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A Trapezoidal Intuitionistic Fuzzy Decision Making System For Car Selection

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Abstract: Decision making is one of the problematic tasks when so many choices are available to choose. Lots of methodologies and hybrids are suggested by the researchers to find a solution for decision-making problem. The goal of the work is to make the multiple criteria decision-making system simpler using intuitionistic fuzzy methodology.
Key Words: Multi-Criteria Decision Making System, Intuitionistic Fuzzy system.

1. INTRODUCTION

Advancement in Decision-making models is required in today's business environment. Especially in the field of MCDM Multicriteria Decision Making System. A fuzzy set is one of the key components which can be utilized with any kind of algorithms to make the method simpler and logical. There are so many decision-making algorithms that are utilizing fuzzy sets like fuzzy AHP [1], fuzzy intuitionistic TOPSIS [2], Intuitionistic fuzzy sets [3] [4] and [5]. Fuzzy handles the values between '0' and '1'. In this study, the trapezoidal fuzzy intuitionistic algorithm is used to make the decision-making system for the customers in a car showroom, to select the car for purchasing by utilizing users' criteria as an input. Some basic axioms of intuitionistic fuzzy are been discussed in [6] and [7]. Intuitionistic algorithms generally follow heuristic approach. Some of the similar research works are discussed below.

There are various researches and extensions are done with intuitionistic fuzzy like clustering analysis [8], rough set approach [9]. [10] This work the author has differentiated the ordinary fuzzy set extension and intuitionistic fuzzy. Intuitionistic fuzzy is used in various fields some of them are: [11] has used trapezoidal intuitionistic fuzzy for land site fill selection and information axiom in been proposed in the study. The authors are also suggested that when the parameters face any uncertain values, then fuzzy sets can be utilized as it is done in the work. One of the applications of intuitionistic fuzzy is ranking solar power plants [12].

A hybrid of the intuitionistic fuzzy system is proposed [13]. [14] The authors shared the solution for non-linear programming difficulties and also suggested two stage geometric programming technique. A new similarity measure is been suggested with intuitionistic fuzzy [15].In this study, a decision-making model is made with trapezoidal intuitionistic fuzzy

2.METHODOLOGY

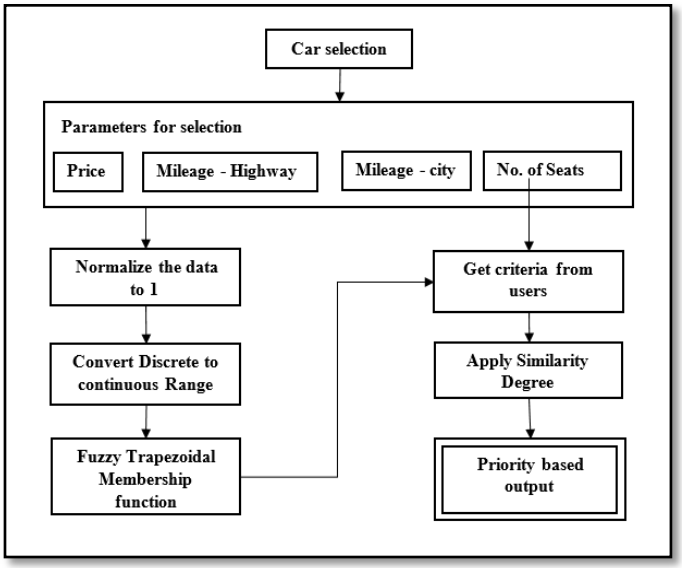

Figure 1 : General Structure of the methodology

The given dataset has both functional and non-functional variables, functional variables. The system design is made to allow more importance to functional variable and meagre importance to non-functional variables.

In this context, Cost, City and Highway Mileage are considered as functional variable. And seating capacity is assumed as non-functional variable. These assumption may vary with respect to the customer criteria.

The detailed algorithm is as follows:

Step 1: As the algorithm utilizes fuzzy logic, the dataset is been normalized from 0 to 1.

Step 2: Though the dataset has discrete values, the customers generally fixes some range as a criteria for decision making. For example the car price ranges from 500k to 1000k.

Step 3: Fuzzy Repertory Table is constructed using trapezoidal function of fuzzy membership for all the four attributes of car. If the attributes are 'l', 'm', 'n', 'o', then the trapezoidal membership variables be 'l_1 to l_4', 'm_1 to m_4' , 'n_1 to n_4' and 'o_1 to o_4' .The membership function can be written as given below.

$$\mu(x) = \begin{cases} 0 & if\ x < l \\ \dfrac{x-l}{l-m} & if\ l \le x \le m \\ 1 & if\ m \le x \le n \\ \dfrac{o-x}{o-n} & if\ n \le x \le o \\ 0 & x < o \end{cases}$$

Step : 4. With respect to the criteria and the available models, the following function of similarity degree is been found.

$$SD(l_i, l_x) = \begin{cases} 0 & if\ x \cap y, = \varphi \\ \dfrac{1}{2}\dfrac{(x_a - y_d)}{(y_c - y_d) + (x_a - x_b)} & if\ x \cap y \ne \varphi \\ & where\ y_d \le x < y_c; x_b < x < x_a \\ \dfrac{1}{2}(y_a - x_d) + (y_b - x_c) & if\ x \cap y \ne \varphi \\ & where\ x_c \le x \le y_b \end{cases}$$

Where,

x = {x_a, x_b, x_c, x_d} are the membership variables of any attribute of the car. y = {y_a, y_b, y_c, y_d} are the membership variables of criteria for the attributes given by the user.

Step: 5. Results of the above Similarity Degree is been sorted and assigned ranks. On the basis of ranks created with the help of users' criteria, they can purchase the car. The result of the above function will be the available suggestions to the users.

3. RESULTS AND DISCUSSION:

Intuitionistic Fuzzy plays an important role in the study. The system gets the user criteria as an input and displays the suggestion from the available cars in the showroom. The following Table 1 acts as a suggestion.

Table 1: Priority based ranking of cars with respect to the customers' criteria

Model No.	Price	Mileage- Highway	Mileage- City	No. of Seats	Rank
M-7	436447	17.88	14.88	4	1
M-5	600000	20	17	4	2
M-12	607160	19.61	16.61	4	3
M-4	700000	22	19	6	4
M-8	765000	16	13	6	5
M-11	916000	21.5	18.5	5	6
M-9	968500	21.64	18.64	4	7
M-13	1300000	21.43	18.43	5	8
M-6	1381000	22.7	19.7	4	9
M-3	1386000	17.3	14.3	6	10
M-14	1540000	19.39	16.39	5	11
M-10	2257000	17.2	14.2	6	12
M-1	2500000	15.73	12.73	4	13

M-2	2790000	15.06	12.06	4	14

If a user wants to buy a car which ranges from 430kto 1200k, and the highway mileage between 17 to 20 km/hr and the city mileage between 14 to 18 km/hr with the seating capacity of 4. The Following table would be the suggested decision for the user. The Model M-7 adheres the most to user's criteria. The
cars that get rank 1 to 5 can be chosen as they will be better choice with respect to the user's criteria

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