

# A Decision Support System for Determining the Best Customer Using the Simple Multi-Attribute Rating Technique (SMART)

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## Abstract

Jaya Bila Makmur is a nine-ingredient grocery store with products sold including cooking oil, instant noodles, rice, margarine, sugar, salt, and so on. With the continuous increase in the number of similar grocery stores on the market, business owners must have a strategy so that customers remain loyal and don't move elsewhere. One of the strategies is to give rewards or gifts to loyal customers for their cooperation so far, but the decisions taken by business owners are still not quite right. Then a decision support system (DSS) is needed that is able to provide alternative solutions. This system was built using PHP and MySQL, modeled using UML, and tested with Blackbox Testing. The method used in DSS uses the Simple Multi-Attribute Rating Technique (SMART) for multi-criteria decision making. The findings of this study are intended to assist in identifying the best customers who shop frequently and will become repeat customers. By implementing this decision-support system, business owners can improve their competitiveness and competence in the business world. From the results of the application built, it is hoped that it will make it easier for users to choose and determine the best customers according to the specified criteria.

**Keywords**— Customers, Best Customers, SMART, SPK, Web.

## 1 Introduction

Customers are the best asset for a business. Providing the best service is an effort to retain customers so they don't move to other places [1 – 10]. One of the strategies used by Toko Jaya Makmur to provide for and retain its customers is to give annual gifts during Eid to its best customers. The problem is that Jaya Makmur stores are often unfair in determining their best customers because so far the process of determining the best customers has been carried out only by looking at how often buyers shop and the quantity of buyers, but this determination is still made by feeling only for customers who are close to the owner. effort. The existence of a decision support system is expected to assist business owners in making decisions by providing a reference value for each customer. As for when the reward or bonus will be given, it will be on certain days, such as Eid al-Fitr, New Year's Day, and/or days that are deemed appropriate for giving gifts to the best customers. It is necessary to implement a decision support system (DSS) capable of providing alternative solutions by weighting customer data, so that determining the best customer is no longer solely based on gut instinct from business owners to customers. With the implementation of this decision-support system, business owners can improve their competence in the business world. According to [2], "competitive strategy" is the search for a profitable competitive position within an industry, the fundamental arena where competition occurs.

Decision Support Systems (DSS) are computer technology solutions that can be used to support complex decision-making in solving problems in an organization. Decision support systems (DSS) are part of a computer-based information system, including knowledge-based systems or knowledge management, that are used to support decision-making in an organization or company. According to [3], it can also be said to be a computer system that processes data into information to make decisions on specific semi-structured problems.

The Simple Multi Attribute Rating Technique (SMART) is a multi-criteria decision-making method based on the theory that each alternative consists of a number of criteria that have values, and each criterion has a weight that describes how important it is compared to other criteria. This weighting is used to assess each alternative in order to obtain the best one. Based on references from other research journals, the same method was not found with this study, so it might be a new study to analyze and test whether the SMART method can be applied in recommending the best customers. The results of the research can provide recommendations in the form of alternative customers to business owners according to their needs and criteria.

Based on the formulation of the problem that arises from the background presented above, how do you design and build a decision support system for determining the best customer using the Simple Multi-Attribute Rating Technique (SMART) method?

The criteria selected to determine the best potential customers at the Jaya Bila Makmur wholesale store are as follows: length of subscription, number of arrivals, number of orders, and total shopping. This decision support system uses the SMART method to determine the best customer. The system was developed using PHP and MySQL databases and modeled using UML. The system will provide alternative decision-making in determining the best potential customers only at the Jaya Makmur wholesale store.

## 2 Research methods

According to [4], "a decision support system is a specific information system that is intended to assist management in making decisions related to semi-structured issues. This system has the facility to produce various alternatives that are interactively used by the user.

According to [5], the DSS is a system "designed to communicate and solve semi-specific problems by managers in order to make a decision." It can be concluded that a decision support system is an information system that can assist users in making decisions in the form of data modeling or data analysis tools as a basis for developing alternatives that can be used by users. Decision support systems are not meant to automate the process of making decisions. Instead, they are meant to give decision makers interactive tools that let them use models to do different kinds of analyses. According to [6], the purpose of a decision support system is to: (a) assist managers in making decisions on semi-structured problems. (b) Provide support at the discretion of the manager; it is not intended to replace the manager's function. (c) Increasing the effectiveness of decisions taken by managers is more important than improving efficiency. (d) The speed of computer computing allows decision makers to perform many computations quickly at low cost. (e) Increasing productivity builds a group of decision-makers, especially experts. (f) Quality computer support can improve the quality of decisions made. (g) Competitive management and empowering company resources, as well as competitive pressures (h) makes the decision-making task difficult. (i) Overcoming cognitive limitations in processing and storage.

The Simple Multi Attribute Rating Technique (SMART) is a multi-criteria decision-making method developed by Edward in 1977. This multi-criteria decision-making technique is based on the theory that each alternative consists of a number of criteria that have values, and each criterion has a weight that describes how important one criterion is to another. This weighting is used to assess each alternative in order to obtain an alternative. The sequence for using the SMART method (Godwin and Wright, 2004) is as follows: (a) Determine the number of criteria used. (b) Determine the weight of the criteria for each criterion by using an interval of 1-100 for the criterion with the highest priority. (c) Calculate the normalization of each criterion by comparing the criterion weight value to the total criterion weight. (d) Provide criteria parameter values for each criteria in each alternative. (e) Determine the utility value by converting the criterion value for each criterion to the standard data criterion value. (f) Determine the final value of each criterion by switching the value obtained from normalizing the standard data criterion value with the criterion weight normalization value.

As with other Multiple Criteria Decision Making (MCDM) methods, the SMART method also has several advantages and disadvantages. The following are some of the advantages and disadvantages of the SMART method. The advantages of the Simple Multi-Attribute Rating Technique (a) The Simple Multi Attribute Rating Technique (SMART) can be used quickly to obtain a weighted total score. (b) SMART is one of the most applicable MCDM methods, and since the majority of the panelists were not familiar with the MCDM method, it should be simple. (c) The SMART method is easy to modify as the number of categories increases. (d) The SMART approach uses a ratio scale to assess panelist preferences. (e) SMART is a useful technique because it is simple, easy, and requires little time in making decisions that are quite important for those involved in the decision-making process. (f) In SMART, changing the number of alternatives will not change the decision of the original number of alternatives, and this is useful when new alternatives are added. (g) Using SMART in performance measures can be a better alternative than other methods. (h) SMART is very popular because its analysis

incorporates a variety of quantitative and qualitative criteria. (i) While SMART has been successfully applied to MCDM problems, this approach is not effective when dealing with the ignorance inherent in linguistic judgments in decision making. (j) The advantage of the SMART model is that it does not depend on alternatives. (k) Non-technical participants felt that SMART was easier to understand than the trade-off method. The development of this system uses a waterfall, and the stages of the waterfall are as follows:

1. System Analysis  
At this point, the results of the data collection were analyzed by reading about, observing, and talking to the research objects in order to figure out what was needed in the application.
2. System Design  
This is the design stage, and the fashion style is decided by the application design based on the physical criteria that were made by making decisions about the input, process, output, and database.
3. 3. Software Development  
This is the process of building fashion-style applications based on physical criteria using a PHP (Hypertext Preprocessor)-based framework that can be used to make large-scale web-based applications with MySQL as the data storage database.
4. Software Testing  
This stage is tested to find out whether the application is as expected, and the application testing used in this analysis uses black box testing.
5. Implementation and Maintenance  
At this stage, the software that has been created and has passed the testing stage will be implemented (launched) on the website so that it can be used by users or internet users. And if the software has problems or errors, maintenance will be carried out to fix problems or errors that were not found in the previous step.

### 3 Results and Discussion

#### 3.1 Best Customer SPK Analysis using SMART

1. Define the criteria

Table 1. Decision Criteria

No	Criteria
C1	Subscription Length
C2	Number of Visits
C3	Number of Orders
C4	Total Spend

2. Assign weight to the criteria

Table 2. Criteria Weight

Kriteria	Weight
Subscription Length	75
Number of Visits	25
Number of Orders	100
Total Spend	50
Grand Total	250

3. Normalizing Criteria Weight

Table 3. Weight of normalized results criteria

Criteria	Normalization = $\frac{W_j}{\sum w_j}$
Subscription Length	$75/250 = 0,3$
Number of Visits	$25/250 = 0,1$
Number of Orders	$100/250 = 0,4$
Total Spend	$50/250 = 0,2$
Total $W_j$	250

4. Determine parameter values and criteria values for each customer.

Table 4. Criteria Weight Value

Criteria	Parameter	Criteria Weight
Subscription Length	More Than 6 Months	3
	3 - 6 Months	2
	Less than 3 Months	1
Number of Visits	More than 20 visits	3
	10-20 Visits	2
	Less than 10 visits	1
Number of Orders	More than 20 Orders	3
	10 - 20 orders	2
	Less than 10 Orders	1
Total Spend	More than IDR. 5,000,000	3
	IDR. 3,000,000 – 5,000,000	2
	Less than IDR. 3,000,000	1

5. Alternate Value

Table 5. Some Alternative Values

No	Alternatives	Criteria			
		Subscription Length	Number of Visits	Number of Orders	Total Spend
A1	ABBAS	2	1	3	1
A2	ADBULLAH	1	2	1	2
A3	ADAM RIZKI	1	1	3	2
A4	ADRIAN	2	1	3	3
A5	AGUSRIYAN	1	3	1	1
A6	AHMAD	3	3	1	1
A7	AILA	2	1	3	3
A8	AINI	1	1	1	1
A9	ALDA	1	3	3	1
A10	ALFARIZI	1	2	2	1
A11	ALIF	3	3	3	2
A12	AMANDA	1	1	1	1
A13	AMIRA	2	2	2	2

Determine the final value of each criterion by multiplying the value obtained from normalizing the standard data criterion value by the normalized criterion weight value. Then add up the value of the multiplication. The following is the calculation of the final value (see Table 6).

Tabel 6. Final Weight Calculation

Alternatives	Final Value Calculation
A1	$= (0,5*0,3) + (0*0,1) + (1*0,4) + (0*0,2) = 0,55$
A2	$= (0*0,3) + (0,5*0,1) + (0*0,4) + (0,5*0,2) = 0,15$
A3	$= (0*0,3) + (0*0,1) + (1*0,4) + (0,5*0,2) = 0,55$
A4	$= (0,5*0,3) + (0*0,1) + (1*0,4) + (1*0,2) = 0,75$
A5	$= (0*0,3) + (1*0,1) + (0*0,4) + (0*0,2) = 0,1$
A6	$= (1*0,3) + (1*0,1) + (0*0,4) + (0*0,2) = 0,4$
A7	$= (0,5*0,3) + (0*0,1) + (1*0,4) + (1*0,2) = 0,75$
A8	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A9	$= (0*0,3) + (1*0,1) + (1*0,4) + (0*0,2) = 0,5$
A10	$= (0*0,3) + (0,5*0,1) + (0,5*0,4) + (0*0,2) = 0,25$
A11	$= (1*0,3) + (1*0,1) + (1*0,4) + (0,5*0,2) = 0,9$
A12	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A13	$= (0,5*0,3) + (0,5*0,1) + (0,5*0,4) + (0,5*0,2) =$
A14	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A15	$= (0*0,3) + (0*0,1) + (0,5*0,4) + (1*0,2) = 0,4$
A16	$= (0*0,3) + (1*0,1) + (0,5*0,4) + (0*0,2) = 0,3$
A17	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A18	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A19	$= (0*0,3) + (1*0,1) + (0*0,4) + (0*0,2) = 0,1$
A20	$= (0*0,3) + (0*0,1) + (0,5*0,4) + (0,5*0,2) = 0,3$
A21	$= (0,5*0,3) + (0*0,1) + (0*0,4) + (1*0,2) = 0,35$
A22	$= (0,5*0,3) + (1*0,1) + (0*0,4) + (0*0,2) = 0,25$
A23	$= (1*0,3) + (0*0,1) + (0*0,4) + (1*0,2) = 0,5$
A24	$= (0*0,3) + (0*0,1) + (0,5*0,4) + (0*0,2) = 0,2$
A25	$= (0,5*0,3) + (0*0,1) + (0,5*0,4) + (0*0,2) = 0,35$
A26	$= (0*0,3) + (0,5*0,1) + (0*0,4) + (0*0,2) = 0,05$
A27	$= (1*0,3) + (0,5*0,1) + (1*0,4) + (1*0,2) = 0,95$
A28	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A29	$= (0,5*0,3) + (0*0,1) + (1*0,4) + (0,5*0,2) = 0,65$
A30	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A31	$= (0,5*0,3) + (0,5*0,1) + (1*0,4) + (0,5*0,2) = 0,$
A32	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A33	$= (0,5*0,3) + (1*0,1) + (0*0,4) + (0*0,2) = 0,25$
A34	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A35	$= (0*0,3) + (0*0,1) + (0,5*0,4) + (1*0,2) = 0,4$
A36	$= (0,5*0,3) + (0,5*0,1) + (0*0,4) + (0*0,2) = 0,2$
A37	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A38	$= (0,5*0,3) + (0,5*0,1) + (0,5*0,4) + (1*0,2) = 0,$
A39	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A40	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$

Table 6. Cont.

Alternatives	Final Value Calculation
A41	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A42	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A43	$= (0*0,3) + (0,5*0,1) + (0*0,4) + (1*0,2) = 0,25$
A44	$= (1*0,3) + (0,5*0,1) + (1*0,4) + (0*0,2) = 0,75$
A45	$= (1*0,3) + (1*0,1) + (0,5*0,4) + (0,5*0,2) = 0,7$
A46	$= (1*0,3) + (1*0,1) + (0*0,4) + (0,5*0,2) = 0,5$
A47	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (0,5*0,2) = 0,$
A48	$= (0,5*0,3) + (1*0,1) + (1*0,4) + (0,5*0,2) = 0,75$
A49	$= (0,5*0,3) + (0,5*0,1) + (0,5*0,4) + (0,5*0,2) =$
A50	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (1*0,2) = 0,65$
A51	$= (1*0,3) + (1*0,1) + (0*0,4) + (0*0,2) = 0,4$
A52	$= (1*0,3) + (1*0,1) + (0*0,4) + (1*0,2) = 0,6$
A53	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A54	$= (0,5*0,3) + (0*0,1) + (1*0,4) + (1*0,2) = 0,75$
A55	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (0,5*0,2) = 0,$
A56	$= (1*0,3) + (1*0,1) + (0*0,4) + (1*0,2) = 0,6$
A57	$= (0,5*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 0,85$
A58	$= (0,5*0,3) + (0*0,1) + (1*0,4) + (0*0,2) = 0,55$
A59	$= (0*0,3) + (0,5*0,1) + (0,5*0,4) + (1*0,2) = 0,45$
A60	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (1*0,2) = 0,65$
A61	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (0,5*0,2) = 0,$
A62	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (0*0,2) = 0,45$
A63	$= (1*0,3) + (1*0,1) + (1*0,4) + (0*0,2) = 0,8$
A64	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A65	$= (0*0,3) + (1*0,1) + (0,5*0,4) + (0*0,2) = 0,3$
A66	$= (1*0,3) + (1*0,1) + (1*0,4) + (0,5*0,2) = 0,9$
A67	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A68	$= (0*0,3) + (0*0,1) + (1*0,4) + (0,5*0,2) = 0,5$
A69	$= (0*0,3) + (1*0,1) + (0,5*0,4) + (1*0,2) = 0,5$
A70	$= (1*0,3) + (0*0,1) + (0*0,4) + (1*0,2) = 0,5$
A71	$= (1*0,3) + (0,5*0,1) + (0*0,4) + (0*0,2) = 0,35$
A72	$= (0*0,3) + (1*0,1) + (0,5*0,4) + (1*0,2) = 0,5$
A73	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A74	$= (0*0,3) + (0,5*0,1) + (0,5*0,4) + (0*0,2) = 0,25$
A75	$= (1*0,3) + (0,5*0,1) + (0,5*0,4) + (0,5*0,2) = 0,$
A76	$= (0*0,3) + (0,5*0,1) + (0*0,4) + (0*0,2) = 0,05$
A77	$= (0*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0$
A78	$= (1*0,3) + (0,5*0,1) + (0,5*0,4) + (0,5*0,2) = 0,$
A79	$= (0,5*0,3) + (1*0,1) + (0*0,4) + (1*0,2) = 0,45$

Table 6. Cont.

Alternatives	Final Value Calculation
A80	$= (1*0,3) + (0*0,1) + (1*0,4) + (1*0,2) = 0,9$
A81	$= (0,5*0,3) + (0,5*0,1) + (1*0,4) + (1*0,2) = 0,8$
A82	$= (0*0,3) + (1*0,1) + (0,5*0,4) + (1*0,2) = 0,5$
A83	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (0*0,2) = 0,45$
A84	$= (1*0,3) + (1*0,1) + (0,5*0,4) + (0,5*0,2) = 0,7$
A85	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A86	$= (0,5*0,3) + (0,5*0,1) + (1*0,4) + (0*0,2) = 0,6$
A87	$= (0*0,3) + (0*0,1) + (1*0,4) + (1*0,2) = 0,6$
A88	$= (0,5*0,3) + (1*0,1) + (1*0,4) + (0,5*0,2) = 0,75$
A89	$= (0,5*0,3) + (0,5*0,1) + (0,5*0,4) + (0,5*0,2) =$
A90	$= (0,5*0,3) + (0,5*0,1) + (0,5*0,4) + (0,5*0,2) =$
A91	$= (0,5*0,3) + (0,5*0,1) + (1*0,4) + (0*0,2) = 0,6$
A92	$= (0,5*0,3) + (0,5*0,1) + (0,5*0,4) + (0,5*0,2) =$
A93	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (0,5*0,2) = 0,$
A94	$= (1*0,3) + (1*0,1) + (1*0,4) + (1*0,2) = 1$
A95	$= (0,5*0,3) + (1*0,1) + (0,5*0,4) + (0*0,2) = 0,45$
A96	$= (0,5*0,3) + (0,5*0,1) + (1*0,4) + (0*0,2) = 0,6$
A97	$= (0,5*0,3) + (0*0,1) + (0*0,4) + (0*0,2) = 0,15$
A98	$= (1*0,3) + (0,5*0,1) + (0,5*0,4) + (1*0,2) = 0,75$
A99	$= (0,5*0,3) + (0*0,1) + (1*0,4) + (1*0,2) = 0,75$
A100	$= (0*0,3) + (1*0,1) + (0*0,4) + (0*0,2) = 0,1$

Based on the results of calculating the final value of the best alternative that has the greatest preference, namely A18, A32, A34, A40, A41, A42, A53, A67, A73, A85, and A94, the eleven alternatives were selected as customers to be used as the best customer recommendations in determining customers based on criteria determined by calculating a decision support system using the SMART method.

#### 4 Conclusion

Based on the research results of the Decision Support System for Determining the Best Customer with the Simple Multi-Attribute Rating Technique Method, which have been done from the design stage to the testing stage, the following can be said:

- a. This decision support system uses the SMART method for selecting customers based on 4 criteria: length of subscription, loyalty, number of orders, and total spending, as considerations for business or store owners in selecting customers. Creating, building, and using the SMART SPK method to find the best customer who can do calculations well and get good results
- b. This web-based decision support system application can help users figure out the best recommendations for customers so that they are less likely to miss the mark.

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