DETERMINING THE VALUE OF CARS

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Abstract: This research aims to study how to determing the value of cars by applying fuzzy logic. Four parameters: consumption, reliability, age and mileage are the input variables for this model. Consumption, age and mileage inputs have three membership functions and reliability has two membership functions. This models is based on twelve fuzzy IF–THEN rules and fuzzy reasoning. The output variable "Value" which has three membership functions, takes values from zero to one hundred corresponding to the percentage for value of car. All implementation are done with MATLAB R2008a.

Keywords: car, value, fuzzy

1. Introduction

Every man in the world is met with the problem of buying the car. A car is a wheeled, self-powered motor vehicle used for transportation. Most definitions of the term specify that cars are designed to run primarily on roads, to have seating for one to eight people, to typically have four wheels, and to be constructed principally for the transport of people rather than goods [1] [2]. The main problem for people is to determine real price of the car they want to buy.

With the help of fuzzy logic to create a model that will be determined on the value of the car based on its characteristics:

- Consumption
- Reliability
- Age
- Mileage

2. Fuzzy logic

The Fuzzy Logic tool was introduced by Lotfi Zadeh (1965), and is a mathematical tool for dealing with uncertainty [3]. Fuzzy logic systems are suitable for approximate reasoning. Fuzzy logic systems have faster and smoother response than conventional systems and control complexity is less. One of the features of fuzzy logic is that it is based on natural language, on the basis of human communication. This model use IF-THEN rules. The fuzzy inference engine uses these fuzzy IF–THEN rules to determine a mapping from fuzzy sets in the input universe of discourse to fuzzy sets in the output universe of discourse based on fuzzy logic principles. In order to build this models it is defined the fuzzy sets consist of four parameters: consumption, reliability, age and mileage are the input variables for this model. Consumption, age and mileage inputs have three membership functions and reliability has two membership functions. The output variable "Value" which has three membership functions, takes values from zero to one hundred corresponding to the percentage for value of car. Under the fuzzy set theory, elements of a fuzzy set are mapped to a universe of membership values using a function theoretic form belonging to the closed interval from 0 to 1 [4] . Fuzzy logic is very useful in modeling complex and imprecise systems, and fuzzy set theory is a powerful tool and its applications have rapidly increased with establishing its utility in numerous areas of the scientific world. Any system consisting of vague and ambiguous input variables may contribute to an ultimate effect. The fuzzy logic possibility

and its degree of effect due to the ambiguous input variables are considered by some as being generated in the human mind and is often referred to as expert knowledge. This expert knowledge is the accumulation of knowledge and ideas as a result of the expert's experience in a particular system; hence, decision-making processes may be considered as fuzzy expressions perceived by the expert [5] [6].

The fuzzy theory first proposed by L.A. Zadeh (1965), operated through three main steps [7].

- Fuzzification: The first step is to determine the definition domain of each variable based on the ranges of input and output variables in actual conditions.
- Fuzzy rules determination and fuzzy inference: Based on the experience and knowledge of experts, the language rules of determination were transferred into the executable fuzzy syntax for inference.
- Defuzzification: The fuzzy inference outputs are finally transformed back into crisp values [8].

A membership function (MF) is a curve that defines how each value in the input space is mapped to a membership value between 0 and 1. Thus, it specifies the degree to which a given input belongs to a set or is related to a concept. Depending on the methods for the fuzzy rules, FIS type is selected. The most common FIS types are Mamdani type and Sugeno-type. Mamdani type is used widely by fuzzy system designers in which the fuzzy sets from the consequent of each rule are combined through the aggregation operator and the resulting fuzzy set is defuzzified to yield the output of the system [9] [10].

3. Implementation

First we define the fuzzy values of input variables Consumption,Reliability, Age and Mileage.

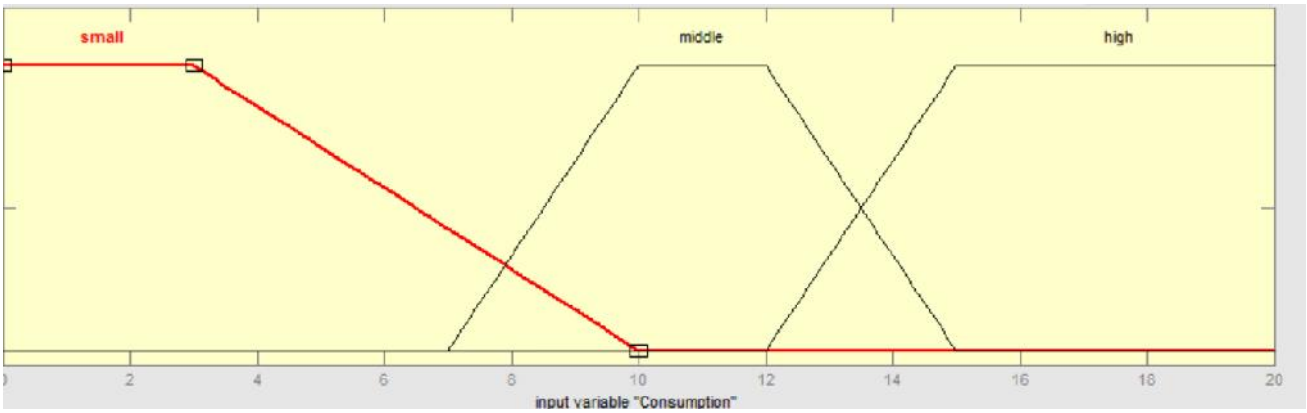

Figure 1. Membership functions associated with the consumption are referred to as "small", "middle" and "high."

Fig.1. Consumption ranging from 0-20 has three membership functions: small, middle and high all well-known trapezoidal membership function. It is l/100km.

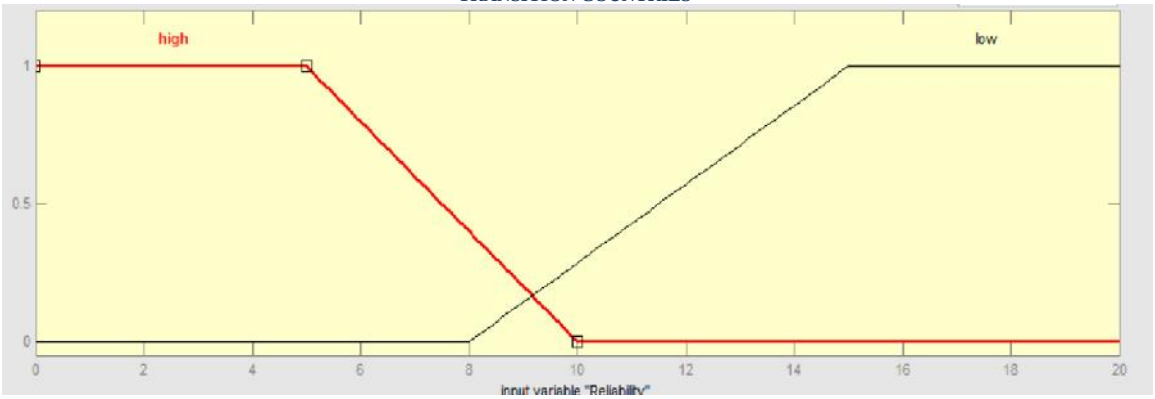

Figure 2. Membership functions associated with the reliability are referred to as ““high” and “low.”

Fig.2. Reliability ranging from 0-20 has two membership functions: low and high all well-known trapezoidal membership function. It is failures/100000km.

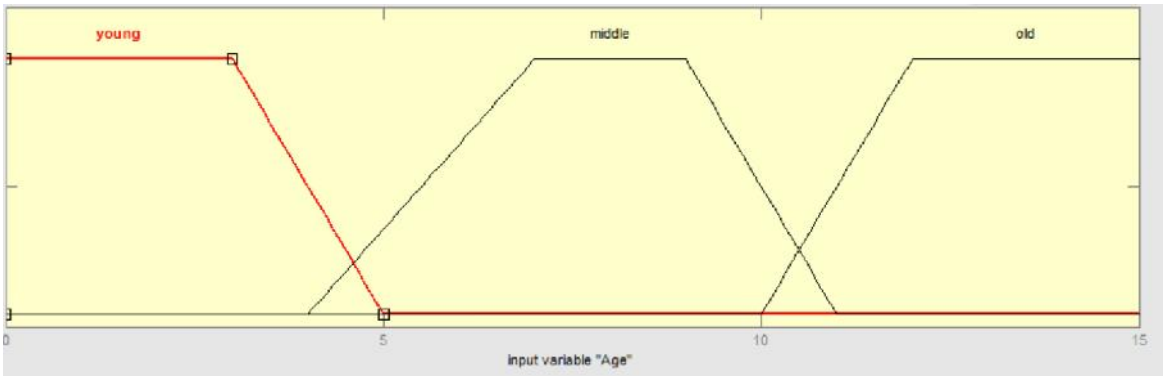

Figure 3. Membership functions associated with the age are referred to as “young”, “middle” and “old.”

Fig.3. Age ranging from 0-15 has three membership functions: young, middle and old all well-known trapezoidal membership function.

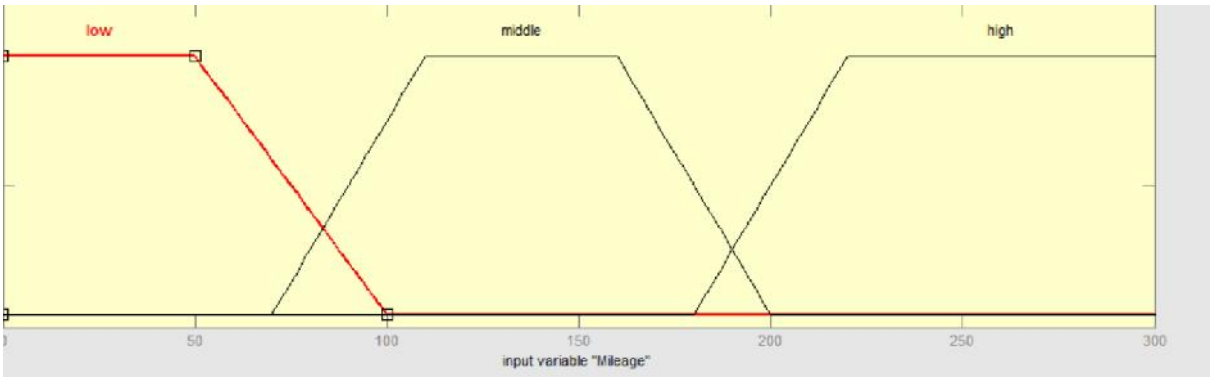

Figure 4. Membership functions associated with the mileage are referred to as “low”, “middle” and “high.”

Fig.4. Mileage ranging from 0-300 (in real it means 0-300000 km) has three membership functions: low, middle and high all well-known trapezoidal membership function. Then we define the fuzzy values of output variable "Value".

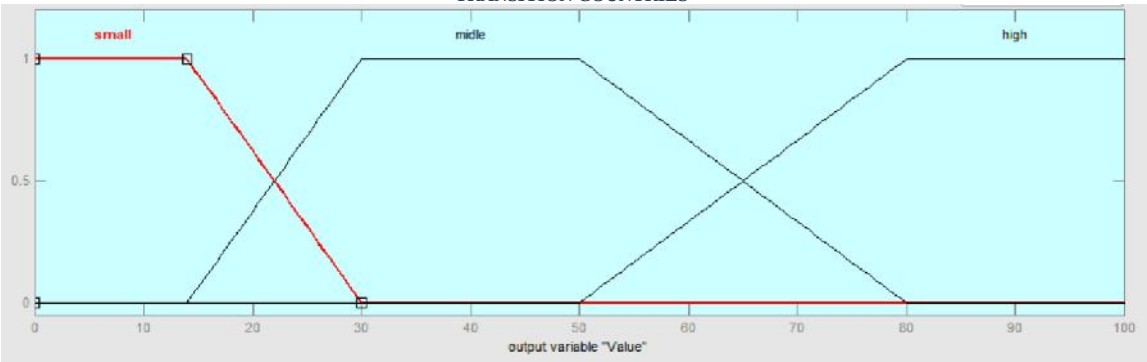

Figure 5. Membership functions associated with the value are referred to as "small", "middle" and "high."

Fig.5. Value ranging from 0-100 has three membership functions: small, middle and high all well-known trapezoidal membership function.
Finally, based on our knowledge we define a set of causal rules:

	Consumption	**Reliability**	**Age**	**Mileage**	**Value**
1.	Small	Low	Young	Low	Middle
2.	Small	Low	Middle	Middle	Middle
3.	Small	High	Old	High	Small
4.	Small	High	Young	Low	High
5.	Middle	Low	Middle	Middle	Middle
6.	Middle	Low	Old	High	Small
7.	Middle	High	Young	Low	High
8.	Middle	High	Middle	Middle	Middle
9.	High	Low	Old	High	Small
10.	High	Low	Young	Low	Middle
11.	High	High	Middle	Middle	Middle
12	High	High	Old	High	Small

Consequently we created Fuzzy model for determining the value of the vehicle.
According to this table we define twelve IF-THEN rules :

1. If (Consumption is small) and (Reliability is low) and (Age is young) and (Mileage is low) then (Value is midle) (1)
2. If (Consumption is small) and (Reliability is low) and (Age is middle) and (Mileage is middle) then (Value is midle) (1)
3. If (Consumption is small) and (Reliability is high) and (Age is old) and (Mileage is high) then (Value is small) (1)
4. If (Consumption is small) and (Reliability is high) and (Age is young) and (Mileage is low) then (Value is high) (1)
5. If (Consumption is middle) and (Reliability is low) and (Age is middle) and (Mileage is middle) then (Value is midle) (1)
6. If (Consumption is middle) and (Reliability is low) and (Age is old) and (Mileage is high) then (Value is small) (1)
7. If (Consumption is middle) and (Reliability is high) and (Age is young) and (Mileage is low) then (Value is high) (1)
8. If (Consumption is middle) and (Reliability is high) and (Age is middle) and (Mileage is middle) then (Value is midle) (1)
9. If (Consumption is high) and (Reliability is low) and (Age is old) and (Mileage is high) then (Value is small) (1)
10. If (Consumption is high) and (Reliability is low) and (Age is young) and (Mileage is low) then (Value is midle) (1)
11. If (Consumption is high) and (Reliability is high) and (Age is middle) and (Mileage is middle) then (Value is midle) (1)
12. If (Consumption is high) and (Reliability is high) and (Age is old) and (Mileage is high) then (Value is small) (1)

Figure 6. IF-THEN rules in MATLAB

4. Results

There are numerous defuzzification methods. Each defuzzification method outputs different results [11]. There is no exact rule on selection of defuzzification for certain applications. The suitable defuzzification method for certain application is chosen through trial-and-error by the

use of software [12]. In this work, LOM defuzzification is proven to be the suitable defuzzification method.

Largest of maximum zLOM: zLOM is the maximum (in terms of magnitude) of the maximizing z. Because of their obvious bias, zSOM and zLOM are not used as often as the other three defuzzification methods. The LOM defuzzification is done in two steps. First the largest height in the union is determined: $hgt(\underset{\sim}{Z}_k) = \sup_{z \in Z} \ll_{\underset{\sim}{B}^k}(z)$

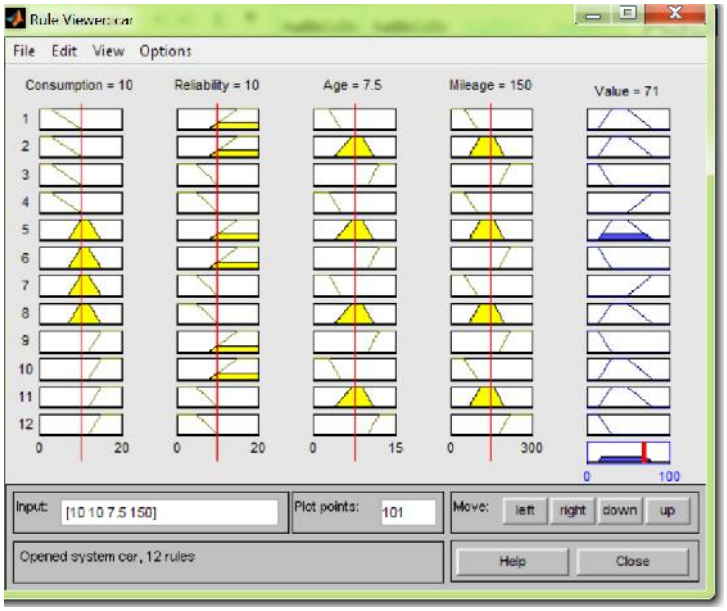

Figure 7. Result in MATLAB

Conlusion

This model gives a new dimension in deciding the value of the car. Does not use the traditional method of valuation of the car. Introduced the intelligent model, depending on the input parameters to decide the value of the car. Regardless of whether the car we want to buy or to sell.

The model presented can further improve by increasing the set of input parameters; adjusting the set of rules. Since the set of rules is mainly responsible for the accuracy of the model highly dependent on the experience of the one who puts the rules.

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