

## CHAPTER 4

### ANALYSIS AND DESIGN

#### 4.1. Analysis

The purpose of this project is to analyze and compare the performance of the Prophet algorithm and the Weighted Moving Average algorithm in predicting stocks. Prophet is a library created by the Facebook Core Data Science team. This research does not use Facebook's library but uses a method created by Facebook. The two methods that will be compared are written in Python. Stock price data obtained from yahoo.finance.com. This data amounted to as much as 300 data. This is stock price data from November 20, 2019 to February 16, 2021. To calculate accuracy, the stock price data is divided into 3 parts namely train, validation, and test. The train part will be used to train the algorithm. The validation and test sections will be used to check the accuracy of the algorithm in predicting stocks.

#### 4.2. Weighted Moving Average

**F =**

W1 = First data weight

W2 = Second data weight

D1 = First data

D2 = Second data

TW = Total data weight

The Weighted Moving Average works by calculating a moving average on the data and assigning a weight that is adjusted according to the order. The workflow is, first the program will determine the amount of load that will be given to the data. So for example there are three data, the first data will have a smaller weight than the second data weight. And the

second data will have a smaller weight than the third data weight. The load is adjusted according to the order of the data, the newer the data the bigger the load. Then the data will be multiplied by the load and the result will be divided by the total of all existing loads.

### **4.3. Prophet**

In making predictions, the Prophet uses the Generalized Additive Model (GAM) technique. Prophet works by dividing the time series into 3 components: trend, seasonality, and holidays. A trend is a time series pattern that indicates growth or shrinkage. Seasonality is a cycle that repeats itself over a specific period of time. Holiday is the effect of a holiday at a certain time. Holiday is an additional feature that can be activated if you want to use it. However, because the stock market does not operate during holidays, the holiday feature is not used.

#### **4.3.1. Create changepoint**

The changepoint is the time when a change in trend occurs. A total of 25 changepoints were installed within the predicted timeframe. How big the change in changepoint will be determined by the size of the delta.

#### **4.3.2. Trend Formula**

$$g(t) = (k + a(t) | \delta)t + (m + a(t) | \gamma)$$

k = growth rate

$\delta$  = rate adjustments

m = offset parameter

a = changepoint location

$\gamma$  = continuous parameter

t = time

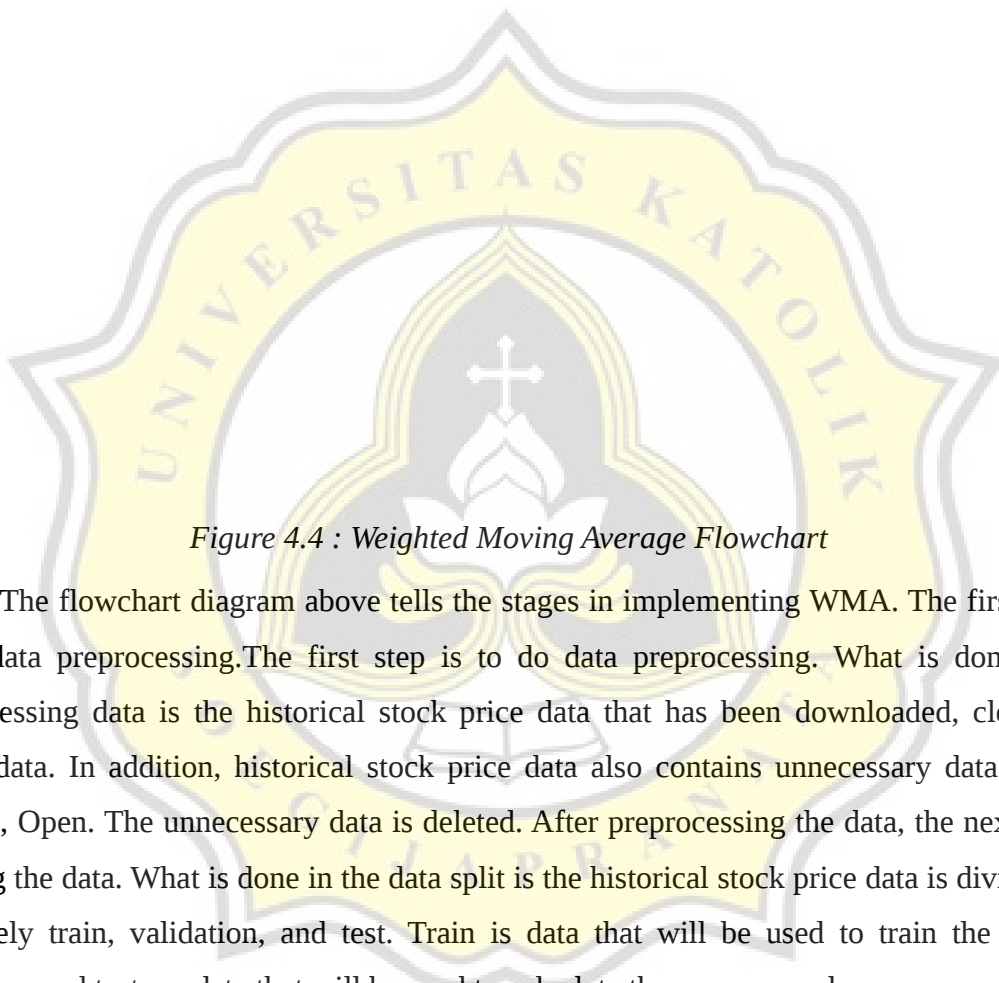
In calculating the trend value, what is done is to add the value of the growth rate and a multiplied by delta (matrix multiplication). A is a matrix containing the time of the changepoint change. Delta is the trend rate adjustment parameter. The purpose of the delta is to control how much the trend changes. The delta value can be changed. The greater the delta value, the greater the trend change.

#### **4.3.3. Seasonality Formula**

$$s(t) = X(t)\beta$$

In calculating the seasonality value, the program will detect the amount of prediction time. If the prediction time is 30 days or less then N is 3 and P is 7. If the prediction time is less than 365 days then N is 10 and P is 365.25. After that the program will calculate the value of seasonality. After getting the seasonality value, the seasonality value will be multiplied by beta. Beta is the seasonality adjustment parameter. The use of beta is as a controller of how much change in seasonality. After that the trend values and seasonality values will be added, the results are predictions.

#### 4.4. Design



*Figure 4.4 : Weighted Moving Average Flowchart*

The flowchart diagram above tells the stages in implementing WMA. The first step is to do data preprocessing. The first step is to do data preprocessing. What is done in the preprocessing data is the historical stock price data that has been downloaded, cleaned of empty data. In addition, historical stock price data also contains unnecessary data such as Volume, Open. The unnecessary data is deleted. After preprocessing the data, the next step is splitting the data. What is done in the data split is the historical stock price data is divided into 3, namely train, validation, and test. Train is data that will be used to train the method. Validation and test are data that will be used to calculate the accuracy value.

After splitting the data, the next step is to determine the amount of data to be used in training the WMA method. After that the program will determine the amount of load that will be given to the data. So for example there are three data, the first data will have a smaller weight than the second data weight. And the second data will have a smaller weight than the third data weight. The load is adjusted according to the order of the data, the newer the data the bigger the load. After carrying out the weighting process, the next step is to make

predictions using the WMA formula. The data will be multiplied by the load and the result will be divided by the total of all existing loads. After finding the prediction results, the prediction accuracy will be calculated using the MAPE method.

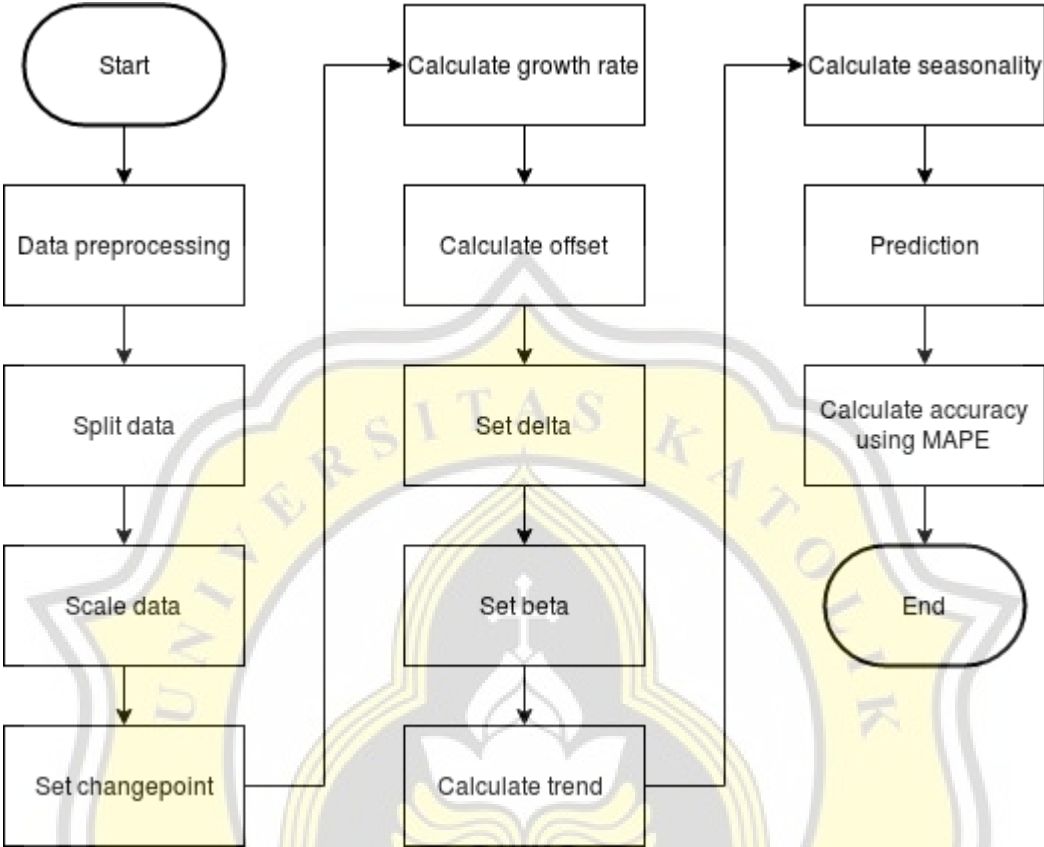


Figure 4.4 : Prophet Flowchart

The flowchart diagram above tells the stages in implementing the Prophet. The first step is to do data preprocessing. What is done in the preprocessing data is the historical stock price data that has been downloaded, cleaned of empty data. In addition, historical stock price data also contains unnecessary data such as Volume, Open. The unnecessary data is deleted. After preprocessing the data, the next step is splitting the data. What is done in the data split is the historical stock price data is divided into 3, namely train, validation, and test. Train is data that will be used to train the method. Validation and test are data that will be used to calculate the accuracy value. After splitting the data, the next step is scaling the data. So the stock price data will be scaled with the absolute maximum method. And the time data will be scaled with the min max method. After scaling the data, the next step is to install a changepoint. The

change point is the time when a change in trend occurs. A total of 25 change points were installed within the predicted timeframe.

After installing the change point, the next step is to calculate the growth rate. After calculating the growth rate, the next step is to calculate the offset. The growth rate and offset values need to be calculated because they will later be needed in calculating the trend value. After calculating the offset value, the next step is to set the delta value. Delta is the trend rate adjustment parameter. The purpose of the delta is to control how much the trend changes. The delta value can be changed. The greater the delta value, the greater the trend change. After setting the delta value, the next step is to set the beta value. Beta is the seasonality adjustment parameter. The use of beta is as a controller of how much change in seasonality. The beta value can be changed. The greater the beta value, the greater the seasonality change. After setting the beta value, the next step is to calculate the trend value. In calculating the trend value, what is done is to add the value of the growth rate and a multiplied by delta (matrix multiplication). A is a matrix containing the time of the change point change. Delta is the trend rate adjustment parameter. The purpose of the delta is to control how much the trend changes. The delta value can be changed. The greater the delta value, the greater the trend change. After calculating the trend value, the next step is to calculate the seasonality value. In calculating the seasonality value, the program will detect the amount of prediction time. If the prediction time is 30 days or less then N is 3 and P is 7. If the prediction time is less than 365 days then N is 10 and P is 365.25. After that the program will calculate the value of seasonality. After getting the seasonality value, the seasonality value will be multiplied by beta. Beta is the seasonality adjustment parameter. The use of beta is as a controller of how much change in seasonality. After calculating the seasonality value, the next step is trend values and seasonality values will be added, the results are predictions. After finding the prediction results, the prediction accuracy will be calculated using the MAPE method.