Rishikesh_Yadav_HW1

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Part I

1.1 Vector

1. Create 2 vector, each containing 10 random numbers.

```
v1 <- sample(0:100, 10, replace=TRUE)
v2 <- sample(0:100, 10, replace=TRUE)
is.vector(v1)
```

```
## [1] TRUE
```

```
is.vector(v2)
```

```
## [1] TRUE
```

2. Appending Vector 2 to Vector 1.

```
appended.vector <- append(v1,v2)
appended.vector
```

```
##  [1] 65  6 77 84 57 60 69 86  1 62 49 52 65 31 55 77 37 13 51 92
```

3. Calculate the mean of the new combined vector.

```
mean.vector <- mean(appended.vector)
mean.vector
```

```
## [1] 54.45
```

4. If element is lager than the mean, print 'True', else print 'False'.

```
for (x in appended.vector) {
  if (x > mean.vector) {
    print(TRUE)
  } else {
    print(FALSE)
  }
}
```

```
## [1] TRUE
## [1] FALSE
## [1] TRUE
## [1] TRUE
## [1] TRUE
## [1] TRUE
```

```
## [1] TRUE
## [1] TRUE
## [1] FALSE
## [1] TRUE
## [1] FALSE
## [1] FALSE
## [1] TRUE
## [1] FALSE
## [1] TRUE
## [1] TRUE
## [1] FALSE
## [1] FALSE
## [1] FALSE
## [1] TRUE
```

1.2 Matrix

1. Create a vector with 100 random numbers.

```
vector <- round(runif(n = 100, min = 1, max = 100), 0)
```

2. Transfer the above vector into a 10 by 10 matrix M.

```
matrix <- matrix(vector, nrow = 10)
matrix
```

```
##       [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
##  [1,]   78   68   57   21   91   98   64   54   84    71
##  [2,]   91   40   57   83    5   80   19   88    3    72
##  [3,]   15   78   76   74   12   81   83   47   73    30
##  [4,]   98   81   33   60   24   78   99   35   95    35
##  [5,]   13   96   16   37   67   70    8   52   42    45
##  [6,]    7   76   59   63   62   88   93    2   33    80
##  [7,]   30   65   53   24   61   81   76   99    7    34
##  [8,]   85   62   71   94   92   61   88   83   50     7
##  [9,]   70   45   24   72   22    1   46   71   38    58
## [10,]   22   34   36   14    9   59   24   33   40    61
```

3. Find the transposed matrix

```
transposed.matrix <- t(matrix)
print(transposed.matrix)
```

```
##       [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
##  [1,]   78   91   15   98   13    7   30   85   70    22
##  [2,]   68   40   78   81   96   76   65   62   45    34
##  [3,]   57   57   76   33   16   59   53   71   24    36
##  [4,]   21   83   74   60   37   63   24   94   72    14
##  [5,]   91    5   12   24   67   62   61   92   22     9
##  [6,]   98   80   81   78   70   88   81   61    1    59
##  [7,]   64   19   83   99    8   93   76   88   46    24
##  [8,]   54   88   47   35   52    2   99   83   71    33
##  [9,]   84    3   73   95   42   33    7   50   38    40
## [10,]   71   72   30   35   45   80   34    7   58    61
```

```
print(transposed.matrix[2,1])
```

```
## [1] 68
```

4. Nested loop to calculate the inner product between M.T and M.

```
InnerProduct <- function(a, b){
  if(ncol(a) != nrow(b)){
    return("can't multiply")
  }
  else{
    c = matrix(rep(0, nrow(a) * ncol(b)), nrow = nrow(a))
    for(i in 1:nrow(a)){
      for(j in 1:ncol(b)){
        for(k in 1:nrow(b)){
          c[i,j] <- c[i,j] + a[i,k] * b[k, j]
        }
      }
    }
  }
  return(c)
}

matrix.product <- InnerProduct(transposed.matrix, matrix)
print(matrix.product)
```

```
##        [,1]  [,2]  [,3]  [,4]  [,5]  [,6]  [,7]  [,8]  [,9] [,10]
##  [1,] 37921 30950 24725 31161 22778 34292 31931 32766 26007 24132
##  [2,] 30950 45111 30928 34824 31377 47006 40723 34735 32386 30611
##  [3,] 24725 30928 26822 28019 22523 35960 32165 27803 22534 22913
##  [4,] 31161 34824 28019 36536 22861 36082 34902 31818 24912 24996
##  [5,] 22778 31377 22523 22861 30109 33414 29553 25900 21898 20539
##  [6,] 34292 47006 35960 36082 33414 55057 43967 37785 33654 34906
##  [7,] 31931 40723 32165 34902 29553 43967 46072 31982 31942 26999
##  [8,] 32766 34735 27803 31818 25900 37785 31982 39622 22667 25383
##  [9,] 26007 32386 22534 24912 21898 33654 31942 22667 29865 21457
## [10,] 24132 30611 22913 24996 20539 34906 26999 25383 21457 29065
```

5. Calculate the same inner product using operator %∗%.

```
matrix.operator <- transposed.matrix %*% matrix
print(matrix.operator)
```

```
##        [,1]  [,2]  [,3]  [,4]  [,5]  [,6]  [,7]  [,8]  [,9] [,10]
##  [1,] 37921 30950 24725 31161 22778 34292 31931 32766 26007 24132
##  [2,] 30950 45111 30928 34824 31377 47006 40723 34735 32386 30611
##  [3,] 24725 30928 26822 28019 22523 35960 32165 27803 22534 22913
##  [4,] 31161 34824 28019 36536 22861 36082 34902 31818 24912 24996
##  [5,] 22778 31377 22523 22861 30109 33414 29553 25900 21898 20539
##  [6,] 34292 47006 35960 36082 33414 55057 43967 37785 33654 34906
##  [7,] 31931 40723 32165 34902 29553 43967 46072 31982 31942 26999
##  [8,] 32766 34735 27803 31818 25900 37785 31982 39622 22667 25383
```

```
##  [9,] 26007 32386 22534 24912 21898 33654 31942 22667 29865 21457
## [10,] 24132 30611 22913 24996 20539 34906 26999 25383 21457 29065
```

1.3 Function

1. Load the given CSV file

```
df <- read.csv("stock_data-1.csv", head = TRUE)
df$X <- as.Date(df$X, format = "%Y-%m-%d")
head(df)
```

```
##            X     AAPL     AMGN      AXP       BA      CAT CRM     CSCO
CVX
## 1 1996-01-02 0.286830 14.56250 12.10832 39.93750 14.87500  NA 4.243055
26.43750
## 2 1996-01-03 0.286830 14.40625 12.10832 39.56250 15.12500  NA 4.076389
26.50000
## 3 1996-01-04 0.281808 13.78125 11.99890 38.56250 15.00000  NA 3.923611
27.25000
## 4 1996-01-05 0.305804 14.09375 11.96243 39.25000 15.25000  NA 3.972222
27.68750
## 5 1996-01-08 0.309152 13.85938 11.96243 40.12500 15.18750  NA 3.934028
27.81250
## 6 1996-01-09 0.292411 13.53125 11.78008 39.67969 14.78125  NA 3.631944
27.92188
##        DIS DOW GS        HD      IBM     INTC      JNJ      JPM       KO
## 1 20.01773  NA NA 10.527778 22.71875 7.328125 21.06250 19.58333 18.75000
## 2 20.14104  NA NA 10.333333 22.31250 7.218750 21.90625 19.58333 18.90625
## 3 19.89442  NA NA 10.305555 21.71875 7.187500 21.68750 18.75000 18.75000
## 4 20.26435  NA NA 10.055555 22.15625 7.187500 21.68750 18.66667 18.65625
## 5 20.38767  NA NA  9.777778 22.28125 7.203125 21.96875 18.66667 18.78125
## 6 20.41850  NA NA  9.666667 21.68750 6.875000 22.09375 18.20833 18.53125
##       MCD      MMM     MRK     MSFT      NKE       PG     TRV      UNH  V
## 1 22.7500 33.87500 32.1250 5.609375 4.445313 20.78125 28.2500 8.078125 NA
## 2 22.7500 33.81250 31.6875 5.429688 4.312500 21.40625 28.6250 8.109375 NA
## 3 22.8750 33.68750 31.8750 5.460938 4.265625 21.75000 29.0000 8.187500 NA
## 4 22.5000 33.75000 31.5000 5.398438 4.132813 21.84375 29.0625 7.859375 NA
## 5 22.5625 33.50000 31.9375 5.390625 4.203125 21.93750 29.1875 7.703125 NA
## 6 22.1875 33.01562 31.7500 5.011719 4.117188 21.90625 28.9375 7.265625 NA
##         VZ     WBA     WMT
## 1 30.46456 7.53125 11.6250
## 2 31.42009 7.50000 11.7500
## 3 30.85801 7.40625 11.8750
## 4 31.19526 7.68750 11.6875
## 5 30.97043 7.62500 11.6875
## 6 30.93530 7.56250 11.5000
```

2. Delete the columns containing NA(empty values).

```
df<- df[ , colSums(is.na(df))==0]
head(df)
```

```
##            X     AAPL     AMGN      AXP       BA      CAT     CSCO
CVX
## 1 1996-01-02 0.286830 14.56250 12.10832 39.93750 14.87500 4.243055
26.43750
## 2 1996-01-03 0.286830 14.40625 12.10832 39.56250 15.12500 4.076389
26.50000
## 3 1996-01-04 0.281808 13.78125 11.99890 38.56250 15.00000 3.923611
27.25000
## 4 1996-01-05 0.305804 14.09375 11.96243 39.25000 15.25000 3.972222
27.68750
## 5 1996-01-08 0.309152 13.85938 11.96243 40.12500 15.18750 3.934028
27.81250
## 6 1996-01-09 0.292411 13.53125 11.78008 39.67969 14.78125 3.631944
27.92188
##        DIS        HD      IBM     INTC      JNJ      JPM       KO     MCD
## 1 20.01773 10.527778 22.71875 7.328125 21.06250 19.58333 18.75000 22.7500
## 2 20.14104 10.333333 22.31250 7.218750 21.90625 19.58333 18.90625 22.7500
## 3 19.89442 10.305555 21.71875 7.187500 21.68750 18.75000 18.75000 22.8750
## 4 20.26435 10.055555 22.15625 7.187500 21.68750 18.66667 18.65625 22.5000
## 5 20.38767  9.777778 22.28125 7.203125 21.96875 18.66667 18.78125 22.5625
## 6 20.41850  9.666667 21.68750 6.875000 22.09375 18.20833 18.53125 22.1875
##        MMM     MRK     MSFT      NKE       PG     TRV      UNH       VZ
WBA
## 1 33.87500 32.1250 5.609375 4.445313 20.78125 28.2500 8.078125 30.46456
7.53125
## 2 33.81250 31.6875 5.429688 4.312500 21.40625 28.6250 8.109375 31.42009
7.50000
## 3 33.68750 31.8750 5.460938 4.265625 21.75000 29.0000 8.187500 30.85801
7.40625
## 4 33.75000 31.5000 5.398438 4.132813 21.84375 29.0625 7.859375 31.19526
7.68750
## 5 33.50000 31.9375 5.390625 4.203125 21.93750 29.1875 7.703125 30.97043
7.62500
## 6 33.01562 31.7500 5.011719 4.117188 21.90625 28.9375 7.265625 30.93530
7.56250
##       WMT
## 1 11.6250
## 2 11.7500
## 3 11.8750
## 4 11.6875
## 5 11.6875
## 6 11.5000
```

3. Calculate daily log return for each stock.

```
daily.log.return <- as.data.frame(sapply(df[2:26], function(x) diff(log(x))))
head(daily.log.return)
```

```
##          AAPL        AMGN          AXP           BA          CAT
CSCO
## 1  0.00000000 -0.01078759  0.000000000 -0.009434032  0.016667052 -
```

```
0.040071981
## 2 -0.01766372 -0.04435317 -0.009077177 -0.025601398 -0.008298803 -
0.038199144
## 3  0.08171839  0.02242246 -0.003044156  0.017671143  0.016529302
0.012313233
## 4  0.01088869 -0.01676954  0.000000000  0.022048137 -0.004106782 -
0.009661798
## 5 -0.05567272 -0.02396007 -0.015361271 -0.011160162 -0.027113235 -
0.079895795
## 6  0.04478403 -0.02573241 -0.034649121 -0.033433214 -0.010627093
0.020814407
##            CVX          DIS           HD          IBM         INTC
JNJ
## 1  0.002361276  0.006141243 -0.018642404 -0.018043515 -0.015037877
0.039277776
## 2  0.027908788 -0.012320435 -0.002691813 -0.026971117 -0.004338402 -
0.010035927
## 3  0.015927527  0.018424292 -0.024557852  0.019943681  0.000000000
0.000000000
## 4  0.004504512  0.006066728 -0.028012958  0.005625894  0.002171554
0.012884931
## 5  0.003924872  0.001510949 -0.011428684 -0.027009460 -0.046623316
0.005673774
## 6 -0.052265699 -0.040570375  0.011428684  0.005747142 -0.016036999 -
0.033072748
##            JPM           KO          MCD          MMM          MRK
MSFT
## 1  0.000000000  0.008298803  0.000000000 -0.001846723 -0.013712262 -
0.032557631
## 2 -0.043485146 -0.008298803  0.005479466 -0.003703708  0.005899722
0.005738896
## 3 -0.004454386 -0.005012542 -0.016529302  0.001853569 -0.011834458 -
0.011510917
## 4  0.000000000  0.006677821  0.002773927 -0.007434978  0.013793322 -
0.001448319
## 5 -0.024859965 -0.013400536 -0.016760169 -0.014564505 -0.005888143 -
0.072882364
## 6 -0.009195541 -0.017007213 -0.017045867 -0.008077972 -0.036076056
0.026914398
##            NKE           PG          TRV          UNH           VZ
WBA
## 1 -0.030332500  0.029631798  0.013187004  0.003861009  0.030883522 -
0.004158010
## 2 -0.010929071  0.015930822  0.013015368  0.009587801 -0.018051105 -
0.012578782
## 3 -0.031630423  0.004301082  0.002152853 -0.040901514  0.010869672
0.037271395
## 4  0.016870007  0.004282662  0.004291852 -0.020080996 -0.007233283 -
0.008163311
## 5 -0.020657890 -0.001425517 -0.008602204 -0.058471768 -0.001134952 -
```

```
0.008230499
## 6 -0.003802285 -0.012921931 -0.010857870 -0.002152853 -0.007980903 -
0.008298803
##           WMT
## 1  0.01069529
## 2  0.01058211
## 3 -0.01591546
## 4  0.00000000
## 5 -0.01617286
## 6 -0.01643873
```

4. Calculate the mean and standard deviation of log return for each stock

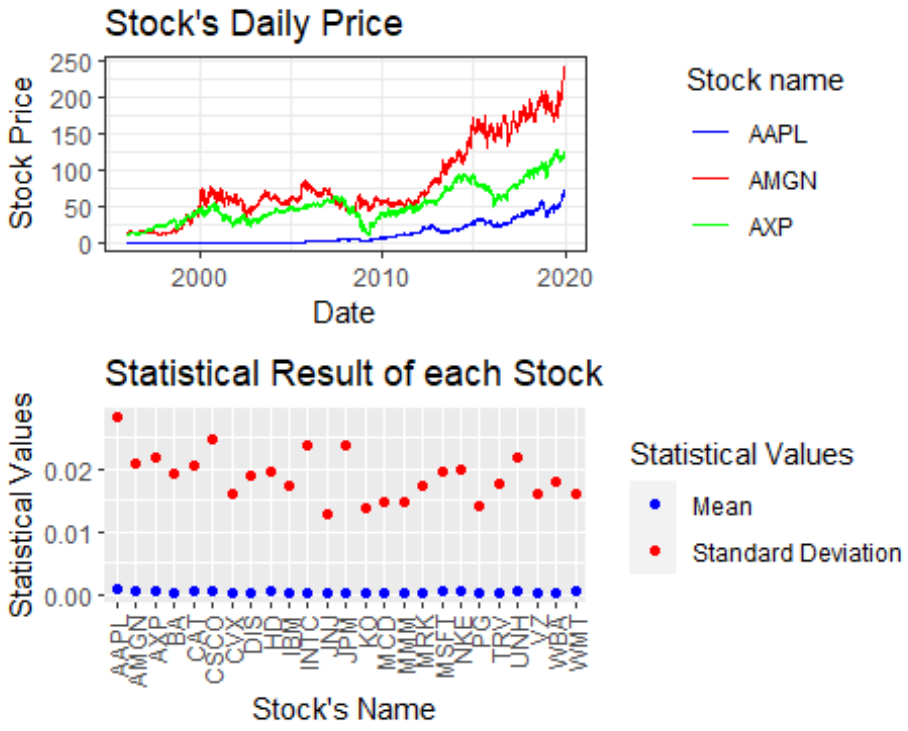
```
mean.and.std <- as.data.frame(sapply(daily.log.return, function(x)
  c("Mean" = mean(x, na.rm=TRUE),
    "Standard.deviation" = sd(x)
  )
))
mean.and.std
```

```
##                            AAPL          AMGN          AXP           BA
## Mean                0.0009168344 0.0004641248 0.0003855638 0.0003478159
## Standard.deviation  0.0284047796 0.0208557858 0.0219789482 0.0193786437
##                             CAT          CSCO          CVX          DIS
## Mean                0.000379848 0.0004002217 0.0002502413 0.0003264233
## Standard.deviation  0.020493476 0.0247623992 0.0159682591 0.0188428129
##                              HD           IBM          INTC           JNJ
## Mean                0.0005012099 0.0002923392 0.0003470648 0.0003197527
## Standard.deviation  0.0195658648 0.0173720510 0.0237095985 0.0129114075
##                             JPM            KO           MCD          MMM
## Mean                0.0003240281 0.0001789796 0.0003573148 0.0002726557
## Standard.deviation  0.0238587249 0.0138393263 0.0149395005 0.0149365129
##                             MRK          MSFT          NKE           PG
## Mean                0.0001724428 0.0005522446 0.0005167696 0.0002963599
## Standard.deviation  0.0173385301 0.0195438394 0.0199581843 0.0142370700
##                             TRV           UNH           VZ          WBA
## Mean                0.0002607877 0.0005950182 0.000115521 0.0003405546
## Standard.deviation  0.0177976490 0.0219630363 0.015967949 0.0181026340
##                             WMT
## Mean                0.0003856492
## Standard.deviation  0.0160858239
```

5. Build a graph with two sub-plots.

```
library(ggplot2)
library(patchwork)
knitr::opts_chunk$set(fig.width=unit(18,"cm"), fig.height=unit(11,"cm"))
p1 <- ggplot() + geom_line(data=df, aes(x=X, y=AAPL, color = "AAPL")) +
geom_line(data=df, aes(x=X, y=AMGN, color = "AMGN")) + geom_line(data=df,
aes(x=X, y=AXP, color = "AXP")) + theme_bw() + labs(y="Stock Price",
x="Date", title="Stock's Daily Price") +
  scale_color_manual(name = "Stock name", values = c("AAPL" = "blue", "AMGN"
```

```
= "red", "AXP" = "green"))
p2 <- ggplot() + geom_point(data = stack(mean.and.std[1,]), aes(x = ind, y =
values, color = "Mean")) +
  geom_point(data = stack(mean.and.std[2,]), aes(x = ind, y = values, color =
"Standard Deviation")) + labs(x="Stock's Name", y="Statistical Values",
title="Statistical Result of each Stock") + theme(axis.text.x =
element_text(angle = 90, vjust = 0.5, hjust=1)) +
  scale_color_manual(name = "Statistical Values", values = c("Mean" = "blue",
"Standard Deviation" = "red"))
p1 / p2
```



Part II

1. Download Amazon daily stock price data from 2021-01-01 to 2021-12-31 and save the data to a csv file.

```
#install.packages("quantmod")
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

start.date <- as.Date('2021-01-01')
end.date <- as.Date('2021-12-31')
getSymbols('AMZN', src = 'yahoo', from = start.date, to = end.date, warnings
= FALSE, auto.assign = TRUE)

## [1] "AMZN"

amazon.data <- data.frame(AMZN)
amazon.data$date <- rownames(amazon.data)
rownames(amazon.data) <- NULL
write.zoo(amazon.data, "amazon.csv", sep = ",")
```

2. Calculate weekly log returns based on adjusted close price.

```
log.return <- diff(log(AMZN$AMZN.Adjusted))[-1]
weekly.log.return <- apply.weekly(log.return, FUN = sum)
head(weekly.log.return)

##            AMZN.Adjusted
## 2021-01-08  -0.001234051
## 2021-01-15  -0.024957760
## 2021-01-22   0.058793021
## 2021-01-29  -0.026478700
## 2021-02-05   0.044515496
## 2021-02-12  -0.022456923
```

3. Calculate median, mean, standard deviation of log returns.

```
mean.d <- mean(log.return)
median.d <- median(log.return)
standard.deviation <- sd(log.return)

cat(" Mean:", round(mean.d, 6), "\n",
    "Median:", round(median.d, 6), "\n",
    "Standard Deviation:", round(standard.deviation, 6))

##  Mean: 0.000227
##  Median: 0.001126
##  Standard Deviation: 0.015196
```

4. Plot the distribution of stock daily log returns

```
log.return.plot <- ggplot(data = log.return, aes(x =
log.return$AMZN.Adjusted)) + geom_histogram(color = "darkblue", fill =
```

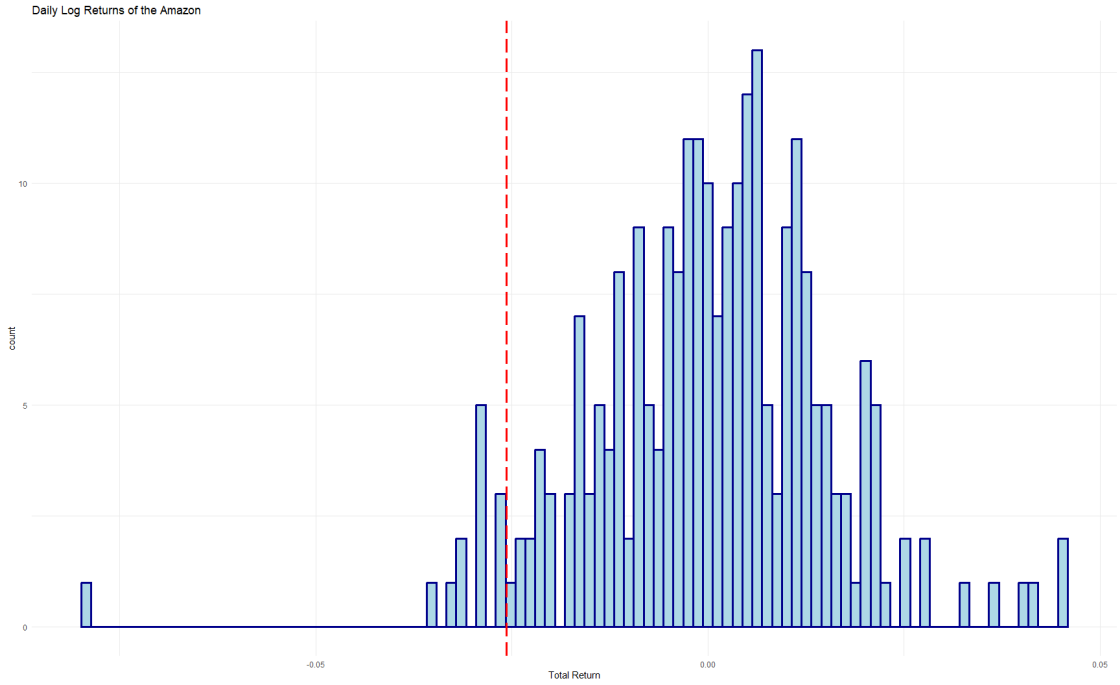
```
"lightblue", size = 1.2, bins = 100) + ggtitle("Daily Log Returns of the
Amazon") + geom_vline(xintercept = quantile(x = as.vector(log.return), probs
= 0.05),

color = "red", size = 1.2, linetype = "longdash") + xlab("Total Return") +
theme_minimal()

## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## ℹ Please use `linewidth` instead.

log.return.plot

## Don't know how to automatically pick scale for object of type <xts/zoo>.
## Defaulting to continuous.
```



5. Observation in this series with log return is between 0.01 and 0.015

```
sum(log.return > 0.01 & log.return < 0.015)

## [1] 31
```