SC1003: Introduction to Computational Thinking and Programming

Assignment 1

Done By Ang Ming Ze, Aaron, U2122736A

MACD Trend Reversal Model Design

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1: Brief Introduction of MACD Trading

What is MACD?

It stands for Moving Average Convergence Divergence, consisting of 2 lines and histograms.

Such two lines are the MACD line and the signal line.

Below are the properties of the lines and histograms:

**MACD Line:**

It is the moving averages of a security’s price.

It uses recent price movement to plot a line and it is the result of a calculation between 2 different moving averages:

* MACD= 26 period EMA -12 period EMA
* EMA stands for exponential moving average

One more point to note is that the MACD line responds faster compared to the signal line towards price changes.

**Signal Line:**

The signal line is plotted alongside the MACD line.

It is the 9 period EMA of the MACD line.

In terms of price changes, the signal line responds slower compared to the MACD line.

Hence, we usually refer to the signal line as a slightly slower and more smoothed out version of the MACD line.

**Histogram:**

Essentially, it serves to plot the difference between the MACD line and the Signal line.

There are two types of histograms in the chart:

* Positive histogram
* Negative histogram

A positive histogram occurs when the MACD line crosses the signal line from bottom to top. This represents a trend reversal turning bullish.

A negative histogram, conversely, occurs when the MACD line crosses the signal line from top to bottom. This represents a trend reversal turning bearish.

An interesting relationship between the two lines and histogram is that:

* the wider the distance between the MACD line and the signal line, the larger the bars of the histogram
* vice versa

**Definition of a moving average:**

It is the average of a time series over a specific window size that slides along as we move along the time series.

Long Moving Average (LMA) is considered as 26 days whereas,

a short Moving Average (SMA) is regarded as 1 day.

**MACD Model:**

Trend reversal:

Each pair forms a BUY-HOLD-SELL action and with each BUY and SELL position there is a commission loss incurred.

MACD line= SMA – LMA (MA can be either SMA or EMA of the time series)

MACD histogram= MACD – 9-MACD-MA

Assume all the holdings are bought or sold with all the accumulated funds.

Usage of the simple moving average with past data is restricted due to the inability to have future data values in the time series.

An exponential moving average helps to mitigate the issue with the lack of future data by utilising more recent data.

Calculation of Exponential moving average (EMA) is as of below:

EMA = (today’s closing price \*K) + (Previous EMA \* (1 – K))

N = number of days in EMA

K (Smoothing Factor) = 2/(N+1)

LEMA: N=26 days

SEMA: N=12 days

2. Computerisation of the MACD trend reversal system: depicted by Flowchart and Pseudo Code

**Pseudo Code:**

User choose if use SMA or EMA

INITIATE Balance of BUY and SELL pair to be equal to BUY-SELL -1/8(commission)

INITIATE BUY to be zero

INITIATE SELL to be zero.

WHILE there is a trend reversal AND User choose to use SMA

IF signal line cross under MACD line

Buy signal is given (Bullish)

INITIATE a BUY

ADD 7/8 of Buy to Balance #inclusive of 1/8 of commission loss

ELSE signal line cross over MACD line

Sell signal is given (Bearish)

INITIATE a SELL

SUBTRACT 9/8 of SELL from Balance #inclusive of 1/8 of commission loss

END WHILE

WHILE there is a trend reversal AND User choose to use EMA

IF signal line cross under MACD line

Buy signal is given (Bullish)

INITIATE a BUY

ADD 7/8 of Buy to Balance #inclusive of 1/8 of commission loss

ELSE signal line cross over MACD line

Sell signal is given (Bearish)

INITIATE a SELL

SUBTRACT 9/8 of SELL from Balance #inclusive of 1/8 of commission loss

END WHILE

IF Balance <0

IF BUY-HOLD-SELL > Balance

PRINT “Losses are more than a BUY-HOLD-SELL position from the entire period of trend reversal trading”

PRINT BUY-HOLD-SELL

PRINT Balance

ELSE IF

PRINT “Losses are less than a BUY-HOLD-SELL position from the entire period of trend reversal trading”

PRINT BUY-HOLD-SELL

PRINT Balance

ELSE IF

IF BUY-HOLD-SELL < Balance

2. Computerisation of the MACD trend reversal system: depicted by Flowchart and Pseudo Code (continued)

PRINT “Profits are more than a BUY-HOLD-SELL position from the entire period of trend reversal trading”

PRINT BUY-HOLD-SELL

PRINT Balance

ELSE IF

PRINT “Profits are less than a BUY-HOLD-SELL position from the entire period of trend reversal trading”

PRINT BUY-HOLD-SELL

PRINT Balance

2. Computerisation of the MACD trend reversal system: depicted by Flowchart and Pseudo Code (continued)

**Flowchart:**

INPUT USE SMA OR EMA

START

INITIATE Balance to be BUY and SELL pair to equal to BUY-SELL-1/8 OF COMMISSION

INITIATE BUY AND SELL TO BE ZERO

USE SMA

USE EMA

ENDWHILE

ENDWHILE

FALSE

WHILE TREND REVERSAL

FALSE

WHILE TREND REVERSAL

TRUE

TRUE

TRUE

IF signal line cross under MACD line

IF signal line cross under MACD line

FALSE

TRUE

ADD 7/8 BUY To Balance

BUY signal given (Bullish)

INITIATE a BUY

BUY signal given (Bullish)

INITIATE a BUY

SELL signal given (Bearish)

INITIATE a SELL

SELL signal given (Bearish)

INITIATE a SELL

ADD 7/8 BUY To Balance

SUBTRACT 9/8 SELL from Balance

SUBTRACT 9/8 SELL from Balance

2. Computerisation of the MACD trend reversal system: depicted by Flowchart and Pseudo Code (continued)

ENDWHILE

ENDWHILE

TRUE

IF Balance <0

FALSE

TRUE

FALSE

FALSE

IF BUY-HOLD-SELL>Balance

IF BUY-HOLD-SELL< Balance

TRUE

PRINT “Losses are more than a BUY-HOLD-SELL…”

PRINT “Losses are less than a BUY-HOLD-SELL”

PRINT “Profits are less than a BUY-HOLD-SELL”

PRINT “Profits are more than a BUY-HOLD-SELL…”

PRINT BUY-HOLD-SELL

PRINT Balance

PRINT BUY-HOLD-SELL

PRINT Balance

PRINT BUY-HOLD-SELL

PRINT Balance

PRINT BUY-HOLD-SELL

PRINT Balance

END

3: Advantages and Limitations of Design for Maintainability

One of the main limitations of the design of the computerised MACD trading system is:

There are high chances of False positives in the MACD chart due to divergences.

As we all know, the MACD chart is usually based on prediction from the present values and extrapolation has been done to predict future data.

Divergence predicts more than plenty of reversals in which some of such reversals are not real. This highlights the inaccuracy of divergence in MACD.

With many false positives, it will trigger a lot of BUY-HOLD-SELL transactions from users even though there is no real bullish or bearish trend. This incurs more commission losses for each transaction per false trend reversals.

Based on the assumptions, all the holdings are bought or sold with all the accumulated funds. Hence, there would not be overall losses.

Overall, this results in lower profits margins gained over time, ceteris paribus.

Another limitation of the design is that in a MACD chart, there can be multiple trend reversals of gradual changes (small bar positive histograms and negative histograms) or weak trend reversals within a short period of time. If we utilise the design of MACD trading, there will be a buy or sell transaction each time there is a trend reversal. Similarly, from the above, it means that there would be excessive commission losses.

From a big picture, this results in significantly lowered profit margins as compared to having such transactions when there is a sustained positive histogram pattern.

As for the advantages, the main and essential thing about a computerised trading system is that we do not need to have constant monitoring of the chart.

Why do we monitor the chart for the MACD line and signal line?

It is to take note of trends, trend reversals and strike while the iron is hot for good opportunities.

Unlike professional traders, other walks of life have other commitments like working, family, studying, leisure, etc.

Hence, the computerised system would be very convenient for them.

Furthermore, those who are not tech-savvy like senior citizens, they may have problems navigating trading sites or their accounts in carrying out transactions independently. Such a computerised system would be easier for them to access and handle their transactions with ease.

4: If we intend to reduce unnecessary trade due to weak trend reversal, what must be added to your design?

Since weak trend reversal is an issue in accounting for unnecessary commission losses, we need to target the root problem.

In the design, as long as a trend reversal is detected, BUY or SELL would be proceeded accordingly.

That goes to show that it is important to define what is a weak trend reversal, so-so trend reversal and a strong trend reversal or a trend reversal that is not weak.

Hence, the conditions of the trend reversal need to be defined and met before proceeding with the transaction. Otherwise, we ignore any weak trend reversals.

**Some possible inclusions in defining the trend reversal strength:**

1. positive/negative histogram needs to be sustained for a minimum duration of 1 hour
2. the size of the positive histogram needs to be at least 2.5 times the first happening after increasing
3. the size of the negative histogram must be not more than 2.5 times of first happening of negative histogram after decreasing

**An Add-on Function:**

For those who are freer to handle the system, we can provide a special enable or disable the function that allows users to be prompted on a potential not so strong trend reversal.

Users who enable this function would be asked to make their decision to BUY/HOLD/SELL in the trend reversal time frame.

This would give flexibility and some form of independence in users’ involvement in the system instead of a fully automated system.

To address the issue of not having time to constantly handle the system, users can also input to toggle or disable the function when necessary.