Real-Time Information System Basic Needs Price Change Predictions in The Traditional Market

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Abstract. Currently, the traditional market is a place that is popular in society to buy various basic needs. But unfortunately, until this time information about prices in the traditional market still very minimal, and prediction of the price in later days not available yet, as of this necessary there is a system that can deliver information of basic needs price, and a feature that can be predicting price in later days. In this research method that is used to perform the price prediction is the weighted moving average (WMA), and determine the length of data retrieved is 7 days. As of the calculation accuracy result, the lowest MAPE value is 2.4768% and the maximum is 7.8829%, it can be concluded predictions were made already quite accurate and the price predictions can be informed to the public on every day.

1. Introduction

Based on the BPS data, the traditional market in Indonesia still dominated compared to the modern store and central shopping area, with the number of each of as many as 14,182, 1,131, and 708 units [1]. In general, people buy basic needs in the traditional market because prices are relatively more inexpensive. But the basic needs price in the traditional market often changing on every day, so people feel confused about what is the price at the moment they will buy.

It has been supposed information about basic needs price can easily be obtained by the public, but in practice, if they want to know the price of basic needs then they should visit a nearby traditional market. Also, yet not available application to predict basic needs price in later days.

Based on the problem above, then need a system that can display information about the price that can be accessible by the public. Real-time in this research meaning the data are changed on everyday. To perform predictions, the weighted moving average is used in this research because based on the results of previous research, generated predictions were fairly accurate. For calculating accuracy of the predictions, mean absolute percentage error is used in this research because most often used and suitable for checking prediction errors.

2. Method

The method for starting the research is determining the length of historical data, determine the weights, and calculate the prediction. The framework of thinking can be seen in Figure 1.
The data is used to perform the predictions of the price is the data growth rates taken through field survey by the Department of Cooperative, SMEs, Trade, and Industry of Cianjur Regency.

In this research, the weighted moving average (WMA) method is used. The WMA method assigns heavier weight to recent data because it is more relevant than previous data [2]. WMA describes the arithmetic weight of price fluctuations over a certain period [3]. The WMA formula can be seen in equation 1.

$$F_t = \frac{\sum (\text{weight period } n)(\text{data period } n)}{\sum \text{weight}}$$  \hspace{1cm} (1)$$

Weights in the WMA are obtained by decreasing arithmetic progression, with n-day WMA, then the last or most recent day has the weight of n, the second most recent n-1, and so on until it drops to 1 [4]. The most recent data is given the greatest weight because usually more important than others [5].

3. Results and discussion

3.1. Calculating the predictions

The result of the predictions by taking basic needs sample boiler chicken egg, kampung chicken meat, red chili pepper, red onion, and tomatoes in the Cianjur Central Market, the actual prices data that is used is taken from the Department of Cooperative, SMEs, Trade, and Industry of Cianjur Regency on May 8 to 21, 2020. The actual data can be seen in Table 1.
Table 1. The actual price data table

| Date       | Actual Price |
|------------|--------------|
|            | Sarah        |
|            | Eggs         |
|            | Meat         |
|            | Pepper       |
|            | Onion        |
|            | Tomato       |
| 08/05/2020 | Rp22.000     | Rp45.000 | Rp40.000 | Rp40.000 | Rp7.000 |
| 09/05/2020 | Rp22.000     | Rp45.000 | Rp40.000 | Rp40.000 | Rp8.000 |
| 10/05/2020 | Rp20.000     | Rp45.000 | Rp30.000 | Rp40.000 | Rp7.000 |
| 11/05/2020 | Rp20.000     | Rp45.000 | Rp25.000 | Rp40.000 | Rp8.000 |
| 12/05/2020 | Rp20.000     | Rp45.000 | Rp25.000 | Rp40.000 | Rp7.000 |
| 13/05/2020 | Rp20.000     | Rp45.000 | Rp25.000 | Rp40.000 | Rp7.000 |
| 14/05/2020 | Rp20.000     | Rp45.000 | Rp25.000 | Rp40.000 | Rp8.000 |
| 15/05/2020 | Rp20.000     | Rp50.000 | Rp30.000 | Rp45.000 | Rp8.000 |
| 16/05/2020 | Rp20.000     | Rp50.000 | Rp28.000 | Rp45.000 | Rp8.000 |
| 17/05/2020 | Rp20.000     | Rp50.000 | Rp25.000 | Rp45.000 | Rp8.000 |
| 18/05/2020 | Rp20.000     | Rp50.000 | Rp25.000 | Rp45.000 | Rp7.000 |
| 19/05/2020 | Rp20.000     | Rp50.000 | Rp30.000 | Rp48.000 | Rp8.000 |
| 20/05/2020 | Rp22.000     | Rp50.000 | Rp30.000 | Rp48.000 | Rp8.000 |
| 21/05/2020 | Rp22.000     | Rp50.000 | Rp30.000 | Rp48.000 | Rp8.000 |

In this research, the length of the taken data is 7 days. Then weights are determined based on the series of arithmetic declining i.e. 7 for the 7th-day price data, 6 for 6th-day price data, and so on until weight value is 1 for the first-day price data. After the weights are determined, a calculation is made to predict the 8th-day price data in a way that can be seen in equation 2.

\[
F_{7+1} = \frac{7(Y_7)+6(Y_6)+5(Y_5)+4(Y_4)+3(Y_3)+2(Y_2)+1(Y_1)}{28}
\]  

(2)

Description:

\(F_{7+1}\) = 8th-day price prediction

\(Y_7\) = 7th-day price data

\(Y_6\) = 6th-day price data

\(Y_5\) = 5th-day price data

\(Y_4\) = 4th-day price data

\(Y_3\) = 3rd-day price data

\(Y_2\) = 2nd-day price data

\(Y_1\) = 1st-day price data

To perform price predictions of boiler chicken egg dated 15 May 2020, the weights and calculations can be seen in Table 2.
Table 2. WMA calculation table

| Day | Date    | Actual Prices | Weight | Weight * Actual Price |
|-----|---------|---------------|--------|-----------------------|
| 1   | 08/05/2020 | Rp22000       | 1      | 22000                 |
| 2   | 09/05/2020 | Rp22000       | 2      | 44000                 |
| 3   | 10/05/2020 | Rp20000       | 3      | 60000                 |
| 4   | 11/05/2020 | Rp20000       | 4      | 80000                 |
| 5   | 12/05/2020 | Rp20000       | 5      | 100000                |
| 6   | 13/05/2020 | Rp20000       | 6      | 120000                |
| 7   | 14/05/2020 | Rp20000       | 7      | 140000                |
|     | Amount   |               | 28     | 566000                |

Then after an obtained amount of weights that is 28 and the number of the results of the calculation (weight * data) is 566000, carried out the division number of the results of the calculation (weight * data) divided by the amount of the weight, the results are obtained is 20214 (566000/28) and the value of such outcome predictions for the date of 15 May 2020. The results of the overall prediction for each date at 15 through 21 May 2020 can be seen in Table 3.

Table 3. Price prediction results table

| Date    | Price Prediction |
|---------|------------------|
|         | Boiler Chicken Eggs | Kampung Chicken Meat | Red Chili Pepper | Red Onion | Tomato |
| 15/05/2020 | Rp20.214          | Rp45.000             | Rp27.143         | Rp40.000 | Rp7.214  |
| 16/05/2020 | Rp20.071          | Rp46.250             | Rp27.143         | Rp41.250 | Rp7.393  |
| 17/05/2020 | Rp20.000          | Rp47.321             | Rp27.000         | Rp42.321 | Rp7.536  |
| 18/05/2020 | Rp20.000          | Rp48.214             | Rp26.536         | Rp43.214 | Rp7.679  |
| 19/05/2020 | Rp20.000          | Rp48.929             | Rp26.250         | Rp43.929 | Rp7.536  |
| 20/05/2020 | Rp20.000          | Rp49.464             | Rp27.214         | Rp45.214 | Rp7.679  |
| 21/05/2020 | Rp20.500          | Rp49.821             | Rp28.000         | Rp46.214 | Rp7.786  |

3.2. Calculating Accuracy of The Predictions

After the prediction results are obtained, the next step is to calculate the accuracy value with Mean Absolute Percentage Error (MAPE). MAPE is defined as the difference in the absolute mean between actual and predicted values divided by actual values [6]. MAPE allows testing the accuracy of a prediction because it uses a way to measure the average distance of the actual value with the predicted value [7]. The MAPE formula can be seen in equation 3.

$$MAPE = \frac{\sum|A-P|_A}{N} \times 100$$  \hspace{1cm} (3)

The result of the calculation of the accuracy value can be seen in Table 4.
Table 4. Table of MAPE calculation results

| Basic Needs     | Date     | Actual Price | Price Prediction | Absolute Percentage Error |
|-----------------|----------|--------------|------------------|---------------------------|
| **Boiler**      | 15/05/2020 | Rp20.000    | Rp20.214         | 1,0714 %                  |
| **Chicken Eggs**| 16/05/2020 | Rp20.000    | Rp20.071         | 0,3571 %                  |
|                 | 17/05/2020 | Rp20.000    | Rp20.000         | 0,0000 %                  |
|                 | 18/05/2020 | Rp20.000    | Rp20.000         | 0,0000 %                  |
|                 | 19/05/2020 | Rp20.000    | Rp20.000         | 0,0000 %                  |
|                 | 20/05/2020 | Rp22.000    | Rp20.000         | 9,0909 %                  |
|                 | 21/05/2020 | Rp22.000    | Rp20.500         | 6,8182 %                  |
|                 |           |              |                  | **MAPE =** 2,4768 %       |
| **Kampung**     | 15/05/2020 | Rp50.000    | Rp45.000         | 10,0000 %                 |
| **Chicken Meat**| 16/05/2020 | Rp50.000    | Rp46.250         | 7,5000 %                  |
|                 | 17/05/2020 | Rp50.000    | Rp47.321         | 5,3571 %                  |
|                 | 18/05/2020 | Rp50.000    | Rp48.214         | 3,5714 %                  |
|                 | 19/05/2020 | Rp50.000    | Rp48.929         | 2,1429 %                  |
|                 | 20/05/2020 | Rp50.000    | Rp49.464         | 1,0714 %                  |
|                 | 21/05/2020 | Rp50.000    | Rp49.821         | 0,3571 %                  |
|                 |           |              |                  | **MAPE =** 4,2857 %       |
| **Red Chili**   | 15/05/2020 | Rp30.000    | Rp27.143         | 9,5238 %                  |
| **Pepper**      | 16/05/2020 | Rp28.000    | Rp27.143         | 3,0612 %                  |
|                 | 17/05/2020 | Rp25.000    | Rp27.000         | 8,0000 %                  |
|                 | 18/05/2020 | Rp25.000    | Rp26.536         | 6,1429 %                  |
|                 | 19/05/2020 | Rp30.000    | Rp26.250         | 12,5000 %                 |
|                 | 20/05/2020 | Rp30.000    | Rp27.214         | 9,2857 %                  |
|                 | 21/05/2020 | Rp30.000    | Rp28.000         | 6,6667 %                  |
|                 |           |              |                  | **MAPE =** 7,8829 %       |
| **Red Onion**   | 15/05/2020 | Rp45.000    | Rp40.000         | 11,1111 %                 |
|                 | 16/05/2020 | Rp45.000    | Rp41.250         | 8,3333 %                  |
|                 | 17/05/2020 | Rp45.000    | Rp42.321         | 5,9524 %                  |
|                 | 18/05/2020 | Rp45.000    | Rp43.214         | 3,9683 %                  |
|                 | 19/05/2020 | Rp48.000    | Rp43.929         | 8,4821 %                  |
|                 | 20/05/2020 | Rp48.000    | Rp45.214         | 5,8036 %                  |
|                 | 21/05/2020 | Rp48.000    | Rp46.214         | 3,7202 %                  |
| Date     | Actual  | Predicted | MAPE  |
|----------|---------|-----------|-------|
| 15/05/20 | Rp8.000 | Rp7.214   | 9,8214 % |
| 16/05/20 | Rp8.000 | Rp7.393   | 7,5893 % |
| 17/05/20 | Rp8.000 | Rp7.536   | 5,8036 % |
| 18/05/20 | Rp7.000 | Rp7.679   | 9,6939 % |
| 19/05/20 | Rp8.000 | Rp7.536   | 5,8036 % |
| 20/05/20 | Rp8.000 | Rp7.679   | 4,0179 % |
| 21/05/20 | Rp8.000 | Rp7.786   | 2,6786 % |

MAPE = 6,4869 %

The comparison graph of predicted and actual prices can be seen in Figure 2.

**Figure 2.** Actual and prediction price of basic needs sample
The result of the calculation of the value predicted by MAPE is at 2.4768% for boiler chicken egg, 4.2857% for kampung chicken meat, 7.8829% for red chili pepper, 6.7673% for red onion, and 6.4869% for tomatoes. That value is sufficiently low so that the results of prediction were done already quite accurate.

3.3. Website Implementation
For the information so that the prediction information can be seen by the public, then the predicted value is implemented on the website. The homepage of the website can be seen in Figure 3.

4. Conclusion
After doing a calculation of the predicted prices of the sample basic needs boiler chicken egg, kampung chicken meat, red chili pepper, red onion, and tomatoes in the Cianjur Central Market for date 15 to 21 May 2020, and based on the MAPE value accuracy the lowest is 2.4768% and the highest is 7.8829%, it can be concluded predictions were made already quite accurate and the price predictions can be informed to the public on every day.

5. References
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