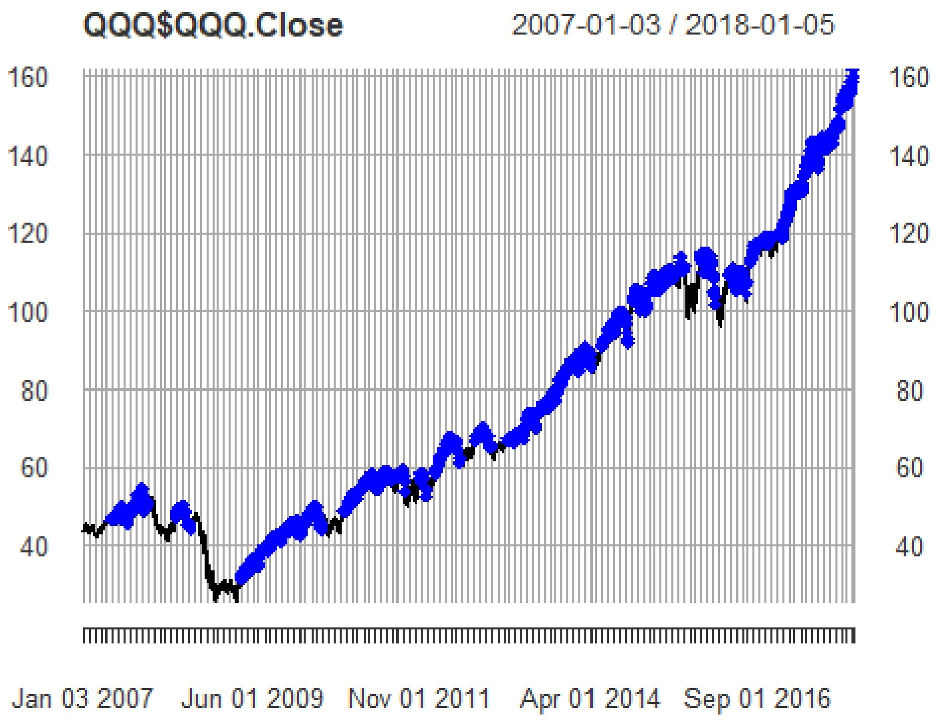
```
# QQQ
VWAP.Slow <- VWAP(price=QQQ$QQQ.Close, volume=QQQ$QQQ.Volume, n=100)
VWAP.Fast <- VWAP(price=QQQ$QQQ.Close, volume=QQQ$QQQ.Volume, n=20)
VWAP.Diff <- VWAP.Fast- VWAP.Slow

chartSeries(QQQ, theme="white", TA="addVo();addTA(VWAP.Slow, on=1,
col='red');addTA(VWAP.Fast, on=1, col='blue');addTA(VWAP.Diff, col='blue')")
```



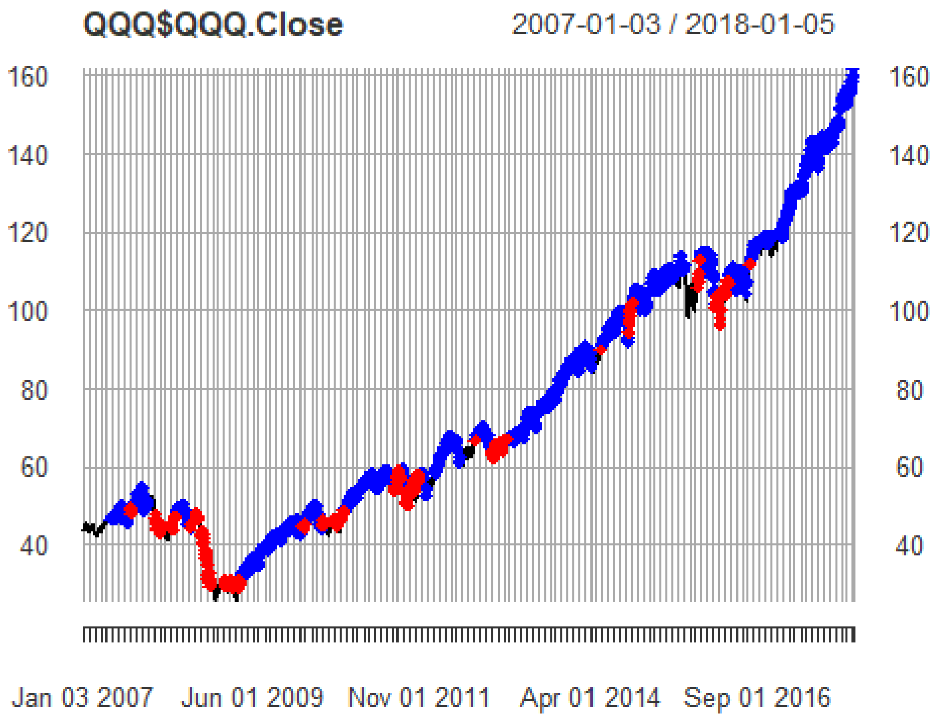
```
ADX.20 <- ADX(QQQ,n=14)

# look for long entries
Long_Trades <- ifelse(
  ADX.20$ADX > 20 &
    VWAP.Diff> 0, QQQ$QQQ.Close, NA)

# look for long entries
Short_Trades <- ifelse(
  ADX.20$ADX > 20 &
    VWAP.Diff < 0, QQQ$QQQ.Close, NA)

plot(QQQ$QQQ.Close)
```



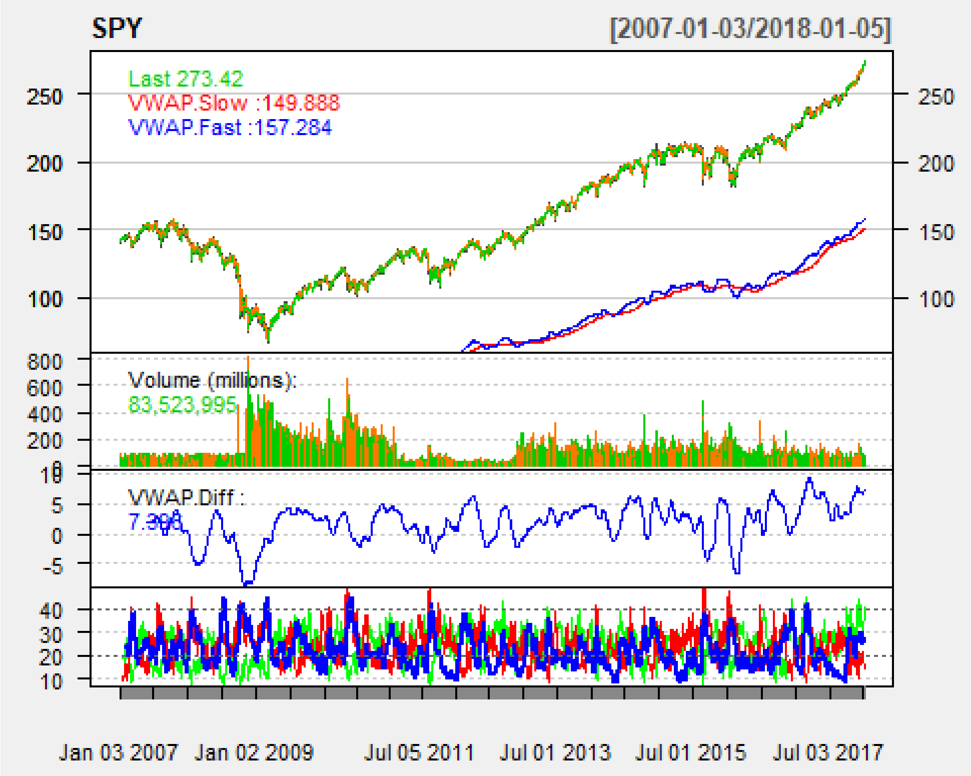
```
points(Long_Trades, col='blue', cex=1, pch=18)
```



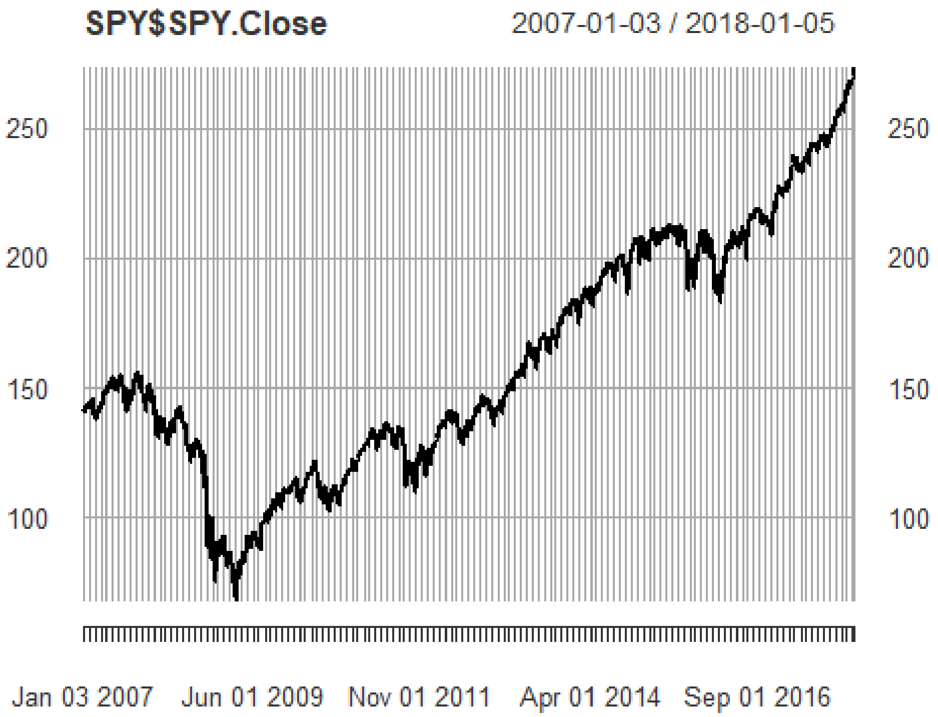
```
points(Short_Trades, col='red', cex=1, pch=18)
```



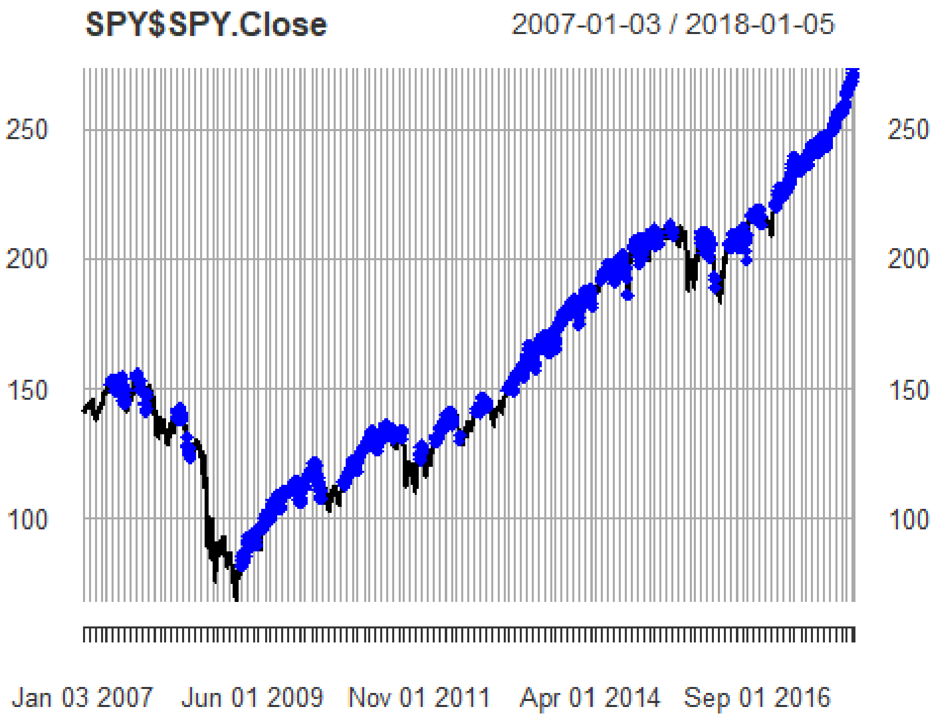
```
chartSeries(SPY, theme="white", TA="addVo();addTA(VWAP.Slow, on=1,
col='red');addTA(VWAP.Fast, on=1, col='blue');addTA(VWAP.Diff, col='blue');
            addADX(n = 14, maType='EMA', wilder=TRUE)")
```



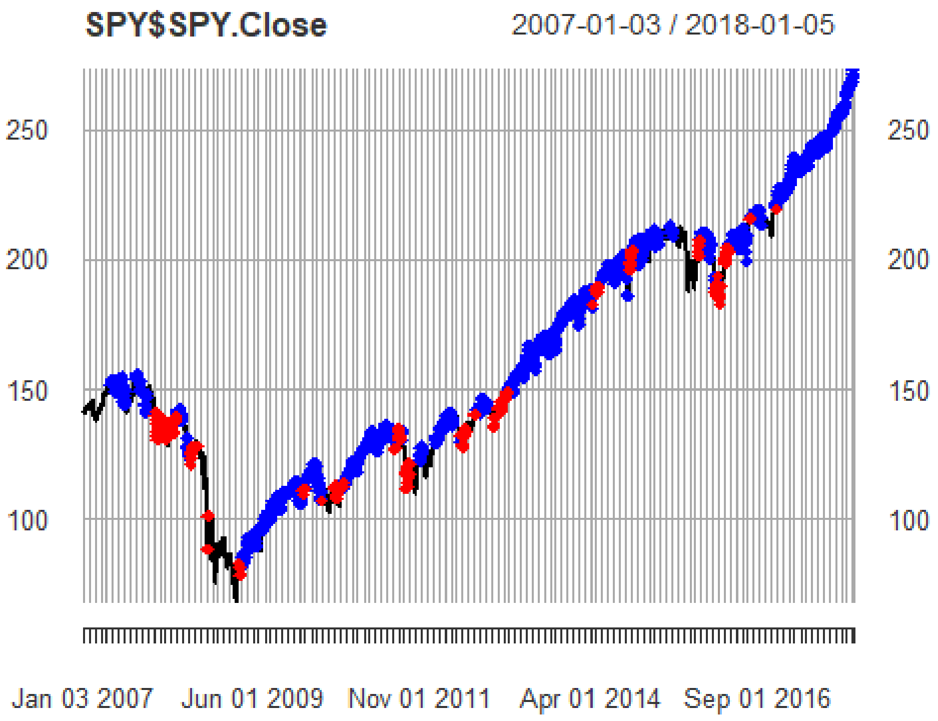
```
ADX.20 <- ADX(SPY,n=14)

# look for long entries
Long_Trades <- ifelse(
        ADX.20$ADX > 20 &
        VWAP.Diff> 0, SPY$SPY.Close, NA)

# look for long entries
Short_Trades <- ifelse(
        ADX.20$ADX > 20 &
        VWAP.Diff < 0, SPY$SPY.Close, NA)

plot(SPY$SPY.Close)
```



```
## Warning in plot.xts(SPY): only the univariate series will be plotted
points(Long_Trades, col='blue', cex=1, pch=18)
```

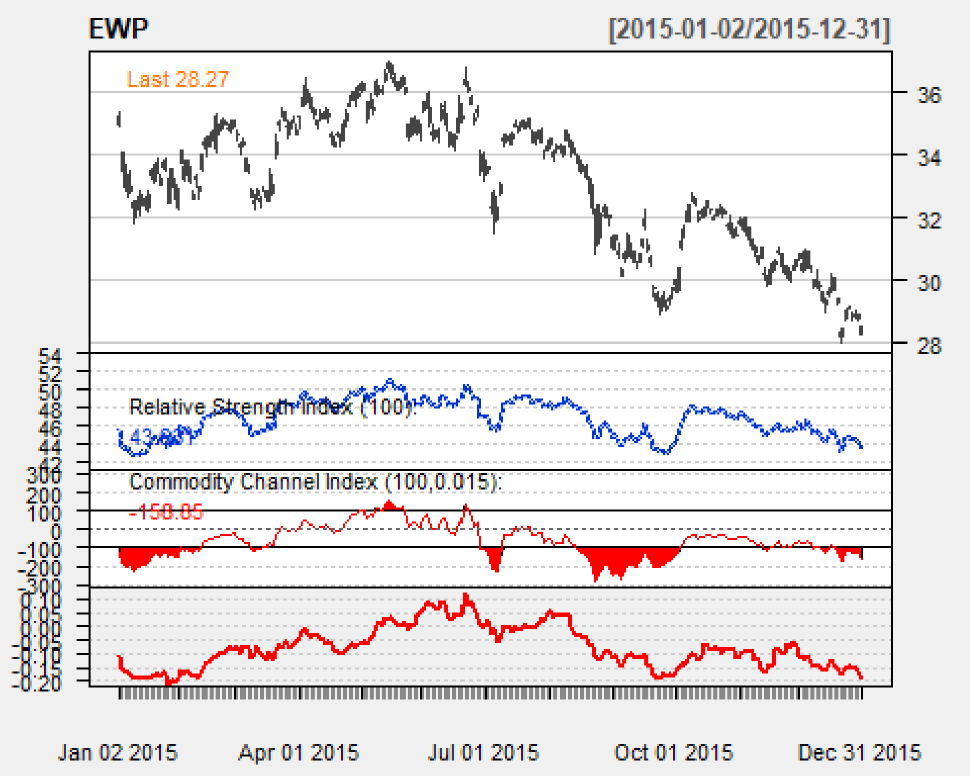


```
points(Short_Trades, col='red', cex=1, pch=18)
```

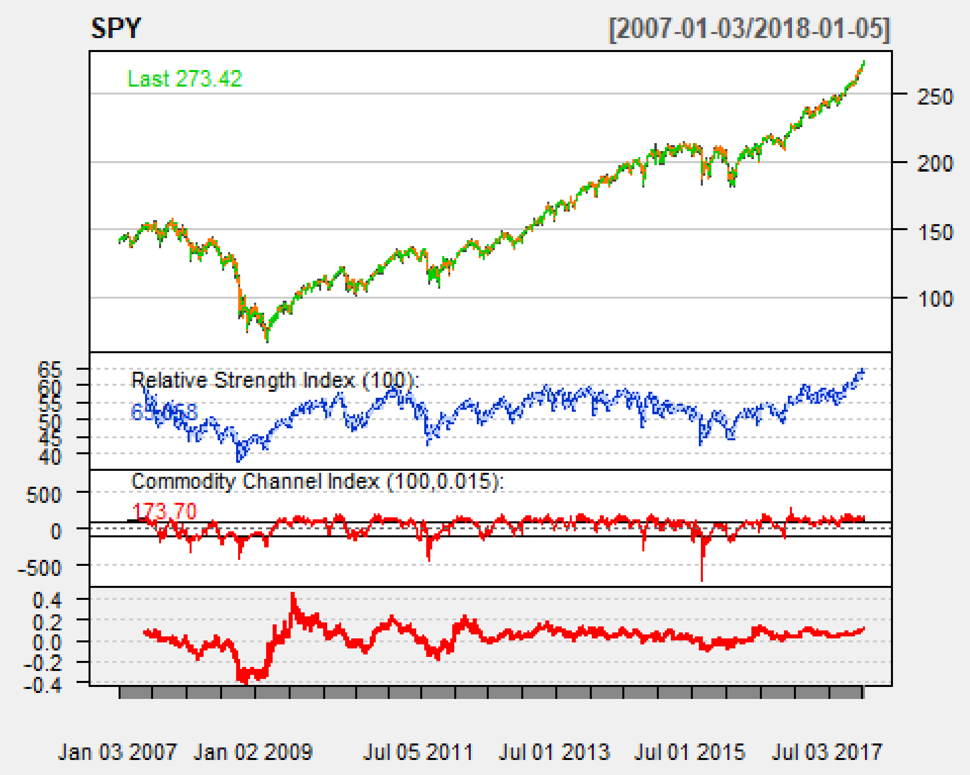


```
print ("STEP 2.7: Counter-Trend Systems including * Momentum Indicators *
Volatility Indicator * Counter-Trend Systems")

## [1] "STEP 2.7: Counter-Trend Systems including * Momentum Indicators *
Volatility Indicator * Counter-Trend Systems"

#Counter-trend systems are tricky. You trade raw counter trends when you�re
sure you�re in a range-bound market
#and are trading at the extremes otherwise you use added indicators to stay
aligned with longer-term trends.
#Raw counter-trend trading feels like picking tops and bottoms, and those
rarely work out.
#Here we�ll focus on trading the short-term counter trend, while following
the long-term trend.


library(binhf)
library(quantmod)
getSymbols(c('EWP', 'SPY'), src='google')

## [1] "EWP" "SPY"

# remove any NAs
EWP <- EWP[!(rowSums(is.na(EWP))),]
SPY <- SPY[!(rowSums(is.na(SPY))),]




#Momentum Indicators

#We�re going to look at 3 interesting momentum indicators that capture short-
term cycles:

#Relative Strength Index (RSI), is an momentum indicator that measures
movement. Its author, J. Welles Wilder, recommends using a period of 14 and
when it is over 70, it is strongly bought (or overbought) and under 30, it is
strongly sold (or oversold).
#REF: https://en.wikipedia.org/wiki/Relative_strength_index
#Commodity Channel Index (CCI) by Donald Lambert, is a price-derived
indicator revolving around 0, where 100 is usually considered overbought and
-100, oversold.
#REF:https://en.wikipedia.org/wiki/Commodity_channel_index
#Rate of Change (ROC), also a momentum indicator, looks at accelerating and
decelerating market moves.
#REF:https://en.wikipedia.org/wiki/Momentum_(technical_analysis)


#Let�s look at all 3 of them with a 20-period setting:
```

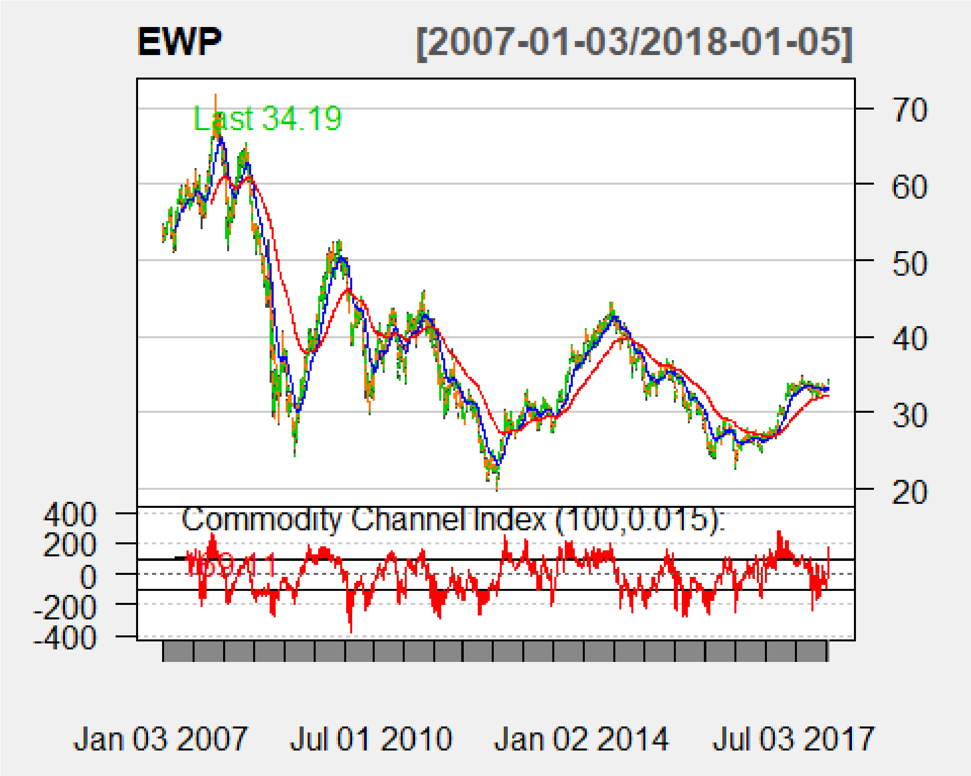
```
chartSeries(EWP, theme="white",
TA="addRSI(n=100);addCCI(n=100);addROC(n=100)", subset='2015')
```



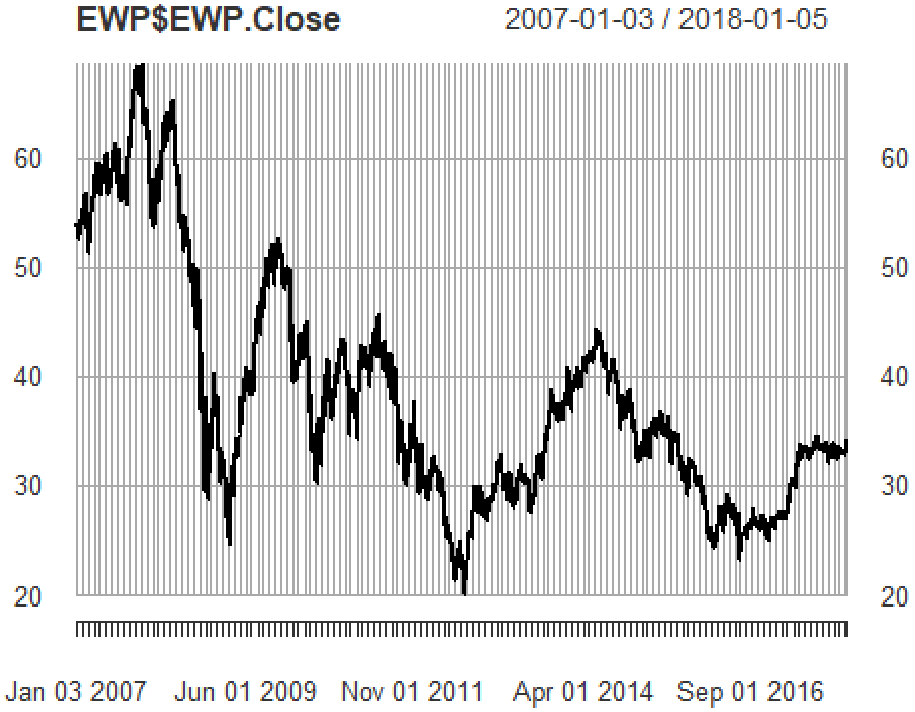
```
chartSeries(SPY, theme="white",
TA="addRSI(n=100);addCCI(n=100);addROC(n=100)")
```



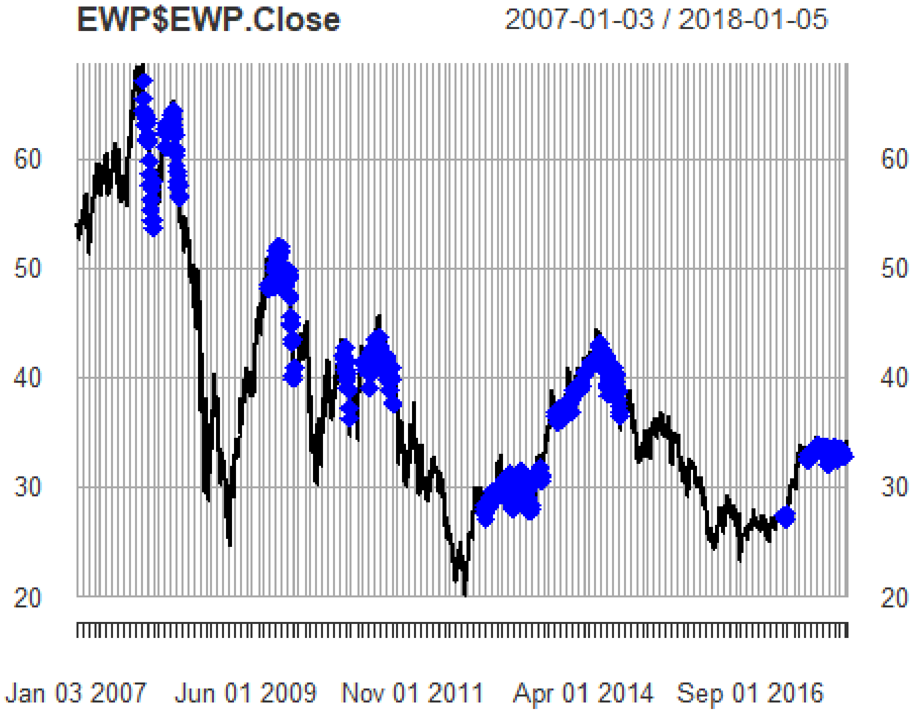
```
#Counter-Trend Systems

#For our counter-trend system, we will counter a faster cycle but stay in the
direction of the slower one. In essence, we�re trading with the slow trend
but against the fast one. While in the previous systems, we only took a trade
while both directions aligned in the direction of the long-term trend.

#The key is to use one of the derived indicators that best signals
overbought/oversold signals.

#We�ll try each one of them with a long-term EMA.

chartSeries(EWP, theme="white",
TA="addCCI(n=100);addEMA(n=50,col='blue');addEMA(n=200,col='red')")
```



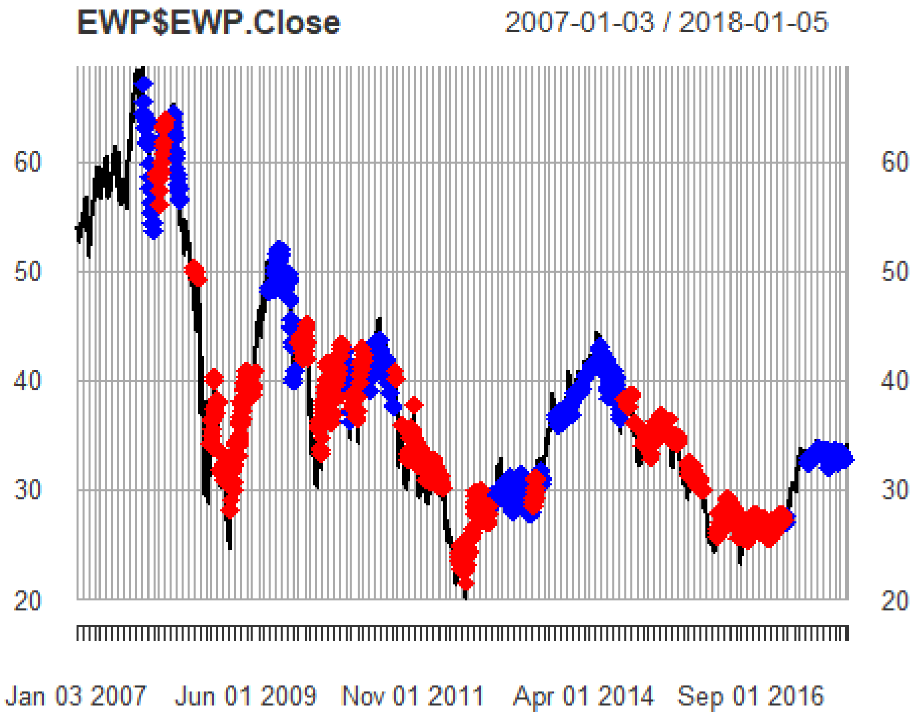
```
# create a slow ema difference
EWP.EMA.50 <- EMA(EWP$EWP.Close, n=50)
EWP.EMA.200 <- EMA(EWP$EWP.Close, n=200)
Slow.Diff <- EWP.EMA.50 - EWP.EMA.200
CCI.IND <- CCI(HLC=EWP[,c("EWP.High","EWP.Low","EWP.Close")],n=100)

# look for long entries
Long_Trades <- ifelse(
  shift(v=as.numeric(CCI.IND), places=1, dir="right") > CCI.IND &
    CCI.IND < 100 &
    Slow.Diff > 0, EWP$EWP.Close, NA)

# look for short entries
Short_Trades <- ifelse(
  shift(v=as.numeric(CCI.IND), places=1, dir="right") < CCI.IND &
    CCI.IND > -100 &
    Slow.Diff < 0, EWP$EWP.Close, NA)

plot(EWP$EWP.Close)
```



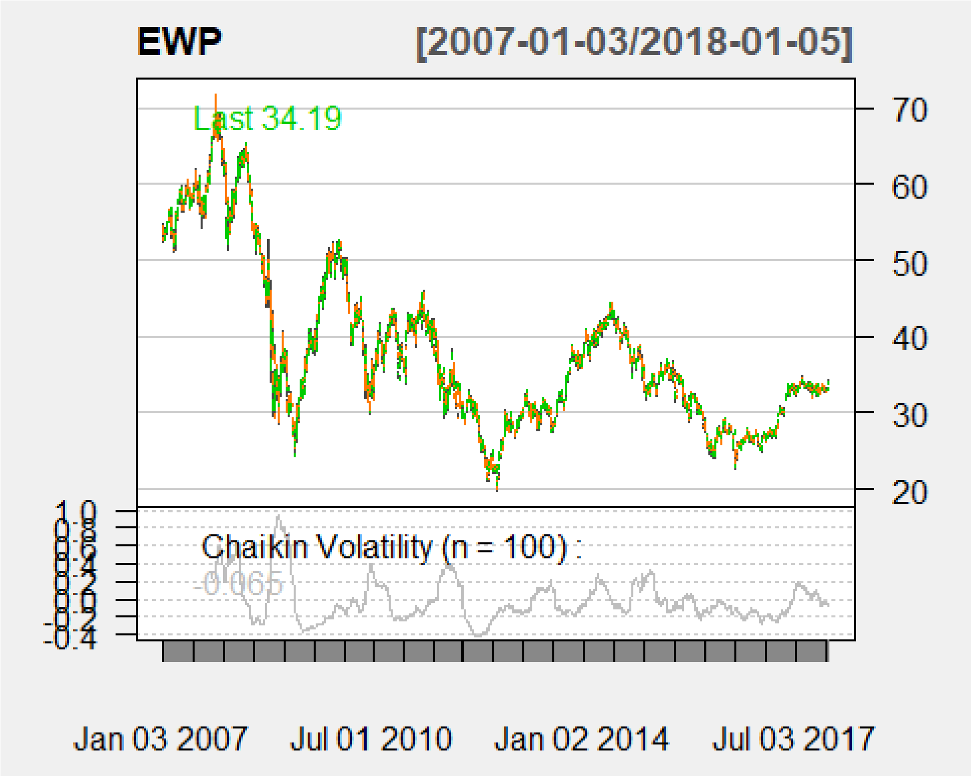
```
## Warning in plot.xts(EWP): only the univariate series will be plotted
points(Long_Trades, col='blue', cex=1.5, pch=18)
```



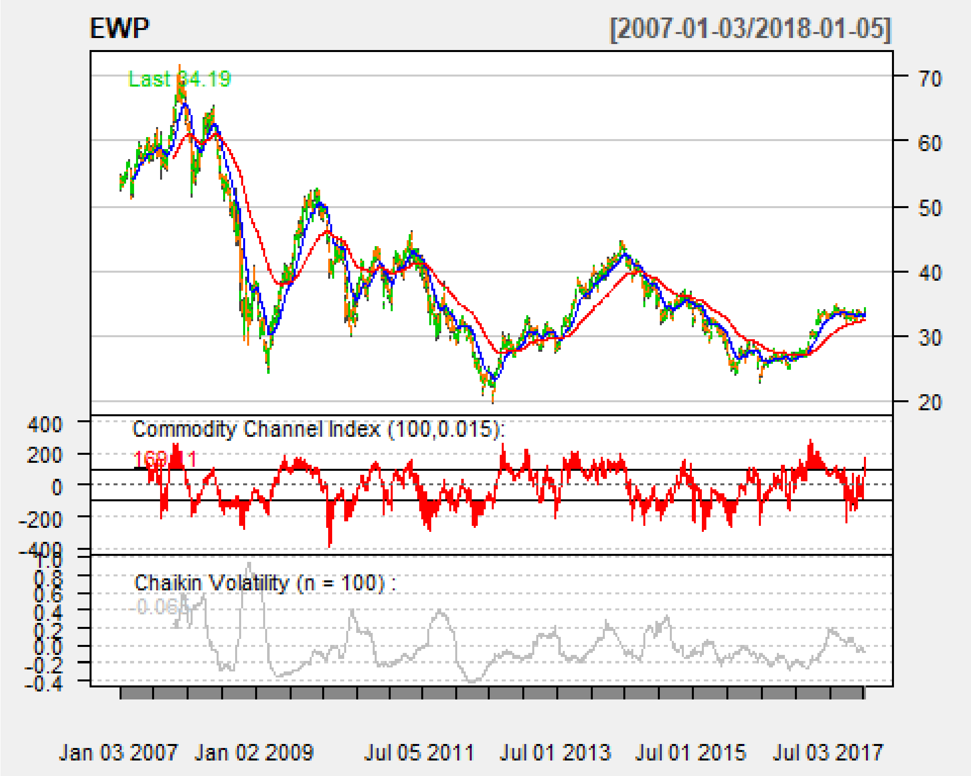
```
points(Short_Trades, col='red', cex=1.5, pch=18)
```



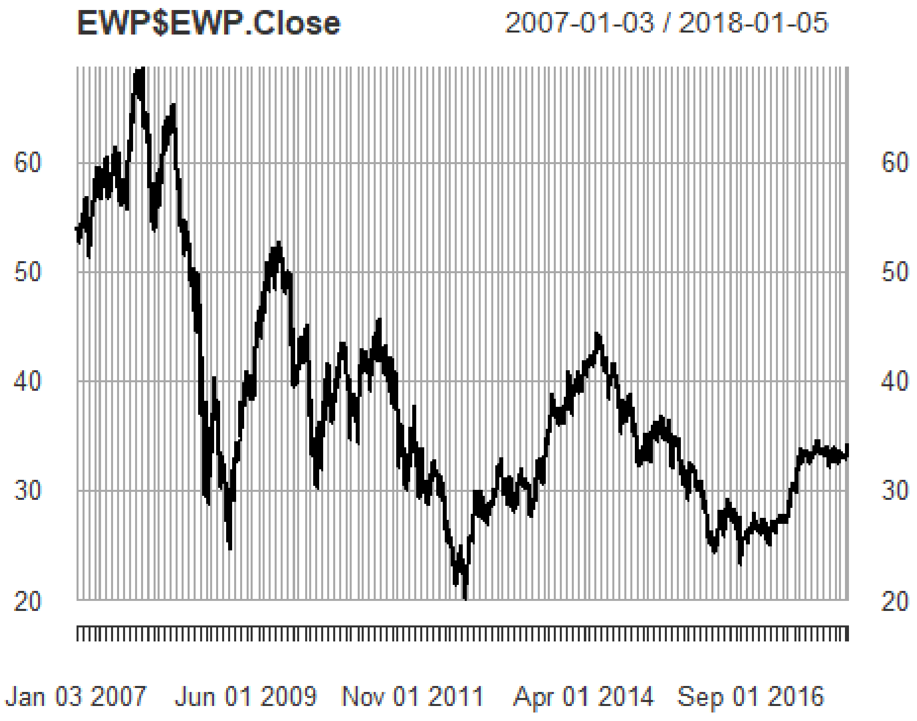
```
#Volatility indicator

#Chaikin Volatility, uses the high, low, close for its
accumulation/distribution and subtracts two moving averages of different
#periods of the AD.

chartSeries(EWP, theme="white", TA="addChVol(n=100);")
```



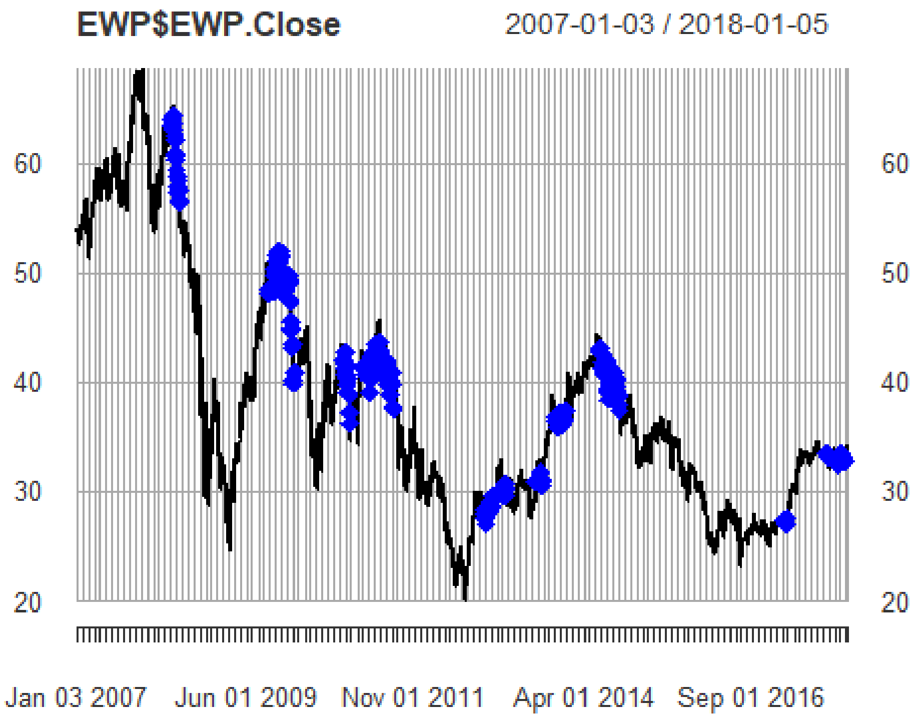
```
chartSeries(EWP, theme="white",
TA="addCCI(n=100);addEMA(n=50,col='blue');addEMA(n=200,col='red');addChVol(n=
100);")
```



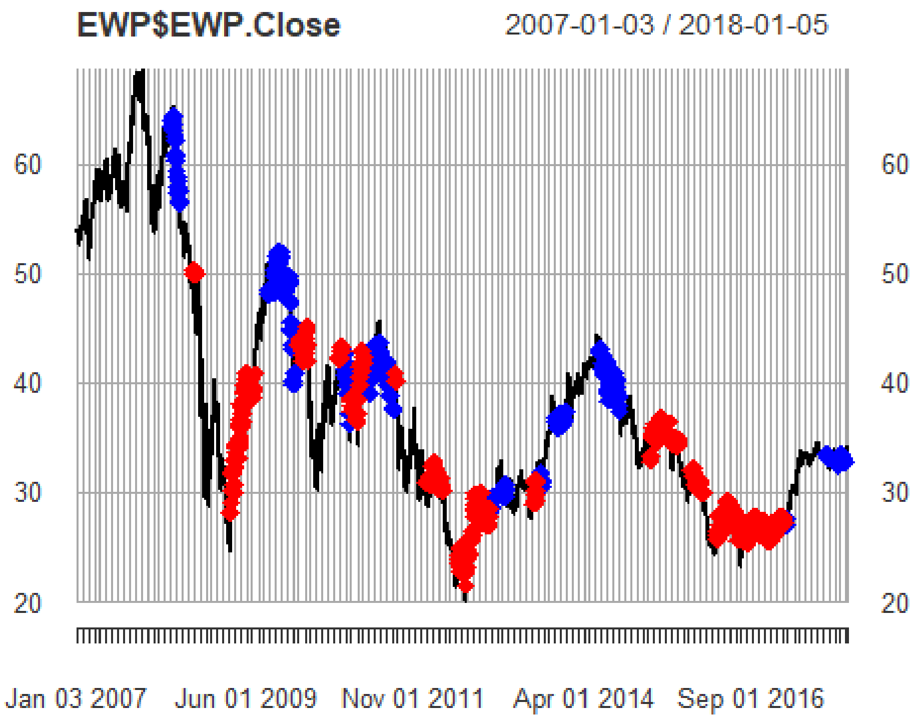
```
# create a slow ema difference
EWP.EMA.50 <- EMA(EWP$EWP.Close, n=50)
EWP.EMA.200 <- EMA(EWP$EWP.Close, n=200)
Slow.Diff <- EWP.EMA.50 - EWP.EMA.200
CCI.IND <- CCI(HLC=EWP[,c("EWP.High","EWP.Low","EWP.Close")],n=100)
CV.IND <- chaikinVolatility(HL=EWP[,c("EWP.High","EWP.Low")], n=100)

# look for long entries
Long_Trades <- ifelse(
     shift(v=as.numeric(CCI.IND), places=1, dir="right") > CCI.IND &
        CCI.IND < 100 &
        CV.IND < 0 &
        Slow.Diff > 0, EWP$EWP.Close, NA)

# look for short entries
Short_Trades <- ifelse(
       shift(v=as.numeric(CCI.IND), places=1, dir="right") < CCI.IND &
        CCI.IND > -100 &
        CV.IND < 0 &
        Slow.Diff < 0, EWP$EWP.Close, NA)

plot(EWP$EWP.Close)
```



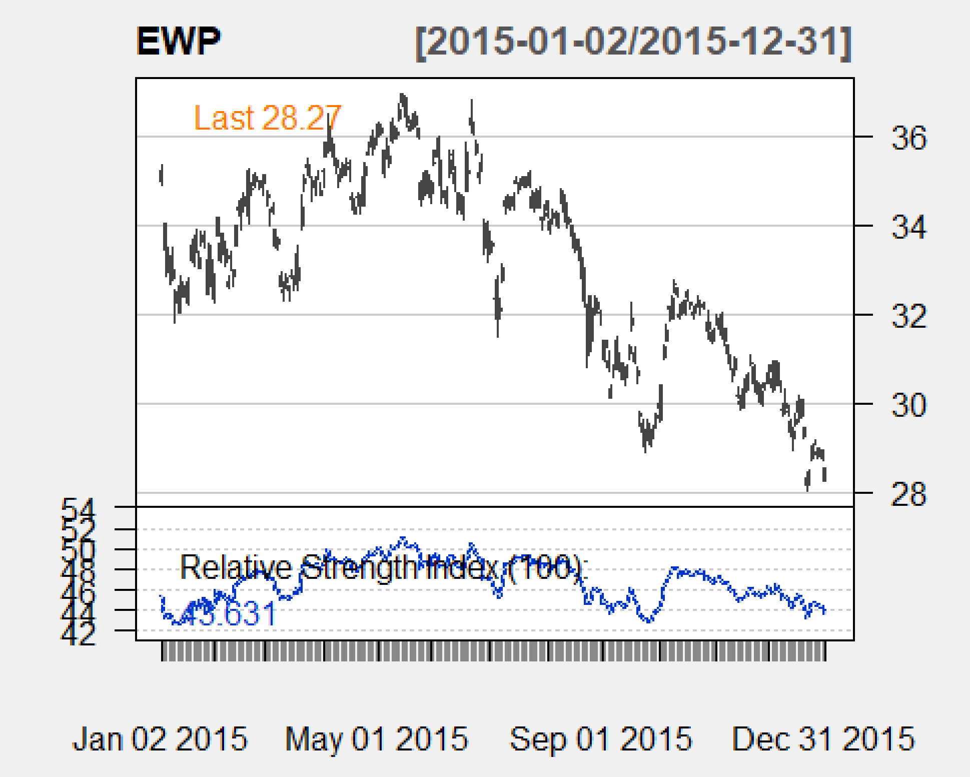
```
## Warning in plot.xts(EWP): only the univariate series will be plotted
points(Long_Trades, col='blue', cex=1.5, pch=18)
```



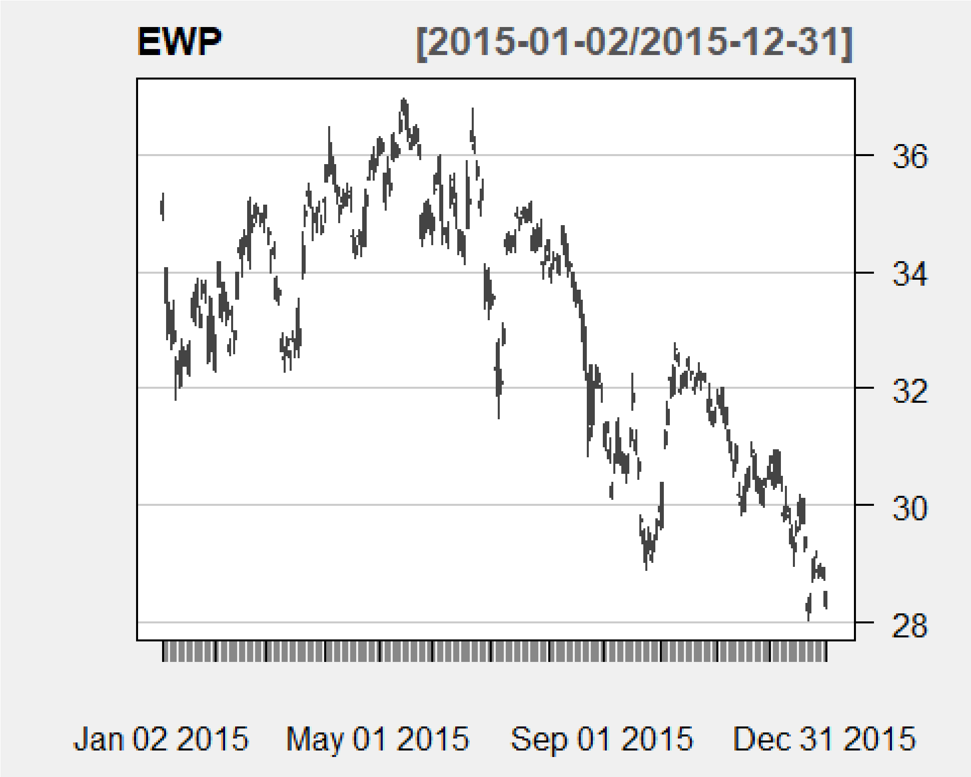
```
points(Short_Trades, col='red', cex=1.5, pch=18)
```



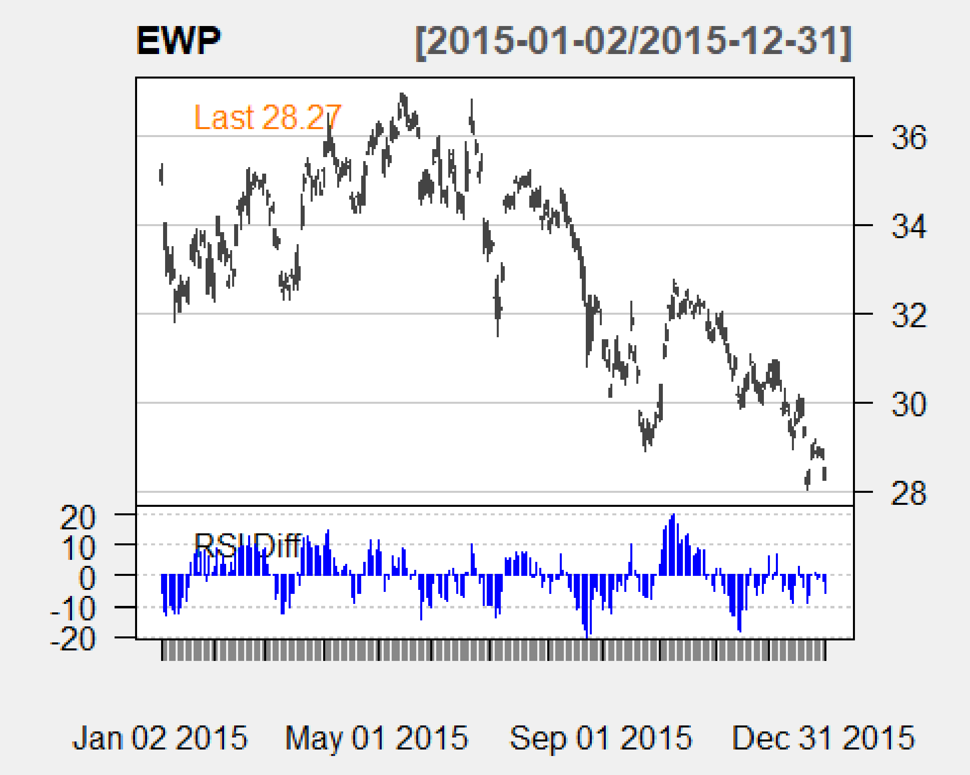
```
#What about shifting further back on the CCI, this ensures that it is a
retracement and not a random bump

chartSeries(EWP, theme="white", TA="addRSI(n=100);", subset='2015')
```



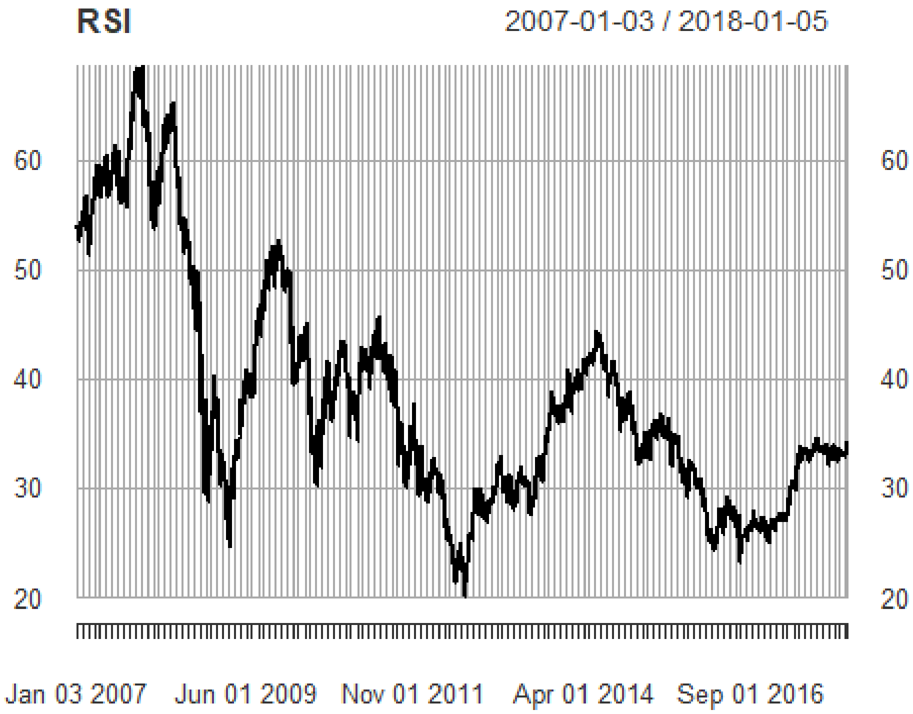
```
chartSeries(EWP, theme="white", TA=NULL, subset='2015')
```



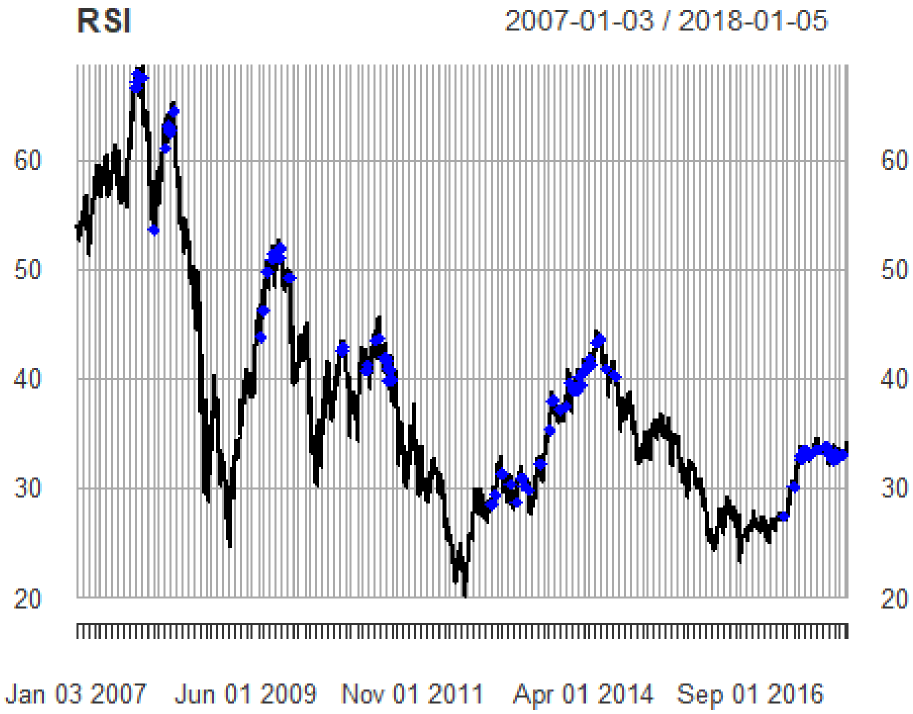
```
RSI.Fast <- RSI(price=EWP$EWP.Close,n=10)
RSI.Slow <- RSI(price=EWP$EWP.Close,n=30)
RSI.Diff <- RSI.Fast-RSI.Slow
addTA(RSI.Diff, col='blue', type='h',legend="RSI Diff")
```



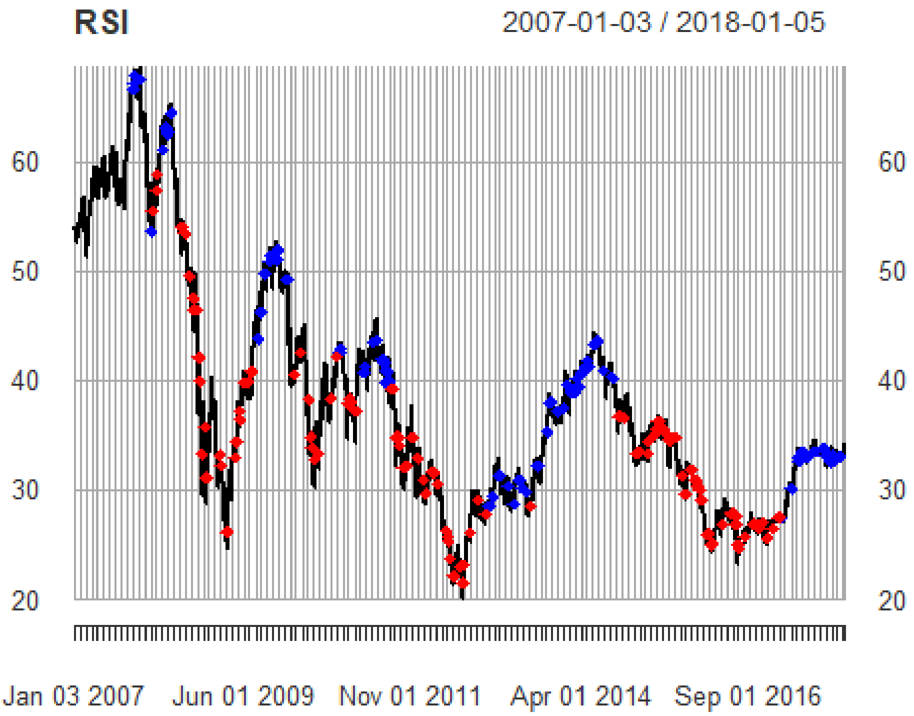
```
# create a slow ema difference
EWP.EMA.50 <- EMA(EWP$EWP.Close, n=50)
EWP.EMA.200 <- EMA(EWP$EWP.Close, n=200)
Slow.Diff <- EWP.EMA.50 - EWP.EMA.200

RSI.IND <- RSI(price=EWP$EWP.Close,n=30)

# look for long entries
Long_Trades <- ifelse(
  RSI.Diff  < 0 &
    shift(v=as.numeric(RSI.Diff ), places=1, dir="right") > 0  &
    Slow.Diff > 0, EWP$EWP.Close, NA)

# look for short entries
Short_Trades <- ifelse(
  RSI.Diff  > 0 &
    shift(v=as.numeric(RSI.Diff ), places=1, dir="right") < 0  &
    Slow.Diff < 0, EWP$EWP.Close, NA)

plot(EWP$EWP.Close, main='RSI')
```



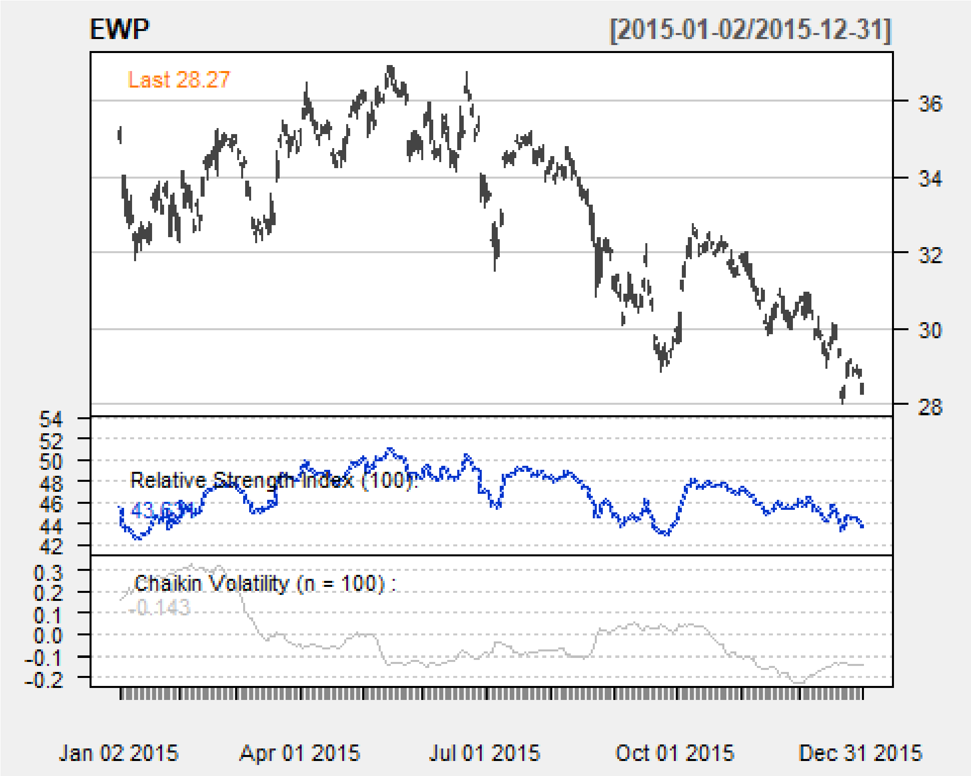
```
## Warning in plot.xts(EWP, main = "RSI"): only the univariate series will be
## plotted
points(Long_Trades, col='blue', cex=1, pch=18)
```



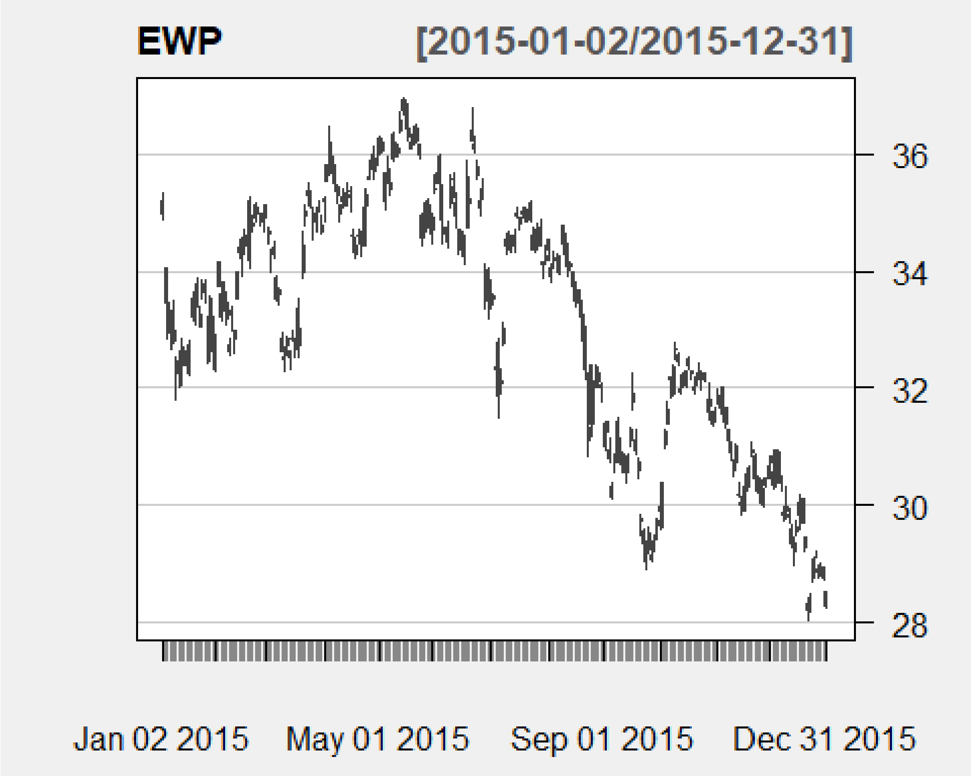
```
points(Short_Trades, col='red', cex=1, pch=18)
```



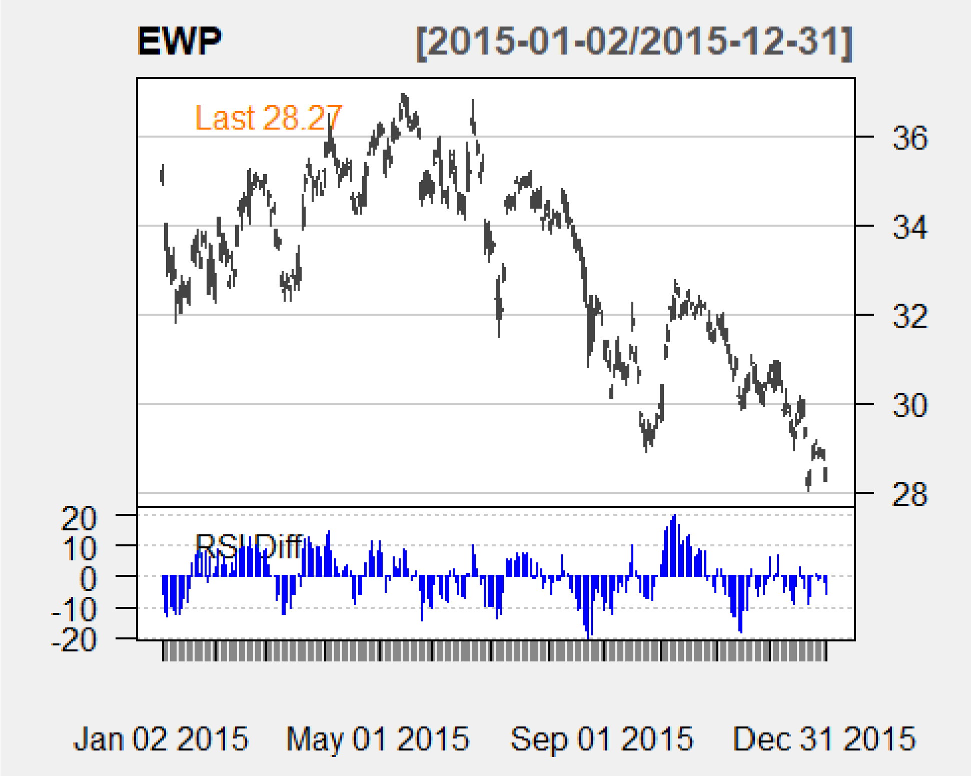
```
#Lets see if we can improve this by adding the Chaikin Volatility to the RSI
like we did earlier with the CCI counter-trading system.

chartSeries(EWP, theme="white", TA="addRSI(n=100);addChVol(n=100);",
subset='2015')
```



```
chartSeries(EWP, theme="white", TA=NULL, subset='2015')
```

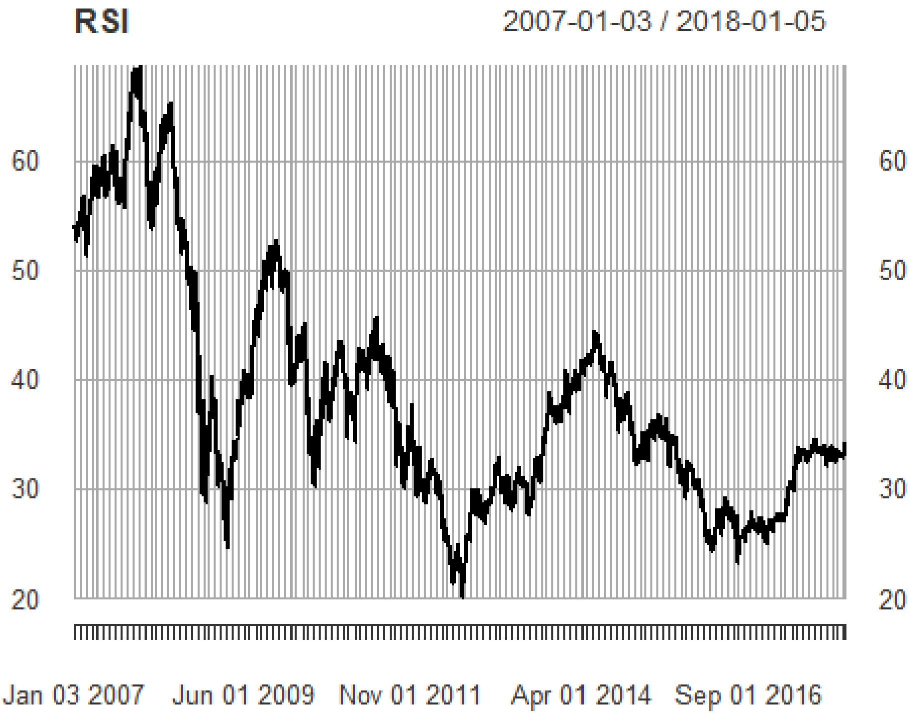


```
RSI.Fast <- RSI(price=EWP$EWP.Close,n=10)
RSI.Slow <- RSI(price=EWP$EWP.Close,n=30)
RSI.Diff <- RSI.Fast-RSI.Slow
addTA(RSI.Diff, col='blue', type='h',legend="RSI Diff")
```

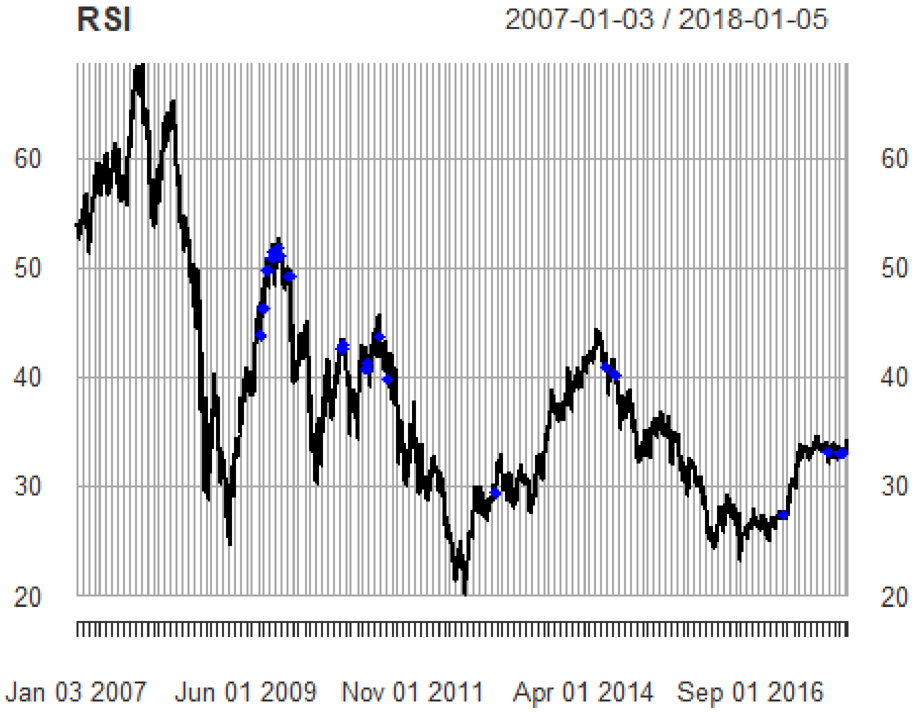


```
# create a slow ema difference
EWP.EMA.50 <- EMA(EWP$EWP.Close, n=50)
EWP.EMA.200 <- EMA(EWP$EWP.Close, n=200)
Slow.Diff <- EWP.EMA.50 - EWP.EMA.200
CV.IND <- chaikinVolatility(HL=EWP, n=100)
RSI.IND <- RSI(price=EWP$EWP.Close,n=30)

# look for long entries
Long_Trades <- ifelse(
  RSI.Diff  < 0 &
    shift(v=as.numeric(RSI.Diff ), places=1, dir="right") > 0  &
    CV.IND < -0.1 &
    Slow.Diff > 0, EWP$EWP.Close, NA)

# look for short entries
Short_Trades <- ifelse(
  RSI.Diff  > 0 &
    shift(v=as.numeric(RSI.Diff ), places=1, dir="right") < 0  &
    CV.IND < -0.1 &
    Slow.Diff < 0, EWP$EWP.Close, NA)
```

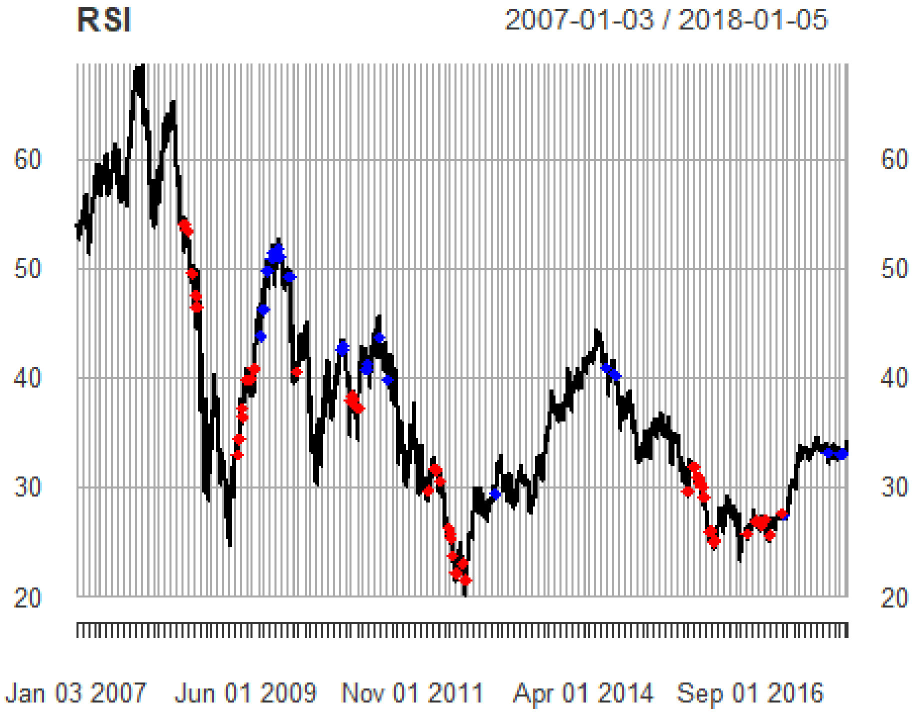
```
plot(EWP$EWP.Close, main='RSI')
```



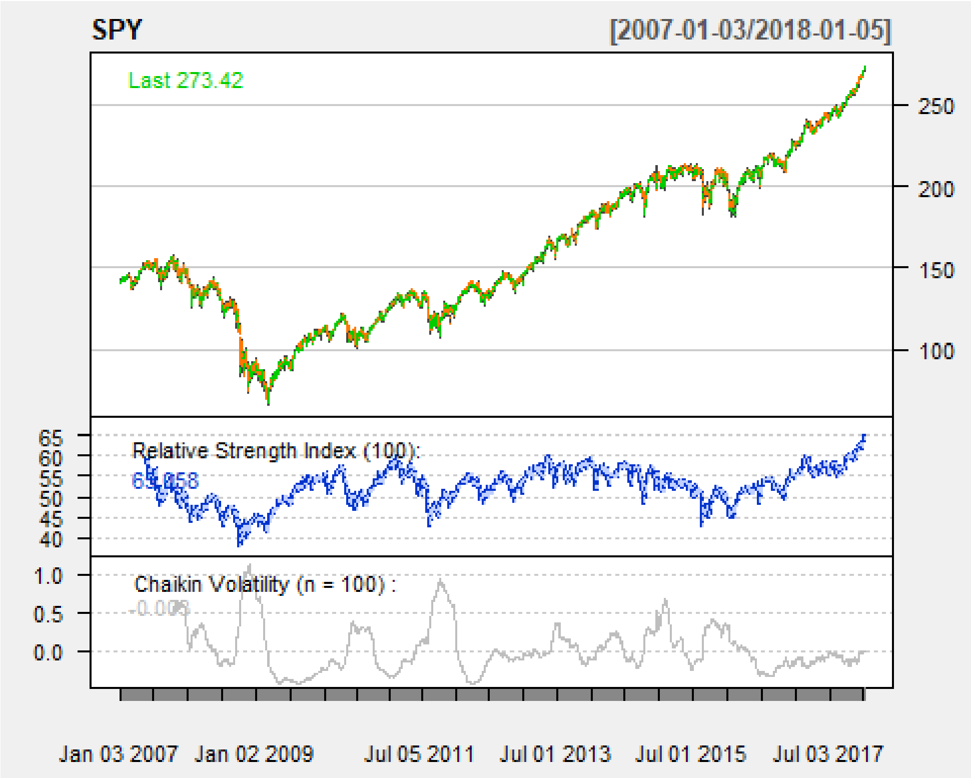
```
## Warning in plot.xts(EWP, main = "RSI"): only the univariate series will be
## plotted
points(Long_Trades, col='blue', cex=1, pch=18)
```



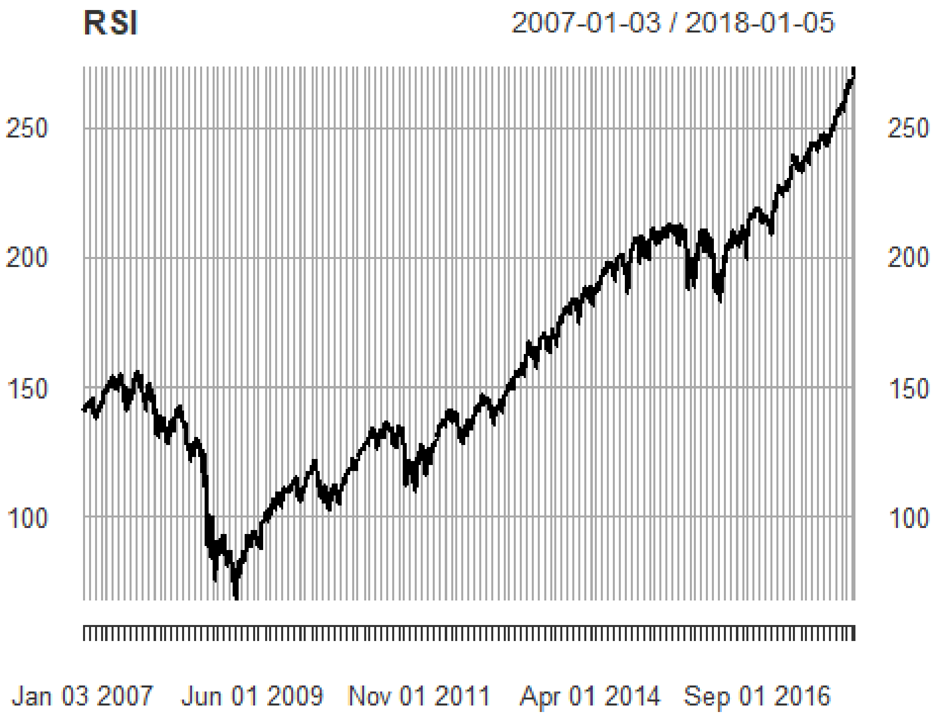
```
points(Short_Trades, col='red', cex=1, pch=18)
```



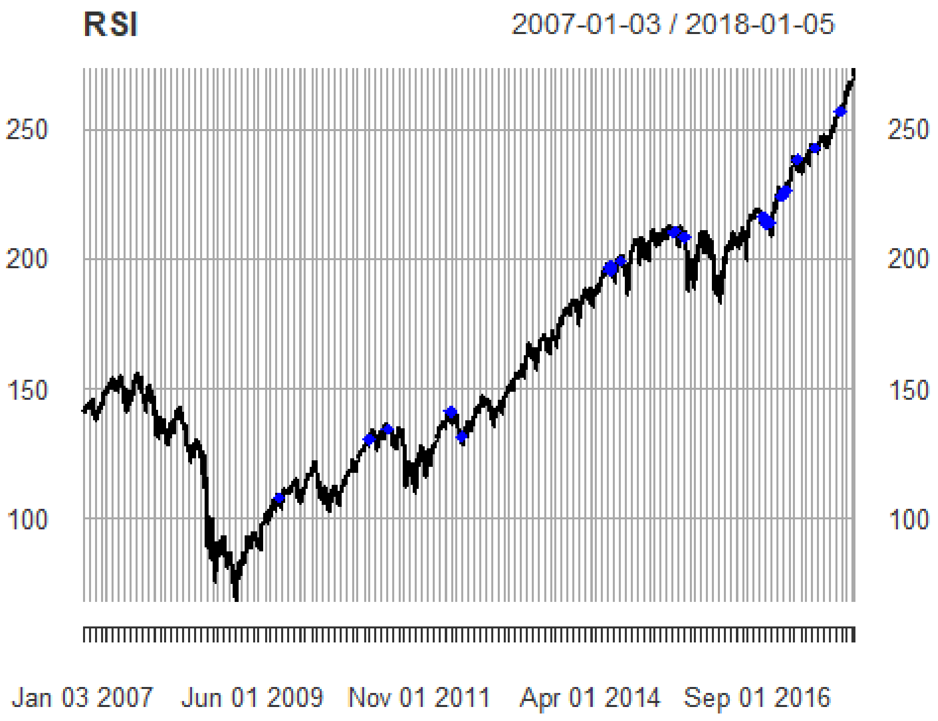
```
#Let�s try this final system on the S&P 500
chartSeries(SPY, theme="white", TA="addRSI(n=100);addChVol(n=100);")
```



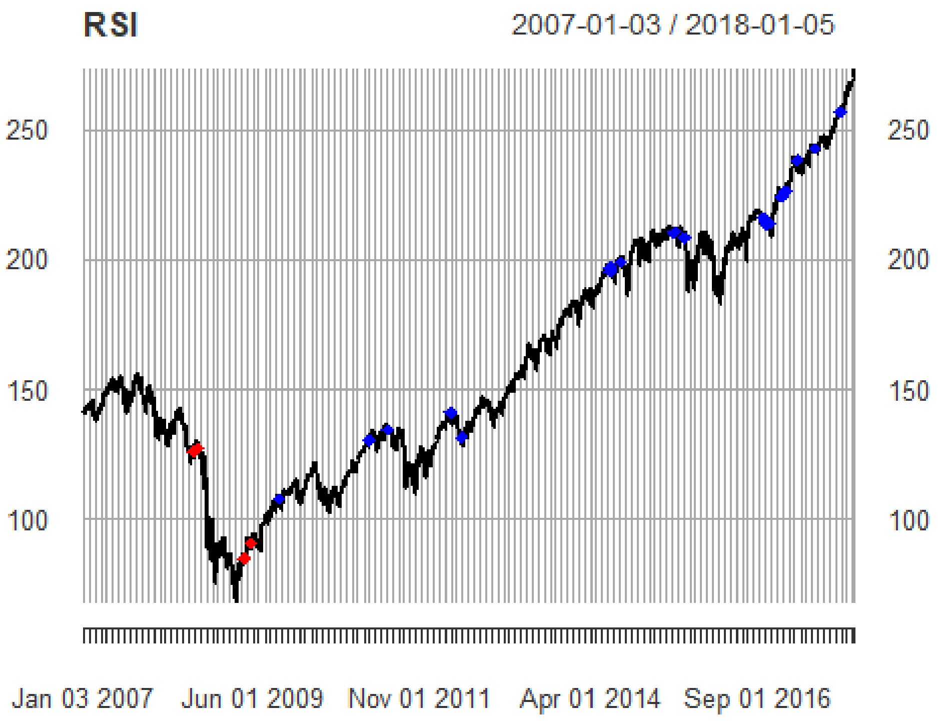
```
# create a slow ema difference
SPY.EMA.50 <- EMA(SPY$SPY.Close, n=50)
SPY.EMA.200 <- EMA(SPY$SPY.Close, n=200)
Slow.Diff <- SPY.EMA.50 - SPY.EMA.200

RSI.Fast <- RSI(price=SPY$SPY.Close,n=10)
RSI.Slow <- RSI(price=SPY$SPY.Close,n=30)
RSI.Diff <- RSI.Fast-RSI.Slow

CV.IND <- chaikinVolatility(HL=SPY, n=100)

# look for long entries
Long_Trades <- ifelse(
  CV.IND < -0.1 &
    RSI.Diff  < 0 &
    shift(v=as.numeric(RSI.Diff ), places=1, dir="right") > 0  &
    shift(v=as.numeric(RSI.Diff ), places=2, dir="right") < 0  &
    Slow.Diff > 0, SPY$SPY.Close, NA)

# look for short entries
Short_Trades <- ifelse(
  CV.IND < -0.1 &
    RSI.Diff  > 0 &
    shift(v=as.numeric(RSI.Diff ), places=1, dir="right") < 0  &
    shift(v=as.numeric(RSI.Diff ), places=2, dir="right") > 0  &
    Slow.Diff < 0, SPY$SPY.Close, NA)

plot(SPY$SPY.Close, main='RSI')
```



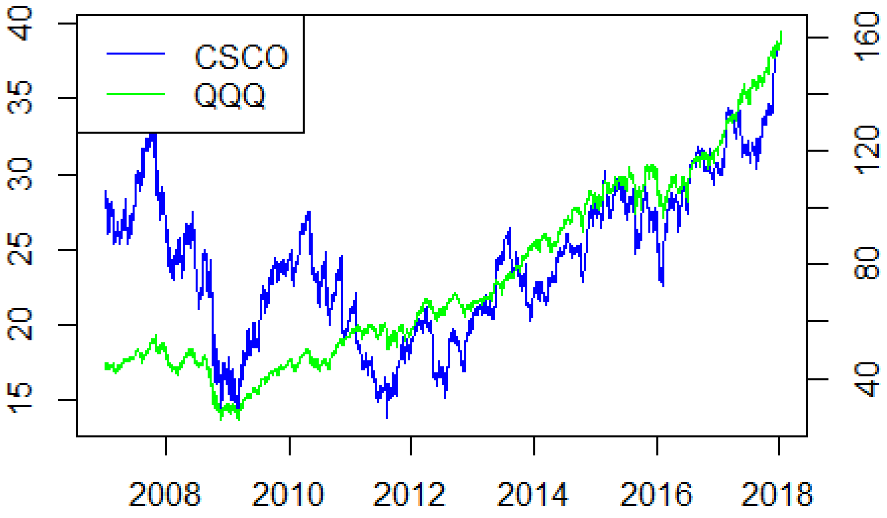
```
## Warning in plot.xts(SPY, main = "RSI"): only the univariate series will be
## plotted
points(Long_Trades, col='blue', cex=1, pch=18)
```



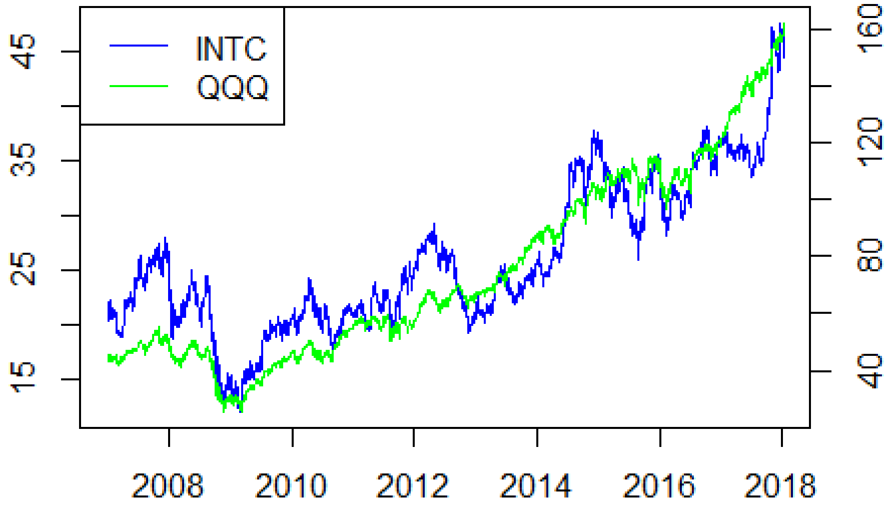
```
points(Short_Trades, col='red', cex=1, pch=18)
```



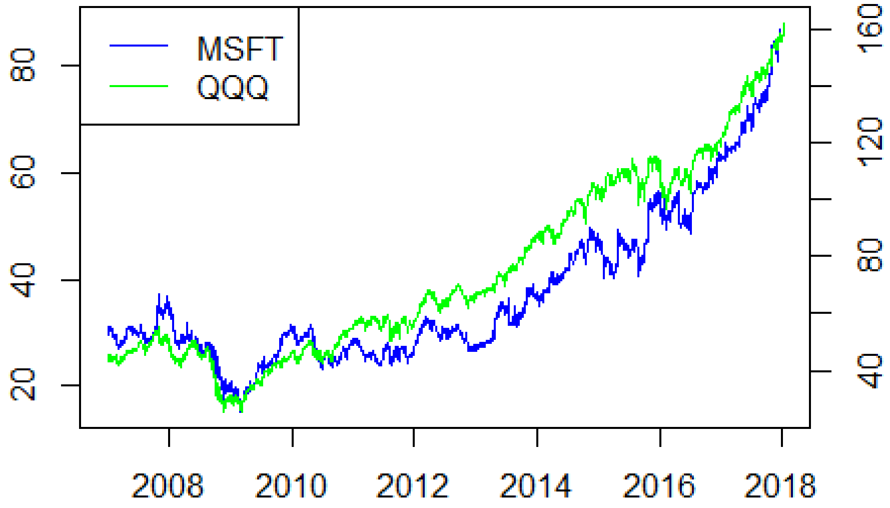
```
# Basket Analysis
#Basket of stocks related to the QQQ

#We'll use a few member stocks of the QQQ Index. This makes things easy for
us, but the concepts discussed here can be
#applied to any other financial product and index as long they are related in
some way.

#We'll focus on the following tech stocks:

#CSCO, INTC, MSFT, YHOO, TXN. They're fairly related, of similar size, and we
can donwload 10+ years of data for each.

print ("STEP 2.8: Basket of stocks related to the QQQ Index")

## [1] "STEP 2.8: Basket of stocks related to the QQQ Index"

library(quantmod)
basket_symbols <- c('MSFT', 'INTC', 'YHOO', 'CSCO', 'TXN', 'QQQ')
getSymbols(basket_symbols, src='google')

## [1] "MSFT" "INTC" "YHOO" "CSCO" "TXN"  "QQQ"

#We need to merge all the stocks into one data.frame. We'll use as.xts that
converts objects to xts class,
#this will merge by time all our columns into one data frame:
basket <- data.frame(as.xts(merge(MSFT, INTC, YHOO, CSCO, TXN, QQQ)))
head(basket,2)

##            MSFT.Open MSFT.High MSFT.Low MSFT.Close MSFT.Volume INTC.Open
## 2007-01-03     29.91     30.25    29.40      29.86    77574283     20.45
## 2007-01-04     29.70     29.97    29.44      29.81    46120855     20.63
##            INTC.High INTC.Low INTC.Close INTC.Volume YHOO.Open YHOO.High
## 2007-01-03     20.88    20.14      20.35    69803965     25.85     26.26
## 2007-01-04     21.33    20.56      21.17    89514297     25.64     26.92
##            YHOO.Low YHOO.Close YHOO.Volume CSCO.Open CSCO.High CSCO.Low
## 2007-01-03    25.26      25.61    26654067     27.46     27.98    27.33
## 2007-01-04    25.52      26.85    32565729     27.68     28.49    27.54
##            CSCO.Close CSCO.Volume TXN.Open TXN.High TXN.Low TXN.Close
## 2007-01-03      27.73    64882632    29.12    29.22   28.35     28.56
## 2007-01-04      28.46    73336624    28.50    29.11   28.41     29.10
##            TXN.Volume QQQ.Open QQQ.High QQQ.Low QQQ.Close QQQ.Volume
## 2007-01-03   20650100    43.46    44.06   42.52     43.24  168787533
## 2007-01-04   20117000    43.30    44.21   43.15     44.06  137380464

#To keep things simple, we'll only keep the Close column for all symbols:
basket <- basket[,names(basket)[grepl(x=names(basket), pattern='Close')]]
head(basket)

##            MSFT.Close INTC.Close YHOO.Close CSCO.Close TXN.Close QQQ.Close
## 2007-01-03      29.86      20.35      25.61      27.73     28.56     43.24
## 2007-01-04       29.81       21.17       26.85       28.46       29.10       44.06
## 2007-01-05       29.64       21.10       27.74       28.47       28.76       43.85
## 2007-01-08       29.93       21.01       27.92       28.63       28.90       43.88
## 2007-01-09       29.96       21.03       27.58       28.47       28.84       44.10
## 2007-01-10       29.66       21.52       28.70       28.68       29.33       44.62

#Let's pair every stock with the QQQ in a chart. We'll overlay them together, 
and, even though they won't share the same price scale,
#it should still give us an idea of how they both move:
plot(as.Date(row.names(basket)), basket$CSCO.Close, col="blue", type='l', 
ylab="", xlab="")
par(new=TRUE)
plot(as.Date(row.names(basket)), basket$QQQ.Close, col='green', type='l',
     xaxt="n", yaxt='n', xlab="",ylab="")
axis(4)
legend("topleft",col=c("blue","green"),lty=1,legend=c("CSCO","QQQ"))
```



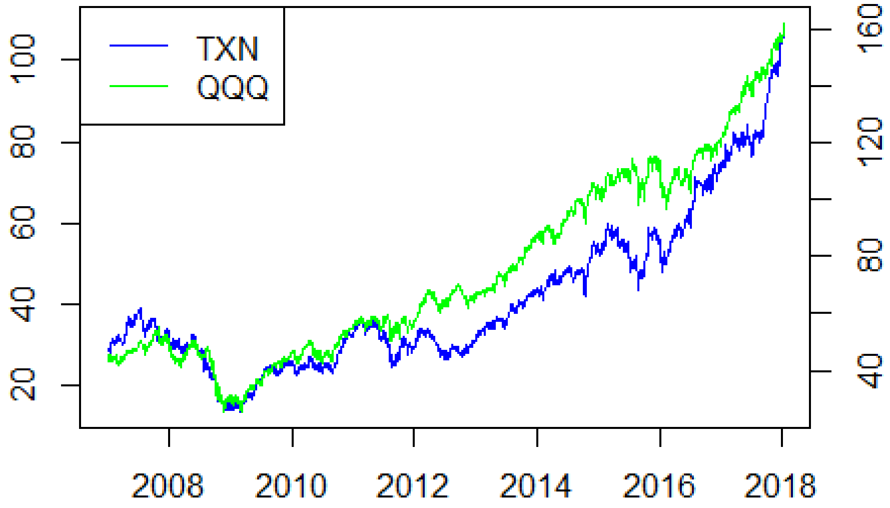
```
plot(as.Date(row.names(basket)), basket$INTC.Close, col="blue", type='l', 
ylab="", xlab="")
par(new=TRUE)
plot(as.Date(row.names(basket)), basket$QQQ.Close, col='green', type='l',
     xaxt="n", yaxt='n', xlab="",ylab="")
axis(4)
legend("topleft",col=c("blue","green"),lty=1,legend=c("INTC","QQQ"))
```



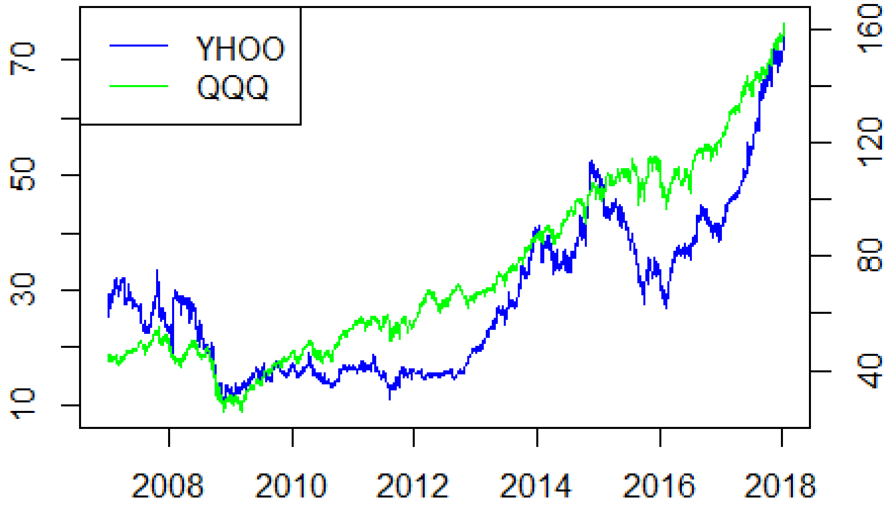
```
plot(as.Date(row.names(basket)), basket$MSFT.Close, col="blue", type='l',
ylab="", xlab="")
par(new=TRUE)
plot(as.Date(row.names(basket)), basket$QQQ.Close, col='green', type='l',
     xaxt="n", yaxt='n', xlab="",ylab="")
axis(4)
legend("topleft",col=c("blue","green"),lty=1,legend=c("MSFT","QQQ"))
```



```
plot(as.Date(row.names(basket)), basket$TXN.Close, col="blue", type='l',
ylab="", xlab="")
par(new=TRUE)
plot(as.Date(row.names(basket)), basket$QQQ.Close, col='green', type='l',
     xaxt="n", yaxt='n', xlab="",ylab="")
axis(4)
legend("topleft",col=c("blue","green"),lty=1,legend=c("TXN","QQQ"))
```



```
plot(as.Date(row.names(basket)), basket$YHOO.Close, col='blue', type='l',
ylab="", xlab="")
par(new=TRUE)
plot(as.Date(row.names(basket)), basket$QQQ.Close, col='green', type='l',
     xaxt="n", yaxt='n', xlab="",ylab="")
axis(4)
legend("topleft",col=c("blue","green"),lty=1,legend=c("YHOO","QQQ"))
```



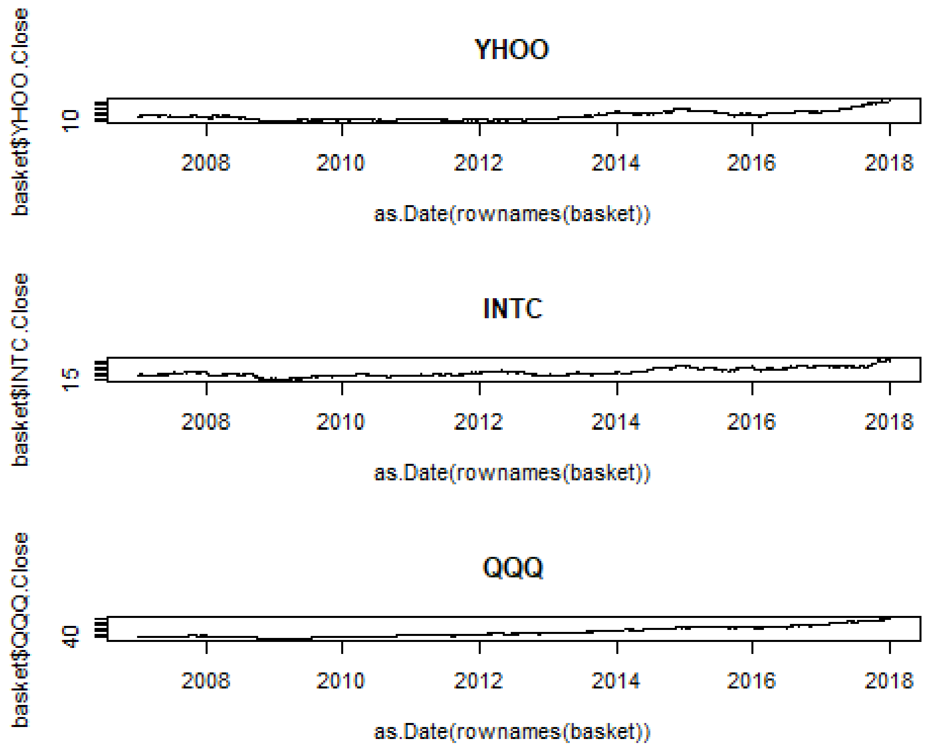
```
#All the stocks in our basket have followed the QQQ relatively well with the
exception of CISCO.
#The point here, is that there may be arbitrage opportunities with stocks
that deviate from their group or index but
#it's important to be cautious. Stocks deviate from their peers for a reason
and may want to investigate before jumping in -
#whether its just a perception or a serious change.

#Looking at direction

#There is a handy function in quantmod called OHLC.Transformations.
#This allows you to quickly tranform and compare time-series data.
#We'll use the ClCl function that will calculate the difference between the
current and previous close.
#We will use the difference between closes to determine if it is an up or
down day bar
#(if yesterday's close is lower than today's, then its an up day).

movement_MSFT <- ifelse(ClCl(MSFT)[-1] > 0, 1, -1)
movement_QQQ <- ifelse(ClCl(QQQ)[-1] > 0, 1, -1)
# use a table to see what matched and what didn't
table(movement_MSFT, movement_QQQ)

##              movement_QQQ
## movement_MSFT   -1    1
##            -1  956  418
##            1   295 1102

# Or a simpler way:
sum(movement_MSFT == movement_QQQ) / length(movement_QQQ)

## [1] 0.7426922

#The resulting table matrix tells us that out of the 2167 trading days
recorded,
#they both had the same down days 762 times and the same up days 843 times.
They basically were in sync 74% of the time.

#Let's compare our other symbols:

movement_INTC <- ifelse(ClCl(INTC)[-1] > 0, 1, -1)
sum(movement_INTC[-1] == movement_QQQ) / length(movement_QQQ)

## [1] 0.737279

movement_YHOO <- ifelse(ClCl(YHOO)[-1] > 0, 1, -1)
sum(movement_YHOO[-1] == movement_QQQ[-1]) / length(movement_QQQ)

## [1] 0.6997474

movement_CSCO <- ifelse(ClCl(CSCO)[-1] > 0, 1, -1)
sum(movement_CSCO == movement_QQQ[-1]) / length(movement_QQQ)

## [1] 0.7390834

movement_TXN <- ifelse(ClCl(TXN)[-1] > 0, 1, -1)
sum(movement_TXN == movement_QQQ[-1]) / length(movement_QQQ)

## [1] 0.7416095

print ("STEP 2.9:Basket Analysis * Overall correlation * Time-split
correlations")

## [1] "STEP 2.9:Basket Analysis * Overall correlation * Time-split
correlations"

library(quantmod)
basket_symbols <- c('MSFT', 'INTC', 'YHOO', 'CSCO', 'TXN', 'QQQ')
getSymbols(basket_symbols, src='google')

## [1] "MSFT" "INTC" "YHOO" "CSCO" "TXN"  "QQQ"

basket <- data.frame(as.xts(merge(MSFT, INTC, YHOO, CSCO, TXN, QQQ)))
basket <- basket[,names(basket)[grepl(x=names(basket), pattern='Close')]]

#Overall correlation

#So, how correlated are our stocks in our basket? Let's find out.
```

```
#We'll use the base cor function in R. It basically compares two vectors
applying covariances and standard deviations
# Look at the last column, this shows the QQQ's correlation to each stock:
results <- c()
for (basket_name in names(basket)) {
       result <- round(as.numeric(cor(basket)[,basket_name]),2)
       results <- rbind(results, c(basket_name,result))
}
results <- data.frame(results)
names(results)[-1] <- names(basket)
results
```

```
##            X1 MSFT.Close INTC.Close YHOO.Close CSCO.Close TXN.Close
## 1 MSFT.Close          1       0.92       0.91       0.79      <NA>
## 2 INTC.Close       0.92          1       0.86       0.75      <NA>
## 3 YHOO.Close       0.91       0.86          1        0.8      <NA>
## 4 CSCO.Close       0.79       0.75        0.8          1      <NA>
## 5  TXN.Close       <NA>       <NA>       <NA>       <NA>         1
## 6  QQQ.Close       0.96       0.93       0.89       0.69      <NA>
##   QQQ.Close
## 1      0.96
## 2      0.93
## 3      0.89
## 4      0.69
## 5      <NA>
## 6         1
```

```
#Time-split correlations

#Let's dig deeper and build a function to generelaize the process of getting
a correlation table.
#With this function in hand, we will split the data by time and compare
different time periods

# time for a correlation function
Get_Column_Correlations <- function(objDF){
        results <- c()
        for (col_name in names(objDF)) {
               result <- round(as.numeric(cor(objDF)[,col_name]),2)
               results <- rbind(results, c(col_name,result))
        }
        results <- data.frame(results)
        names(results)[-1] <- names(objDF)
        return (results)
}
Get_Column_Correlations(basket[as.Date(rownames(basket)) < '2015-01-
01',])[,c('X1','QQQ.Close')]
```

```
##            X1 QQQ.Close
## 1 MSFT.Close      0.88
## 2 INTC.Close      0.82
## 3 YHOO.Close      0.73
## 4 CSCO.Close      0.15
## 5  TXN.Close      <NA>
## 6  QQQ.Close         1

Get_Column_Correlations(basket[as.Date(rownames(basket)) >= '2015-01-
01',])[,c('X1','QQQ.Close')]

##             X1 QQQ.Close
## 1 MSFT.Close      0.96
## 2 INTC.Close       0.8
## 3 YHOO.Close       0.9
## 4 CSCO.Close      0.88
## 5  TXN.Close      0.95
## 6  QQQ.Close         1

par(mfrow=c(3,1))
plot(as.Date(rownames(basket)), basket$YHOO.Close, type='l', col='black',
main='YHOO')
plot(as.Date(rownames(basket)), basket$INTC.Close, type='l', col='black',
main='INTC')
plot(as.Date(rownames(basket)), basket$QQQ.Close, type='l', col='black',
main='QQQ')
```



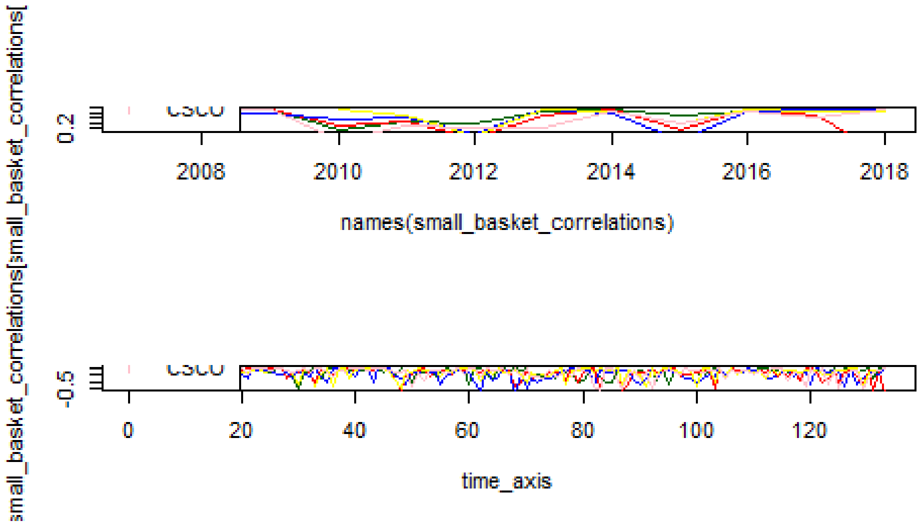
```
#Let's look at all of these by year and analyze correlations with the QQQ:
basket_years <- unique(substr(rownames(basket), start=1, stop=4))
```

```
small_basket <- basket
MSFT_QQQ <- c()
INTC_QQQ <- c()
YHOO_QQQ <- c()
TXN_QQQ <- c()
CSCO_QQQ <- c()
for (year in basket_years) {
        print(year)
        temp_df <- small_basket[substr(rownames(basket), start=1,
stop=4)==year,]
        MSFT_QQQ <- cbind(MSFT_QQQ, cor(temp_df$MSFT.Close,
temp_df$QQQ.Close))
        INTC_QQQ <- cbind(INTC_QQQ, cor(temp_df$INTC.Close,
temp_df$QQQ.Close))
        YHOO_QQQ <- cbind(YHOO_QQQ, cor(temp_df$YHOO.Close,
temp_df$QQQ.Close))
        TXN_QQQ <- cbind(TXN_QQQ, cor(temp_df$TXN.Close, temp_df$QQQ.Close))
        CSCO_QQQ <- cbind(CSCO_QQQ, cor(temp_df$CSCO.Close,
temp_df$QQQ.Close))
}
```

```
## [1] "2007"
## [1] "2008"
## [1] "2009"
## [1] "2010"
## [1] "2011"
## [1] "2012"
## [1] "2013"
## [1] "2014"
## [1] "2015"
## [1] "2016"
## [1] "2017"
## [1] "2018"
```

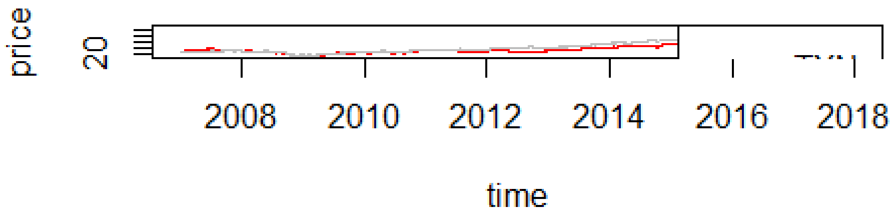
```
small_basket_correlations <- data.frame(rbind(MSFT_QQQ, INTC_QQQ, YHOO_QQQ,
TXN_QQQ, CSCO_QQQ))
colnames(small_basket_correlations) <- basket_years
plot(names(small_basket_correlations), small_basket_correlations[1,],
type='l', col='darkgreen')
lines(names(small_basket_correlations), small_basket_correlations[2,],
type='l', col='red')
lines(names(small_basket_correlations), small_basket_correlations[3,],
type='l', col='blue')
lines(names(small_basket_correlations), small_basket_correlations[4,],
type='l', col='yellow')
lines(names(small_basket_correlations), small_basket_correlations[5,],
type='l', col='pink')
legend(x='bottomleft', legend=c("MSFT", "INTC", "YHOO", "TXN", "CSCO"),
col=c("darkgreen","red", "blue", "yellow", "pink"), lwd=1, lty=c(0,0),
        pch=c(3,3))
```

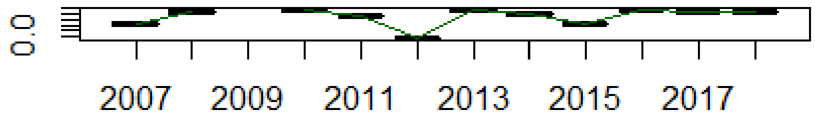
```
#This is very revealing how the correlation of both stocks with the index
waxes and wanes. Let's visualize these results.

basket_months <- unique(substr(rownames(basket), start=1, stop=7))
small_basket <- basket #[,names(basket)[grepl(x=names(basket),
pattern='MSFT|INTC|QQQ')]]
MSFT_QQQ <- c()
INTC_QQQ <- c()
YHOO_QQQ <- c()
TXN_QQQ <- c()
CSCO_QQQ <- c()
for (yearmonth in basket_months) {
        temp_df <- small_basket[substr(rownames(basket), start=1,
stop=7)==yearmonth,]
        MSFT_QQQ <- cbind(MSFT_QQQ, cor(temp_df$MSFT.Close,
temp_df$QQQ.Close))
        INTC_QQQ <- cbind(INTC_QQQ, cor(temp_df$INTC.Close,
temp_df$QQQ.Close))
        YHOO_QQQ <- cbind(YHOO_QQQ, cor(temp_df$YHOO.Close,
temp_df$QQQ.Close))
        TXN_QQQ <- cbind(TXN_QQQ, cor(temp_df$TXN.Close, temp_df$QQQ.Close))
        CSCO_QQQ <- cbind(CSCO_QQQ, cor(temp_df$CSCO.Close,
temp_df$QQQ.Close))
}

small_basket_correlations <- data.frame(rbind(MSFT_QQQ, INTC_QQQ, YHOO_QQQ,
TXN_QQQ, CSCO_QQQ))
time_axis <- seq(1,ncol(small_basket_correlations))
plot(time_axis, small_basket_correlations[1,], type='l', col='darkgreen')
lines(time_axis, small_basket_correlations[2,], type='l', col='red')
lines(time_axis, small_basket_correlations[3,], type='l', col='blue')
lines(time_axis, small_basket_correlations[4,], type='l', col='yellow')
lines(time_axis, small_basket_correlations[5,], type='l', col='pink')
legend(x='bottomleft', legend=c("MSFT", "INTC", "YHOO", "TXN", "CSCO"),
col=c("darkgreen","red", "blue", "yellow", "pink"), lwd=1, lty=c(0,0),
        pch=c(3,3))
```



```
print ("STEP 2.10:Basket Analysis * Applying correlations to entries")

## [1] "STEP 2.10:Basket Analysis * Applying correlations to entries"

 library(quantmod)
 library(binhf)
 basket_symbols <- c('TXN', 'QQQ')
 getSymbols(basket_symbols, src='google')

## [1] "TXN" "QQQ"

 basket <- data.frame(as.xts(merge(TXN, QQQ)))
basket <- basket[,names(basket)[grepl(x=names(basket), pattern='Close')]]

#This is a very simplistic arbitrage-type trade.

#So, what if we buy/hold one of these whenever its far from the index?
#So , let's pick a stock that doesn't overly control the index TXN.

getSymbols(c('TXN', 'QQQ'), src='google')

## [1] "TXN" "QQQ"

basket_years <- unique(substr(rownames(basket), start=1, stop=4))
basket_months <- unique(substr(rownames(basket), start=1, stop=7))
small_basket <- basket[,names(basket)[grepl(x=names(basket),
pattern='TXN|QQQ')]]
TXN_QQQ <- c()
```

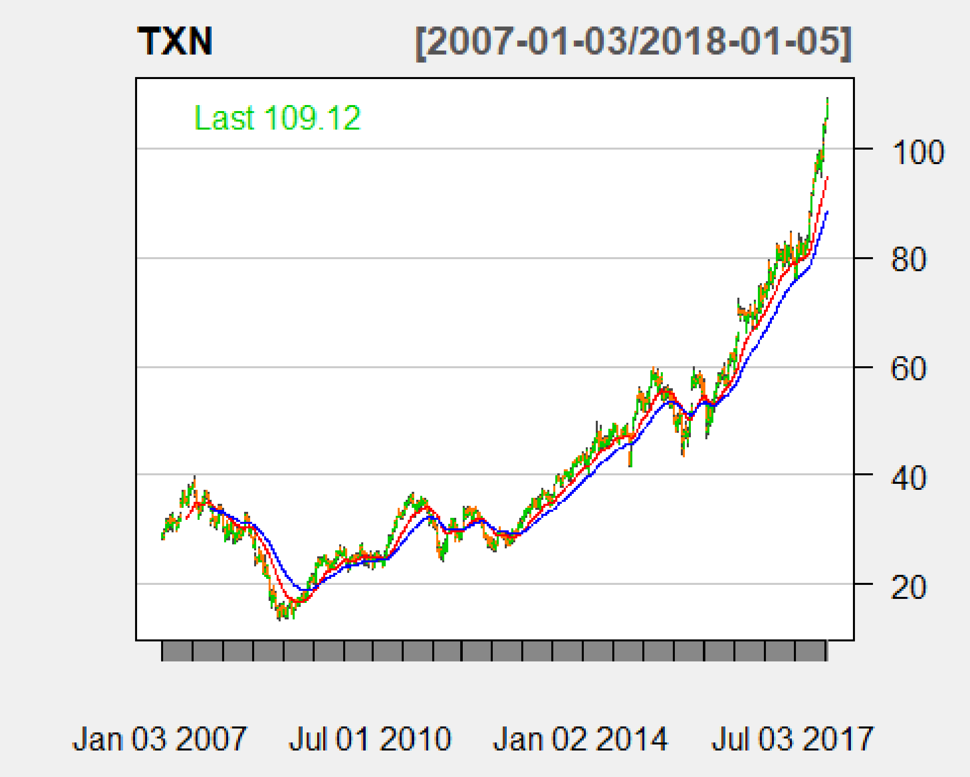
```
for (yearmonth in basket_years) {
        temp_df <- small_basket[substr(rownames(basket), start=1,
stop=4)==yearmonth,]
        TXN_QQQ <- cbind(TXN_QQQ, cor(temp_df$TXN.Close, temp_df$QQQ.Close))
}

small_basket_correlations <- data.frame(rbind(TXN_QQQ))
colnames(small_basket_correlations) <- basket_years

par(mfrow=c(2,1))
plot(as.Date(row.names(basket)), basket$TXN.Close, col='red',
     type='l', ylab="price", xlab='')
par(new=TRUE)
plot(as.Date(row.names(basket)), basket$QQQ.Close, col='gray', type='l',
xaxt="n",yaxt="n",ylab="", xlab='time')
legend("topright",col=c("red","gray"),lty=1,legend=c("TXN","QQQ"))

plot(type='l', col='darkgreen',
x=as.factor(names(small_basket_correlations)),
y=as.numeric(small_basket_correlations[1,]))
lines(type='l', col='darkgreen',
x=as.factor(names(small_basket_correlations)),
     y=as.numeric(small_basket_correlations[1,]))
```



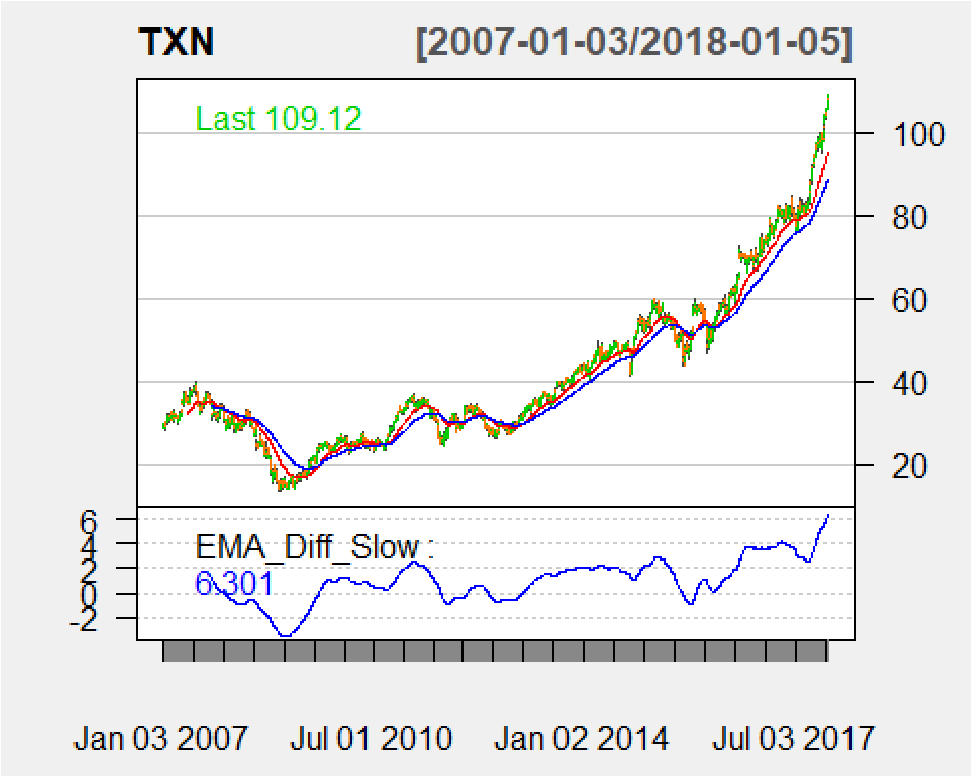


```
#So, let's create moving-average differences like we did in previous lectures
to capture trends:
```

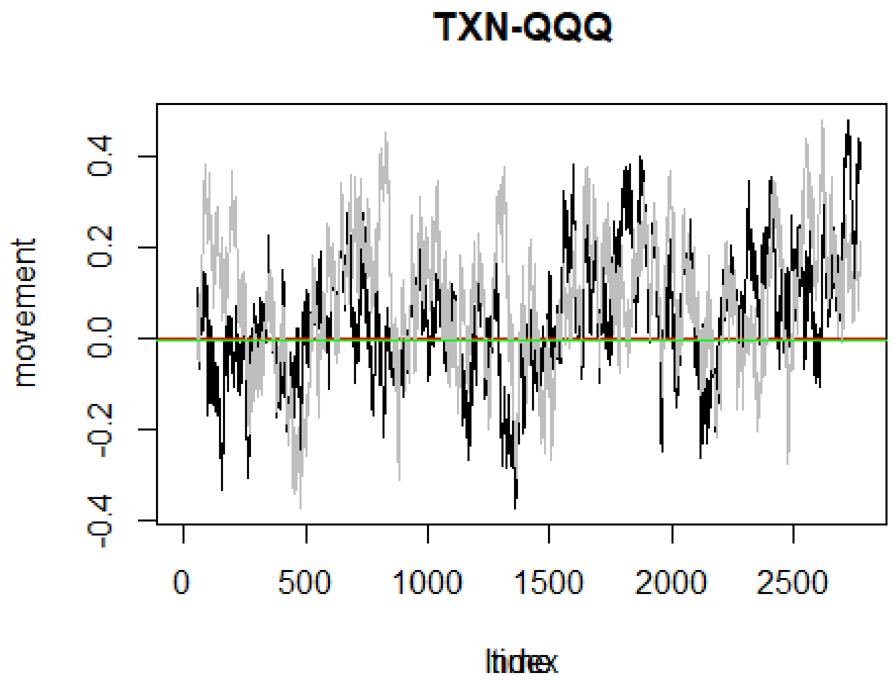
```
EMA.Fast <- EMA(TXN$TXN.Close, n=30)
EMA.Medium <- EMA(TXN$TXN.Close, n=100)
EMA.Slow <- EMA(TXN$TXN.Close, n=200)
EMA_Diff_Fast <- EMA.Fast - EMA.Medium
EMA_Diff_Slow <- EMA.Medium - EMA.Slow

chartSeries(TXN, theme="white", TA="addEMA(n=100, col='red');addEMA(n=200,
col='blue')")
```



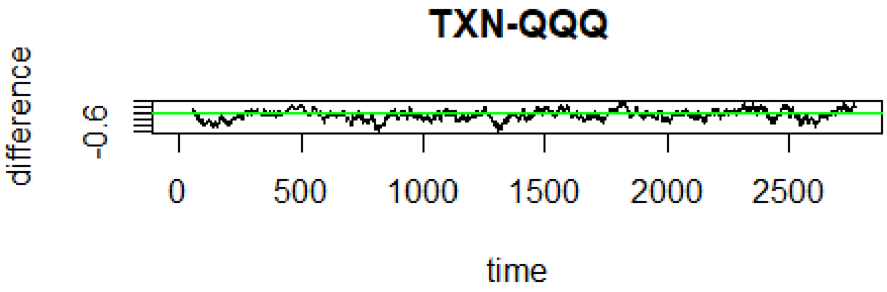
```
addTA(EMA_Diff_Slow, col='blue')
```

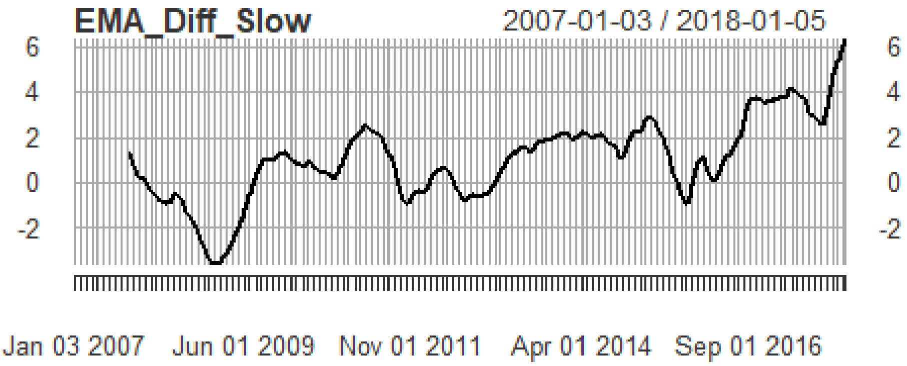


```
QQQ$QQQ.movement <- EMA(ifelse(ClCl(QQQ)  > 0, 1, -1),50)
TXN$TXN.movement <- EMA(ifelse(ClCl(TXN) > 0, 1, -1),50)

plot(as.numeric(TXN$TXN.movement ), col='black', ylab="movement",  main='TXN-
QQQ', type = 'l')
abline(h=0, col='red')
par(new=TRUE)
plot(as.numeric(QQQ$QQQ.movement ), col='gray', xaxt="n",yaxt="n",ylab="",
xlab='time', type='l')
abline(h=0, col='green')
```



```
par(mfrow=c(2,1))
diff <- as.numeric(TXN$TXN.movement)-as.numeric(QQQ$QQQ.movement)

## Warning in as.numeric(TXN$TXN.movement) - as.numeric(QQQ$QQQ.movement):
## longer object length is not a multiple of shorter object length

## Warning in as.numeric(TXN$TXN.movement) - as.numeric(QQQ$QQQ.movement):
## longer object length is not a multiple of shorter object length
plot(diff,
     col='black', type='l', xlab='time', ylab='difference',
     main='TXN-QQQ')
abline(h=0, col='green')
plot(EMA_Diff_Slow)
abline(h=0, col='green')
```





```r
print ("end of script.")

## [1] "end of script."
```