COMP396
Design Presentation

Weiyi Liu
Zixuan Zhu
Yiwang Tian
Zhiyu Chen
Tianyi Ye

Team 7

Contents

01 Executive summary

Executive summary

Breakdown of teamwork

Zixuan Zhu

-Momentum strategy with simple moving average and macd indicators.

-Completed the position sizing part.

Yiwang Tian

-Resistance support relative strength(RSRS) strategy based on the limitations of bollinger bands.

-Proposed the combined ideas based on extensive research.

Executive summary

Breakdown of teamwork

Zhiyu Chen

-Did basic data analysis and found the characteristics of each stock separately

-Multi-factor strategy.

Tianyi Ye

-Testing of Multi-factor strategy.

-Decide the future plan.

Weiyi Liu

-The role of secretary.

-Coding support and editing the whole design report.

Executive summary

The whole introduction -- Momentum strategy

-Ten stock markets, meaning there may be trend-following markets.

-The simple moving average in COMP226 is ideal for this situation,as the two lines can indicate very clear entry and exit points.

-A lag, Zixuan searched the internet and found that MACD indicators can temper the lag and can indicate a strong trend.

-So momentum strategy is one combination of SMA and MACD indicators.

Executive summary

The whole introduction -- RSRS strategy

-A way to use resistance and support levels

-Focuses on the relative strengths between them, rather than interpreting them directly as thresholds in a price range.

-No longer sees resistance and support as a fixed value, but as a variable

Executive summary

The whole introduction -- Multi-factor strategy

-As the first two strategies have limitations in terms of stock market selection, for example, the momentum strategy is more suited to trend-following markets.

-The multi-factor strategy is intended to break this limitation and can be executed in each series.

-Relatively flexible - can help to redirect the overall strategy in the event of future combinations.

02

Momentum strategy

Double moving average and MACD indicators

Momentum Strategy

Intrdocution

Data analysis
Trending test data detection

Basic logic
Clear entry and exit points to the market

Preliminary testing
Parameter selection, in-sample and out-of-sample tests

Momentum Strategy

Data analysis

- Volatility detection

  Based on an analysis of the volatility of the overall data opening and closing prices

open_to_open

	mean	std	min	25%	50%	75%	max
1	0.000220	0.026972	-0.241745	-0.013458	0.000919	0.013596	0.135427
2	0.000116	0.027669	-0.265703	-0.012202	0.000000	0.013615	0.150823
3	-0.000101	0.017751	-0.120953	-0.009527	0.000000	0.009431	0.099018
4	-0.000009	0.016194	-0.115143	-0.009069	-0.000844	0.008307	0.116433
5	-0.000176	0.018291	-0.096515	-0.008249	0.000000	0.008193	0.134442
6	0.000071	0.003032	-0.014997	-0.001546	0.000344	0.001781	0.016323
7	-0.000055	0.007012	-0.041964	-0.003590	-0.000392	0.003531	0.033572
8	-0.000307	0.020870	-0.145016	-0.010480	0.000000	0.010861	0.091937
9	-0.000281	0.013734	-0.085507	-0.008047	0.000752	0.008368	0.059285
10	-0.000021	0.007508	-0.056541	-0.002825	0.000590	0.003675	0.032374

close_to_close

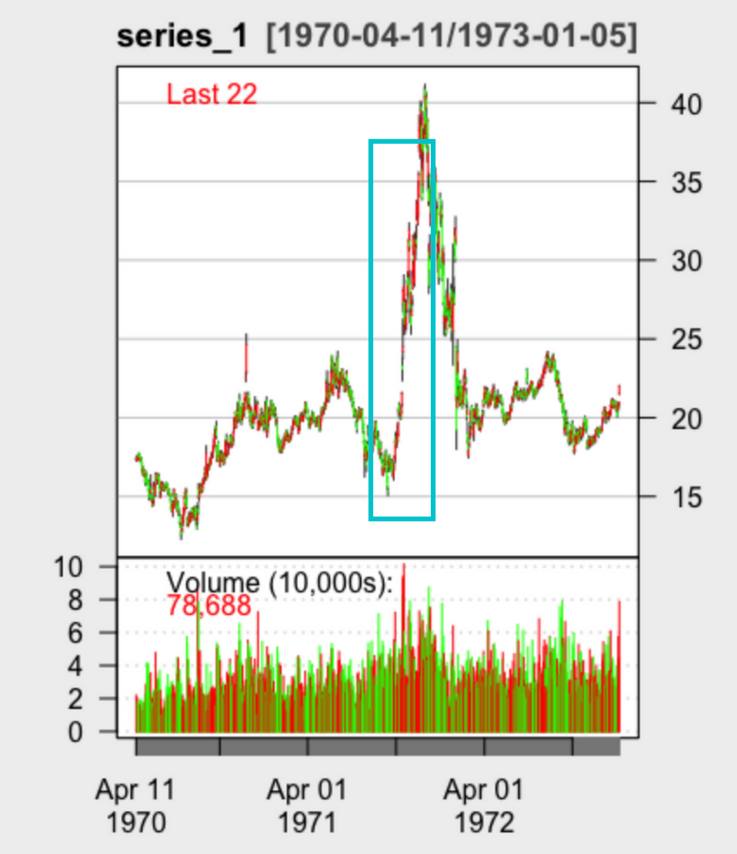
	mean	std	min	25%	50%	75%	max
1	0.000198	0.029452	-0.400478	-0.012132	0.000765	0.012462	0.135724
2	0.000111	0.029703	-0.390942	-0.010572	0.002086	0.013296	0.139942
3	-0.000104	0.016854	-0.123481	-0.008226	0.000392	0.008395	0.072225
4	-0.000008	0.015147	-0.073338	-0.008717	0.000502	0.007673	0.064143
5	-0.000179	0.019207	-0.135403	-0.007468	0.000277	0.006989	0.238970
6	0.000070	0.002888	-0.017042	-0.001279	0.000360	0.001652	0.019916
7	-0.000055	0.007083	-0.041325	-0.003808	-0.000398	0.003603	0.039457
8	-0.000315	0.020250	-0.110105	-0.010047	0.000000	0.010342	0.084023
9	-0.000275	0.013152	-0.056242	-0.006312	0.000000	0.007061	0.054067
10	-0.000026	0.007081	-0.060455	-0.002716	0.000241	0.003129	0.027419

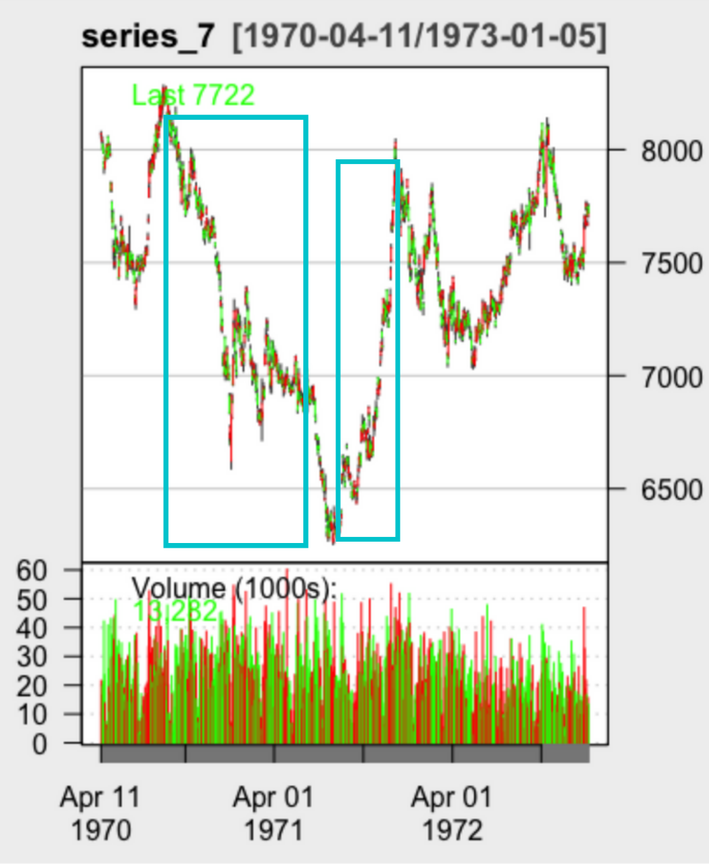
Momentum Strategy

Data analysis

- K-chart analysis

  Use K-line charts to visualise the stock to determine if the trend is visually represented on the graph





Momentum Strategy

Data analysis

- Mann-Kendall test.

  Trends in time series data were analysed using the Mann-Kendall test.

```
Mann_Kendall_Test(trend='increasing',
 h=True, p=0.0, z=20.254244713045708,
 Tau=0.40777400943006037, s=246479.0,
 var_s=148089483.0, slope=0
 .005197889182058045, intercept=16
 .943759894459106)
```

Series 1

```
Mann_Kendall_Test(trend='decreasing',
 h=True, p=2.2111121830650 88e-12,
 z=-7.019845064778539, Tau=-0
 .14133013483331955, s=-85427.0,
 var_s=148089780.33333334, slope=-0
 .3273809523809524, intercept=7664
 .895833333333)
```

Series 7

Momentum Strategy

Basic logic—Design concept

- Simple Moving Average can give a good indication of the general trend of a time series. Two SMA will have some cross points.
- MACD uses exponential weighting to calculate the mean, so it is weighted by time on the basis of the moving average.
- If the macd indicator is added to the entry rules, it can alleviate the lag of the SMA, making the indicator more accurate in grasping the medium and long-term trends.

Momentum Strategy

Basic logic—Design concept

- When the short SMA crosses the long SMA and macd$macd crosses macd$signal from bottom to top → A clear signal to long and indicates an uptrend ahead
- When the short SMA crosses the long SMA and macd$macd crosses macd$signal from top to bottom → A clear signal to leave or short and represents the existence of a downtrend and a short market

Momentum Strategy

Basic logic—Code implementation

```
#when there is a cross in double moving average and macd indicators
#it is a clear entry point and it also implies the future up-ward trending
if (last((SMA(store$cl[startIndexma:(store$iter-1),i],n=params$dmalookbacks$short)))
    <
    last((SMA(store$cl[startIndexma:(store$iter-1),i],n=params$dmalookbacks$long)))
    &&
    short_ma >= long_ma
    && macd$macd >macd$signal ) {
  pos[params$series[i]] <-  params$posSizes[params$series[i]]
}


#when there is a cross in double moving average and macd indicators
#it is a clear exit point and it also implies the future down-ward trending
else if (last((SMA(store$cl[startIndexma:store$iter-1,i],n=params$dmalookbacks$short)))
         >
         last((SMA(store$cl[startIndexma:store$iter-1,i],n=params$dmalookbacks$long)))
         &&
         short_ma <= long_ma
         && macd$macd < macd$signal
         ) {

  pos[params$series[i]] <- -params$posSizes[params$series[i]]

}
else{
  pos[params$series[i]] <- 0
}
```

Momentum Strategy

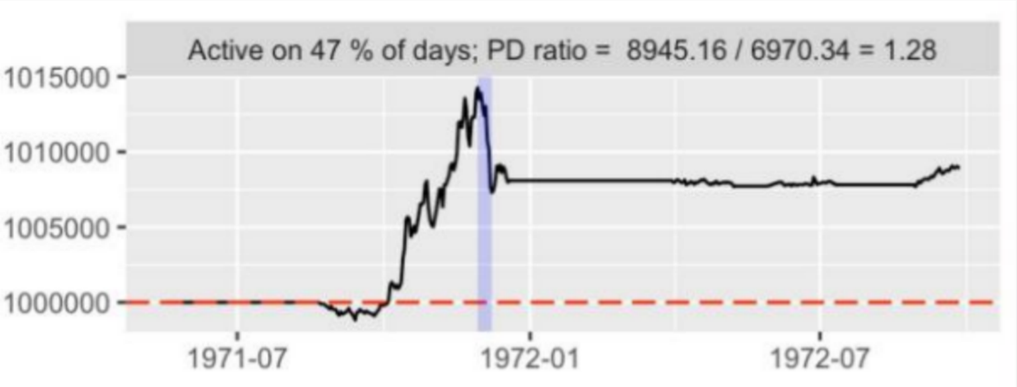
Preliminary testing

- Firstly, the data were averaged (500 days for both in-sample and out-of-sample respectively)
- Secondly, the best-performing combination of data from the in-sample was selected by cross-validation and applied to the out-of-sample for initial testing.
- Finally, the results are echoed in the data analysis

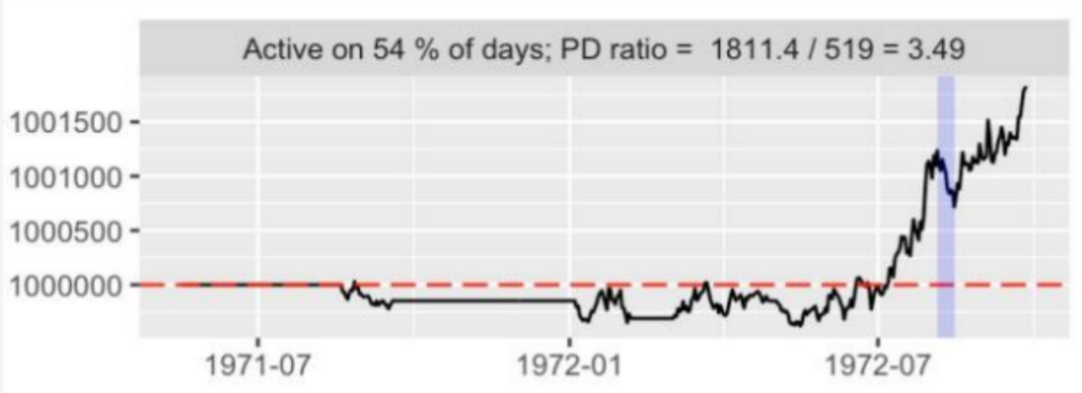
Momentum Strategy

Preliminary testing

The following pictures are from out-of-sample data set



Series 1



Series 7

03

Resistance Support Relative Strength Strategy

Resistance Support Relative Strength(RSRS) Strategy

Introduction

Data analysis
BBands & Inspiration

Basic logic
Concept of RSRS indicator
Constructure of RSRS strategy
Threshold determine

Implementation
In-sample and out-of-sample tests

RSRS Strategy

BBands:

Concept

- moving average
  using support and resistence as threshold

Drawback

- time lag
  ---In uncertainty markets, using this approach means constantly switching between long and short, with little chance to generate profit

RSRS Strategy

Inspiration

- Focusing on relative strength between resistance and support, regard it as a variable

- The daily highs and lows can quickly reflect the nature of recent market attitudes toward resistance and support levels, and that is the most important reason we use them.

RSRS Strategy

Concept

- Slope of (low[0],high[0]) and (low[1],high[1])
  Building a linear regression model for the last N (low, high)

$$high = alpha + beta*low + epsilon, epsilon \sim N(0,sigma) \quad (1)$$

RSRS → beta

Advantage

- Reflecting the traders' expected judgment of the top and bottom of the current market state, which can have good immediacy.

RSRS Strategy

RSRS construction

- 1) Take the highest price sequence and the lowest price sequence of the previous N day.
  2) OLS linear regression of the two list of data(high & low) according to formula ①.
  3) The fitted beta value was taken as the RSRS slope index value of that day

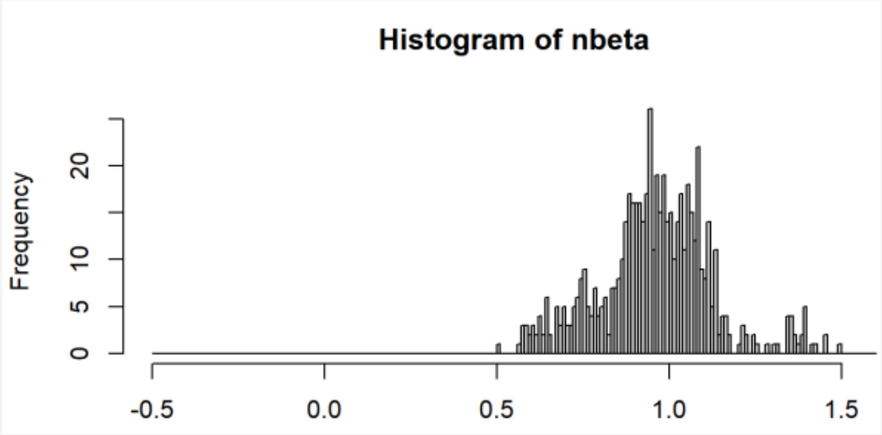
Strategy logic

- Long when the RSRS exceeds buy threshold ,
  Short to close positions when the RSRS crosses sell threshold

RSRS Strategy

Threshold determine

- To find a more reasonable threshold value, we calculated the slope for the sample-test and observed the historical data distribution of the slope



Mean	0.958
Standard Deviation	0.165
Skewness	0.167
Kurtosis	0.680

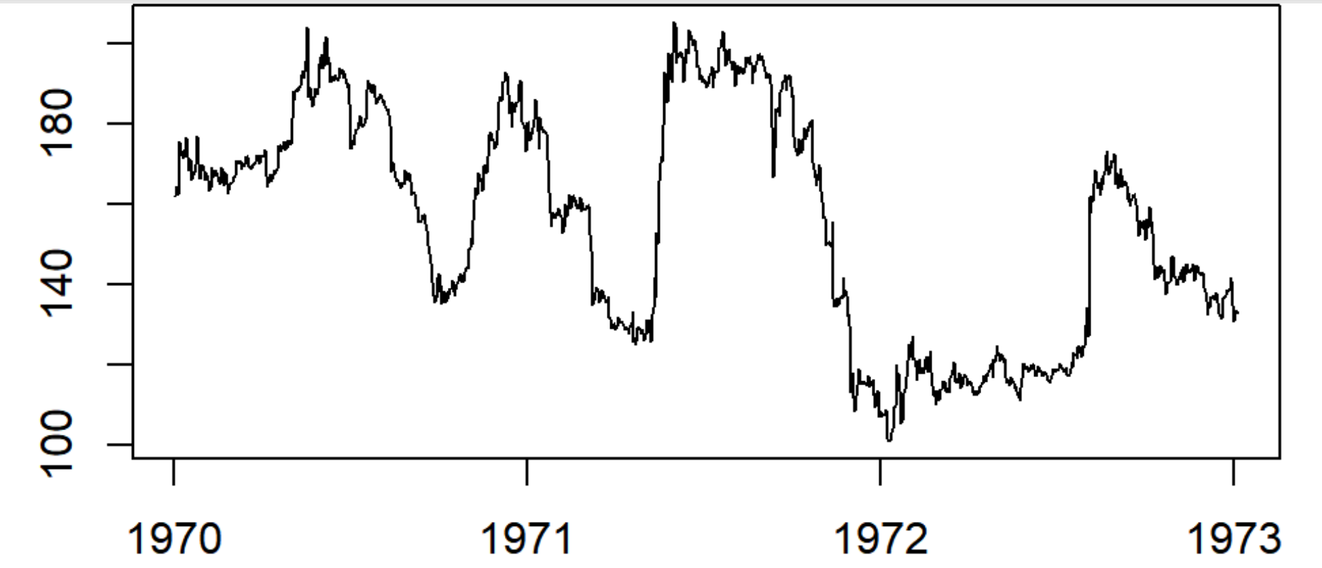
- From the data, a more reasonable threshold selection is the mean plus and minus a standard deviation, we take S1=1.1 and S2=0.8.

RSRS strategy

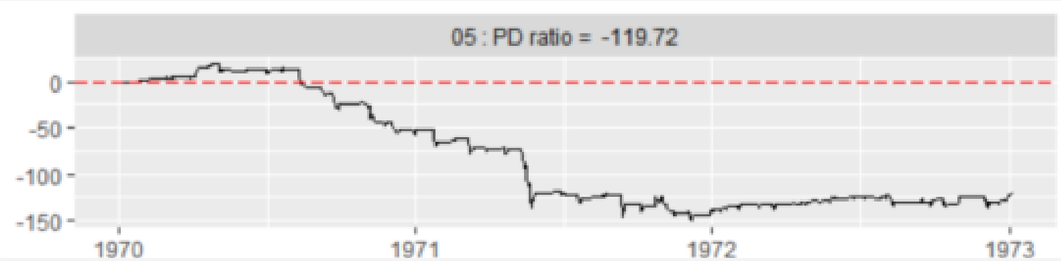
RSRS strategy framework

- Calculate the RSRS slope.
  If the slope is greater than (buy threshold)S1, return 1(long) .
  If the slope is less than (sell threshold)S2, return -1(short).
  Otherwise, return 0.

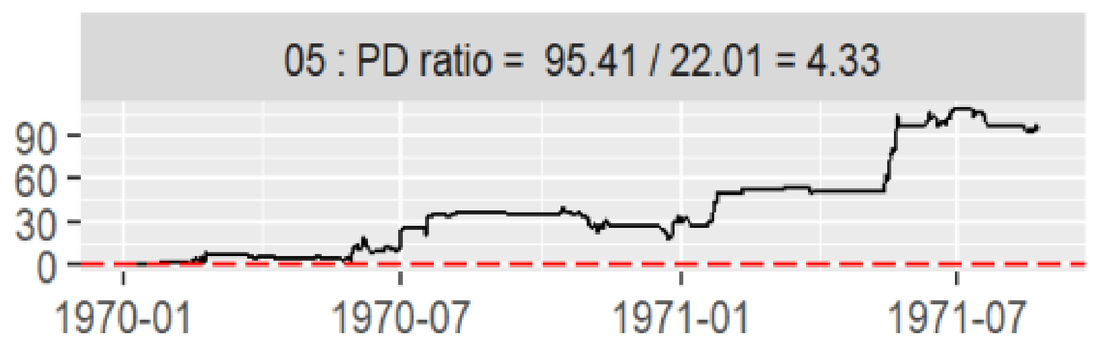
RSRS Strategy



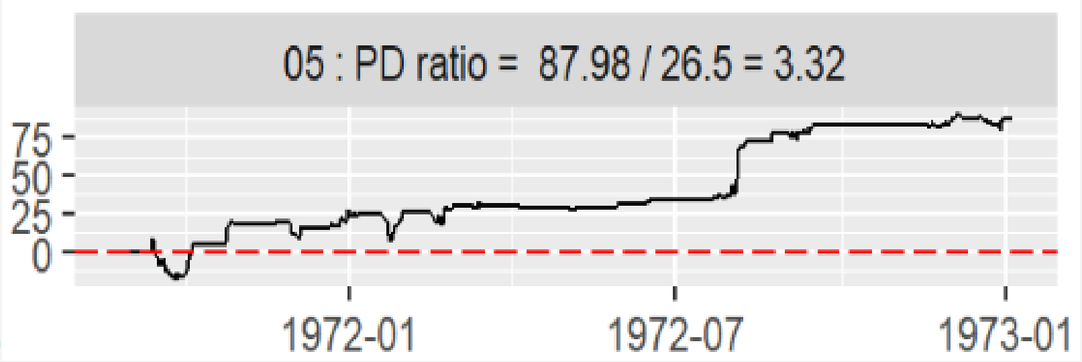
BBands



IN SAMPLE



OUT-OF SAMPLE



04 Multi-Factor Strategy

Multi-Factor Strategy

Intrdocution

Key factor
modified from the original Alpha-006

Basic logic
go long when the stock price and volume are negatively correlated

Implementation
calculate the correlation between the close price and the volume

Multi-Factor Strategy

Formula

$$\alpha = -1 * correlation(close, volume)$$

$$where\ observed\ time = most\ recent\ n\ days$$

1. calculate the correlation between the close price and the volume in the most recent n days

   The higher the correlation, the closer the opening price and trading volume are to positively correlated

2. multiply the factor by -1

Multi-Factor Strategy

Data Analysis

1 Prove of correlation between close price and volume

```
#Additional - Correlation Analysis
Stock <- read.csv("10.csv", header=TRUE, sep=",", dec=".", fileEncoding="UTF-8-BOM")
head(Stock)
#Remove the date index
Stock <- Stock[,-1]
head(Stock)
#Use of function cor()
cor(Stock$Close, Stock$Volume, method='pearson')
#Use of function rcorr()
library(Hmisc)
Stock <- as.matrix(Stock)
rcorr(Stock)
#Visualization
library(PerformanceAnalytics)
chart.Correlation(Stock)
```

Multi-Factor Strategy

Data Analysis

high levels of correlation (0.43) between Open Price and Volume

```
> rcorr(Stock)
        Open High  Low Close Volume
Open    1.00 1.00 1.00  0.99   0.43
High    1.00 1.00 1.00  1.00   0.44
Low     1.00 1.00 1.00  1.00   0.42
Close   0.99 1.00 1.00  1.00   0.43
Volume  0.43 0.44 0.42  0.43   1.00
```

Multi-Factor Strategy

Data Analysis

2

The stocks' volatilities and the observed period setting

- stock no.1, 2 and 8 have the greatest fluctuation - set the observed period shorter
- The decision will not be greatly affected by fluctuations

- stock no.6, 7 and 10 have the smallest fluctuation - set the observed period longer
- The decision on a particular day can reference more previous day’ s data, more reliable decision

Multi-Factor Strategy

Key Strategy

Why “go long when the stock price and volume are negatively correlated”

It means that the stock price has bottomed out, the downtrend is about to end, and the uptrend is about to start, which is a buy signal, and investors can consider buying some.

Multi-Factor Strategy

Code Logic

Determine each day's value of α006 Factor based on previous n days' data

α006 Factor > Threshold - go long 1
α006 Factor = Threshold - no trading
α006 Factor < Threshold - go short 1

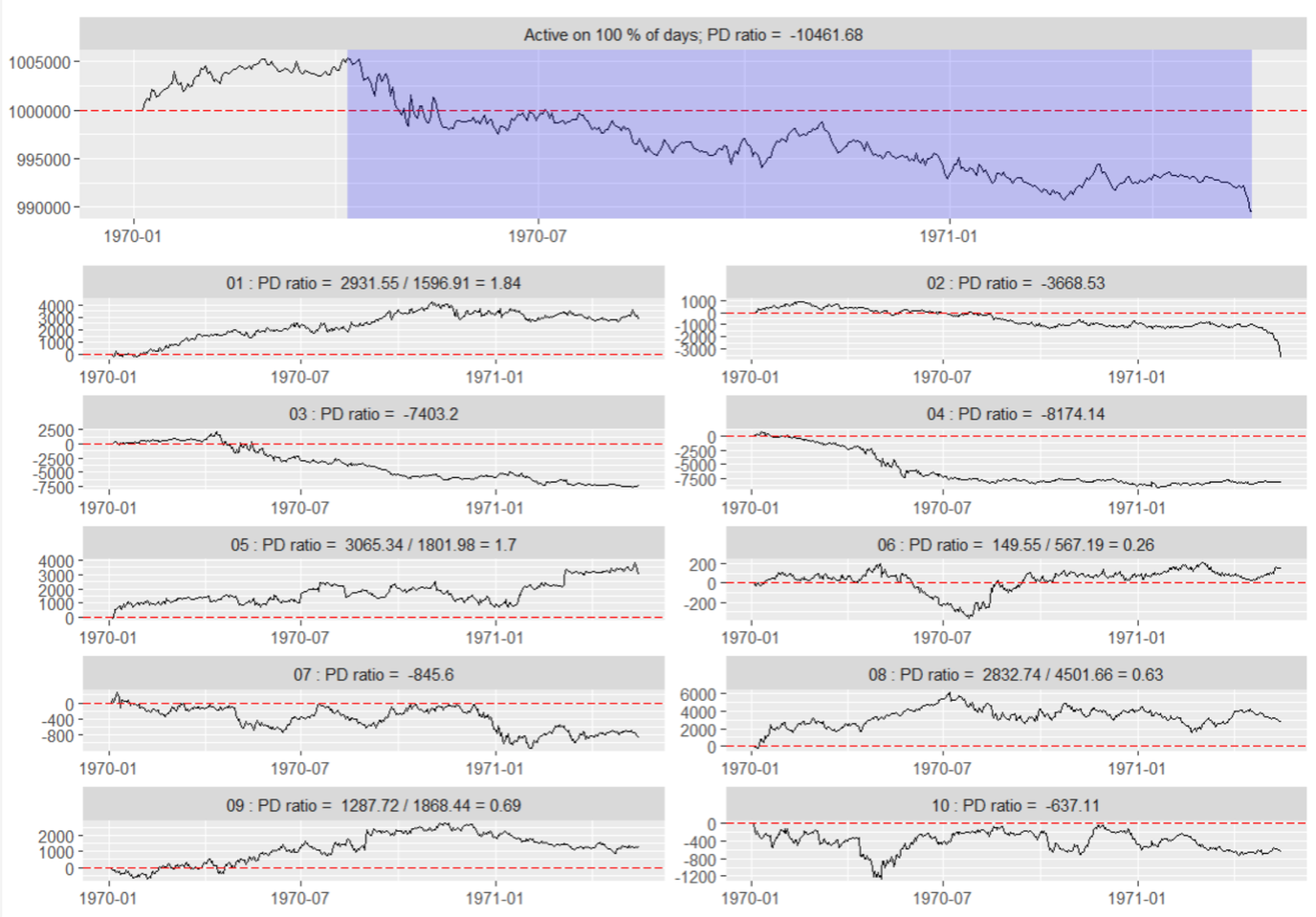
Multi-Factor Strategy

```r
getOrders <- function(store, newRowList, currentPos, info, params) {

  #Initializing
  allzero  <- rep(0,length(newRowList)) # used for initializing vectors

  if (is.null(store)) store <- initStore(newRowList,params$series)
  store <- updateStore(store, newRowList, params$series)

  marketOrders <- -currentPos; pos <- allzero

  #Initialize threshold value
  thr <- params$thr

  #Iterate through the series in params$series
  for (i in params$series){

    #Ignore the first day, or it shall occur error
    if(store$iter>1){

      #Get every stock's volume and closed price data
      VOLUME = store$vol[,i]
      CLOSE = store$cl[,i]

      #For the first specified days, store the first day to today's volume and close price
      if(store$iter<=params$obday){
        VOLUMELIST <- VOLUME[0:store$iter]
        CLOSELIST <- CLOSE[0:store$iter]
      }

      #After the specified days, store the most recent n days' data
      #n is the observed day and is passed in through parameter "obday"
      else if(store$iter>params$obday){
        VOLUMELIST <- VOLUME[as.numeric(store$iter-params$obday):store$iter]
        CLOSELIST <- CLOSE[as.numeric(store$iter-params$obday):store$iter]
      }

      #Apply Alpha006 equation
      #Get Everyday's new alpha rate
      alpha = -1*cor(as.vector(CLOSELIST), as.vector(VOLUMELIST), use = "everything", method="pearson")

      print(paste("day", store$iter))
      print(paste("series no.", i))
      print(paste("alpha006 =",alpha))

      #Change Position
      if (alpha*100 < thr){
        pos[params$series[i]] <- -1
      }
      else if (alpha*100 > thr){
        pos[params$series[i]] <- 1
      }
      else if (alpha*100 == thr){
        pos[params$series[i]] <- 0
      }

    }
  }

  #Update market orders
  marketOrders <- -currentPos + pos
```

Multi-Factor Strategy

Implementation

- choose the first 500 days as an in-sample test
- thr=0 and obday=35
- Positions were set up by opening price normalisation (COMP396 Lec4)



Multi-Factor Strategy

Weakness & Plan

- **Inability to determine the optimal threshold**

  "backtest() <-> getOrders()" infinite recurssion

- **Maybe more factors?**

  Current: Only Alpha-006

  Others factors: 1.require additional stock indicators
  2.require functions that we cannot express correctly
  3. even worst performance

05 Test and Combination

Test and Combination

Intrdocution

Test

how to test while coding

Combination

how to combine the three strategy and future plan

Test and Combination

Test

Detail

Check that each part of the function is working properly

Test and Combination

Test

Advantage

it will make the debug much easier

Test and Combination

Combination

Step 1

Combined three strategy into 2

Combined "RSRS" and "Momentum" as one

1. they have low correlation

2. ease the lag

--These two strategies can complement each other

Test and Combination

Combination

Step 2 Allocate capital to these two strategies

The allocation of capital is specific to the strategy

1. Strategies show a good PD-ratio in the in-sample are allocated more money

2. Strategies show a bad PD ratio in the in-sample will be allocated less money

Test and Combination

Combination

Step 3 Allocate position to these 10 stores

The allocation of positions is specific to the store

1. In the RSRS strategy: High volatility - high risk - low positions

2. In the multi-factor strategy: Low correlation - a signal to buy - a large position

- For the combination: Add up the positions of each strategy
- Considering continuing using open prices normalisation to make 10 series have distributions to the aggregate profit relatively equally.
- The result is the final trading position

Test and Combination

Combination

Step 4 Risk management

Out of strategy

- each strategy has a different condition
- It must meet the conditions for the implementation of the strategy in order to be implemented

note： we did not consider limit order in our strategy

we all based on market order

Test and Combination

Combination

Step 5 Future plan

Detail of how to allocate the position

1. stores **Risk** parity

If the volatility of the two stores is: 3:2

High volatility --high risk -- low position

⟶ the position will be: 2:3

Test and Combination

Combination

Step 5 Future plan

2. the Cross-validation

-split the entire data into training set/test set

-apply the results of the training set to the test set for validation

-divide the part 1 data into four-part--use each of them as the test set and the rest of them is the training set

- Find the average value of these four result and the result will be used in part 2 data

Thank you