JURNAL RISET INFORMATIKA **P-ISSN: 2656-1743 |E-ISSN: 2656-1735**
Vol. 5, No. 1 December 2022 DOI: https://doi.org/10.34288/jri.v5i1.471
Accredited rank 3 (SINTA 3), excerpts from the decision of the Minister of RISTEK-BRIN No. 200/M/KPT/2020

IMPLEMENTATION OF THE FUZZY TSUKAMOTO METHOD FOR OFFICE STATIONERY ESTIMATION STOCK SYSTEM

Tedy Rukmana[-1*)], Hersanto Fajri[-2], Dahlia Widhyaestoeti[-3]

Fakultas Teknik & Sains, Program Studi Teknik Informatika,
Konsetrasi Sistem Informasi,
Universitas Ibn Khaldun Bogor, Indonesia
https://uika-bogor.ac.id/
tedyrukmana1502@gmail.com[-1*)], hersanto.fajri@gmail.com[-2], dahlia@uika-bogor.ac.id[-3]

(*) Corresponding Author

Abstract

Information technology supports the company's operational activities in recording incoming goods, outgoing goods, and existing inventory. PT. Mitraniaga Distribusindo is a company engaged in food distribution, which includes supporting aspects for smooth operations, such as stock availability of office stationery. The Tsukamoto fuzzy method aims to calculate the estimated stock of office stationery needed to provide recommendations for deciding the estimated stock. The estimated target variable is more numerical, with models built using complete records providing the variable value of the target as a predictive value. Testing the accuracy of the calculation results of the office stationery stock estimation system was conducted using the Root Mean Squared Error (RMSE) to get a value of 5.9 to make the decisions more precise. In application development, using the waterfall model, which provides a sequential or sequential software life flow approach starting from design analysis, coding, and up to application testing using black box testing that is produced, each test form produces an appropriate status, according to the expected results.

Keywords: Fuzzy Tsukamoto; Root Mean Squared Error; Estimation Stock System

Abstrak

Teknologi informasi mempunyai peranan penting untuk menunjang seluruh aktifitas operasional perusahaan dalam mencatat barang masuk, barang keluar serta persediaan barang yang ada. PT. Mitraniaga Distribusindo merupakan salah satu perusahan yang bergerak dibidang distribusi makanan yang tentu didalamnya terdapat aspek pendukung untuk kelancaran operasional seperti ketersediaan stok alat tulis kantor. Metode fuzzy tsukamoto bertujuan untuk melakukan perhitungan estimasi stok alat tulis kantor yang dibutuhkan mendatang sehingga mampu memberikan rekomendasi dalam memutuskan jumlah estimasi stock alat tulis kantor. Variabel target estimasi lebih kearah numerik dengan model yang dibangun menggunakan record lengkap menyediakan nilai variabel dari target sebagai nilai prediksi. Uji keakuratan hasil perhitungan sistem estimasi stok alat tulis kantor dilakukan menggunakan Root Mean Squared Error (RMSE) mendapatkan nilai 5,9 sehingga keputusan yang diperoleh lebih tepat. Dalam pengembangan aplikasi menggunakan model waterfall yang menyediakan pendekatan alur hidup perangkat lunak secara sekuensial atau terurut dimulai dari analisis desain , pengkodean dan sampai pengujian aplikasi menggunakan blackbox testing yang dihasilkan setiap form uji menghasilkan status sesuai, sesuai dengan hasil yang di harapkan.

Kata kunci: Fuzzy Tsukamoto; Root Mean Squared Error; Sistem Estimasi Stok

INTRODUCTION

Science and technology are currently developing very rapidly, especially in the field of information technology, and the development of information technology is very beneficial for developments, one of which is in the field of trade (Haryati, 2012). Information technology is important in supporting all company operations to record incoming, outgoing, and inventory of goods such as PT. Mitraniaga Distribusindo is a company engaged in the food distribution sector, which

includes aspects that support smooth operations, such as the availability of stationery stock.

The importance of stock availability is one factor that affects the smooth operation of a company in which administrative needs need special attention, as is the case in determining the need for office stationery stock. The estimation system can provide recommendations for deciding the number of stock receipts using the Tsukamoto fuzzy method to make decisionsore precise and computerized and prevent subjective decision-making (Novianti Puspitasari, Andi Tejawati, & Friendy Prakoso, 2019). Tsukamoto's fuzzy logic reasoning provides a way to understand system performance by assessing system input and output from observations. The research (Hendi Setiawan, 2020) explains that Fuzzy logic is a technique/method used to deal with uncertainties in problems with many answers. If you look at fuzzy logic, it is easy to understand, and fuzzy logic uses basic set theory. Fuzzy logic is a group set representing a certain state in a variable. An application is needed that can simplify performance and solve problems related to inventory processing, and also the method used is the fuzzy logic method.

In research conducted by (Prayogi & Santoso, 2018), the Tsukamoto method is an extension of monotone reasoning. In the Tsukamoto method, each consequence of a rule in IF-THEN must be represented by a fuzzy set with a monotonous membership function. As a result, the output of the inference results from each rule is given strictly (crisp) based on the α predicate (fire strength). The final result is obtained by using a weighted average. Based on the accuracy test results, the error value obtained from the small forecasting results is 0.0607%. In other research (Huda, 2018), Controlling raw material stocks is an activity that a company or agency always carries out with the constraint that often occurs in raw material stocks. When the demand for raw material quantities is not correct, it can result in running out of raw materials, impacting cafe operations. The implementation of Fuzzy Tsukamoto is widely used to predict or predict the future, such as the use of Fuzzy Tsukamoto in predicting the availability of teak wood based on the variables that affect it. The application of Fuzzy Tsukamoto in controlling warehouse stock recommends purchasing goods based on consumer needs using the Tsukamoto method.

Office stationery is a supporting factor for smooth operational activities. Office stationery is objected that is used up in the daily work of administrative employees. (M. Ramaddan Julianti, Muhammad Iqbal Dzulhaq, & Ahmad Subroto, 2019) The waterfall model is a system development model for this research. The waterfall model provides a sequential or sequential software life-flow approach starting from analysis, design, coding, and testing.

The Tsukamoto fuzzy method aims to calculate the estimated stock needed in the future to provide recommendations for the estimated amount of office stationery stock. The estimated target variable is more numerical, with models built using complete records providing the variable value of the target as a predictive value. Building a web-based estimation system helps determine the estimated amount of office stationery stock needed by implementing the Tsukamoto fuzzy method. The accuracy of the calculation results of the office stationery stock estimation system is tested using Root Mean Squared Error (RMSE). In application development, the waterfall model provides a sequential or sequential software life flow approach starting from design analysis and coding until the application testing using black box testing.

Research (Huda, 2018) shows that Requests for the wrong amount of raw materials can result in running out of raw materials, impacting operational disruptions. There needs to be an appropriate raw material management system to fulfil stock availability in the warehouse. The system to be designed uses the Tsukamoto fuzzy method. In testing the accuracy of the system also uses RMSE (Root Mean Square Error). The results of the Tsukamoto fuzzy test on 25 training data with sales parameters, expiration date, demand, and yield 0.78%.

Research on implementation of fuzzy Tsukamoto method for office stationery estimation stock system. Designed to calculate the estimated stock needed for the future so that it can provide advice when determining the estimated amount of office stationery stock.

RESEARCH METHODS

This study uses a qualitative method approach. To obtain data by interviewing parties related to this research. Describe the meaning of research facts through the interview and observation stages of participation and explain the facts that occur in the field (Muhammad Rijal Fadli, 2021). The research methodology can be seen in Figure 1.

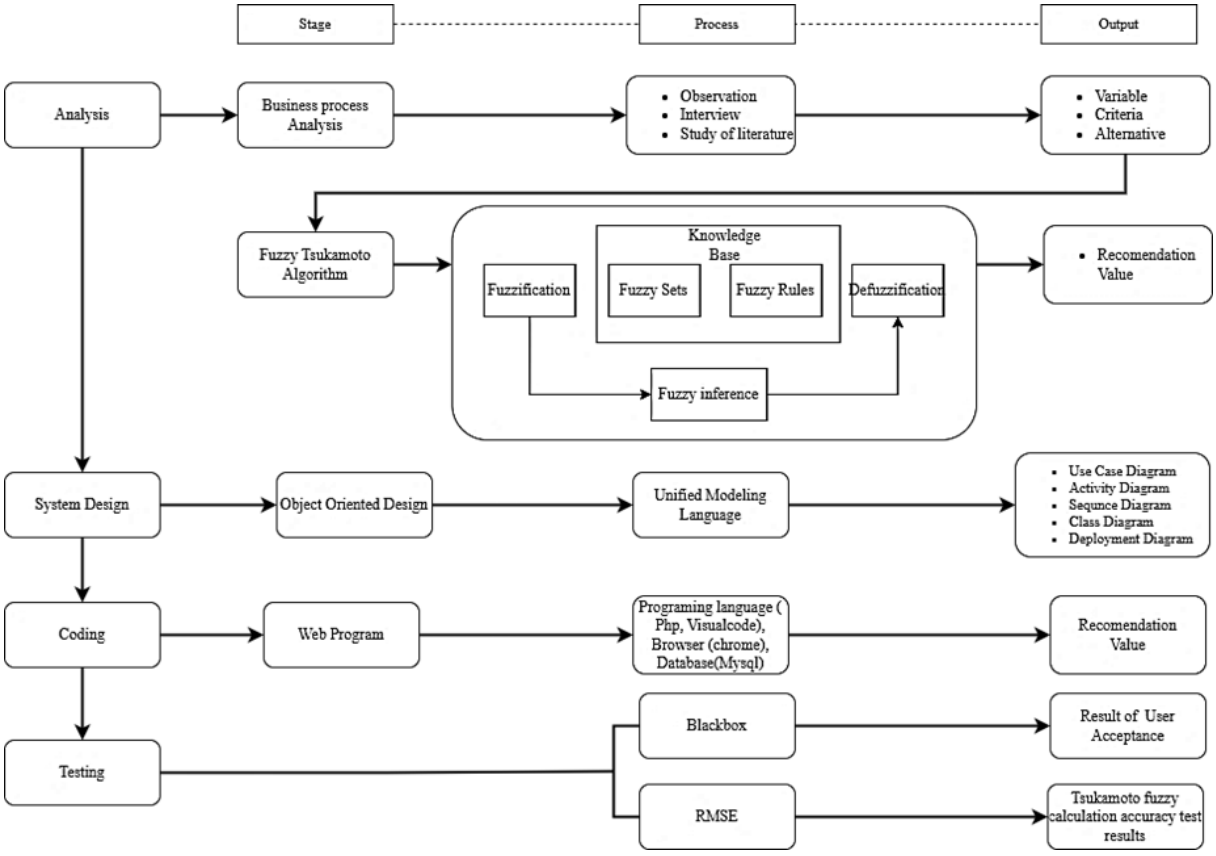

Figure 1. Research Methods

Time and Place of Research

This research was conducted at PT. Mitraniaga Distribusindo starts from August 2022 to October 2022.

Research Target / Subject

In this research, the target/subject is the admin head, who acts as the person in charge of the operational office stationery stock, and then the interview stages are carried out in the formation of data, variables, and criteria.

Procedure

Based on the research method described in Figure 1, where the initial stage is analysis. Analysis of business processes begins with observation, interview stages, and the application of literature studies resulting in output in the form of variable data, criterion data, and alternative data, which is then carried out by the fuzzy Tsukamoto algorithm to produce recommendation values.

In the next stage, the results of Tsukamoto's fuzzy calculations built a program with the application of object-oriented programming through the Unified Modeling Language (UML) design process to produce use cases, activities, sequences, classes, and deployment diagrams.

The next stage is coding in implementing web-based programs using the PHP programming language, writing code using Visual Studio, databases using MySQL, and web browsers using Chrome.

Furthermore, at the testing stage, testing the results of estimation calculations uses the Tsukamoto fuzzy method to find out how accurate the stock inventory estimation is. Carried out by Root Mean Squared Error (RMSE) and black box testing provides test results for the suitability of the application with the function or functional capability of the system. This testing phase is carried out to find out how the results of the system design are to be able to find out deficiencies and what things need to be fixed for further development.

Data, Instruments, and Data Collection Techniques

In this study, the data formed will then be processed for Tsukamoto fuzzy calculations, for the

criteria can be seen in table 1. the formation of fuzzy sets can be seen in table 2.

Table 1. Kriteria Data

No	Variable	Statement
1	*Permintaan*	Office stationery expenditure data
2	*Stock*	Office stationery inventory data
3	*Estimasi*	Office stationery stock estimation data

Table 2 Fuzzy Function

Function	Variable	Fuzzy set	Universal set	Domain
Input	*Permintaan*	*Sedikit*	10-80	10 s/d 40
		Banyak		40 s/d 80
	Stock	*Sedikit*	10-80	10 s/d 40
		Banyak		40 s/d 80
Output	*Estimasi*	*Berkurang*	10-80	10 s/d 40
		Bertambah		40 s/d 80

Alternative data is office stationery data contained in PT. Mitraniaga Distribusindo.

The instrument is to interview the Admin head, who is in charge of office stationery operations. In order to obtain data on the criteria variable for implementing fuzzy through the stages of fuzzification, fuzzy inference, and defuzzification.

Data analysis technique with Fuzzy Tsukamoto

The Tsukamoto fuzzy algorithm then processes the data obtained by forming variables and fuzzy sets beforehand. As an example of the office stationery stock data that will be processed in this case, the variable values obtained consist of requests 60 and stock 47 and the estimated value to be searched for

1. Fuzzification

After obtaining the next variable is the fuzzification process of forming curves, sets, and membership functions for each variable.

a. Permintaan

There are 2 sets : *Sedikit* and *Banyak*

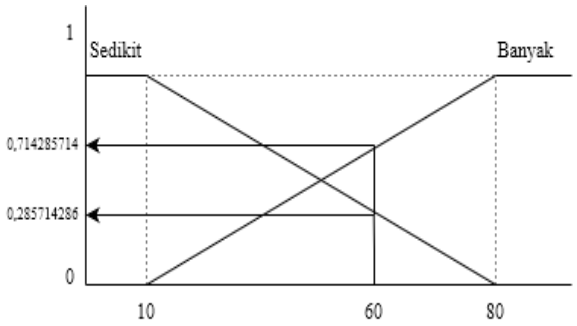

Figure 2 Permintaan Curve

Domain Figure 2 is a process of fuzzification of the *permintaan* variable, which consists of sets of *sedikit* and *banyak*, showing the degree of membership value resulting from the calculation as follows:

The membership function :

$$\mu_{PermintaanSedikit}[x] = \begin{cases} 1, & x \leq 10 \\ \frac{80-x}{70}, & 10 \leq x \leq 80 \\ 0, & x \geq 80 \end{cases} \quad \ldots\ldots (1)$$

$$\mu_{PermintaanBanyak}[x] = \begin{cases} 0, & x \leq 10 \\ \frac{X-10}{70}, & 10 \leq x \leq 80 \\ 1, & x \geq 80 \end{cases} \quad \ldots\ldots (2)$$

The value of the degree of membership is obtained :

$$\mu_{PermintaanSedikit}[60] = \frac{80-60}{70} = \frac{20}{70} = 0{,}285714286$$

$$\mu_{PermintaanBanyak}[60] = \frac{60-10}{70} = \frac{50}{70} = 0{,}714285714$$

b. Stock

There are 2 sets : *Sedikit* and *Banyak*

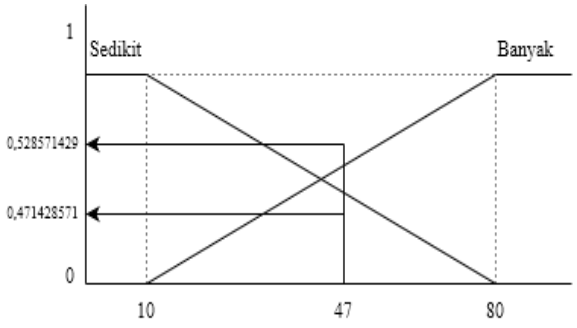

Figure 3 Stock Curve

Figure 3 is a process of fuzzification of the *stock* variable, which consists of sets of *sedikit* and *banyak*, showing the degree of membership value resulting from the following calculations :

The membership function :

$$\mu_{StockSedikit}[y] = \begin{cases} 1, & y \leq 10 \\ \frac{80-y}{70}, & 10 \leq y \leq 80 \\ 0, & y \geq 80 \end{cases} \quad (3)$$

$$\mu_{StockBanyak}[y] = \begin{cases} 0, & y \leq 10 \\ \frac{y-10}{70}, & 10 \leq y \leq 80 \\ 1, & y \geq 80 \end{cases} \quad \ldots\ldots (4)$$

The value of the degree of membership is obtained :

$$\mu_{StockSedikit}[47] = \frac{80-47}{70} = \frac{33}{70} = 0{,}471428571$$

$$\mu_{StockBanyak}[47] = \frac{47-10}{70} = \frac{37}{70} = 0{,}528571429$$

c. Estimasi

There are 2 sets : *Berkurang* and *Bertambah*

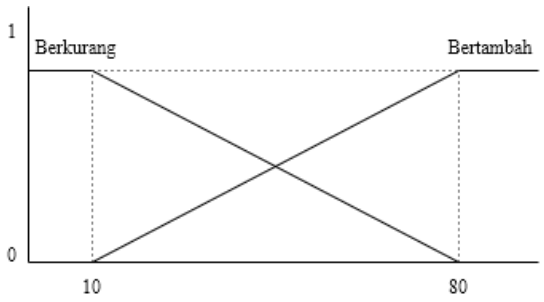

Figure 4 Estimasi Curve

Figure 4 is a process of fuzzification of the estimated variable. The value to be searched for consists of a "berkurang" and "bertambah" set; the final value will show the value that will enter the "berkurang" or "bertambah" set, and the resulting degree of membership value in Figure 4 is generated from the following calculations :

$$\mu_{EstimasiBerkurang}[z] = \begin{cases} 1, & z \leq 10 \\ \frac{80-z}{70}, & 10 \leq z \leq 80 \\ 0, & z \geq 80 \end{cases} \quad \ldots\ldots (5)$$

$$\mu_{EstimasiBertambah}[z] = \begin{cases} 0, & z \leq 10 \\ \frac{z-10}{70}, & 10 \leq z \leq 80 \\ 1, & z \geq 80 \end{cases} \quad \ldots\ldots (6)$$

2. Fuzzy Inference

This stage is the process of forming the rules (rules) that will be used, and the following are the rules in this case :

a. [R1] IF *Permintaan Sedikit* AND *Stock Banyak* THEN *Estimasi Berkurang*.
b. [R2] IF *Permintaan Sedikit* AND *Stock Sedikit* THEN *Estimasi Berkurang*.
c. [R3] IF *Permintaan Banyak* AND *Stock Sedikit* THEN *Estimasi Bertambah*.
d. [R4] IF *Permintaan Banyak* AND *Stock Banyak* THEN *Estimasi Bertambah*.

The value obtained in the rule ;

[R1] IF *Permintaan Sedikit* AND *Stock Banyak* THEN *Estimasi Berkurang*.

$$\alpha - predikat_1 = \mu PermintaanSedikt \cap \mu StockBanyak$$
$$= min\ (0{,}285714286;\ 0{,}714285714)$$
$$= (0{,}285714286)$$
$$\frac{80-Z}{70} = 0{,}285714 \qquad Z_1 = 60$$

[R2] *IF Permintaan Sedikit* AND *Stock Sedikit* THEN *Estimasi Berkurang*.

$$\alpha - predikat_2 = \mu PermintaanSedikt \cap \mu StockSedikit$$
$$= min\ (0{,}285714286\ ;\ 0{,}471428571)$$
$$= (0{,}285714286)$$
$$\frac{80-Z}{70} = 0{,}285714286 \qquad Z_2 = 60$$

[R3] IF *Permintaan Banyak* AND *Stock Sedikit* THEN *Estimasi Bertambah*.

$$\alpha - predikat_3 = \mu PermintaanBanyak \cap \mu StockSedikit$$
$$= min\ (0{,}714285714\ ;\ 0{,}471428571)$$
$$= (0{,}471428571)$$
$$\frac{Z-10}{70} = 0{,}471428571 \qquad Z_3 = 43$$

[R4] IF *Permintaan Banyak* AND *Stock Banyak* THEN *Estimasi Bertambah*.

$$\alpha - predikat_4 = \mu PermintaanBanyak \cap \mu StockBanyak$$
$$= min\ (0{,}714285714\ ;\ 0{,}528571429)$$
$$= (0{,}528571429)$$
$$\frac{Z-10}{70} = 0{,}528571429 \qquad Z_4 = 47$$

3. Defuzzification

Defuzzification is the final stage of calculation using a weighted average. So that the following values are obtained :

$$z = \frac{\alpha_{predikat\ 1} * z1 + \alpha_{predikat\ 2} * z2 + \alpha_{predikat\ 3} * z3 + \alpha_{predikat\ 4} * z4}{\alpha_{predikat\ 1} + \alpha_{predikat\ 2} + \alpha_{predikat\ 3} + \alpha_{predikat\ 4}}$$

$$z = \frac{79{,}4}{1.57142857} = 50{,}5272728$$

The result of the Tsukamoto fuzzy calculation is 50.5272728, rounded up to 51 with additional estimation information. Next, an accuracy test using the RMSE is carried out. The following is a table of the results of the RMSE test on the results of accuracy of the results of the calculation of the office stationery stock estimation system using the Root mean squared error method.

Table 3 Root Mean Squared Error

No	Nama Alternatif	Manual	Sistem	Error	Square of Error
n	i	yi'	yi	yi'-yi	(yi' -yi)^2
1	Amplop Coklat F4	50,9615	42,45	8,5	72,4
2	Bantex Besar	30	30	0,0	0,0
3	Bantex Kecil	30	30	0,0	0,0
4	Binder Clip No. 200	47,7344	44,655	3,1	9,5
5	Binder Clip No. 155	57,7556	70	-12,2	149,9
6	Binder Clip No. 105	39,0909	33,333	5,8	33,2
7	Binder Clip No. 107	47,6923	46,667	1,0	1,1
8	Binder Clip No. 220	49,8983	46,833	3,1	9,4
9	Double Tape	46,2727	47	-0,7	0,5
10	Ballpoint Biru	41,1818	39,333	1,8	3,4
11	Ballpoint Hitam	45,9706	43,515	2,5	6,0
12	Ballpoint Merah	33,3333	30	3,3	11,1
13	Box File (Bindex/Gema)	16	10	6,0	36,0
14	Buku Besar	35,6889	36,8	-1,1	1,2
15	Buku Kecil	37,451	35,385	2,1	4,3
16	Buku Pencatatan Ekspedisi	54,5455	70	-15,5	238,8
17	Buku Pencatatan Km	53,2727	58	-4,7	22,3
18	Business File	47,5455	46	1,5	2,4
19	Cutter Kecil	10	10	0,0	0,0
20	Dudukan Lakban	28	28	0,0	0,0
21	Isi Cutter Kecil	15	10	5,0	25,0
22	Isi Cutter Besar	30	30	0,0	0,0
23	Isi Straples Kecil	78	70	8,0	64,0
24	Isi Straples Besar	40,0862	35,625	4,5	19,9
25	Isolatip 12Mm X 72	18,9744	10	9,0	80,5
26	Kertas 3 Play Full	25,1136	10	15,1	228,4
27	Kertas 3 Play Prs	33,1	30,4	2,7	7,3
28	Kertas 4 Play	48,8871	47,074	1,8	3,3
29	Kertas A4	49,8983	46,833	3,1	9,4
30	Kertas Karbon	38	36	2,0	4,0
Total				**1043,462465**	

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(yi' - yi)^2}$$

n	**30**
RMSE	**5,897633607**
Dibulatkan	**5,9**

The table presents a process for calculating the Root mean squared error (RMSE) where a comparison is made where manual calculations with system calculations are tested so that the total RMSE obtained in the calculation of the office stationery stock estimation system is 5.897633607 rounded up to 5.9.

JURNAL RISET INFORMATIKA **P-ISSN: 2656-1743 |E-ISSN: 2656-1735**
Vol. 5, No. 1 December 2022 DOI: https://doi.org/10.34288/jri.v5i1.471
Accredited rank 3 (SINTA 3), excerpts from the decision of the Minister of RISTEK-BRIN No. 200/M/KPT/2020

RESULTS AND DISCUSSION

Tsukamoto fuzzy calculations produce a recommendation value from the process that starts with strict numbers as input. Fuzzy numbers are formed through fuzzification, and then fuzzy sets are grouped through an inference process. From the inference results, a defuzzification process is to confirm numbers as output. Then the RMSE accuracy test results get a value of 5.9. RMSE can be negatively oriented, where a lower value indicates a better value.

The system development resulted in a business process implemented with the Tsukamoto fuzzy method, as seen in Figure 5.

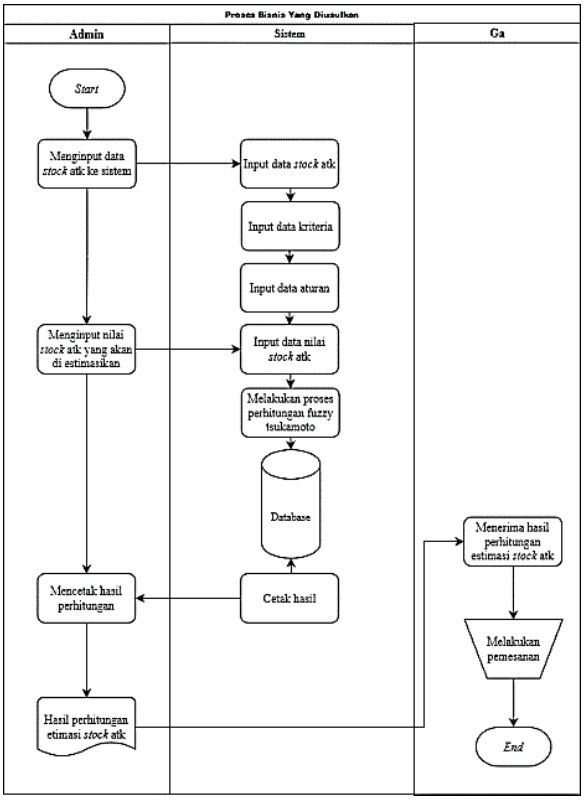

Figure 5 Business Process

There is an admin actor in the implementation of office stationery stock estimation with a system that has been built, which starts with inputting stock data, and then the system performs input tasks. Then the admin inputs the value to be estimated, and the system performs the task of inputting value data, then the system performs the Tsukamoto fuzzy algorithm then all the tasks that have been carried out are recorded in the system database. In the next stage, the admin can print the system calculation results.

In the system, development use UML so that Class Diagram diagrams are formed describing the system's structure in terms of defining the classes that will be made to build the system. The following is a class diagram which can be seen in Figure 6.

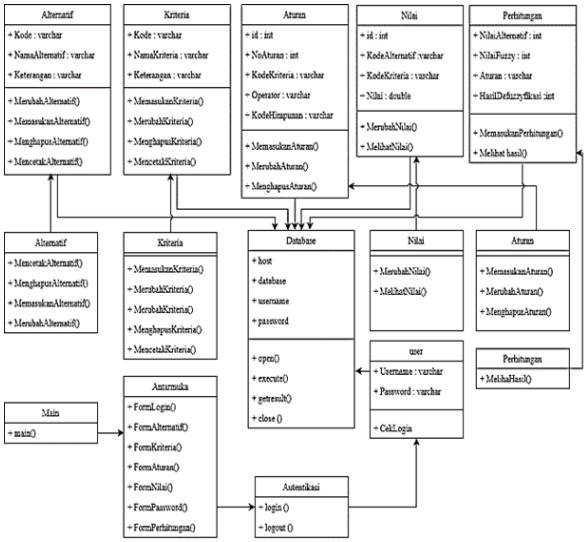

Figure 6 Class Diagram

Next, the use case diagram is obtained. Use case diagrams are used to find out what functions are contained in the system and who has the right to perform these functions. This system has login functions, alternative data management, data management criteria, data management rules, calculations, and data management passwords. The following is a use case for the office stationery stock estimation system depicted in Figure 7.

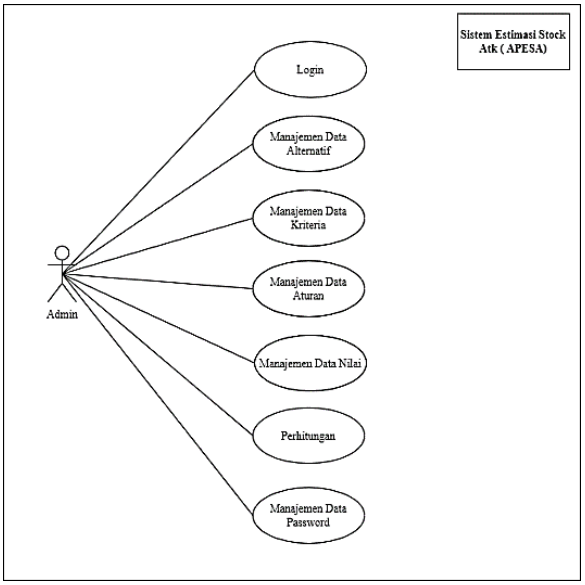

Figure 7 Use Case Diagram

In building this system, it is necessary to have a database design to find out how the system processes and records data in the database, the database used is MySQL.

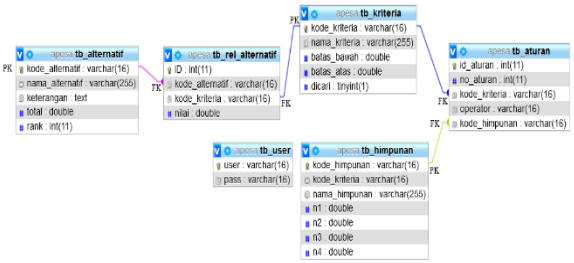

Figure 8 Database Relationship

In figure 8. Shows a relational database consisting of the following:

1. Table *tb_alternatif*

Contains office stationery stock item data consisting of *kode_alternatif, nama_alternatif, and keterangan.* Next, *kode_alternatif* is the primary key connected to the *tb_rel_alternatif* table.

2. Table *tb_rel_alternatif*

The stock value of office stationery consists of *id, kode_alternatif, and kode_kriteria*. Next, *kode_kriteria* is the primary key connected to the *tb_kriteria* table.

3. Table *tb_kriteria*

Contains variable criteria for office stationery stock that will be used to form a set consisting of *kode_kriteria, nama_kriteria, batas_bawah, and batas_atas*. Next, *kode_kriteria* is the primary key connected *to the tb_aturan* table.

4. Table *tb_aturan*

Contains variable rules for the fuzzy inference process consisting of *id_atuan, no_aturan, kode_kriteria, operator, and kode_himpunan*. Next, *kode_himpunan* is the primary key connected to the *tb_himpunan* table.

5. Table *tb_himpunan*

Contains variable set consisting of *kode_himpunan,kode_kriteria,nama_himpunan*.

6. Table *tb_user*

Contains user data variables consisting of *user* and *pass*.

System Implementation

The implementation process into program code uses the PHP programming language. This stage is converting system specifications into an executable system to produce a system view that makes it easier for users to access each feature.

1. Dashboard Page

The page displays the main page after logging in and presents the features of the office stationery stock estimation system. The following is the dashboard display which is seen in Figure 9.

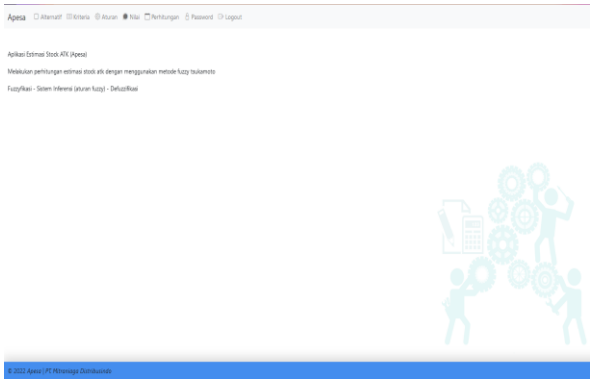

Figure 9. Dashboard Page

2. *Nilai* Page

This page functions to add valuable data that will be estimated based on alternative data, criteria data, and rule data used. The following is a display of the value page, which can be seen in Figure 10.

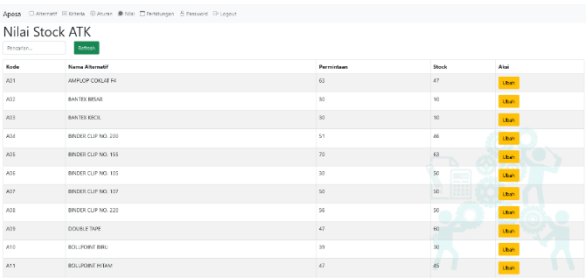

Figure 10. Nilai Page

3. *Perhitungan* Page

This page shows the results of estimation calculations using the Tsukamoto fuzzy Method. The following displays the calculation page, which can be seen in Figure 11.

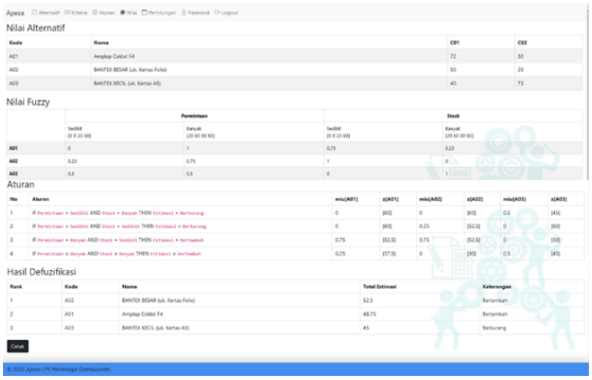

Figure 11. Perhitungan Page

CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the author's description regarding the implementation of the Tsukamoto fuzzy method of office stationery, a stock estimation system has been prepared. Office stationery stock estimation system performs the calculation process using the Tsukamoto fuzzy method where through the process of fuzzification stages, fuzzy inference, then defuzzification, testing the accuracy of the calculation results of the office stationery stock estimation system is carried out using the Root mean squared error (RMSE) to get a value 5,9. If the RMSE value is smaller, the predicted value is close to the observed value, and the RMSE can range from 0 to ∞. RMSE can be negatively oriented, where a lower value indicates a better value. Office stationery stock estimation system has been implemented using the waterfall method, which goes through the stages of analysis, UML diagram design, database design, and coding using visual code. The PHP programming language has been successfully tested using black box testing so that this system makes it easier for the Admin Head to estimate the office stationery stock that will be needed.

Suggestion

It is suggested that for future research development, it is expected to develop a desktop-based estimation system using other fuzzy methods such as the Mamdani and Sugeno methods.

REFERENCES

Agus Prayogi, Edy Santoso, & Sutrisno. (2018). *Sistem Pendukung Keputusan Untuk Penentuan Jumlah Produksi Nanas Menggunakan Metode Fuzzy Tsukamoto (Studi kasus PT.Great Giant Pineapple)* (Vol. 2). Retrieved 29 December 2022 from https://j-ptiik.ub.ac.id/index.php/j-ptiik/article/view/1596/540.

Budi Santosa. (2007). *Data Mining : Teknik Pemanfaatan Data untuk Keperluan Bisnis* (Ed. 1, cet. 1). Yogyakarta: Graha Ilmu.

Didik Setiawan, S. A. (2017). *Buku sakti pemrograman web : HTML, CSS, PHP, MYSQL & JAVASCRIPT / Didik Setiawan ; penyunting, Sony Adams*. Yogyakarta: Start Up.

Haryati. (2012). *Pemanfaatan Teknologi Informasi dan Komunikasi (TIK) dalam Meningkatkan Nilai Tambah Pelayanan Publik Guna Mewujudkan Masyarakat Berbasis Informasi*. Retrieved from https://balitbangsdm.kominfo.go.id/upt/bandung/?mod=publikasi&action=dl&cid=10&pub_id=5.

Hendi Setiawan. (2020). Prediksi Kebutuhan Alat Tulis Kantor Dengan Metode Fuzzy Logic Tsukamoto Di BPR Dana Mulia Sejahtera. *Bangkit Indonesia*, IX(01), 1–5. Retrieved 29 December 2022 from https://doi.org/https://doi.org/10.52771/bangkitindonesia.v9i1.105.

Kusrini, E. T. L. (2009). *Algoritma Data Mining*. Yogyakarta: ANDI Yogyakarta.

M. Ramaddan Julianti, Muhammad Iqbal Dzulhaq, & Ahmad Subroto. (2019). Sistem Informasi Pendataan Alat Tulis Kantor Berbasis Web pada PT Astari Niagara Internasional. *JURNAL SISFOTEK GLOBAL*, 9(2088 – 1762). Retrieved 12 December 2022 from https://doi.org/http://dx.doi.org/10.38101/sisfotek.v9i2.254.

M. Shalahuddin, & Rosa A.S. (2014). *Rekayasa Perangkat Lunak : Terstruktur dan berorientasi objek*. Bandung: Informatika Bandung.

Miftahul Huda, K. H. (2018). *Model Prediksi Kebutuhan BahanBakuPada Cafe Menggunakan Algoritma Fuzzy Tsukamoto*. Retrieved 15 December 2022 from Pangkalpinang: http://jurnal.atmaluhur.ac.id/index.php/knsi2018/article/view/408.

Yudantoro, T., Triyono, L., Suyanto, B., Sulistyo, W., Mardiyono, M., Sakinah, A., & Handoko, S. (2018). Sistem Informasi Monitoring Tugas Akhir Mahasiswa Prodi Teknik Informatika polines. SINTAK, 2. Retrieved from https://unisbank.ac.id/ojs/index.php/sintak/article/view/6604.

Muhammad Rijal Fadli. (2021). Memahami Desain Metode Penelitian Kualitatif. *Humanika*, 21(1), 33–54. Retrieved 29 December 2022 from https://doi.org/10.21831/hum.v21i1.

Muhammad Robith Adani. (2018). Jenis Aplikasi Berbasis Web Beserta Contoh Penerapannya. Retrieved 29 December 2022, from https://www.sekawanmedia.co.id/blog/aplikasi-berbasis-web/.

Novianti Puspitasari, Andi Tejawati, & Friendy Prakoso. (2019). Estimasi Stok Penerimaan Bahan Bakar Minyak Menggunakan Metode Fuzzy Tsukamoto. *JRST (Jurnal Riset Sains Dan Teknologi)*, 3(1), 9. Retrieved from https://doi.org/10.30595/jrst.v3i1.3112.

Sri Kusumadewi, & Hari Purnomo. (2013). *Aplikasi Logika Fuzzy Untuk Pendukung Keputusan* (2nd ed.). Yogyakarta: Graha Ilmu.

Suardika, K. W., Gandhiadi, G. K., & Harini, L. P. I. (2018). Perbandingan Metode Tsukamoto, Metode Mamdani Dan Metode Sugeno Untuk Menentukan Produksi Dupa (Studi Kasus : Cv. Dewi Bulan). *E-Jurnal Matematika*, 7(2), 180. Retrieved From https://doi.org/10.24843/mtk.2018.v07.i02.p201.

Supono. (2016). *Buku Pemrograman Web dengan Menggunakan PHP dan Framework Codeignite*. Yogyakarta: Deepublish.

Widhyaestoeti, D., Iqram, S., Mutiyah, S. N., & Khairunnisa, Y. (2021). Black box testing equivalence partitions for front-end testing on academic systems sitoda. Jurnal Ilmiah Teknologi Infomasi Terapan, 7(3), 211–216. https://doi.org/10.33197/jitter.vol7.iss3.2021.626