Fuzzy Expert System For The Selection Of Tourist Hotels

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Abstract : In the present work, a simple and very effective mathematical model is designed for tourist hotels of LEVEL 2. Location of hotels, building structure of hotels, quality of hotels, feedback of hotels and advertisement of hotels are as input factors. Trapezoidal membership function and triangular membership function are used for fuzzification process and defuzzification is done by COG technique. The fuzzy logic has been utilized in several different approaches to modeling "the selection of tourist hotels" process. This model addressed the hotel of LEVEL2 and this model concludes that the hotel is LEVEL 2 with degree of precision 52.15 %.

Key Words- Fuzzy logic, Fuzzy validation expert system, Linguistic variables, Root sum square (RSS)

1. Introduction:

In order to present a model of selection of hotels, where the expectations are fulfill for the arrival tourist. There is a huge problem in hotel industry to face the problems in selection of tourist hotels. In this study, we attempt to find a suitable response to this research need by a mathematical model, using fuzzy expert system. Therefore, hotel accommodations are formulated by appropriate fuzzy logic system. In this order, we have to select a prime location for the hotels. The location is the main issue in the hotel industry. Here, we have to try to solve the problems of selection of tourist hotels by using some important parameters. Many methods are developed in selection of tourist hotels; almost evaluation method has its strong points and issues for different situations. In this order, we will use fuzzy logic to solve the problems of selection of tourist hotels because hotels are main important part for positive thinking in the field of tourism. Good hotel location cannot only help increase market share and profitability but can also enhance the convenience of customer lodging because establishing a fine location will shorten the payoff period for fixed capital investment.[9] Accurate forecasts of tourist arrivals and study of the tourist arrival patterns are the tourism related industries to formulate efficient and effective strategies on maintaining and boosting tourism industry in a country.[13] In order to develop the fuzzy decision making model for selection of tourist hotels. We will focus on some parameters, which will help us in selection of tourist hotels. In this session, we use location of hotels, building structure of hotels, quality of hotels, and feedback of hotels and advertisement of hotels. Here we have three level hotels for the tourist and try to control this problem in a better way. A tourist hotel has a crucial role to developing and underdeveloped countries. Accurate forecasts on tourist hotels demand and study on the pattern of tourist demand from various origins are essential for the tourism. Selection of tourist hotels depends upon the tourist's choices. Good quality and good business are the main demand in the tourist hotel industry.

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In this order, we can gather that influential factors for hotels to achieve success and reputation, branding of tourist hotels depends upon the management of the hotels. Here, each hotel requires attracting the tourist by their good qualities, good location, good atmosphere and good reputation etc.

2. Tourist hotels overview:

In order to present a model of selection of hotels, where the expectations are fulfill for the arrival tourist. There is a huge problem in hotel industry to face the problems in selection of tourist hotels. In this order, we have to select a prime location for the hotels. The location is the main issue in the hotel industry and approximately 80 % of all cases of the tourist are related to hotels. Every tourist have requirements that, how they choose their level hotels. In a business environment, tourist hotels are good business in the future. Tourist demand forecasting focuses on traditional time series in tourist hotels. A tourist hotel has a crucial role to developing and underdeveloped countries. Accurate forecasts on tourist hotels demand and study on the pattern of tourist demand from various origins are essential for the tourism. Selection of tourist hotels depends upon the tourist's choices. Good quality and good business are the main demand in the tourist hotel industry. In this order, we can gather that influential factors for hotels to achieve success and reputation, branding of tourist hotels depends upon the management of the hotels. Here, each hotel requires to attract the tourist by their good qualities, good location, good atmosphere and good reputation etc.

3. FUZZY LOGIC

The concept of fuzzy sets was introduced in 1965 by Lotfi Zadeh (Zadeh L.A., 1965) as a means of representing vagueness in applications. Fuzzy logic is the logic corresponding to fuzzy sets. In classical two-valued logic, or Boolean logic or binary logic, a proposition is either true or false. The only permitted membership values are 0 or 1. Every item in the universe of discourse is either a full member of the set or not a member at all. Two valued logic works well for problems which are linear and systems that can be modeled precisely and it has proved to be effective in solving such problems. In multivalued logic, a proposition may be true, false or have an intermediate truth value. The set of truth values is assumed to be evenly divided over the interval [0, 1]. In fuzzy logic, the membership function can have values ranging from 0 to 1.

4. Modeling process

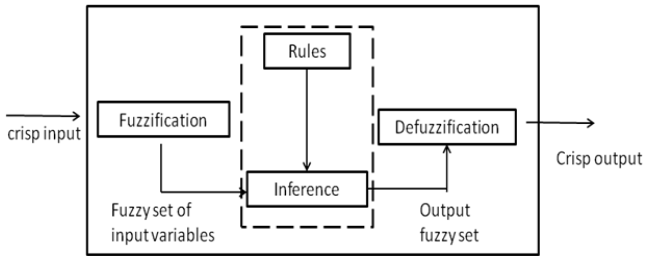


Figure 1.1 Fuzzy Validation Expert System

5. Types of tourist hotels

Here, we will use five input parameters and try to find the level of hotel in the output.

Location of hotels:
Location of hotel is divided in four parts:
Low: Hotel is established in town area or nearby to city.
Average: Hotel is established in city but we are far from main tourist place.
Good: Hotel is established in city and we are nearby to main tourist place.
Excellent: Hotel is established in city and we have lot of choice to travel any tourist place.
Quality of hotels:
Qualities of hotels have many sub-parameters:
Food, service, room quality, etc. Taking all these sub-parameters in our mind, we will divide quality of hotels in four parts:
Low: food is available by simple choices, service is low, and rooms have simple quality.
Average: Food is on demand, service is low, and rooms have medium quality.
Good: Food is on demand, service is medium, and rooms have good quality.
Excellent: Food is on demand, service is very fast, and rooms have standard quality.
Building structure of hotels:
Building structure is divided in four parts:
Low: Building is old and simple decoration.
Average: Building is old and good decoration.
Good: Building is new and good decoration
Excellent: Building is new and excellent decoration.
Feedback Of hotels:
Feedback of hotels is divided in four parts: low, average, good, excellent.
Advertisement of hotels:
Advertisement of hotels is divided in four parts: low, average, good, excellent.
Using all these parameters, we will decide the level of hotels:

Level 1: If hotel is established in city but we are far from main tourist place or hotel is established in city and we are nearby to main tourist place, food is available by simple choices, service is low, rooms have simple quality, building is old and good decoration., feedback is low and advertisement is good then, this is level 1 hotel.
Level 2: If hotel is established in city but we are far from main tourist place, food is available by simple choices, service is low, rooms have simple quality or food is on demand, service is low, rooms have medium quality, building is old and good decoration, feedback is average or low and advertisement is excellent or good then, this is level 2 hotel.
Level 3: Hotel is established in city and we are nearby to main tourist place, food is on demand, service is low, rooms have medium quality, building is old and good decoration or building is new and good decoration, feedback is low and advertisement is good or excellent then, this is level 3 hotel.

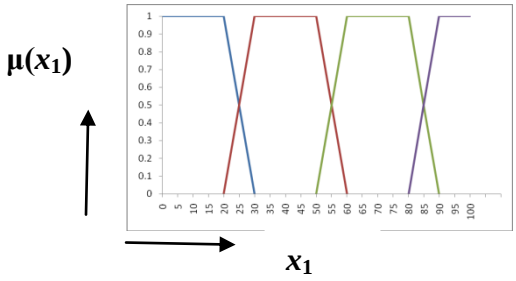
1. Location of hotels:

$$\mu_L(x_1)=\begin{cases}1 & x_1 \le 20 \\ \dfrac{30-x_1}{10} & 20 \le x_1 \le 30\end{cases} \quad (1.2)$$

$$\mu_A(x_1)=\begin{cases}\dfrac{x_1-20}{10} & 20 \le x_1 \le 30 \\ 1 & 30 \le x_1 \le 50 \\ \dfrac{60-x_1}{10} & 50 \le x_1 \le 60\end{cases} \quad (1.3)$$

$$\mu_G(x_1)=\begin{cases}\dfrac{x_1-50}{10} & 50 \le x_1 \le 60 \\ 1 & 60 \le x_1 \le 80 \\ \dfrac{90-x_1}{10} & 80 \le x_1 \le 90\end{cases} \quad (1.4)$$

$$\mu_E(x_1)=\begin{cases}\dfrac{x_1-80}{10} & 80 \le x_1 \le 90 \\ 1 & x_1 \ge 90\end{cases} \quad (1.5)$$



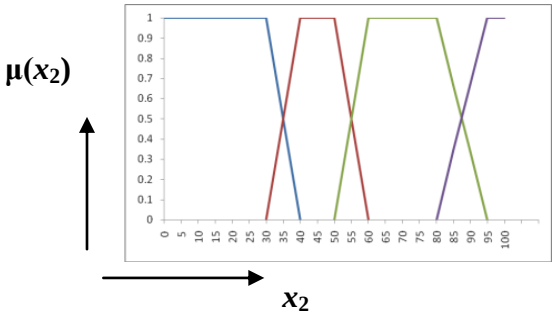
2. Building structure of hotels: $\mu(x_3)$

$$\mu_L(x_2)=\begin{cases}1 & x_2 \le 30\\ \dfrac{40-x_2}{10} & 30 \le x_2 \le 40\end{cases} \quad (1.6)$$

$$\mu_A(x_2)=\begin{cases}\dfrac{x_2-30}{10} & 30 \le x_2 \le 40\\ 1 & 40 \le x_2 \le 50\\ \dfrac{60-x_2}{10} & 50 \le x_2 \le 60\end{cases} \quad (1.7)$$

$$\mu_G(x_2)=\begin{cases}\dfrac{x_2-50}{10} & 50 \le x_2 \le 60\\ 1 & 60 \le x_2 \le 80\\ \dfrac{95-x_2}{15} & 80 \le x_2 \le 95\end{cases} \quad (1.8)$$

$$\mu_E(x_2)=\begin{cases}\dfrac{x_2-80}{15} & 80 \le x_2 \le 95\\ 1 & x_2 \ge 95\end{cases} \quad (1.9)$$



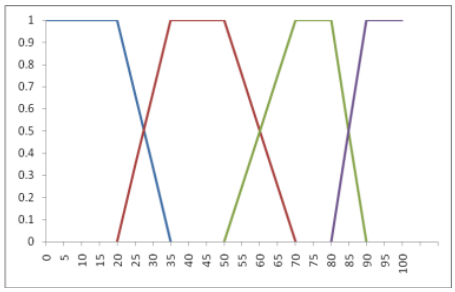
3. Quality of hotels X_3 :

$$\mu_L(x_3)=\begin{cases}1 & x_3 \le 20\\ \dfrac{35-x_3}{15} & 20 \le x_3 \le 35\end{cases} \quad (1.10)$$

$$\mu_A(x_3)=\begin{cases}\dfrac{x_3-20}{15} & 20 \le x_3 \le 35\\ 1 & 35 \le x_3 \le 50\\ \dfrac{70-x_3}{20} & 50 \le x_3 \le 70\end{cases} \quad (1.11)$$

$$\mu_G(x_3)=\begin{cases}\dfrac{x_3-50}{20} & 50 \le x_3 \le 70\\ 1 & 70 \le x_3 \le 80\\ \dfrac{90-x_3}{10} & 80 \le x_3 \le 90\end{cases} \quad (1.12)$$

$$\mu_E(x_3)=\begin{cases}\dfrac{x_3-80}{10} & 80 \le x_3 \le 90\\ 1 & x_3 \ge 90\end{cases} \quad (1.13)$$



4. **Feedback of the hotels X_4**

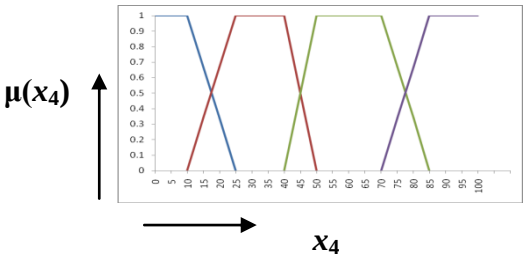
$$\mu_L(x_4)=\begin{cases}1 & x_4 \le 10\\ \dfrac{25-x_4}{15} & 10 \le x_4 \le 25\end{cases} \quad (1.14)$$

x_3

$$\mu_A(x_4)=\begin{cases}\dfrac{x_4-10}{15} & 10 \le x_4 \le 25\\ 1 & 25 \le x_4 \le 40\\ \dfrac{50-x_4}{10} & 40 \le x_4 \le 50\end{cases} \quad (1.15)$$

$$\mu_G(x_4)=\begin{cases}\dfrac{x_4-40}{10} & 40 \le x_4 \le 50\\ 1 & 50 \le x_4 \le 70\\ \dfrac{85-x_4}{15} & 70 \le x_4 \le 85\end{cases} \quad (1.16)$$

$$\mu_E(x_4)=\begin{cases}\dfrac{x_4-70}{10} & 70\le x_4\le 85\\ 1 & x_4\ge 85\end{cases} \quad (1.17)$$



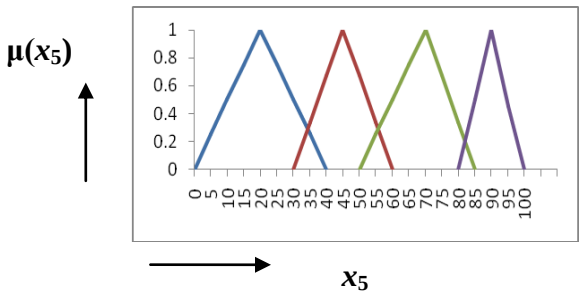
5. Advertisement of hotels X_5

$$\mu_L(x_5)=\begin{cases}\max\{0,\ \dfrac{x_5-0}{20} & x_5<20\\ \max\{0,\dfrac{40-x_5}{20} & 20\ge x_5\end{cases} \quad (1.18)$$

$$\mu_A(x_5)=\begin{cases}\max\{0,\ \dfrac{x_5-30}{15} & x_5<40\\ \max\{0,\dfrac{60-x_5}{15} & 45\ge x_5\end{cases} \quad (1.19)$$

$$\mu_G(x_5)=\begin{cases}\max\{0,\ \dfrac{x_5-50}{20} & x_5<70\\ \max\{0,\dfrac{85-x_5}{15} & 70\ge x_5\end{cases} \quad (1.20)$$

$$\mu_E(x_5)=\begin{cases}\max\{0,\ \dfrac{x_5-80}{10} & x_5<90\\ \max\{0,\dfrac{100-x_5}{10} & 90\ge x_5\end{cases} \quad (1.21$$



1. Defuzzification

The center of gravity (COG) method is used for defuzzification process which is the most popular technique and is widely utilized in actual applications. In this method the weighted strengths of each output membership function are multiplied by their respective output membership function center points and summed.Finally this area is divided by the sum of the weighted membership function strength and the result is taken as the crisp output. The COG method can be expressed as

$$\text{OutputData}=\frac{\sum_{i\in x_{\min}}^{x_{\max}} x_i.\mu(x_i)}{\sum_{i\in x_{\min}}^{x_{\max}} \mu(x_i)}$$

2. Case-Study

For the purpose of illustration, we consider that the nature of the road using four inputs viz location of hotels X_1, building structure of hotels X_2, quality of hotels X_3, feedback of hotels $X_4$and advertisement of hotels X_5.

1. Evaluate the authenticity of the tourist hotels: The values of the inputs of the tourist hotels have to evaluated, X_1=52, X_2=34, X_3=54, X_4=18, X_5=83 (say).

2. Fuzzification of the crisp values of inputs: Through the use of membership functions defined for each fuzzy set for each linguistic variable. The degree of membership of a crisp value in each fuzzy set is determined as follows:

$\mu_L(x_1)=0$, $\mu_A(x_1)=0.8$, $\mu_G(x_1)=0.2$, $\mu_E(x_1)=0$ **(1.22)**
$\mu_L(x_2)=0.6$, $\mu_A(x_2)=0.4$, $\mu_G(x_2)=0$, $\mu_E(x_2)=0$ **(1.23)**
$\mu_L(x_3)=0$, $\mu_A(x_3)=0.8$, $\mu_G(x_3)=0.2$, $\mu_E(x_3)=0$ **(1.24)**
$\mu_L(x_4)=0.47$, $\mu_A(x_4)=0.53$, $\mu_G(x_4)=0$, $\mu_E(x_4)=0$ **(1.25)**
$\mu_L(x_5)=0$, $\mu_A(x_5)=0$, $\mu_G(x_5)=0.13$, $\mu_E(x_5)=0.3$ **(1.26)**

Fire the rule bases that correspond to the inputs: Based on the value of fuzzy membership function values for the example under consideration, the following rules apply:

Rule No.	If					Then
	X_1	X_2	X_3	X_4	X_5	
1	AVERAGE	LOW	AVERAGE	LOW	GOOD	LEVEL 1
4	AVERAGE	LOW	AVERAGE	AVERAGE	EXCELLENT	LEVEL 2
9	AVERAGE	AVERAGE	AVERAGE	LOW	GOOD	LEVEL 2
14	AVERAGE	AVERAGE	GOOD	LOW	EXCELLENT	LEVEL 3
17	GOOD	LOW	AVERAGE	LOW	GOOD	LEVEL 1
20	GOOD	LOW	AVERAGE	AVERAGE	EXCELLENT	LEVEL 2

25	GOOD	AVERAGE	AVERAGE	LOW	GOOD	LEVEL 3
30	GOOD	AVERAGE	GOOD	LOW	EXCELLENT	LEVEL 3

1. Execute the inference system

We use "Root Sum Square" (RSS) method to combine the effects of all applicable rules. Root sum square method scales the function at their respective magnitudes and computes the "fuzzy centroid" of the composite area. This method is more complicated mathematically than other methods level

$$Level\ 1 = \sqrt{\sum_{i \in L_1} \left(\mu_{R_i}\right)^2} = \sqrt{(0.13)^2 + (0.13)^2} = 0.1838$$

$$Level\ 2 = \sqrt{\sum_{i \in L_2} \left(\mu_{R_i}\right)^2} = \sqrt{(0.3)^2 + (0.13)^2 + (0.2)^2} = 0.3832$$

$$Level\ 3 = \sqrt{\sum_{i \in L_3} \left(\mu_{R_i}\right)^2} = \sqrt{(0.13)^2 + (0.2)^2 + (0.2)^2} = 0.3112$$

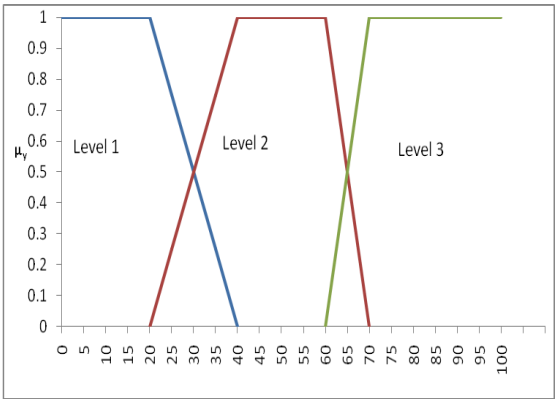


Figure:1.2 Output of the decision of the expert system

$$Output = \frac{(0.1838 \times 0.20) + (0.3832 \times 0.45) + (0.3112 \times 0.80)}{0.1838 + 0.3832 + 0.3112}$$

$$= 0.5215$$

This output shows that the hotel is **LEVEL 2** with **52.15% degree of precision**

1. Conclusion

We use "Center of gravity (COG)" for defuzzification. The defuzzification of the data into crisp output is accomplished by combining the results of the inference process. In the COG method, the weighted strengths of each output membership function are multiplied by their respective output membership function center points and summed. Finally, this area is divided by the sum of the weighted membership function strength and the result is taken as the crisp output. This shows the crisp output belongs to LEVEL 2 with 52.15 % degree of precision.

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