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Research Article

The Development of a Tourism Attraction Model by Using Fuzzy Theory

Jieh-Ren Chang and Betty Chang

National Ilan University, No. 1, Section 1, Shen-Lung Road, Yilan City 26047, Taiwan

Correspondence should be addressed to Jieh-Ren Chang; jrchang@niu.edu.tw

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The purpose of this study is to develop a model to investigate the tourists' preference. Ten attributes of tourist destinations were used in this study. Fuzzy set theory was adopted as the main analysis method to find the tourists' preference. In this study, 248 pieces of data were used. Besides the evaluations for the factors, the overall evaluations (namely, satisfied, neutral, and dissatisfied) for every tourism destination were also inquired. After screening, 201 pieces of these data could be used. In these 201 pieces of data, 141 were classified into "satisfied" with the tourism destination, accounting for 70.15%, and 49 were "neutral," accounting for 24.38%, while 11 were "dissatisfied," accounting for 5.47%. Eight rules were obtained with the method of fuzzy preprocess. Regarding the condition attributes, three of the original ten attributes were found influential, namely, level of prices, living costs, information and tourist services, and tourist safety of the tourism destinations. From the results of this study, it is shown that top management of tourism destinations should put resources in these fields first, in order to allow limited resources to perform to maximum effectiveness.

1. Introduction

With the rapid economic and social development, the increase in GDP every year, and people's growing concern toward recreations, the tourism industry has been developing vigorously. In many countries, the tourism industry is a main industry that deserves our policy attention, and obviously it has become a global socioeconomic phenomenon [1]. A successful tourism industry can enhance regional economic development, as well as becoming a source of rich foreign exchange income [2]. The tourism industry is one of the main industries that determine the world's long-term economic growth [3].

The tourism industry has a far-reaching influence on many aspects such as social and economic development, culture, city development, and revival; in particular, it has the greatest influences on economics [4]. The output value of the tourism industry accounts for US$ 6 trillion of the global economy which is 9% of global GDP [5]. UNWTO (2011) [4] further estimated that, by 2020, the number of global tourists will reach 1.6 billion and 2 million people; global tourism earnings will reach as much as two trillion US dollars. The data indicates that tourism can bring in an enormous amount of economic benefits [6].

However, in modern society, no tourism industry can escape from international competition due to globalization. In this situation, how to increase international competitiveness of the tourism industry has become one of the greatest concerns.

This study investigated into tourist destinations. A tourist destination (such as city or region) is no longer viewed as a place that features unique natural landscape, culture, or art; instead, it is seen as a compound product that satisfies the tourists' need [1]. Now, many countries are actively developing their own tourist destinations' international competitiveness [2]. However, how to enhance tourist destinations' attractiveness to tourists relies on more than a single factor; it requires an overall plan to increase the tourist destinations' competitiveness in the international market [7].

The goal of this study is to establish a model for managing tourist destinations. The management of all tourism destinations should focus on enhancing their attractiveness and quality, as well as effectively using the limited resources in the current environment [8]. Therefore, this study explores

various tourist destinations from the perspective of tourists. In addition, how these tourism destinations attract tourists and the tourists' evaluations are also included in this study [9].

Fuzzy model is similar to the thinking model of human beings [10, 11]. This study therefore uses fuzzy model to analyze the preference rules of tourist destinations. Hereby, this research aims to develop a model for investigation of tourist destinations management. It adopts fuzzy set theory as the main analysis method for tourism industry to find the tourists' preference. In the second part of this study, it does literature exploration on the competitiveness and attractiveness of tourism destination. The third section focuses on introduction of fuzzy set theory and fuzzy rules extraction algorithm [12]. The fourth section gives a possible explanation for the results. Finally, the authors draw a conclusion and the suggestions for future research in the last section.

2. Review and Discussion of the Literature

Tourism refers to people's temporary movement from their residence or working environment to a destination, and all related facility or services in the destination which are to be provided to tourists are covered in the tourism industry [13].

Gunn [14] reported that the so-called destination refers to local residents' "location"; on the other hand, it is a "playground" for tourists from other areas. A better explanation for a playground is a tourist destination, as it can be a specific tourist attraction, a town, a certain region in a country, an entire country, or even a bigger area on the planet [15]. Cracolici and Nijkamp [1] believed a tourist destination is a supplier that satisfies tourists physically and mentally; two parts are included: "structural" and "nonstructural." "Structural" refers to the natural landscape and cultural resources in a tourist destination, while "nonstructural" means human resources, perceptions, and so forth. Accordingly, if an area plans to develop tourism, the key point basically lies in how to present a destination that attracts tourists [16] and how to become more appealing and competitive than any other areas' destinations.

The critical factor model of tourist destinations' competitiveness established by Cracolici and Nijkamp [1] based on the concept of Crouch and Ritchie [8] encompasses physiography, culture and history, market ties, activities, events, and the tourism superstructure. Ten attractions of tourist destinations were compiled and used as the attributes in this study, as follows: (F1) reception and sympathy of local residents, (F2) artistic and cultural cities, (F3) landscape, environment, and nature, (F4) hotels and other accommodation, (F5) typical foods, (F6) cultural events (concerts, art exhibitions, festivals, etc.), (F7) level of prices, living costs, (F8) quality and variety of products in the shops, (F9) information and tourist services, and (F10) tourist safety.

3. Establishment of Fuzzy Decision Rules

3.1. Introduction of Fuzzy Concept. Fuzzy theory has been widely studied and successfully applied in various fields, which has got remarkable achievements so far. The fuzzy set defined by Professor Zadeh is represented by characteristic function $\mu_A(x)$ in mathematics, in which the value of membership function is the degree of element x belonging to a fuzzy set A. Therefore, the function matches the elements in the universal set to another set that is between 1 and 0:

$$\mu_A : X \longrightarrow [0, 1], \tag{1}$$

where $x \in X$, X indicates the universal set that is defined for the specific problem, while $[0, 1]$ refers to the range of real numbers between 0 and 1. Accordingly, this study will apply the two operating factors in the deduction of if-then fuzzy rules and membership function.

The vague linguistics between "yes" and "no" could be all represented by membership function values, which is the basic concept of fuzzy set theory. It aims to illustrate fuzzy phenomenon by clear and strict mathematic methods.

In this study, the tourism management of towns with cultural heritage is investigated. Ten attributes about tourism management of these towns were used for the study. In addition, fuzzy set theory is utilized to obtain the rules of tourist preference. During the fuzzy deduction, we collect various data from complicated environments and apply them in fuzzy deduction rules and membership functions to make the final decisions.

For the tourism management of cultural heritage towns, ten properties are investigated. Besides, the fuzzy set theory is also used to obtain the rules of tourists' preference. To sum up, the fuzzy system theory is scientific, advanced, and practical and can also provide correct guidance to our work. A new learning method for automatically deriving fuzzy rules and membership functions from a given set of training instances is proposed here as the knowledge acquisition facility [17]. Notation and definitions are introduced below.

Data preprocess and fuzzy rule establishment are included in the fuzzy learning algorithm. A set of training instances are collected from the environment. Our task here is to generate automatically reasonable membership functions and appropriate decision rules from these training data, so that they can represent important features of the data set. In order to avoid the disturbance of ineffective information, all the data should be preprocessed in advance [18].

The support set of fuzzy set D is a crisp set; it includes all the elements in the universe set U, but the membership value in D must be greater than 0 as follows:

$$\operatorname{supp}(D) = \{x \in U \mid \mu_D(x) > 0\}. \tag{2}$$

The center of a fuzzy set is defined as if the membership values which correspond to fuzzy set D from every element in $\operatorname{supp}(D)$ are finite (basically 1 is supposed to be the maximum value). In this situation, the position of the maximum value or the medium point of the maximum value is defined as the center of the fuzzy set as shown in Figure 1. The typical center of a fuzzy set is shown in Figure 1.

Fuzzy set includes all the points in the set U. Concerning set D, when the membership value is equal to 0.5, it is the vaguest point.

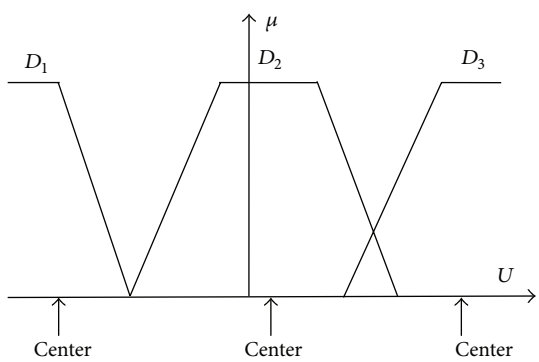

Figure 1: Typical centers in fuzzy set.

In order to obtain the support set higher than a certain level, α-cut is used to extract the support set and α-cut of fuzzy set D is a definite set D_α as follows:

$$D_\alpha = \{x \in U \mid \mu_D(x) \geq \alpha\}. \tag{3}$$

Fuzzy proposition includes two types, namely, atomic fuzzy proposition and compound fuzzy proposition. An atomic fuzzy proposition is a single fuzzy proposition as follows:

$$q_1 \text{ is } a_1, \tag{4}$$

where q is a linguistic variable and a_1 is the linguistic value of q_1.

A compound fuzzy proposition is using conjunctions such as "and," "or," and "not" to joint atomic fuzzy propositions to make fuzzy intersection set, fuzzy union set, and fuzzy compensate set. For example, q_1 stands for "information and tourist services," q_2 stands for "level of prices, living costs," a_1 and a_2 stand for linguistic values "very good" and "barely acceptable," and then the compound fuzzy proposition will be as follows:

$$q_1 \text{ is } a_1 \text{ and } q_2 \text{ is } a_2. \tag{5}$$

Fuzzy rules are made of "if-then" and fuzzy propositions as shown in rule r:

$$\begin{aligned} r\text{: If } & q_1 \text{ is } a_1 \text{ and } q_2 \text{ is } a_2 \\ \text{Then } & y \text{ is } b_1. \end{aligned} \tag{6}$$

In an "if fuzzy proposition," the questionnaire analysis is set as a condition attribute and, in a "then fuzzy proposition," the questionnaire analysis is set as a decision attribute. When linguistic variable q_1 is a_1 and q_2 is a_2, linguistic variable y will be b_1; therefore with fuzzy rules, the linguistic causal relationship can be inferred. All the fuzzy rules can be put together to make a fuzzy rule database and this database includes various corresponding fuzzy rules.

Fuzzy inferences mean making inferences with all the rules in fuzzy rule database. There are three types in fuzzy inferences, namely, type 1, type 2, and type 3, which stand for singleton, linguistic, and linear inference rules. In this study, linguistic inference rules were used, and the method proposed by Tsukamoto was applied.

3.2. Deleting Ineffective Data. In order to avoid the interruption from ineffective data, preprocessing is necessary before data analysis [19]. There are many different methods that can be used for preprocessing. However, one preprocessing method may not be suitable for all of the fields. In this study, a novel preprocessing method of screening ineffective data for questionnaires was proposed. Here we define the effective data as honest data and ineffective data as dishonest data. Some attributes and data might be deleted to let decision-makers obtain precise and useful data in questionnaire analysis process. In this process, it is supposed that data from some respondents can be neglected. This type can be considered as a form of majority verdict which can obtain the main consensus from the majority of the questionnaire respondents. Concerning the data analysis in this study, the answers from questionnaires responded by tourists were used for data analysis. The effective data are defined as responses from the majority of tourists. The ineffective data, on the other side, include dishonest data and data from respondents with special preference.

3.3. Establishing Questionnaire Rules. The method of deleting ineffective data will be reported in this part. First of all, the authors assumed that most people have similar perception. Therefore, concerning a specific tourism destination, it is supposed that the scoring toward a specific attribute from the questionnaire respondents would be aggregated in a range. In the space of condition attribute, every decision attribute forms a block space and has its own center; those data with bias might be far from the center and more likely to be ineffective data. In addition, in the space of condition attribute, the intersection with different decision attribute might be small or empty; this assumption is to make sure that the classification of decision attribute is identifiable.

With establishing fuzzy rules, the authors can screen ineffective data with the method of fuzzy inference. Concerning the content of the questionnaire, there are n subquestion items in each of the questions, and these n subquestion items stand for condition attribute items as follows:

$$Q = \{q_1, q_2, \ldots, q_n\}, \tag{7}$$

where $n \in N$ and N stands for the set of positive integers.

The overall evaluation a respondent made is the decision attribute y in a fuzzy rule. Supposing that a respondent answered a specific question item q_p, the set of linguistic values is as follows:

$$a^p = \left\{a_1^p, a_2^p, \ldots, a_{j_p}^p\right\}, \tag{8}$$

where $1 \leq p \leq n$ and $p \in N$, j_p is the number of the linguistic values of a specific condition attribute, and $j_p \in N$.

After answering all the subquestions, the respondent must select a linguistic value from set B as the overall evaluation, where set B is a set of linguistic values as follows:

$$B = \{b_1, b_2, \ldots, b_i\}, \tag{9}$$

where i is the number of decision attribute linguistic values and $i \in N$.

The data of the answers from respondents were transferred into fuzzy rules. For example, when the linguistic value of the decision attribute inference is b_h, the first fuzzy rule will be as follows:

$$r_1^h\text{: } q_1 \text{ is } a_{p_1}^1 \text{ and } q_2 \text{ is } a_{p_2}^2 \text{ and } \cdots \text{ and } q_n \text{ is } a_{p_n}^3 \longrightarrow y \text{ is } b_h, \tag{10}$$

where $1 \le h \le i$ and $h \in N$.

Then all the fuzzy rules would be put together in fuzzy rule database as follows:

$$R = \left\{r^1, r^2, \ldots, r^i\right\}. \tag{11}$$

The linguistic values of decision attribute in fuzzy rule of R could be classified into i categories and every category would correspond to the linguistic values in set B as follows:

$$r^h = \left\{r_1^h, r_2^h, \ldots, r_{k_h}^h\right\}, \tag{12}$$

where r^h stands for the fuzzy rule classification of b_h and the number of rules is k_h.

The previous part reported the principles of fuzzy rules for multiple condition attribute to single decision attribute. It is found from rule classification that the distribution space of b_h corresponds to set Q in (7) as follows:

$$F_h = \left\{a^{-1}(b_h), a^{-2}(b_h), \ldots, a^{-n}(b_h)\right\}, \tag{13}$$

where F_h is the linguistic value distribution space of b_h and $a^{-1}(b_h)$ stands for the distribution situation of a^1, which is corresponded from b_h.

4. Results and Discussion

4.1. Overview of the Research Data. In this study, 248 data used were retrieved. Most of the respondents are the office workers and young persons in Taiwan. In these 248 data, 201 of the tourist sites the respondents mentioned include the sites in northern parts, central parts, southern parts, and eastern parts of Taiwan. And the other 47 ones are international tourist sites out of Taiwan. In these data, tourists' evaluations for each of the factors about the tourism destinations were included. Besides the evaluations for the factors, the overall evaluations (namely, satisfied, neutral, and dissatisfied) for every tourism destination were also inquired. After screening, 201 of these data could be used. In these 201 data, 141 were classified into "satisfied" with the tourism destination, accounting for 70.15%, and 49 were "neutral," accounting for 24.38%, while 11 were "dissatisfied," accounting for 5.47%. The numbers and percentages of data classified into each category were shown in Table 1. The evaluation of the attribute "level of prices, living costs," has three fuzzy linguistic terms of levels ("good," "barely acceptable," and "poor.") On the other hand, the attribute "tourist safety" has four fuzzy linguistic terms of levels ("very good," "good," "poor," and "very poor.") The levels of these two attributes were shown in Table 2. Through the method of fuzzy preprocess, 8 rules were obtained. These fuzzy rules were shown in Table 3. Concerning the condition attributes, two of the original ten attributes were found influential, namely, level of prices, living costs (F7), and tourist safety (F10) of the tourism destinations.

Table 1: The numbers and percentages of overall evaluation.

	Satisfied	Neutral	Dissatisfied	Total
Numbers of data classified into each category	141	49	11	201
Percentage	70.15%	24.38%	5.47%	100.00%

4.2. Fuzzy Rules Analysis. The results of the fuzzy rules analysis were shown in Table 3. According to fuzzy mathematics, only two (F7, level of prices, living costs, and F10, tourist safety) of the 10 attributes were strongly influential attributes. From these rules, the following results can be obtained.

(1) From Rule 2 and Rule 3, when F7 (level of prices, living costs) received "good," the overall evaluations would be "satisfied" if F10 (tourist safety) received "good" or "very good."

(2) From Rule 1 and Rule 3, when F10 (tourist safety) received "very good," the overall evaluations would be "satisfied" even if F7 (level of prices, living costs) received "barely acceptable."

(3) From Rule 4 and Rule 5, when F7 (level of prices, living costs) received "barely acceptable," the overall evaluations would be neutral, if F10 (tourist safety) received the level of "good" or "poor."

(4) From Rule 6 and Rule 7, when F7 (level of prices, living costs) received "poor," the overall evaluations would be dissatisfied, if F10 (tourist safety) received the level of "poor" or "very poor."

(5) From Rule 6 and Rule 8, if F10 (tourist safety) received "very poor," the overall evaluations would be dissatisfied, no matter F7 (level of prices, living costs) received "barely acceptable" or "poor."

(6) Comparing Rule 1 and Rule 4, F7 (level of prices, living costs) received "barely acceptable" in both rules and at this time F10 (tourist safety) would be a key for the overall evaluations. F10 (tourist safety) received "very good" in Rule 1 and the overall evaluations were "satisfied," while, in Rule 4, the overall evaluations were "neutral" as F10 (tourist safety) received "poor."

(7) While comparing Rule 2 and Rule 5, F10 (tourist safety) received "good" in both of these rules. F7 (level of prices, living costs) would be a key for the overall evaluations in this situation. In Rule 2 F10 (tourist safety) received "good" and the overall evaluations were "satisfied"; in Rule 5, however, the overall evaluations were "neutral" as F7 (level of prices, living costs) received "barely acceptable."

Table 2: Levels of attributes.

Attributes	Numbers of levels	Fuzzy linguistic terms of levels (form high level to low level)
F7: level of prices, living costs	3 levels	"Good," "barely acceptable," and "poor."
F10: tourist safety	4 levels	"Very good," "good," "poor," and "very poor."

Table 3: The 8 rules derived from fuzzy analysis.

	F7 level of prices, living costs	F10 tourist safety	Evaluation
Rule 1	Barely acceptable	Very good	Satisfied
Rule 2	Good	Good	Satisfied
Rule 3	Good	Very good	Satisfied
Rule 4	Barely acceptable	Poor	Neutral
Rule 5	Barely acceptable	Good	Neutral
Rule 6	Poor	Very poor	Dissatisfied
Rule 7	Poor	Poor	Dissatisfied
Rule 8	Barely acceptable	Very poor	Dissatisfied

(8) Comparing Rule 4 and Rule 7, as F10 (tourist safety) received "poor" in both rules, F7 (level of prices, living costs) would be a key for the overall evaluations. For example, F7 (level of prices, living costs) received "barely acceptable" in Rule 4 and the overall evaluations were "neutral," while, in Rule 7, F7 (level of prices, living costs) received "poor" and the overall evaluations turned to "dissatisfied" consequently.

(9) Comparing Rule 5 and Rule 8, when F7 (level of prices, living costs) received "barely acceptable," F10 (tourist safety) played a crucial role for deciding the overall evaluations. In other words, if F10 (tourist safety) received "good," the overall evaluations would be "neutral." On the other hand, if F10 (tourist safety) received "very poor," the overall evaluations would be "dissatisfied."

(10) From the comparison of Rule 1, Rule 4, Rule 5, and Rule 8, it was found that F7 (level of prices, living costs) received "barely acceptable" in each of the rules. In Rule 1, for example, the overall evaluations were "satisfied" since F10 (tourist safety) received "very good." The overall evaluations of Rule 4 and Rule 5 were "neutral" on the other hand as F10 (tourist safety) received either "good" or "poor." In Rule 8, however, the overall evaluations were "dissatisfied" when F10 (tourist safety) received "very poor."

In this section, the rules in Table 3 were represented as in Figure 2. In Figure 2, the upper right corner (areas of Rule 1, Rule 2, Rule 3, and Rule 5) shows that when the attribute "tourist safety" was evaluated as "good" or "very good," the attribute "level of prices, living costs" was also evaluated as "good" or "barely acceptable," and the overall evaluations were satisfied or neutral. The reason might be that most tourists already had sufficient information about the level of local living costs before they made decision for

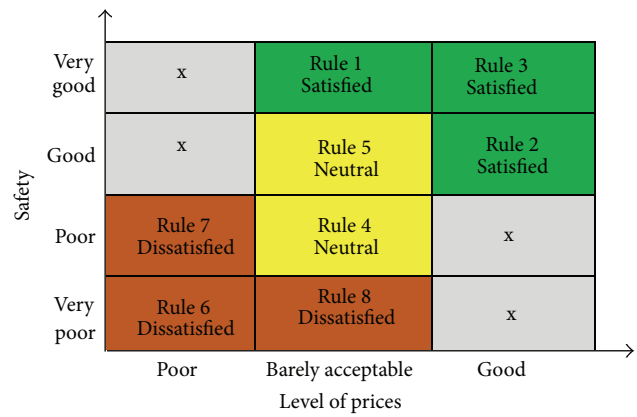

Figure 2: Fuzzy rule base (for all tourists).

their destinations. The tourist might therefore think the level of price is agreeable. On the other hand, the lower left corner (areas of Rule 6, Rule 7, Rule 8, and Rule 4) shows that when the attribute "tourist safety" was evaluated as "poor" or "very poor," the attribute "level of prices, living costs" was evaluated as "poor" or "barely acceptable," and the overall evaluations were dissatisfied or neutral. It is believed that the poor safety might impair tourists' confidence. To sum up, tourist safety is the attribute the tourists care about the most.

In Figure 2, "x" stands for no rules in that exact area. According to Figure 2, no rules were found in the upper left corner; these areas stand for destinations with high safety and high price. The reason for no rules here might be that most respondents are office workers and young persons, they made very different evaluations about these destinations, and therefore no consistent rules could be produced. Besides, there are no rules either in the lower right corner. This lower right corner area stands for tourist destinations with poor safety. Since tourist safety was the attribute the tourists care about the most, very few tourists would select these destinations.

4.3. Comparison of the Results from Tourists of Different Ages. Tourism is getting more and more popular in the 21st century. However, tourists of different ages might have various demands and different preference regarding tourism destinations. In order to investigate the tourist preference of different ages, the authors divided the data of tourists into two groups: one group is of tourists above 30 years old and the other group is of tourists of 30 years old and below.

4.3.1. Results from Tourists of 30 Years Old and Below. In the group of tourists of 30 years old and below, there are 139 pieces of data collected from these tourists. After programming

Table 4: Levels of attributes (tourists of 30 years old and below).

Attributes	Numbers of levels	Fuzzy linguistic terms of levels (form high level to low level)
F7: level of prices, living costs	3 levels	"Good," "barely acceptable," and "poor."
F9: information and tourist services	3 levels	"Good," "barely acceptable," and "poor."
F10: tourist safety	4 levels	"Very good," "good," "poor," and "very poor."

Table 5: The 13 rules derived from fuzzy analysis (tourists of 30 years old and below).

	F7 level of prices, living costs	F9 information and tourist services	F10 tourist safety	Evaluation
Rule 1	Barely acceptable	Barely acceptable	Very good	Satisfied
Rule 2	Barely acceptable	Good	Good	Satisfied
Rule 3	Barely acceptable	Good	Very good	Satisfied
Rule 4	Good	Barely acceptable	Good	Satisfied
Rule 5	Good	Barely acceptable	Very good	Satisfied
Rule 6	Good	Good	Good	Satisfied
Rule 7	Good	Good	Very good	Satisfied
Rule 8	Barely acceptable	Barely acceptable	Poor	Neutral
Rule 9	Barely acceptable	Barely acceptable	Good	Neutral
Rule 10	Poor	Poor	Very poor	Dissatisfied
Rule 11	Poor	Barely acceptable	Very poor	Dissatisfied
Rule 12	Barely acceptable	Poor	Very poor	Dissatisfied
Rule 13	Barely acceptable	Poor	Poor	Dissatisfied

with fuzzy set theory, three of the attributes were found to be crucial, namely, "level of prices, living costs" (F7), "information and tourist services" (F9), and "tourist safety" (F10). The evaluations of both of the attributes "level of prices, living costs" and "information and tourist services" were divided into three fuzzy linguistic terms of levels "good," "barely acceptable," and "poor" while the evaluation of the attribute "tourist safety" could be divided into four fuzzy linguistic terms of levels "very good," "good," "poor," and "very poor" as shown in Table 4. Thirteen fuzzy rules were derived from fuzzy computing as shown in Table 5.

According to the fuzzy rules obtained from the data of tourists of 30 years old and below, the following results can be obtained.

(1) Comparing Rule 4 and Rule 9, F9 (information and tourist services) received "barely acceptable" and F10 (tourist safety) received "good" in both rules; at this time F7 (level of prices, living costs) would play a crucial role in deciding the overall evaluations. For example, when F7 received "good" in Rule 4, the overall evaluation would be "satisfied" while, in Rule 9, F7 received "barely acceptable" and the overall evaluation was then "neutral."

(2) Comparing Rule 4 and Rule 9, F9 (information and tourist services) received "barely acceptable" and F10 (tourist safety) received "good" in both rules; at this time F7 (level of prices, living costs) would play a crucial role in deciding the overall evaluations. For example, when F7 received "good" in Rule 4, the overall evaluation would be "satisfied" while, in Rule 9, F7 received "barely acceptable" and the overall evaluation was then "neutral."

(3) Comparing Rule 1, Rule 8, and Rule 9, both of F7 (level of prices, living costs) and F9 (information and tourist services) received "barely acceptable" in each of the rules. In this situation, F10 (tourist safety) would be a key for the overall evaluations. In Rule 1, F10 (tourist safety) received "very good" and the overall evaluation was "satisfied," while, in Rule 8, F10 (tourist safety) received "poor"; and in Rule 9, F10 (tourist safety) received "good" and the overall evaluations of both of Rule 8 and Rule 9 were "neutral."

(4) Comparing Rule 8 and Rule 13, F7 (level of prices, living costs) received "barely acceptable" and F10 (tourist safety) received "poor" in both rules; at this time F9 (information and tourist services) would play an influential role in deciding the overall evaluations. For example, when F9 received "barely acceptable" in Rule 8, the overall evaluation would be "neutral," while, in Rule 13, F9 received "poor" and the overall evaluation was then "dissatisfied."

According to the results of fuzzy analysis, for tourists of 30 years old and below, three (F7, level of prices, living costs, F9, information and tourist services, and F10, tourist safety) of the 10 attributes were strongly influential attributes. Compared with the results in the previous section, there was

Table 6: Levels of attributes (tourists above 30 years old).

Attributes	Numbers of levels	Fuzzy linguistic terms of levels (form high level to low level)
F7: level of prices, living costs	4 levels	"Very good," "good," "poor," and "very poor."
F9: information and tourist services	4 levels	"Very good," "good," "poor," and "very poor."
F10: tourist safety	4 levels	"Very good," "good," "poor," and "very poor."

an extra influential attribute, namely, information and tourist services (F9). In order to analyze the relationship among these three attributes, 3 figures based on three different levels (good, barely acceptable, and poor) of information and tourist services were generated.

Figure 3(a) shows the rule base of tourists of 30 years old and below when information and tourist services of the destinations are good. Only four rules were generated in the upper right corner of Figure 3(a). These 4 rules are all evaluated as "satisfied" with very good or good in safety and good or barely acceptable in living cost. On the other hand, there were no rules created in other areas in Figure 3(a). In the condition of sufficient information, tourists would try their best to avoid going to destinations with poor safety or poor level of prices. Similar to the condition in Figure 2, no rules were found in the upper left corner and the lower right corner.

Figure 3(b) shows the rule base of tourists of 30 years old and below when information and tourist services of the destinations are barely acceptable. Comparing Figure 3(b) with Figure 3(a), Rule 9 in Figure 3(b) is in the same position as Rule 2 in Figure 3(a). However, the overall evaluation of Rule 9 in Figure 3(b) is neutral and that of Rule 2 in Figure 3(a) is satisfied; the authors therefore inferred that good information and tourist services of the destinations may promote the image of a tourist site.

Figure 3(c) shows the rule base of tourists of 30 years old and below when information and tourist services of the destinations are poor. Comparing Figure 3(c) with Figure 3(b), Rule 12 in Figure 3(c) is in the same position as Rule 8 in Figure 3(b). Nevertheless, the overall evaluation of Rule 12 in Figure 3(c) is dissatisfied and that of Rule 8 in Figure 3(b) is neutral; it is therefore inferred that poor information and tourist services of a tourist site may degrade the overall evaluation of a destination. On the other hand, there were no rules generated in other areas in Figure 3(c). Actually, very few people know destinations with poor information. Besides, it is supposed that a tourist site with good safety and living cost condition will soon be popular in this Internet era, and then those cases will be transferred into the section of sufficient information such as the cases in Figures 3(a) and 3(b).

4.3.2. Results from Tourists above 30 Years Old. In the group of tourists above 30 years old, there are pieces of 34 data collected from these tourists. After programming with fuzzy set theory, three of the attributes were found to be crucial, namely, "level of prices, living costs" (F7), "information and tourist services" (F9), and "tourist safety" (F10). The evaluation of all the attributes "level of prices, living costs," "information and tourist services," and "tourist safety" was shown as four fuzzy linguistic terms of levels ("very good," "good," "poor," and "very poor") as shown in Table 6. Fourteen fuzzy rules were derived from fuzzy computing as shown in Table 7.

According to the fuzzy rules obtained from the data of tourists above 30 years old, the following results can be obtained.

(1) Comparing Rule 8 and Rule 14, F7 (level of prices, living costs) received "good" and F10 (tourist safety) received "very poor" in both rules; at this time F9 (information and tourist services) would play a crucial role in deciding the overall evaluations. For example, when F9 received "good" in Rule 8, the overall evaluation would be "neutral," while, in Rule 14, F9 received "very poor" and the overall evaluation was then "dissatisfied."

(2) Comparing Rule 4 and Rule 11, F9 (information and tourist services) received "very good" and F10 (tourist safety) received "good" in both rules; at this time F7 (level of prices, living costs) would be a key for the overall evaluations. In Rule 4, F7 (level of prices, living costs) received "very good" and the overall evaluation was "satisfied," while, in Rule 11, F7 (level of prices, living costs) received "good" and the overall evaluation of Rule 11 was then "neutral."

According to the results of fuzzy analysis, for tourists above 30 years old, three (F7, level of prices, living costs, F9, information and tourist services, and F10, tourist safety) of the 10 attributes were strongly influential attributes. Besides, there are four levels in each of the three attributes as shown in Table 6. In order to analyze the relationship among these three attributes, 4 figures based on four different levels (very good, good, poor, and very poor) of information and tourist services were generated.

Figure 4(a) shows the rule base of tourists above 30 years old when information and tourist services of the destinations are very good. Seven rules were generated: four rules of satisfied were in the upper right corner of Figure 4(a) and the other three rules are of neutral. Comparing Figure 4(a) with Figure 4(b), Rule 7 in Figure 4(a) is in the same position as Rule 13 in Figure 4(b). However, the overall evaluation of Rule 7 in Figure 4(a) is neutral and that of Rule 13 in Figure 4(b) is dissatisfied; it is therefore inferred that better information

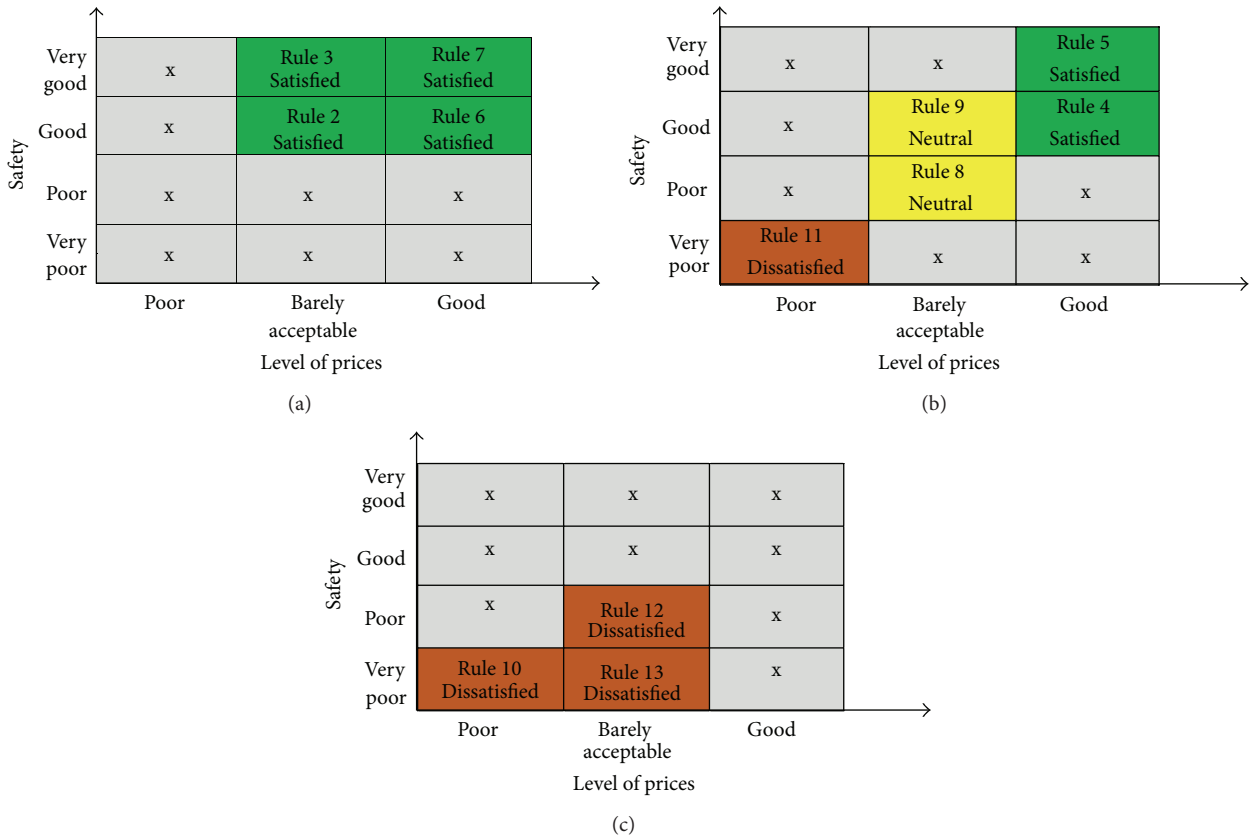

Figure 3: (a) Tourists of 30 years old and below/information and tourist services are good. (b) Tourists of 30 years old and below/information and tourist services are barely acceptable. (c) Tourists of 30 years old and below/information and tourist services are poor.

Table 7: The 14 rules derived from fuzzy analysis (tourists above 30 years old).

	F7 level of prices, living costs	F9 information and tourist services	F10 tourist safety	Evaluation
Rule 1	Poor	Very good	Very good	Satisfied
Rule 2	Good	Very good	Very good	Satisfied
Rule 3	Very good	Poor	Very good	Satisfied
Rule 4	Very good	Very good	Good	Satisfied
Rule 5	Very good	Very good	Very good	Satisfied
Rule 6	Very poor	Very good	Poor	Neutral
Rule 7	Poor	Very good	Poor	Neutral
Rule 8	Good	Good	Very poor	Neutral
Rule 9	Good	Good	Poor	Neutral
Rule 10	Good	Good	Good	Neutral
Rule 11	Good	Very good	Good	Neutral
Rule 12	Very good	Good	Poor	Neutral
Rule 13	Poor	Good	Poor	Dissatisfied
Rule 14	Good	Very poor	Very poor	Dissatisfied

and tourist services of a tourist site may promote the overall evaluation of a destination.

It is found that very few rules are in Figures 4(c) and 4(d). Similarly, there are few rules found in Figure 3(c) (three rules). The authors inferred that destinations with poor information and tourist services have fewer tourists. There is only one rule especially in each of Figures 4(c) and 4(d) because of lack of data from tourists above 30 years old. It is therefore concluded that tourists in this group (tourists above 30 years old) seldom travel to destinations with poor

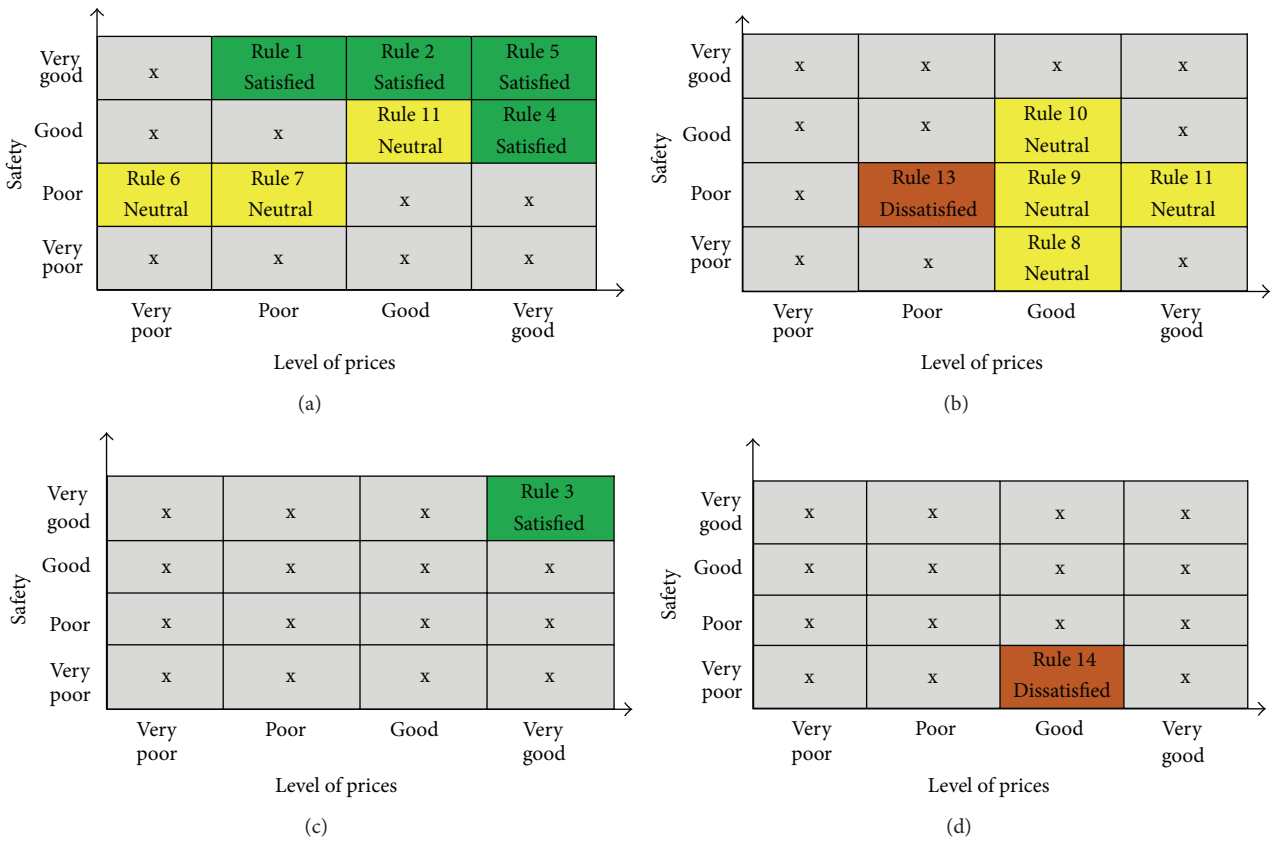

Figure 4: (a) Tourists above 30 years old/information and tourist services are very good. (b) Tourists above 30 years old/information and tourist services are good. (c) Tourists above 30 years old/information and tourist services are poor. (d) Tourists above 30 years old/information and tourist services are very poor.

information and tourist services. In other words, tourists above 30 years old need good information and tourist services when they select destinations for tour.

5. Conclusion

In this study, F7 (level of prices, living costs) and F10 (tourist safety) were found influential factors through fuzzy algorithm analysis [20]. From this research, a fuzzy rule database of tourism destinations is established to provide a fuzzy system inference decision-making model. This decision-making rule model can be provided to the tourism managers as a reference to establish tourism management. Tourism planners can use the ten attributes as a reference.

However, the budgets of some tourism destinations are often limited. This research simplified the ten constituent elements into two; in other words, two key attributes were found. While the budgets are limited, the tourism destinations could use the resource in the most crucial attributes to create comparatively large benefit.

From the rule analysis, it can be speculated that when tourists visit a tourism destination, they value "level of prices, living costs" (F7) and "tourist safety" (F10) of this area.

In order to investigate the tourist preference of different ages, the authors divided the data of tourists into two groups: one group is of tourists above 30 years old and the other group is of tourists of 30 years old and below. It was found that tourists of different ages showed their different preferences in three fields, namely, "level of prices, living costs" (F7), "information and tourist services" (F9), and "tourist safety" (F10). In other words, if the tourism industry would satisfy tourists' demands and preferences, especially for tourists of different ages, they have to focus on information and tourist services as well.

On the basis of the results of this study, it is shown that top management of tourism destinations should put resources in these fields first, in order to allow limited resources to perform to maximum effectiveness for the positive evaluations by tourists.

Lastly, this study still has parts that can be further researched or improved. In terms of the fuzzy linguistics, attribute F7 (level of prices, living costs) is of 3 levels, while attribute F10 (tourist safety) is of 4 levels, and 8 rules were produced. If other attributes such as tourists' age or gender are further considered, more focused rules will be obtained, which will assist in providing management of tourism destinations with more precise reference rules. At the same time, this can help decision-makers to make future development plans for tourism destinations that they manage, so as to cater to the preferences of different groups.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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