# OPTIMIZATION OF N VALUE ON *SINGLE MOVING AVERAGE (SMA)* WITH *PARTICLE SWARM OPTIMIZATION (PSO)* CASE STUDY OF BRI STOCK

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**ABSTRACT**
The stock market is a promising business area. The potential to obtain high returns in a fairly short time is one of the main attractions of this business. Prediction of stock prices has become a very interesting and challenging thing for researchers and academics, recently it was found that stock prices can be predicted with a certain degree of accuracy. *Single Moving Average* (SMA) is one method for predicting time series data. However, the N value in SMA needs to be optimized in order to get the N value with optimal results at the SMA and get accurate results. The *Particle Swarm Optimization* Algorithm is implemented to find out the best N value in the *Single Moving Average* methodwhich is more optimal. SMA+PSO and SMA are calculated using the initial N values of 3,5,7,9,11. So the results of this study are SMA with an accuracy of 97.98464% and for SMA+PSO with an accuracy of 98.15442% . The test results from this study are the influence of PSO on SMA in increasing accuracy in determining the best N value.

**Keywords :** Stocks, BRI Stocks, Prediction, *Single Moving Average, Particle Swarm Optimization*

## 1. Introduction

The amount of the Exchange shares an area of business that is promising . Potential to earn a return that is high in a time that is sufficiently short become one of the power pull itself out of the business of this . Prediction of the price of the stock into a thing that is very interesting and challenging for the researchers and academics , later found that the price of the stock can be predicted with a degree of accuracy specified . Predictions are really accurate will help the perpetrators business in predicting the purchase or sale of shares are owned ( Koesriputranto , 2015).

Investment in the form of shares in the capital market in Indonesia has increased marked by the achievement of the highest number of share trading in February 2017 since the Indonesian stock market was established according to the records of the Indonesia Stock Exchange (IDX) and an increase in the Indonesian Stock Price Index (IHSG) by 15%. It 's made the stock became one of the objects of

investment are promising . Based on the data of operational IDX and Data Custodian Sentra Securities Indonesia (KSEI) the number of investors new Indonesian capital market increased by 23.47% throughout the year 2016 ( Rusmalawati , 2018).

In order to making the decision that is the right to buy and sell stocks that have always fluctuated in the floor of the exchange, so obtaining a profit , then the offender must master the method that is appropriate for predicting the movement of the price of the stock ( Zunaidi , 2016).

Single Moving Average or commonly abbreviated as SMA is the simplest Moving Average and does not use weighting in the calculation of closing price movements . Single moving average (SMA) is calculated by way of taking the value of the average of the price of a security in the span of time specified to the rear . Calculation of this can be taken from the value of the average price of opening , the price of closing , the price of the highest , or the price of the lowest of a securities ( Prasetya , 2017).

According to M. Azman Maricar (2019) In the method of simple average would produce a forecast that is good if the value of the observations do not show any trend and did not show any element of seasonal . In addition to the drawbacks of the method simple average is on methods that did not exist a process of constant when predicting the data series of periodic (time series). The simple average method is then refined by the single moving average method . The advantages of the method of the single moving average is the number of points of data in each average does not change with the passage of time and the method is only requires a period of time that the last of the data is known . While the method of simple average need of all the data time ago . But the method Single Moving Average (SMA) also has weaknesses such as the need to deposit that much much and not be able to cope with both if the data is known there is an element of a trend or seasonal .

According to Mohammed Gandi Pramayudha (2019) in his research mentions that the single moving average (SMA) is a method of forecasting that is done by taking a group of the value of observation , searching for value on average such as a forecast for the period that will dat a ng . Methods This has the characteristics of a special , namely , to obtain or determine the forecast in the period that will come require a data historically during the period of time specified , for example, with 3 - month moving average, the forecast in 5 new could be made after months to 4 completed or ended , and the more long- term a single moving average, the effect pelicinan increasingly visible in the forecast or produce singlemoving average are more subtle .

Research by Iwan Fitriadi Mukhlis (2016) on " Optimization of PSO for Forecasting Gold Prices in Time Series ". The data used in the study is that the data the price of gold from 26 November 2010 until January 18, 2011. The study is proposed time series model based PSO for forecasting the price of gold which uses algorithms PSO to estimate the parameters. Evaluate the capability of the proposed model by applying it to daily observations of gold prices and comparing the results

with the previous method . Results of the study showed that the model proposed is able to cope with fluctuations in the price of gold time series and also produce accurate predictions of the well and outperformed the models more that exist in the literature .

Based on the research that it will dilalukan research related to the influence of the results of the accuracy of forecasting Single Moving avarage (SMA) as do the optimization value of N by using the algorithm Particle Swarm Optimization (PSO) in forecasting the level of accuracy of the stock BRI and assist forecasting stock of BRI . The type of data used in research this is the time series data of stock of BRI from the date of 04 October 2018 until 04 November 2020 and the use of datasets is simply to do the testing of the effect of the PSO to the value of N in high school .

## 2. Research Methodology

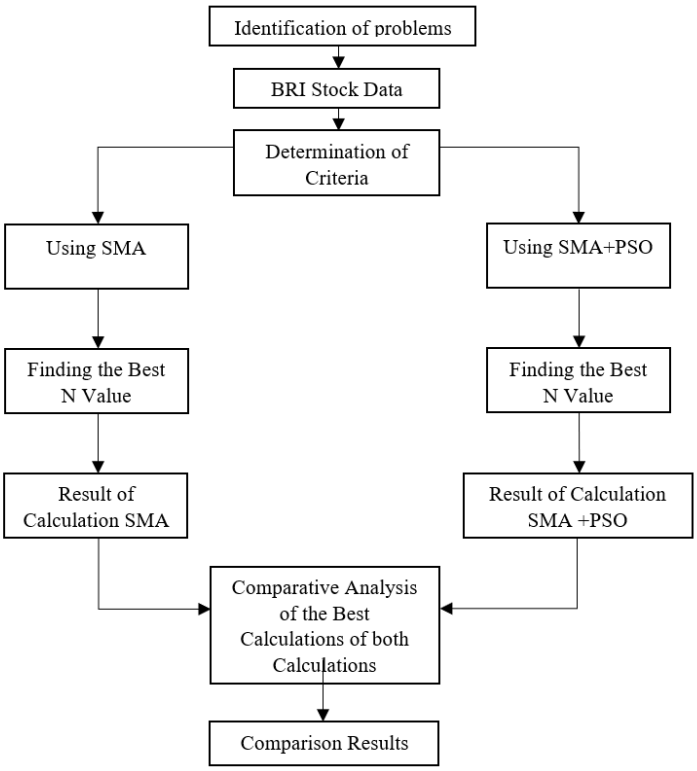


Figure 1. Research Flow

### 2.1 Data Collection

The collection of data is a process for obtaining the data stock that will be used in the calculation of the research this . Data stock that is the data stock of Bank BRI (BBRI). This stock data is in the form of daily data and this stock data is obtained from yahoo finance

### 2.2 Implementation

The data is implemented by two algorithms including:

### 2.2.1 Single Moving Average

On stage is implemented forcaseting by using the Single Moving Average (SMA) using language programming Python for predicting the data stock of Bank BRI (BBRI) which has been determined .

The steps of the Single Moving Average (SMA) algorithm process flow in this study are as follows :

a. Input

Input data coherently when the price of shares of the index BRI (BBRI) from the date of 04 October 2018 until November 4, 2020 .

b. Process

The process of applying the Single Moving Average (SMA) algorithm in this study is as follows :

1) Initialization of SMA parameters, namely :

$$F_{t+1} = \frac{Y_{t-1} + Y_{t-2} \ldots + Y_{t-n}}{\mathrm{n}}$$

Information :

Ft+1 = Forecast For Period

t + 1 Yt = Value of Real period to t

n = time period of the moving average, the value of n is the number of periods in the moving average .

1) Calculate forecaseting using Single Moving Average (SMA).
2) Calculate error value with MAPE calculation perhitungan

c. Output

Output that is produced in the form of the values of the parameters SMA and outcome prediction of the price of the stock .

### 2.2.2 Single Moving Average + PSO

At this stage , optimizing the value of N on the Single Moving Average (SMA) using particle swarm optimization (PSO) on Bank BRI (BBRI) stock data .

The steps in Particle Swarm Optimization (PSO) to optimize the value of N on the Single Moving Average are as follows :

1. Initialization process
   a. Initialization of Particle Initial Position
      At iteration beginning or iteration to 0, the position of the beginning of the particles generated by random or random
   b. Calculating Fitness Score
   c. Inisisalisasi Value Pbest and Gbest
   d. Particle Speed Update

$$v'_{id} = w * v_{id} + c_1 * r_1 * (p_{id} - x_{id}) + c_2 * r_2 * (p_{gd} - x_{id})$$

Description :

$v'_{id}$ = Particle velocity at iteration before his
$w$ = Inertial Weight
$c_1$ = coefficient of acceleration 1
$c_2$ = coefficient of acceleration 2
$r_1, r_2$ = Random value (0-1)
$p_{id}$ = Best position in the previous iteration
$p_{gd}$ = Global optimum pada iterasi sebelumnya

2. Upadate position of the particle

$$x'id = x'id + v'id$$

3. Update Pbest and Gbest Values

   To get the value Pbest can be done by way of comparing the value Pbest on iterations before the result of the calculation updates the position . The value of fitness which is great on both will be the value of the new . Whereas to obtain the value of Gbest latest , can do the calculation by way of seeing the value of Pbest which has a value of fitness most large .

4. Repeating steps to (2-4) until the condition stops or fulfilled ( Termination condition ). There are some conditions to stop the use of which is :
   a. When the iteration has reached its maximum .
   b. Iteration stops but is not there a change that is significant .
   c. When it has reached the maximum time .

   ( Rusmalawati , 2018).

To overcome the problem the movement of particles which only occurs in the area of solutions locally and globally, should the reduction in linear value ω of the value of the maximum to the value of the minimum each iteration increases .

$$w = wmax - iter * \frac{w_{max} - w_{min}}{itermax}$$

Iter is an iteration now while itermax shows the maximum iteration , $\omega max$ and $\omega min$ usually set at a value of 0.9 and 0.1. In addition to the reduction in linear niai ω do also changes in the value $c$ 1 and $c$ 2 based on time or called time-varying Acceleration Coefficients (TVAC). The goal is that with the change in the coefficient will affect the components of cognitive and social so that at the beginning of PSO particles will move more freely in space quest than moving only towards the population best , and getting towards the end of the optimization is to change the coefficient will allow the particles will gather in the global optimum. Here is the equation of change in value $c$ 1 and $c$ 2:

$$c_1 = \left(c_{1f} - c_{1i}\right) * \frac{iter}{itermax} + c_{1i}$$

$$c_2 = \left(c_{2f} - c_{2i}\right) * \frac{iter}{itermax} + c_{2i}$$

Where the value c1i, $c$ 1f, C2i, and $c$ 2f is constant with iter is value iteration now and itermax is the maximum iteration . Value $c$ li, $c$ 1 $f$ , c2 $i$ , and $c$ 2 $f$ set at 2.5, 0.5, 0.5 and 2.5.

Each particle has a fitness value where the greater the fitness , the better the particle is to be used as a solution . The fitness value for optimization of SMA problems is obtained from the calculation of the evaluation of the Single Moving Average (SMA) model . Fitness value can be obtained using the level of error from the process of evaluation were performed as in the equation below :

$$fitness = \frac{1}{1+MAPE}$$

Description :

MAPE = Mean Absolute Percentage Error ( level value error rate).

The method used to perform the calculation of the value of the error rate is Mean Absolute Percentage Error (MAPE), with the formula as in the equation below :

$$MAPE = \sum_{i=1}^{n} \left| \frac{yi - \hat{y}i}{yi} \right|$$

Where $yi$ and the actual value and the target value, while n is the number of predicted data (Rusmalawati, 2018).

### 2.3 Best Calculation Analysis of both calculations

Determine the best N value for SMA and the best N value for SMA+PSO from the forecasting results that have been calculated from Bank BRI (BBRI) stock data .

### 2.4 Comparison Results

Comparing the results of the value of N best between the two methods that are used in forecasting the data stock BBRI is the value of N the best out of high school and niali N best of the value of N SMA + PSO.

## 3. Results and Discussion

### 3.1 Results

The data used in the research of this is the data from sectors banking stocks BRI from 04 October 2018 until November 4, 2020 with the amount of data as much as 509 data. Data shares were acquired as contained in Table 3.

Table 1. Sample Data in 2018

| No | Date | Price | Open | High | Low | Vol | Change % |
|---|---|---|---|---|---|---|---|
| 1 | Dec 28, 2018, | 3,66 | 3,68 | 3,68 | 3,65 | 122.95M | 0.00% |
| 2 | Dec 27, 2018, | 3,66 | 3,65 | 3,67 | 3,62 | 71.72M | 1.67% |
| 3 | Dec 26, 2018, | 3,6 | 3,55 | 3,63 | 3,52 | 83.41M | -0.55% |
| 4 | Dec 21, 2018, | 3,62 | 3,61 | 3,63 | 3,6 | 174.47M | -0.82% |
| 5 | Dec 20, 2018, | 3,65 | 3,61 | 3,66 | 3,61 | 67.33M | -0.54% |
| 6 | Dec 19, 2018, | 3,67 | 3,6 | 3,67 | 3,6 | 133.10M | 1.10% |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 55 | Oct 10, 2018, | 3,01 | 3,03 | 3,04 | 3,01 | 61.26M | -0.33% |
| 56 | Oct 09, 2018, | 3,02 | 2,97 | 3,03 | 2,97 | 51.20M | 1.68% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 57 | Oct 08, 2018, | 2,97 | 2,97 | 3,01 | 2,96 | 64.84M | -0.34% |
| 58 | Oct 05, 2018, | 2,98 | 3 | 3,04 | 2,96 | 145.46M | -0.67% |
| 59 | Oct 04, 2018, | 3 | 3,06 | 3,06 | 2,98 | 147.17M | -3.23% |

Table 2. Sample Data in 2019

| No | Date | Price | Open | High | Low | Vol | Change % |
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| 1 | Dec 28, 2018, | 3,66 | 3,68 | 3,68 | 3,65 | 122.95M | 0.00% |
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| 3 | Dec 26, 2018, | 3,6 | 3,55 | 3,63 | 3,52 | 83.41M | -0.55% |
| 4 | Dec 21, 2018, | 3,62 | 3,61 | 3,63 | 3,6 | 174.47M | -0.82% |
| 5 | Dec 20, 2018, | 3,65 | 3,61 | 3,66 | 3,61 | 67.33M | -0.54% |
| 6 | Dec 19, 2018, | 3,67 | 3,6 | 3,67 | 3,6 | 133.10M | 1.10% |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 55 | Oct 10, 2018, | 3,01 | 3,03 | 3,04 | 3,01 | 61.26M | -0.33% |
| 56 | Oct 09, 2018, | 3,02 | 2,97 | 3,03 | 2,97 | 51.20M | 1.68% |
| 57 | Oct 08, 2018, | 2,97 | 2,97 | 3,01 | 2,96 | 64.84M | -0.34% |
| 58 | Oct 05, 2018, | 2,98 | 3 | 3,04 | 2,96 | 145.46M | -0.67% |
| 59 | Oct 04, 2018, | 3 | 3,06 | 3,06 | 2,98 | 147.17M | -3.23% |

Table 3. Sample Data in 2020

| No | Date | Price | Open | High | Low | Vol | Change % |
|---|---|---|---|---|---|---|---|
| 1 | Nov 04, 2020, | 3,29 | 3,42 | 3,42 | 3,29 | 138.23M | -2.66% |
| 2 | Nov 03, 2020, | 3,38 | 3,39 | 3,4 | 3,36 | 121.46M | 0.00% |
| 3 | Nov 02, 2020, | 3,38 | 3,36 | 3,39 | 3,3 | 156.78M | 0.60% |
| 4 | Oct 27, 2020, | 3,36 | 3,34 | 3,4 | 3,33 | 183.31M | 0.60% |
| 5 | Oct 26, 2020, | 3,34 | 3,3 | 3,36 | 3,29 | 101.22M | 1.52% |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 200 | Jan 09, 2020, | 4,4 | 4,4 | 4,42 | 4,37 | 72.07M | 0.46% |
| 201 | Jan 08, 2020, | 4,38 | 4,38 | 4,4 | 4,34 | 171.75M | -0.45% |
| 202 | Jan 07, 2020, | 4,4 | 4,41 | 4,41 | 4,38 | 103.95M | 0.69% |
| 203 | Jan 06, 2020, | 4,37 | 4,36 | 4,39 | 4,32 | 44.23M | -1.13% |
| 204 | Jan 03, 2020, | 4,42 | 4,42 | 4,44 | 4,39 | 82.90M | 0.23% |
| 205 | Jan 02, 2020, | 4,41 | 4,4 | 4,41 | 4,36 | 41.71M | 0.23% |

Data is obtained in the form of writing that is attached in the Microsoft Exwl . This stock data is the result of BRI stock trends which is obtained from the results of BRI stock trends for each period .

### 3.1.1 Calculations using the WMA + PSO method

Data processing in this study is the determination of the variables used to perform forcaseting calculations using the SMA method and the SMA+PSO method .

Table 4. Examples of Data to be Entered in SMA and SMA+PSO

| No | Date | Price |
|---|---|---|
| 1 | Nov 04 2020 | 3290 |
| 2 | Nov 03 2020 | 3380 |
| 3 | Nov 02 2020 | 3380 |
| 4 | Oct 27 2020 | 3360 |
| 5 | Oct 26 2020 | 3340 |
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| 505 | Oct 10 2018 | 3010 |
| 506 | Oct 09 2018 | 3020 |
| 507 | Oct 08 2018 | 2970 |
| 508 | Oct 05 2018 | 2980 |
| 509 | Oct 04 2018 | 3000 |

Kemudian menginputkan nilai N awal pada partikel yang terdiri dari beberapa nilai. Berikut contoh nilai N.

Table 5. Nilai Input Nilai N Awal

| Nilai N | | | | |
|---|---|---|---|---|
| 3 | 5 | 7 | 9 | 11 |

### 3.1.2 *Forcasting Implementation*

Forecasting implementation uses two algorithms, namely SMA+PSO and SMA. The data used is stock data , totaling 509 data. Following the implementation of forecasting by using an algorithm - an algorithm that :

1. Implementation of SMA+PSO
   The process flow in the Particle Swarm Optimization algorithm with a Single Moving Average is as follows :
2. Input
   Input data coherently when the price of shares of BRI of the month January 2013 until July 2019 has given the index date and price.
   Then input the value random that where the value of random are tested in 10 times with iterated as many as 20 times in every test and get the one result value random in R1 and R2.

3. Process

The process of applying the Particle Swarm Optimization and Single Moving Average algorithms is as follows :

1) Test initialization beginning of the particles to the Single Moving Average with.

$$\mathbf{Ft} = (\mathbf{Wt-1At-1} + \mathbf{Wt-2At-2} + \ldots + \mathbf{Wt-nAt-n}) / (\mathbf{Wt-1} + \mathbf{Wt-2} + \ldots + \mathbf{Wt-n})$$

Description :

Ft = Forecasting for the future period

Wt = Weight of which provide ( Every value dipartikel PSO)

At = Actual data in the previous period

n = Number of periods that averaged averaged

2) Test the Mean Percentage Error on the results of the initial initialization test for the value of N with the Single Moving Average algorithm with

$$Mape = 100\text{x}\frac{\sum_{t=1}^{n}\frac{(At-Ft)}{At}}{\text{n}}$$

3) Calculating the value of fitness in every particle circuitry using

$$Fitness = \frac{1}{1+Mape}$$

4) Determine the value pbest , in determining the value of pbest or value of local best in every particle equal to the value or the position of the particle that already exist.

5) Finding the value Gbest , in the search for the value of global best then compared to the value of fitness, which is where the value of fitness site that there was misconstrued the particles that become the value Gbest or global best .

6) Update the pace after the obtained value of fitness the best and also the value of gbest and pbest her then do look for the value of the speed as follows :

$$v'_{id} = w * v_{id} + c_1 * r_1 * (p_{id} - x_{id}) + c_2 * r_2 * (p_{gd} - x_{id})$$

Description :

$v'_{id}$ = Speed of particles in the iteration before his

$w$ = Inertial Weight

$c_1$ = coefficient of acceleration 1

$c_2$ = coefficient of acceleration 2

$r_1, r_2$ = Random value (0-1)

7) Update the position of the particle , after the obtained result of the speed at iteration 1 then do update the position of the particle that is

new with :

$$x'id = x'id + v'id$$

4. Output

To determine the value of the accuracy of the algorithm SMA + PSO then use the equation below this :

Accuracy = 100% - MAPE

Then we get the results of the accuracy of each weight as follows :

Table 6. Optimal Result for N Value and Accuracy 20

| Nilai N | 2 | 2 | 2 | 2 | 2 |
|---|---|---|---|---|---|
| MAPE | 1,85 | 1,85 | 1,85 | 1,86 | 1,86 |

The results of the optimal values , MAPE and Fitness , the accuracy of the optimization of the N value can be calculated with the initial values of 3, 5, 7, 9, 11 as follows :

Accuracy iterations 20 = 100% - 1.85% = 98.15%.

Furthermore, the results of the calculation values until the last iteration are forecasted using the entire data, then the graph results are obtained as follows:

Table 7. High School Forecasting Results

| No | Date | Price | N=3 | N=5 | N=7 | N=9 | N=11 |
|---|---|---|---|---|---|---|---|
| 1 | Nov 04 2020 | 3290 | | | | | |
| 2 | Nov 03 2020 | 3380 | | | | | |
| 3 | Nov 02 2020 | 3380 | | | | | |
| 4 | Oct 27 2020 | 3360 | 3350 | | | | |
| 5 | Oct 26 2020 | 3340 | 3373,33 | | | | |
| 6 | Oct 23 2020 | 3290 | 3360 | 3350 | | | |
| 7 | Oct 22 2020 | 3300 | 3330 | 3350 | | | |
| 8 | Oct 21 2020 | 3240 | 3310 | 3334 | 3334,29 | | |
| 9 | Oct 20 2020 | 3250 | 3276,67 | 3306 | 3327,14 | | |
| 10 | Oct 19 2020 | 3280 | 3263,33 | 3284 | 3308,57 | 3314,44 | |
| 11 | Oct 16 2020 | 3250 | 3256,67 | 3272 | 3294,29 | 3313,33 | |
| 12 | Oct 15 2020 | 3310 | 3260 | 3264 | 3278,57 | 3298,89 | 3305,45 |
| 13 | Oct 14 2020 | 3360 | 3280 | 3266 | 3274,29 | 3291,11 | 3307,27 |
| 14 | Oct 13 2020 | 3280 | 3306,67 | 3290 | 3284,29 | 3291,11 | 3305,45 |
| 15 | Oct 12 2020 | 3190 | 3316,67 | 3296 | 3281,43 | 3284,44 | 3296,36 |
| .... | .... | .... | .... | .... | .... | .... | .... |
| .... | .... | .... | .... | .... | .... | .... | .... |
| .... | .... | .... | .... | .... | .... | .... | .... |
| 505 | Oct 10 2018 | 3010 | 2953,33 | 2986 | 3005,71 | 3012,22 | 3005,45 |
| 506 | Oct 09 2018 | 3020 | 2956,67 | 2974 | 3004,29 | 3011,11 | 3006,36 |
| 507 | Oct 08 2018 | 2970 | 2980 | 2978 | 2994,29 | 3007,78 | 3012,73 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 508 | Oct 05 2018 | 2980 | 3000 | 2972 | 2980 | 3002,22 | 3008,18 |
| 509 | Oct 04 2018 | 3000 | 2990 | 2978 | 2977,14 | 2990 | 3001,82 |

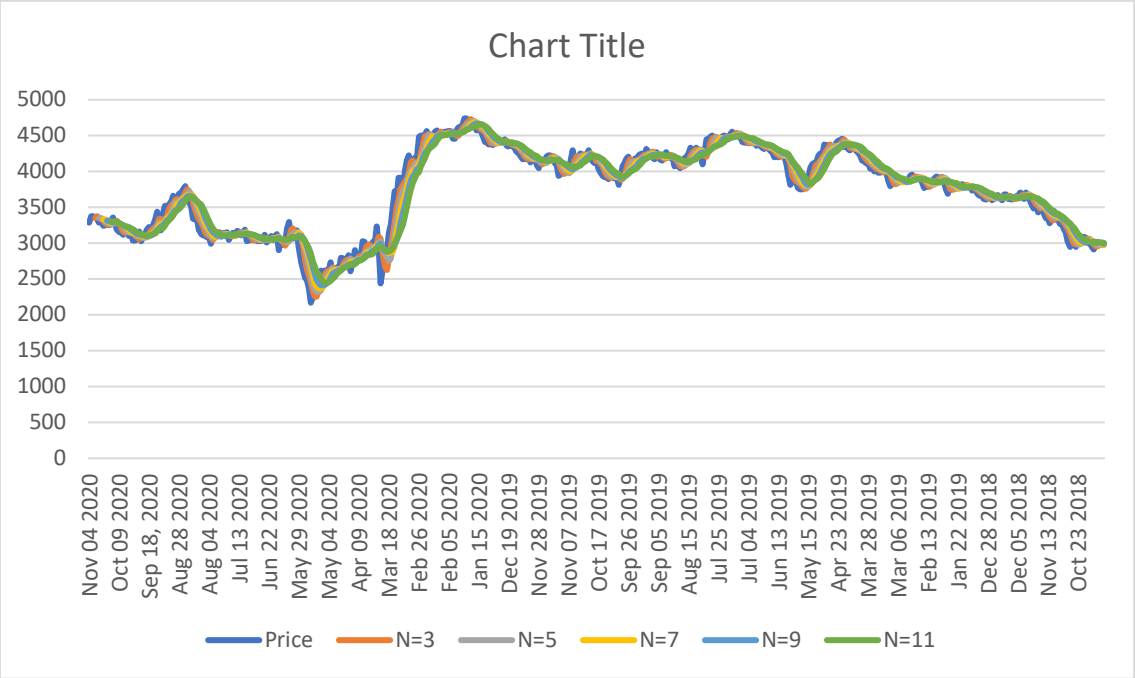


Figure 1 . High School Forecasting Results Graph

Table 8. Forecasting Results SMA+PSO

| | | ITERASI 20 | | | | |
|---|---|---|---|---|---|---|
| No | Price | N=2 | N=2 | N=2 | N=2 | N=2 |
| 1 | 3290 | | | | | |
| 2 | 3380 | | | | | |
| 3 | 3380 | 3335,00 | 3335,00 | 3335,00 | 3335,00 | 3335,00 |
| 4 | 3360 | 3380,00 | 3380,00 | 3380,00 | 3380,00 | 3380,00 |
| 5 | 3340 | 3370,00 | 3370,00 | 3370,00 | 3370,00 | 3370,00 |
| .... | .... | .... | .... | .... | .... | .... |
| .... | .... | .... | .... | .... | .... | .... |
| .... | .... | .... | .... | .... | .... | .... |
| 505 | 3010 | 2930,00 | 2930,00 | 2930,00 | 2930,00 | 2930,00 |
| 506 | 3020 | 2960,00 | 2960,00 | 2960,00 | 2960,00 | 2960,00 |
| 507 | 2970 | 3015,00 | 3015,00 | 3015,00 | 3015,00 | 3015,00 |
| 508 | 2980 | 2995,00 | 2995,00 | 2995,00 | 2995,00 | 2995,00 |
| 509 | 3000 | 2975,00 | 2975,00 | 2975,00 | 2975,00 | 2975,00 |

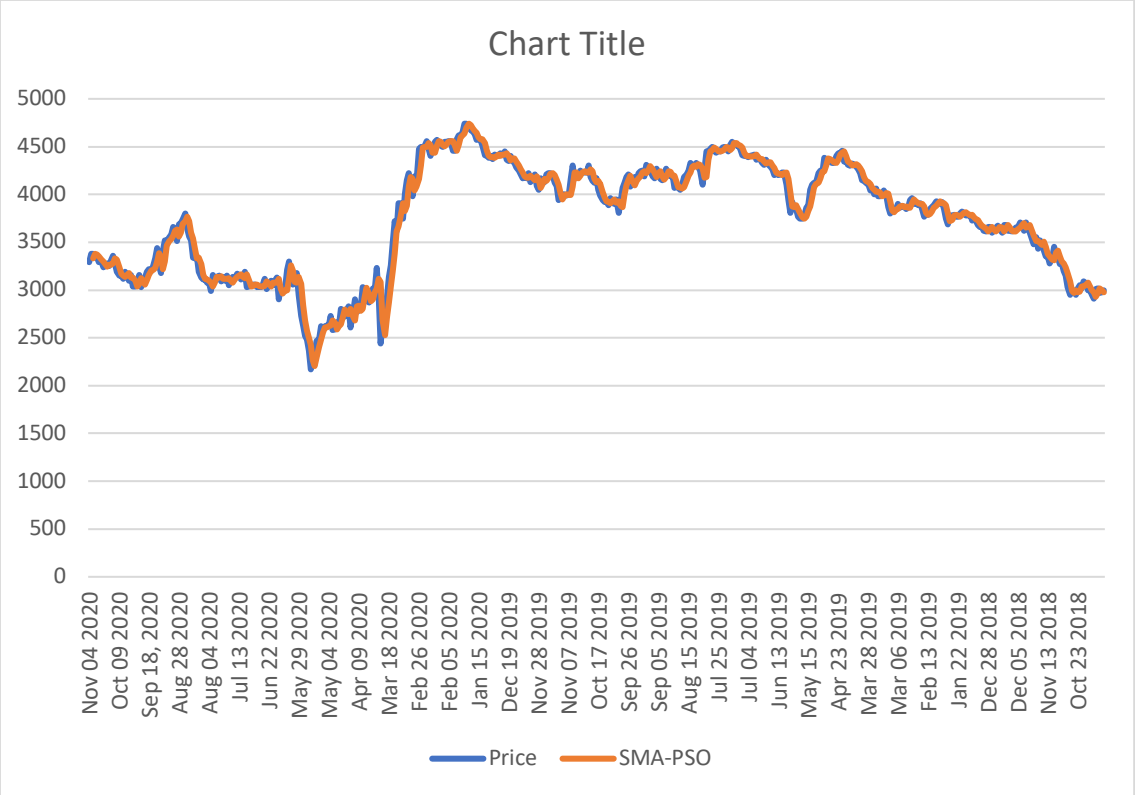


Figure 2 . SMA+PSO Forecasting Results

Table 9. Forecasting Results for SMA and SMA+PSO

| No | Date | Price | SMA | SMA-PSO |
|---|---|---|---|---|
| 1 | Nov 04 2020 | 3290,000 | | |
| 2 | Nov 03 2020 | 3380,000 | | |
| 3 | Nov 02 2020 | 3380,000 | | 3335 |
| 4 | Oct 27 2020 | 3360,000 | 3350,000 | 3380 |
| 5 | Oct 26 2020 | 3340,000 | 3373,330 | 3370 |
| .... | .... | .... | .... | .... |
| .... | .... | .... | .... | .... |
| .... | .... | .... | .... | .... |
| 505 | Oct 10 2018 | 3010,000 | 2953,330 | 2930 |
| 506 | Oct 09 2018 | 3020,000 | 2956,670 | 2960 |
| 507 | Oct 08 2018 | 2970,000 | 2980,000 | 3015 |
| 508 | Oct 05 2018 | 2980,000 | 3000,000 | 2995 |
| 509 | Oct 04 2018 | 3000,000 | 2990,000 | 2975 |

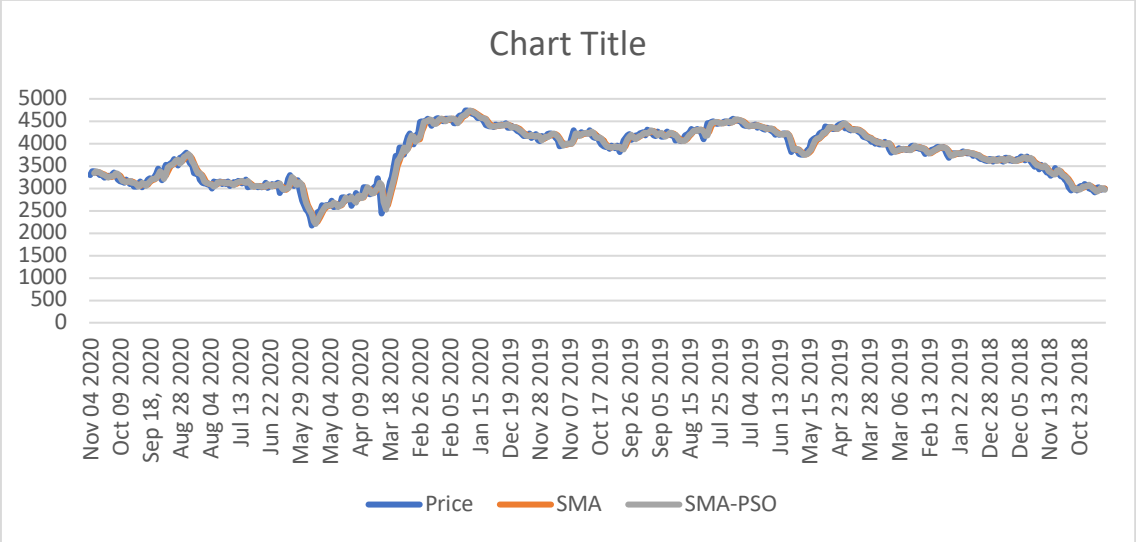


Figure 3 . Graph of Forecasting Results for SMA and SMA+PSO

### 3.1.3 High School Comparison Test with SMA + PSO

Test comparisons made to see the results of the level of accuracy of any calculation that is obtained from each method . Value N beginning which is used is 3, 5, 7, 9, 11. For a method that is used in comparison this is a method Single Moving Average which is already in the optimization using the method of Particle Swarm Optimization with methods Single Moving Average without do optimization or so . So didapatkanlah result of perbandingang methods such as the following this :

Table 10. Comparison of SMA and SMA+PSO

| Metode | Nilai N Terbaik | Price | Mape |
|---|---|---|---|
| SMA | 3 | 3350 | 2,01536 |
| SMA + PSO | 2 | 3335 | 1,84558 |

Test table comparison menunujukan THAT there is a difference that is quite significantly from the value of Mean Absolute Percentage Error between algorithms Single Moving Average which is already in the optimization using the method of Particle Swarm Optimization with methods Single Moving Average shows that the mean average value of the accuracy of the result of the method Single Moving Average that is optimized the method of Particle Swarm Optimization value of the accuracy of its much better than the value of Single Moving Average which is not optimized using methods Particle Swarm Optimization.

## 4. Discussion

The data used in the study of this is a data share on BRI data obtained as many as 509 data where the data that is the data results tred each period on the stock of BRI. In the process, the data obtained is forecasted using the Single Moving Average

method which has been optimized by the Particle Swarm Optimization method and forecasting is also carried out using the Single Moving Average method . In this study using 509 data. In each method performed forecasting using a value of N initial 3, 5, 7, 9, 11, in the calculation method Single Moving Average that has been optimized by the method of Particle Swarm Optimization to do optimization as much as 20 times in order to find the value of N best of methods Single Moving Average which is more optimal. Having done the optimization niulai N on methods Single Moving Average then will do ratings were seen from the results of the accuracy of which is produced using the Mean Absolute Percentage Error.

Thus obtained was the result of the accuracy of methods Single Moving Average that has been optimized using the method of Particle Swarm Optimization in the data stock of BRI and the results of the accuracy of methods Single Moving Average on the data stock of BRI. In the calculation that uses the methods Single Moving Average that has been optimized by the method of Particle Swarm Optimization obtained results of MAPE it is 1.845584 %, while using the Single Moving Average just the result of MAPE her as much as 2.01536 %.

Based on the results of MAPE were obtained in the study is that which results from the overall weighting of the method Single Moving Average that has been optimized by the method of Particle Swarm Optimization indicates the result of MAPE which tend to be small compared with the methods Single Moving Average course . So the results the accuracy of methods Single Moving Average that has been optimized by the method of Particle Swarm Optimization is much 98.15442% while the methods Single Moving Average is as much 97.98464%.

From the results of accuracy that earned it can be interpreted that the method Single Moving Average that has been optimized using the method of Particle Swarm Optimization memeiliki result accuracy that is great in compare that using methods Single Moving Average course . Thus the results of the research have found that the method of Particle Swarm Optimization can optimize the value of N in the methods Single Moving Average which is seen from the results of MAPE which tend to be smaller than MAPE are generated methods Single Moving Average that grades the accuracy of SMA + PSO is better than high school alone .

## 5. Closing

### 5.1 Conclusion

From the research that has been done , the conclusions that can be drawn are as follows :

1. Effect of methods Particle Swarm Optimization can optimize the value of N in the methods Single Moving Average on the data stock BRI obtained results value N optimum is N = 2 of 20kali looping .
2. The level of accuracy of the method Single Moving Average which is optimized by the method of Particle Swarm optimization obtained

result accuracy is the most good at the value N = 2 with MAPE 1.845584 % and the value of accuracy that is obtained by 98.15442%.

## 5.2 Suggestions

The suggestions that can be given based on this research are as follows :

1. In the next research using Single Moving Average which is optimized by Particle Swarm Optimization method with different data .
2. In the study further can use the methods of optimization else that can optimize the value of the weight on the methods Wighted Moving Average.

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