Implementation of Tahani Fuzzy Logic Method for Selection of Optimal Tourism Site

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Abstract. Indonesia has a variety of tourism industries. Travel makes people's interest increase in visiting tourist sites. A recommendation application in the field of tourism is needed for the selection of the right tourism object to be implemented in Central Java. This application is expected to provide information on prospective tourists in choosing tourist attractions effectively. This application can facilitate prospective tourists to choose tourist objects that match the criteria by applying the fuzzy tahani method. Fuzzy Tahani describe a fuzzy query processing method, based on language manipulation known as SQL (Structured Query Language). The Fuzzy Tahani model is very appropriate to be used in the process of finding the right and accurate data. Variables used in this application are variable ticket prices, number of facilities, number of visitors, distance traveled and types of tourist attractions.

1. Introduction

The tourism industry is a collection of interrelated tourism businesses aimed at producing goods and services for meeting the needs of tourists. Tourism is a leading sector that is expected to be able to drive the Indonesian economy. Existing data on tourism is not enough to help tourists determine the choice of tourist sites. The number of tourist attractions with several choices of facilities, ticket prices and distance to the location confuses tourists who will visit the tourist attractions. To make it easier for tourists to choose tourist objects, decision making is needed to solve the problem.

Multi attribute decision making is a field of research that is still widely studied by researchers. The Multi-Atributte Decision Making (MADM) is the study of decision-making methods and procedures in which there are concerns about conflicting criteria in an unstructured manner. With a series of limited multi-criteria and alternatives, the problem of decision making consists of ranking each alternative from the best to the worst. In the case of MADM, decision-making preferences information is often used to determine alternative ratings.

The approaches to solving MADM problem can be classified into three categories according to different preference information given by the decision makers: (1) without preference information, (2) with preference information on attributes, and (3) with preference information on alternatives. Research on multi-attribute decision making has been carried out by researchers. The research is MADM electrician, supplier selection, contractor selection. Problem of
contractor selection is an MADM problem because it involves subjective judgments, multiple decision makers and multiple criteria.

The fuzzy concept is applied to measure alternative ranks and rank criteria in the proposed MADM assessment model. Fuzzy theory allows handling uncertainty in information by allowing obscurity in the specification of the information. Priority ratings for each criteria are given a membership value for fuzzy subsets that are determined by the membership value.

Fuzzy logic studies on decision making have been developed by researchers. Research has been developed by [14] using the Tahani Fuzzy model for several criteria such as price, size, memory capacity, RAM in determining the selection of a computer. [15] in their research has developed a fuzzy tahani model to determine the right employee for the promotion of positions in a company[10].

In the process of finding the optimum location that meet desired conditions the analyst is challenged by management of multi-attribute decision making. The management that can be formed to attract tourists is to build a system that is able to provide information quickly and precisely on tourist objects. The system is expected to help tourists in making decisions about the selection of attractions effectively. This study will discuss the decision support system for choosing tourist attractions, especially in Central Java using the fuzzy tahani model.

This paper is organized as follows: In Section 2, we give the basic theory of our model. In Section 3, we present our algorithm and proposed model used to find the best alternative. In Section 4, we discuss the testing and evaluation results. Some conclusions are parts of Section 5.

2. Fuzzy Model

The classic database only handles crisp data. Whereas in reality humans often communicate in languages that contain uncertain data. To solve this problem a database with a fuzzy logic approach was built. A database that uses a fuzzy approach not only stores and manipulates crisp data but also subjective opinions, decisions and values that can be explained in linguistic terms. In general, there are two ways to put in elements of fuzziness into a database, namely:

2.1. Fuzzy Database

Fuzzy database is a database that has the ability to store and manipulate data directly. This database contains uncertainty. Users provide information that contains elements of obscurity into the database. This type of database is also supported by fuzzy queries to obtain information.

2.2. Fuzzy Query Database

Fuzzy database query is to create a fuzzy query in a classic database. The query has linguistic variables. While the data in the database that will be accessed is certain data. The database proposed by Tahani is a form of Fuzzy Query Database. The Tahani database still uses standard relations and this model uses fuzzy set theory to obtain information in its query.

3. Methodology

The database of the fuzzy Tahani model uses a standard relation but this model uses fuzzy set theory to get the query information. The preliminary data is data that has a crisp value. The next step is the fuzzy data search process called fuzzy query process through fuzzy database model Tahani. The idea of a fuzzy database model of the Tahani system is to define the concept of a fuzzy database in a system database using membership degrees. The stages of the research are carried out based on the block diagram in the figure 1.
Based on the stages of the research process in figure 1 can be explained as follows: in preliminary data, all data relating to parameters and alternatives from tourist attractions are prepared. The data is crisp data. Membership function is a curve that shows the use of data input into its membership value. Membership function have intervals between 0 and 1. A way that can be used to get membership values through a function approach.

The membership function in a fuzzy system is a combination membership degree between the left shoulder curve function, the triangle curve, and the right shoulder curve. The domain of each function starts from 0 to ∞ (infinite), so that the domain of the function is more flexible.

Fuzzification is the conversion of crisp values to fuzzy values. Fuzzy Inference System (FIS) is a system for making conclusions from a set of fuzzy rules. In this study the results of the FIS will determine the value of recommendations from tourist attractions. Query fuzzification is assumed to be a conventional query database management system creates and implements a basic system of fuzzy query logic.

The membership value of 2 fuzzy sets is called Fire Strength or $\alpha$-predicate. Basic operators are used in the query process, namely AND and OR operators. $\alpha$-predicate as a result of AND operator operation is obtained by selecting the smallest membership value in the respective sets. It can seen in equation (1).

$$\mu A \cap B = \min(\mu A[x], \mu B[y])$$

(1)

The results of calculations with OR operators are obtained by selecting the largest membership value in the sets, can be seen in equation (2):

$$\mu A \cup B = \max(\mu A[x], \mu B[y])$$

(2)

Alternative recommendations are chosen from alternatives that have ‘fire strength’ values between 0 and 1.

4. Result and Analysis

In Tahani fuzzy database, initially a fuzzy set is formed with its membership function. To assess the desired tourist attractions, several categories are formed which need to be considered with the set of each parameter. These parameters are price, facility, number of visitors and distance.

The database used in this study is the Tahani database and the database structure used is a relational database structure. The selected data will be processed using fuzzy tahani method with the parameters desired by tourists. This process is expected to produce appropriate tourist recommendations.

Membership function of each variable fuzzy uses a combination of a left shoulder curve, triangle curves and right shoulder curve for set which has 3 fuzzy sets.

For membership function that have 2 fuzzy sets using a combination of left shoulder and right shoulder curve.

4.1. Ticket Price

Domain of functions membership of parameter 1 (ticket price) is presented at figure 2. Ticket price parameter are divided into 3 interval fuzzy : Cheap, Normal, Expensive. Degree of membership at ticket price parameter can be seen in table 2.
4.2. Facilities of Tourist Attraction

Fuzzification is performed using the facility parameter membership function divided into 3 criteria, namely Less, Enough and Good.

![Membership function curve of ticket price and facility parameter](image1)

Figure 2. Membership function curve of ticket price and facility parameter

The fuzzification process in the facility parameters obtained membership degrees as in table 2:

4.3. Number of Visitor

From table 1 above, fuzzification is performed using number of visitor parameter membership function which divides it into 3 criteria, namely Little, Normal and Many.

The fuzzification process in the facility parameters obtained membership degrees as in table 2.

4.4. Distance (Location of Tourism Site)

Fuzzification is performed using location of tourism site distance(from the capital of Central Java) parameter membership function which divides it into 3 intervals, namely Close, Enough and Far.

![Membership function curve of number of visitor and distance parameter](image2)

Figure 3. Membership function curve of number of visitor and distance parameter

The fuzzification process in the distance parameter obtained membership degrees as in table 1

| Alternatives | Ticket Price | Number of Facility | Number of Visitor | Distance (Km) |
|--------------|--------------|--------------------|------------------|--------------|
|              | Cheap        | Normal             | Expensive        | Less         | Enough | Good | Little | Normal | Many | Close | Enough | Far |
| Alt 1        | 0            | 0                  | 1                | 0             | 1       | 0    | 0.37   | 0.63   | 1    | 0     | 0     | 1 |
| Alt 2        | 1            | 0                  | 0                | 0             | 0.2     | 0.8  | 0      | 0      | 0    | 1     | 0     | 1 |
| Alt 3        | 1            | 0                  | 0                | 0             | 0.8     | 0.2  | 0.7    | 0      | 0    | 1     | 0     | 1 |
| Alt 4        | 1            | 0                  | 0                | 0             | 0.9     | 0.1  | 0.88   | 0.11   | 0    | 0     | 1     | 1 |
| Alt 5        | 1            | 0                  | 0                | 0             | 0.6     | 0.4  | 0.84   | 0.16   | 0    | 1     | 0     | 1 |
| Alt 6        | 1            | 0                  | 0                | 0             | 0.8     | 0.2  | 0.80   | 0.20   | 0    | 1     | 0     | 1 |
| Alt 7        | 1            | 0                  | 0                | 0             | 0.4     | 0.3  | 0.43   | 0.57   | 0    | 1     | 0     | 1 |
| Alt 8        | 1            | 0                  | 0                | 0             | 0.25    | 0.75 | 0      | 0      | 0    | 1     | 0     | 1 |
| Alt 9        | 1            | 0                  | 0                | 0             | 0.92    | 0.08 | 0.92   | 0      | 1    | 0     | 0     | 1 |
| Alt 10       | 1            | 0                  | 0                | 0             | 0.08    | 0.92 | 0      | 0.92   | 1    | 0     | 0     | 1 |

The implementation of the data in table 1 for the selection of tourism site parameters based on the rules : Ticket prices “CHEAP”, Facilities “ENOUGH”, Number of visitors “NORMAL”, Distance “FAR”, which is executed by using Structure Query Language (SQL).
Calculation of fire strength is obtained from the degree of database membership. Each degree of membership that matches the query parameters is processed according to the rules or operators used, for example AND, OR or NOT. FireStrength as a result of operations with AND operators is obtained by taking the smallest membership value between elements in the corresponding sets, using the equation 1.

\[
\mu_{\text{FireStrength}} = \min (\mu_{\text{CheapPrice}}, \mu_{\text{GoodFacilities}}, \mu_{\text{ManyVisitors}})
\]

The results of fire strength calculations for each alternative are presented in table 2.

| Tourism Site Name (Alternative) | Cheap Price | Enough Facilities | Normal Visitor | Far Distance | Fire Strength |
|---------------------------------|-------------|--------------------|----------------|--------------|--------------|
| Borobudur Temple (Alt 1)        | 0           | 0                  | 0.62           | 1            | 0            |
| Bandengan Beach (Alt 2)         | 1           | 0.2                | 1              | 1            | 0.2          |
| Kartini Beach (Alt 3)           | 1           | 0.8                | 0.7            | 1            | 0.7          |
| Empu Rancak Beach (Alt 4)       | 1           | 0.9                | 0.11           | 1            | 0.11         |
| Menganti Beach (Alt 5)          | 1           | 0.4                | 0.15           | 1            | 0.4          |
| Kartini Museum (Alt 6)          | 1           | 0.2                | 0.19           | 1            | 0.2          |
| Mantingan Mosque (Alt 7)        | 1           | 0                  | 0.43           | 1            | 0            |
| Hian Thian Siang Tee Pagoda (Alt 8) | 1       | 0                  | 0.25           | 1            | 0            |
| Cinta Hill (Alt 9)              | 1           | 0                  | 0.07           | 0            | 0            |
| Ranjeng Lake (Alt 10)           | 1           | 0                  | 0.08           | 1            | 0            |

Search results on queries in the calculation of fire strength produce sequences or ranks of alternatives. Alternative tourism objects that have the highest fire strength value are Kartini Beach. This alternative is recommended as a tourist destination according to the calculation parameters used.

5. Conclusion

Determination of alternative ranks in a decision making is obtained using the degree of membership of each parameter in a database. The fuzzy rules are integrated into the knowledgebase structured aims to make the stored data reusable. Fuzzy Tahani method can be implemented to help the decision maker to choose tourist attractions with various parameters such as consideration of ticket prices, tourist facilities, distance of tourist locations and the average visitor on tourist objects. This model is expected to make tourists satisfied in enjoying tourism activities and at the same time increase state revenue from the tourism sector.

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