Strategy for algo trading

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***Abstract*—This project is a strategy built for algo trading. It is based on three technical indicators – MACD, RSI and Vortex. The code [1] is written in Python and such indicators comes from the library *pandas_ta*.**

Keywords—algo trading, trading, strategy, back testing, stock

I. Introduction

This project is based on a Python script [1] algorithm for algo trading. It uses the library *pandas_ta* to calculate three technical indicators – MACD, RSI and Vortex. Although, the studies of price pattern for decision making has been gaining traction in the past years, "whether technical trading rules can generate excess returns has long been a controversial issue" (CHONG, 2008).

It performs a back testing utilizing two years of data of Apple´s stock (March 6th, 2018, to March 6th, 2020) as well as Microsoft and Google for the same time period. As a result, each of the indicators generates a value, 1 if indicates buy and -1 if indicates sell. The sum of the three values is the final position of the strategy.

II. Methodology

A. Data Selection

The project was back tested based on two years of data from Apple, Microsoft and Google´s stock (March 6th, 2018, to March 6th, 2020). To do so, it was employed the Yahoo Financials library [2]. From such library, it was generated five values – open, high, low, close, adjusted close and volume – and they were stored in a data frame. An example of the data used is presented on Table 1.

	formatted_date	open	high	low	close	adjclose	volume
0	2018-03-06	44.477501	44.562500	44.032501	44.167500	42.105804	95154000
1	2018-03-07	43.735001	43.962502	43.567501	43.757500	41.714943	126814000
2	2018-03-08	43.869999	44.279999	43.767502	44.235001	42.170158	95096400
3	2018-03-09	44.490002	45.000000	44.347500	44.994999	42.894676	128740800
4	2018-03-12	45.072498	45.597500	45.052502	45.430000	43.309383	128828400

Table 1: Data pulled from Yahoo – Apple Stock.

B. Relative Strength Index (RSI)

The Relative Strength Index (RSI) is a momentum oscillator that indicates if the market is overbought or oversold. To do so, it calculates a value that ranges from 0 to 100. Table 2 points out the recommendation based on the value of RSI. In the case of sell, the indicator is -1, neutral 0 and buy 1.

RSI – Band	Recommendation
0 – 10	Sell
11 – 89	Neutral
90 – 100	Buy

Table 2: Value of indicator for each value of the RSI.

RSI is calculated from the ratio of the average of the positive returns and the average of the negative ones (Equation 1). For each new value of the share´s price (close), such number is compared with the band. Depending on the range (Table 2), RSI provides a recommendation.

$$RSI = 100 - 100 * (1 + \frac{up}{down})$$

Equation 1: Equation of RSI

Interesting to highlight that RSI has been used by other papers to calculate returns on different assets – London Stock Exchange (CHONG, 2008) and Forex (HABIBILASHKARY, 2013).

C. Average Directional Movement (ADX)

Average Directional Movement (ADX) is an indicator that calculates the strength of movement of the asset. Such value, called ADX, ranges from 0 to 100. In cases of values above 25, there is enough certainty to provide an indication of buy or sell. In addition to ADX, such strategy also calculates DMN and DMP indicating whether the trend is positive or negative. In case ADX is greater than 25, it is compared the value of DMN and DMP. If the former is greater, the recommendation is sell, if the latter is, than buy.

Indicator	Meaning
ADX	Strength of the trend
DMN	Trend that indicates sell
DMP	Trend that indicates buy

Table 3: Meaning of the indicators generated by ADX.

Back testing of the Average Directional Movement (ADX) on other markets and assets can be found in literature – Bitcoin (SZATELA, 2020) and USD currency (GURRIB, 2018).

D. Vortex

Vortex is an indicator based on the values of "high" and "close". Its origin was inspired by the movement of the water in motion, studied by Viktor Schauberger (1885-1958) (BOTES and SIEPMAN, 2008). Figures 1 and 2 compare the motion seen with water with the indicator used in the stock market.

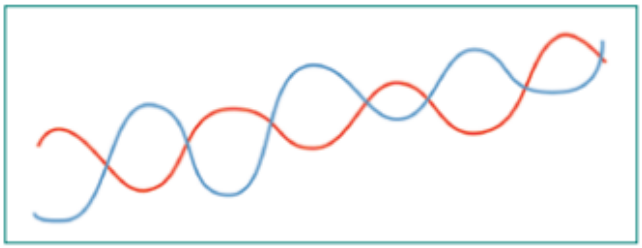

Figure 1: Typical vortex flow of water (BOTES and SIEPMAN, 2008).

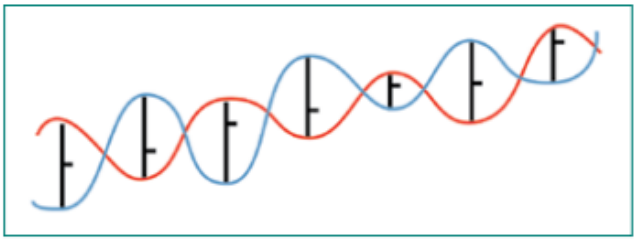

Figure 2: Vortex pattern in the market (BOTES and SIEPMAN, 2008).

As output, it calculates two values: "VTXP" and "VTXM". The former indicates a positive trend, and it is given by Equation 2. The latter, on the other hand, indicates a negative trend and it is presented by Equation 3.

$$VTXP = Absolute\ value\ of\ current\ high - previous\ low$$

Equation 2: Equation of VTXP

$$VTXM = Absolute\ value\ of\ current\ low - previous\ high$$

Equation 3: Equation of VTXM

The bias is defined by the difference between VTXP and VTXM. If VTXP is greater, then Vortex would be 1. If VTXM is higher, then -1.

E. Mix of Signals

After each new event of price, the three indicators are calculated and they give an indication of buy, sell or neutral. The sum of the three is the final position of the strategy (Equation 4).

$$Mix\ Strategies = RSI + ADX + Vortex$$

Equation 4: Equation of the Mix Strategies

Finally, it is important to notice that the size of the position is equivalent to the value of the sum. For instance, in case Mix Strategies results in 3, then it would be bought 3 shares. In case of -2, then it would short 2 shares.

III. Results

The strategy was back tested on Apple ("AAPL") stocks as well as Microsoft ("MSFT" and Google ("GOOG").

Results were positive for Apple. The return on capital annualized was 19% and a gross profit of 122 dollars. It made 44 trades in two years, with a hitting ratio of 40.91%. When the strategy got it right, it won on average 6.26 dollars. When it was wrong, it lost on average 2.02 dollars.

Value	Amount
Gross Profit	$122.77
Gross Loss	$ -52.57
Gross Total	$60.20
Average Allocation	$73.62
Net Total	$31.30
Net Return Capital Yearly	19.08%

Table 4: Results for back testing of Mix Strategies on Apple.

In terms of Microsoft, the result was negative. The return on capital was -15%, with a total gross loss of 99 dollars. Although the average win for trade was greater than the average loss (5.74 dollars and -2.48 dollars respectively, giving a ratio of 2.31) the hitting ratio was low – 36.51%. It was made 63 trades in the two year period.

Value	Amount
Gross Profit	$131.96
Gross Loss	$ -99.61
Gross Total	$32.61
Average Allocation	$135.70
Net Total	$-8.27
Net Return Capital Yearly	-15.15%

Table 4: Results for back testing of Mix Strategies on Microsoft

Finally, the results for Google were also negative. It resulted in a yearly return of -26%. After 71 trades, 44 resulted in a loss. The ratio of the average trade win and the average trade loss was only 1.2. The ratio close to 1 in addition to the low hitting ratio of 39% determined the final negative result.

Value	Amount
Gross Profit	$58.28
Gross Loss	$ -74.41
Gross Total	$-16.13
Average Allocation	$73.96
Net Total	$-44.26
Net Return Capital Yearly	-26.11%

Table 5: Results for back testing of Mix Strategies on Google

IV. Conclusion

This project intended to build a Python strategy based on three technical indicators from the library pandas_ta. It was chosen RSI, ADX and Vortex.

The negative results for the back testing of 2 out of 3 companies suggest that there is definitely room for improvement. For future projects, it makes sense to take a closer look on improving the hitting ratio (in all the simulations the value was less than 50%). To do so, a suggested strategy would be a new implementation of the merging of the indicators (Mix Strategies). A more complex approach in substitution to the current simple sum.

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