Application of Unsupervised K Nearest Neighbor (UNN) and Learning Vector Quantization (LVQ) Methods in Predicting Rupiah to Dollar

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Abstract **- One of the factors in a country's economy is the exchange value of the currency towards another currency. The exchange value of Rupiah towards Dollar (USA) can quickly change depending on the environmental conditions and has a huge impact for the Indonesian Government. In this research, Learning Vector Quantization (LVQ) and Unsupervised K Nearest Network (UNN) was implemented in predicting the currency value towards dollar. The UNN method was used to predict the selling value of the currency, the LVQ method was used to predict the buying value of the currency. The input data that is used is the selling, buying and interest data times series of the currency from the central back of the United States.From the research result and discussions that was made, UNN can achieve the lowest MAPE, which is 1,544% with the amount of data as much as 25 and the LVQ algorithm can accurately achieve a forecast with the amount of data as much as 25 with the learning rate of 0,075.The amount of trained data and the many patterns that exist in one LVQ class method can affect the result of the study and the result of the system.**

Keywords : Dollar, Foreign Exchange Rates, Learning Vector Quantization, LVQ, Rupiah, Unsupervised K Nearest Network, UNN

I. INTRODUCTIONS

Every country has its own currency as a means of exchange. The exchange value of money is a a central role in international trade relations, because it allows the exchange rate to compare prices of goods and services produced by a country. Dollar (USA) is one of the foreign currency used as the standard international payment [8].

The rupiah exchange rate against the dollar can change quickly dependon environmental conditions, such as political issues, disease, inflation rates, interest rates, trade balance, public debt, the ratio of import-export, natural disasters, and so on.One of the impact that Indonesia perceives is in the event of depreciation or reduction in value of the rupiah against the dollar that directly affects the amount of foreign debt to be paid, either by the Indonesian government and the private sector, therefore the the exchange rate forecast will be necessary to determine the future economic policy.

Research in the field of foreign exchange market is very interesting because of the very large opportunity to benefit financially if the forecasts of currency movements are accurate. Therefore, many studies have been done in this field. Such as research using Fuzzy Takagi Sugeno to forecast the rupiah against the dollar by Setiyani in 2011 [9]. A research by Dini Oktaviani in 2010 used a neural network in predicting foreign exchange rates [3]. A research based on forecast using quickpropogation methods was also conducted by Prabowo in 2010 [6] .

Previous studies have also been done at the Department of Information Engineering UIN Suska Riau regarding forecasting stock prices using Fuzzy Time Series. In addition to the above methods, methods of unsupervised k-nearest neighbor has also been used to forecast the price, which predicts the price of pepper commodities.

Of all types of research, there are 2 methods that is used, namely the Learning Vector Quantization (LVQ) method with the Unsupervised K Nearest Neighbor (UNN) method. LVQ is a supervised learning algorithm while UNN is one of the unsupervised learning algorithm. Supervised learning aims to get a new pattern while unsupervised learning goal was to get into a pattern of data [7]. The writer examines the results of both methods and see the advantages and disadvantages of each method.

The UNN method was used to predict the selling value of the currency, the LVQ method was used to predict the buying value of the currency. There are 3 classes in LVQ, namely the exchange rate increase, decrease or fixed. The class is determined by comparing with the previous day's exchange rates. The type of input is the times series selling rate data, buying rate and the interest rate of the US central bank for 4 months, 3 months, 2 months and 1 month prior to the date of the predictions of June, July, August and September. Time series data is taken from the official website of Bank Indonesia at www.bi.go.id. Training data: test data used in this study was 80:20. The output of this system is the predicted value of the exchange rate for tomorrow.

II. RESEARCH METHOD

The research methodology describes how the steps or stages will be carried out in research to be able to answer the problem formulation of the research. Stages of research that is to be conducted in this study can be seen in figure 1.

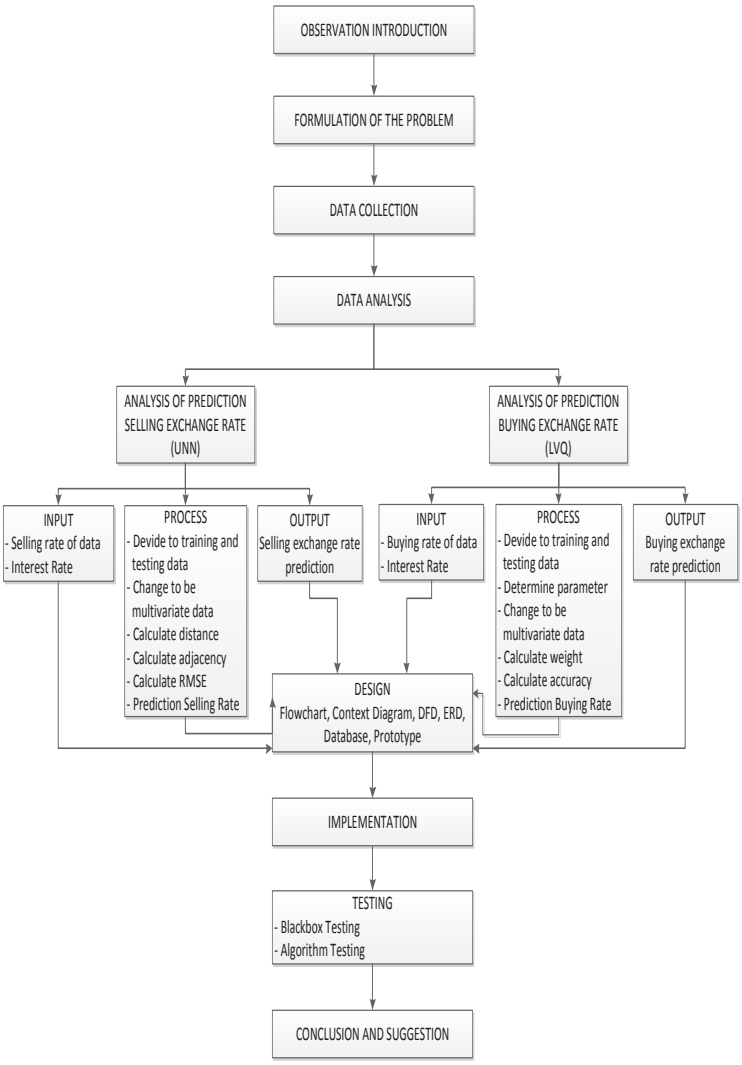


Fig 1. Research Stages

III. ANALYSIS

3.1 The Analysis Process of Exchange Rate Predictions

In general, the stages in predicting the selling rate by using the Unsupervised K Nearest Neighbor (UNN) method are:

1. Divide the data into two parts, namely the training data and test data, data to be shared is 80 : 20

2. Change the data from the data unilabiate to multivariate, which converts the data into multiple periods [5] as in Table 1 below.

TABLE 1
Data Pattern from univariate to multivariate

Pattern	Input lag	Output/ target
1	x1, x2, x3, ..., xp	xp+1
2	x2, x3, ..., xp+1	xp+2
3	x3, x4, ..., xp+2	xp+3
...	...	...
m-p	xm-p, xm-p+1, xm-p+2, ..., xm-1	xm

3. Calculate the distance between the training data to test data using the following formula :

$$D=\sqrt{(x_1-y_1)^2+(x_2-y_2)^2} \quad (1)$$

Description:

x = training data

y = test data

D = Distance

4. Calculate the closets neighbor from 1nn to Xnn

$$fknn(x')=\frac{1}{k}\sum_{i\in N_{k(x')}} y_i \quad (2)$$

x' = Estimates
K = Number of nearest neighbors
$N_k(x')$ = Nearest neighbor
yi = Output of nearest neighbor

5. Calculate the RMSE and find the smallest error value with the formula:

$$RMSE=\sqrt{\frac{\sum(y_t-\hat{y}_t)^2}{n}} \quad (3)$$

y_t=actual index value
$\hat{y}_t$=forecast index value
n =number of samples

View the period and distance of their closeness. This is the pattern to look for forecast.

6. Prediction selling rate pattern is formed.

3.2 The analysis of the currency buying proses

LVQ is used for the predictive value of the buying process stage. The following are the stages in predicting the selling rate by using Learning Vector Quantization (LVQ):

1. Determine the training data (training) and test data (testing) is 80:20.

2. Determine the algorithm parameters required in the learning process LVQ1 namely learning rate = 0.05, the maximum epoch = 10, and the reduction of learning rate = 0.1 x α.

3. Change the data from the data univariate be multivariate, which converts the data into several periods as shown in Table 1.

4. Determine the 3 different classes of data as an initial weight initialization, while other data as training data in the learning process
5. Looking weight value end of each period until the Epoh > Maximum Epoh in a way [8]:
   a. Calculate the euclidean distance between the vectors W and vectors X: $\sqrt{(X-W)^2}$
   b. Determine K such that min ||Xi-Wj|| minimum.
   c. Fix Wj with the following provisions:
   - If T = Cj then Wj(new) = Wj (old) + α (Xi-Wj)
   - If T ≠ Cj then Wj(new) = Wj (old) - α (Xi-Wj)
   d. Subtract the value of α.

6. Perform testing with test data weighting each end of each period by means
   a. Enter the data to be tested, for example Xij with i = 1,2, ..., np and j = 1,2, ..., m.
   b. Do it i=1 untilnp.
   c. Determine J such that ||Xij-Wij|| J is the minimum classes of Xi

7. Calculate the accuracy and looking for the smallest error value. See the selected period. This is the pattern to look for predictions.

IV. RESULTS & DISCUSSIONS

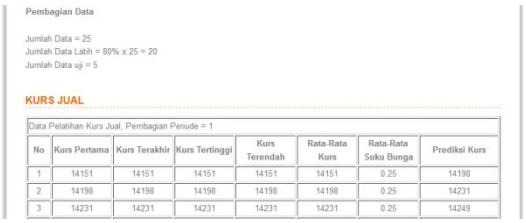
Results of the analysis toward the application that is developed are as follows:

A. Implementation of Home

Fig 2. Home

Fig 3. Initial Appearance

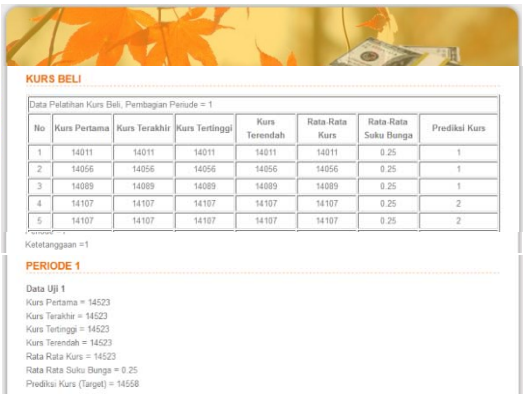
B. Implementation of Data Distribution Process



No	Kurs Pertama	Kurs Terakhir	Kurs Tertinggi	Kurs Terendah	Rata-Rata Kurs	Rata-Rata Suku Bunga	Prediksi Kurs
1	14151	14151	14151	14151	14151	0.25	14198
2	14198	14198	14198	14198	14198	0.25	14231
3	14231	14231	14231	14231	14231	0.25	14249

Fig 4. Data Distribution Appearance

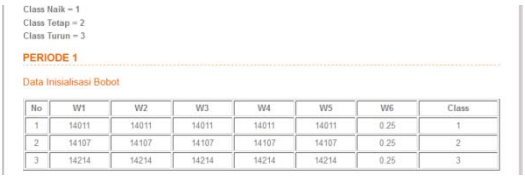
C. Implementation of the UNN Learning Process



No	Kurs Pertama	Kurs Terakhir	Kurs Tertinggi	Kurs Terendah	Rata-Rata Kurs	Rata-Rata Suku Bunga	Prediksi Kurs
1	14011	14011	14011	14011	14011	0.25	1
2	14056	14056	14056	14056	14056	0.25	1
3	14089	14089	14089	14089	14089	0.25	1
4	14107	14107	14107	14107	14107	0.25	2
5	14107	14107	14107	14107	14107	0.25	2

Fig 5. UNN Learning Appearance

D. Implementation of LVQ Learning Process



No	W1	W2	W3	W4	W5	W6	Class
1	14011	14011	14011	14011	14011	0.25	1
2	14107	14107	14107	14107	14107	0.25	2
3	14214	14214	14214	14214	14214	0.25	3

Fig 6. LVQ Learning Appearance

E. Forecast Implementation

Fig 7. Forecast Appearance

The testing of this study by looking at the forecasting accuracy and precision of the results. The prediction results with the selling rate UNN method, against the amount of data that is input. Here are the results of testing predictions selling rate :

TABLE 2
UNN Accuracy Testing Results

	currency	deviation	MAPE
actual	14763		
n = 25	14535	228	1,544%
n = 56	14382	153	2,581%
n = 87	14356	26	2,757%
n = 117	14162,8	193,2	4,066%

Buying rate prediction results with LVQ, testing is done based on the amount of data and learning rate that is used. Here are the results of testing prediction buying rate :

TABLE 3
Results of Testing LVQ

α	n=25	n=56	n=87	n=117
0,025	down	up	up	up
0,05	up	up	up	up
0,075	fixed	up	up	up
0,1	up	up	up	up
0,5	up	up	up	up

V. CONCLUSIONS

From the results of research and discussion that was made, it can be concluded as follows:

1. Unsupervised K Nearest Neighbor algorithm (UNN) can predict the exchange rate better than the algorithm Learning Vector Quantization (LVQ).
2. Results of the UNN algorithm output is in the form of figures, while the LVQ algorithm can only predict the form of class or target that has been previously classified as increase of rate, exchange rate or a fixed rate.
3. The amount of data used and the sharing of training data, test data affects the study outcomes and the results of the systems that implements the UNN algorithm.
4. From the test results with the selling rate UNN method, the results of the Mean Absolute Percentage Error (MAPE) as low of 1.544% with the amount of data as much as 25 and the results of the highest MAPE 4,066% with the amount of data as many as 117. The lower the value, the MAPE results predicted results more closely to the actual data.
5. The value of learning rate on LVQ affect the predicted results. Results of a correct prediction is the amount of data as much as 25 with learning rate 0.075.

Based on the results obtained and during the research authors have suggestions for further research to adds another variable factors thet affecting the increase of foreign exchange rates egg inflation data, trade balance data, public debt, and others.

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