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Decision Support Systems For Selection of Pet Cat using Preference Selection Index (PSI) & Multi-Objective Optimization on The Basis of Ratio Analysis (MOORA) Methods

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In its evolution, cats have many variants that make adopters confused in determining the right choice. In the early stages of the search there are several common ways that adopters use, such as visiting websites on the internet, reading magazines or books, or directly coming to a pet store. The search process requires money, effort, and time. Therefore, in this final project was built a Decision Support System for Selection of Pet Cat using Preference Selection Index (PSI) & Multi-Objective Optimization On The Basis Of Ratio Analysis (MOORA) Methods which is expected to be able to help adopters to improve cost efficiency, energy and issued time. This system is expected to be able to provide recommendations for the type of pet cat according to the criteria and needs of the adopter. The criteria used include adoption costs, health, nature, weight, and treatment time. The basic concept of the two method is to calculate the weight of the criteria which is then multiplied by a normalized matrix and ranking. Based on the results of usability testing that applies the Technology Acceptance Model (TAM) theory by distributing questionnaire to 69 respondents, the results obtained are 0.92 with a VERY STRONG relationship level, so this system can be considered useful for users.

1. Introduction

Cats are one of the animals that are usually kept by the public. The level of public interest in choosing a cat to be a pet is quite high. The reason behind the high public interest in keeping cats is that cats can provide positive benefits for their owners such as being able to make their keepers feel entertained and comfortable when playing with cats so as to reduce stress and having a cat can increase the sense of affection and concern for fellow living creatures.

There are many types of cats that can be kept by humans and each type of cat has a different appearance, character and nature. This is what makes adopters confused in choosing the type of cat to be kept. Therefore choosing the right type of pet cat is very important before deciding to keep a cat. A decision support system (DSS) is expected to be a solution to this problem, namely to determine the right type of cat to be kept.

The method that will be used in this research is the Preference Selection Index (PSI) and Multi-Objective Optimization on The Basis of Ratio Analysis (MOORA) methods. The PSI method is used for criterion weighting and normalization, while the MOORA method used for ranking which will select the best alternative a number of available alternatives.

In the PSI method, the results obtained are based on minimal and simple calculations in accordance with statistical concepts but without the need to determine the importance of the criteria first. This method is very useful in determining the value of the importance of each criterion in the event of a value conflict [1].The MOORA method itself has a good level of selectivity in getting the best alternative from several available alternative options, because the MOORA method can determine different criteria values. These criteria can be worth the benefits (benefits) or unprofitable

(cost). The MOORA method also has other advantages, namely being flexible and easy to understand in separating objects from the evaluation process into decision weight criteria [2].

The system testing stage is also made to ensure that the system is in accordance with the expected needs and objectives. To find out, measurements were taken using the Technology Acceptance Model (TAM) theory reference by Davis FD in 1989. According to Davis (1989) as quoted by Fatmawati (2015), the purpose of TAM is to provide an explanation of what factors determine acceptance technology that is able to explain the behavior of its users. From this theory, 1 of 6 existing variables is used, namely Perceived Usefulness which is used to determine user perceptions of the usefulness of a system. [3]

2. Literature Study / Hypotheses Development

a. Preference Selection Index (PSI) Method

In this method there is no need to determine the relative importance between attributes first. This method is useful when there is a conflict in determining the relative importance between attributes. The steps for completing the PSI method are:

1) Determine the problem
   Determine the attributes and alternatives involved in decision making.

2) Formulate the decision matrix
   m in the matrix Xij is the number of alternatives and n is the number of attributes. Xij is the i-th alternative decision matrix with the j-th criteria.

$$X_{ij} = \begin{vmatrix} x11 & x12 & \dots & x1n \\ x21 & x22 & \dots & x2n \\ \vdots & & & \\ xm1 & xm2 & \dots & xmn \end{vmatrix} \quad (1)$$

3) Normalization of the decision matrix
   If the attribute type of benefit (benefit), then the larger value is desired, use the equation 2 following:

$$Ri_{ij} = \frac{x_{ij}}{xj^{max}} \quad (2)$$

If the attribute is of the unfavorable type (cost), then a smaller value is desired, use the following equation 3:

$$R_{ij} = \frac{xj^{min}}{x_{ij}} \quad (3)$$

4) Calculating the mean value of normalized data
   The mean value is calculated by the following equation:

$$N = \frac{1}{N}\sum_{i=1}^{m} R_{ij} \quad (4)$$

5) Calculating the value of variation preferences
   In this step, the preference value variation(Øj) between each attribute is determined using the following equation:

$$Ø_j = \sum_{i=1}^{m}[R_{ij} - N]^2 \quad (5)$$

6) Determine deviation preference value

$$Ωj = 1 - Øj \quad (6)$$

7) Determine the weight of the criteria

$$w_j = \frac{Ωj}{\sum_{j=1}^{n} Ωj} \quad (7)$$

The total value of all the weighted criteria for all attributes should be one, for example $\sum_{j=1}^{n} \Omega j = 1$.

8) Calculate the Preference Selection Index

$$\theta_j = \sum_{j=1}^{m} (R_{ij} W_j) \quad (8)$$

The alternative that has the value preference selection index largest is the best alternative [4]

b. Multi-Objective OptimizationOn The Basis Of Ratio Analysis (MOORA) Method

The MOORA method is applied to solve problems by using complex mathematical methods. However, the calculation using the MOORA method is only the one that produces the largest value which will be selected as the best alternative [2]. The steps for completing the MOORA method are:

1) Identifying attributes and inputting criteria values for an alternative.

2) Making a decision matrix

The decision matrix is represented as Xij matrix, i represents m which is the number of alternatives while j represents n which is the number of criteria.

$$X_{ij} = \begin{vmatrix} x11 & x12 & \dots & x1n \\ x21 & x22 & \dots & x2n \\ \vdots & & & \\ xm1 & xm2 & ... & xmn \end{vmatrix} \quad (9)$$

3) Normalization of matrix decision

$$X^*_{ij} = X_{ij} / \sqrt{[\sum_{i=1}^{m} x_{ij}^2]} \quad (10)$$

4) Optimizing the attributes

For optimization of multi-objective, the size of the normalized added in the case of maximization (for attributes that are favorable or benefit) and reduced in the case of minimization (for attributes that are not profitable or cost). When the weight of attributes considered, using the following equation:

$$Y_i = \sum_{j=1}^{g} w_j X^*_{ij} - \sum_{j=g+1}^{n} w_j w^*_{ij} \quad (11)$$

g is the number of attributes to be maximized, (n-g) is the number of attributes to be minimized, and Yi is the normalized value of alternative 1 for all the attributes.

5) Ranking of Y values

The value of Yi can be positive or negative depending on the maximum and minimum totals in the decision matrix. Thus the best alternative has the value of Yi highest worst alternative while having value of Yi the lowest. [5]

3. Methodology

The type of data used in this study is secondary data, in the form of data on cat sales at the Keibi Cats Palembang Pet Shop and several stores in 3 marketplaces including Shopee, Tokopedia, and OLX, namely data on criteria for the owner of the pet shop which includes: Adoption Costs, Health, Nature, Weight, Treatment Time, and Age.

Table 1. Criteria

Sub-criteria	Type Criteria
Adoption Costs	Cost of
Health	Benefit

Nature	Benefit
Weight	Benefit

Treatment Time	Cost
Usia	Benefit

Tables 2 to 6 below are value to the five criteria that support the determination of the cats. For the adoption cost criteria, no sub-criteria weighting is needed because the value can be used directly. Ratings or value are given on a scale of 1 to 5, where a value of 1 is for the worst rating, and 5 is for the best rating.

Table 2. Sub-Criteria of Health

Sub-criteria	Value
Unhealthy	2
Healthy Enough	3
Healthy	4
Very Healthy	5

Table 3. Sub Criteria of Nature

Sub-criteria	Value
Unfriendly	2
Friendly Enough	3
Friendly	4
Very Friendly	5

Table 4. Sub Criteria of Weight

Sub-criteria	Value
>4	2
<0.8	3
2.6 – 4	4
0.8 – 2.5	5

Table 5. Sub-Criteria of Treatment Time

Sub-criteria	Value
Every day	1
Once a week	2
Every two weeks	3
Every three weeks	4
Every four weeks	5

Tabel 6. Sub-criteria of Age

Sub-criteria	Bobot
19 month - 24 month	2
13 month - 18 month	3
7 month - 12 month	4
2 month - 6 month	5

Table 7 below is a table of cat alternative data that has been collected and will be used in this research.

4. Result and Discussion

In this section will explain the calculation process using the PSI and MOORA methods. The PSI method is used in the normalization process and calculates the weight of the criteria. Then the MOORA method is used to find the highest value by ranking the results. Table 7 is the initial data used

Table 7. Alternative Data

	Alternative Name	C1	C2	C3	C4	C5	C6
A1	Persia Medium	2.000.000	Very Healthy	Friendly	3 kg	Once every 3 weeks	10 months
A2	Himalaya Sealpoint	1.750.000	Healthy	Friendly	1,5 kg	Once every 2 weeks	3 months
A3	Persia Peaknose	3.000.000	Healthy	Very Friendly	1 kg	Once every 2 weeks	3 months
A4	Anggora X Persia	1.500.000	Healthy	Friendly	3,5 kg	Once every 3 weeks	12 months
A5	Anggora X Persia	700.000	Very Healthy	Very Friendly	1 kg	Once every 2 weeks	2 months
…	**…**	**…**	**…**	**…**	**…**	**…**	**…**
A20	Ragdoll	4.500.000	Very Healthy	Friendly	1,7 kg	Once every a week	3 months

The data above is the data that is used as the initial cats alternative data. There are 6 criteria used to support the calculation process. Each criterion is filled with specific values in Table 8.

Table 8. Alternative Value Table

This alternative value must be normalized. Table 9 is the result of normalization and mean of criteria using PSI methods.

	Alternative Name	C1	C2	C3	C4	C5	C6
A1	Persia Medium	2.000.000	5	4	4	2	4
A2	Himalaya Sealpoint	1.750.000	4	4	5	3	5
A3	Persia Peaknose	3.000.000	4	5	5	3	5
A4	Anggora X Persia	1.500.000	4	4	4	2	4
A5	Anggora X Persia	700.000	5	5	5	3	5
…	**…**	**…**	**…**	**…**	**…**	**…**	**…**
A20	Ragdoll	4.500.000	5	4	5	4	5

Table 9. Normalization calculation table (PSI)

	Alternative Name	C1	C2	C3	C4	C5	C6
A1	Persia Medium	0,30	1	0,8	0,8	1	0,8
A2	Himalaya Sealpoint	0,34	0,8	0,8	1	0,67	1
A3	Persia Peaknose	0,20	0,8	1	1	0,67	1
A4	Anggora X Persia	0,40	0,8	0,8	0,8	1	0,8
A5	Anggora X Persia	0,86	1	1	1	0,67	1
…	**…**	**…**	**…**	**…**	**…**	**…**	**…**
A20	Ragdoll	0,13	1	0,8	1	0,5	1
Total		**7,3**	**17,6**	**17,4**	**18,8**	**14**	**19,2**
Mean		**0,36**	**0,88**	**0,87**	**0,94**	**0,7**	**0,96**

After getting the results of normalization and the mean, then calculate the preference variation value on the PSI method. The results are shown in Table 10 below.

Table 10. Preference Variation Value calculation table (PSI)

	Alternative Name	Q1	Q2	Q3	Q4	Q5	Q6
A1	Persia Medium	0,0040	0,0144	0,0049	0,0196	0,09	0,0256
A2	Himalaya Sealpoint	0,0004	0,0064	0,0049	0,0036	0,0011	0,0016
A3	Persia Peaknose	0,0266	0,0064	0,0169	0,0036	0,0011	0,0016
A4	Anggora X Persia	0,0014	0,0064	0,0049	0,0196	0,09	0,0256
A5	Anggora X Persia	0,2439	0,0144	0,0169	0,0036	0,0011	0,0016
…	…	…	…	…	…	…	…
A20	Ragdoll	0,0529	0,0144	0,0049	0,0036	0,04	0,0016
Total		**1,2506**	**0,192**	**0,182**	**0,168**	**0,7**	**0,128**

Then the total of each of these criteria is calculated for the deviation of the preference value. So that it can produce the weight of each criterion whose total must be 1.

Table 11. Preference value deviation calculation table (PSI)

Ω1	Ω2	Ω3	Ω4	Ω5	Ω6	Total
-0,2506	0,808	0,818	0,832	0,3	0,872	**3,3794**

Table 12. Criteria weight calculation table (PSI)

w1	w2	w3	w4	w5	w6	Total
-0,0741	0,2391	0,2421	0,2462	0,0888	0,258	**1**

After getting the weight of each criterion, the calculation proceeds to the MOORA method, which is to optimize the attributes by including the weights. The result are shown in Table 13 blow.

Table 13. Attribute optimization table with included weights (MOORA)

	Alternative Name	C1	C2	C3	C4	C5	C6
A1	Persia Medium	-0,0222	0,2391	0,194	0,1970	0,0888	0,2064
A2	Himalaya Sealpoint	-0,025	0,1913	0,194	0,2462	0,0592	0,2580
A3	Persia Peaknose	-0,0148	0,1913	0,242	0,2462	0,0592	0,2580
A4	Anggora X Persia	-0,0297	0,1913	0,194	0,1970	0,0888	0,2064
A5	Anggora X Persia	-0,0636	0,2391	0,242	0,2462	0,0592	0,2580
…	…	…	…	…	…	…	…
A20	Ragdoll	-0,0099	0,2391	0,194	0,2462	0,0444	0,2580

After that, the preference value of Yi is determined after getting the attribute optimization values. The value of Yi can be positive or negative depending on the maximum and minimum totals in the decision matrix. Thus the best alternative has the highest Yi value while the worst alternative has the lowest Yi value.

Table 14. Yi preference value determination table (MOORA)

	Max (C2+C3+C4+C6)	Min (C1+C5)	Yi = Max - Min
A1	0,8361	0,0665	0,7696
A2	0,8891	0,0338	0,8554
A3	0,9376	0,0444	0,8932
A4	0,7883	0,0591	0,7292
A5	0,9854	-0,0044	0,9897
…	…	…	…
A20	0,9370	0,0345	0,9025

Table 15. Ranking result table

	Alternative	Result	Ranking
A5	Anggora X Persia Kitten	0,9897	1
A7	Siam (Siamese)	0,9420	2
A11	Persia Flatnose	0,9351	3
A8	British Short Hair	0,9059	4
A10	Munchkin	0,9038	5
A20	Ragdoll	0,9025	6
A15	Anggora Asli Kitten	0,9000	7
A3	Persia Peaknose	0,8932	8
A14	Persia Medium Kitten	0,8856	9
A12	Persia Himalaya	0,8650	10
A2	Himalaya Seal Point	0,8554	11
A6	Persia Odd Eye	0,8540	12
A9	Bengal (Blacan)	0,8528	13
A13	Anggora Odd Eye	0,8474	14
A16	Anggora Asli Remaja	0,8428	15
A19	Himalaya X Ragdoll	0,8333	16
A17	Anggora X Domestik	0,8253	17
A1	Persia Medium Dewasa	0,7696	18
A18	Himalaya Short Hair	0,7657	19
A4	Anggora X Persia Dewasa	0,7292	20

From Table 15 above, it can be concluded that the second alternative can be recommended as a pet cat breed, namely the Anggora X Persia Kitten cat which has the highest Yi value of 0,9897.

Below is the results of the system usability test (perceived of usefulness) which is measured using the Technology Acceptance Model (TAM) theory reference. Questionnaires were distributed and then got 69 respondents. The calculation is done by assigning a rating to the test variable using the formula below:

$$\text{Score} = \frac{\text{Actual}}{\text{score Ideal score}} \text{ x } 1 \quad (12)\ [6]$$

Then these results are interpreted using the Correlation Coefficient by Sugiyono which can be seen in the following table.[7]

Table 16. Interpretation Correlation Coefficient

Interval Coefficient	Relationship Level
0.00 – 0.199	Very Low
0.20 – 0.399	Low
0.40 – 0.599	Moderate
0.60 – 0.799	Strong
0.80 – 1,000	Very Strong

The results of the calculation of the questionnaire respondents are in the following table:

Table 17. Answer Frequency Score

Q No.	Frequency of Answers					Total Score	Actual	Score Ideal Score
	STS	TS	KS	S	SS			
1.	0	0	5	19	45	69	316	345
2.	0	0	5	12	52	69	323	345
3.	0	0	7	13	49	69	318	345
4.	0	0	6	21	42	69	312	345
5.	0	0	4	19	46	69	318	345
6.	0	1	4	14	50	69	320	345
7.	0	0	2	22	45	69	319	345
8.	0	1	5	25	38	69	307	345
9.	0	1	7	13	48	69	315	345
10.	0	0	4	13	52	69	324	345
Actual Score							**3172**	
Ideal Score							**3450**	

The final score calculation process is then carried out using the following calculation formula:

$$\text{Score} = \frac{3172}{3450} \times 1 = 0.92$$

Based on the results of the above calculation, it can be seen that the score obtained is 0.92. This score is then interpreted using the correlation coefficient by Sugiyono. So this system is considered useful for users with a relationship level to a score of 0.92 which is VERY STRONG.

5. Conclusion

The conclusion obtained in this research is that the Preference Selection Index (PSI) and Multi-Objective Optimization on The Basis of Ratio Analysis (MOORA) methods have been successfully applied in the decision support system for selection of pet cat. The results of the weighting in the calculation of the PSI method are very helpful for the MOORA method in optimizing attributes or criteria which can then produce a ranking of pet cat types.

The results of the system usability test (perceived of usefulness) by applying the theory of Technology Acceptance Model (TAM) get a value of 0.92 with a VERY STRONG relationship level, so this system can be considered useful for users.

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