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Analysis Of Customer Satisfaction With Solaria Restaurants In Medan City Using K-Means Clustering Method

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ABSTRACT

Customer satisfaction is the key to the success of a company in the modern business context. In strategic planning and business management, a focus on customer satisfaction has become essential to ensure that the services a company provides not only retain customers but also enable sustainable growth. In the case of Solaria Restaurant, it helps to find groups of customers with comparable satisfaction patterns, which allows businesses to optimize their marketing strategies and improve their service quality. Specifically, this study uses the K-Means Clustering method to evaluate customer satisfaction with Solaria Restaurant services. The research utilized an online questionnaire distributed to 250 surveyed people to assess factors such as service response and the physical appearance of the restaurant that affect customers' perceptions of the business. The results showed that customer satisfaction is generally considered very good, the results of clustering analysis of customer satisfaction at Solaria Restaurant resulted in the number of very good clusters is cluster I. This result increases our understanding of customer preferences. These results increase our understanding of customer preferences and build a basis for improvement strategies that focus more on improving the customer experience.

Keywords: Customer Satisfaction, K-Means Clustering, Product Quality, Questionnaire.

INTRODUCTION

Customer satisfaction is one of the indices that can be seen and measured in the service of a company, customer satisfaction has become an important concept in business planning and management of a company. Having customers ensures that companies in service providers continue to benefit in developing their business. In this way, to increase customer satisfaction, companies must strive to create pleasant experiences for customers and eliminate unpleasant experiences. Good service increases customer satisfaction and purchase intention, which naturally leads to increased revenue. It is important as a reference to improve the quality of our services so that the services provided can ensure optimal satisfaction. The logical reason for this business is that it is able to generate huge profits. With the rapid growth of the restaurant industry, the number of existing restaurants is increasing, causing competition with other restaurants. Therefore, the effectiveness of marketing strategies will

affect the increase in restaurant sales. However, if the marketing strategy is not implemented correctly, sales can also decline.

In business, every company faces fierce competition. This makes the company must continue to pay attention to the needs and desires of its customers. To compete and dominate the market, companies must ensure that they exceed customer expectations by providing services that are more satisfying than competitors. Only high-quality companies are able to achieve this.

Quality has a close relationship with customer satisfaction. Quality encourages consumers to build strong relationships with companies. In the long run, this relationship allows businesses to thoroughly understand customer needs and expectations, so that businesses can increase customer satisfaction by ensuring as many people as possible have a pleasant experience and as few people as possible have an unpleasant experience (Atmawati and Wahyuddin, 2007).

Customers have different levels of satisfaction regarding the service or what is served. Customers feel dissatisfied if the food or drink ordered does not match their expectations after consumption, but on the other hand if the food or drink matches their expectations then they will feel satisfied, and return to the restaurant someday. Satisfied customers will share their experiences related to the service they get and the food and drinks served to others, friends, and family. Therefore, this research was conducted to analyze customer satisfaction with Solaria Restaurants in the city of Medan.

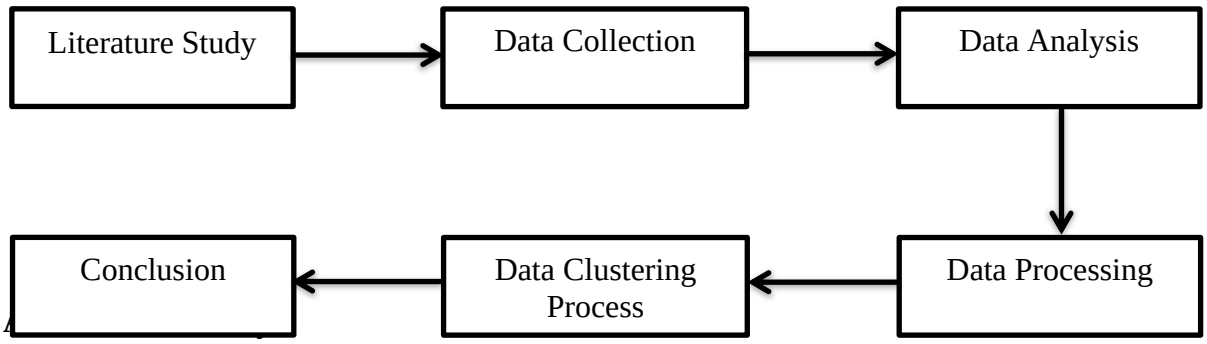
The analysis that can be done to find out the analysis of the level of customer satisfaction with the restaurant is to use data mining techniques with the K-Means Clustering method. Data mining is the process of extracting important information from data after collecting and processing the right data. The information collected can be in the form of numbers or information that can be used for various purposes.

One of the methods applied in data mining is the K-Means Clustering method, the K-Means Clustering method or analysis to find natural groups in cases, Clustering is also known as segmentation grouping data that has similar characteristics. Clustering is unsupervised data mining, as all input attributes are treated equally as no single attribute is used to guide the learning process. Most clustering algorithms build a model through a series of iterations and stop when the model has centered or converged, a point at which the betas segmentation remains. In this research, the K-Means Clustering Method is used to cluster data that can help restaurants to improve restaurant quality. This of course will be able to help restaurants in improving the quality and service of customers who come to the restaurant.

LITERATURE REVIEW

The type of research used is quantitative research with the K-means clustering method. Quantitative research is a systematic scientific study of the causal relationship between parts and their phenomena. The purpose of quantitative research is to develop and use mathematical models, theories, and hypotheses related to phenomena. Therefore, this quantitative survey combines quantitative data and objective data through scientific calculations obtained from a sample of people or residents who are asked to answer a series of questions in a survey to determine the frequency and percentage of responses. The K-Means Clustering method is a clustering method that groups data based on the cluster center (centroid) that is closest to the data. The purpose of K-means clustering is to group data by maximizing data similarity within clusters and minimizing data similarity between clusters. This research applies the K-Means Clustering method in analyzing customer satisfaction with Solaria Restaurant in order to facilitate customers in providing an assessment of the Restaurant. In addition, the best cluster is determined from the tests carried out, so that the test results become a reference in determining the best satisfaction cluster.

In this study, a work procedure process is used to assist in making research reports, a systematic research framework is needed, a research framework that is in accordance with the steps that will be taken so that the research can run well, there are research work procedures. The work procedures for this research are as follows**:**



Literature study is a way to collect information by reading, recording, and analyzing relevant sources. So the literature study in this research was carried out by research by reading journals, the internet, and other sources related to research problems and objectives. This literature study is carried out with the aim of collecting information related to the topic or problem that is the subject of the research.

B. Data Collection

Time and Location of Research, this research began in December 2023. At Medan solaria restaurant located at Plaza Medan Fair Jl. Gatot Subroto No.30 4th floor, Sekip, Kec. Medan Petisah, Medan City, North Sumatra 20113. The data used in this study is a dataset taken from the results of an analysis or survey using a link by distributing questionnaires online to customers.

C. Data Analysis

This data analysis is carried out by conducting a clustering process, namely classifying existing categories according to the percentage of each cluster. The clusters formed in this study are 5 clusters, namely 1 = Very Good, 2 = Good, 3 = Quite Good, 4 = Not Good, 5 = Very Not Good.

D. Data Processing

Data processing is processing existing data with the k-means clustering method which is calculated to group the results of customer satisfaction with restaurant services.

E. Data Clustering Process

Data The data clustering process (customer satisfaction analysis) is carried out using the k-Means Clustering method.

F. Conclusion Drawing

Conclusions can be drawn after the clustering process is complete and the results are obtained in the form of the amount of data for the percentage of each cluster formed. The conclusion of the calculation and data processing results is done using the website.

Theoretical Basis

Respondents in this study were 250 respondents with data types male and female gender.

Criteria for Determining Service Quality

In providing good service, according to Zeitthami, Parasuma, and Berry, there are several criteria that determine service quality, called Servqual service (Kotler, 2009), namely:

a. Responsiveness: The company's responsiveness in providing services to consumers appropriately.

b. Tangible: The physical appearance of the company's services, which is measured through physical appearance, equipment, and means of communication.
c. Empathy: The company's ability to understand the wishes of consumers and understand the needs and concerns of employees.
d. Reliability: The company's ability to meet the needs and concerns of employees.

METHODS

K-Means Clustering Method

K-means is a non-hierarchical data classification mechanism that attempts to partition existing data into one or more groups. This structure divides data into several groups so that data that has the same characteristics is placed in different groups. The purpose of clustering this data is to minimize the objective function specified in the clustering process, which usually seeks to minimize variation within groups and maximize variation between groups.

K-Means clustering is used for data clustering and pattern recognition, by randomly selecting some initial data points (k), then moving them around until the most ideal clustering is found. The K-Means Clustering method belongs to a distance-based clustering algorithm that divides data into a number of clusters and this algorithm only works on numerical attributes. K-Means Clustering is an effective algorithm for determining data clusters. K-Means Clustering is often used in various fields such as customer segmentation, image segmentation, market research, and document clustering.

The following are the stages of the K-Means Clustering method, namely:

1. Determine the number of clusters (K) to be created.
2. Determine the center data point or centroid randomly.

$$\mathbf{V}=\frac{\sum_{i=1}^{n} \boldsymbol{xi}}{\boldsymbol{n}}; \boldsymbol{i} = \mathbf{1}, \mathbf{2}, \mathbf{3}, \ldots \boldsymbol{n}$$

Where:

v = centeroid in the cluster

xi = i-th object

n = number of objects/number of objects that are members of the cluster

3. Calculate the distance of each object to each centroid using the Euclidean

Distance formula until the closest distance of each data to the centroid is found. To calculate the distance between objects and centroids, the Euclidean Distance method is used.

$$D(X,Y) = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \cdots (1)}$$

Description;

D = Distance

x = Data

y = Centroid

4. Classify data based on its proximity to the centroid.
5. Recalculate the cluster center with the current cluster members. The cluster center is the average value of all data objects in a particular cluster.
6. If the cluster center does not change anymore then the clustering process is complete. Otherwise, stop the clustering process or return to step number 3 until the cluster center does not change again.

RESULTS

To obtain data results related to customer satisfaction analysis by distributing questionnaires online to respondents using a Likert scale of 1 to 5 with information:

No	Points	Description
1	5	Very good
2	4	Good
3	3	Fair
4	2	Not Good
5	1	Not very good

Table 3.1 Likert Scale

Based on the data from the distribution of online questionnaires, the analysis of customer satisfaction at Solaria Restaurant in the last 3 (three) months, namely 2023 - 2024, which has been collected as follows:

	A	B	C	D	E	F	G	H	I
1	Nama	Gender	Usia	Tangible	Reliability	Responsiveness	Assurance	Empathy	CustomerSatisfaction
2	Dimas Halim Pratama	Male	19	[5,5,4,5,5]	[4,4,5,5,4]	[5,5,4,5,5]	[5,4,5,4,5]	[5,5]	[5,4,5]
3	Mega	Female	22	[4,5,4,5,4]	[4,5,4,4,4]	[5,4,4,4,4]	[5,5,4,4,5]	[4,4]	[4,4,5]
4	Nurima	Female	23	[4,4,4,4,4]	[4,3,3,4,5]	[5,4,5,5,5]	[4,5,4,4,4]	[4,5]	[4,4,5]
5	Teddy C Wijaya	Male	22	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5]	[5,5,5]
6	Elvi	Female	24	[4,4,4,4,4]	[4,4,4,4,4]	[4,4,4,4,4]	[4,4,4,4,4]	[4,4]	[4,4,4]
7	ANGEL VIONA PATRICIA TAMBUNAN	Female	21	[1,1,1,1,1]	[1,1,1,1,1]	[1,1,1,1,1]	[1,1,1,1,1]	[1,1]	[1,1,1]
8	Erna	Female	30	[4,4,4,4,5]	[4,5,4,4,4]	[4,4,4,4,4]	[4,4,4,4,4]	[4,4]	[4,4,4]
9	Friska Sinaga	Female	22	[4,4,4,4,4]	[4,4,4,4,4]	[4,4,4,4,4]	[4,4,4,4,4]	[4,4]	[4,4,4]
10	Oktafiani br ginting	Female	22	[4,4,4,4,3]	[3,4,4,3,3]	[3,3,3,4,3]	[3,4,4,3,3]	[4,3]	[4,3,4]
11	TABAS GABE MULIA SIAGIAN	Male	23	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5]	[5,5,5]
12	Anne	Female	23	[5,5,4,5,5]	[4,5,5,5,5]	[5,4,5,4,4]	[5,5,5,5,5]	[5,5]	[5,5,5]
13	RUTH CHAROLINE MARGARET MANURUNG	Female	23	[5,5,4,4,4]	[4,4,4,4,4]	[4,4,4,4,4]	[4,4,4,5,5]	[4,4]	[4,4,5]
14	Jan Piter Boan Ricky Manalu	Male	21	[5,5,5,5,5]	[5,5,5,5,5]	[5,4,5,4,4]	[4,4,4,4,4]	[5,3]	[4,4,3]
15	Kriting	Male	20	[4,5,4,5,4]	[5,4,4,4,4]	[4,4,4,4,4]	[4,5,4,5,4]	[5,4]	[4,5,4]
16	Nurmida Nainggolan	Female	21	[4,4,4,4,4]	[4,4,5,5,3]	[3,4,4,4,4]	[5,3,5,4,4]	[4,4]	[4,4,4]
17	Fernando situmorang	Male	20	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5]	[5,5,5]
18	Cynthia	Female	22	[4,4,4,4,4]	[4,4,4,4,4]	[4,4,4,4,4]	[4,4,4,4,4]	[4,4]	[4,4,4]
19	RICHARDO APRIANTO SIANTURI	Male	21	[5,3,4,5,3]	[5,5,5,5,5]	[4,4,4,4,4]	[5,5,5,5,5]	[5,3]	[5,5,5]
20	Xclave	Male	21	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5]	[5,5,5]
21	beni	Male	17	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5,5,5,5]	[5,5]	[5,5,5]
22	Yohana Siagian	Female	16	[5,5,5,5,4]	[4,4,5,4,4]	[5,4,4,4,5]	[5,5,5,5,5]	[5,5]	[5,5,5]
23	Ashade Citra Nasution	Female	25	[4,4,4,3,4]	[4,4,2,2,2]	[4,4,3,3,3]	[2,4,4,4,4]	[4,4]	[4,4,4]
24	Manna Uli Sibuea	Female	24	[4,4,4,3,5]	[3,4,4,4,3]	[4,3,4,4,4]	[4,4,3,3,4]	[4,5]	[4,4,4]

Table 3.2 Dataset Table Reporting Research Results

System Design Method

At the system design method stage, data is processed to obtain strata that can be useful in decision making. From the questionnaire data, calculations are carried out using the K-Means Clustering method to produce clustering and analysis of customer satisfaction.

K-Means Clustering Algorithm

The K-Means Clustering algorithm in ensuring the level of favorability of Solaria Restaurant buyers to the services provided is explained as follows.

Flowchart of the Completion Method

The following is a flowchart of the data mining implementation program design to determine the level of customer satisfaction of Solaria Restaurant using the K-Means Clustering method.

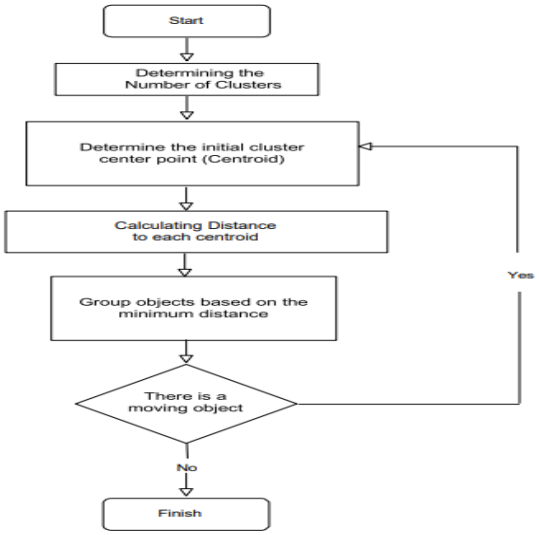


Figure 3.1 Flowchart of K-Means Clustering Method.

- **Select Number of Clusters**

In the 1st iteration, the initial center or centroid is randomly selected from the existing data. In this case, the initial centroids are the 26th data and the 53rd data.

Centroid	Data	Nama	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Centroid 1	26	Osi	4	3	5	4	3	5	4	4	5	3	5	4	5	4	3	4	3	5	4	5	4	4	5	4	3
Centroid 2	53	Edi Purba	5	4	3	4	3	4	3	5	4	3	4	3	5	4	3	5	4	3	4	3	4	4	3	4	5

Table 3.2 Center Point Table (Initial Centroid)

- **Calculate the Distance of Data to the Nearest Cluster**

The distance strata of the 1st respondent material to the cluster center point are as follows:

$$D(X1,C1) = \sqrt{\begin{matrix}(4-4)^2+(4-3)^2+(3-5)^2+(4-4)^2+(3-3)^2+(3-5)^2+(3-4)^2+(4-4)^2+(4-5)^2+(3-3)^2+(3-5)^2+\\(3-4)^2+(3-5)^2+(4-4)^2+(5-3)^2+(4-4)^2+(3-3)^2+(3-5)^2+(5-4)^2+(3-5)^2+(3-4)^2+(5-4)^2+\\(3-5)^2+(3-4)^2+(3-3)^2\end{matrix}}$$

$= 5{,}385164807$

$$D(X1,C2) = \sqrt{\begin{matrix}(4-5)^2+(4-4)^2+(3-3)^2+(4-4)^2+(3-3)^2+(3-4)^2+(3-3)^2+(4-5)^2+(4-4)^2+(3-3)^2+(3-4)^2+\\(3-3)^2+(3-5)^2+(4-4)^2+(5-3)^2+(4-5)^2+(3-4)^2+(3-3)^2+(5-4)^2+(3-3)^2+(3-4)^2+(5-4)^2+\\(3-3)^2+(3-4)^2+(3-5)^2\end{matrix}}$$

$= 5{,}916079783$

Furthermore, using the formula above, distance calculations are carried out for the 2nd to 250th respondent data. So that the computational strata of the range of each data in the new cluster center is received as follows:

No	Distance From Cluster 1	Distance From Cluster 2	Distance From Cluster 3	Distance From Cluster 4	Distance From Cluster 5	Cluster Membership
1	5,385164807	5,916079783	5,477225575	4,795831523	5,291502622	C4
2	4,795831523	4,358898944	4,242640687	4,123105626	4,898979486	C4
3	5,291502622	4,898979486	4,123105626	5,916079783	6	C3
4	5,916079783	6,8556546	6	6,08276253	4,123105626	C1
5	4,795831523	3,74165787	4,123105626	4	16,1245155	C2
96	8,774964387	8,062257748	10,67707825	8,426149773	8,602325267	C2
97	11,09053651	8,774964387	9,055385138	10,53565375	9,797958971	C2
98	8,062257748	0	11,18033989	10	9,643650761	C2
99	10,53565375	10,14889157	10,09950494	9,848857802	11,04536102	C4
100	9,797958971	8,717797887	9,327379053	8,246211251	8,774964387	C4

Table 3.3 Euclidean Distance Calculation Results

- **Recalculate Cluster Centers**

After the members of each cluster are known, the new cluster center is calculated based on the data of the members of each cluster using the cluster member center formula. The computation of the new cluster center is done by calculating the average value.

Centroid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Centroid 1	4,14286	3,57143	4,2381	4,04762	4,2381	4,04762	4,28571	4,19048	4,14286	3,85714	4,47619	4,33333	4,38095	4,33333	3,66667	4,28571	3,90476	4,38095	4,28095	4,52381	3,95238	3,95238	4,28571	4,33333	4,28571
Centroid 2	3,35965	3,38868	3,20755	3,45283	3,11321	3,3434	2,73585	3,16981	3,07547	2,49057	2,73585	2,86792	3,16981	3,16981	2,75472	3,30189	3,16981	2,73585	3,03774	2,79245	2,86792	2,90113	2,90113	3,24528	2,90566

Table 3.4 Results of New Cluster Center Formation

Strata practice results are fragments that explain the use and results of data mining applications in detail. Here are some display results of the Solaria Restaurant customer clustering application in Medan City.

1. Login Page Display
The login page is used to access the admin page. There, you must enter a username and password that has been registered in the database to have access to the admin page.

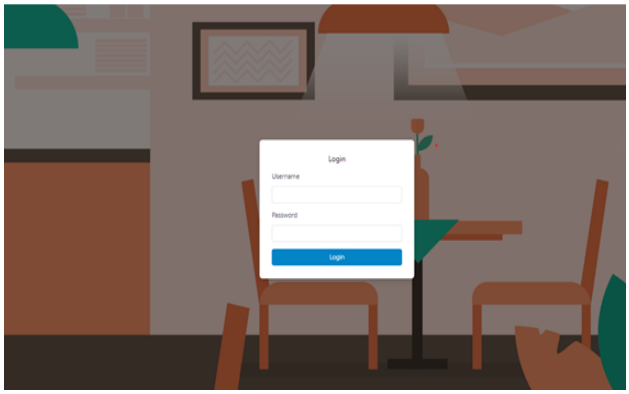


Figure 3.2 Login Page Display

2. Nomalization Dataset Display in the Program
This data has been preprocessed or normalized using the program code that has been created. Normalization refers to reducing the data set so that the normalized data is at 0 and 1.

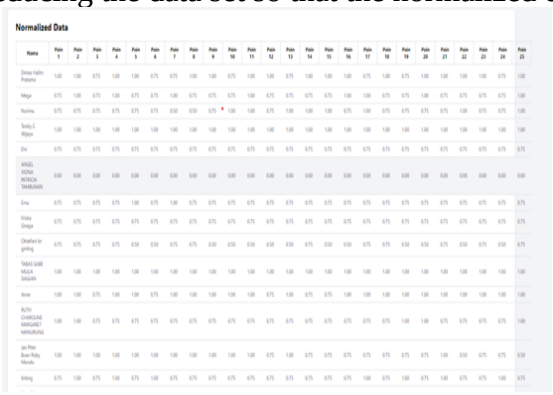


Figure 3.3 Display of Data Normalization Results

3. K-Means Clustering Process View

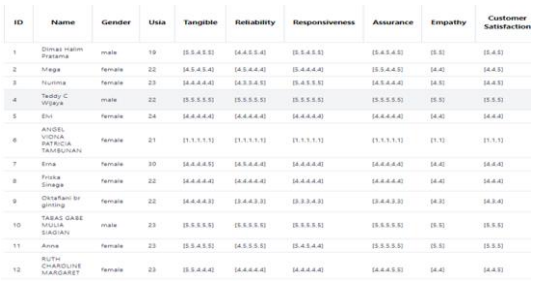


Figure 3.4 K-Means Clustering Process

4.Display of Iteration Centroid Graph

Figure 3.5 Iteration Centroid Graph Display

5. Display of Clustering Results

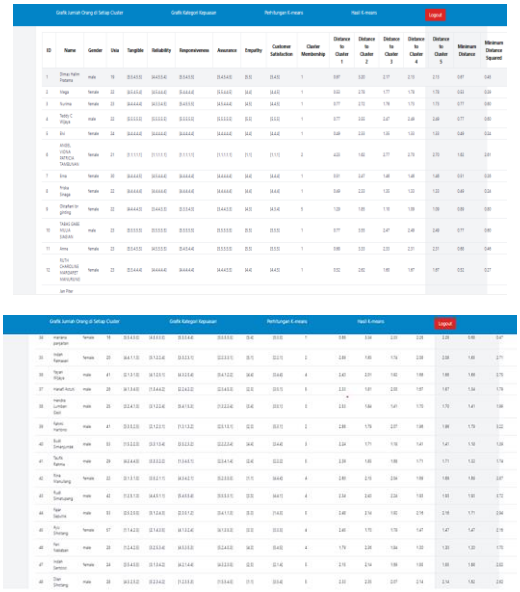


Figure 3.6 K-Means Clustering Results

6. Graph of Data Clustering Results

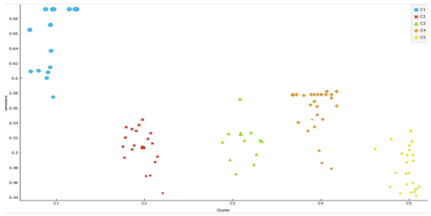


Figure 3.7 Graph of Data Clustering Results

DISCUSSION

From the results of this study, the best cluster is the result of cluster I. It appears that the personality of customers from cluster I is favored for customers who come from real services (Tangibles), as well as clusters II, III, IV, V are favored according to customers who come

from real services (Tangibles). So it can be concluded that the average level of customer satisfaction with the Solaria Restaurant service is very good on the real criteria (Tangibles).

The application results related to the calculation stage from Iteration I - X did not detect the closest cluster placement, so the iteration continued until iteration XI and finally found the closest cluster placement. If the next iteration is continued, then the calculation results of the closest cluster placement will remain consistent. The test results of the K-Means Clustering method also show that service satisfaction at Solaria Restaurant is very good, which is obtained from the results of respondents with an average answer of very good with the real criteria (Tangibles) and the physical appearance of reliability (Reliability) services at Solaria Restaurant.

CONCLUSION

Based on the results of the research conducted, the authors can draw conclusions, including the following:

1. K-Means Clustering mechanism can be used to measure the level of customer satisfaction with Solaria Restaurant services. By grouping customers based on their satisfaction using K-Means Clustering, the data grouping stage can be done automatically so that companies can focus on analyzing and interpreting the results. This level of satisfaction is used as a reference for the Solaria Restaurant service to improve and evaluate the quality of the Solaria Restaurant service.
2. This study aims to find customer segmentation that has similar satisfaction characteristics, which can be used for a more targeted marketing strategy and service improvement
3. The results of the clustering of customer satisfaction analysis at Solaria Restaurant resulted in several clusters, with cluster I evidenced by the results of the questionnaire filled out by respondents as Solaria Restaurant customers who considered that there was satisfaction with the dishes served according to the menu list, the timeliness of serving food and drinks ordered, the way employees communicate well with guests and other things that are the reasons that make customers choose cluster I.

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RESOR (POLRES) DUMAI MENGGUNAKAN ALGORITMA *K-MEANS CLUSTERING*

Arinda Salbinda, Normah, Siti Nurajizah Jurnal Teknik Komputer AMIK BSI (Teknik Informatika Universitas Nusa Mandiri), Volume 7, No.2, Juli 2021 p-ISSN 2442-2436, E-ISSN: 2550-0120 PenerapanData Mining Metode *K-Means Clustering* Untuk Analisa Penjualan Pada Toko Fashiaon Hijab Banten

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Dwipa Junika Putra, Hasnah Vithon Carelsa, Rio Andika Malik Jised(journal of Informatika System and Education Development) Vol. 1 No. 2 (2023) e-ISSN: 2988-6821 PENGUKURAN TINGKATAN KEPUASAN MAHASISWA TERHADAP PELAYANAN DI KANTIN KAMPUS MENGGUNAKAN ALGORITMA *K-MEANS CLUSTERRING*

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