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Rough Set Method for Determining Customer Satisfaction at Pdam Tirtanadi Medan City

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ABSTRACT: It is very important to evaluate customer satisfaction as an effort to see the level of performance of PDAM Tirtanadi, Medan City. With this research was carried out to determine the level of customer satisfaction at PDAM Tirtanadi, Medan City using data mining. The research method used is an analytical method with a structured approach which is complete with the tools and techniques needed in the system so that the analysis results of the system being developed produce a system whose structure can be defined well and clearly. The main goal of rough set analysis is to synthesize conceptual approaches from the data obtained. This research aims to determine the level of customer satisfaction of PDAM Tirtanadi Medan City so that it can help PDAM to better understand the complaints of people who use PDAM Tirtanadi Medan City services.

KEYWORDS: Customer Satisfaction, Rough Set, Data mining

INTRODUCTION

Indonesia Constitution (UUD 1945) Article 33 paragraph 3 state that the earth, water and natural resources contained therein are controlled by the state and used as much as possible for the prosperity of the people. Water resources in Indonesia are managed by the Drinking Water Company (PAM) which has authority from the government to manage the community's clean water consumption needs. Drinking Water Companies (PAM) located in regional government areas are called Regional Drinking Water Companies (PDAM), one of which is PDAM Tirtanadi located in Medan City, North Sumatra Province.In order to increase customer satisfaction, PDAM Tirtanadi often experiences difficulties in maintaining the production of clean water installations because the quantity of clean water to consumers is disrupted. The instability of raw water supply to production installations is caused by the amount of water discharge experiencing uncertainty in the time process from one dry season to another,To find out the level of consumer satisfaction, data mining is one solution to solve this problem (Istianingsih & Defit, 2021) (Oyedele et al., 2020). Data Mining is a process that uses statistical techniques, mathematics, artificial intelligence, machine learning to extract and identify useful information and related knowledge from various large databases (Saura, 2021)(Rao Vajjhala & Ramollari, 2016).

METHOD

Research Method is a scientific way to obtain data with a specific purpose and use, a Rational scientific method means that research is carried out in ways that make sense, so that research activities are based on scientific characteristics, namely rational, empirical and systematic (Maroufkhani et al., 2020) (Carrillo-Larco & Castillo-Cara, 2020). Rational means that research is carried out in ways that make sense, so that it is within reach of human reasoning. Empirical means that the methods used can be observed by the human senses so that other people can observe and know the methods used. Systematic means that the process used in the research uses certain logical steps(Shao et al., 2020).In this research, researchers used descriptive methods. The descriptive method is a research method that aims to explain an event that is taking place in the present and also in the past. In this research, the researcher did not manipulate the data being studied. This research method can be divided into two, namely Longitudinal (over time) and Cross Sectional (certain time). In this research, researchers used a quantitative approach, namely research carried out systematically, structured and in detail. In its implementation, method

This research focuses on the use of numbers, tables, graphs and diagrams to display the results of data / information obtained in the information system used.

RESULTS AND DISCUSSION

Case studies conducted on customer satisfaction. Customer data will be used as a sample to analyze customer satisfaction data, which is the criterion used to determine the level of customer satisfaction.

Table. 1 Assessment Criteria

Input/Output	Criteria	Variables	Set	Universe	Range
Inputs	Tangibles	TA	Good Enough Not enough	1-20	15-20 7-14 1-6
	Responsiveness	RS	Tall Low	1-8	6-8 1-5
	Reliability	RL	Tall Low	1-8	6-8 1-5
	Assurance	US	Tall Low	1-8	6-8 1-5
Outputs	Customer Satisfaction	CS	Very satisfied Quite satisfied Less satisfied	1-44	34-44 16-33 1-15

Source: Researchers, Processed Data

The first step is to determine information systems. explained the recapitulation of the results of filling out questionnaires from customers who have been transformed. The data used as a random sample was 10 customers.

Table 2. Information Systems

Name	Inputs				Outputs
	Tangibles	Responsiveness	Reliability	Assurance	Customer Satisfaction
A001	15	6	6	6	34
A002	14	6	6	5	31
A003	20	8	8	8	44
A004	15	6	6	6	34
A005	11	4	6	4	24
A006	10	5	6	4	24
A007	15	7	6	6	34
A008	13	6	7	6	33
A009	16	6	6	7	35
A010	16	6	6	6	34

Source: Researchers, Processed Data

The second step after determining information systems is to carry out the Decision System process. The Decision System for customer satisfaction consists of:

1. Condition Attributes, namely Tangible, Responsiveness, Reliability and Assurance,
2. Decision Attribute, namely Customer Satisfaction.

The existing Decision System can be used as an example of 10 data.

Table 3. Decision System

Name	Inputs				Outputs
	Tangibles	Responsiveness	Reliability	Assurance	Customer Satisfaction
A001	Good	Tall	Tall	Tall	Very satisfied
A002	Enough	Tall	Tall	Low	Quite satisfied
A003	Good	Tall	Tall	Tall	Very satisfied
A004	Good	Tall	Tall	Tall	Very satisfied
A005	Enough	Low	Low	Low	Quite satisfied
A006	Enough	Low	Low	Low	Quite satisfied
A007	Good	Tall	Tall	Tall	Very satisfied

A008	Enough	Tall	Tall	Tall	Quite satisfied
A009	Good	Tall	Tall	Tall	Very satisfied
A010	Good	Tall	Tall	Tall	Very satisfied

Source: Researchers, Processed Data

The third step is the establishment of an Equivalence Class. Equivalence Class is the process of grouping the same objects. In Table 4 you can see the results of the formation of the Equivalent Class, where you can obtain the Equivalent Class (EC1 – EC4).

Table 4. Equivalent Class

Object	A	B	C	D	E
EC1	Good	Tall	Tall	Tall	Very satisfied
EC2	Enough	Tall	Tall	Low	Quite satisfied
EC3	Enough	Low	Low	Low	Quite satisfied
EC4	Enough	Tall	Tall	Tall	Quite satisfied

Source: Researchers, Processed Data

The fourth step is to determine the discernibility matrix value. To get the discernibility matrix value, you need to classify the different attributes between the ith object and the jth object (only the condition attributes are visible). Based on the data above, the following is the discernibility matrix:

Table 5. Dicerniability Matrix

Object	EC1	EC2	EC3	EC4
EC1	X	AD	A B C D	A
EC2	AD	X	BC	D
EC3	A B C D	BC	X	BCD
EC4	A	D	BCD	X

Source: Researchers, Processed Data

The fifth step is to form the Discernibility Matrix Modulo D. The Discernibility Matrix Modulo D is a matrix that contains comparisons between data from different condition attributes and decision attributes. Data with different attribute conditions, but the same decision attributes are still considered the same. To get the discernibility matrix value, that is by classifying the different attributes between the ith object (row) and the jth object (column), if they are the same then they are given an X mark. As for the Discernibility Matrix Modulo.

Table 6. Discernibility Matrix Modulo D

Object	EC1	EC2	EC3	EC4
EC1	X	**AD**	**A B C D**	**A**
EC2	**AD**	X	X	X
EC3	**A B C D**	X	X	X
EC4	A	X	X	X

Source: Researchers, Processed Data

The sixth step in the next Rough Set process is Reduction. The author uses the Discernibility Matrix as a reference for carrying out the Reduction process. For data with a very large number of variables, it is impossible to search for all existing combinations of variables, therefore a technique for searching attribute combinations known as Quick Reduct was created, namely by:

1. The first Indiscernibility value to look for is Indiscernibility which is the smallest combination of attributes, namely
2. Then carry out the process of searching for dependency attributes. If the dependency attribute value obtained is equal to 1, then the indiscernibility for the minimum set of variables is that variable.
3. If in the process of searching for attribute combinations you do not find a dependency attribute equal to 1, then search for a larger combination, where the variable combination you are looking for is the combination of variables with the largest dependency attribute value. Perform process 3 until the dependency attribute value is equal to 1.

Table 7. Reduction

Object	CNF Of Boolean Functions	Prime implication	Reduct
EC1	AvD*AvBvCvD*A	A	{A}
EC2	AvD	(A),(D)	{A,D}
EC3	AvBvCvD	(A B C D)	{A B C D}

EC4	A	A	{A}

Source: Researchers, Processed Data

The seventh step after obtaining the results from Reduction is determining the General Rules. The resulting General Rules consist of a combination of attributes as follows:

Table 8. General Rules

No.	Reduction	Rules
	{A}	If Direct Evidence = "Good" then Customer Satisfaction = "Very Satisfied"
	{A}	If Direct Evidence = "Enough" then Customer Satisfaction = "Quite Satisfied"
	{A,D}	If Direct Evidence = "Enough", Guarantee = "Low" then Customer Satisfaction = "Quite Satisfied"
	{A,D}	If Direct Evidence = "Good", Guarantee = "High" then Customer Satisfaction = "Quite Satisfied" or "Very Satisfied"
	{A,D}	If Direct Evidence = "Enough", Guarantee = "Low" then Customer Satisfaction = "Quite Satisfied"
	{A B C D}	If Direct Evidence = "Enough", Responsiveness = "Low", Reliability = "Low", Guarantee = "Low" then Customer Satisfaction = "Quite Satisfied"
	{A B C D}	If Direct Evidence = "Good", Responsiveness = "High", Reliability = "High", Guarantee = "High" then Customer Satisfaction = "Quite Satisfied" or "Very Satisfied"
	{A B C D}	If Direct Evidence = "Enough", Responsiveness = "High", Reliability = "High", Guarantee = "Low" then Customer Satisfaction = "Quite Satisfied"

Source: Researchers, Processed Data

CONCLUSION

General rules/information produced by the rough set method can help business managers determine the level of customer satisfaction that is expected to be used as a basis for making policies for customer satisfaction.

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