Lecture 2 R version

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Bollinger Bands Strategy

```
# import library
library("quantmod")
```

```
## Loading required package: xts
```

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

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

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

```
## Loading required package: TTR
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

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

```
library("PerformanceAnalytics")
```

```
##
## Attaching package: 'PerformanceAnalytics'
```

```
## The following object is masked from 'package:graphics':
##
##     legend
```

```
getSymbols("^DJI")
```

```
## '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.
```

```
## [1] "^DJI"
```

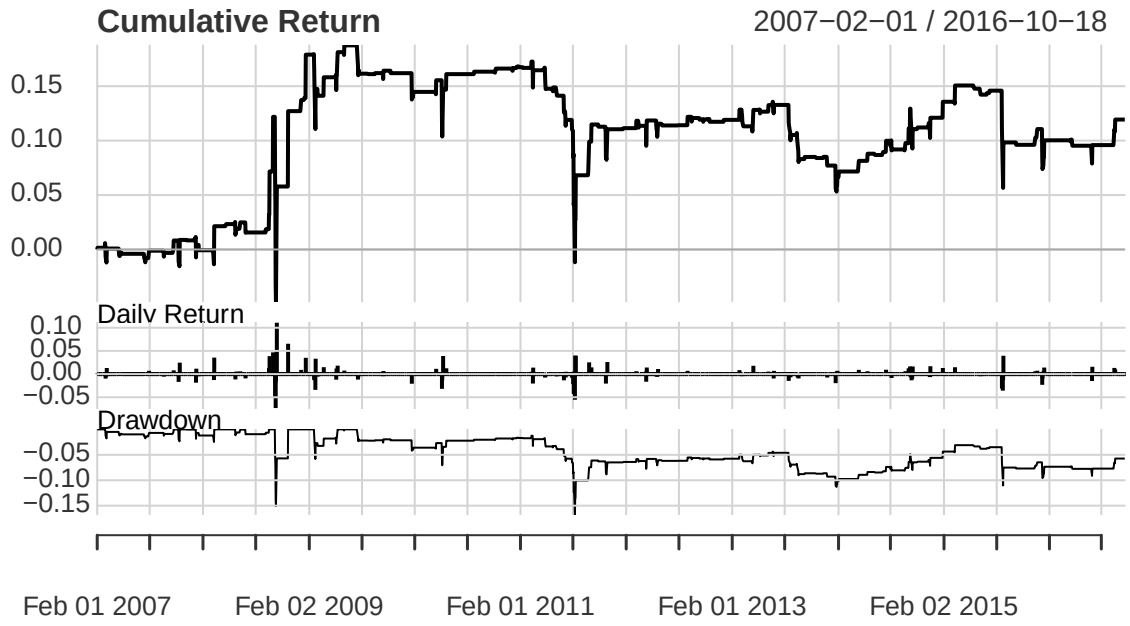
```
head(DJI)
```

```
##            DJI.Open DJI.High  DJI.Low DJI.Close DJI.Volume DJI.Adjusted
## 2007-01-03 12459.54 12580.35 12404.82  12474.52  327200000     12474.52
## 2007-01-04 12473.16 12510.41 12403.86  12480.69  259060000     12480.69
## 2007-01-05 12480.05 12480.13 12365.41  12398.01  235220000     12398.01
## 2007-01-08 12392.01 12445.92 12337.37  12423.49  223500000     12423.49
## 2007-01-09 12424.77 12466.43 12369.17  12416.60  225190000     12416.60
## 2007-01-10 12417.00 12451.61 12355.63  12442.16  226570000     12442.16
```

```r
# Slice data set
dji <- DJI[,"DJI.Adjusted"]
# Select window size
dji<- dji[(index(dji) <= "2020-12-31"),]
# Covert price to return
ret_dji<- Delt(dji,k=1)
# Split data set
index <- 1:(nrow(dji)*0.7)
in_dji <- dji[index]
in_ret_dji <- ret_dji[index]
out_dji <- dji[-index]
out_ret_dji <- ret_dji[-index]
# Create BB signal
bb_in <- BBands(in_dji)
signal_in <- NULL
signal_in <- ifelse(in_dji < bb_in[,'dn'], 1, ifelse(in_dji > bb_in[,'up'],-1 ,0))
stra_bb_in <- in_ret_dji*lag(signal_in)
```

```r
# Plotting Performance
charts.PerformanceSummary(stra_bb_in)
```

Delt.1.arithmetic Performance




```
# Metrics
table.Stats(stra_bb_in)
```

```
##                  Delt.1.arithmetic
## Observations            2447.0000
## NAs                      20.0000
## Minimum                  -0.0733
## Quartile 1                0.0000
## Median                    0.0000
## Arithmetic Mean           0.0001
## Geometric Mean            0.0000
## Quartile 3                0.0000
## Maximum                   0.1108
## SE Mean                   0.0001
## LCL Mean (0.95)          -0.0001
## UCL Mean (0.95)           0.0003
## Variance                  0.0000
## Stdev                     0.0051
## Skewness                  3.8089
## Kurtosis                147.1070
```

```
table.AnnualizedReturns(stra_bb_in)
```

```
##                            Delt.1.arithmetic
## Annualized Return                     0.0117
## Annualized Std Dev                    0.0809
## Annualized Sharpe (Rf=0%)             0.1443
```

```
table.DownsideRisk(stra_bb_in)
```

```
## VaR calculation produces unreliable result (inverse risk) for column: 1 : -0.0137133796224713
```

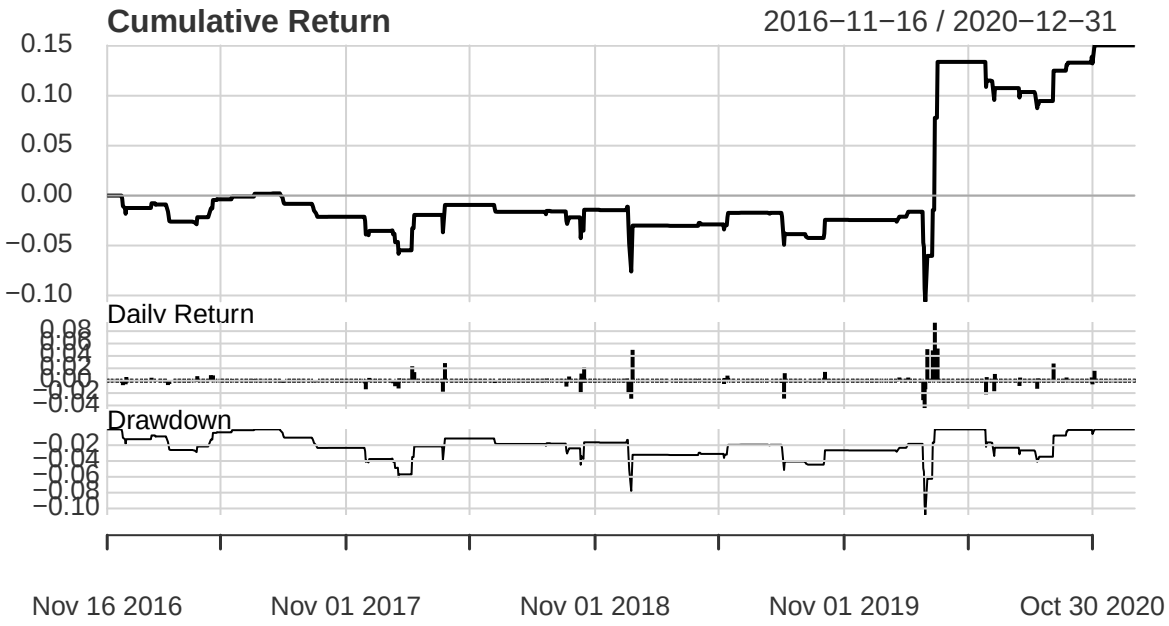
```
##                                Delt.1.arithmetic
## Semi Deviation                            0.0032
## Gain Deviation                            0.0148
## Loss Deviation                            0.0115
## Downside Deviation (MAR=210%)             0.0092
## Downside Deviation (Rf=0%)                0.0032
## Downside Deviation (0%)                   0.0032
## Maximum Drawdown                          0.1678
## Historical VaR (95%)                     -0.0002
## Historical ES (95%)                      -0.0086
## Modified VaR (95%)                           NA
## Modified ES (95%)                        -0.2579
```

```
table.Drawdowns(stra_bb_in)
```

```
##         From     Trough         To   Depth Length To Trough Recovery
## 1 2009-07-17 2011-08-08       <NA> -0.1678   1829       520       NA
## 2 2008-10-07 2008-10-10 2008-11-21 -0.1511     34         4       30
## 3 2009-02-19 2009-02-23 2009-05-11 -0.0583     57         3       54
## 4 2008-01-08 2008-03-10 2008-03-11 -0.0248     44        43        1
## 5 2007-11-08 2007-11-12 2007-11-13 -0.0235      4         3        1
```

```
# Repeat for out-of sameples
bb_out <- BBands(out_dji)
signal_out <- NULL
signal_out <- ifelse(out_dji < bb_out[,'dn'], 1, ifelse(out_dji > bb_out[,'up'],-1 ,0))
stra_bb_out <- out_ret_dji*lag(signal_out)
charts.PerformanceSummary(stra_bb_out)
```

Delt.1.arithmetic Performance




```
table.Stats(stra_bb_out)
```

```
##                  Delt.1.arithmetic
## Observations             1038.0000
## NAs                        20.0000
## Minimum                    -0.0442
## Quartile 1                  0.0000
## Median                      0.0000
## Arithmetic Mean             0.0001
## Geometric Mean              0.0001
## Quartile 3                  0.0000
## Maximum                     0.0936
## SE Mean                     0.0002
## LCL Mean (0.95)            -0.0002
## UCL Mean (0.95)             0.0005
## Variance                    0.0000
## Stdev                       0.0055
## Skewness                    6.7701
## Kurtosis                  112.6670
```

```
table.AnnualizedReturns(stra_bb_out)
```

```
##                            Delt.1.arithmetic
## Annualized Return                     0.0346
## Annualized Std Dev                    0.0876
## Annualized Sharpe (Rf=0%)             0.3948
```

```
table.DownsideRisk(stra_bb_out)
```

```
## VaR calculation produces unreliable result (inverse risk) for column: 1 : -0.0189894467915478
```

```
##                                Delt.1.arithmetic
## Semi Deviation                            0.0029
## Gain Deviation                            0.0178
## Loss Deviation                            0.0089
## Downside Deviation (MAR=210%)             0.0091
## Downside Deviation (Rf=0%)                0.0028
## Downside Deviation (0%)                   0.0028
## Maximum Drawdown                          0.1079
## Historical VaR (95%)                     -0.0014
## Historical ES (95%)                      -0.0086
## Modified VaR (95%)                           NA
## Modified ES (95%)                        -0.1123
```

```
table.Drawdowns(stra_bb_out)
```

```
## Warning in table.Drawdowns(stra_bb_out): Only 4 available in the data.
```

```
##         From     Trough         To   Depth Length To Trough Recovery
## 1 2017-07-28 2020-02-28 2020-03-13 -0.1079    661       651       10
## 2 2020-05-27 2020-08-10 2020-10-29 -0.0409    110        53       57
## 3 2016-12-08 2017-03-27 2017-06-20 -0.0288    133        74       59
## 4 2020-10-30 2020-10-30 2020-11-02 -0.0059      2         1        1
```

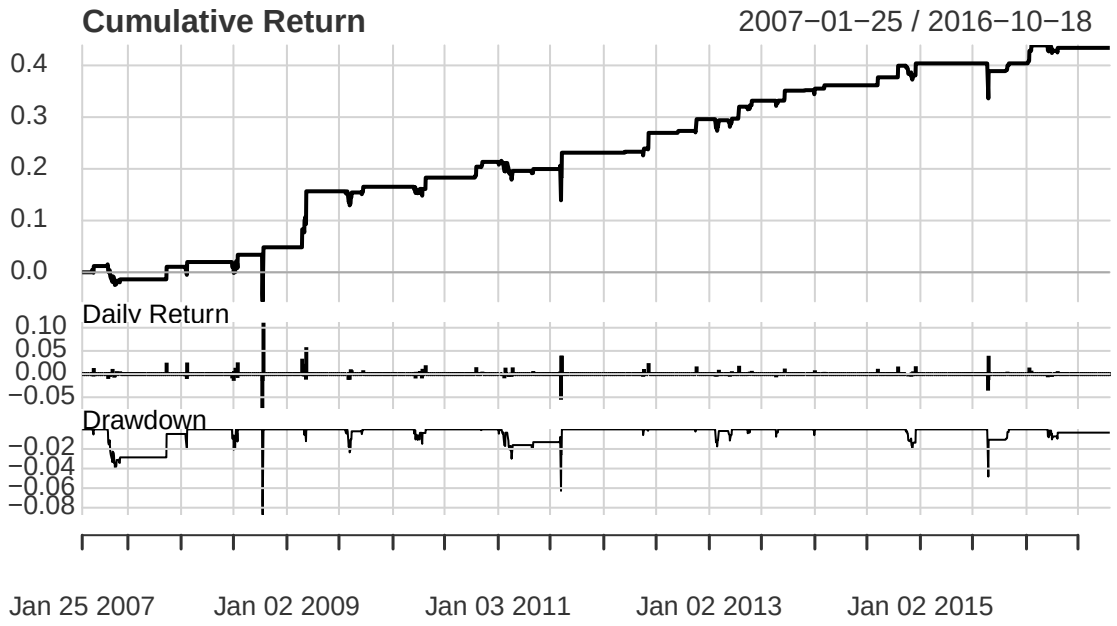
Exercise: RSI Strategy

```
library("quantmod")
library("PerformanceAnalytics")
getSymbols("^DJI")
```

```
## [1] "^DJI"
```

```
dji <- DJI[,"DJI.Adjusted"]
dji<- dji[(index(dji) <= "2020-12-31"),]
ret_dji<- Delt(dji,k=1)
index <- 1:(nrow(dji)*0.7)
in_dji <- dji[index]
in_ret_dji <- ret_dji[index]
out_dji <- dji[-index]
out_ret_dji <- ret_dji[-index]
rsi_in <-  RSI(in_dji)
signal_in <- NULL
signal_in <- ifelse(rsi_in < 30, 1, ifelse(rsi_in >70,-1 ,0))
stra_rsi_in <- in_ret_dji*lag(signal_in)
charts.PerformanceSummary(stra_rsi_in)
```

Delt.1.arithmetic Performance




```
table.Stats(stra_rsi_in)
```

```
##                  Delt.1.arithmetic
## Observations            2452.0000
## NAs                      15.0000
## Minimum                  -0.0733
## Quartile 1                0.0000
## Median                    0.0000
## Arithmetic Mean           0.0002
## Geometric Mean            0.0001
## Quartile 3                0.0000
## Maximum                   0.1108
## SE Mean                   0.0001
## LCL Mean (0.95)           0.0000
## UCL Mean (0.95)           0.0003
## Variance                  0.0000
## Stdev                     0.0041
## Skewness                  7.2932
## Kurtosis                297.8240
```

```
table.AnnualizedReturns(stra_rsi_in)
```

```
##                            Delt.1.arithmetic
## Annualized Return                     0.0377
## Annualized Std Dev                    0.0654
## Annualized Sharpe (Rf=0%)             0.5768
```

```
table.DownsideRisk(stra_rsi_in)
```

```
## VaR calculation produces unreliable result (inverse risk) for column: 1 : -0.0308036264302444
```

```
## ES calculation produces unreliable result (inverse risk) for column: 1 : -0.000155341118980194
```

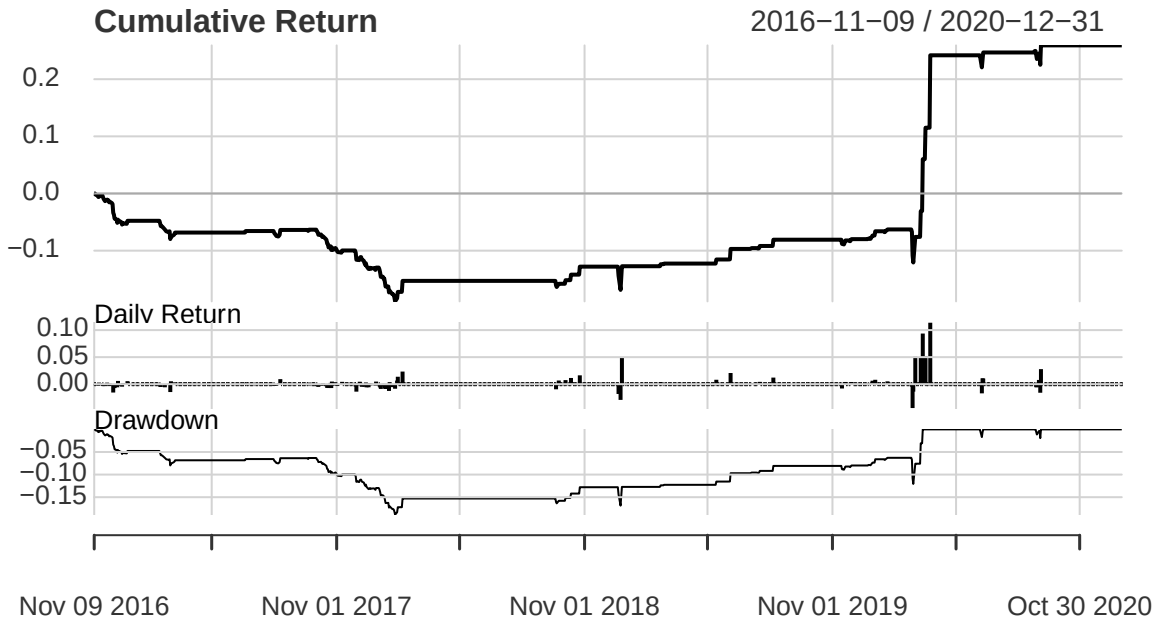
```
##                                Delt.1.arithmetic
## Semi Deviation                            0.0023
## Gain Deviation                            0.0137
## Loss Deviation                            0.0098
## Downside Deviation (MAR=210%)             0.0087
## Downside Deviation (Rf=0%)                0.0023
## Downside Deviation (0%)                   0.0023
## Maximum Drawdown                          0.0872
## Historical VaR (95%)                      0.0000
## Historical ES (95%)                      -0.0058
## Modified VaR (95%)                           NA
## Modified ES (95%)                            NA
```

```
table.Drawdowns(stra_rsi_in)
```

```
##         From     Trough         To   Depth Length To Trough Recovery
## 1 2008-10-09 2008-10-10 2008-10-13 -0.0872      3         2        1
## 2 2011-01-18 2011-08-08 2011-08-11 -0.0628    144       141        3
## 3 2015-08-24 2015-08-25 2015-11-04 -0.0482     52         2       50
## 4 2007-04-24 2007-05-18 2008-01-23 -0.0394    190        19      171
## 5 2009-07-24 2009-08-07 2009-09-23 -0.0235     43        11       32
```

```
rsi_out <- RSI(out_dji)
signal_out <- NULL
signal_out <- ifelse(rsi_out < 30, 1, ifelse(rsi_out > 70,-1 ,0))
stra_rsi_out <- out_ret_dji*lag(signal_out)
charts.PerformanceSummary(stra_rsi_out)
```

Delt.1.arithmetic Performance




```
table.Stats(stra_rsi_out)
```

```
##                  Delt.1.arithmetic
## Observations            1043.0000
## NAs                      15.0000
## Minimum                  -0.0442
## Quartile 1                0.0000
## Median                    0.0000
## Arithmetic Mean           0.0002
## Geometric Mean            0.0002
## Quartile 3                0.0000
## Maximum                   0.1137
## SE Mean                   0.0002
## LCL Mean (0.95)          -0.0001
## UCL Mean (0.95)           0.0006
## Variance                  0.0000
## Stdev                     0.0063
## Skewness                 10.2609
## Kurtosis                162.6759
```

```
table.AnnualizedReturns(stra_rsi_out)
```

```
##                           Delt.1.arithmetic
## Annualized Return                    0.0573
## Annualized Std Dev                   0.1002
## Annualized Sharpe (Rf=0%)            0.5717
```

```
table.DownsideRisk(stra_rsi_out)
```

```
## VaR calculation produces unreliable result (inverse risk) for column: 1 : -0.0414363780064339
```

```
## ES calculation produces unreliable result (inverse risk) for column: 1 : -0.000237272342013639
```

```
##                                Delt.1.arithmetic
## Semi Deviation                            0.0025
## Gain Deviation                            0.0195
## Loss Deviation                            0.0061
## Downside Deviation (MAR=210%)             0.0089
## Downside Deviation (Rf=0%)                0.0024
## Downside Deviation (0%)                   0.0024
## Maximum Drawdown                          0.1888
## Historical VaR (95%)                     -0.0030
## Historical ES (95%)                      -0.0079
## Modified VaR (95%)                            NA
## Modified ES (95%)                             NA
```

```
table.Drawdowns(stra_rsi_out)
```

```
## Warning in table.Drawdowns(stra_rsi_out): Only 3 available in the data.
```

```
##         From     Trough         To   Depth Length To Trough Recovery
## 1 2016-11-11 2018-01-26 2020-03-13 -0.1888    838       303      535
## 2 2020-08-27 2020-09-02 2020-09-03 -0.0194      6         5        1
## 3 2020-06-08 2020-06-08 2020-06-10 -0.0170      3         1        2
```