Estimate Earning Based on MACD Stock Indicator (OpenMP)

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What is MACD or Moving Average Convergence and Divergence

- Moving average convergence and divergence is a oscillator used to calculate the momentum of a stock.
- A oscillator is a technical analysis tool used to calculate the high and low bands between two extremes of a stock chart.
- Momentum of a stock refers to the inertia of a price trend to continue rising or falling for a particular length of time.

Formula for (MACD) indicator Line & (Signal) Line

MACD LINE

Exponential moving average EMA of 26 days subtracted from EMA of 12 days

MACD=12-Period EMA − 26-Period EMA

SIGNAL LINE

SIGNAL=9-Period EMA - MACD

Formula for Exponential moving average (EMA)

EMA for Period p at Time (t) & α = (2 / (1.0+period))

= (Closing Price(t) - EMA(t-1)) * α + EMA(t-1) ;

$$EMA(t) = (P_t - EMA(t-1)) * \alpha + EMA(t-1)$$

Removing Loop carried Dependency in EMA for multithreading

EMA for Period p at Time (t)

& α = (2 / (1.0+period))

Although the exponential moving average can be computed by using the formula

$$EMA(t) = (P_t - EMA(t-1)) * \alpha + EMA(t-1)$$

We can rewrite the formula as the follows.

$$EMA(t) = \alpha P_t + \alpha(1-\alpha)P_{t-1} + \alpha(1-\alpha)^2 P_{t-2} \ldots + \alpha(1-\alpha)^{n-1} P_{t-n+1}$$

Let's denote $(1-\alpha)$ as β. The above formula will then become

$$EMA(t) = \alpha P_t + \alpha\beta P_{t-1} + \alpha\beta^2 P_{t-2} \ldots + \alpha\beta^{n-1} P_{t-n+1}$$

The algorithm that computes the EMA is listed as in Figure 3

Transaction Signal

1. MACD line crosses above the Signal line - Bullish
2. MACD line crosses below Signal line - Bearish

Input

BTC to USD closing price per day

- from Yahoo finance for all historical data available.

Transaction Signal Calculation

Transaction function = MACD line - Signal line

Brute Force:

Look for a sign change in Transaction function and execute trades at those points.

Regula Falsi

Look for roots in given period, and execute trades at those points.

Accuracy and Precision

Brute Force:

There were 192 trade points
Linear interpolate between day at 86400 points giving us an accuracy of 1 second.

Regula Falsi

There were 724 trade points
Linear interpolate between day with precision of 0.000157, which is equivalent to 1 second in a day.

Profit Calculated

Brute Force

$ 24824.605103

Regula Falsi

$ 269098.430766

Excel plot

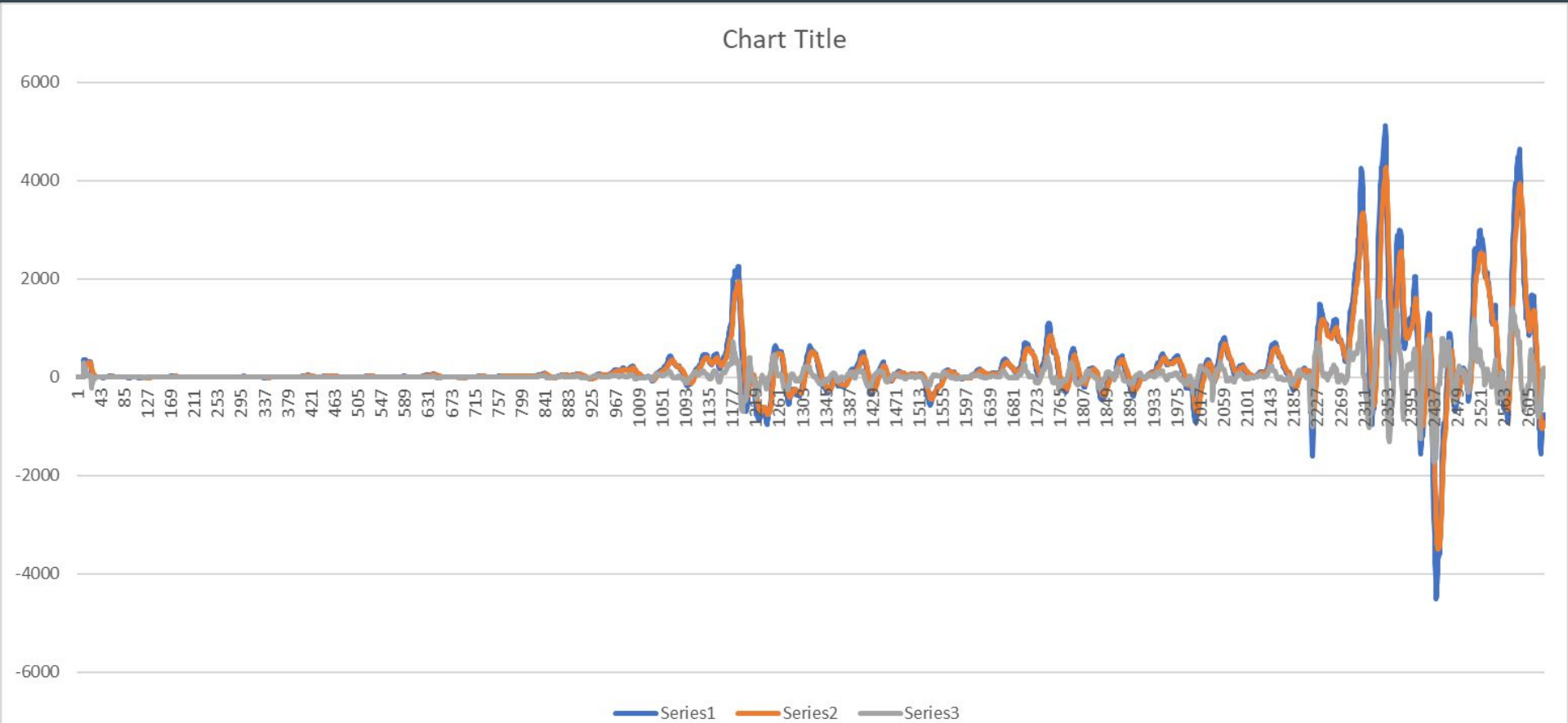
Chart Title
6000
4000
2000
0
-2000
-4000
-6000
1
43
85
127
169
211
253
295
337
379
421
463
505
547
589
631
673
715
757
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883
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1975
2017
2059
2101
2143
2185
2227
2269
2311
2353
2395
2437
2479
2521
2563
2605
Series1
Series2
Series3

Error in profit

Regula Falsi - Brute Force = $ 244,273.825663

Suspects

Regula Falsi giving out more accurate results, thus ensuring more trading points than brute force during linear interpolation.

Brute force is short of 1 day in the end.

Time required for completion - 0244-27

Brute Force

Single Thread :- 28.675091 sec = 0.4779 min
Multi Thread :- 12.971248 sec = 0.2161 min

Regula Falsi

Single Thread :- 680.145505 sec = 11.3357 min
Multi Thread :- 286.340167 sec = 4.77233 min

Speed UP

Brute force approach was speed up with 2.21066x

Regula falsi approach along with EMA speedup total equals 2.37530x speedup

Future work

- Convert EMA calculation to MPI to make log(n) complexity.
- Implement Newton Raphson and compare with Regula Falsi.
- Investigate change in number of roots in regula falsi based on all error.

Resources

https://www.fidelity.com/viewpoints/active-investor/how-to-use-macd

https://investopedia.com/terms/o/oscillator.asp#:~:text=An%20oscillator%20is%20a%20technical,term%20overbought%20or%20oversold%20conditions

https://www.investopedia.com/terms/m/momentum.asp

https://finance.yahoo.com/news/trading-trends-macd-030000467.html

https://www.investopedia.com/terms/m/macd.asp

https://www.iiis.org/CDs2013/CD2013SCI/SCI_2013/PapersPdf/SA695UD.pdf

https://www.investopedia.com/articles/trading/04/012804.asp

Code Review

Brute Force

Regula Falsi

Thank You