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Customer Segmentation Using the K-means Clustering Algorithm and Recency Frequency Monetary Model at Pharmaceutical Product Wholesaler

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Abstract: PT Kimia Farma Trading and Distribution (KFTD) is a company engaged in the distribution and trading services of Indonesian health products, on a national scale. In 2022, the company aims to increase sales to be awarded as one of the top 3 national pharmaceutical product distributors by 2024. Their current strategy is to provide customers with delayed payment permission and integrated complaint services. However, the offers and services are the same for all customers which does not consider customer track record hence it is not cost-effective. One way to increase sales is by enhancing customer satisfaction and loyalty by implementing Customer Relationship Management (CRM) strategies. Several strategies can be carried out, namely analysis of associations related to pharmaceutical products, and analysis of customer segmentation and clustering of products. The method used in this study was the K-means clustering algorithm combined with the Recency Frequency Monetary (RFM) model. Experiments showed that the optimal clustering results are 4 therefore they are categorized into 4 customer segments, namely Superstar, Golden, Typical, and Occasional Customers.

Keywords: Pharmaceutical Distributor, Customer Relationship Management, K-Means Clustering Algorithm, and Regency Frequency Monetary

1. Introduction

PT Kimia Farma Trading and Distribution (KFTD) is a company with a focus on national trade in health products and services distribution. The area coverage served by KFTD consists of 34 Provinces and is spread across 511 districts or cities. One of the branches of the company is PT Kimia Farma Trading and Distribution Jakarta 1, which is located in Central Jakarta. KFTD Jakarta 1 is one of the drug distributors that serves Central Jakarta, North Jakarta, and West Jakarta areas. Product sales at KFTD are divided into 2 categories, namely regular (pharmacies, clinics, hospitals, etc.) and agency (institution). The products provided are medicines, health devices to cosmetic products. In addition, the products are handled by KFTD not only by Kimia Farma products but there are also products from third parties, such as Biofarma, PT Pharos, and so on.

In 2021, based on the highest sales level of drug distributors nationally, KFTD is included in the top 10, namely ranking 6th. Meanwhile, in 2022, there are targets that they aim to achieve, which want to increase sales so that it can occupy a position in the top 3 national drug distributors by 2024. One way that can be carried out by companies to increase sales is by providing sales promotions according to customer groups [1]. On the other hand, KFTD has already grouped the data related to the products it handles, the group is adapted to categories, including ethical products, generics, herbal, medical devices, cosmetics, and so forth. This

supports that in this research, customer grouping can be proposed.

The business process contained in KFTD Jakarta 1, namely sales in which sales makes offers for every product owned by KFTD to customers. Followed by the customer placing an order for the product desired by the salesperson. Then the warehouse from KFTD Jakarta 1 processes ordered products according to customer requests until the product can be distributed by the goods delivery department. Currently, KFTD Jakarta 1 is still providing offers and services the same to each customer. KFTD Jakarta 1 does not pay attention to the nominal amount of a transaction that is being carried out, namely continuing to serve its customers accordingly with the order of incoming orders received by the company. Until now, the company has not provided special promotions or rewards for customers who have high loyalty to the company.

To achieve this target, several strategies can be conducted based on previous studies, including marketing-related strategies [2], analysis of product-related associations pharmaceuticals [3], and analysis of creating customer segmentation and customer clustering of products pharmaceutical retail [4]. Ways that can be done to increase customer satisfaction and loyalty by implementing Customer Relationship Management (CRM) strategies [5]. Companies can identify customers who own through customer segmentation, to acquire customer behavior and implement appropriate marketing strategies to get profits for the company [6]. In this research, customer segmentation is carried out, because the process of customer segmentation can increase the effectiveness of recommendations in the form of strategies for marketing the products it offers to increase sales value [1]. After knowing the customer clustering, then the company can plan strategies to increase income based on promotional offers that are right for that customer group. One of the clustering techniques is a data mining technique.

Data mining is a stage to obtain an interesting pattern, namely in the form of rules or knowledge based on large amounts of data [7]. Various methods can be used in conducting clustering, namely consisting of the K-Means, Fuzzy C-Means (FCM), Learning Vector Quantization (LVQ), and Self-Organizing Map (SOM) [8]. This research uses the K-means algorithm clustering method. K-Means is a method of non-hierarchical data clustering. The K-means method does classification based on the level of similarity to the number of groups produced [9]. Grouping is assessed based on correlation objects so that the group contains data that is similar to numbers average to the center of mass [9]. The advantage of the K-means method is that the results at the clustering stage are not affected by the order of data entry in the dataset [10]. This method is a solution to finding out customer segmentation, namely, it can categorize customers based on similarities in characteristics, and outcomes clustering can be used to determine marketing strategies [11]. This method produces information in the form of customer scoring and customer profiling more precisely [8].

In determining the number of clusters, the Elbow method is used. This method provides data visualization, namely graphs showing points in a large number of clusters. Thus, the optimal number of clusters is obtained by grouping based on these variables [12]. In forming optimal clusters, the Recency Frequency method is also used Monetary (RFM) in the data preparation process. The RFM analysis model aims to analyze customer value to form customer segmentation. Using the RFM model, the results of customer segmentation can be used as an assessment of customers (customer scoring) and determining customer profiles (customer profiling) [6].

Customer segmentation can be formed based on customer data, namely by using three attributes consisting of customer purchase time interval, purchase frequency, and amount of money spent by the customer [4]. In addition, measuring cluster validity can be done using several methods, including the Sum of Squared Error (SSE), Davies Boulding Index (DBI), Silhouette Coefficient, and Calinski-Harabasz [13]. Based on this, the use of the K-means clustering method and the RFM model can be used in this research.

Therefore, it is necessary to increase product sales so that the company can achieve this target. Currently, the strategy being implemented by KFTD is to provide easing payments and integrated complaint services to their customers. However, the offers and services distributed by the company are the same for all customers, so the company has not provided special offers or awards for customers who have high loyalty to the company. Customer loyalty is a customer's commitment to a market, which can be seen through repeated and consistent purchases [14]. Apart from that, the sales transaction data held by KFTD is large, namely 13,993 data. Therefore, it is necessary to segment customers using the K-means clustering method and the RFM model to determine sales strategies for each customer at PT Kimia Farma Trading and Distribution Jakarta 1.

2. Literature Review

2.1. Customer Relationship Management

Customer Relationship Management (CRM) is a strategy or way to maintain customer loyalty and maximize the services provided to customers. CRM in companies has a goal, namely providing the best service for customers and maintaining customer satisfaction based on their needs. This is based on customer patterns so that companies can offer, serve, and provide programs that suit the company's customers [5]. CRM is a stage for determining strategies to be able to compete with competitors, provide added value to customers or producers, as well as form strategies to gain profits for the company [15]. CRM combines with customers to form conditions or circumstances that can increase the value of customers so that they become loyal to the company

at all times [16]. CRM is working together with customers to produce the best solutions, namely by increasing value for customers at all times to gain customer loyalty [17].

2.2. Analytical CRM

Analytical CRM is a procedure for obtaining, storing, processing, defining, and creating reports from customer data to be analyzed according to their needs consisting of strategies and methods [18]. Aims to increase customer satisfaction or company revenue [19]. In CRM, data mining is the implementation of predictive or descriptive analysis based on large datasets to support business functions, namely sales, marketing, and service. Data mining can analyze large amounts of data quickly and reduce costs for analysis [19]. With CRM, data mining analysis can be done in several ways [19], consisting of:

1. Describing and visualizing, explaining data in a large database by describing it. Then, analysis can also be carried out by describing it so that users can more easily understand related information, such as in the form of graphs, plots, and so on.
2. Estimation, carrying out analysis based on the sequence of customer ranking data to find a method that can be applied. If a customer is outside certain limits, it means that the customer does not accept the offer given.
3. Classification, carrying out analysis by classifying various objects being observed according to a predetermined classification scheme. For example, classifying new customers based on gender.
4. Prediction is a special application that comes from estimation and classification analysis. These predictions can be structured into a problem in estimation or classification based on the variables to be predicted, which are included in continuous/categorical variables.
5. Affinity grouping is grouping based on associations between the data used, namely by knowing things that are done simultaneously. This analysis can be used to identify cross-selling opportunities or design product layouts that can be placed close together.
6. Clustering, analyzing through grouping, namely by finding clusters in the dataset used. The aim is to maximize the differences in each resulting cluster and minimize the differences in each item or member in the cluster.

2.3. Data Mining

Data mining is a technique used to convert data into various information so that it can be used. Data mining is a technique for searching for patterns and insights in large amounts of data [5]. Data mining can be implemented to achieve various goals, such as market segmentation, customer loyalty, sales forecasting, product production and warranties, and others. Data mining can be interpreted as detecting an insight based on the Knowledge Discovery from Data (KDD) procedure. KDD is a series of information extraction from a data set that is not previously known and will later be used in analyzing the data [20].

2.4. Recency, Frequency, Monetary Model

The Recency, Frequency, Monetary (RFM) analysis model was first developed by [21]. This model separates customers from data based on three specified attributes, namely the purchase interval for each customer, the frequency of purchases for each customer, and the total customer expenditure in transactions. The following is the meaning of these three attributes:

1. The recency of the Last Purchase (R)
   R means review, which is the distance between the last time a customer made a purchase and the current time. The shorter the period, the greater the resulting R-value.
2. Frequency of Purchases (F)
   F means frequency, which is the number of transactions in a certain period, such as a customer making two transactions in one year and so on. The more the frequency, the greater the resulting F value.
3. Monetary Value of the Purchases (M)
   M means monetary, which is the amount of money that must be spent by customers in making transactions in a certain period. The greater the monetary value, the higher the resulting M value.

2.5. Clustering Method

Clustering or clustering is a method used to group data. Clustering is a stage in grouping data into various groups, so that the data in one cluster has the maximum level of similarity, while the data produced between one cluster and another cluster has a minimum level of similarity [22]. Data clustering is a method in data mining that is undirected or unsupervised. Two types of data clustering are commonly applied to group data, consisting of hierarchical clustering data and non-hierarchical clustering data [23]. Clustering is used as an instrument to be applied in various fields, such as business intelligence, web search, biology, and security [24].

3. Research Methodology

There are 8 stages of the process in this research, as explained below:

1. Problem Identification and Formulation
   Identifying problems that occur at PT Kimia Farma Trading and Distribution Jakarta 1, namely related to company targets. In 2024, KFTD has a target to rank in the top 3 national drug distributors based on sales level, so a strategy is needed to increase sales of pharmaceutical products. One of the stages carried out was conducting interviews with the sales supervisor and branch head of PT Kimia Farma Trading and Distribution Jakarta 1 to obtain this information. Then, proceed with formulating the problem to determine

the topic that will be used in the research, namely grouping customers based on their purchasing level and knowing the sales strategy that will be implemented at PT Kimia Farma Trading and Distribution Jakarta 1.

2. Problem Goal Determination
   The next stage is to determine the objectives related to the research being carried out. The following research was carried out based on the aim of grouping customers using the K-means clustering method and finding out the appropriate sales strategy for each cluster produced at PT Kimia Farma Trading and Distribution Jakarta 1.
3. Study of Literature
   Literature studies are carried out to obtain previous references, which can be books, journals, or other references related to the theory and methods that will be used according to the predetermined topic, namely related to customer segmentation using clustering, and the K-means algorithm.
4. Data Collection
   Data collection for this research was obtained by compiling sales transactions at PT Kimia Farma Trading and Distribution Jakarta 1 from March 2021 to March 2022. The data used is the primary, namely through interviews with sales supervisors and branch heads of related companies; and secondary data, namely sales transaction data and other supporting data. The transaction data is in the form of product purchase transaction data, of which there are 13,993 data collected.
5. Data Processing
   The data that has been collected will be processed by observing Customer Relationship Management (CRM) to produce customer segmentation, namely by using the clustering method, specifically the K-means algorithm. The attributes used in clustering are Recency, Frequency, and Monetary (RFM) models.
   a. Data Preprocessing
      In this stage, various stages are carried out, namely data cleaning, data selection, and transformation.
   b. Determining the RFM value
      Calculation of values for recency, frequency, and monetary attributes conducted on the sales transaction data that has been obtained and then processed in Microsoft Excel software.
   c. K-means Clustering
      In carrying out clustering, various stages are done, including:
      i. Data normalization using the min-max method normalization. This method works by adjusting the data to a certain range, namely on a scale of 0 to 1. This aims to suppress or reduce the outlier effect of the data used.
      ii. Data visualization, in the form of 3D images.
      iii. Determination of the number of clusters (Elbow method).
6. Data processing
   The data that has been collected will be processed by observing Customer Relationship Management (CRM) to produce customer segmentation, namely by using the clustering method, the K-means algorithm. The attributes used in clustering are Recency, Frequency, and Monetary (RFM) models.
7. Results Analysis
   An analysis of the cluster results was carried out to determine customer segmentation at KFTD Jakarta 1 according to the characteristics that have been determined based on the RFM model, where this can be used as a basis for recommendations in implementing customer relationship management.
8. Validation of Results
   Validation of cluster results can be executed using various methods, namely consisting of the Sum of Squared Error (SSE), Davies Boulding Index (DBI), Silhouette Coefficient, and Calinski-Harabasz [13].
9. Conclusions and Recommendations
   Conclusions are summarized based on the results or solutions obtained in this research, which are in line with the problem formulation that has been determined. Apart from that, this stage also provides suggestions for related companies and further researchers.

4. Results and Discussion

In this research, the data used is internal in the form of product sales transaction data at PT Kimia Farma Trading and Distribution Jakarta 1, starting from March 2021 to March 2022. In the product sales transaction data, there are various attributes used, consisting of transaction date, transaction number, customer name, customer address, delivery city, and total sales. Customer names contained in sales transaction data are converted into customer codes to simplify data processing. The assignment of customer codes is based on 5 customer categories. The following Table 1 shows the customer codes used. In a year, total product sales transactions at PT Kimia Farma Trading and Distribution Jakarta 1 amounted to 13,993 transactions with a total of 649 customers.

Table 1. *Customer Code Based on Customer Type*

Customer Type	Customer Code
Pharmacy	A
Institution	I
Clinic	K
Health Center	P
Hospital	R

Sales transaction data will be divided into 4 attributes that will be used for K-means clustering calculations. These

attributes are customer code, recency, frequency, and monetary. Recency (R) is the interval between the last time a customer made a transaction and the last time data was collected. The date set for calculating the recency value is April 1, 2022, because the data used in data processing is sales transaction data up to March 2022. Frequency (F) is the number of transactions carried out by each customer in a certain period. In this study, the period used is one year, starting from March 2021 to March 2022. Monetary (M) is the total costs incurred by customers in handling transactions in one period, that is one year. Calculation of values for the recency, frequency, and monetary attributes used in the clustering stage is obtained using the Microsoft Excel application. The results of calculating the RFM value can be seen in Table 2.

Table 2. *Customer Code Based on Customer Type*

Customer Code	Purchase Time Distance (Days)	Purchase Frequency	Total Sales (IDR)
A 001	183	8	3.043.490
A 002	94	11	5.293.609
A 003	95	63	87.402.277
A 004	190	76	206.805.112
A 005	92	56	167.210.606
A 006	99	6	1.500.710
A 007	120	9	3.171.224
…	…	…	…
I 068	2	153	718.967.388
I 069	4	74	377.542.175

Normalization in this study uses the min-max method normalization. The purpose of data normalization is to prevent attributes with a large range from having values that are too large than attributes with a small range, namely equalizing the scale for each data on a scale of 0-1. Three-dimensional visualization can be seen through the 3D scatter plot in Figure 1 which consists of three attributes, namely recency, frequency, and monetary. Based on the figure, the value of every object tends to be at the same point therefore it can be interpreted that the relationships in each resulting cluster have a high level of similarity.

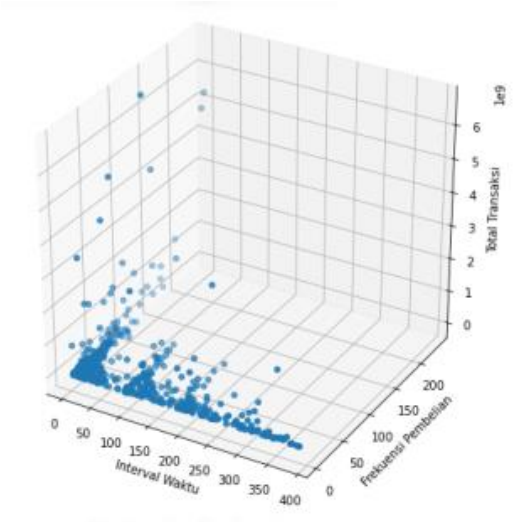

Figure 1. *Data Visualization.*

In determining the number of *k* values in the cluster, can be determined by identifying the Elbow point on the Elbow graph. Where the Elbow point is a graph position that will drop drastically and then slope so that this point will be chosen as the cluster value. Elbow graph determination is shown in Figure 2 in which we can see that the position of the graph points drops drastically then the slope will be at number 4, so we get a value of k is 4.

Clustering was done using K-means and we can get the results as can be seen in Figure 3. Based on the visualization of the clustering results, it can be known that there are 4 clusters with different colors. The red cluster is the distribution for Cluster 1, the yellow is for Cluster 2, the green is for Cluster 3, and the blue is the distribution for Cluster 4.

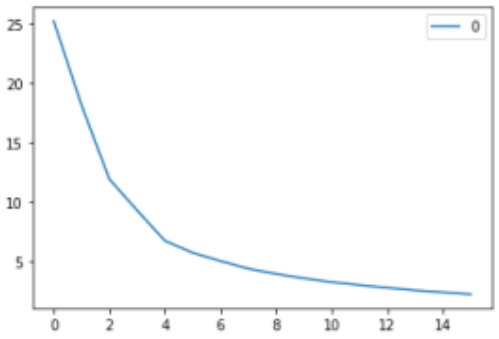

Figure 2. *Elbow Graph.*

The following Table 3 is a calculation resume related to the RFM values and clusters obtained from the data processing stage. From Table 3, the average recency value in Cluster 1 is 296 days, Cluster 2 is 128 days, Cluster 3 is 13 days, and Cluster 4 is 4 days. Then the average frequency value in Cluster 1 is 6 times, Cluster 2 is 15 times, Cluster 3 is 22 times, and Cluster 4 is 124 times. Meanwhile, the average monetary value in Cluster 1 is IDR 46,343,223,

Cluster 2 is IDR 103,612,022, Cluster 3 is IDR 91,292,464, and Cluster 4 is IDR 1,945,928,653.

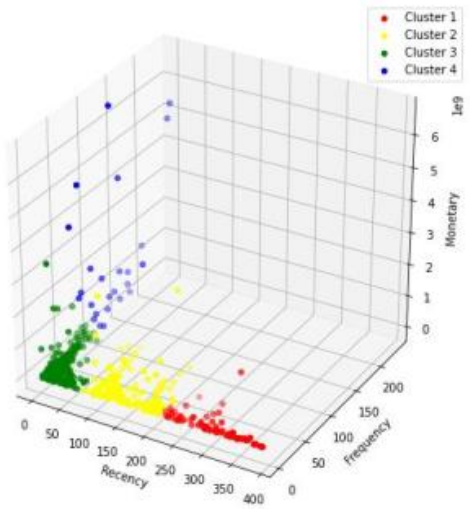

Figure 3. *Data Distribution for Every Cluster.*

From the data processing stage, a *k* value of 4 is obtained based on the results of the Elbow graph in Figure 2, so that the optimal clustering results are 4 clusters. The cluster results can be seen in Figure 4. From Table 3, 4, 5, and Figure 4, Cluster 1 is a customer in the occasional customer category. This cluster has an average interval value between the last time a customer made a transaction and the last time data was collected 296 days therefore it can be interpreted that customers in this category are customers who made the last transaction, namely in the first 3 months at the time of data collection. This category represents customers with low loyalty and profits for the company, which can be proven by the average purchasing frequency of only 6 transactions in one year with the average total purchases made by customers for one year worth around 46 million rupiahs. The types of customers in this cluster are mostly pharmacies. Where, members of cluster 1 or the occasional customer category number 78 customers, consisting of 59 pharmacies, 14 agencies, 3 clinics, and 2 hospitals. Cluster 2 is a customer in the typical customer category. This cluster has an average interval value between the last time a customer made a transaction and the last time of data collection 128 days, which means that the customer has not made a transaction in the last 3 months based on the data collection time used. This category is customers who have a medium level of loyalty to the company. This can be proven by the average purchasing frequency of 15 transactions in one year with an average total sales value of around 100 million rupiah. In this cluster, the customer type is dominated by pharmacies. Where, members of cluster 2 or the typical customer category number 218 customers, consisting of 151 pharmacies, 29 agencies, 6 clinics, 3 health centers, and 29 hospitals. Cluster 3 is a customer in the golden customer category. This cluster has an average interval value between the last time a customer made a transaction and the last time they collected data of 13 days, which means that customers made transactions up to the last 2 weeks based on the data collection time used. This customer category is a customer with high loyalty to the company, which is based on an average customer purchasing frequency of 22 transactions over one year with an average total customer purchase value of around 90 million rupiahs. Most customer types in this cluster are pharmacies. Where, members from cluster 3 or the golden customer category totaling 328 customers, namely consisting of 251 pharmacies, 20 agencies, 21 clinics, 9 health centers, and 27 hospitals.

Table 3. *Minimum and Maximum RFM Values: Recency*

Cluster	Min	Max	Average
1	214	387	296
2	79	213	128
3	1	67	13
4	1	52	4

Table 4. *Minimum and Maximum RFM Values: Frequency*

Cluster	Min	Max	Average
1	1	44	6
2	1	86	15
3	1	91	22
4	54	236	124

Table 5. *Minimum and Maximum RFM Values: Monetary*

Cluster	Min	Max	Average
1	Min	Max	Avg
2	105,600	1,239,814.139	46,343,223
3	68,330	2,874,198.158	103,612,022
4	97,300	3,342,305.602	91,292,464

Cluster 4 is a customer in the superstar category. This cluster has the average value of the interval between the last time a customer performed transactions with the latest data collection time of 4 days. So that it can This means that customers in this category are regular customers who make purchases with a very high level of loyalty and profit accepted by the company. This can also be proven by the average frequency of purchases made by customers was 124 for one year, which means every customer in this category makes a purchase minimum of 4 to 5 transactions every month. Average total cost transactions issued by customers in this cluster are worth approx. 1.9 billion rupiah in one period, namely one year starting from March 2021 until March 2022. Customers who fall into this category have huge potential to increase sales for the company. Type Most of the customers in this cluster are hospitals. Where, members from cluster 4 or the superstar category there are 25 customers, consisting of 6 pharmacies, 6 agencies, and 13 hospitals.

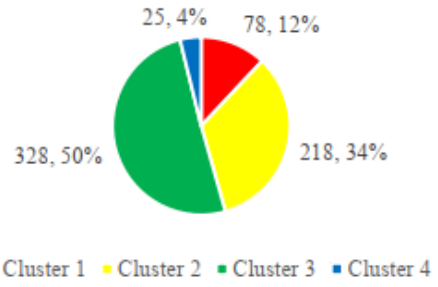

Figure 4. *Data Distribution for Every Cluster.*

In this study, validation of cluster results was carried out to find out whether the clusters produced in data processing are good or not. The validation value of the cluster results can be seen from the standard deviation values for the Sum of Squared Error (SSE), Calinski Harabasz (CH), Davies Boulding Index (DBI), and Silhouette Coefficient. At the cluster results validation stage, running was carried out 20 times to evaluate or ensure that the results were correctly obtained there was no change [18]. Each running result that has been carried out on the SSE, DBI, CH, and Silhouette values does not show any changes in the values for each measurement therefore it can be interpreted that the cluster results obtained, namely 4 clusters, are very stable or the data is very well separated.

4. Conclusion

PT Kimia Farma Trading and Distribution (KFTD) is a company engaged in the distribution and trading services of Indonesian health products, on a national scale. In 2022, the company aims to increase sales to be awarded as the top 3 national pharmaceutical product distributors by 2024. Their current strategy is to provide customers with delayed payment permission and integrated complaint services. However, the offers and services are the same for all customers which does not consider customer track record hence it is not cost-effective. One strategy that can be implemented to increase customer satisfaction and loyalty at KFTD is a sales promotion strategy. This is based on the implementation of a business-to-business (B2B) strategy, where in this strategy it is necessary to know the specific characteristics of each customer so that the strategy created can be right on target and can build long-term relationships to increase customer loyalty according to the company's segmentation.

The advantages of combining RFM and K-means are enhanced segmentation, improved precision, automation and efficiency, and scalability so they can lead to even more powerful customer segmentation strategies, enabling businesses to better understand and target their customer base especially in the pharmaceutical sector that have several unique characteristics such as market dynamics which influenced by factors such as healthcare policies, pricing pressures, patent expirations, and competition from generic drugs therefore increasing sales becomes another challenge.

From experiments, it is known that cluster 3 customers, or what can be called golden customers have high loyalty, and cluster 4 customers, or what can be called the superstar customer category have very high loyalty. These two customer segmentations meet the criteria for getting certain discounts because the company can receive large profits from these two customer segmentations therefore it can be interpreted that customer segmentation can be carried out and the strategy applied can be more focused according to the customer category. Based on the group categorization that has been carried out in data processing, it produces 4 customer clusters. Of the total 101 vitamin product purchase transactions in March 2022, these purchases were only made by customers from Cluster 3 and Cluster 4, consisting of 75 transactions carried out by Cluster 3 customers and 26 transactions carried out by Cluster 4 customers hence this is following the criteria existing in each predetermined customer segmentation category. This can be proven by customers in the 2 highest classes, namely in Cluster 3 and Cluster 4 making purchase transactions when certain discounts are given. This finding is in line with the existing criteria in each customer segmentation that has been formed. It can be seen that customer groups in the 2 highest loyalty classes are known to have made significant purchase transactions when discounts were implemented by KFTD. These two segments meet the criteria to get special discounts in the future to remain loyal to the company.

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