Implementing Bisection Method on Forex Trading Database for Early Diagnosis of Inflection Point

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Abstract—**Many people are trading in the forex market during the COVID-19 pandemic with the hope of earning money, but they are experiencing shortages due to the lack of information and technology-based tools for existing daily data. Sometimes traders only use moving averages in trading data, even though this information needs to be processed again to get the right inflection point. The objective of this research is to find inflection points based on Forex trading database. Another algorithm can also be used to determine the inflection point between two points on a moving average. This can be supported by the Bisection method used because it can guarantee that convergence will occur. The results show that the points resulting from the bisection calculation on the moving average provide a fairly accurate decision support for the location where the inflection point is located. From 10,000 data there is a standard deviation of 0.71 points which is very small compared to an average of 20 pips (points used as the difference in price values in forex). The use of the bisection method provides an accuracy of the results in seeing the inflection point of 87%.**

Keywords—*Bisection method; moving average; inflection point; forex trading; decision support*

I. INTRODUCTION

Since the COVID-19 pandemic, the value of trade transactions has decreased, this is due to unstable economic conditions and tends to decline and so many speculators do wait and see [1–4]. Based on these problems, this research is focused on finding a solution by processing a database containing transaction data and forex value movements obtained from the meta trader application connected to the broker server [5–7]. From this problem arises the question, how to know the inflection point on a curve that can be seen by the user in real time [8].

Many researchers use the moving average method to assist in making buy or sell decisions based on a certain time frame, but often moving averages are less accurate because errors often occur, especially when there is a change in trend. For this reason, an additional method is needed that can overcome the problems that occur in moving averages, especially in determining inflection points.

The bisection method is a way to determine the value of a curve by dividing the interval in half; this method is used to find the equation of a straight line [9–11]. Because the downward movement of the curve tends to be linear, the researcher uses this method to determine the inflection point [12-13]. The bisection method could help estimate the value of

past data so that the results are expected to determine the inflection point properly.

In this research, it will be proved that by looking for inflection points, it can speed up the decision-making process accurately, because the method to be used in this study uses the Bisection Method, which can speed up the search for the midpoint of a line. So, it is expected that between these inflection points an up or down curve can be found which has an important role in decision making.

II. LITERATURE REVIEW

A. Forex Database

To be able to observe price movements in forex trading, a connection is needed to the account of one of the brokers that serves forex trading. To be able to get a database related to forex prices, you can choose a currency pair such as USD and JPY. After selecting a currency pair, price movements can be observed directly depending on the desired timeline. Starting from every 1 minute, 15 minutes, 30 minutes, 1 hour, 4 hours, daily, weekly, and even monthly [14].

To be able to accurately perform formula calculations accurately, of course you cannot use all time frames. For this reason, this study uses a 1-hour and 4-hour and daily time frame to check currency price movements [15-16].

The data obtained from previous researchers is the dataset that will be used in this study. The dataset is not directly used in research but it is necessary to clean the data using SPSS to find out that the data is free from outliers. SPSS helps find statistics from a data set, i.e., statistics that include median, mean, mode, variance, and standard deviation.

The resulting statistical data will be processed by Python to remove invalid data, usually invalid data due to redundancy, political factors that affect foreign exchange rates, certain major factors such as explosions, wars, and others. Many researchers do data cleaning with various parameters that are felt to interfere with research, but with a statistical approach it is expected that the dataset will be of better quality.

Data on currency price movements can be downloaded using the .csv format [17-19] so that later it can be used for further calculation processes. Forex price movement data in the form of candlesticks can be seen in Fig. 1.

Fig. 1. Candlestick chart for an hourly chart.

To get hourly price data both the price at open, close, high and low can be seen in detail in Fig. 2.

Time	Open	High	Low	Close
13/12/2022 01:00	137412	137704	137355	137642
13/12/2022 02:00	137643	137771	137559	137676
13/12/2022 03:00	137675	137832	137567	137612
13/12/2022 04:00	137612	137634	137507	137556
13/12/2022 05:00	137555	137564	137259	13732
13/12/2022 06:00	137321	137423	134943	135154
13/12/2022 07:00	135154	135244	13465	134984
13/12/2022 08:00	134985	135372	134923	135191
13/12/2022 09:00	135191	135262	134914	135143
13/12/2022 10:00	135148	135335	135089	135324
13/12/2022 11:00	135324	135595	135279	135556
13/12/2022 12:00	135557	135582	135404	135478
13/12/2022 13:00	135477	135645	135449	13564
13/12/2022 14:00	13564	135645	135546	135546
13/12/2022 15:00	135546	135587	135435	135439
13/12/2022 16:00	135439	135733	135432	135573
13/12/2022 17:00	135573	135689	135328	135383
13/12/2022 18:00	13538	135672	135286	135585

Fig. 2. Forex price data per 1 hour in .CSV form.

Open price data indicates the price at the beginning of the new time frame. High data indicates the highest value the price reached during that time frame. Low data indicates the lowest value the price reached during that time frame. Close data indicates the price at the end of the time frame [20-21].

B. Inflection Point

The inflection point is the point where a curve will change sign, for example from a curve that tends to decrease in value to change with a value that tends to increase [20]. This change is usually marked with an acceleration that is zero. The acceleration itself is obtained from the second derivative of a function equation; in this study the function is the movement of exchange rate data over time.

In this study, the inflection points where $f''(x)=0$ has a relationship with the bisection method because both will stop at a point with a zero value, zero for the acceleration at the inflection point and for the middle value of the Bolzano method [22-23]. The value of $f(x)$ in this study is the lowest or highest value of the exchange rate as shown in Fig. 3.
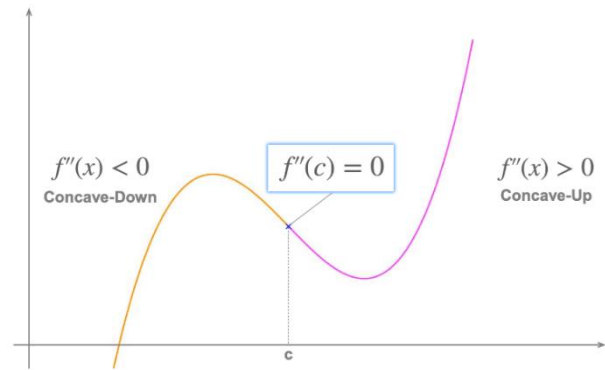

Fig. 3. Example of an inflection point.

C. Bisection Method

The Bisection method is a root search algorithm at an interval [24-26]. The interval divides into two parts, then chooses from these two parts which part contains roots and which part does not contain roots is discarded. This is done repeatedly until the roots of the equation are obtained or close to the roots of the equation [27] This method is applicable when you want to solve the equation $f(x)=0$ where $f(x)$ is a continuous function. Bisection Method can be seen in Fig. 4.
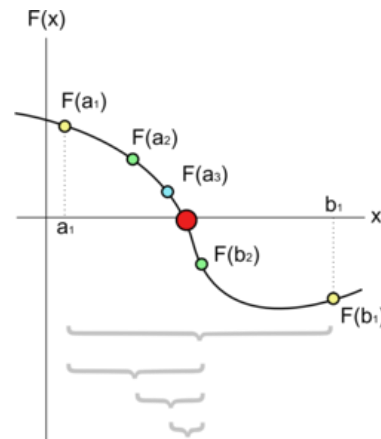

Fig. 4. Bisection method.

Suppose it is guaranteed that f(x) is a continuous function on the interval [a, b] and $f(a)f(b) < 0$. This means that f(x) must at least have roots on the interval [a, b]. Then define the midpoint of the interval [a, b] namely c = (a+b)/2. From this we obtain two subintervals namely [a, c] and [c, b]. After that, check whether $f(a)f(c) < 0$ or $f(b)f(c) < 0$. If $f(a)f(c) < 0$ then b = c (meaning point b is replaced by point c which serves as point b in the next iteration), otherwise a = c. From the first iteration we obtain a new interval [a, b] and a new midpoint c. Then check again as before until you get a small enough error.

III. METHODOLOGY

This research uses a simple research method that can be seen in the picture. Before the research was carried out, the researcher collected datasets obtained from meta traders. This dataset is then processed using python to look for data patterns, outliers and dataset variances that are beyond reasonable limits.
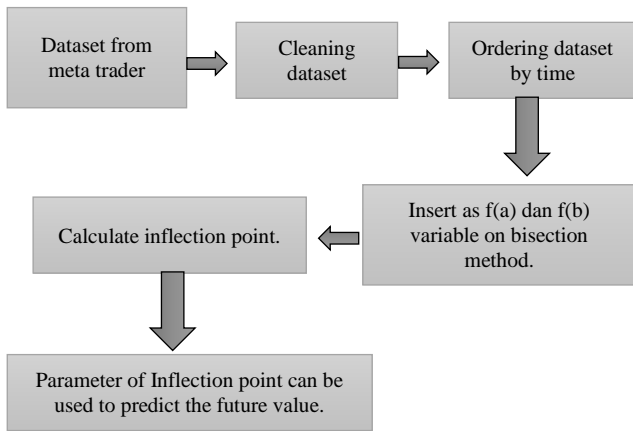
Fig. 5. Flowchart of research stages.

After the dataset has been successfully cleaned, the dataset is sorted by time, this aims to make it easier to take points that will be used as points f(a) and f(b). This point is then entered into the bisection formula by determining the new point c=(a+b) / 2, where point c is the midpoint or inflection point. Of course, there are many midpoints, so it is necessary to look for several possibilities from several existing datasets. From this point, it can be predicted that the forex price will go up or down so that better decisions can be made. The flowchart of the various stages as explained can be seen in Fig. 5.

To calculate this inflection point, researchers use the Python programming language which makes it easy to calculate quickly. This algorithm is validated by experts in mathematics and when the validation is appropriate then it is tested on a server, the researcher uses a 10-core server with 16GB RAM. The data entered in the algorithm consists of a one-month timeframe.

TABLE I. VALIDATOR QUESTIONNAIRE

Question Number	Question
1	Is the bisection formula made in accordance with the journal?
2	is the transformation of the formula to the python program appropriate?
3	Have the computational results been compared with the original formula?
4	Are the results of the estimated value in accordance with statistical calculations?

In Table I, the validator fills in the maximum value or approves it for the next stage.

IV. RESULT AND DISCUSSION

The dataset in this study was taken from secondary data on export results in the form of .csv from the Metatrader software. This dataset consists of four data types, namely: High, Low, Open, Close. The next process is to clean the data by not entering datasets that exceed the upper and lower limits based on statistical analysis which includes median, mean, standard deviation and variance.

After the dataset is already cleaned, the next step is to run the dataset in an application made using Python. Python program code can be seen in Algorithm 1.

Algorithm 1:

```
def bisection (f, a, b, tol=1e-6, max_iter=100):
    if f(a) * f(b) >= 0:
        raise ValueError("Interval is not valid: f(a) and f(b) has similar sign.")
    c = (a + b) / 2
    iter_count = 0
    while abs(f(c)) > tol and iter_count < max_iter:
        if f(a) * f(c) < 0:
            b = c
        else:
            a = c
        c = (a + b) / 2
        iter_count += 1

    if iter_count == max_iter:
        print("Outbound Maximum Values")
    return c
```

From the dataset point entered in the program code, it will produce a curve as displayed in Fig. 6.
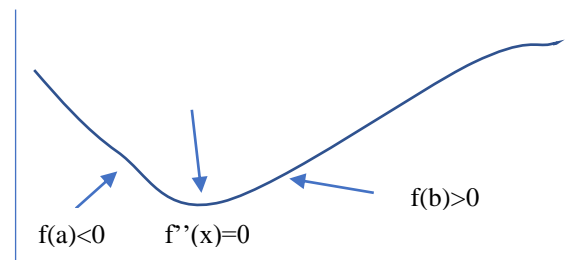

Fig. 6. Graph showing how the bisection program code work in python.

After the application is run, the results will look like in Table II.

TABLE II. RESULTS OF RUNNING MULTIPLE DATASETS

f(a)	f(b)	c (Previous Research)	Predicted (Current Research)
1914.760	1905.340	1910.050	1912.900
1913.450	1909.780	1911.615	1912.250
1918.530	1912.060	1915.295	1916.490
1921.720	1915.360	1918.540	1919.550
1925.080	1920.590	1922.835	1921.090
1923.610	1920.090	1921.850	1922.480
1922.870	1918.920	1920.895	1921.590
1925.440	1921.410	1923.425	1922.870
1925.400	1922.300	1923.850	1924.700
1934.970	1924.520	1929.745	1930.030
1933.780	1930.490	1932.135	1932.080
1934.430	1927.820	1931.125	1931.440
1936.400	1932.260	1934.330	1933.390
1934.760	1929.960	1932.360	1931.830
1941.920	1929.700	1935.810	1935.740

From the table it appears that the predicted value using bisection has a small error range when compared between the 'c' column and the 'predicted' column. With accuracy of an inflection point is 87% by SPSS and standard deviation about 0.71 and 20 pips moving. This will help users when they get information that after inflection there has been an increase in forex prices.

V. CONCLUSION

The research resulted in several conclusions, namely: a combination of bisection formulas on moving averages that work well. This is because both have the same scalar properties. In addition, the error rate of both algorithms is less than 3%. Furthermore, including optimization in determining future prediction values has been carried out by the bisection method even though it still has an error, but the error is still below 5%; this gives a sense of optimism for users to make decisions on buying or selling forex trading. This study was conducted in several experiments and ran well in the Python language environment with the objective achieved.

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