JEEE-U
Journal of Electrical and Electronic Engineering-UMSIDA
ISSN 2460-9250 (print), ISSN 2540-8658 (online)
Vol. 7, No. 1, April 2023
10.21070/jeeeu.v7i1.1636

E-Transaction Point Of Sales (Pos) With Fuzzy Tsukamoto Algorithm At Pt. Samihasa Kita

E-Transaction Point Of Sales (Pos) Dengan Algoritma Fuzzy Tsukamoto Di Pt. Samihasa kami

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Abstract,_*PT. Samihasa Kita is a glass product distributor company that was founded in 1989, which is located in the city of Semarang, Central Java, with sales area coverage in Central Java, D.I Yogyakarta, Jakarta, and Kalimantan. So far, PT Samihasa Kita has an erratic amount of demand for goods, as a result, sometimes the number of goods produced for sale with the goods purchased by consumers is not balanced. This resulted in PT Samihasa Kita not getting the maximum profit. Based on this problem, Fuzzy Tsukamoto logic was chosen to determine the optimal daily production amount. By using fuzzy logic can be determined the relative size of the production of goods. The Fuzzy Tsukamoto method can also be used to forecast sales in the coming month based on the amount of inventory. Thus the amount of production and demand for goods PT. Samihasa Kita is predictable and balances transactions. This research aims to be able to predict demand and procurement of goods that will have an impact on optimizing revenue at PT. Samihasa Kita.*

Keywords: Point Of Sales; E-Transaction; Sales Forecasting; Fuzzy Tsukamoto

Abstrak,_ PT. Samihasa Kita adalah perusahaan distributor produk kaca yang berdiri sejak tahun 1989 yang berlokasi di kota Semarang, Jawa Tengah, dengan cakupan area penjualan di Jawa Tengah, D.I Yogyakarta, Jakarta, dan Kalimantan. Selama ini PT Samihasa Kita memiliki jumlah permintaan barang yang tidak menentu, akibatnya terkadang jumlah barang yang diproduksi untuk dijual dengan barang yang dibeli oleh konsumen tidak seimbang. Hal ini mengakibatkan PT Samihasa Kita tidak mendapatkan keuntungan yang maksimal. Berdasarkan permasalahan tersebut, logika Fuzzy Tsukamoto dipilih untuk menentukan jumlah produksi harian yang optimal. Dengan menggunakan logika fuzzy dapat ditentukan ukuran relatif dari produksi suatu barang. Metode Fuzzy Tsukamoto juga dapat digunakan untuk meramalkan penjualan di bulan yang akan datang berdasarkan jumlah persediaan. Dengan demikian jumlah produksi dan permintaan barang PT. Samihasa Kita dapat diprediksi dan menyeimbangkan transaksi. Penelitian ini bertujuan untuk dapat memprediksi permintaan dan pengadaan barang yang akan berdampak pada optimalisasi pendapatan pada PT. Samihasa kami.

Kata Kunci: Titik Penjualan; Transaksi Elektronik; Peramalan Penjualan; Fuzzy Tsukamoto

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I. INTRODUCTION

The sales system is the key to the success of a company. For a business, the sales process is one of the most important processes for a business to survive. The high number of requests is the main factor that drives the need for an information technology-based sales system to help manage data and information in running this business [1].

Most businesses do not fully use computer equipment to record sales and purchases. In the sense that the data processing in these businesses is still manual, either using books or Microsoft Excel. This makes it impossible to process data, generate sales reports, and make calculations on the fly. In addition, data storage media is still in the form of archives that can be easily damaged or even lost.

PT. Samihasa Kita is a glass product distributor company that was founded in 1989. The company is based in the city of Semarang, Central Java with a customer area coverage of all of Central Java and Yogyakarta. PT. Samihasa Kita through its slogan is determined to provide ease of ordering, timely delivery of products, and to provide quality guaranteed products at competitive prices.

As a glass distributor company, this company offers various types of glass and customers can buy it by telephone or by visiting in person.

Point Of Sale (POS) is an application that is designed according to your needs and can be combined with various tools to speed up the transaction process. The POS system can not only make purchases and sales, but also includes product and stock management as well as sales reports on a weekly, monthly or periodic basis according to customer needs [2].

Point of sale is usually an application designed to make sales, purchases, returns, and inventory transactions. Web-based POS applications can be very useful. First, consumers do not need to come to the company to see the products they want to buy. Second, from a financial perspective, consumers can save money. If the location of the store is far, consumers can replace the cost of traveling to the company's location with cheaper shipping costs.

So far, PT Samihasa Kita has an erratic amount of demand for goods, as a result, sometimes the number of goods produced for sale with the goods purchased by consumers is not balanced. This resulted in PT Samihasa Kita not getting the maximum profit.

There are many ways to determine the optimal daily production amount, and one of them is by using fuzzy logic. By using fuzzy logic can be determined the relative size of the production of goods. This aims to balance the number of goods produced with the amount of demand for goods by consumers so that a meeting point is reached between the amount of production and the amount of demand for goods.

There are three methods in the fuzzy inference system that can be used to determine the amount of production, namely: the Tsukamoto method, the Mamdani method, and the Sugeno method [3]. The method that will be used in this study in determining the amount of production is the Tsukamoto method. This method was chosen because every consequence of the IF-THEN rule must be represented by a fuzzy set with a monotonous membership function. As a result, the inference output of each rule is given in a crisp (crisp) based on the - predicate (fire strength). The final result is obtained using the weighted average [4].

This research aims to be able to predict demand and procurement of goods that will have an impact on optimizing revenue at PT. Samihasa Kita.

II. THEORETICAL BASIS

A. Literature Review

Monitoring Point Of Sale (Pos) Based on Web & SMS Gateway at Printing Kompas Banjarbaru explained about the development of web-based applications and SMS Gateway to make it easier for Kompas printing companies in terms of report generation, file transfer processes, recap of material purchases to be more computerized and also able to send notification that the order from the customer has been completed automatically [5].

Point Of Sale at the Tupperware Kupang Store built a Point Of Sales application to promote products at the Tupperware Kupang store in order to reduce the amount of promotional costs, and increase the promotional coverage area so that it is not only limited to certain areas that sell the newspaper and the information [6].

Point Of Sale Using Dynamic Software Development Method on Softdrink Agent (Case study: Agen Sahri Jaya)" explained that the Point of Sale (POS) transaction application is an application system consisting of hardware and software designed according to needs and can be integrated with various supporting tools to help speed up the transaction process. The POS system designed by Ardeansyah includes buying and selling transactions, as well as accounting processes, goods and stock management, and reports that are the needs of agents [1].

Point of Sale for data collection of goods and transactions at Optik Tazma as a solution to improve the sales process more effectively and efficiently, as well as facilitate the work of employees related to service, making it easier for optical owners to check and evaluate income from sales . Harahap emphasized that the Point Of Sale (POS) Sales application on Optik Tazma can help facilitate the work of other employees and make it easier to plan future sales targets so that they continue to increase [2].

Pos (Point Of Sale) Cafes for Portable Cashiers and Bluetooth Printers explained that some of the problems that existed were that the cafe's financial transaction system had not yet utilized a digital cash register, only a drawer machine. So there is a limit on the calculation of transactions. Therefore, Pamungkas and Yuliansyah designed an android tablet cashier application to help process sales transactions and be able to

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recapitulate transaction data reports in cafes. In addition, their application added a receipt printing feature for customers [7].

B. Electronic Commerce (E-Commerce)

Electronic Commerce or abbreviated as E-commerce does not yet have a uniform term in Indonesian. The definition of electronic transactions is contained in Law Number 19 of 2016 concerning Information and Electronic Transactions, Article 1 number 2 that "Electronic Transactions are legal actions carried out using computers, computer networks, and/or other electronic media."

C. Point of Sales (POS)

Point Of Sale is a sales-oriented activity as well as a system that helps process transactions. Each POS consists of hardware in the form of (Terminal/PC, Receipt Printer, Cash Drawer, Payment terminal, Barcode Scanner) and software in the form of (Inventory Management, Reporting, Purchasing, Customer Management, Transaction Security Standards, Return Processing) where the two components are used to every transaction process [1].

D. Fuzzy Tsukamoto

The Tsukamoto method is an extension of monotonous reasoning. In the Tsukamoto method, every consequence of the IF-Then rule must be represented by a fuzzy set with a monotonic membership function. As a result, the inference output of each rule is given in a crisp (crisp) based on the D-predicate (fire strength). The final result was obtained using the weighted average [8].

III. Research Method

A. System Architecture

[figure 1 about here.]

Point Of Sale E-Transactions are carried out using the Fuzzy Tsukamoto algorithm to forecast demand and procurement of goods that will have an impact on revenue optimization.

B. Activity Diagram Sales Forecast

[figure 2 about here.]

C. Method Fuzzy Tsukamoto

The Tsukamoto method is an extension of monotonous reasoning. In Tsukamoto's method, a fuzzy set with a monotonic membership function must be used to represent each result of the IF-THEN rule. As a result, the output of the inference results of each rule is explicitly (obviously) given based on the predicate (firepower). It is known that the purchase and inventory data of 10 products from PT. Samihasa Kita in November 2021 (in PCS) is as follows:

[Tabel 1 about here.]

From these data, it can be seen that NR 2 72 x 48 Inch glass has the following data:

- Purchase amount = 50 sheet
- Amount of stockpile = 25 sheet

Sales forecasting in December using the fuzzy tsukamoto algorithm is as follows:

1. Purchase Data (X) is assumed to have 3 members, namely:

Membership	Value Interval
Low (b)	<35
Normal (c)	35-70
High Score (d)	>70

Lowest purchase amount (a) : 10
Highest number of purchases (e) : 90

2. Inventory data (Y) is assumed to have 3 members, namely:

Membership	Value Interval
less value (g)	<30
enough value (h)	30-60
too much (i)	>60

Minimum inventory quantity (f) : 5
Most inventory quantity (j) : 100

3. Sales data (Z) is assumed to have 3 members, namely:

Membership	Value Interval
Little (l)	<30
Medium (m)	30-75
Many (n)	>75

Minimum number of sales (k) : 10
Most sales (o) : 100

4. Tsukamoto Fuzzy Calculation Formula:
   1. Purchase Membership function:
      If purchase stats go up (μXn)

$$\mu[x]\begin{cases}0 \text{ if } x \le a\\ (x-a)/(b-a) \text{ if } a \le x \le b\\ (x-b)/(c-b) \text{ if } b \le x \le c\\ (x-c)/(d-c) \text{ if } c \le x \le d\\ (x-d)(e-d) \text{ if } d \le x \le e\\ 1 \text{ if } x \ge e\end{cases}$$

      If purchase stats drop (μXt)

$$\mu[x]\begin{cases}(a-x)/(b-a) \text{ if } a \le x \le b\\ (b-x)/(c-b) \text{ if } b \le x \le c\\ (d-x)/(d-c) \text{ if } c \le x \le d\\ (e-x)/(e-d) \text{ if } d \le x \le e\\ 0 \text{ if } x \ge e\end{cases}$$

   2. Inventory Membership Functions:
      If inventory stats increase (μYn)

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$$\mu[x]\begin{cases} 0 \text{ if } x \le f \\ (x-f)/(g-f) \text{ if } f \le x \le g \\ (x-g)/(h-g) \text{ if } g \le x \le h \\ (x-h)/(i-h) \text{ if } h \le x \le i \\ (x-i)(j-i) \text{ if } i \le x \le j \\ 1 \text{ if } x \ge j \end{cases}$$

If inventory stats decrease (μYt)

$$\mu[x]\begin{cases} (g-x)/(g-f) \text{ if } f \le x \le g \\ (h-x)/(h-g) \text{ if } g \le x \le h \\ (i-x)/(i-h) \text{ if } h \le x \le i \\ (j-x)/(j-i) \text{ if } i \le x \le j \\ 0 \text{ if } x \ge j \end{cases}$$

3. Sales Membership Functions:
If the sales statistics are getting less (μZn)

$$\mu[x]\begin{cases} 0 \text{ if } x \le k \\ (x-k)/(l-k) \text{ if } k \le x \le l \\ (x-l)/(m-l) \text{ if } l \le x \le m \\ (x-m)/(n-m) \text{ if } m \le x \le n \\ (x-n)(o-n) \text{ if } n \le x \le o \\ 1 \text{ if } x > o \end{cases}$$

If the sales statistics are more and more (μZt)

$$\mu[x]\begin{cases} (l-x)/(l-k) \text{ if } k \le x \le l \\ (m-x)/(m-l) \text{ if } l \le x \le m \\ (n-x)/(n-m) \text{ if } m \le x \le n \\ (o-x)/(o-n) \text{ if } n \le x \le o \\ 0 \text{ if } x \ge o \end{cases}$$

Rules that apply in fuzzy:
[R1] IF Purchases DOWN And Inventories INCREASE, THEN Sales ARE GETTING LESS;

[R2] IF Purchases DOWN And Inventory is DECREASING, THEN Sales ARE GETTING LESS;

[R3] IF Purchases INCREASE And Inventories INCREASE,THEN Sales ARE GETTING MORE;

[R4] IF Purchases are UP and Inventory is DECREASING, THEN Sales ARE GETTING MORE;

IV. Result and Discussion

Sample Case:

Purchase amount = 50

Amount of stockpile = 25

What is the total sales?

FUZZY PURCHASE

$(\mu Xn) = (x-c)/(d-c) = 50 - 35 / 70 - 35 = 0{,}43$
$(\mu Xt) = (d-x)/(d-c) = 70 - 50 / 70 - 35 = 0{,}57$

FUZZY INVENTORY

$(\mu Yn) = (x-f)/(g-f) = 25 - 50 / 30 - 5 = 0{,}8$
$(\mu Yt) = (g-x)/(g-f) = 30 - 25 / 30 - 5 = 0{,}2$

RULE FUZZY

[R1] IF Purchases DOWN And Inventory INCREASED, THEN Sales ARE GETTING LESS;

R1 = min(0,57 , 0,8) = 0,57

R1 = (Z1 – minSales) / (maxSales – minSales)

0,57 = (Z1 – 10) / (100-10)

Z1 = 61,3

[R2] IF Purchases are DOWN and Inventory is DECREASING, THEN Sales ARE GETTING LESS;

R2 = min(0,57 , 0,2) = 0,2

R2 = (Z2 – minSales) / (maxSales – minSales)

0,2 = (Z2 - 10) / (100-10)

Z2 = 28

[R3] IF Purchases INCREASE And Inventories INCREASE, THEN Sales ARE GETTING MORE;

R3 = min(0,43 , 0,8) = 0,43

R3 = (maxSales – Z3) / (maxSales – minSales)

0,43 = (100 – Z3) / (100-10)

Z3 = 61,3

[R4] IF Purchases are UP and Inventory is DECREASING, THEN Sales ARE GETTING MORE;

R4 = min(0,43 , 0,2) = 0,2

R4 = (maxSales – Z4) / (maxSales – minSales)

0,2 = (100 – Z4) / (100-10)

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Z4 = 82

WEIGHTED MOVING AVERAGE

$$Z = \frac{(R1 \times Z1)+(R2 \times Z2)+(R3 \times Z3)+(R4 \times Z4)}{R1+R2+R3+R4}$$

$$Z = \frac{(0{,}57 \times 61{,}3)+(0{,}2 \times 28)+(0{,}43 \times 61{,}3)+(0{,}2 \times 82)}{0{,}57+0{,}2+0{,}43+0{,}2}$$

$$Z = 61{,}0577 = 61{,}06$$

Thus the total sales of 3mm ribbon glass at PT. Samihasa Kita in December is estimated to be 61 pieces.

Item Data Forecast Display

[figure 3 about here.]

The results of the calculations performed using the Tsukamoto fuzzy algorithm as shown above. Calculations are made based on the number of goods available with the number of sales of goods in that month, it is obtained forecasts of goods that should be produced by PT. Samihasa Kita.

Sales Revenue Forecast Display

[figure 4 about here.]

The picture above is a calculation for the sales revenue forecast for the next month. The calculation is based on the number of items sold with the total sales for the month.

CONCLUSION

Based on the results of the E-Transaction Point Of Sales (POS) testing of glass sales with the Tsukamoto fuzzy algorithm, it can be concluded that the application of the Tsukamoto fuzzy algorithm in forecasting sales has good accuracy. Forecasting with Tsukamoto fuzzy can recommend the number of goods produced in the future and predict future sales which have an impact on optimizing the company's revenue.

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Peer reviewed under reponsibility of Stikubank University Semarang, Semarang, Indonesia

Received: 2022-02-06
Accepted: 2022-02-25
Published: 2023-2-18

Journal of Electrical and Electronic Engineering-UMSIDA
ISSN 2460-9250 (print), ISSN 2540-8658 (online)
Vol. 7, No. 1, April 2023
10.21070/jeeeu.v7i1.1636

DAFTAR TABEL

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Journal of Electrical and Electronic Engineering-UMSIDA
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Vol. 7, No. 1, April 2023
10.21070/jeeeu.v7i1.1636

Table 1. Item Data Sample

No	Name of Goods	Supply	Purchase	Forecast
1	FHSM84 BOAI	23	25	4
2	SM 10 PSS	21	25	4
3	SM 20 PSS	15	25	4
4	SMUS 10 PSS	30	25	4
5	NR 2 72 x 48 Inch	25	50	40
6	FL 2 48 x 24 Inch	15	50	25
7	FL 2 48 x 36 Inch	34	50	10
8	FL 2 48 x 34 Inch	48	50	15
9	FL 2 50 x 30 Inch	32	50	20
10	FL 6 120 x 84 Inch	24	50	10

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DAFTAR GAMBAR

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Vol. 7, No. 1, April 2023
10.21070/jeeeu.v7i1.1636

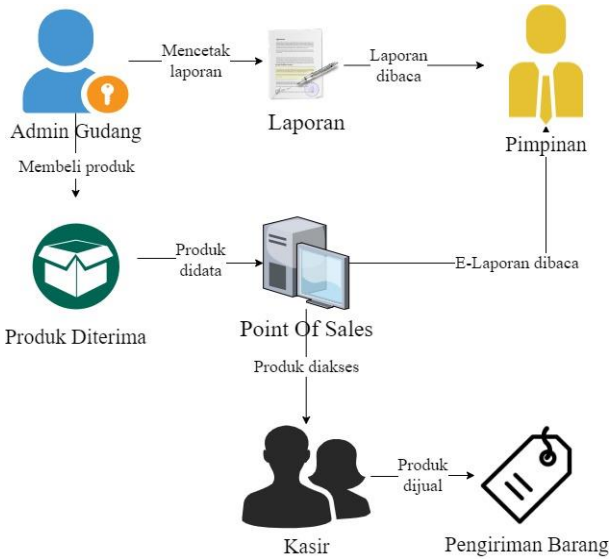

Figure 1. System Architecture

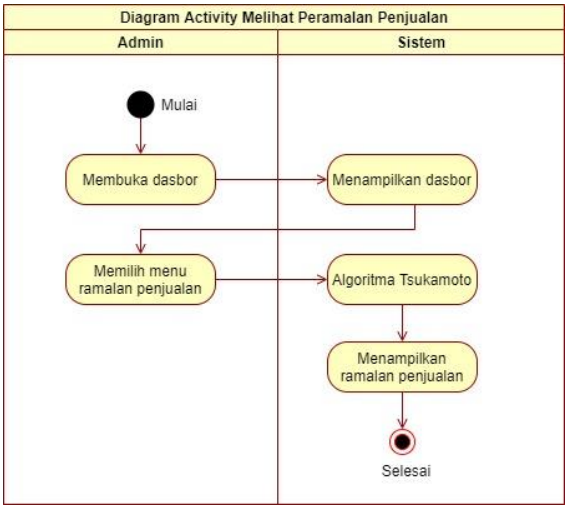

Figure 2. Activity Diagram

Journal of Electrical and Electronic Engineering-UMSIDA
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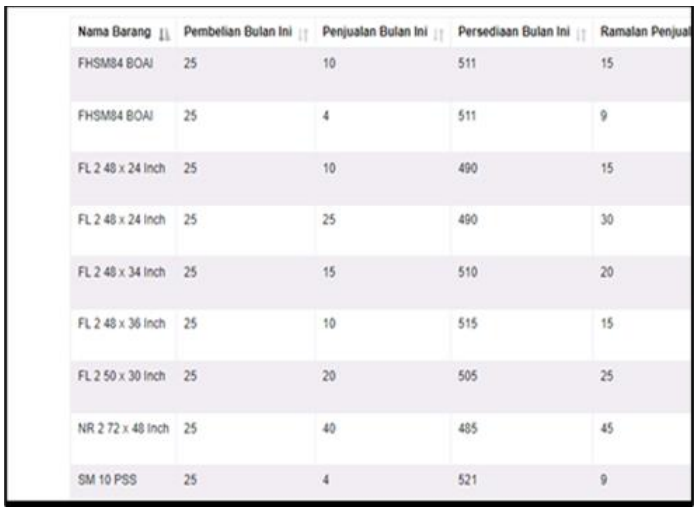
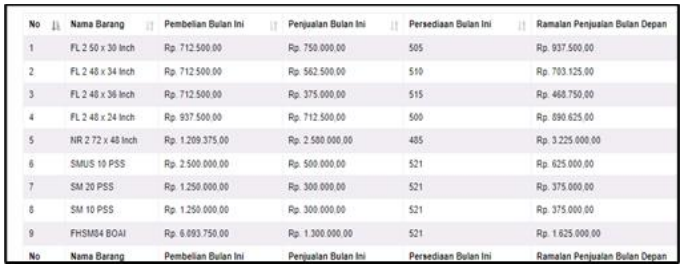


Nama Barang	Pembelian Bulan Ini	Penjualan Bulan Ini	Persediaan Bulan Ini	Ramalan Penjual
FHSM84 BOAI	25	10	511	15
FHSM84 BOAI	25	4	511	9
FL 2 48 x 24 Inch	25	10	490	15
FL 2 48 x 24 Inch	25	25	490	30
FL 2 48 x 34 Inch	25	15	510	20
FL 2 48 x 36 Inch	25	10	515	15
FL 2 50 x 30 Inch	25	20	505	25
NR 2 72 x 48 Inch	25	40	485	45
SM 10 PSS	25	4	521	9

Figure 3. Goods Data Forecast Results



No	Nama Barang	Pembelian Bulan Ini	Penjualan Bulan Ini	Persediaan Bulan Ini	Ramalan Penjualan Bulan Depan
1	FL 2 50 x 30 Inch	Rp. 712.500,00	Rp. 750.000,00	505	Rp. 937.500,00
2	FL 2 48 x 34 Inch	Rp. 712.500,00	Rp. 562.500,00	510	Rp. 703.125,00
3	FL 2 48 x 36 Inch	Rp. 712.500,00	Rp. 375.000,00	515	Rp. 468.750,00
4	FL 2 48 x 24 Inch	Rp. 937.500,00	Rp. 712.500,00	500	Rp. 890.625,00
5	NR 2 72 x 48 Inch	Rp. 1.209.375,00	Rp. 2.580.000,00	485	Rp. 3.225.000,00
6	SMUS 10 PSS	Rp. 2.500.000,00	Rp. 500.000,00	521	Rp. 625.000,00
7	SM 20 PSS	Rp. 1.250.000,00	Rp. 300.000,00	521	Rp. 375.000,00
8	SM 10 PSS	Rp. 1.250.000,00	Rp. 300.000,00	521	Rp. 375.000,00
9	FHSM84 BOAI	Rp. 6.093.750,00	Rp. 1.300.000,00	521	Rp. 1.625.000,00
No	Nama Barang	Pembelian Bulan Ini	Penjualan Bulan Ini	Persediaan Bulan Ini	Ramalan Penjualan Bulan Depan

Figure 4. Sales Revenue Forecast