



Implementation of Fuzzy Sugeno in the Analysis of the Availability of Split Stone

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Abstract—The development of companies in the industrial sector continues to grow every where. So the level of competition is competitive more increasing. But due to consumer demand that changes, making it a problem serious at the company PT Dexton Mulia Wisesa. especially the demand for split stone. To overcome this problem, a optimization in production quantities so that this does not happen production shortages or excess goods available causing the company to lose. Optimization is possible done by implementing Sugeno fuzzy logic. Sugeno's selection of fuzzy logic is for produce a capable system model estimate the amount of crushed stone inventory. Results from research conducted in July 2023 until June 2024 obtain mape value amounting to 28% and is included in the reasonable category. So it is hoped that in the future, this company can optimize the need for split stone in production.

Keywords: Fuzzy Logic; Sugeno; Split Stone; Availability

1. INTRODUCTION

Production is the center of concrete activities for the procurement of goods and services in a business and company, production is also the process of converting input into output [1]. One of the procurement systems is construction. Construction is one of the procurement systems for goods and services to determine the winner of the construction contract [2]. The construction industry makes a major contribution to infrastructure development and various other development projects [3]. To avoid this, it is necessary to have control in a production process [4]. The production process in question is the company's ability to provide market demand which has an upward trend, it cannot be denied that so much development has been carried out at this time.

If the amount of production is less, it will cause disappointment to consumers and harm the Company, and vice versa, if the amount of production is more, it will incur additional costs Based on the above conditions, the Fuzzy Sugeno method is used to make it easier to determine the split stone inventory at PT. Dexton Mulia Wisesa because with this Sugeno fuzzy method we can find out how much final inventory the Company should have so that the Split Stone inventory is well maintained to meet consumer demand [5]. Production is a problem faced by PT Dexton Mulia Wisesa Company located on Jalan Baru Megawati, Tandem Hulu Satu Kanutan Deli Serdang. Consumer needs that always change every month. So that there is a relationship between demand, supply, and production between one and the other are interrelated. To avoid these problems, the company needs a way to optimize the amount of production every day or even every month, namely by using fuzzy.

What is used in the prediction process generally consists of four stages, namely fuzzification (the process of converting firm numbers into fuzzy numbers), forming a fuzzy rule base, inference system or fuzzy reasoning, defuzzification (the process of converting fuzzy numbers from the fuzzy inference system into firm numbers). In the prediction process, in general, there are four stages, namely fuzzification, namely all members of the crisp set must be included in the set [7]. Forming a fuzzy rule base, an inference system, namely a computational framework based on fuzzy set theory, fuzzy rules in the form of IF-THEN [8]. And the system output is not in the form of a fuzzy set, but in the form of a constant or linear equation [9]. Defuzzification is a fuzzy set obtained from the composition of fuzzy rules. The output produced is a number in the domain of the fuzzy set [10].

The concept of fuzzy logic was introduced by Lotfi A. Zadeh in 1965. Membership functions, fuzzy rules, and fuzzy inference are the main components in fuzzy logic systems. Membership functions are used to describe the extent to which an element belongs to a fuzzy set. Fuzzy rules are used to express the relationship between inputs and outputs in the form of linguistic rules. Fuzzy inference refers to the process of making decisions or drawing conclusions based on previously established fuzzy rules.

In this research, the Matlab application is used to help implement the fuzzy sugeno method. Matlab (Matrix Laboratory) is software or software developed by Mathworks, Inc. by utilizing matrices in its use [11]. Previous research using the Fuzzy Sugeno method on optimizing the stock of coffee beans at the rooster cafe obtained MAPE results of 80.19%. So that in this study there are differences with previous research, namely in the linguistic variables used by previous research using two linguistic variables and in this study using three categories of variables, namely initial inventory, income and expenditure and also have output variables. This research aims to help improve operational efficiency at PT Dexton Mulia Wisesa by implementing Sugeno fuzzy on the company's production system. In this study, the authors can contribute research on knowledge about the results of research that has been done to readers and become a reference and make consideration for conducting the same research as

the author. By doing this research, it is hoped that it can help the company in applying the Fuzzy Sugeno method, so that the company can optimize the split stone inventory owned by the company.

2. RESEARCH METHODOLOGY

The Sugeno method is usually more Sugeno is almost the same as Mamdani's reasoning, except that the output (consequence) of the system is not in the form of a fuzzy set, but in the form of a constant or linear equation [12], thus facilitating further analysis and calculations. This makes it suitable for control systems and decision modeling that require a more direct and easily interpreted structure [13].

The data collection technique that will be carried out in this study is interviews. Interviews are in-depth exploration and comprehensive observation of a phenomenon of a research object [14]. The interview will be conducted with Mr. Amansyah Siregar as the Accounting Staff. The interview was conducted by the company to obtain initial inventory data, input data, and split stone expenditure data, the data used was July 2023 to June 2024 which was used to conduct the research. This research was conducted at a crushed stone grinding company to obtain a history of initial inventory transactions as well as income and expenses from July 2023 to June 2024. The research period was twelve months.

2.1 Target / Research Subject

The aim of this research is to find out whether the implementation of Sugeno Fuzzy Logic can help in measuring and analyzing the amount of crushed stone availability (split) at PT Dexton Mulia Wisesa by including several variables as reference materials to produce more accurate calculations. The research framework can be seen in **Figure 1**.

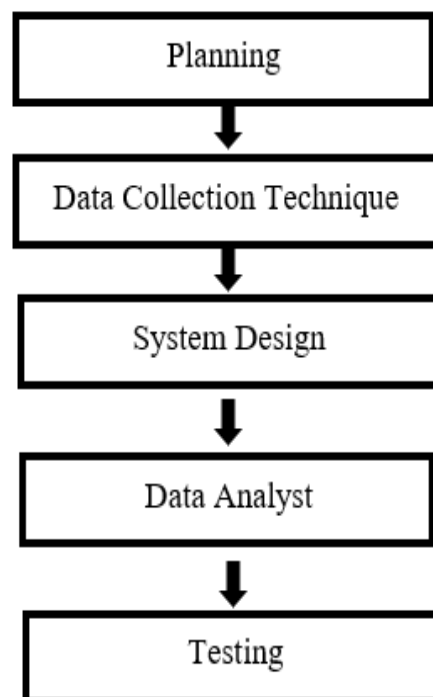


Figure 1. Research Framework

In **Figure 1**, the research framework process can start from the stage of explaining the process steps that will be used to search and identify everything from planning to design in the data. The data source for this research comes from initial inventory data, income and expenditure from July 2023 to June 2024. Then a system design was carried out to overcome the problems faced. Data analysis was carried out to see data comparisons. Testing is carried out to determine the optimization that has been carried out. This study uses primary data from interviews and original data from July 2023 to June 2024. Secondary data comes from journals related to the research conducted. Direct observation to the company was also carried out to find out related information. Interviews were also conducted with related staff.

2.2 Data analysis techniques

This sub-chapter can also contain problem solving methods, as well as the stages of the method. The data obtained will then be analyzed to provide final results later. In the manuscript, citation numbers are listed sequentially in square brackets, as well as a table of numbers and sequential numbers as shown in table 1 and figure 1.

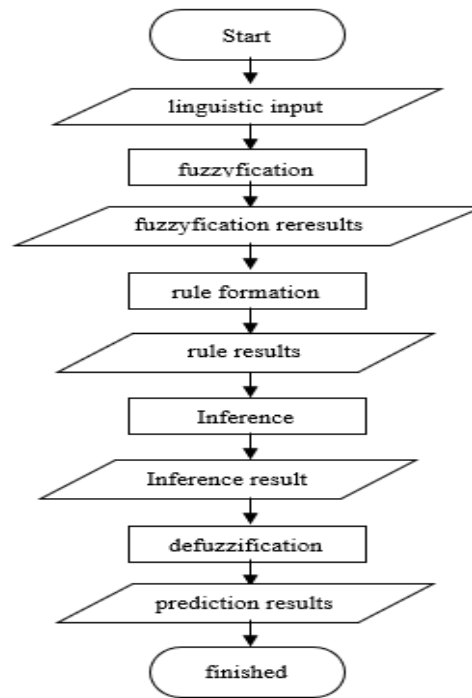


Figure 2. Fuzzy Sugeno Framework

1. Beginning
This is the first step to start processing
2. linguistic input
Refers to the representation of input and output variables in linguistic or human language form. Sugeno's method is a linear consequent function model expressed as a first-order (linear) polynomial, where the coefficients in the polynomial are calculated adaptively based on the input variables [15]. IF-THEN rules to relate input variables to output variables, where the IF condition relates to the linguistic value of the input variable, and the THEN result relates to the numeric value of the output variable.
3. Fuzzyfication
Fuzzification is the initial stage of the process where input data is received and the system will determine the value of its membership function. In other words, this fuzzification is used to change the crisp value of the input as a fuzzy set and determine the degree of membership. the process of changing a firm input variable (non-fuzzy or firm) into a fuzzy input variable [16].
4. Formation of Rules
The formation of a fuzzy rule knowledge base in the context of fuzzy logic systems refers to the process of developing IF-THEN rules that are used to relate input variables to output variables in a control system or decision-making system.[17].
5. Conclusion
Fuzzy output is obtained from changes in fuzzy input values by fuzzifying each IF-THEN rule that has been determined at the beginning[18]. Inference in the context of fuzzy logic systems refers to the process of decision making or drawing conclusions based on pre-defined rules. This process involves evaluating IF-THEN rules using given input values to produce output values or decisions.
6. Defuzzification
Defuzzification is the process of changing fuzzy output into crisp values according to the specified membership function [19]. The final step in the fuzzy logic system with the aim of changing each inference engine result expressed in the form of a fuzzy set into a real number.
7. Finish
End processing and get results in real numbers.

3. RESULT AND DISCUSSION

The data used in this research is processed data from the Dexton Mulia Wisesa Company in North Sumatra province. This data is in the form of income, expenditure and inventory data. This research uses report data from June 2023 to July 2024 as the material that will be calculated to obtain the final results in the form of crushed stone production, so that production results can be optimized with market demand for crushed stone.

Table 1. Data on Inflow, Outflow and Inventory for the Period July 2023 - June 2024 in Tons

Month	Beginning Inventory	Income	Spending	Final Inventory
July	1259	8330	5679	3910
August	3910	5037	4383	4564
September	4564	8893	6584	6874
October	6874	12532	10954	8452
November	8452	5581	6650	7383
December	7383	7727	7162	7783
January	7783	11390	10739	8434
February	8483	6354	5647	9141
March	9141	7969	5586	11524
April	11524	4992	4814	11702
May	11702	4360	4554	11510
June	11510	4099	3799	11810

From **Table 1**, it can be seen that the lowest value for the initial inventory variable was 1259 in July and the highest value was 11702 in May. Meanwhile for the income variable, the lowest value was 4099 in June and the highest was 12532 in October. Furthermore, for the expenditure variable, the lowest value was in June, namely 3099 and the highest value was in October, 10954. And finally, for the ending inventory variable, the lowest value was in July, namely 3910 and the highest value was in June, 11810.

Fuzzy logic is used to change input or used to predict. In this research, the variables used are initial inventory, income and expenditure of rice. These three variables will be used as materials to obtain prediction results in the form of final inventory of crushed stone at the Dexton Mulia Wisesa Company, North Sumatra. Therefore, a Fuzzy Inference System with the Sugeno Zero Order method is used.

From **Table 2**, the initial inventory variable of the speaker universe is from 0 - 11701 with a domain of 0 - 1259 (the lowest data from the initial inventory) then 1259 - 5835 (data with medium values from the initial inventory) 5835 - 11701 (the highest data from the initial inventory) as well as the speaker universe on the income, expenditure and final inventory variables.

Table 2. Fuzzy Set

Function	Variable	Fuzzy Sets	The Universe Of Speakers	Domain
Input	Beginning Inventory	LITTLE	0 - 11701	0 – 1259
		MEDIUM		1259 – 5835
		LOTS		5835 – 11701
	Income	DECREASE	0 – 12532	0 – 4099
		INCREASE		4099 – 12532
		DECREASE		0 – 3799
Spending	INCREASE	0 - 10954	3799 – 10954	
	LITTLE		0 – 3910	
Output	Final Inventory	MEDIUM	0 – 11810	3910 – 5900
		LOTS		5900 – 11810
		LITTLE		0 – 3910

Initial Inventory Variable consists of 3 Fuzzy sets, namely SMALL, MEDIUM and MANY. Based on the maximum and minimum initial inventory data from July 2023 to June 2024.

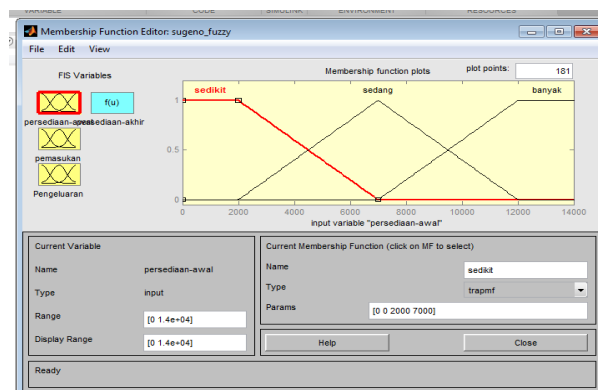


Figure 3. Initial Inventory Variable Fuzzyfication Process



$$\mu_{LITTLE} = \begin{cases} 0, & x \geq 1259 \\ \frac{5835-x}{5835-1259}, & 1259 \leq x \leq 5835 \\ 1, & x \leq 5835 \end{cases} \quad (1)$$

$$\mu_{MEDIUM} = \begin{cases} 0, & x \leq 1259 \text{ or } x \geq 11701 \\ \frac{x-5835}{5835-1259}, & 1259 \leq x \leq 5835 \\ \frac{5835-x}{5835-1259}, & 5835 \leq x \leq 11701 \end{cases} \quad (2)$$

$$\mu_{LOTS} = \begin{cases} 0, & x \geq 5835 \\ \frac{5835-x}{5835-1259}, & 5835 \leq x \leq 11701 \\ 1, & x \leq 11701 \end{cases} \quad (3)$$

At this stage, the income variable consists of 2 fuzzy sets, namely DECREASE and INCREASE. The fuzzy collection process is carried out to obtain a calculation formula that will be used to predict split stones. Based on maximum and minimum income data from June 2023 to July 2024. This process is the same as creating a fuzzy set on the initial inventory variable. So the formulation can be seen as follows :

$$\mu_{DECREASE} = \begin{cases} 0, & x \geq 12532 \\ \frac{12532-x}{12532-4099}, & 4099 \leq x \leq 12532 \\ 1, & x \leq 4099 \end{cases} \quad (4)$$

$$\mu_{INCREASE} = \begin{cases} 0, & x \geq 4099 \\ \frac{x-4099}{12532-4099}, & 4099 \leq x \leq 12532 \\ 1, & x \leq 12532 \end{cases} \quad (5)$$

After getting the fuzzy set formula for the income variable, the next step is to do the same thing as the previous process. The Expenditure variable consists of 2 fuzzy sets, namely DECREASE and INCREASE. Based on maximum and minimum income data for June 2023 to July 2024, the formula search results at this stage are as follows:

$$\mu_{DECREASE} = \begin{cases} 0, & x \geq 10954 \\ \frac{10954-x}{10954-3799}, & 3799 \leq x \leq 10954 \\ 1, & x \leq 3799 \end{cases} \quad (6)$$

$$\mu_{INCREASE} = \begin{cases} 0, & x \leq 3799 \\ \frac{x-3799}{10954-3799}, & 3799 \leq x \leq 10954 \\ 1, & x \geq 10954 \end{cases} \quad (7)$$

At this stage, the Final Inventory variable is also fuzzy aggregated. The fuzzy sets are then grouped into 3 categories, namely SMALL, MEDIUM and MANY. Based on maximum and minimum initial inventory data from July 2023 to June 2024, the results of the formulation of the ending inventory variable can be seen as follows

$$LITTLE = \begin{cases} 0, & x \geq 3910 \\ \frac{5900-x}{5900-1259}, & 3910 \leq x \leq 5900 \\ 1, & x \leq 3910 \end{cases} \quad (8)$$

$$\mu_{MEDIUM} = \begin{cases} 0, & x \leq 3910 \text{ or } x \geq 11810 \\ \frac{x-3910}{5900-3910}, & 3910 \leq x \leq 5900 \\ \frac{11810-x}{11810-5900}, & 5900 \leq x \leq 11810 \end{cases} \quad (9)$$

$$\mu_{LOTS} = \begin{cases} 0, & x \geq 5900 \\ \frac{x-5900}{11810-5900}, & 5900 \leq x \leq 11810 \\ 1, & x \leq 11810 \end{cases} \quad (10)$$

3.1 Unclear ground rules

The modeled fuzzy sets will be combined to determine the membership value of each variable, after determining the membership function of the variable, then fuzzy logic rules must be formed. Based on fuzzy logic reasoning, the linguistic variables in this study obtained 12 implication rules with an example in (R1) if the initial inventory is small, income decreases and costs decrease, then the final inventory is small. For more details on determining the fuzzy set rules can be seen in table 3 as follows:

Tabel 3. Rules of the results formed in fuzzy inference

Rules	Beginning Inventory	Income	Spending	Implementation Function	Final Inventory
R1	LITTLE	DECREASE	DECREASE	Then	LITTLE
R2	LITTLE	INCREASE	DECREASE	Then	MEDIUM
R3	LITTLE	DECREASE	INCREASE	Then	LITTLE
R4	LITTLE	INCREASE	INCREASE	Then	LOTS
R5	MEDIUM	DECREASE	DECREASE	Then	MEDIUM
R6	MEDIUM	INCREASE	DECREASE	Then	LOTS
R7	MEDIUM	INCREASE	INCREASE	Then	LOTS
R8	MEDIUM	DECREASE	INCREASE	Then	LITTLE
R9	LOTS	DECREASE	DECREASE	Then	MEDIUM
R10	LOTS	DECREASE	DECREASE	Then	MEDIUM
R11	LOTS	INCREASE	INCREASE	Then	LOTS
R12	LOTS	INCREASE	INCREASE	Then	LOTS

At this stage, data processing is carried out by entering monthly values or data for 12 months to display fuzzy values by entering values so that the rules perform calculations with the values that have been inputted.

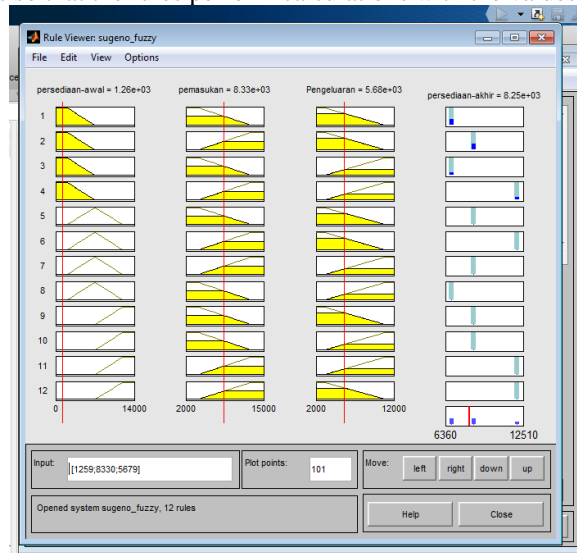


Figure 7. Data Defuzzification Calculation Process

3.2 Data Set

At this stage, the results obtained from preprocessing will be input into a new table to see the comparison between the actual data values and the values obtained in the preprocessing process. The results can be seen in Table 4.

Table 4. Comparison of Defuzzification Results with Original Data

RECAPITULATION OF YEARLY DATA					
Month_Year	Beginning Inventory	Income	Spending	Final Inventory	defuzzification
Jul 2023	1259	8330	5679	3910	8250
Agt 2023	3910	5037	4383	4564	7730
Sept 2023	4564	8893	6584	6874	8920
Okt 2023	6874	12532	10954	8452	8600
Nov 2023	8452	5581	6650	7383	8450
Des 2023	7383	7727	7162	7783	8760
Jan 2024	7783	11390	10739	8434	8810
Feb 2024	8434	6354	5647	9141	8810
Mar 2024	9141	7969	5586	11524	9240
Apr 2024	11524	4992	4814	11702	8680
Mei 2024	11702	4360	4554	11510	8620
Jun 2024	11510	4099	3799	11810	8590

It can be seen that the defuzzification data display is the result of data preprocessing for 12 months starting from July 2023 to June 2024. At this stage, the results obtained from preprocessing have been input into a table to see the comparison between the actual data and the defuzzification data.



3.3 Load Data

At this stage, the data input process in the form of a .csv file is used to find the mean absolute percentage error (MAPE). MAPE is a measure of forecasting accuracy of a forecasting method. The results in the form of a percentage are then absolute. The forecasting results are very good if the MAPE value less than 10% while the MAPE value is said to be good if it is less than 20%. It can be seen that the output produced from the processing carried out to find the mape value of 12 data starting from July 2023 to July 2024 obtained a mape value of 28%, including reasonable research and showing that the Sugeno method is suitable for use in determining crushed stone inventory.

3.4 Discussion

From the figure it can be seen that the output generated from the processing carried out to find the mape value of 12 data starting from July 2023 to July 2024 gets a mape value of 28% including reasonable research and shows that the Sugeno method is feasible in determining the supply of split stone.

4. CONCLUSION

Based on the results of the research that has been carried out, the process of implementing Sugeno fuzzy logic provides good results. When applied to crushed stone data using 35% or 3 months of the total 12 months used, the average absolute error percentage value obtained was 28% and was still in the good or reasonable category. And the comparison of the defuzzification results with the original data is also quite good. So for the next production, PT. It is hoped that Dexton Mulia Wisesa will be better at optimizing production results by applying the final results of the defuzzification that has been carried out. And it can also minimize losses or disappointment for consumers whose market demands are sometimes not met.

REFERENCES

- [1] H. Rudiawan, K. Kunci, and M. Produksi, “Peranan Manajemen Produksi dalam Menyelaraskan Kinerja Perusahaan,” *J. Manaj. FE-UB*, vol. 9, no. 2, p. 66, 2021.
- [2] F. Firnawaty, H. Ashad, and A. Karim Hadi, “Penentuan Pemenang Kontrak Kontruksi dengan Metode Penugasan (Assignment Model) pada Proyek Konstruksi Jalan,” *J. Flyover*, vol. 01, no. 02, pp. 28–37, 2021.
- [3] K. Anuar, H. Heriswanto, and A. Fahrizqa, “Study of Vibrating Screen Machine Damage in Stone Crusher and Its Effect on Production Loss in Cement Factory,” *Motiv. J. Mech. Electr. Ind. Eng.*, vol. 5, no. 1, pp. 75–84, 2022, doi: 10.46574/motivecton.v5i1.133.
- [4] N. K. Budiartami and I. W. K. Wijaya, “Analisis Pengendalian Proses Produksi Untuk Meningkatkan Kualitas Produk Pada CV. Cok Konveksi di Denpasar,” *J. Manaj. dan Bisnis Equilib.*, vol. 5, no. 2, pp. 161–166, 2019, doi: 10.47329/jurnal_mbe.v5i2.340.
- [5] M. A. Hafiz and Sriani, “Penerapan Logika Fuzzy Sugeno Untuk Optimasi Stok Biji Kopi Pada Kafe Rooster,” *J. FASILKOM*, vol. 13, no. 02, pp. 165–172, 2023, doi: 10.37859/jf.v13i02.5460.
- [6] B. Davvaz, I. Mukhlash, and S. Soleha, “Himpunan Fuzzy dan Rough Sets,” *Limits J. Math. Its Appl.*, vol. 18, no. 1, p. 79, 2021, doi: 10.12962/limits.v18i1.7705.
- [7] A. K. Nisa, M. Abdy, and A. Zaki, “Penerapan Fuzzy Logic untuk Menentukan Minuman Susu Kemasan Terbaik dalam Pengoptimalan Gizi,” *J. Math. Comput. Stat.*, vol. 3, no. 1, p. 51, 2020, doi: 10.35580/jmathcos.v3i1.19902.
- [8] U. Athiyah, A. P. Handayani, M. Y. Aldean, N. P. Putra, and R. Ramadhani, “Sistem Inferensi Fuzzy: Pengertian, Penerapan, dan Manfaatnya,” *J. Dinda Data Sci. Inf. Technol. Data Anal.*, vol. 1, no. 2, pp. 73–76, 2021, doi: 10.20895/dinda.v1i2.201.
- [9] R. Rahmawati, N. Nurjannah, A. N. Rahma, and Z. Zukrianto, “Penerapan Fuzzy Inference System Sugeno Dalam Menentukan Penyaluran Pembiayaan Rahn,” *Math Educ. J.*, vol. 5, no. 2, pp. 175–182, 2021, doi: 10.15548/mej.v5i2.2547.
- [10] M. M. F. Fatori, “Aplikasi IoT Pada Sistem Kontrol dan Monitoring Tanaman Hidroponik,” *J. Pendidik. Sains dan Komput.*, vol. 2, no. 02, pp. 350–356, 2022, doi: 10.47709/jpsk.v2i02.1746.
- [11] A. Atina, “Aplikasi Matlab pada Teknologi Pencitraan Medis,” *J. Penelit. Fis. dan Ter.*, vol. 1, no. 1, p. 28, 2019, doi: 10.31851/jupiter.v1i1.3123.
- [12] R. Rizky et al., “Penerapan Metode Fuzzy Sugeno Untuk pengukuran Keakuratan Jarak Pada Pintu Otomatis di CV Bejo Perkasa,” *J. Tek. Inform. Unika St. Thomas*, vol. 05 Nomor 0, no. ISSN: 2548-1916, e-ISSN: 2657-1501, pp. 33–42, 2020.
- [13] M. Al Amin and D. Juniati, “Math Unesa,” *J. Ilm. Mat.*, vol. 9, no. 2, pp. 437–446, 2021.
- [14] S. Hansen, “Investigasi Teknik Wawancara dalam Penelitian Kualitatif Manajemen Konstruksi,” *J. Tek. Sipil*, vol. 27, no. 3, p. 283, 2020, doi: 10.5614/jts.2020.27.3.10.
- [15] A. Burhanuddin, “Analisis Komparatif Inferensi Fuzzy Tsukamoto, Mamdani dan Sugeno Terhadap Produktivitas Padi di Indonesia,” *LEDGER J. Inform. Inf. Technol.*, vol. 2, no. 1, pp. 48–57, 2023.
- [16] M. M. Mardhalena and N. D. Nathasia, “Parking Sensor System Untuk Mendeteksi Jarak Aman Kendaraan Menggunakan Sensor Ultrasonic Berbasis Arduino Uno Atmega328,” *JUPI (Jurnal Ilm. Penelit. dan Pembelajaran Inform.)*, vol. 7, no. 4, pp. 1391–1400, 2022, doi: 10.29100/jupi.v7i4.3888.
- [17] D. P. P. Astuti and Mashuri, “Penerapan Metode Fuzzy Tsukamoto dan Fuzzy Sugeno Dalam Penentuan Harga Jual Sepeda Motor,” *UNNES J. Math.*, vol. 1, no. 2252, pp. 75–84, 2020.



- [18] I. Muhandhis, A. S. Ritonga, and M. H. Murdani, “Implementasi Metode Inferensi Fuzzy Tsukamoto Untuk Memprediksi Curah Hujan Dasarian Di Sumenep,” *J. Ilm. Edutic Pendidik. dan Inform.*, vol. 8, no. 1, pp. 01–10, 2021, doi: 10.21107/edutic.v8i1.8907.
- [19] R. P. Nugroho, B. D. Setiawan, and M. T. Furqon, “Penerapan Metode Fuzzy Tsukamoto untuk Menentukan Harga Sewa Hotel (Studi Kasus : Gili Amor Boutique Resort , Dusun Gili Trawangan , Nusa Tenggara Barat),” *J. Pengemb. Teknol. Informasi dan Ilmu Komput.*, vol. 3, no. 3, pp. 2581–2588, 2019.
- [20] R. Bakri, A. N. Rahma, I. Suryani, and Y. Sari, “Penerapan Logika Fuzzy Dalam Menentukan Jumlah Peserta Bpjs Kesehatan Menggunakan Fuzzy Inference System Sugeno,” *J. Lebesgue J. Ilm. Pendidik. Mat. Mat. dan Stat.*, vol. 1, no. 3, pp. 182–192, 2020, doi: 10.46306/lb.v1i3.38.