

Prediction of Foreign Currency Exchange (IDR and USD) Using Multiple Linear Regression

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Abstract:

In developing countries like Indonesia, the stability of currency values is very important to support sustainable economic development and improve people's welfare. The stability of currency values also affects investment activities in every country, including Indonesia. One of them is foreign exchange trading. Foreign exchange trading is one of the financial markets with high liquidity, therefore it is not uncommon for a trader to have a good predictive analysis ability on price changes in the foreign exchange. This is very important so that investors do not experience losses. The instability of the exchange rate can make investors undermine their desire to invest, this will lead to a decline in development in Indonesia because so far the role of foreign investors is very large in economic growth. In this study the types of predictions made are short-term predictions. The data used is one-year data obtained from the Bank Indonesia website. The prediction method used by the author is Multiple Linier Regression. After the implementation and trial results were obtained, the percentage error value using MSE was 165,38%, using MAPE of 24.04% and using a margin error of 25,7%. This exchange rate prediction application can produce predictions that are close to the value of foreign exchange rates issued by Bank Indonesia.

Keywords — Prediction, Exchange Rate, Foreign Exchange, Linier Regression, Multiple Linier Regression

I. INTRODUCTION

In the past several years the uprising has continued to fluctuate in the global economy. The deteriorating global economy is due to economic recovery in the US and economic performance in the European region which is still confronted with monetary policy problems and weakening market confidence. In developing countries like Indonesia, the stability of the value of a currency is very important to support sustainable economic development and enhance the welfare of the people. If the Rupiah is stable, it will strongly support sustainable economic development and enhance the welfare of the people.

International business requires dealing with other countries' currencies to make payment transactions. Changes in exchange rates at any time,

will affect the amount of transactions between companies in different countries. In addition, the stability of the value of the currency also affects investment activities in every country, including Indonesia. One of them is foreign exchange trading investment. Foreign exchange trading is one of the financial markets with high liquidity. Therefore it is not uncommon for a trader with good predictive analytical skills for changes in prices on these foreign currencies. It is very important so that investors do not experience losses.

Exchange rate is the ratio of the exchange rate of a country's country to a foreign country's currency or the ratio of exchange rates between countries. The exchange rate is also one of the most important macroeconomic variables, because the exchange rate can maintain economic stability in a region or country.

The exchange rate (foreign exchange) is always changing every time, therefore it is very important to know the risks involved in foreign exchange trading so that a policy can be developed to overcome the risks. Changes in foreign exchange rates in Indonesia for IDR and USD currencies can be seen on the Bank Indonesia website (www.bi.go.id).

The instability of the exchange rate can trigger investors to discourage investment. This will cause a setback in development in Indonesia because so far the role of foreign investors has been very large in economic growth. This will further make the exchange rate of US Dollar (USD) to Rupiah higher, because most international transactions in Indonesia use USD. Meanwhile the Rupiah exchange rate will determine the composite stock price index on the Jakarta Stock Exchange [1].

In this study the type of prediction made is a short-term prediction. The data used is data for five years. There are many methods that can be used to make predictions. As technology develops methods for making predictions will also increasingly develop. In this study the author will use the Multiple Linear Regression method (Multiple Linear Regression) which uses supporting variables such as exchange rate, inflation value, export value, import value and gross domestic product (GDP) value which are expected to produce good prediction results based on test results try using Mean Squared Error (MSE), Mean Absolute Percentage Error (MAPE) and error margin.

Based on the background above, the problem formulated is whether the calculation of predictions involving inflation value data, export value, import value and the value of gross domestic product (GDP) in the Multiple Linear Regression method will be able to produce a good exchange rate prediction and close to the exchange rate issued by Bank Indonesia.

The purpose of this study is to provide a prediction model of foreign exchange rates that can explain the movements of the Rupiah and USD exchange rates that are good and close to or equal to the movement of foreign exchange rates issued by Bank Indonesia. In addition, this study also aims to improve the level of accuracy in Mean Squared

Error (MSE), Mean Absolute Percentage Error (MAPE) and error margin. If the prediction results are close to the exchange rate issued by Bank Indonesia, it is expected to make it easier for traders to manage their business finances and foreign exchange investments.

II. RESEARCH METHODS

A. Method of Collecting Data

The method used by the author to obtain data related to the problem in this study is to take (download) several types of data from government websites that have valid data related to exchange rates and other supporting data such as data on exports, imports, inflation and gross domestic product (GDP). Sources of data obtained include:

- 1) Primary data, collected by the author through the website:
 - a. Bank Indonesia (www.bi.go.id) in the form of .xls documents containing developments in foreign exchange rates between IDR and USD in the time span between 1 July 2014 and 30 June 2019.
 - b. Bank Indonesia (www.bi.go.id) in the form of .xls documents containing developments in the inflation rate between July 2014 and June 2019.
 - c. The Ministry of Trade (www.kemendag.go.id) in the form of .xls documents containing the development of export and import values in the time span between July 2014 and June 2019.
 - d. The Ministry of Trade (www.kemendag.go.id) is a .xls document containing developments in the value of gross domestic product (GDP) in the period between 2014 and 2019.
- 2) Secondary data, obtained through the study of literature, literature, journals, lecture material and other materials that are still related to research to obtain theoretical data.

B. Data Analysis Techniques

In this study, researchers used a case study analysis technique, the steps of which are as follows:

- 1) Organizing data and information.

- 2) Make a detailed description of the case and its context.
- 3) Researchers look for relationships between several methods which will then be used.
- 4) The researcher interprets and develops the natural generalization of the case both for the researcher and its application in other cases.
- 5) Present it narratively.

The author chooses several variables used in this study. Variable data used are data on exchange rates, inflation, exports, imports, and gross domestic product. The data is taken from the time span between July 2014 to June 2019.

C. Research Steps

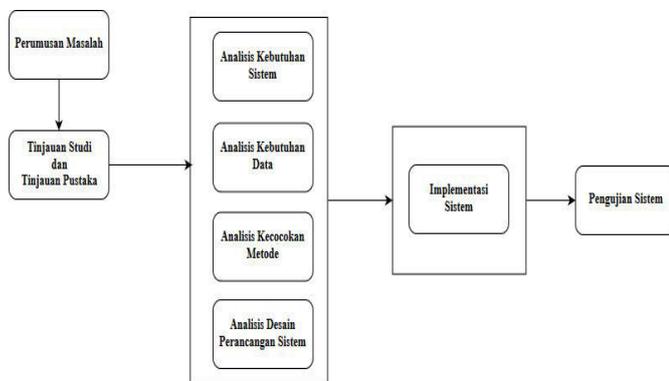


Fig. 1 Research Steps

The initial step of this research is to formulate a problem related to foreign exchange rates between IDR and USD which previously began by reading the various literature studies with similar cases to look for problems from previous research. After reading a number of literary journals, the author began searching for the state of the art of the topic. The result of this step is the formulation of the problem.

This study review was conducted to obtain theories related to prediction of foreign exchange rates in accordance with the formulation of the problem. The method used by the author is to read various references related to foreign exchange rate predictions.

While the literature review is a step taken to collect journals or research related to the research conducted at this time. In this case, the author is

looking for a literature review based on the same case study but with different methods of solving problems. So from the results of this literature review can be obtained a comparison between the results of one study and the other.

System requirements analysis is carried out to find out what data is needed for research, what methods can be used to develop a foreign exchange rate prediction system. So that by knowing the system requirements, the implementation process is expected to be easier. In this case, the system selection will be based on Android. The method chosen for implementation is the method of Multiple Linear Regression. Multiple Linear Regression was chosen because the author uses 4 independent variables and 1 dependent variable which will then be included in the calculation process in the system. The data used to meet the 4 independent variables are inflation, export, import and gross domestic product data. While the dependent variable data used is the exchange rate data.

After the system needs analysis section has been known what data is needed, then the next data needs analysis is the author collects the data needed. These data include the following:

- a. Data from the BI website (www.bi.go.id) is in the form of exchange rates between IDR and USD currencies.
- b. The data used are actual daily data on the exchange rate data obtained, which is calculated from 1 July 2014 to 30 June 2019.
- c. The monthly inflation data for a period of 5 years is taken from the BI website (www.bi.go.id).
- d. Data on exports, imports and gross domestic product (GDP) every month in a period of 5 years is taken from the website of the Indonesian Ministry of Trade (www.kemendag.go.id).

The data collected turns out to have different amounts even though they are taken from the same time span. The exchange rate data taken has daily movement data, but the data provided by BI is the daily exchange rate data when the rate changes only. If the exchange rate does not change today and tomorrow, BI will only record the exchange rate

data that exists today. While tomorrow's data will not be recorded. The exchange rate data obtained in the period of 5 years from July 2014 to June 2019 was 1028 data.

Inflation, export and import data obtained in the form of data every month. So if the data taken within 5 years, the data obtained is 60 data.

The gross domestic product data obtained has a time span every three months (quarterly). So if the data is taken for 5 years, 20 data will be obtained. The condition of the data with different amounts within a period of 5 years made the writer do the data processing first before calculating the data with the Multiple Linear Regression process. Data processing is done by uniting the entire data into one same excel file. Then, the writer makes an average exchange rate every month. So the value of y used is the average exchange rate every month. Existing variable x also began to be categorized, such as inflation value to x_1 , export value to x_2 , import value to x_3 , gross domestic product value to x_4 . If each variable has been described and the data has been processed to be like that, then the next step is to calculate these variables into the calculation formula of Multiple Linear Regression.

The next step after the data has been analyzed is to match the data components with the parameters that exist in the method used. If there are formulas in the method, then the contents of each component of the formula must be adjusted to the data owned to produce a good prediction later.

The author chose the method of Multiple Linear Regression because this method is suitable for making predictions with calculations between independent variables (x) that are more than one with the dependent variable (y). Whereas if using Simple Linear Regression, this method is less suitable because Simple Linear Regression is usually only used for predictions with the condition of independent and bound variables that only have one variable together.

Then the next step is to analyze the system design, such as making a flowchart for the flow that runs on the system. The design of this system design is also a reference for the author to make the functionality of the system. So that the system that will be produced is in accordance with the design

that was created from the beginning. In addition, if the design is made before implementation, it can make the system creation time become more structured and scheduled because whatever has to be in the system has been designed beforehand.

After the entire analysis process has been completed, the next step is the implementation process of the system. Where this implementation will later be continued to the testing phase to test the success of the system created.

The system implementation chosen by the author is an implementation in the form of an Android-based application. When the implementation process has been completed, the final step in the research is to test the system. Testing is done to determine the evaluation results which will be calculated using Mean Squared Error (MSE), Mean Absolute Percentage Error (MAPE) and error margin.

The expected outcome of this process is a prediction system of foreign exchange rates (IDR and USD) that has been tested and can be used by traders and the general public.

D. Design and Testing

1) System Flowchart

The following is an overview of the system flow in the currency prediction application.

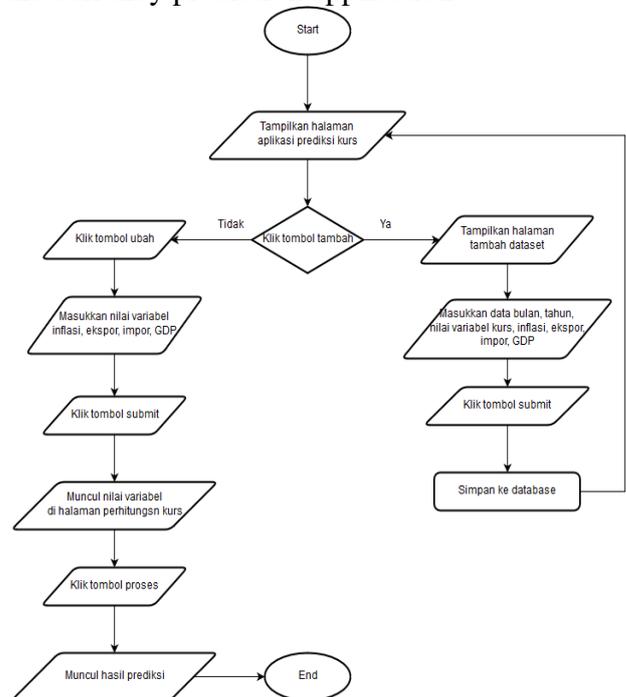


Fig. 2 System Flowchart

When entering the application, the user can input the dataset into the application by pressing the plus button in the upper right corner of the application. After that, the added dataset page will appear. Users can enter data month, year and predictive support variables such as exchange rates, inflation, exports, imports, gross domestic product/GDP.

After completing the data entry, the user can press the submit button and the system will process the data to be stored in the database. Stored data will be displayed on the currency prediction application page.

If the user wants to try to do a prediction test, the user can press the change button to enter the variable parameters. After that, the user can press the submit button so that the previously filled variable appears on the currency prediction page.

If the user has entered the parameter values of each variable, the user can press the process button to start the prediction calculation process. After the prediction calculation process is complete, the application will display the predicted results.

2) Pseudocode Algorithm

The steps in completing the exchange rate prediction are designed as follows.

1. Perform initial initialization to find the value of A.
2. Make a matrix A with the order 5x5 with the contents of the matrix obtained from the total number of datasets and the results of the total multiplication between the values of variable X.
3. Perform initial initialization to find the value of H.
4. Make a 1x1 order matrix with the contents of the matrix obtained from the total addition of Y variables and the results of the total multiplication between the four variables X with Y variables.
5. Calculates the determinant value of matrix A.
6. Calculate cofactor values from matrix A.

7. After getting the results of the cofactor from matrix A, next do an adjoin on the results of the cofactor calculation so that an Adj A matrix is obtained which will be entered in formula A-1.
8. Calculate A-1 by entering the determinant and adjoin values of matrix A that have been done in steps 5 and 7
9. $Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n$ the coefficient b by multiplying the H value obtained from step 4 and the A-1 value obtained from step 8.
10. Fill in the value of a with the value of b0.
11. If the coefficient value b has been obtained, then the next step is to enter the values of a, b and X into the multiple linear regression formula.

3) Model Testing

To obtain the test results, the process of first entering and saving the exchange rate dataset is entered into the application. Then enter the values of the variable X to be tested in order to obtain the predicted value of the exchange rate. After the results of the prediction are obtained, the results are then entered into the test results table and the MAPE, MSE and error margin values are calculated.

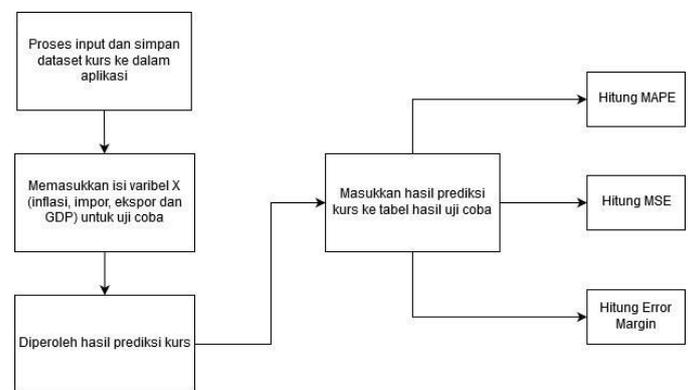


Fig. 3 Model Testing Process

III. RESULT AND DISCUSSION

A. Sample Calculation Data

In addition to using Excel, the calculation sample can also be used manually. However, for the example of this manual calculation, the author only explains how to calculate it according to the

formula with the dummy matrix data. This is because if you use original data in accordance with Excel data that has been processed and then converted into a matrix, the number display will be less tidy and worry about confusion. The formula for Multiple Linear Regression is as shown below:

To make it easier to calculate the regression coefficients (b) for b0, b1, b2, to bn, a calculation using the existing matrix in below:

$$A = \begin{bmatrix} n & \sum X1 & \sum X2 \\ \sum X1 & \sum X1^2 & \sum X1X2 \\ \sum X2 & \sum X2^2 & \sum X2^2 \end{bmatrix} \quad b = \begin{bmatrix} b0 \\ b1 \\ b2 \end{bmatrix} \quad H = \begin{bmatrix} \sum Y \\ \sum x1.Y \\ \sum x2.Y \end{bmatrix}$$

The value of variable b, can be found using the formula: The value of variable b, can be found using the formula:

$$b = A^{-1}H$$

The value of A-1 can be searched using the inverse matrix formula as follows:

$$A^{-1} = \frac{1}{\det(A)} \times \text{Adj}(A)$$

Information::

A^{-1} = inverse matrix A

det A = determinant of matrix A

Adj A = adjoin matrix A

The value of Adj (A), obtained from the results of calculating kof (A) / cofactor matrix A which then the shape of the matrix is changed position. Where previously the numbers in the matrix are in 1 row, moved to 1 column (rows become columns). For example, there is a matrix with the order 5x5 as shown below.

$$A = \begin{bmatrix} n & \sum X1 & \sum X2 & \sum X3 & \sum X4 \\ \sum X1 & \sum X1^2 & \sum X1X2 & \sum X1X3 & \sum X1X4 \\ \sum X2 & \sum X2^2 & \sum X2^2 & \sum X2X3 & \sum X2X4 \\ \sum X3 & \sum X3X4 & \sum X2X4 & \sum X3^2 & \sum X3X4 \\ \sum X4 & \sum X1X4 & \sum X2X4 & \sum X3X4 & \sum X4^2 \end{bmatrix} \quad b = \begin{bmatrix} b0 \\ b1 \\ b2 \\ b3 \\ b4 \end{bmatrix} \quad H = \begin{bmatrix} \sum Y \\ \sum x1.Y \\ \sum x2.Y \\ \sum x3.Y \\ \sum x4.Y \end{bmatrix}$$

$$A = \begin{bmatrix} 3 & 1 & 0 & 6 & 2 \\ 2 & 1 & 1 & 3 & 2 \\ 6 & 2 & 5 & 1 & 3 \\ 3 & 1 & 6 & 2 & 6 \\ 5 & 2 & 3 & 2 & 1 \end{bmatrix} \quad b = \begin{bmatrix} b0 \\ b1 \\ b2 \\ b3 \\ b4 \end{bmatrix} \quad H = \begin{bmatrix} 10 \\ 6 \\ 4 \\ 2 \\ 5 \end{bmatrix}$$

The first step is to calculate the determinant of matrix A. How to calculate it is as follows.

$$\det A = \begin{bmatrix} 3 & 1 & 0 & 6 & 2 \\ 2 & 1 & 1 & 3 & 2 \\ 6 & 2 & 5 & 1 & 3 \\ 3 & 1 & 6 & 2 & 6 \\ 5 & 2 & 3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 3 & 1 & 0 & 6 \\ 2 & 1 & 1 & 3 \\ 6 & 2 & 5 & 1 \\ 3 & 1 & 6 & 2 \\ 5 & 2 & 3 & 2 \end{bmatrix}$$

+ + + + +

$$\det A = \begin{bmatrix} 3 & 1 & 0 & 6 & 2 \\ 2 & 1 & 1 & 3 & 2 \\ 6 & 2 & 5 & 1 & 3 \\ 3 & 1 & 6 & 2 & 6 \\ 5 & 2 & 3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 3 & 1 & 0 & 6 \\ 2 & 1 & 1 & 3 \\ 6 & 2 & 5 & 1 \\ 3 & 1 & 6 & 2 \\ 5 & 2 & 3 & 2 \end{bmatrix}$$

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$$\det A = (3.1.5.2.1) + (1.1.1.6.5) + (0.3.3.3.2) + (6.2.6.1.3) + (2.2.2.6.2) - (5.1.5.3.2) - (2.6.1.2.3) - (3.2.3.2.1) - (2.6.6.1.0) - (1.3.2.1.6)$$

$$\det A = 30 + 30 + 0 + 216 + 96 - 150 - 72 - 36 - 0 - 36$$

$$\det A = 78$$

After getting the determinant value from matrix A, the next step is to calculate the cofactor from matrix A. So that after knowing the cofactor, you can also find out the adjoin of matrix A.

Cofactor matrix is a matrix whose elements are replaced by determinant values whose elements are not in line and not as column with the origin elements. Then proceed with giving positive and negative sign alternately.

In this sample we try to take aij from several points. Where aij are elements of the i-th row and the j-column which will be eliminated later. For example we take a11, a12, a13.

$$A = \begin{bmatrix} 3 & 1 & 0 & 6 & 2 \\ 2 & 1 & 1 & 3 & 2 \\ 6 & 2 & 5 & 1 & 3 \\ 3 & 1 & 6 & 2 & 6 \\ 5 & 2 & 3 & 2 & 1 \end{bmatrix}$$

$$A = \begin{bmatrix} + & 3 & - & 1 & + & 0 & - & 6 & + & 2 \\ - & 2 & + & 1 & - & 1 & + & 3 & - & 2 \\ + & 6 & - & 2 & + & 5 & - & 1 & + & 3 \\ - & 3 & + & 1 & - & 6 & + & 2 & - & 6 \\ + & 5 & - & 2 & + & 3 & - & 2 & + & 1 \end{bmatrix}$$

$$\text{Kof } a_{11} = \begin{bmatrix} 3 & 1 & 0 & 6 & 2 \\ 2 & 1 & 1 & 3 & 2 \\ 6 & 2 & 5 & 1 & 3 \\ 3 & 1 & 6 & 2 & 6 \\ 5 & 2 & 3 & 2 & 1 \end{bmatrix}$$

$$= + \begin{bmatrix} 1 & 1 & 3 & 2 \\ 2 & 5 & 1 & 3 \\ 1 & 6 & 2 & 6 \\ 2 & 3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 1 & 1 & 3 \\ 2 & 5 & 1 \\ 1 & 6 & 2 \\ 2 & 3 & 2 \end{bmatrix}$$

$$= + ((1.5.2.1) + (1.1.6.2) + (3.3.1.3) + (2.2.6.2) - (2.6.1.2) - (3.2.3.1) - (2.6.2.1) - (1.1.5.3)) \\ = + (10 + 12 + 27 + 48 - 24 - 18 - 24 - 15) \\ = + (16) \\ = 16$$

$$\text{Kof } a_{12} = \begin{bmatrix} 3 & 1 & 0 & 6 & 2 \\ 2 & 1 & 1 & 3 & 2 \\ 6 & 2 & 5 & 1 & 3 \\ 3 & 1 & 6 & 2 & 6 \\ 5 & 2 & 3 & 2 & 1 \end{bmatrix}$$

$$= - \begin{bmatrix} 2 & 1 & 3 & 2 \\ 6 & 5 & 1 & 3 \\ 3 & 6 & 2 & 6 \\ 5 & 3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 1 & 3 \\ 6 & 5 & 1 \\ 3 & 6 & 2 \\ 5 & 3 & 2 \end{bmatrix}$$

$$= - ((2.5.2.1) + (1.1.6.2) + (3.3.3.3) + (2.6.6.2) - (5.6.1.2) - (3.2.3.2) - (2.6.6.1) - (1.3.5.3)) \\ = - (20 + 12 + 81 + 144 - 60 - 36 - 72 - 45) \\ = - (44) \\ = -44$$

$$\text{Kof } a_{12} = \begin{bmatrix} 3 & 1 & 0 & 6 & 2 \\ 2 & 1 & 1 & 3 & 2 \\ 6 & 2 & 5 & 1 & 3 \\ 3 & 1 & 6 & 2 & 6 \\ 5 & 2 & 3 & 2 & 1 \end{bmatrix}$$

$$= + \begin{bmatrix} 2 & 1 & 3 & 2 \\ 6 & 2 & 1 & 3 \\ 3 & 1 & 2 & 6 \\ 5 & 2 & 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 1 & 3 \\ 6 & 2 & 1 \\ 3 & 1 & 2 \\ 5 & 2 & 2 \end{bmatrix}$$

$$= + ((2.2.2.1) + (1.1.6.5) + (3.3.3.2) + (2.6.1.2) - (5.1.1.2) - (2.2.3.2) - (2.6.6.1) - (1.3.2.3)) \\ = + (8 + 30 + 54 + 24 - 10 - 24 - 72 - 18) \\ = + (-8) \\ = -8$$

Do the same for all elements. Then the results of the cofactor calculation are entered into matrix A. Examples of the results are like this.

$$A = \begin{bmatrix} 3 & 1 & 0 & 6 & 2 \\ 2 & 1 & 1 & 3 & 2 \\ 6 & 2 & 5 & 1 & 3 \\ 3 & 1 & 6 & 2 & 6 \\ 5 & 2 & 3 & 2 & 1 \end{bmatrix}$$

$$\text{kof } A = \begin{bmatrix} 16 & -44 & -8 & 6 & 8 \\ 8 & 24 & 6 & 9 & 20 \\ -6 & 48 & 24 & -24 & 30 \\ -15 & 9 & 16 & -8 & 6 \\ 9 & -8 & -30 & 15 & 12 \end{bmatrix}$$

The adj A matrix is the kof A matrix whose position is changed to aij

Matriks adj A adalah matrik kof where aij becomes aji (row element becomes a column). The result will be as below.

$$\text{Adj } A = \begin{bmatrix} 16 & 8 & -6 & -15 & 9 \\ -44 & 24 & 48 & 9 & -8 \\ -8 & 6 & 24 & 16 & -30 \\ 6 & 9 & -24 & -8 & 15 \\ 8 & 20 & 30 & 6 & 12 \end{bmatrix}$$

Enter the matrix cofactor yield formula into formula A^{-1} .

$$A^{-1} = 1/78 \times \begin{bmatrix} 16 & 8 & -6 & -15 & 9 \\ -44 & 24 & 48 & 9 & -8 \\ -8 & 6 & 24 & 16 & -30 \\ 6 & 9 & -24 & -8 & 15 \\ 8 & 20 & 30 & 6 & 12 \end{bmatrix}$$

$$= \begin{bmatrix} 1248 & 624 & -468 & -1170 & 702 \\ -3432 & 1872 & 3744 & 702 & -624 \\ -624 & 468 & 1872 & 1248 & -2340 \\ 468 & 702 & -1872 & -624 & 1170 \\ 156 & 1560 & 2340 & 468 & 936 \end{bmatrix}$$

After the results of A-1 are obtained, the next step is to find the value of the coefficient b.

$$b = A^{-1}H$$

$$b = \begin{bmatrix} 1248 & 624 & -468 & -1170 & 702 \\ -3432 & 1872 & 3744 & 702 & -624 \\ -624 & 468 & 1872 & 1248 & -2340 \\ 468 & 702 & -1872 & -624 & 1170 \\ 156 & 1560 & 2340 & 468 & 936 \end{bmatrix} \begin{bmatrix} 20 \\ 15 \\ 25 \\ 10 \\ 30 \end{bmatrix}$$

$$b = \begin{bmatrix} ((1248.20) + (624.15) + (-468.25) + (-1170.10) + (702.30)) \\ ((-3432.20) + (1872.15) + (3744.25) + (702.10) + (-624.30)) \\ ((-624.20) + (468.15) + (1872.25) + (1248.10) + (-2340.30)) \\ ((468.20) + (702.15) + (-1872.25) + (-624.10) + (1170.30)) \\ ((156.20) + (1560.15) + (2730.25) + (468.10) + (936.30)) \end{bmatrix}$$

$$b = \begin{bmatrix} 31980 \\ 41340 \\ -16380 \\ 1950 \\ 127530 \end{bmatrix}$$

So, the formula for calculating the value of Y is:

$$Y = 31980 + 41340 (X_1) + (-16380(X_2)) + 1950(X_3) + 127530 (X_4)$$

B. Implementation Result

1) Display Screen Prediction Exchange Rate

This is the initial page display when the currency prediction application is opened. There will be a dataset that has been previously saved. If there has never been a dataset stored before, the initial page display will be blank.



Fig. 4. Display Screen Prediction Exchange Rate

2) Display Screen Add Dataset

While on the start page of the application, in the upper right corner there is an add (+) button which serves to direct the user to the added

dataset page. Here, users can input variable datasets such as inflation, export, import and GDP values according to the data they have.

If the dataset variable has been entered, the user can save the variable's data into the database by simply pressing the submit button. After successfully submitting, the saved dataset will automatically appear on the home page of the currency prediction application.



$$Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n$$

Fig. 5 Display Screen Add Dataset

3) Display Screen Prediction Test

On the main page of the currency prediction application, at the bottom left of the screen there is a change button. The button is used to display the prediction test page. This page contains fields for variable x which are used for calculating predictions such as inflation, imports, exports and GDP.

After the variable is filled in, the user can then press the submit button and the variable data that is loaded will appear in the lower front of the exchange rate prediction page



Fig. 6 Display Screen Prediction Test

4) Display Screen Prediction Result

If the user has entered the variable value data on the prediction test page, then to find out the result of the prediction the user can press the process button that is on the main page of the exchange rate prediction. The result display of the exchange rate prediction is like this.

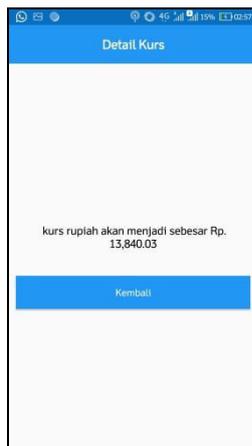


Fig. 7 Display Screen Prediction Result

C. Test Result

After several trials, the following are the results of testing with several methods including MSE, MAPE and error margins.

Based on the results of the research discussed in the previous chapter, then in the study of foreign exchange prediction between IDR and USD the following conclusions can be drawn:

Uji ke-	Bulan	X aktual	X prediksi	X aktual - X prediksi	Deviasi absolut / X aktual
1	Jul 2019	14.160	14.240	-80	-0,56
2	Jun 2019	14.226	13.925	301	2,12
3	Mei 2019	14.392	14.327	65	0,45
4	Apr 2019	14.142	12.231	1.911	13,51
5	Mar 2019	14.211	14.767	-556	-3,91
6	Feb 2019	14.035	11.394	2.641	18,82
7	Jan 2019	14.163	12.985	1.178	8,32
8	Des 2018	14.497	14.651	-154	-1,06
9	Nov 2018	14.697	13.976	721	4,91
10	Okt 2018	15.179	15.911	-732	-4,82
11	Sep 2018	14.869	15.715	-846	-5,69
12	Ags 2018	14.560	14.543	17	0,12
13	Jul 2018	14.415	14.487	-72	-0,50
14	Jun 2018	14.049	15.233	-1.184	-8,43
15	Mei 2018	14.060	15.014	-954	-6,79
16	Apr 2018	13.803	13.712	91	0,66
17	Mar 2018	13.758	10.074	3.684	26,78
18	Feb 2018	13.590	13.528	62	0,46
19	Jan 2018	13.380	13.282	98	0,73
20	Des 2017	13.557	13.569	-12	-0,09
21	Nov 2017	13.527	14.232	-705	-5,21
22	Okt 2017	13.526	14.075	-549	-4,06
23	Sep 2017	13.303	13.960	-657	-4,94
24	Ags 2017	13.342	15.268	-1.926	-14,44
25	Jul 2017	13.342	16.327	-2.985	-22,37
Jumlah 25		350.783	351.426	-643	-6,01

TABLE 1 Test result

$$MSE = \frac{\sum(\text{kesalahan peramalan})^2}{n}$$

$$MSE = \frac{-643^2}{25}$$

$$MSE = \frac{413.449}{25}$$

$$MSE = 16.537,96$$

$$MSE = 16.537,96 \times 100\%$$

$$MSE = 165,38\%$$

$$MSE = \frac{\sum(\text{kesalahan peramalan})^2}{n}$$

$$MSE = \frac{-643^2}{25}$$

$$MSE = \frac{413.449}{25}$$

$$MSE = 16.537,96$$

$$MSE = 16.537,96 \times 100\%$$

$$MSE = 165,38\%$$

$$MAPE = \frac{|\sum(\text{deviasi absolut}/\text{nilai aktual})|}{n} \times 100\%$$

$$MAPE = \frac{|\sum -6.01|}{25} \times 100\%$$

$$MAPE = \frac{(6,01)}{25} \times 100\%$$

$$MAPE = 0.2404 \times 100\%$$

$$MAPE = 24,04\%$$

$$\text{Error Margin} = e_i = (Y_{\text{actual}} - Y_i) / 100$$

$$e1 = 14.160 - 14.240 / 100 = -0.8$$

$$e2 = 14.226 - 13.925 / 100 = 3.01$$

$$e3 = 14.392 - 14.327 / 100 = 0.65$$

$$e4 = 14.142 - 12.231 / 100 = 19.11$$

$$e5 = 14.211 - 14.767 / 100 = -5.56$$

$$e6 = 14.035 - 11.394 / 100 = 26.41$$

$$e7 = 14.163 - 12.985 / 100 = 11.78$$

$$e8 = 14.497 - 14.651 / 100 = -1.54$$

$$e9 = 14.697 - 13.976 / 100 = 7.21$$

$$e10 = 15.179 - 15.911 / 100 = -7.32$$

$$e11 = 14.869 - 15.715 / 100 = -8.46$$

$$e12 = 14.560 - 14.543 / 100 = 0.17$$

$$e13 = 14.415 - 14.487 / 100 = -0.72$$

$$e14 = 14.049 - 15.233 / 100 = -11.84$$

$$e15 = 14.060 - 15.014 / 100 = -9.54$$

$$e16 = 13.803 - 13.712 / 100 = 0.91$$

$$e17 = 13.758 - 10.074 / 100 = 36.84$$

$$e18 = 13.590 - 13.528 / 100 = 0.62$$

$$e19 = 13.380 - 13.282 / 100 = 0.98$$

$$e20 = 13.557 - 13.569 / 100 = -0.12$$

$$e21 = 13.527 - 14.232 / 100 = -7.05$$

$$e22 = 13.526 - 14.075 / 100 = -5.49$$

$$e23 = 13.303 - 13.960 / 100 = -6.57$$

$$e24 = 13.342 - 15.268 / 100 = -19.26$$

$$e25 = 13.342 - 16.327 / 100 = -29.85$$

$$\text{Average error margin} = (|-6.43| / 25) \times 100\%$$

$$= (6.43 / 25) \times 100\%$$

$$= 0,257 \times 100\%$$

$$= 25,7\%$$

IV. CONCLUSION

Based on the research results of exchange rate predictions between IDR and USD using Multiple Linear Regression which involves 4 independent variables namely inflation, exports, imports, and gross domestic product, it can be concluded that this foreign exchange rate prediction system can produce prediction of exchange rates which approaches the exchange rate of Bank Indonesia. After conducting several experiments and calculated using the Mean Squared Error (MSE), Mean Absolute Percentage Error (MAPE) and error margin testing methods, the percentage of error results obtained using MSE of 165.38%, using MAPE of 24.04 % and using an error margin of 25.7%. The trial value with MAPE which shows 24.04%, it can be said that the application of this exchange rate prediction can produce fairly good prediction results or is still within reasonable limits.

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