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ANALYSIS OF PREDICTING THE EXCHANGE RATE OF THE IDR AGAINST THE US DOLLAR USING THE FUZZY TIME SERIES METHODS OF CHEN AND CHENG

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ABSTRACT

The rise and teh exchange rate of the IDR against the US dollar fall starting from 2021 to 2023 will have many impacts in the Indonesian economy both positive and negative impacts. The resulting impact affects the sustainability of the country's economic activities. To maintain the stability of the IDR exchange rate against the US dollar, it is necessary to do forecasting so that it can monitor the movement of the IDR exchange rate in the future. The puIDRose of this study is to find out how the results of the prediction of the IDR Exchange Rate (exchange) against the US Dollar with the Fuzzy Time Series Chen and Fuzzy Time Series Cheng methods and how the comparison of the implementation of the Fuzzy Time Series Chen and Fuzzy Time Series Cheng in predicting the IDR Exchange Rate (exchange) against US Dollar based on MAPE Value. The method used in this research is Chen and Cheng's Fuzzy Time Series. Forecasting results indicate the IDR exchange rate against the US dollar in June and July 2023 in the application of Chen's Fuzzy Time Series method of IDR 15,150.32 and the Fuzzy Time Series Cheng method of IDR 15,127.77. Then the data analysis shows that the MAPE results from the FTS Cheng method are better than the FTS Chen method with a MAPE percentage of 0.970%. The results of the acquisition of this percentage can be used as a reference for the government to weigh the economic policies that will be enacted in order to reduce the negative impacts arising from fluctuations in the IDR exchange rate.

Keywords : Analysis, Fuzzy Time Series, IDR Exchange Rate, Predictions, US Dollar

I. INTRODUCTION

The instability of a country's currency exchange rate can affect capital flows and trade, as many currencies participate in international economic transactions, including domestic trade and foreign currency conversion [1]. This phenomenon has been evident in recent years as the Indonesian IDR weakened against the US Dollar. The behavior of the IDR against the Dollar is influenced by several factors. Fundamental or economic factors that may have an impact include inflation rates, interest rates, money circulation, capital inflows and outflows, Indonesia's balance of payments, and how the country manages its monetary policy. From an exchange rate perspective, high inflation in a country can increase the selling price of domestic goods, making them more expensive and reducing their competitiveness in international markets. At the beginning of 2023, the IDR exchange rate saw a significant rise. According to CNN Indonesia, at the end of 2022, the IDR weakened due to the lingering instability of international trade following the COVID-19 pandemic. This situation continued into early 2023, with the exchange rate dropping again in April 2023 to IDR 14,941.05 and further declining in the following months.

Looking towards Indonesia's "golden" year in 2045, the country aspires to become a developed nation. The most critical indicators include economic growth, infrastructure development, and national advancement. Over the past three years, data has shown significant fluctuations in the IDR's value against the US Dollar, which has had widespread effects on Indonesia's economy. As a result, it is crucial to forecast the IDR exchange rate for the coming months.

The right method to predict the rupiah exchange rate is one of the fuzzy time series methods. An important reason for the fuzzy time series method to be used in handling forecasting is that it is able to handle uncertain and imprecise data, resulting in more accurate predictions, more flexible in handling various data patterns that may appear in exchange rate movements, and able to adapt to the possibility of the model to remain relevant in changing market conditions [2].

Previous research, namely the prediction of gold prices for the next day using the Fuzzy Time Series method, Lee model, produced a low error value [3].Research on forecasting using Fuzzy Time Series Chen on a case study of Samarinda City Rainfall [4]. While the research conducted in this study, namely to predict the rupiah exchange rate using the Fuzzy Time Series Chen and Fuzzy Time Series Cheng methods, is different from previous studies.

Based on the description that has been mentioned, the study aims to determine the forecast of the rupiah exchange rate against the US dollar in 2023 using the Chen and Cheng fuzzy time series method and to compare the Chen and Cheng methods using the MAPE value which will later become reference data for monitoring economic policies in 2023. The forecasts are conducted using the fuzzy time series method. Fuzzy time series forecasting systems gather patterns from past data and use them to project future data [5]. Several models of fuzzy time series exist, such as Chen's fuzzy time series and Cheng's fuzzy time series. The main difference between the two methods lies in the defuzzification process [6]. Chen's defuzzification does not account for repetitions in fuzzy logical

relationships (FLR) and does not include weight values [7]. Meanwhile, Cheng's defuzzification includes multiple relationships, allowing for repetitions in FLR and calculating weight values. The next discussion in this article is the research methodology, results and discussion and conclusions. The discussion of the research methodology is as follows.

II. RESEARCH METHODOLOGY

The research method used in this study is quantitative research, because it uses numbers in the form of secondary data. The research data was taken directly from the official Bank Indonesia website with the data variable taken being the Rupiah exchange rate against the US dollar because the data is guaranteed to be valid. The data used in the study was from January 2021 to May 2023.

The steps of fuzzy time series analysis are descriptive data, formation of the Universe set on the data, fuzzy logic relations (FLR) and fuzzy logic relation groups (FLRG), Chen Defuzzification and Cheng Defuzzification, Ceng weighting, then calculating the forecast accuracy using MAPE (Moving Absolute Percentage Error).

The forecasting stages using fuzzy time series Chen [8] are the first step in determining the universe of discourse with equation (1).

$$U = [X_{min}, X_{\max}], \tag{1}$$

Where U is the universe set, X_{min} is the lowest value of the data, and X_{max} is the highest value of the data. The second step is to define the fuzzy set on U and perform fuzzification on the historical data. By using equation (2), namely

$$A_k = \frac{a_{k1}}{u_1} + \frac{a_{k2}}{u_2} + \cdots + \frac{a_{km}}{u_m}. \tag{2}$$

The third step is to group the FLR based on historical data. The fourth step is to defuzzify the forecast value with equation (3), namely

$$F_{t-1} = A_i. \tag{3}$$

The fifth step determines the middle value of the data $m_j, j = 1, .., n$. The sixth step determines the forecast (F_t) using equation (4), namely

$$F_t = \frac{m_1 + \cdots + m_n}{n} \tag{4}$$

Meanwhile, for the MAPE calculation using equation (5) as follows [9].

$$MAPE = \frac{\left(\sum_{i=1}^{n} \left|\frac{x_i - f_i}{x_i}\right|\right)}{n} \tag{5}$$

where x_i is the i original data and f_i is the i forecast data. Meanwhile, in the cheng step after the FLR process, namely weighting and transferring into the normalized weighting matrix (W(t)) with equation (6), namely

$$W_n(t) = \left[\frac{w_1}{\sum_{h=1}^{t} wh'}, \ldots, \frac{w_k}{\sum_{h=1}^{t} wh'}\right]. \tag{6}$$

The final step in calculating the forecast is using equation (7),

$$F_t = L_{df(t-1)} W_{n(t-1)} \tag{7}$$

Where $L_{df(t-1)}$ is the defuzzification matrix.

III. RESULTS AND DISCUSSION

This research was analyzed over the course of one full month, and the results can be closely observed in the following discussion.

3.1. Descriptive Analysis

The descriptive analysis was conducted to provide a concise and clear explanation of the details related to the average IDR exchange rate against the US Dollar over the past few years, starting from January 2021 to May 2023.

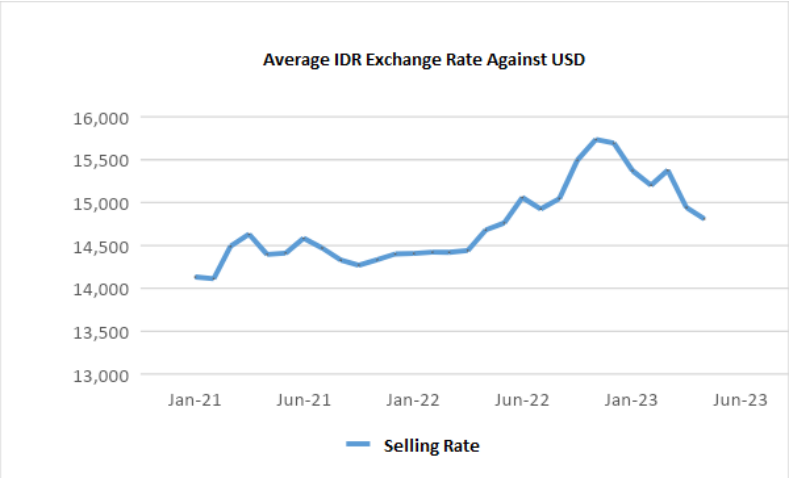

Figure 1 : Relationship Diagram Design.

Based on the line graph in Figure 1, it can be seen that the mean exchange rate of the IDR against the US Dollar from January 2021 to May 2023 experienced significant fluctuations, with noticeable increases and decreases each month.

3.2. Prediction of Chen FTS dan Cheng FTS

Defuzzification data is processed using the mean of all fuzzy groups. The calculation process for forecasting with the Chen Fuzzy Time Series method is done as follows: for example, random data from group 1 containing FLRG A1 and A2, A1 uses the median u1(m1), and A2 uses the median u2(m2). Meanwhile, in the Cheng defuzzification process, the focus is on assigning weights to each fuzzy relationship. When forming the FLRG pattern, if there are multiple repetitions, the weight is assigned according to the number of repetitions.

Table 1 : Chen and Cheng Predictions

Tahun	FTS Chen (IDR)	FTS Cheng (IDR)
2021	14,269.45	14,372.22
2022	14,527.49	14,520.95
2023	15,195.45	15,240.56

Note: The data is taken as an annual average

From the results in Table 1, it can be observed that the difference lies in the magnitude of the annual average predictions, where the FTS Cheng method produces higher values compared to the FTS Chen method.

3.3. Forecast Accuracy Measurement

The calculation of forecast accuracy is used to determine the precision of the forecast or the error rate of the forecast results. The accuracy of the forecast is measured using the Mean Absolute Percentage Error (MAPE).

Table 2 : Forecast Accuracy

Times		Kurs IDR	*Chen of Forecas*	error	Cheng of Forcas	error
2021	Jan	IDR 14,132.00	*	*	*	*
	Feb	IDR 14,112.31	IDR 14,396.60	0.139	IDR 14,372.22	1.808
	Mar	IDR 14,489.48	IDR 14,396.60	2.673	IDR 14,372.22	0.816
2022	Jan	IDR 14,406.92	IDR 14,527.49	0.044	IDR 14,520.95	0.785
	Feb	IDR 14,422.81	IDR 14,527.49	0.110	IDR 14,520.95	0.676
	Mar	IDR 14,420.38	IDR 14,527.49	0.017	IDR 14,520.95	0.693
2023	Jan	IDR 15,371.71	IDR 15,466.23	2.048	IDR 15,511.36	0.900
	Feb	IDR 15,201.63	IDR 15,195.45	1.106	IDR 15,240.56	0.255
	Mar	IDR 15,377.22	IDR 15,195.45	1.155	IDR 15,240.56	0.897
			MAPE	1.032	MAPE	0.970

Based on the average MAPE values, the Cheng Fuzzy Time Series method has a lower error rate, with an accuracy of 0.970%, compared to the Chen Fuzzy Time Series method, which has an accuracy of 1.032%. If the MAPE result is less than 10%, it is categorized as highly predictive. If the MAPE value is more than 10% but less than 20%, it can be assumed to be predictive with good capacity. However, if the percentage exceeds 20%, the forecast is considered not sufficiently reliable to be continued.

IV. CONCLUSION

Based on the results of the research analysis conducted and discussed in this study, several conclusions can be drawn as follow:

1. The forecast values for the period of June and July 2023 show that the IDR exchange rate against the US Dollar using the Chen Fuzzy Time Series method is IDR 15,150, while using the Cheng Fuzzy Time Series method, it is IDR 15,128.
2. According to the analysis conducted by the researchers, the prediction accuracy shows a MAPE of 1.032% for the Chen Fuzzy Time Series and 0.970% for the Cheng Fuzzy Time Series. Therefore, the Cheng Fuzzy Time Series method is considered a suitable method for predicting the IDR exchange rate.

The suggestions provided by the authors are as follows.

1. Relevant institutions involved in this research should consider the Fuzzy Time Series predictions to help minimize shaIDR increases in the IDR exchange rate.
2. Future researchers should incoIDRorate other factors that could influence the IDR exchange rate against the US Dollar when fluctuations occur.
3. Use other forecasting methods that are more varied to predict the IDR exchange rate against the US Dollar for future periods.

REFERENCES

[1]. Z. Z. Mokodongan, T. O. Rotinsulu, dan D. M. Mandeij, "Analisis fluktuasi tingkat kurs IDR (IDR) terhadap Dollar Amerika (USD) pada sistem kurs mengambang bebas di Indonesia dalam periode 2007.1-2014.4," *Jurnal Berkala Ilmiah Efisiensi*, vol. 18, no. 2, pp. 135–145, 2018.

[2]. W. N. Putra, I. S. Nugraha, dan A. I. Gunawan, "Application of fuzzy time series Chen and Cheng methods for forecasting currency exchange rates," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 13, no. 1, pp. 340–346, 2019.

[3]. L. Handayani dan A. Darni, "Perbandingan model Chen dan model Lee pada metode fuzzy time series untuk prediksi harga emas," *Pseudocode*, vol. 2, no. 1, pp. 28–36, 2015.

[4]. N. Fauziah, S. Wahyuningsih, dan Y. N. Nasution, "Peramalan menggunakan fuzzy time series Chen (studi kasus: curah hujan Kota Samarinda)," *Smoothing, Exponential & Network Neural*, vol. 4, no. 2, 2016.

[5]. M. Ilham, A. Aden, dan A. N. Rahman, "Penggunaan metode fuzzy dalam membangun sistem pendukung keputusan pemberian pembiayaan di koperasi syariah Benteng Mikro Indonesia Cabang Jasinga," *MathVision*, 2021.

[6]. R. Prasetyo, H. Lazuardi, A. A. Mulyono, dan C. Lauw, "Penerapan aplikasi RapidMiner untuk prediksi nilai tukar IDR terhadap US Dollar dengan metode linier regression," *Jurnal Nasional Teknologi dan Informasi*, vol. 7, no. 1, pp. 8–17, 2021.

[7]. D. Yustitia, "Perbandingan metode fuzzy time series Chen dan fuzzy time series Cheng pada permintaan pupuk pertanian UREA di Kabupaten Blora," *Repository Universitas Muhammadiyah Semarang*, 2019.

[8]. T. Fahmi, S. Sudarsono, dan W. Yuciana, "Perbandingan metode pemulusan eksponensial tunggal dan fuzzy time series untuk memprediksi indeks harga saham gabungan," *Jurnal Gaussian*, vol. 2, no. 2, pp. 137–146, 2013.

[9]. A. Aden, U. Rahmat, C. Basir, dan Y. Rusdiana, *Metode Peramalan*. Tangerang Selatan: Unpam Press, 2021.