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Product Sales Classification Customer Relationship Management with the K-Nearest Neighbors Algorithm

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Abstract

Developments in the business world do not only depend on the quality of the product, but also in terms of the quality of the services provided by the store. Providing high quality services can provide alignment to customer needs. Customer Relationship Management (CRM) is a business strategy consisting of software and services designed to increase profit, revenue and customer satisfaction. Classification is the process of finding a model that describes and distinguishes data classes, or how to classify data into one or several predefined classes. Classification techniques that are widely used include Neural, Rough sets, K-nearest Neighbors. In increasing sales and grouping goods that are more widely used Customer Relationship Management with the K-Nearest Neighbor method to improve product service quality by communicating with customers on a regular and scheduled basis with social media is intended so that consumers do not miss information about products and expand market share for product sales. The data used is product data along with prices and stock, with this data the ranking results of which products are sold will be obtained.

Keywords: Quality, Profit, Classification, Customer Relationship Management, K-Nearest Neighbor

Abstract

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1. Introduction

Developments in the business world do not only depend on the quality of the product, but also in terms of the quality of the services provided by the store. In terms of the quality of the products offered, it can further encourage customers to buy the products we offer. Service quality is a very important thing, in dealing with customers who require high attention and service. High quality service that can provide alignment to customer needs.

Basically, every shop has a goal, which is to get the maximum profit possible, but sometimes shops tend to forget that customers are one of the assets that play an important role in helping achieve these goals, so companies pay less attention to their customers. What usually happens is that the buyer makes a transaction, after the transaction is completed, there is no contact between the buyer and the store, so the company loses the opportunity to gain further profits from the same buyer. Customers have an important role for the continuity of a store, because if the company does not know its customers and what they want, the company cannot retain its customers.

May17 Store is one of the clothing distribution shops in the city of Padang, this shop sells various types of clothing ranging from clothes, pants, hats, bags and shoes, this shop is located on Jl. S. Parman No. 149 D Ulak K arang, Padang and this study aims to increase sales and grouping of goods that are sold more at the May17 store distribution store. And also increasing Customer Relationship Management can be done by improving the quality of product service by communicating with customers on a regular and

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scheduled basis with social media such as Instagram, Facebook, Tiktok and others. The use of social media aims to keep consumers informed about products and expand their market share. market for product sales.

From the results of this study, modeling was carried out using the K-Nearest Neighbor algorithm using data that had been processed based on the Knowledge Discovery in Database (KDD) stage. The results of data mining calculations using the classification technique and the K-Nearest Neighbor algorithm, obtained the predicted sales of skincare packaging products with 7 product categories using data from January 2019 to June 2021. Attributes consist of product category, quantity and month with the results of testing accuracy calculations using tools Rapidminer Studio to find out the sales of each product in the coming months and the results obtained an accuracy value of 80%. [1].

In the research conducted based on evaluation and analysis results, it can be concluded that the image classification of Sumba ikat weaving is carried out based on digital images with the fuzzy k-Nearest Neighbor which is obtained from 1 image test, the accuracy reaches 98%. Based on 17 different motif images, the smallest average error value is 23.5294 in the 4th test [2].

Based on the research results from the analysis of the K-Nearest Neighbor classification method in identifying customer satisfaction, it can be concluded that the analysis of the K-Nearest Neighbor classification method has an accuracy value of 83.33% and based on the results of processing the K-Nearest Neighbor algorithm data for services provided by PT. Trigatra Komunikatama to its customers, the result is that customers are satisfied with the services provided [3].

Customer Relationship Management (CRM) is a strategy to capture, consolidate, analyze data and use it to interact with customers. CRM can make companies identify and target their best customers, which can benefit the company, so that they can be maintained as loyal customers for their long term [4]

CRM is a strategy for acquiring, consolidating and analyzing customer data and then using it to interact with customers [5]

Customer Relationship Management (CRM), namely Social Customer Relationship Management (SCRM) . CRM signifies the whole process of establishing and maintaining relationships with customers, where these relationships can be a way to maximize customer loyalty[6]

The K-Nearest Neighbor or KNN algorithm is a classification method based on the distance of new data to some of the closest data or neighbors. The Nearest Neighbor approach is an approach to finding cases by calculating the closeness between new cases and old cases, which is based on matching the weights of a number of existing features. The purpose of the Nearest Neighbor algorithm is that the distance between one data and another can be calculated. The calculated distance value can be used as a closeness value or similarity between the test data and the training data [7].

The K-Nnearest Neighbor algorithm is an algorithm related to the process of classifying objects based on distance. The learning data obtained is then projected onto parts of the dimensional space [8].

Unified Modeling Language or more commonly known as UML, is one of the methods in software engineering techniques used to describe the flow and workings of the system, functions, objectives and control mechanisms of the system. In 1997, UML was accepted as the standard software engineering technique for object development [9].

HTML is one of the formats used in creating documents or applications that run on web pages [10]. Cascading Style Sheets or better known as CSS is a stylesheet language that is used to set the appearance of a website, both layout, typeface, color and everything related to appearance. In general, CSS is used to format web pages written with HTML [11] .

PHP is a scripting language especially used for web delevopment. Due to its server side scripting nature, to run PHP you must use a web server [12]. PHP processor running on the server (Windows or Linux)

A database is a collection of lots of data that are interrelated and collected in the same place and used by an application system that is controlled centrally and has valuable value for the owner. "A database is an organization of a set of interrelated data to make it easier for activities to obtain information. The database is intended to solve problems in systems that use a file-based approach." [1 3].

MySql is the language used to manage data on an RDBMS (Relational Database Management System). MySql is an application for managing databases or data management. From the above understanding, the researcher concludes that what is meant by MySql is a database that is RDBMS (Relational Database Management System) in nature. contains related tables.MySql is free and can run on various types of operating systems [14].

2. Research methodology

To assist in the preparation of this research so that the steps in solving the problems to be discussed can be clearly structured, it is necessary to have a framework arrangement. The research framework contained in Figure.1.

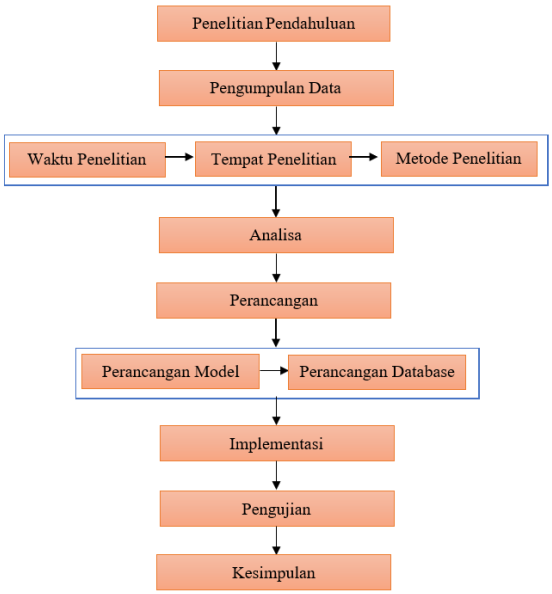

Figure 1. Research Framework

The research stage is a sequence of processes or steps that will be carried out in completing this research. The stages of this research are as follows:

2.1 Field Research

This research was conducted by conducting interviews, namely to obtain the information needed by direct interviews with the owner of the May 17 Store service to be able to analyze the problem and obtain information to support the design .

2.2. Research Library (Library Research)

This research is carried out by reading and studying from books, journals, literature and other sources related to the research being carried out.

2.3. Analysis

Based on the problem identification above, the researcher conducted data analysis first. This is so problem solving can produce new solutions.

2.4. System planning

At the design stage of the Customer Relationship Management product sales classification system at the May 17 Store with the K-Nearest Neighbors Algorithm using the PHP programming language and MySQL database.

2.5. System Implementation

The testing method used in this research is the direct testing method, namely by using *interface testing* . Used to test the special functions of the designed software.

2.6. System Testing

System testing is a stage that is carried out when the repetition process has been completed and the system is ready to be used to find out whether the designed system is running correctly and is free from errors.

3. Results and Discussion

In this study the authors took data from the May17 Store, namely product data along with detailed price of goods.

Table 1. Sales Data Table

Product name	Sale	Stock
Shorts Xl	4	43
L Shorts	5	55
M Shorts	7	70
S Shorts	5	68
Backpack May 17 Brown	6	10
Cooby Army Backpack	2	10
Cooby Navy Backpack	5	10
Black Cooby Backpack	1	10
LongWallet	4	14
Cambridge Wallet	7	14
80k S T-shirt	2	100
T-shirt 80k XL	48	123
80k L T-shirt	50	121
80k M T-shirt	50	100
Fairgood Sweater XL	4	14
Fairgood Sweater L	10	18
Fairgood Sweater M	2	20
Olivin pants Uk36	3	17
Olivin pants Uk34	3	17
Olivin pants Uk32	4	18
Olivin pants Uk30	3	13
Olivin pants Uk28	2	10
GreatDenim Charcoal Pants Uk36	3	21
GreatDenim Charcoal Pants Uk34	1	10
GreatDenim Charcoal Pants Uk32	1	13
GreatDenim Charcoal Pants Uk30	2	17
GreatDenim Charcoal Pants Uk28	1	20
L shorts	13	50
M short-shirt	18	50
Heyboy sandals Uk42	3	6
Heyboy sandals Uk41	1	6
Heyboy sandals Uk40	1	6
Heyboy sandals Uk39	2	5
Heyboy sandals Uk38	1	5
Authentic Geofmax Shoes Uk43	2	10
Authentic Geofmax shoes Uk42	7	10
Authentic Geofmax shoes Uk41	1	4
Authentic Geofmax shoes Uk40	1	5
Slingbag Maroon	7	20
Slingbag Brown	7	20
Navy sling bag	12	28
Slingbag Black	30	40
Black T-Shirt Cambridge Xl	11	40
Black T-Shirt Cambridge L	12	40
Black T-Shirt Cambridge M	19	40
Black T-Shirt Cambridge S	4	30
White T-Shirt Cambridge Xl	11	40
White T-Shirt Cambridge L	12	50
White T-Shirt Cambridge M	6	35
White T-Shirt Cambridge S	6	30
T-Shir 4.20 White Xl	52	135
T-Shir 4.20 White L	58	120
T-Shir 4.20 White M	52	100

T-Shir 4.20 White S	20	75
Black Canvas Belt	1	20
Army Belt Canvas	3	20
Krgr Head Cap	11	35

In this process, the calculation of K-Nearest Neighbor requires several input and output variables. Input and output variables at the May17 Store can be defined as the following table.

Table 2. K-Nearest Neighbor Variable Table

Function	Variable	Information
Inputs	Sale	Is a variable obtained from the sales value input
	Stock	Is a variable obtained from the stock value input
output	ranking	The most dense ranking of products sold and stock.
	description	Description Practices with a percentage value of 50% and above and less than 50% below

At this stage there are several calculation processes that can be seen as follows:

a. Determining Poor Performance Indicators.
   Looking for indicators of behavior and lack can be seen in the following process:

Formula = (Sales / (Stock - Sales))* 100
Cap Head Krgr = (11 / (35 - 11)) *100 = 45.83%
The results of the search process for indicators of behavior and lack can be seen as follows:

Table 1. Table of Variable Performance and Less Indicators

Product name	Sale	Stock	Percent indicator	Indicator
Shorts Xl	4	43	10.26%	Not enough
L Shorts	5	55	10.00%	Not enough
M Shorts	7	70	11.11%	In demand
S Shorts	5	68	7.94%	Not enough
Backpack May 17 Brown	6	10	150.00%	In demand
Cooby Army Backpack	2	10	25.00%	Not enough
Cooby Navy Backpack	5	10	100.00%	Not enough
Black Cooby Backpack	1	10	11.11%	In demand
LongWallet	4	14	40.00%	Not enough
Cambridge Wallet	7	14	100.00%	In demand
80k S T-shirt	2	100	2.04%	In demand
T-shirt 80k XL	48	123	64.00%	In demand
80k L T-shirt	50	121	70.42%	Not enough
80k M T-shirt	50	100	100.00%	In demand
Fairgood Sweater XL	4	14	40.00%	Not enough
Fairgood Sweater L	10	18	125.00%	Not enough
Fairgood Sweater M	2	20	11.11%	Not enough
Olivin pants Uk36	3	17	21.43%	Not enough
Olivin pants Uk34	3	17	21.43%	Not enough
Olivin pants Uk32	4	18	28.57%	Not enough
Olivin pants Uk30	3	13	30.00%	Not enough
Olivin pants Uk28	2	10	25.00%	Not enough
Great Denim Charcoal Pants Uk36	3	21	16.67%	Not enough
Great Denim Charcoal Pants Uk34	1	10	11.11%	Not enough
Great Denim Charcoal Pants Uk32	1	13	8.33%	Not enough
Great Denim Charcoal Pants Uk30	2	17	13.33%	Not enough
Great Denim Charcoal Pants Uk28	1	20	5.26%	In demand
L shorts	13	50	35.14%	In demand
M short-shirt	18	50	56.25%	Not enough
Heyboy sandals Uk42	3	6	100.00%	Not enough
Heyboy sandals Uk41	1	6	20.00%	In demand
Heyboy sandals Uk40	1	6	20.00%	Not enough
Heyboy sandals Uk39	2	5	66.67%	Not enough
Heyboy sandals Uk38	1	5	25.00%	In demand
Authentic Geofmax Shoes Uk43	2	10	25.00%	Not enough
Authentic Geofmax shoes Uk42	7	10	233.33%	Not enough
Authentic Geofmax shoes Uk41	1	4	33.33%	In demand
Authentic Geofmax shoes Uk40	1	5	25.00%	In demand
Slingbag Maroon	7	20	53.85%	In demand
Slingbag Brown	7	20	53.85%	In demand
Navy sling bag	12	28	75.00%	Not enough
Slingbag Black	30	40	300.00%	Not enough
Black T-Shirt Cambridge Xl	11	40	37.93%	In demand
Black T-Shirt Cambridge L	12	40	42.86%	Not enough
Black T-Shirt Cambridge M	19	40	90.48%	Not enough
Black T-Shirt Cambridge S	4	30	15.38%	Not enough
White T-Shirt Cambridge Xl	11	40	37.93%	Not enough
White T-Shirt Cambridge L	12	50	31.58%	Not enough
White T-Shirt Cambridge M	6	35	20.69%	In demand
White T-Shirt Cambridge S	6	30	25.00%	In demand
T-Shir 4.20 White Xl	52	135	62.65%	In

				demand
T-Shir 4.20 White L	58	120	93.55%	Not enough
T-Shir 4.20 White M	52	100	108.33%	Not enough
T-Shir 4.20 White S	20	75	36.36%	Not enough
Black Canvas Belt	1	20	5.26%	Not enough
Army Belt Canvas	3	20	17.65%	Not enough
Krgr Head Cap	11	35	45.83%	Not enough

b. Determine Min Value and Max Value
Look for min values and max values in sales and stock variables which can be seen in the following table.

Table 2. Table of Min and Max Values

Mark	Sale	Stock
Min	1	4
Max	58	135

c. Data Normalization
At this stage, the multiplication of the min and max tables is carried out with the sales table. The process can be seen as follows:

$$V^{I} = \frac{V - MINa}{MAXa - MINa}$$

Sales calculation = (4 - 1) / (58 - 1) = 0.0526
Stock calculation = (43 – 4) / (135 – 4) = 0.2977

From the calculation above, the results obtained can be seen in the following table:

Table 3. Data Normalization Table

Product name	Sale	Stock	Indicator
Shorts Xl	0.0526	0.2977	Not enough
L Shorts	0.0702	0.3893	Not enough
M Shorts	0.1053	0.5038	Not enough
S Shorts	0.0702	0.4885	Not enough
Backpack May 17 Brown	0.0877	0.0458	In demand
Cooby Army Backpack	0.0175	0.0458	Not enough
Cooby Navy Backpack	0.0702	0.0458	In demand
Black Cooby Backpack	0.0000	0.0458	Not enough
LongWallet	0.0526	0.0763	Not enough
Cambridge Wallet	0.1053	0.0763	In demand
80k S T-shirt	0.0175	0.7328	Not enough
T-shirt 80k XL	0.8246	0.9084	In demand
80k L T-shirt	0.8596	0.8931	In demand
80k M T-shirt	0.8596	0.7328	In demand
Fairgood Sweater XL	0.0526	0.0763	Not enough
Fairgood Sweater L	0.1579	0.1069	In demand
Fairgood Sweater M	0.0175	0.1221	Not enough
Olivin pants Uk36	0.0351	0.0992	Not enough
Olivin pants Uk34	0.0351	0.0992	Not enough
Olivin pants Uk32	0.0526	0.1069	Not enough
Olivin pants Uk30	0.0351	0.0687	Not enough
Olivin pants Uk28	0.0175	0.0458	Not enough
Great Denim Charcoal Pants Uk36	0.0351	0.1298	Not enough
Great Denim Charcoal Pants Uk34	0.0000	0.0458	Not enough
Great Denim Charcoal Pants Uk32	0.0000	0.0687	Not enough
Great Denim Charcoal Pants Uk30	0.0175	0.0992	Not enough
Great Denim Charcoal Pants Uk28	0.0000	0.1221	Not enough
L shorts	0.2105	0.3511	Not enough
M short-shirt	0.2982	0.3511	In demand
Heyboy sandals Uk42	0.0351	0.0153	In demand
Heyboy sandals Uk41	0.0000	0.0153	Not enough
Heyboy sandals Uk40	0.0000	0.0153	Not enough
Heyboy sandals Uk39	0.0175	0.0076	In demand
Heyboy sandals Uk38	0.0000	0.0076	Not enough
Authentic Geofmax Shoes Uk43	0.0175	0.0458	Not enough
Authentic Geofmax shoes Uk42	0.1053	0.0458	In demand
Authentic Geofmax shoes Uk41	0.0000	0.0000	Not enough
Authentic Geofmax shoes Uk40	0.0000	0.0076	Not enough
Slingbag Maroon	0.1053	0.1221	In demand
Slingbag Brown	0.1053	0.1221	In demand
Navy sling bag	0.1930	0.1832	In demand
Slingbag Black	0.5088	0.2748	In demand
Black T-Shirt Cambridge Xl	0.1754	0.2748	Not enough
Black T-Shirt Cambridge L	0.1930	0.2748	Not enough
Black T-Shirt Cambridge M	0.3158	0.2748	In demand
Black T-Shirt Cambridge S	0.0526	0.1985	Not enough
White T-Shirt Cambridge Xl	0.1754	0.2748	Not enough
White T-Shirt Cambridge L	0.1930	0.3511	Not enough
White T-Shirt Cambridge M	0.0877	0.2366	Not enough
White T-Shirt Cambridge S	0.0877	0.1985	Not enough
T-Shir 4.20 White Xl	0.8947	1.0000	In demand
T-Shir 4.20 White L	1.0000	0.8855	In demand
T-Shir 4.20 White M	0.8947	0.7328	In demand
T-Shir 4.20 White S	0.3333	0.5420	Not enough
Black Canvas Belt	0.0000	0.1221	Not enough
Army Belt Canvas	0.0351	0.1221	Not enough
Krgr Head Cap	0.1754	0.2366	Not enough

At this stage the author will input sales data of 20 and stock data of 40 while the K-Nearst value is 3 . and at this the input value must be normalized first. The process can be seen as follows:

1. Sales input normalization = (20 - 1) / (58 - 1)= 0.3333
2. Stock input normalization = (50 – 4) / (135 – 4)= 0.2748

d. Euclidean Distance Value Search
At this stage, the multiplication of the normalization tables is carried out with the input normalization results. The process can be seen as follows.

Sales = (0.0526- 0.3333) 2 = 0.0788
Storage = (0.2977 – 0.2748) 2 = 0.0005
Euclidean Distance = √(0.0788+0.0005) = 0.2816

From one of the examples above, the results are as shown in the following table.

Table 4. Euclidean Distance Table

Product name	Sale	Stock	Euclidean Distance	rank	Indicator
Shorts Xl	0.0788	0.0005	0.2816	41	Not enough
L Shorts	0.0693	0.0131	0.2870	40	Not enough
M Shorts	0.0520	0.0524	0.3232	37	Not enough
S Shorts	0.0693	0.0457	0.3390	31	Not enough
Backpack May 17 Brown	0.0603	0.0524	0.3358	32	In demand
Cooby Army Backpack	0.0997	0.0524	0.3901	18	Not enough
Cooby Navy Backpack	0.0693	0.0524	0.3489	26	In demand
Black Cooby Backpack	0.1111	0.0524	0.4044	14	Not enough
LongWallet	0.0788	0.0394	0.3438	29	Not enough
Cambridge Wallet	0.0520	0.0394	0.3023	38	In demand
80k S T-shirt	0.0997	0.2098	0.5563	7	Not enough
T-shirt 80k XL	0.2413	0.4014	0.8017	4	In demand
80k L T-shirt	0.2770	0.3823	0.8120	3	In demand
80k M T-shirt	0.2770	0.2098	0.6977	6	In demand
Fairgood Sweater XL	0.0788	0.0394	0.3438	29	Not enough
Fairgood Sweater L	0.0308	0.0282	0.2429	47	In demand
Fairgood Sweater M	0.0997	0.0233	0.3508	25	Not enough
Olivin pants Uk36	0.0890	0.0308	0.3461	27	Not enough
Olivin pants Uk34	0.0890	0.0308	0.3461	27	Not enough
Olivin pants Uk32	0.0788	0.0282	0.3271	35	Not enough
Olivin pants Uk30	0.0890	0.0425	0.3625	23	Not enough
Olivin pants Uk28	0.0997	0.0524	0.3901	18	Not enough
Great Denim Charcoal Pants Uk36	0.0890	0.0210	0.3316	34	Not enough
Great Denim Charcoal Pants Uk34	0.1111	0.052 4	0.4044	14	Not enough
Great Denim Charcoal Pants Uk32	0.1111	0.0425	0.3919	17	Not enough
Great Denim Charcoal Pants Uk30	0.0997	0.0308	0.3613	24	Not enough
Great Denim Charcoal Pants Uk28	0.1111	0.0233	0.3666	21	Not enough
L shorts	0.0151	0.0058	0.1446	54	Not enough
M short-shirt	0.0012	0.0058	0.0840	56	In demand
Heyboy sandals Uk42	0.0890	0.0674	0.3954	16	In demand
Heyboy sandals Uk41	0.1111	0.0674	0.4225	11	Not enough
Heyboy sandals Uk40	0.1111	0.0674	0.4225	11	Not enough
Heyboy sandals Uk39	0.0997	0.0714	0.4136	13	In demand
Heyboy sandals Uk38	0.1111	0.0714	0.4272	9	Not enough
Authentic Geofmax Shoes Uk43	0.0997	0.0524	0.3901	18	Not enough
Authentic Geofmax shoes Uk42	0.0520	0.0524	0.3232	36	In demand
Authentic Geofmax shoes Uk41	0.1111	0.0755	0.4320	8	Not enough
Authentic Geofmax shoes Uk40	0.1111	0.0714	0.4272	9	Not enough
Slingbag Maroon	0.0520	0.0233	0.2745	42	In demand
Slingbag Brown	0.0520	0.0233	0.2745	42	In demand
Navy sling bag	0.0197	0.0084	0.1676	49	In demand
Slingbag Black	0.0308	0.0000	0.1754	48	In demand
Black T - Shirt Cambridge Xl	0.0249	0.0000	0.1579	52	Not enough
Black T-Shirt Cambridge L	0.0197	0.0000	0.1404	55	Not enough
Black T-Shirt Cambridg	0.0003	0.0000	0.0175	57	In demand

e M					
Black T-Shirt Cambridge S	0.0788	0.0058	0.2909	39	Not enough
White T-Shirt Cambridge Xl	0.0249	0.0000	0.1579	52	Not enough
White T-Shirt Cambridge L	0.0197	0.0058	0.1598	51	Not enough
White T-Shirt Cambridge M	0.0603	0.0015	0.2486	46	Not enough
White T-Shirt Cambridge S	0.0603	0.0058	0.2572	45	Not enough
T-Shir 4.20 White Xl	0.3152	0.5259	0.9171	1	In demand
T-Shir 4.20 White L	0.4444	0.3729	0.9041	2	In demand
T-Shir 4.20 White M	0.3152	0.2098	0.7245	5	In demand
T-Shir 4.20 White S	0.0000	0.0714	0.2672	44	Not enough
Black Canvas Belt	0.1111	0.0233	0.3666	21	Not enough
Army Belt Canvas	0.0890	0.0233	0.3351	33	Not enough
Krgr Head Cap	0.0249	0.0015	0.1624	50	Not enough

From the results of the table above, rank 3 is taken as input earlier. The results of the above process are obtained as follows.

Table 7. Ranking table

Name of goods	rank	Indicator
T-Shir 4.20 White Xl	1	In demand
T-Shir 4.20 White L	2	In demand
80k L T-shirt	3	In demand

4. Conclusion

From the research results and then proceed to the analysis and design of the data processing system that has been carried out, it can be concluded that the web application built on the May17 Store is an application that can facilitate the May17 Store in marketing its products digitally with the aim of expanding the marketing area.

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