Strategy Design (ML Fin Data - Project 1)

Hair Albeiro Parra Barrera

Libraries

0. Scraping the SP500

In order to test the logic within the strategy, I have fetched functions that retrieve a number of sample stocks by sector from the SP500.

```
# to obtain relative paths
library(here)

# Load code into environment
source(here("functions", "fetch_sp500_sectors.R"))
```

```
## Getting holdings for SP500
```

0.0.1 SP500 Economic Sectors

The following function fetches and extract the economic sectors from the SP500, taken from Wikipedia.

```
# fetch the sectors as a dataframe
sp500_sectors <- f_get_sp500_sectors()
head(sp500_sectors)
```

```
##   tickers                sectors
## 1     MMM             Industrials
## 2     AOS             Industrials
## 3     ABT             Health Care
## 4    ABBV             Health Care
## 5     ACN Information Technology
## 6    ATVI Communication Services
```

0.0.2 SP500 Sector Weight

```
# wrap into a single argument funciton
fetch_sp500_sector_data <- function(x){f_fetch_sector_data(x, sp500, sp500_sectors)}

# call the function
head(fetch_sp500_sector_data("Information Technology"))
```

```
##   ticker                sector       weight shares_held
## 1   AAPL Information Technology 0.0702540411   162587331
## 2    ACN Information Technology 0.0054092441     6978653
## 3   ADBE Information Technology 0.0064376791     5042633
## 4    ADI Information Technology 0.0023957535     5547304
## 5   ADSK Information Technology 0.0011986744     2364476
## 6   AKAM Information Technology 0.0004527619     1688579
```

0.0.3 Retrieving top sectors and stocks

Pack everything into one function to retrieve all the data

```
# Retrieve top 10 stocks by weight for each sector in the top 5 sectors from the SP500 (by weight)
sector_list <- f_retrieve_top_sp500(top_n_sectors = 6, top_n_stocks = 15, only_tickers=TRUE)
```

```
## Getting holdings for SP500
```

```
sector_list
```

```
## $Industrials
##  [1] "ADP" "BA"  "CAT" "CSX" "DE"  "ETN" "FDX" "GE"  "HON" "ITW" "LMT" "NOC"
## [13] "RTX" "UNP" "UPS"
##
## $`Health Care`
##  [1] "ABBV" "ABT"  "AMGN" "BMY"  "DHR"  "ELV"  "ISRG" "JNJ"  "LLY"  "MDT"
## [11] "MRK"  "PFE"  "SYK"  "TMO"  "UNH"
##
## $`Information Technology`
##  [1] "AAPL" "ACN"  "ADBE" "AMD"  "AVGO" "CRM"  "CSCO" "IBM"  "INTC" "INTU"
## [11] "MSFT" "NVDA" "ORCL" "QCOM" "TXN"
##
## $`Communication Services`
##  [1] "ATVI"  "CHTR"  "CMCSA" "DIS"   "EA"    "GOOG"  "GOOGL" "META"  "NFLX"
## [10] "OMC"   "T"     "TMUS"  "TTWO"  "VZ"    "WBD"
##
## $Financials
##  [1] "AXP"   "BAC"   "BLK"   "BRK-B" "CB"    "GS"    "JPM"   "MA"    "MMC"
## [10] "MS"    "PGR"   "SCHW"  "SPGI"  "V"     "WFC"
##
## $`Consumer Discretionary`
##  [1] "ABNB" "AMZN" "AZO"  "BKNG" "CMG"  "F"    "GM"   "HD"   "MAR"  "MCD"
## [11] "NKE"  "ORLY" "SBUX" "TJX"  "TSLA"
```

This logic is implemented under **functions/fetch_sp500_sectors.R**

0.0.4 Retrieving top sectors and stocks

```
# function to fetch all the information for one ticker into a nice xts dataframe
sp500_stocks <- lapply(sector_list,
                       f_fetch_all_tickers,
                       start_date="2018-01-01",
                       end_date="2022-12-01")

# update format so that it becomes a named list of lists
sp500_stocks <- lapply(sp500_stocks, function(sector_l){
  setNames(sector_l$stock_data, sector_l$tickers)
  }
)
```

```
# Show the available sectors
names(sp500_stocks)
```

```
## [1] "Industrials"            "Health Care"            "Information Technology"
## [4] "Communication Services" "Financials"             "Consumer Discretionary"
```

```
# Show available stocks for Industrials
names(sp500_stocks$Industrials)
```

```
##  [1] "ADP" "BA"  "CAT" "CSX" "DE"  "ETN" "FDX" "GE"  "HON" "ITW" "LMT" "NOC"
## [13] "RTX" "UNP" "UPS"
```

```
# access the xts of the stocks in industrials
head(sp500_stocks$Industrials$ADP)
```

```
##            direction_lead adp_adjclose_lead adp_adjclose_lag0 adp_adjclose_lag1
## 2018-01-03             NA       0.003405680                NA                NA
## 2018-01-10             NA       0.036716665       0.003405680                NA
## 2018-01-17             NA      -0.009797875       0.036716665       0.003405680
## 2018-01-24             NA       0.022660367      -0.009797875       0.036716665
## 2018-01-31             NA      -0.084961843       0.022660367      -0.009797875
## 2018-02-07             NA      -0.007513292      -0.084961843       0.022660367
##            adp_adjclose_lag2 adp_adjclose_lag3 atr adx aaron bb chaikin_vol clv
## 2018-01-03                NA                NA  NA  NA    NA NA          NA  NA
## 2018-01-10                NA                NA  NA  NA    50 NA          NA  NA
## 2018-01-17                NA                NA  NA  NA   100 NA          NA  NA
## 2018-01-24       0.003405680                NA  NA  NA   100 NA          NA  NA
## 2018-01-31       0.036716665        0.00340568  NA  NA   100 NA          NA  NA
## 2018-02-07      -0.009797875        0.03671667  NA  NA   -50 NA          NA  NA
##            emv macd mfi      sar smi volat month_index
## 2018-01-03  NA   NA  NA 115.3586  NA    NA           1
## 2018-01-10  NA   NA  NA 115.4054  NA    NA           1
## 2018-01-17  NA   NA  NA 115.5252  NA    NA           1
## 2018-01-24  NA   NA  NA 115.9245  NA    NA           1
## 2018-01-31  NA   NA  NA 116.4665  NA    NA           1
## 2018-02-07  NA   NA  NA 125.2400  NA    NA           2
```

1. Backtesting Logic

Adding a numeric index

First, we need to create a corresponding index for each week:

```
# count number of weeks in data from one of the dataframes
sample_xts <- sp500_stocks$Industrials$ADP
head(sample_xts)
```

```
##            direction_lead adp_adjclose_lead adp_adjclose_lag0 adp_adjclose_lag1
## 2018-01-03             NA       0.003405680                NA                NA
## 2018-01-10             NA       0.036716665       0.003405680                NA
## 2018-01-17             NA      -0.009797875       0.036716665       0.003405680
## 2018-01-24             NA       0.022660367      -0.009797875       0.036716665
## 2018-01-31             NA      -0.084961843       0.022660367      -0.009797875
## 2018-02-07             NA      -0.007513292      -0.084961843       0.022660367
##            adp_adjclose_lag2 adp_adjclose_lag3 atr adx aaron bb chaikin_vol clv
## 2018-01-03                NA                NA  NA  NA    NA NA          NA  NA
## 2018-01-10                NA                NA  NA  NA    50 NA          NA  NA
## 2018-01-17                NA                NA  NA  NA   100 NA          NA  NA
## 2018-01-24       0.003405680                NA  NA  NA   100 NA          NA  NA
## 2018-01-31       0.036716665        0.00340568  NA  NA   100 NA          NA  NA
## 2018-02-07      -0.009797875        0.03671667  NA  NA   -50 NA          NA  NA
##            emv macd mfi      sar smi volat month_index
```

```
## 2018-01-03  NA   NA  NA 115.3586  NA    NA           1
## 2018-01-10  NA   NA  NA 115.4054  NA    NA           1
## 2018-01-17  NA   NA  NA 115.5252  NA    NA           1
## 2018-01-24  NA   NA  NA 115.9245  NA    NA           1
## 2018-01-31  NA   NA  NA 116.4665  NA    NA           1
## 2018-02-07  NA   NA  NA 125.2400  NA    NA           2
```

```r
# month index are assigned automatically
sample_xts[, c( "month_index")]
```

```
##            month_index
## 2018-01-03           1
## 2018-01-10           1
## 2018-01-17           1
## 2018-01-24           1
## 2018-01-31           1
## 2018-02-07           2
## 2018-02-14           2
## 2018-02-21           2
## 2018-02-28           2
## 2018-03-07           3
##        ...
## 2022-09-28          57
## 2022-10-05          58
## 2022-10-12          58
## 2022-10-19          58
## 2022-10-26          58
## 2022-11-02          59
## 2022-11-09          59
## 2022-11-16          59
## 2022-11-23          59
## 2022-11-30          59
```

splitting data by week

Initially, the idea was to split week-by-week, however, since we have to rebalance everymonth, this might lead to inconsistent results. Therefore, here I'm splitting the data week by week:

```r
library(xts)

# spli by months
sample_xts_by_month <- split.xts(sample_xts, f= "months")
names(sample_xts_by_month)
```

```
##  [1] "Jan 2018" "Feb 2018" "Mar 2018" "Apr 2018" "May 2018" "Jun 2018"
##  [7] "Jul 2018" "Aug 2018" "Sep 2018" "Oct 2018" "Nov 2018" "Dec 2018"
## [13] "Jan 2019" "Feb 2019" "Mar 2019" "Apr 2019" "May 2019" "Jun 2019"
## [19] "Jul 2019" "Aug 2019" "Sep 2019" "Oct 2019" "Nov 2019" "Dec 2019"
## [25] "Jan 2020" "Feb 2020" "Mar 2020" "Apr 2020" "May 2020" "Jun 2020"
## [31] "Jul 2020" "Aug 2020" "Sep 2020" "Oct 2020" "Nov 2020" "Dec 2020"
## [37] "Jan 2021" "Feb 2021" "Mar 2021" "Apr 2021" "May 2021" "Jun 2021"
## [43] "Jul 2021" "Aug 2021" "Sep 2021" "Oct 2021" "Nov 2021" "Dec 2021"
## [49] "Jan 2022" "Feb 2022" "Mar 2022" "Apr 2022" "May 2022" "Jun 2022"
## [55] "Jul 2022" "Aug 2022" "Sep 2022" "Oct 2022" "Nov 2022"
```

```r
length(names(sample_xts_by_month)) # total number of months of data
```

```
## [1] 59
```

BACKTESTING_PROCEDURE

1. Assume we have N_{years} years of weekly data, giving a total of N_{months} many months. 2. We want to fix a window of $N_W = 12$ months at the time (i.e. a year of data).
2. The total number of runs is given by

$$N^{runs} = \left\lfloor \frac{N_{months} - N_W}{s} \right\rfloor$$

, where $s = 1$ is the number of months to move at the time (because of monthly rebalance).

In our case, this gives

$$N^{runs} = \left\lfloor \frac{59 - 12}{1} \right\rfloor = 47$$

i.e., we can move 47 times when predicting one week at the time, starting with having all the data until month 12.

```
# Set up backtesting simulation parameters
sample_xts <- sp500_stocks$Industrials$ADP
sectors <- names(sp500_stocks)

N_months <- length(names(split.xts(sample_xts, f= "months")))
N_window <- 12
N_runs <- floor((N_months - N_window)/1)
N_sector_stocks <- 3

# setup variables to record results
portfolio <- rep(NA, length(sectors)*N_sector_stocks)
weights <- rep(1/length(portfolio), length(portfolio)) # initialize to 1/n

# Initiate backtesting
print("BACKTESTING")
```

```
## [1] "BACKTESTING"
```

```
# for every run (sliding window of time to consider)
for(tau in seq(N_runs)){
  # close any positions
  print(paste0("(tau=", tau, ") CLOSE all positions."))

  # Calculate and record profit-loss
  print("P/L:")

  # keep index counter for sectors
  i_sector <- 1

  # loop through all the sectors
  for(G in sectors){
    # execute sector procedure
    print(paste0("    SECTOR_PROCEDURE(G=", G, ", tau=",tau, ")"))

    # return top 3 best stocks according to procedure
    top_sector_stocks <- sample(names(sp500_stocks[[G]]), 3 )

    # assign best stocks to portfolio (NEED TO UPDATE LOGIC!)
    i_replace <- c(i_sector, i_sector+1, i_sector+2)
    portfolio[i_replace] <- top_sector_stocks
    i_sector <- i_sector + 3
```

```
  }

  # Display selected portfolio tickers
  print("Cur Portfolio:")
  print(portfolio)

  # Optimize portfolio weights using modified min_variance
  print("OPTIMIZE_PORTFOLIO(portfolio)")
  print("LONG PORTFOLIO()")
  print(paste(rep("-", 75), collapse = ""))
}
```

```
## [1] "(tau=1) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=1)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=1)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=1)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=1)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=1)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=1)"
## [1] "Cur Portfolio:"
##  [1] "ETN"  "UNP"  "BA"   "TMO"  "ISRG" "JNJ"  "INTU" "ORCL" "AVGO" "TTWO"
## [11] "META" "TMUS" "WFC"  "MS"   "MA"   "NKE"  "TSLA" "HD"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "---------------------------------------------------------------------------"
## [1] "(tau=2) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=2)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=2)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=2)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=2)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=2)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=2)"
## [1] "Cur Portfolio:"
##  [1] "ETN"  "HON"  "NOC"  "ABBV" "TMO"  "PFE"  "QCOM" "ORCL" "INTC" "T"
## [11] "EA"   "OMC"  "MA"   "SCHW" "PGR"  "GM"   "CMG"  "TSLA"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "---------------------------------------------------------------------------"
## [1] "(tau=3) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=3)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=3)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=3)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=3)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=3)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=3)"
## [1] "Cur Portfolio:"
##  [1] "ETN"   "FDX"   "ITW"   "LLY"   "ELV"   "JNJ"   "ADBE"  "CRM"   "ORCL"
## [10] "CMCSA" "GOOG"  "META"  "WFC"   "MS"    "BLK"   "MCD"   "TSLA"  "BKNG"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "---------------------------------------------------------------------------"
## [1] "(tau=4) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=4)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=4)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=4)"
```

```
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=4)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=4)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=4)"
## [1] "Cur Portfolio:"
##  [1] "DE"   "ITW"  "FDX"  "DHR"  "LLY"  "AMGN" "AAPL" "TXN"  "INTC" "T"
## [11] "NFLX" "DIS"  "PGR"  "AXP"  "JPM"  "AMZN" "TSLA" "F"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------------"
## [1] "(tau=5) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=5)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=5)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=5)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=5)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=5)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=5)"
## [1] "Cur Portfolio:"
##  [1] "ITW"  "GE"   "CSX"  "LLY"  "ISRG" "ABBV" "CSCO" "QCOM" "ORCL" "TTWO"
## [11] "T"    "WBD"  "CB"   "PGR"  "SCHW" "TJX"  "CMG"  "ABNB"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------------"
## [1] "(tau=6) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=6)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=6)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=6)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=6)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=6)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=6)"
## [1] "Cur Portfolio:"
##  [1] "UNP"  "CSX"  "BA"   "AMGN" "BMY"  "ABBV" "ACN"  "CRM"  "INTC" "VZ"
## [11] "T"    "TTWO" "MMC"  "SCHW" "JPM"  "MCD"  "ORLY" "CMG"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------------"
## [1] "(tau=7) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=7)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=7)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=7)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=7)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=7)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=7)"
## [1] "Cur Portfolio:"
##  [1] "BA"   "HON"  "UNP"  "TMO"  "AMGN" "JNJ"  "NVDA" "ORCL" "INTU" "WBD"
## [11] "META" "EA"   "AXP"  "SCHW" "MA"   "MAR"  "ABNB" "MCD"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------------"
## [1] "(tau=8) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=8)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=8)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=8)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=8)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=8)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=8)"
## [1] "Cur Portfolio:"
```

```
##  [1] "RTX"  "CAT"  "ETN"  "LLY"  "ABBV" "SYK"  "IBM"  "AAPL" "ACN"  "WBD"
## [11] "TTWO" "GOOG" "GS"   "MA"   "WFC"  "TSLA" "MCD"  "BKNG"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=9) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=9)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=9)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=9)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=9)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=9)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=9)"
## [1] "Cur Portfolio:"
##  [1] "FDX"  "UNP"  "UPS"  "JNJ"  "MDT"  "SYK"  "ACN"  "AVGO" "IBM"  "NFLX"
## [11] "GOOG" "TTWO" "GS"   "MA"   "SPGI" "AMZN" "F"    "MCD"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=10) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=10)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=10)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=10)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=10)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=10)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=10)"
## [1] "Cur Portfolio:"
##  [1] "BA"    "UPS"   "ETN"   "ABBV"  "SYK"   "ABT"   "INTU"  "CRM"   "AAPL"
## [10] "GOOGL" "TMUS"  "CMCSA" "AXP"   "MA"    "BLK"   "CMG"   "ABNB"  "F"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=11) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=11)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=11)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=11)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=11)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=11)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=11)"
## [1] "Cur Portfolio:"
##  [1] "UPS"  "DE"   "NOC"  "LLY"  "ABBV" "ABT"  "ADBE" "CRM"  "QCOM" "TMUS"
## [11] "WBD"  "VZ"   "MA"   "PGR"  "V"    "GM"   "ABNB" "BKNG"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=12) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=12)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=12)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=12)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=12)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=12)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=12)"
## [1] "Cur Portfolio:"
##  [1] "UNP"   "CSX"   "CAT"   "MRK"   "JNJ"   "PFE"   "ACN"   "QCOM"  "ORCL"
## [10] "TTWO"  "DIS"   "CMCSA" "WFC"   "SCHW"  "CB"    "HD"    "NKE"   "TJX"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
```

```
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=13) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=13)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=13)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=13)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=13)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=13)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=13)"
## [1] "Cur Portfolio:"
##  [1] "DE"    "GE"    "HON"   "SYK"   "ABT"   "LLY"   "ORCL"  "ADBE"  "IBM"
## [10] "TTWO"  "META"  "VZ"    "MA"    "BAC"   "BRK-B" "MAR"   "ORLY"  "HD"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=14) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=14)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=14)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=14)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=14)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=14)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=14)"
## [1] "Cur Portfolio:"
##  [1] "GE"   "LMT"  "UPS"  "PFE"  "ABBV" "AMGN" "ADBE" "INTU" "AVGO" "CHTR"
## [11] "TTWO" "OMC"  "BLK"  "PGR"  "MS"   "CMG"  "ORLY" "TJX"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=15) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=15)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=15)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=15)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=15)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=15)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=15)"
## [1] "Cur Portfolio:"
##  [1] "ITW"  "BA"   "CSX"  "UNH"  "ELV"  "ABBV" "IBM"  "NVDA" "AAPL" "T"
## [11] "GOOG" "NFLX" "MA"   "AXP"  "MMC"  "GM"   "MCD"  "AMZN"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=16) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=16)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=16)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=16)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=16)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=16)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=16)"
## [1] "Cur Portfolio:"
##  [1] "BA"    "GE"    "RTX"   "ISRG"  "ABT"   "AMGN"  "ORCL"  "ADBE"  "CSCO"
## [10] "T"     "CHTR"  "TMUS"  "MS"    "BLK"   "BRK-B" "HD"    "AMZN"  "ORLY"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=17) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=17)"
```

```
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=17)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=17)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=17)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=17)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=17)"
## [1] "Cur Portfolio:"
##  [1] "CAT"  "GE"   "DE"   "ISRG" "LLY"  "ABBV" "ORCL" "AAPL" "CSCO" "TTWO"
## [11] "DIS"  "NFLX" "CB"   "V"    "JPM"  "AMZN" "F"    "TSLA"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=18) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=18)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=18)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=18)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=18)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=18)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=18)"
## [1] "Cur Portfolio:"
##  [1] "LMT"   "BA"    "ETN"   "BMY"   "MRK"   "DHR"   "ACN"   "AMD"   "CRM"
## [10] "EA"    "TTWO"  "T"     "BAC"   "MS"    "BRK-B" "GM"    "ABNB"  "MAR"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=19) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=19)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=19)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=19)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=19)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=19)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=19)"
## [1] "Cur Portfolio:"
##  [1] "NOC"  "UPS"  "GE"   "ELV"  "AMGN" "PFE"  "CSCO" "ADBE" "CRM"  "EA"
## [11] "T"    "ATVI" "JPM"  "MA"   "WFC"  "ABNB" "MCD"  "BKNG"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=20) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=20)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=20)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=20)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=20)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=20)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=20)"
## [1] "Cur Portfolio:"
##  [1] "CAT"   "FDX"   "ETN"   "PFE"   "SYK"   "DHR"   "ORCL"  "AMD"   "TXN"
## [10] "CMCSA" "TMUS"  "EA"    "CB"    "BLK"   "BRK-B" "ORLY"  "MCD"   "BKNG"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=21) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=21)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=21)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=21)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=21)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=21)"
```

```
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=21)"
## [1] "Cur Portfolio:"
##  [1] "ADP"  "UPS"  "GE"   "AMGN" "DHR"  "ABT"  "TXN"  "CSCO" "AMD"  "WBD"
## [11] "META" "TMUS" "V"    "MMC"  "BAC"  "SBUX" "BKNG" "ORLY"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=22) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=22)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=22)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=22)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=22)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=22)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=22)"
## [1] "Cur Portfolio:"
##  [1] "ETN"  "RTX"  "HON"  "DHR"  "SYK"  "TMO"  "AVGO" "AMD"  "NVDA" "ATVI"
## [11] "TTWO" "CHTR" "SPGI" "PGR"  "JPM"  "AMZN" "ABNB" "TSLA"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=23) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=23)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=23)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=23)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=23)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=23)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=23)"
## [1] "Cur Portfolio:"
##  [1] "ADP"   "ETN"   "HON"   "ABT"   "LLY"   "PFE"   "MSFT"  "CSCO"  "AVGO"
## [10] "CMCSA" "META"  "EA"    "SCHW"  "WFC"   "PGR"   "F"     "ABNB"  "AZO"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=24) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=24)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=24)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=24)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=24)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=24)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=24)"
## [1] "Cur Portfolio:"
##  [1] "ITW"  "HON"  "ADP"  "UNH"  "MDT"  "AMGN" "ACN"  "AVGO" "CSCO" "TTWO"
## [11] "META" "GOOG" "BAC"  "PGR"  "MS"   "MCD"  "CMG"  "AMZN"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=25) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=25)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=25)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=25)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=25)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=25)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=25)"
## [1] "Cur Portfolio:"
##  [1] "ADP"  "ETN"  "UNP"  "ABBV" "ABT"  "BMY"  "CRM"  "ADBE" "TXN"  "TTWO"
## [11] "WBD"  "TMUS" "CB"   "V"    "JPM"  "HD"   "TSLA" "ABNB"
```

```
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=26) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=26)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=26)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=26)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=26)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=26)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=26)"
## [1] "Cur Portfolio:"
##  [1] "ETN"   "LMT"   "NOC"   "LLY"   "SYK"   "MDT"   "INTU"  "NVDA"  "MSFT"
## [10] "EA"    "GOOGL" "VZ"    "V"     "MA"    "SPGI"  "TSLA"  "TJX"   "HD"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=27) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=27)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=27)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=27)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=27)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=27)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=27)"
## [1] "Cur Portfolio:"
##  [1] "GE"    "BA"    "ADP"   "AMGN"  "MDT"   "ISRG"  "IBM"   "ACN"   "AMD"
## [10] "CHTR"  "WBD"   "EA"    "BRK-B" "CB"    "PGR"   "AZO"   "AMZN"  "SBUX"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=28) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=28)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=28)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=28)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=28)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=28)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=28)"
## [1] "Cur Portfolio:"
##  [1] "BA"   "CAT"  "RTX"  "ISRG" "JNJ"  "DHR"  "ORCL" "AAPL" "MSFT" "META"
## [11] "TTWO" "OMC"  "MA"   "SPGI" "MMC"  "F"    "TJX"  "AZO"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=29) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=29)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=29)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=29)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=29)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=29)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=29)"
## [1] "Cur Portfolio:"
##  [1] "HON"   "ETN"   "ITW"   "ABBV"  "MDT"   "BMY"   "AVGO"  "INTU"  "CSCO"
## [10] "GOOGL" "NFLX"  "ATVI"  "SCHW"  "BAC"   "MMC"   "ABNB"  "F"     "TJX"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=30) CLOSE all positions."
```

```
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=30)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=30)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=30)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=30)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=30)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=30)"
## [1] "Cur Portfolio:"
##  [1] "BA"   "ITW"  "NOC"  "AMGN" "ABT"  "ISRG" "TXN"  "IBM"  "MSFT" "CHTR"
## [11] "T"    "TTWO" "MA"   "PGR"  "SCHW" "TSLA" "MCD"  "AMZN"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=31) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=31)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=31)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=31)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=31)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=31)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=31)"
## [1] "Cur Portfolio:"
##  [1] "UPS"   "LMT"   "DE"    "ISRG"  "SYK"   "PFE"   "IBM"   "TXN"   "CSCO"
## [10] "OMC"   "CMCSA" "TMUS"  "WFC"   "V"     "BAC"   "CMG"   "F"     "MCD"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=32) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=32)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=32)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=32)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=32)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=32)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=32)"
## [1] "Cur Portfolio:"
##  [1] "CAT"  "HON"  "LMT"  "MDT"  "DHR"  "BMY"  "NVDA" "CRM"  "INTU" "WBD"
## [11] "VZ"   "TMUS" "AXP"  "MMC"  "MS"   "CMG"  "TJX"  "BKNG"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=33) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=33)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=33)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=33)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=33)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=33)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=33)"
## [1] "Cur Portfolio:"
##  [1] "ETN"  "UNP"  "FDX"  "SYK"  "UNH"  "ABBV" "TXN"  "AAPL" "ADBE" "META"
## [11] "EA"   "TTWO" "V"    "SPGI" "MA"   "CMG"  "BKNG" "HD"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=34) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=34)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=34)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=34)"
```

```
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=34)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=34)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=34)"
## [1] "Cur Portfolio:"
##  [1] "CSX"   "BA"    "NOC"   "MRK"   "UNH"   "AMGN"  "AVGO"  "QCOM"  "ORCL"
## [10] "TMUS"  "CHTR"  "META"  "BRK-B" "SCHW"  "V"     "MCD"   "GM"    "SBUX"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=35) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=35)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=35)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=35)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=35)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=35)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=35)"
## [1] "Cur Portfolio:"
##  [1] "DE"    "ETN"   "BA"    "ABT"   "JNJ"   "LLY"   "MSFT"  "INTU"  "ADBE"
## [10] "META"  "GOOGL" "WBD"   "MMC"   "BRK-B" "SPGI"  "AMZN"  "AZO"   "TJX"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=36) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=36)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=36)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=36)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=36)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=36)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=36)"
## [1] "Cur Portfolio:"
##  [1] "LMT"   "CAT"   "ETN"   "LLY"   "DHR"   "TMO"   "CRM"   "MSFT"  "AAPL"
## [10] "ATVI"  "GOOGL" "OMC"   "MA"    "MS"    "BAC"   "ABNB"  "BKNG"  "NKE"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=37) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=37)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=37)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=37)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=37)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=37)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=37)"
## [1] "Cur Portfolio:"
##  [1] "GE"   "BA"   "RTX"  "ELV"  "DHR"  "ABBV" "TXN"  "QCOM" "INTU" "EA"
## [11] "META" "T"    "SCHW" "CB"   "JPM"  "TJX"  "AZO"  "TSLA"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=38) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=38)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=38)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=38)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=38)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=38)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=38)"
## [1] "Cur Portfolio:"
```

```
##  [1] "ITW"  "BA"   "UNP"  "TMO"  "SYK"  "MDT"  "NVDA" "QCOM" "IBM"  "GOOG"
## [11] "META" "WBD"  "MS"   "AXP"  "BAC"  "TSLA" "BKNG" "NKE"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=39) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=39)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=39)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=39)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=39)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=39)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=39)"
## [1] "Cur Portfolio:"
##  [1] "NOC"  "ITW"  "UPS"  "ELV"  "JNJ"  "TMO"  "AMD"  "IBM"  "AAPL" "TMUS"
## [11] "NFLX" "CHTR" "SPGI" "JPM"  "WFC"  "SBUX" "HD"   "AZO"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=40) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=40)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=40)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=40)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=40)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=40)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=40)"
## [1] "Cur Portfolio:"
##  [1] "HON"   "BA"    "CSX"   "LLY"   "MRK"   "ABT"   "NVDA"  "AMD"   "MSFT"
## [10] "CMCSA" "VZ"    "GOOGL" "JPM"   "BRK-B" "MMC"   "SBUX"  "ABNB"  "TJX"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=41) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=41)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=41)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=41)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=41)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=41)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=41)"
## [1] "Cur Portfolio:"
##  [1] "LMT"   "CSX"   "RTX"   "SYK"   "MRK"   "UNH"   "ACN"   "INTC"  "IBM"
## [10] "VZ"    "META"  "GOOG"  "CB"    "AXP"   "BRK-B" "AMZN"  "NKE"   "ORLY"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------"
## [1] "(tau=42) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=42)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=42)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=42)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=42)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=42)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=42)"
## [1] "Cur Portfolio:"
##  [1] "ETN"  "ITW"  "DE"   "BMY"  "JNJ"  "ELV"  "NVDA" "IBM"  "CSCO" "TMUS"
## [11] "DIS"  "ATVI" "MS"   "V"    "SCHW" "MCD"  "TSLA" "SBUX"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
```

```
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=43) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=43)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=43)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=43)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=43)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=43)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=43)"
## [1] "Cur Portfolio:"
##  [1] "ADP"   "CAT"   "HON"   "MDT"   "MRK"   "BMY"   "ACN"   "IBM"   "CRM"
## [10] "VZ"    "GOOG"  "GOOGL" "PGR"   "BRK-B" "BAC"   "F"     "GM"    "ORLY"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=44) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=44)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=44)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=44)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=44)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=44)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=44)"
## [1] "Cur Portfolio:"
##  [1] "GE"   "NOC"  "UNP"  "MDT"  "ABT"  "PFE"  "QCOM" "ADBE" "AVGO" "TMUS"
## [11] "DIS"  "GOOG" "SCHW" "BLK"  "MS"   "BKNG" "SBUX" "F"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=45) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=45)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=45)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=45)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=45)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=45)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=45)"
## [1] "Cur Portfolio:"
##  [1] "LMT"   "FDX"   "ADP"   "UNH"   "ELV"   "AMGN"  "INTU"  "TXN"   "ORCL"
## [10] "CHTR"  "DIS"   "EA"    "BRK-B" "V"     "BAC"   "NKE"   "F"     "ABNB"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=46) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=46)"
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=46)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=46)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=46)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=46)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=46)"
## [1] "Cur Portfolio:"
##  [1] "UNP"  "CAT"  "ETN"  "AMGN" "MRK"  "PFE"  "INTC" "QCOM" "AMD"  "META"
## [11] "VZ"   "DIS"  "SPGI" "GS"   "BLK"  "ORLY" "CMG"  "BKNG"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "--------------------------------------------------------------------------------"
## [1] "(tau=47) CLOSE all positions."
## [1] "P/L:"
## [1] "    SECTOR_PROCEDURE(G=Industrials, tau=47)"
```

```
## [1] "    SECTOR_PROCEDURE(G=Health Care, tau=47)"
## [1] "    SECTOR_PROCEDURE(G=Information Technology, tau=47)"
## [1] "    SECTOR_PROCEDURE(G=Communication Services, tau=47)"
## [1] "    SECTOR_PROCEDURE(G=Financials, tau=47)"
## [1] "    SECTOR_PROCEDURE(G=Consumer Discretionary, tau=47)"
## [1] "Cur Portfolio:"
##  [1] "ETN"  "ITW"  "CAT"  "TMO"  "ABT"  "ISRG" "CSCO" "MSFT" "INTU" "GOOG"
## [11] "DIS"  "TMUS" "MMC"  "CB"   "PGR"  "CMG"  "SBUX" "AMZN"
## [1] "OPTIMIZE_PORTFOLIO(portfolio)"
## [1] "LONG PORTFOLIO()"
## [1] "------------------------------------------------------------------------------"
```