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Loyal Customer Classification using Fuzzy Logic Inference System

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A company will be better if it can maintain its existence in the community, then the company is more oriented to acquire new customers.But one day it will lose customers if it is not managed properly. In this case there is a customer satisfaction variable that affects customer loyalty in a company. In this study apply fuzzy logic inference method to select customers with the highest level of loyalty. The extraordinary value of a customer towards a company certainly cannot be declared with certainty or exactness. So that the decision making is very suitable when using the concept of fuzzy logic, because it can represent variables that are vague or not exact. The case study in this study was conducted in a trading company or supermarket. The result of its implementation is that the system can determine who is the most loyal of several selected samples of customers.

Keywords: Classification, Customer loyalty, Fuzzy Logic.

Suatu perusahaan semakin baik jika dapat mempertahankan eksistensinya di masyarakat, maka perusahaan tersebut lebih berorientasi untuk memperoleh pelanggan baru. Namun suatu saat akan mengakibatkan kehilangan pelanggan jika tidak diatur dengan baik. Dalam hal ini terdapat variabel kepuasan pelanggan yang mempengaruhi loyalitas pelanggan pada sebuah perusahaan. Dalam penelitian ini menerapkan metode inferensi fuzzy logic untuk memilih pelanggan dengan tinggat loyalitas paling tinggi. Seberapa loyal seorang pelanggan terhadap suatu perusahaan tentunya tidak bisa dideklarasikan secara pasti atau eksak. Sehingga pengambilan keputusannya sangat cocok apabila menggunakan konsep fuzzy logic, karena dapat merepresentasikan variabel yang bersifat samar atau tidak eksak. Studi kasus pada penelitian ini dilakukan pada perusahaan dagang atau swalayan. Hasil penerapannya adalah sistem bisa menentukan pelanggan yang paling loyal dari beberapa sampel pelanggan terpilih.

Kata Kunci: Fuzzy Logic, Klasifikasi, Loyalitas pelanggan.

INTRODUCTION

The economic growth rate in Indonesia is growing every year, according to the Central Statistics Agency of the Republic of Indonesia, economic growth in the second quarter of 2024 was quite impressive at 3.79%, then balanced with the stability of the rupiah exchange rate which is quite good, as well as the growth of the composite stock price index which is quite high when compared to the G20 countries and around ASEAN [1]. The level of consumption of the Indonesian people is also high, this has given rise to many trading companies that are present in society, both in minimalist and large forms. With the competition, of course, various methods are used by these trading companies to increase the number of their customers. The level of economic growth in Indonesia is growing every year, according to the Central Statistics Agency of the Republic of Indonesia, economic growth in the second quarter of 2024 was quite impressive at 3.79%, then balanced with the stability of the rupiah exchange rate which is quite good, as well as the growth of the composite stock price index which is quite high when compared to the G20 countries and around ASEAN [1]. The level of consumption of the Indonesian people is also high, this has given rise to many trading companies that are present in society, both in minimalist and large forms. With the existence of competition, of course, various methods are used by these trading companies to increase the number of their customers. However, many companies do not focus on the customers they have acquired, so they will tend to lose customers (loss of customer) if not handled immediately [2][3]. Of course, if this happens, it will affect the existence of the company because customers will focus more on satisfaction and services in a company such as supermarkets [4]. From these problems, supermarkets should maintain their customers. There are many ways to do this, one of which is by giving awards to the most loyal customers of the company. The characteristics of a developing supermarket are offering class-specific value propositions for each customer category. Such strategies usually begin with customer classification, a concept that has developed into an integral part of marketing and is applied by many supermarkets to meet customer needs more precisely [5][6]. In customer classification requires several variables such as customer satisfaction level, and how loyal a customer is to a company visited, it will be difficult to represent. Therefore, in this study, the concept of fuzzy logic is applied which has been known as a logic concept that can represent inexact variables. Several previous studies have mentioned that the concept of fuzzy logic is quite effective in the problem of determining a decision [7][8]. In this study, the concept of fuzzy logic can be applied as an effective optimization method for the problem of determining customer loyalty. It is expected that this method can select the most loyal customers without including subjective elements in the selection

METHODOLOGY

Basically, a fuzzy system has the following stages:

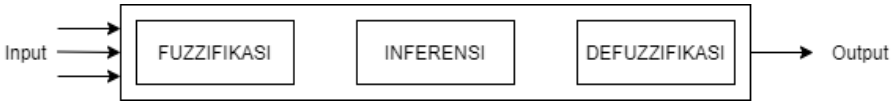

Figure 1.
Fuzzy System Structure

Fuzzifikasi

The fuzzification process is changing the input values and determining the degree of membership where the input values become members of each appropriate fuzzy set [9].
The stages in this process are determining fuzzy variables, fuzzy sets, universes of discourse, and domains of fuzzy sets.

a. Fuzzy variables

Some variables that will be discussed to determine the objectives to be achieved are:

- Total sales (A1)
  That is the total spending of each customer.
- Total customer arrivals (A2)
  That is the frequency of each customer's arrival to shop.
- Sales Increase (A3)
  That is the increase in the amount of spending of each customer.

b. Fuzzy set

For variables A1 and A3, divide the fuzzy set into 3, namely low, medium, high. While for A2, divide the fuzzy set into few, medium, and many.
Figure 2 shows an example of a fuzzy set graph on variable A1. While Figure 3 is an example of a graph of the output variable set.

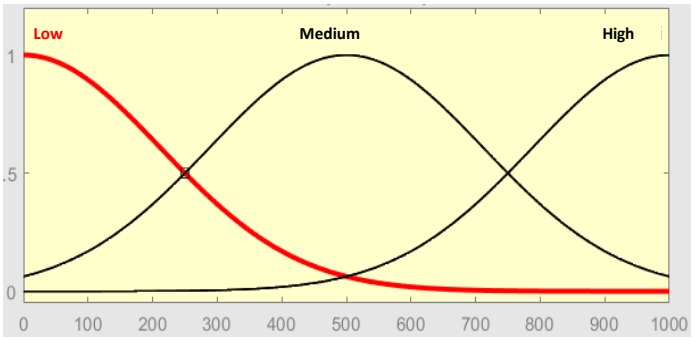

Figure 2.
Fuzzy Set Variable A1

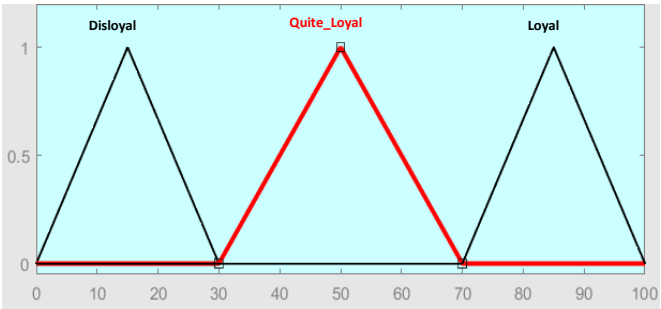

Figure 3.
Fuzzy Set of Output Variables

c. Universe of discourse

The universe of discourse is the entire value that is allowed to be operated on in fuzzy variables [9].

- Universe of discourse for A1: [0,+∞].
- Universe of discourse for A2: [0, 50].
- Universe of discourse for A3: [0, 100].

d. Domain

The domain is the entire range of values that can be operated on in a fuzzy set.

- A1 :
  Low = [0,500].
  Medium = [200, 800].
  High = [600, +∞].
- A2 :
  Low = [0, 25].
  Medium = [15, 35].
  High = [35, +∞].
- A3 :
  Low = [0, 50].
  Medium = [25, 75].
  High = [50, 100].

Inference

Inference is the process of transforming an input to an output in a fuzzy domain. In this process, there are rules stored in the knowledge base. The MAX-MIN reasoning technique in this study is used as logic for decision making [6]. With the many parameters available, the rules used will also be many.

Of the 27 rules used, the following are the core rules of all the rules for determining LOYAL, QUITE LOYAL and DISLOYAL customers:

[R1] IF A1 is high AND A2 is high AND A3 is high THEN LOYAL customers.
[R2] IF A1 is moderate AND A2 is moderate AND A3 is moderate THEN QUITE LOYAL customers.
[R3] IF A1 is low AND A2 is low AND A3 is low THEN customer DISLOYAL.

Defuzzification

Defuzzification is the process of changing fuzzy quantities in the form of fuzzy output sets with their membership functions [10]. Defuzzification contains input, process and output. In this study, defuzzification is illustrated in Figure 4.

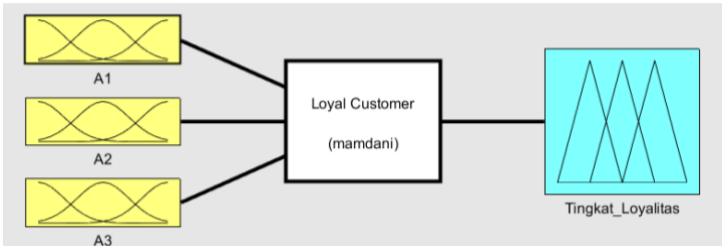

Figure 4.
Defuzzification Illustration

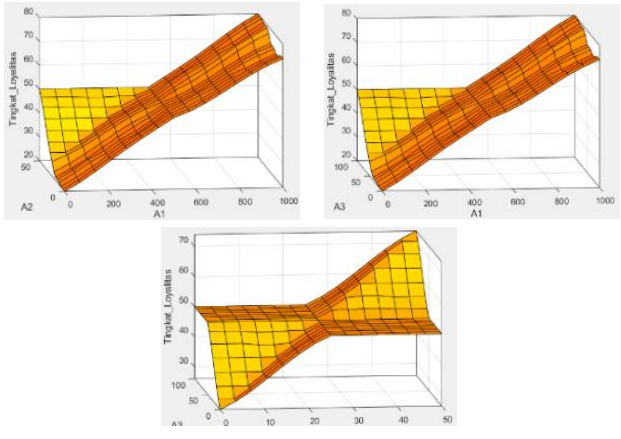

Figure 5.

Fuzzy Logic Surface

RESULT AND DISCUSSION

From the available data, 10 customers were selected who had the highest total purchases and consistently shopped every month. This is very possible, because the customers in question are customers who shop for their respective store needs and the items purchased will be resold.

The five customers who are candidates to be promoted as the most loyal customers are C1, C2, C3, C4, C5, C6, C7, C8, C9, and C10, respectively, customers 1 to 10.

From the results of the implementation of fuzzy logic C1, C3, C7, and P9 are disloyal customers symbolized by D. For quite loyal customers (QL) are C6, C8 and C10, while C2, C4, and C5 are loyal customers (L). The following is the data for each customer:

Table 1.
Customer Data

Customer	A1 (Million)	A2 (Time)	A3 (%)	Information
C1	19,7	7	12	D
C2	573	49	89	L
C3	184	7	14	D
C4	621	45	92	L
C5	1.211	41	79	L
C6	250	31	37	QL
C7	129	20	31	D
C8	453	42	45	QL
C9	37	17	25	D
C10	724	39	69	QL

Next, the calculation is done using the Zadeh operator so that the predicate α is obtained to determine the z value. The following is the calculation for customer P1:

α (R1) = μ (A1 low) $\cap$ μ (A2 little) $\cap$ μ(V3 low)
= min{0;0;0}
= 0

α (R5) = μ (A1 high) $\cap$ μ (A2 lots) $\cap$ μ(V3 high)
= min{1;1;1}
= 1

α (R8) = μ (A1 medium) $\cap$ μ (A2 lots) $\cap$ μ(V3 medium)
= min{0,5;1;0,5}
= 0,5

$$Nilai\ Z5 = \frac{x - 35}{60 - 35} = 1$$

$$x = 60$$

The calculation is done using 3 samples because some customers have the same characteristics. For C1, the value of α (R1) is 0, the same as C3, C7 and C9. For C8, the value of α (R1) is 0.5, the same as C6 and C10, while for P5, the value of α (R1) is the largest, which is 1, the same as C2 and C4.

Then from the calculation results for P1 to P10, it is known that C2, C4 and C5 have the highest loyalty values among other customers. Because for C1, C3, C7 and C9, the results of α (R) are all 0. While C6, C8 and C10 each have a Z value of 42.5.

From the calculation results and the application of fuzzy logic, the value of consumer loyalty can be sorted from highest to lowest with the results C5> C4> C2> C10> P8> C6> C7> C4> C9> C1.

CONCLUSIONS AND SUGGESTIONS

From the research study that has been conducted with reference to the implementation of fuzzy logic in determining the level of customer loyalty, the following conclusions can be drawn:

a. To make decisions that have linguistic variables, it will be suitable to apply the fuzzy logic concept based on data owned by a company.
b. The fifth customer is determined as the most loyal customer without any subjectivity in making decisions.

The research study that has been conducted by the author has not been maximized, so the suggestion for further research is to find or apply a more accurate method for making decisions that have linguistic variables.

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