

STRATEGY EVALUATION PROJECT

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(Used 2Free Days)

```
library(quantmod)

## Loading required package: TTR

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

library(tidyquant)
## Attaching package: 'lubridate'

library(tidyverse)

## Warning: package 'tidyverse' was built under R version 3.6.2
```

- Using get symbols to get the stock of SPY organization.
- tq_get is used to fetch the stocks of the SPY organization from a specified data to till date or any other specified date.
- This project has used tq_get to fetch data of stocks of SPY since 30 years to till date.
- Utilizing the quantmod to calculate the gain that can obtained from 2 strategies of investment in stocks of SPY.

Strategy 1) Keep investing in the S&P 500 index fund SPY with \$1000 added each month, irrespective of whether the market is going up or down.

Strategy 2) Save \$1000 and add to a savings account. Next step would be to decide on one of the Technical Trading Rules (TTR), which are available as part of the TTR package. Using the TTR to figure out when the market is up/down in SPY organization and invest accordingly

```
getSymbols("SPY")

## [1] "SPY"
```

- Initially invest 1000\$ every month irrespective of the up/down fall of the stock in SPY
- The investment is added with return multiples of saving of every year
- The return may be a postive value or negative value based on the rise and fall of the stock in SPY
- The final gain made by investing every 30 years is 894328.337203995

```
#----- STRATEGY-1 -----#

spy_stocks <- c("SPY") %>%
  tq_get(get = "stock.prices",
        from = "1990-01-01",
        to = "2020-04-30") %>%
  group_by(symbol) %>%
  tq_transmute(select = adjusted,
               mutate_fun = periodReturn,
               period = "monthly", col_rename = "SPY_return")

savings = 0
spy_stocks$Strategy1_return <- NA
n <- nrow(spy_stocks)

for (i in 1:n)
{
  return_amt = spy_stocks$SPY_return[i]*savings
  investment = savings +1000
  savings = return_amt+investment
  if(i %% 12 == 0){
    spy_stocks$Strategy1_return[i] <- (savings - (1000*i))
  }
}
```

- The Strategy1_return column of spy_stock_return1 is the return obtained every year made from 1000\$ investment every month.
- This shows the cumulative sum of the return obtained every year irrespective of rise and fall of stock(return).

```
spy_stocks_return1 <- na.omit(spy_stocks)
print(spy_stocks_return1)

## # A tibble: 27 x 4
## # Groups:   symbol [1]
##   symbol date      SPY_return Strategy1_return
##   <chr> <date>         <dbl>         <dbl>
```

```
## 1 SPY 1993-12-31 0.0123 495.
## 2 SPY 1994-12-30 0.00728 588.
## 3 SPY 1995-12-29 0.0157 11677.
## 4 SPY 1996-12-31 -0.0238 23714.
## 5 SPY 1997-12-31 0.0191 49230.
## 6 SPY 1998-12-31 0.0654 82330.
## 7 SPY 1999-12-31 0.0571 115147.
## 8 SPY 2000-12-29 -0.00523 94906.
## 9 SPY 2001-12-31 0.00564 72139.
## 10 SPY 2002-12-31 -0.0566 32174.
## # ... with 17 more rows

gain <- (savings - n*1000)
print(paste("Total Gain obtained from the investment in SPY irrespective of market up/down",gain))

## [1] "Total Gain obtained from the investment in SPY irrespective of market up/down 894328.337203995"
```

- The Strategy2 includes calculating the investment and return obtained every year by buying stock when there is a rise in the stock of SPY and sell stock when there is a fall of the SPY stock.
- The rise and fall of the stock can be obtained from the return of each day stock.
- Each day stock is retrieved initially to get the adjusted stock by the end of each day. Using TTR to buy or sell and invest or stay during the up and down in the market.

```
#----- STRATEGY-2 -----#

spy_data <- c("SPY") %>%
  tq_get(get = "stock.prices",
        from = "1990-01-01",
        to = "2020-04-30")
head(spy_data)

## # A tibble: 6 x 8
##   symbol date      open high low close volume adjusted
##   <chr> <date>    <dbl> <dbl> <dbl> <dbl>    <dbl>    <dbl>
## 1 SPY 1993-01-29 44.0 44.0 43.8 43.9 1003200 26.3
## 2 SPY 1993-02-01 44.0 44.2 44.0 44.2 480500 26.5
## 3 SPY 1993-02-02 44.2 44.4 44.1 44.3 201300 26.5
## 4 SPY 1993-02-03 44.4 44.8 44.4 44.8 529400 26.8
## 5 SPY 1993-02-04 45.0 45.1 44.5 45 531500 26.9
## 6 SPY 1993-02-05 45.0 45.1 44.7 45.0 492100 26.9
```

- The `spy_data` gives the Open, Close, Low, High and Adjusted values of the stock by the end of the each day since last 30 years.
- Using the date, the data from monthly stock of SPY can be merged with `spy_data` daily stock so that, the open,close,low,high data of stock can be obtained for a particular date of every month.
- The stock details of every month is taken and the rise and fall is observed to decide if to buy or sell stocks.

```
spy_stocks <- c("SPY") %>%
  tq_get(get = "stock.prices",
        from = "1990-01-01",
        to = "2020-04-30") %>%
  group_by(symbol) %>%
  tq_transmute(select = adjusted,
               mutate_fun = periodReturn,
               period = "monthly", col_rename = "SPY_return")

save = 0
balance = 0
adjusted = 0
ret = 0

spy_data_return <- as_tibble(merge(spy_data, spy_stocks, by.spy_data = 'date'
, by.spy_stocks = 'date'))
head(spy_data_return)

## # A tibble: 6 x 9
##   symbol date      open  high   low close  volume adjusted SPY_return
##   <chr> <date>    <dbl> <dbl> <dbl> <dbl>   <dbl>   <dbl>    <dbl>
## 1 SPY   1993-01-29  44.0  44.0  43.8  43.9  1003200    26.3      0
## 2 SPY   1993-02-26  44.4  44.4  44.2  44.4    66200    26.6    0.0107
## 3 SPY   1993-03-31  45.3  45.5  45.2  45.2   111600    27.2    0.0224
## 4 SPY   1993-04-30  44.1  44.3  44.0  44.0    88500    26.5   -0.0256
## 5 SPY   1993-05-28  45.4  45.4  45    45.2    79100    27.2    0.0270
## 6 SPY   1993-06-30  45.1  45.2  45    45.1   437600    27.3    0.00361
```

- The `spy_data_return` is the merged table of monthly stock details of SPY company.
- This includes the OHCL details of the closure of the month. Using this data, if there is a rise in the stock the SPY stock should be bought and if there is a fall in the stock the SPY stock should be sold.
- The adjusted value is multiplied with the return of that day's stock cumulatively to get the mean average of the adjusted stock.
- If the adjusted i.e. average of the stock is higher than the return(i.e. `ret` variable), then the stock must be bought. If balance is 0, then the savings is added with the adjusted value less than the times of your investment i.e. 1000\$. ##### If the balance is not zero, the balance is considered instead of the 1000\$ investment.
- If the adjusted stock value is less than the return, then the stock must be sold(sell) to prevent from the loss of losing the gained savings.
- The `strategy2_return` is the profit calculated by computing the profit from buying and selling stock - the initial investment every year.

```
spy_data_return$Strategy2_return <- NA

n <- nrow(spy_data_return)

for(i in 1:n){
  ret <- ret + spy_data_return$SPY_return[i]
  adjusted <- spy_data_return$adjusted[i] + ret
  if(adjusted > ret){
    if (balance == 0){
      save = save + (1000 / adjusted)}
    else{
      save = save + (balance / adjusted)
      balance = 0
    }
  }
  else if(adjusted < return) {
    balance = balance + 1000
    if (save > 0){
      selling = 1000 / adjusted
      save = save - selling
      if (save < 0) {
        save = 0 }
      balance = balance + (adjusted * selling)
    }
  }
  if (i %% 12 == 0){
    spy_data_return[i,"Strategy2_return"] <- (balance + (save * adjusted) -
1000 * i)
  }
}
```

- The `spy_stocks_return2` is the final table with the return every year from the investment made by buying stock only when market is up and sell stock when down.

```
spy_stocks_return2 <- na.omit(spy_data_return)
head(spy_stocks_return2)

## # A tibble: 6 x 10
##   symbol date      open  high  low close volume adjusted SPY_return
##   <chr>  <date>    <dbl> <dbl> <dbl> <dbl>  <dbl>    <dbl>
## 1 SPY    1993-12-31  46.9  47    46.6  46.6  3.13e5    28.6    0.0123
## 2 SPY    1994-12-30  46.2  46.2  45.6  45.6  2.21e6    28.7    0.00728
## 3 SPY    1995-12-29  61.5  61.5  61.2  61.5  3.39e5    39.6    0.0157
## 4 SPY    1996-12-31  75.3  75.4  73.8  73.8  1.38e6    48.5   -0.0238
## 5 SPY    1997-12-31  96.9  97.6  96.7  97.1  4.36e6    64.8    0.0191
## 6 SPY    1998-12-31 123.  124.  122.  123.  6.79e6    83.4    0.0654
## # ... with 1 more variable: Strategy2_return <dbl>

gain = (balance + (save * adjusted) - 1000 * n)

print(paste("Savings made by buying the total amount of ", save, "stocks "))
## [1] "Savings made by buying the total amount of 4123.3243340042 stocks "

print(paste("Profit made by buying stocks only when the market is up in SPY",
gain))
## [1] "Profit made by buying stocks only when the market is up in SPY 891941.565170342"
```

- The final savings in the account through the initial investment is 4123.3243340042.
- The profit made at the end of 30 years cumulatively is 891941.565170342. This final profit is similar to the profit gained from strategy1.

```
#----- Comparison of two strategies -----#

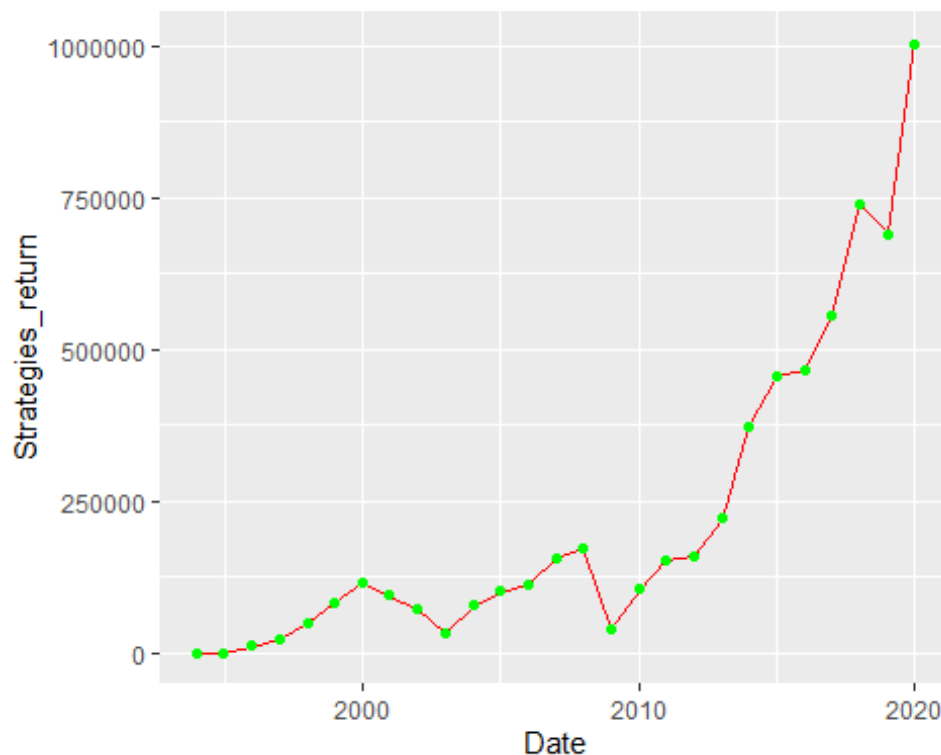
analysis <- cbind(spy_stocks_return1[, 'Strategy1_return'], spy_stocks_return2
[,c('Strategy2_return', 'date')])
head(analysis)

##   Strategy1_return Strategy2_return      date
## 1         494.7328         512.5424 1993-12-31
## 2         587.6790         612.0857 1994-12-30
## 3        11676.9055        11997.2448 1995-12-29
## 4        23714.0755        24259.2117 1996-12-31
## 5        49230.4186        50097.9833 1997-12-31
## 6        82329.8992        83459.7686 1998-12-31
```

Summary of the Analysis:

- The analysis table gives the merged table of the profit gained by the 2 strategies and their respective dates of their stock.
- This shows that the profit gained by both strategies are similar since there is no huge downfall in the stock of the SPY data since last 30 years.
- The profit of the strategy2 is slightly higher than the strategy1 since there is no huge fall in the stock of the SPY market.
- Even there is a minimal fall in the market it does not affect the investment of 1000\$ every month.
- The stock did not fall many times, it happened just few days in some years but that overcame since only the stock at the end of the month is calculated every year.

```
ggplot(analysis)+ xlab('Date')+ylab ('Strategies_return')+  
  geom_line(mapping = aes(x = date,y = Strategy1_return ), col = "red") +  
  geom_point(mapping = aes(x = date, y = Strategy2_return), col = "green")
```



- This plot shows the curve of the profit gained at each year for the past 30 year with the investment of 1000\$ each month. The Red line indicates the gain obtained using Strategy1 and the Green dots indicates the gain obtained using Strategy2.

```
getSymbols("SPY")
## [1] "SPY"
chartSeries(SPY, from = "1990-01-01", to = "2020-04-30")
addMACD(type = "EMA")
addBBands()
```

- This is the analysis of the SPY stock since the last 30 years using the Trading Rules with the inbuilt graphical representation. The MACD - Moving Average Convergence Divergence is plotted with the Bollinger Bands to show the rise/fall of the stock based on the volume and OHCL details of the stock.

