Implementation of the Least Square Method in the Forecasting System Prices of Stop Materials in the Traditional Market Unit of Palembang City

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Abstract

This study aims to build a forecasting that makes it easier to estimate food commodity prices in traditional market units in the city of Palembang. The data used in this research are basic material data and basic material price data. This study uses the least square method as a problem solving method and method Rapid Application Development (RAD) as a system development method. The results of this study are in the form of a forecasting for staple food prices in traditional market units in the city of Palembang based on the name of the commodity and the date to be predicted, and an updated to the public.system force-casting is expected to assist the Palembang City Trade Office in providing information on food prices to the public and making strategies in the event of a price increase.

I. Introduction

Food is anything that comes from biological sources of agricultural, plantation, forestry, fishery, livestock, aquatic and water products, whether processed or unprocessed intended as food or drink for human consumption, including food additives, food raw materials, and other materials used in the process of preparing, processing, making food or beverages. As the main food of human daily life, food is intended to fulfill basic human needs so that food is the main item or object that can be traded. Food is very closely related to basic ingredients which are often called sembako (Nine staples), namely the basic needs of the community consisting of food and drink ingredients in general.

According to the Decree of the Minister of Industry and Trade No. 15/mpp/kep/2/1998 dated 27 February 1998 the members of these staples include: rice and sago, corn, vegetables and fruits, meat (beef and chicken), milk, sugar, salt containing iodine/ iodine, salt oil and margarine, and kerosene or LPG. The increasing number of people in Indonesia, also affects the value of demand for basic commodities (sembako) which can affect the prices of basic commodities, so that the prices of basic commodities often experience price changes.

Changes in prices can occur at any time which can cause the price of basic commodities to become unstable so that it results in the community, especially the lower classes, being unable to buy basic necessities if the price suddenly rises. So the government must have a plan to maintain price stability for the people in each region. Maintaining stability and direct supervision of the prices of basic commodities or basic necessities is the duty of the Trade Office. This is also done by the Trade Office of the City of Palembang.

Currently, the Trade Office of the City of Palembang in making policies to maintain the stability of the prices of basic commodities (sembako) can be done by looking at the prices of basic materials in the next period, so an accurate and precise price forecasting is

needed. By getting a precise and accurate price forecasting result, technology is needed that can produce close calculations.

Development is a change towards improvement (Shah et al, 2020). Currently, the development of technology and information makes changes to people's lifestyles. With this technological advancement, the Palembang City Trade Office seeks to create a *website* can assist activities in predicting the prices of basic commodities or basic necessities.

Therefore, to solve this problem, the author uses the *Least Square* which is one of the forecasting methods used to see the trend of time series data. By using the *Least Square* it is possible to carry out forcasting the prices of basic commodities every week or day of the various types of staples, making it easier to present updated information on forcasing prices of basic commodities in an easy, fast, and accessible *online* by the public. Based on the description above, the author intends to compile this research report with the title **"Implementation of the Least Square Method in the Forecasting System of Basic Material Prices in the Traditional Market Unit of Palembang City".**

II. Review of Literature

2.1 Forecasting

Forecasting is calculating something that will happen in the past or future. Meanwhile, in another sense, *Forecasting* is determining when an event will occur by predicting or predicting a situation in the future based on past and present conditions so that appropriate alternative actions can be taken (Anjani et al., 2020).

The author concludes, *Forecasting* is a calculation analysis technique that is carried out to estimate future events by using reference data in the past. There are two main things that must be considered in an accurate and useful forecasting process, namely:
a. Collecting relevant data in the form of information that can produce accurate forecasts.
b. Selection of the right forecasting technique that will utilize the data information obtained as much as possible.

2.2 The Least Square method

is one of the methods in carrying out future sales forecasting which is sourced from *time series data* so that the results can be determined(Hariri et al., 2016). *Least Square* is one of the forecasting techniques used to see trends from time series data. Meanwhile, another understanding of *Least Square* is a technique that is often used to determine estimates, because the results of the estimates are assessed in detail and thoroughly (Dewi, Indah listiowrni, 2019).

Based on the description above, it can be concluded that the *Least Square* Method is a forecasting method used to see the trend of time series data. Periodic series or time series is a series of observations of events, events or variables taken from time to time, recorded carefully according to the sequence in which they occur, then compiled as statistical data. The following formula is used:

$$Y = a + bx$$

Least Square Formula

Where:
Y   = total sales
a and b = constant
X   = certain time.
while to find the value of constants (a) and (b) as follows:

$$a = \frac{\sum Y}{N} \text{ and } b = \frac{\sum XY}{X^2}$$

Formulas a and b

III. Research Method

Implementation of the Least Square Method in the Forecasting System of Basic Materials Prices, to solve the problem in this research the stages of the research design were made as follows:
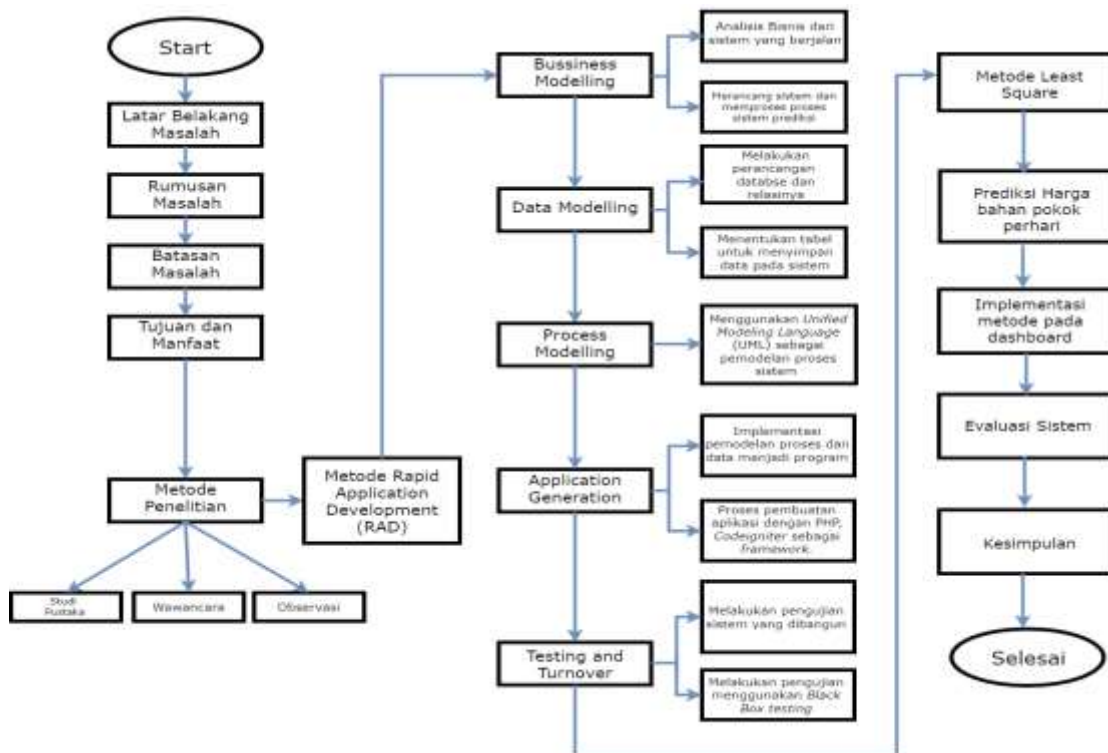

Figure 1. *Research Design*

3.1 System Development
Method *Rapid Application Development (RAD)*

The following are the stages of the *Rapid Application Development (RAD)* which has been made by the author:

a. Business Modeling

Conduct business analysis of the system that runs based on information then design a system related to the process of *Forecasting* the price of basic materials on the market 10 Ulu Palembang City and who *users* involved in this system and what just done.

b. Data Modeling
   Doing design that is focused on the database and its relationships that will be used based on the information needs that have been identified.
c. Process Modeling
   Applying a more specific modeling according to the current business model. This research uses UML *(Unified Modeling Language)* as the process modeling of the system being built.
d. Making Applications (*Application Generation*)
   Implementing process and data modeling into programs. In this study, the application development process is carried out by coding using the PHP *(Hypertext Preprocessor)*, *CodeIgniter* as a *framework,* HTML as a display setting, and Boostrap as *a front end framework.*
e. Testing and Turnover
   to test the system that has been built. This test is carried out using *black box testing* to find out the software is operating properly or not.

3.2 Problem Solving
a. Calculation *Least Square*

Method *Least* has 2 (two) cases in the division of cases, namely the case of even data and odd data. In time series analysis, the quality or accuracy of the information or data obtained and the time or period from which the data is collected is the most decisive thing. For good forecasting results, a large amount of information (data) is needed and is observed over a relatively long period of time. The less data collected, the worse the estimation or forecasting results will be. On the other hand, the more data collected, the better the estimation or forecasting obtained.

The prediction process is carried out based on data with a period of 1 (one) month in advance. The calculation is done using even data and odd data. The smaller the percentage value of the error rate, the more accurate the prediction value.

b. Calculation if the Data

The following table is the price data for broiler chickens from November 01, 2021 to November 30, 2021 and will make price predictions on December 01, 2021.

Table 1. Broiler prices (even)

No.	Date	Unit	Yesterday	's Price Today's Price
1.	November 1, 2021	Kg	Rp. 30,000	Rp. 30.000
2.	2 November 2021	Kg	Rp. 30,000	Rp. 30.000
3.	3 November 2021	Kg	Rp. 30,000	Rp. 30.000
4.	November 4, 2021	Kg	Rp. 30,000	Rp. 30.000
5.	5 November 2021	Kg	Rp. 30,000	Rp. 28.000
6.	6 November 2021	Kg	Rp. 28.000	Rp. 28.000
7.	7 November 2021	Kg	Rp. 28.000	Rp. 28.000
8.	8 November 2021	Kg	Rp. 28.000	Rp. 28.000
9.	, 2021	Kg	Rp. 28.000	Rp. 28.000
10.	10 November 2021	Kg	Rp. 28.000	Rp. 30.000
11.	11 November 2021	Kg	Rp. 30,000	Rp. 30.000
12.	12 November 2021	Kg	Rp. 30,000	Rp. 30.000
13.	13 November 2021	Kg	Rp. 30,000	Rp. 30.000

14.	14 November 2021	Kg	Rp. 30,000	Rp. 30.000
15.	15 November 2021	Kg	Rp. 30,000	Rp. 30.000
16.	16 November 2021	Kg	Rp. 30,000	Rp. 30.000
17.	17 November 2021	Kg	Rp. 30,000	Rp. 30.000
18.	18 November 2021	Kg	Rp. 30,000	Rp. 30.000
19.	19 November 2021	Kg	Rp. 30,000	Rp. 31,000
20	November 2021	Kg	Rp. 31,000	Rp. 31,000
21	November 21 2021	Kg	Rp. 31,000	Rp. 31,000
22	November 2021	Kg	Rp. 31,000	Rp. 31,000
23	November 2021	Kg	Rp. 31,000	Rp. 31,000
24	November 2021	Kg	Rp. 31,000	Rp. 31,000
25	November 2021	Kg	Rp. 31,000	Rp. 31,000
26	November 2021	Kg	Rp. 31,000	Rp. 31.000
27	November 2021	Kg	Rp. 31,000	Rp. 31,000
28	November 2021	Kg	Rp. 31,000	Rp. 31,000
29	November 2021	Kg	Rp. 31,000	Rp. 31.000
30	November 2021	Kg	Rp. 31,000	Rp. 31.000
31	December 01 2021	Kg	Rp. 31,000	?

The data in the table is included in the even data category so that the X value is
X = -29,-27,-25,-23, -21,-19, -17,-15,-13, -11, -9, - 7, -5, -3, -1, 1, 3, 5, 7, 9,11, 13, 15, 17, 19, 21, 23, 25, 27, 29

To find the forecast on December 1, 2021, you need to find the value $XY, X^2, \sum Y, \sum XY, and \sum X^2$.

3.3 Analysis Using *Least Square Method*

Table 2. Analysis of the *Least Square* on Even

No.	Date	Price (Y)	X	X^2	XY
1.	November 1, 2021	30,000	-29	841	-870,000
2.	November 2, 2021	30,000	-27	729	-810,000
3.	November 3, 2021	30,000	-25	625	-750,000
4.	November 4, 2021	30,000	- 23	529	-690,000
5.	5 November 2021	30,000	-21	441	-630,000
6.	6 November 2021	28,000	-19	361	-532,000
7.	7 November 2021	28,000	-17	289	-476,000
8.	8 November 2021	28,000	-15	225	-420,000
9.	November 9, 2021	28,000	-13	169	-364,000
10.	November 10, 2021	28,000	-11	121	-308,000
11.	11 November 2021	30,000	-9	81	-270,000
12.	November 12, 2021	30,000	-7	49	-210,000
13.	November 13, 2021	30,000	-5	25	-150,000
14.	November 14, 2021	30,000	-3	9	-90,000
15.	November 15, 2021	30,000	-1	1	-30,000
16.	November 16, 2021	30,000	1	1	30,000
17.	November 17, 2021	30,000	3	9	90,000
18.	November 18, 2021	30,000	5	25	150,000

19.	19 November 2021	31,000	7	49	217,000
20	20 November 2021	31,000	9	81	279,000
21	November 2021	31,000	11	121	341,000
22	22 November 2021	31,000	13	169	403,000
23	23 November 2021	31,000	15	225	465,000
24	24 November 2021	31,000	17	289	527,000
25	November 2021	31,000	19	361	589,000
26	November 2021	31,000	21	441	651,000
27	27 November 2021	31,000	23	529	713,000
28	28 November 2021	31,000	25	625	775,000
29	November 2021	31,000	27	729	837,000
30	November 2021	31,000	29	841	899.000
	TOTAL	902,000		8990	366,000

1. Finding values for a and b

   Finding values for $a = \dfrac{\Sigma \, Y}{n} \rightarrow a = \dfrac{902,000}{30} = 30.067$

   Finding the value of $b = \dfrac{\Sigma \, XY}{X^2} \rightarrow b = \dfrac{366.000}{8990} = 40.71$

2. Then the *Least Square* is

   $Y = a + bX$

   $Y = 30.067 + 40.71 \, X$

3. Input the value of x to be searched

   $Y = 30.067 + 40.71 \, (31)$

4. So that the resulting price prediction is as follows

   $Y = 31.329$

   Sothe price on December 1, 2021 is Rp. 31.329

5. Forecasting Error Rate or standard error in 01 December 2021:

   $\text{MAD} = \dfrac{n}{\Sigma \, Y}$ (Forecast value – Real Value)

   $= \dfrac{30}{366.000} (31.329 - 31.000)$

   $= 0.011$

So the forecasting error rate or standard error in 01 December 2021 is 1.1%

IV. Results and Discussion

The results of the implementation of the Least Square Method in the *Forecasting* of Basic Materials Prices have three users, namely UPTD Pasar 10 Palembang City, Head of the Stabilization Section for Staples and Important Materials and the Community.

Figure 2. *Use Case Diagram*

Event List:
1. This system has three actors, namely the Palembang City Market UPTD as admin, the Head of the Staple and Important Materials Stabilization Section, and the Community.
2. The community can see a graph of price changes and information on the price of basic commodities every day.
3. Palembang City Market UPTD and the Head of The Statistical and Important Materials Stabilization Section can login and enter the *dashboard page.*
4. The Palembang City Market UPTD can process data on basic materials, prices of basic commodities at the 10 Ulu market in Palembang City, and general factors for price changes.
5. Furthermore, the Head of Staples and Important Materials Stabilization Section can manage user data, perform *forecasting*, and view and print reports.

Figure 3. *Class Diagram*

System structure in terms of defining the classes that will be made to build the system, which consists of 4 classes a *Figure*.

Figure 4. *Display of Home Page*

Figure 5. *Price Forcasting Page*

Figure 5. There is an *updated* that can be seen by the public, Palembang City Market UPTD and Head of Staple Material Stabilization Section.
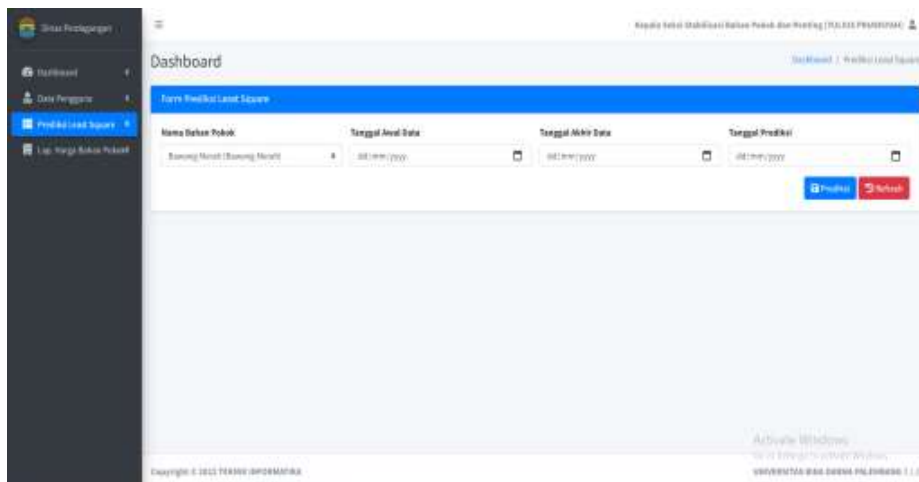
Figure 6. *Price Forcasting page*

Figure 6. On this page you can *forecast* the price of basic commodities by the Head of the Staple and Important Materials Stabilization Section based on the name of the staple material and the date to be *forecasted*.

4.1 Testing Table

The test table uses black box testing which is the initial stage of checking the suitability of a system. The tests were carried out by 2 users, including:

Table 3. Admin Testing UPTD Pasar Kota Palembang

No	Class Test	Item Test	Results
1	Login	Verification Username and Password	Successful
2	Managing Basic Material Data	Displaying data, deleting and editing	Successfully
3	Managing Price Data	Displaying data, deleting and editing	Successfully
4	Manage Factor Data	Displays data, deletes and edits	Successfully

4.2 Admin Test Results UPTD Pasar Kota Palembang

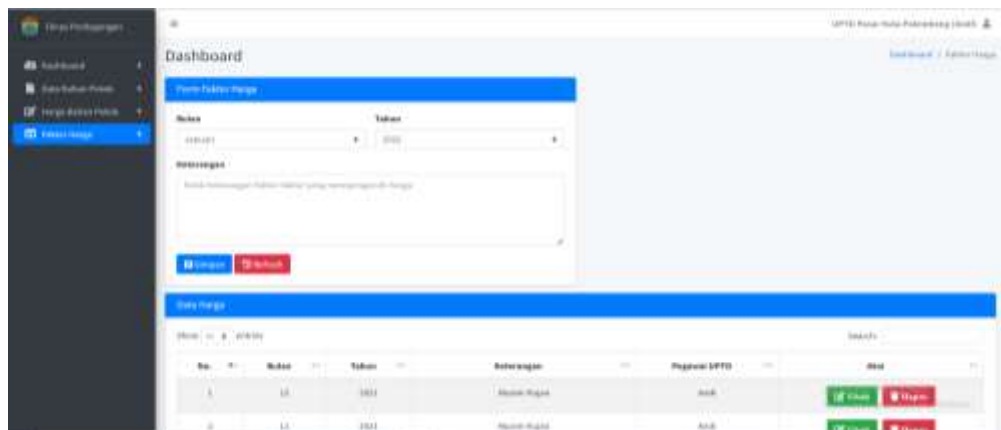**Figure 7.** *Login Page Display*
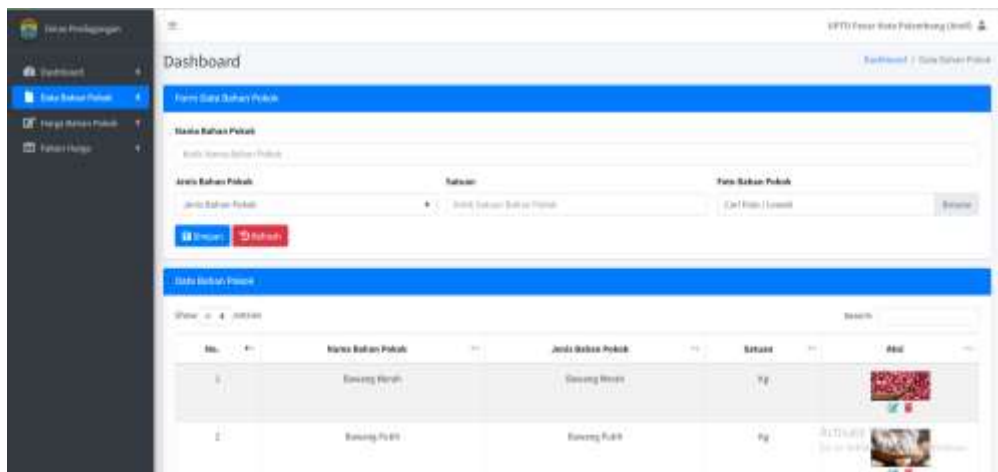
Figure 8. *Staple Material Data Page Display*
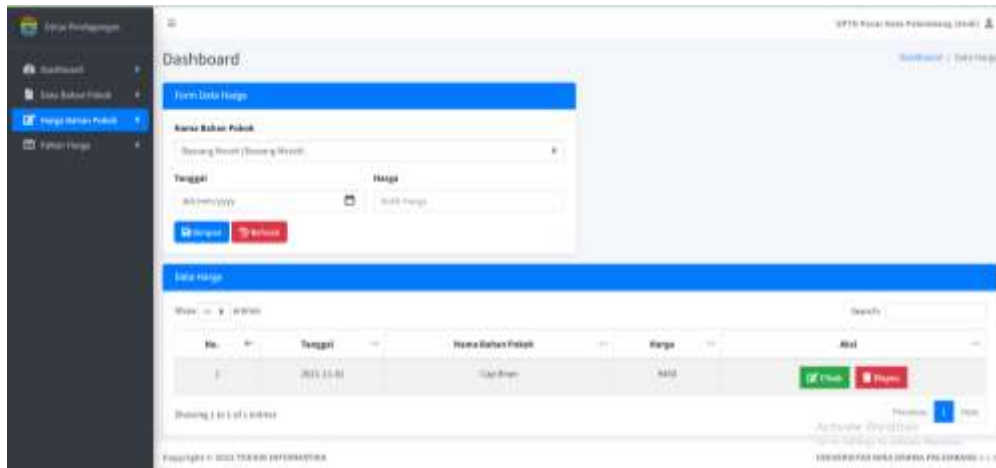
Figure 9. *Price Data Page Display*

Figure 10. *Factor Data Page Display*

Table 4. Admin Testing UPTD Pasar Kota Palembang

No	Class Test	Items Test	Results
2	Managing User Data	Displays data, deletes and edits	Forcasting
	Successfully *Prices* Materials	Forcasting Prices of	Successfully
	Viewing Reports on Prices of Basic Materials	Displays data, deletes and edits	Successfully

4.3 Head of Section for Stabilization of Staples and Important
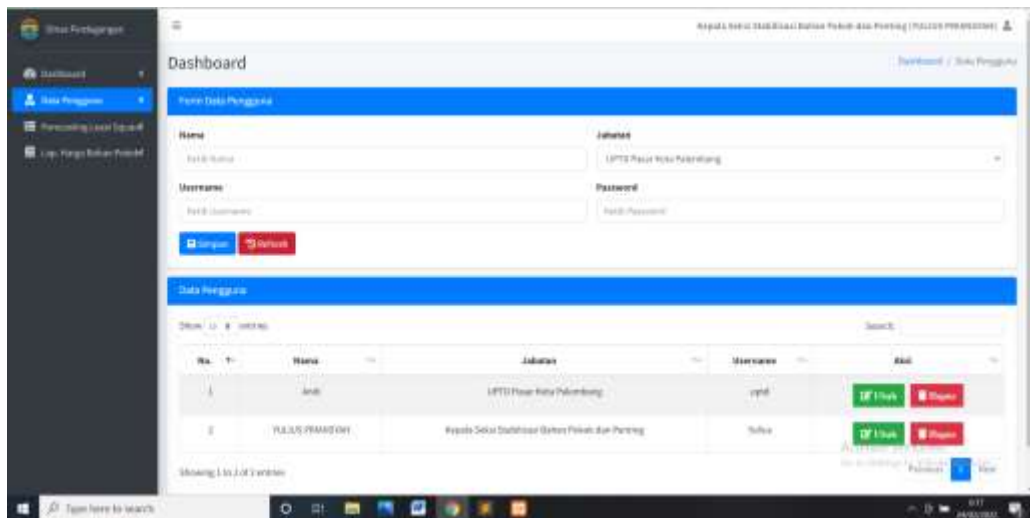
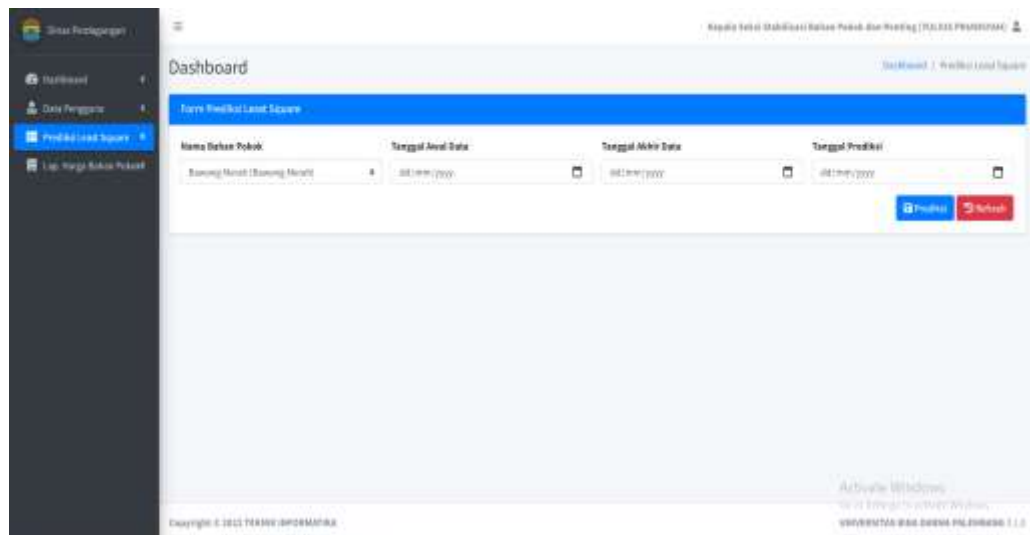***Figure 11.*** *User Data Page Display*

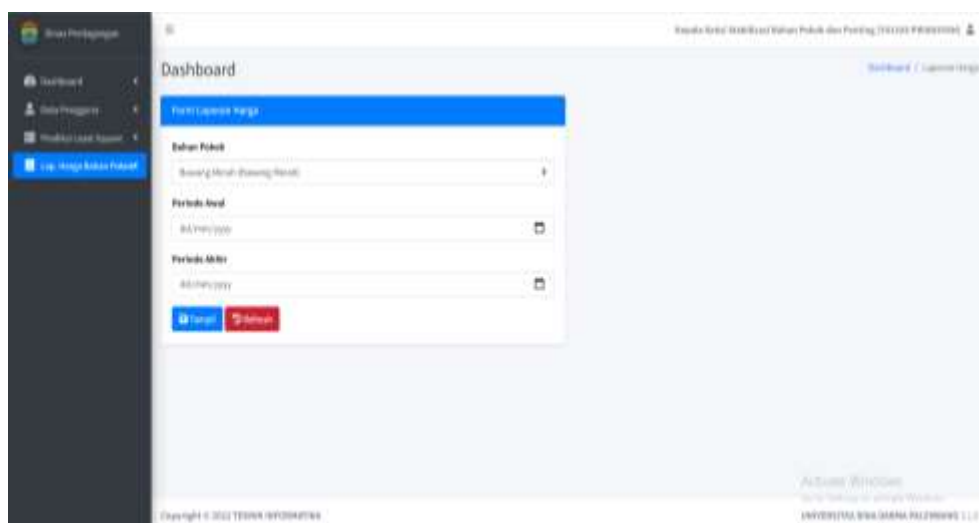***Figure 12.*** *H. Display Forecasting page Price*

Figure 13. *Report Page Display*

V. Conclusion

Based on the results of the discussion taken from research conducted at the Trade Office of the City of Palembang, several conclusions can be drawn, namely:

1. The basic commodity price forecasting system using the *Least Square* is made to facilitate the City Trade Office Palembang is in the process of predicting the price of basic commodities based on the date and type to be predicted.
2. The basic material price forecasting system using the *Least Square* was created using the PHP *(Hypertext Preprocessor)*, *CodeIgniter* as *the framework,* HTML as the display setting, and Boostrap as *the front end framework* and MySQL as the database. This application can input, edit data and can also get reports.
3. The implementation of this system consists of 3 (three) users, namely UPTD Pasar Kota Palembang as admin, Head of Statistical and Important Materials Stabilization Section, and the community. The admin menu page consists of processing pages for basic material data, basic material price data, and factor data. The menu page for the Head of Staples and Important Materials Stabilization Section consists of a user data processing page, *forecasting*, and a basic material price data report page at the 10 ulu market in Palembang City. Meanwhile, the public can view the updated information page on basic material prices.

Suggestions

Based on the discussion that has been described in the previous chapter, the suggestions that can be given by the author are as follows:

1. Conduct an evaluation of the implementation of the system so that it can be implemented, and an increase in supporting facilities for the system.
2. It is advisable for the Palembang City Trade Office to conduct training in the use of the system.
3. Carry out further development based on technological developments.

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