

Design & Simulation of Tiffin Food Problem Using Fuzzy Logic

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Abstract- In today's world, there are various simulation software are present in real world scenario which are used to perform the multiple tasks based on artificial intelligence and simulation. In this paper, we describe that how to deals with MATLAB® simulation and methodology using the fuzzy logic technique. The fuzzy logic technique describes vagueness of variable to approach "Degree of truth", instead of the value "true or false". The fuzzy logic is a many valued technique which is based on concept of partially truth and partially false. Basically the Fuzzy logic was invented to reduce the difficulties of development & analysis of human reasoning, sharp boundary and uncertainty of the complex system. In simple demo, we will discuss about the Tiffin food problem using Fuzzy logic in MATLAB Simulation.

Keywords- Fuzzy logic, Fuzzy Set, Rules, Function, Tiffin Food.

I. INTRODUCTION

The term Fuzzy logic was discovered by Prof. Lofti A.Zahed in 1964.the Fuzzy logic deals with the Fuzzy logic is a technique which refers the all technologies that are grade of sharp boundary. This technique is based on four concept i.e. fuzzy sets, linguistic variable, possibility distribution and fuzzy if-else rules. The fuzzy logic deals approximations instead of exact or fix reasoning. It provides a platform for the engineers to introduce the human reasoning with the control algorithm. The fuzzy logic technique is not only based on the data computing process but also implements the artificial intelligence, human reasoning as well as control algorithm. In this paper, we will deal with the various fuzzy rules, Member functions in MATLAB® Simulation using fuzzy logic toolbox. The fuzzy logic toolbox provides the interfaces with member function for designing or simulation fuzzy logic system. It defines the precious definitions and boundary (does not exist) .In the Tiffin food problem we cannot determine the exact human reasoning, so using the fuzzy logic we can determine the status of this problem.

II. METHODOLOGY

In the Tiffin food problem, we can determine the proper tip based on quality of service and the quality of food.

The fuzzy logic toolbox is a solution to determine the answer of tip and status of food, because without fuzzy logic toolbox the determination of the tip is very difficult.

In the fuzzy logic technique of simulation, there are four major operations are performed. These four operations are described as (1.) To set the Input & output variable, (2.) Create Membership function, (3.) Create Rules and (4.) Simulation.

To create the simulation of the Tiffin food problem, first of all open the MATLAB® Command window. In the command window type "fuzzy" then press ENTER key. Then a new tap appear with name FIS Editor (Fuzzy Insurance System).this window contains Input an Output variable as well as name also. The definition of the variable can be defined by the member functions. In the Fuzzy logic there are many membership functions, these are:-

A. Triangular membership function:-

The triangular membership function has three values left ,right and the mid point of the membership function. It defined as :

$$X \rightarrow 1:10$$

$$Y \rightarrow \text{trimf}(a,b,c)$$

Where

a= left point,
b= center point and
c= right point.

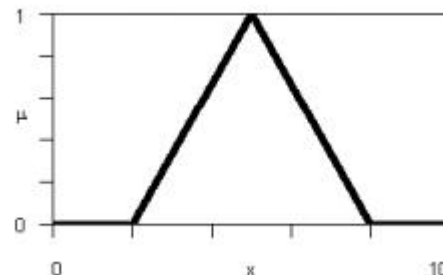


Fig: Triangular membership function

B. Trapezoidal membership function:-

The trapezoidal membership function defines the four values for a membership function, in which contains left slope and right slope also. It defined as:

$$X \rightarrow 0:10$$

$$Y \rightarrow \text{trapmf}(a,b,c,d)$$

Where

a=right point,
 b=right slope point from point a, c=right slope from point d to c and d=right side point,

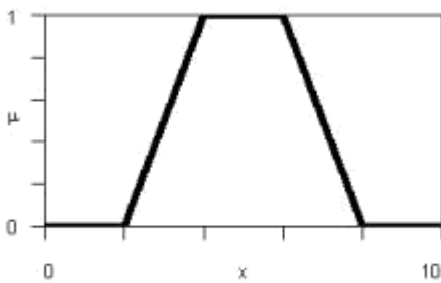


Fig: Trapezoidal membership function

C. Gaussian membership function:-

The Gaussian membership function defines the center of the sigma and the Gaussian. It can be defined as;

$$X \rightarrow 1:10$$

$$Y \rightarrow \text{gaussmf}(x,c(2,5))$$

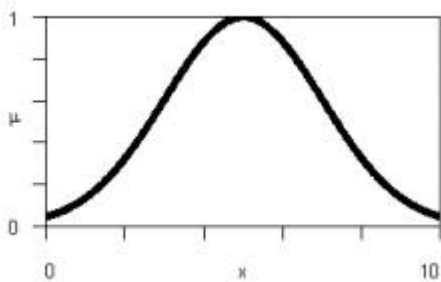


Fig:Gaussian membership Function

D. Sigmoidal membership function:-

The sigmoidal membership function describes the width and the center of the slope. It defined as:

$$X \rightarrow 1:10$$

$$Y \rightarrow \text{sigmf}(x,c(3,8))$$

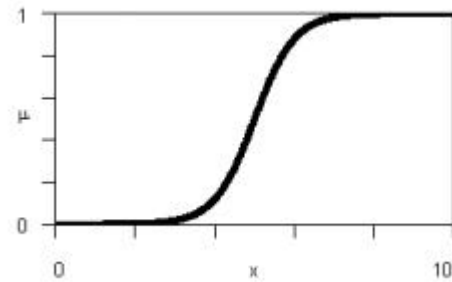


Fig: Sigmoidal membership function

E. S membership function

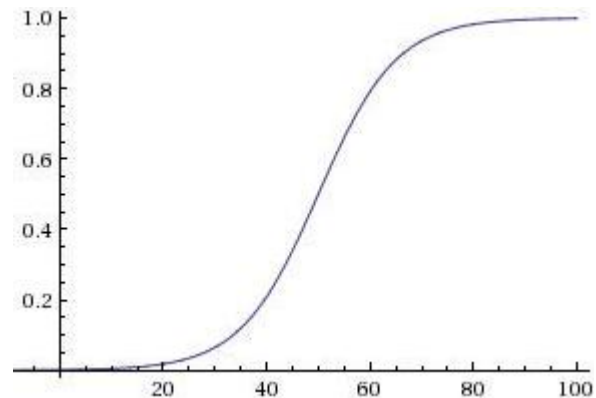


Fig:-S member function

F. Bell shaped membership function

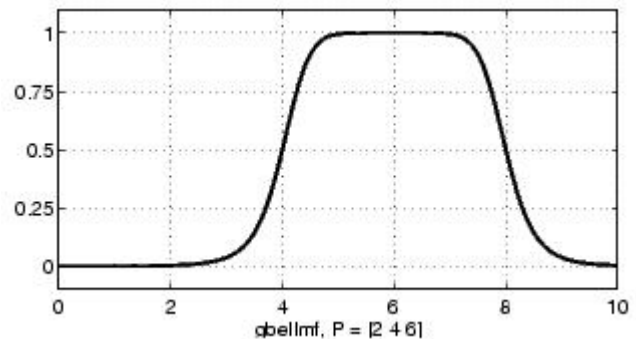


Fig:-Bell shaped membership function

To set the Input & Output variable and create membership functions:-

In the FIS Editor, There can be multiple inputs and outputs variable. In the Tiffin food problem. In the Tiffin problem Tip of Tiffin can be determined based on quality of food and quality of service. There are two inputs and one output variables should be present in FIS editor for food, service and tip variable named as service, food and tip.

i. Input variable Food:-

For adding the input *Food*, there are many type of definition of the membership function Such as triangular, trapezoidal, Gaussian ,bell member function etc. In this project we chose Gaussian membership function to define the range of quality of food.

The quality of the food can be defined as rancid and delicious food. There are only two choices to definition of the quality of food. So only two linguistic variables are required to express this definition. In this paper, these are defined by the Trapezoidal membership function. Where linguistic variable mf1 is named by rancid and another linguistic variable mf2 is named as delicious in figure.

In these membership functions, the range has taken as 0 to 10 for each of the membership function.

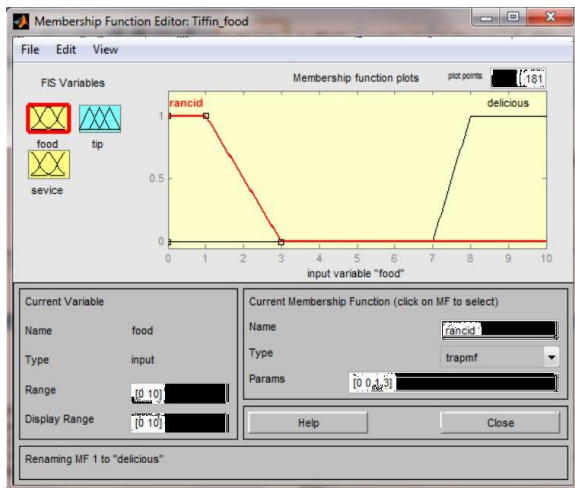


Fig :-Input variable Food

ii. Input variable Service:-

In the FIS Editor, another input is added for adding the another input *service*, it contains three linguistic variables mf1,mf2 & mf3 ,which is named as three parameters i.e. poor, good and excellent respectively.

Membership function is Gaussian type membership function . has range 0 to 10. In figure, the definition of the quality of service is defined as well as in MFE.

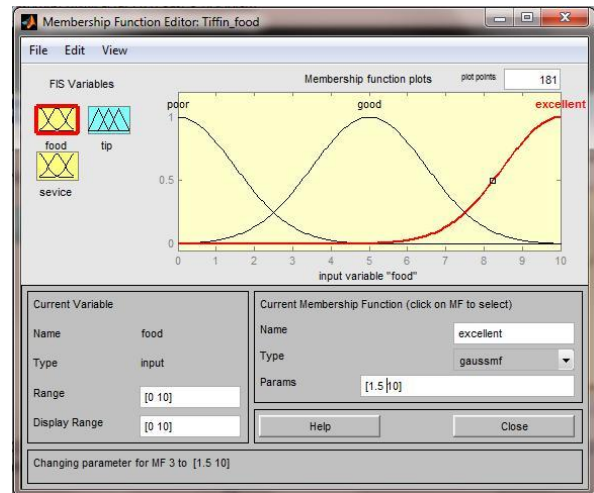
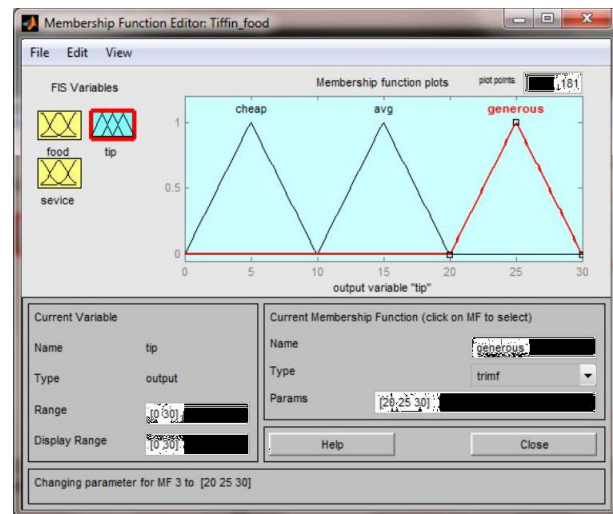


Fig:-Input variable Service

iii. Output variable Tip:-

To define the output variable Tip, There are three parameters to determine the quality of it i.e. cheap, average and generous. Membership function is type of the triangular membership function which has the range 0 to 30.

On the bases of parameters of Input food Quality and service quality, Tip can be determined. Variable initialization shown in fig (3) as well as in MFE.



Fig(3):-Output variable Tip

Create Rules:-

To determine the relation between the input variables and output variables, Rules are derived. Rules are the basic cell to capturing the knowledge in fuzzy logic concept based on the human reasoning. These are the conditions, which describe how the input variables are related to the output variables.

Rules consist two part in the fuzzy logic that are “If statement” and “Then statement”. In the “if-statement” the input conditions are present while in “Then-statement” the output conditions are present.

For determine the status of a Tiffin food quality, there are only three rules are derived in below.

Rule 1:-

It consists the condition, if Quality of service is Poor or Quality of Food is Rancid, then Tip is Cheap. Expressed as:-

If (Service is poor) or (Food is Rancid) then (Tip is Cheap)

Rule 2:-

It consists the condition, if Quality of Service is Good, then Tip is Average.

Expressed as:-

If (Service is Good) then (Tip is Average).

Rules 3:-

It consists another condition, if Quality of Service is Excellent or Quality of Food is Delicious, then Tip is Generous. Expressed as:-

If (Service is Excellent) or (Food is Delicious)then(Tip is Generous)

All membership functions and Linguistic variables are shown in the tables as per definition:-

Table 1. Input details

Input variable	Range	Linguistic Variable	Parameters
Service	0 to 10	Poor	[1.5 0]
		Good	[1.5 5]
		Excellent	[1.5 10]
Food	0 to 10	Rancid	[0 0 1 3]
		Delicious	[7 8 10 10]

Table 2. Output details

Output variable	Range	Linguistic variable	Parameters
Tip	0 to 30	Cheap	[0 5 10]
		Average	[10 15 20]
		Generous	[20 25 30]

MATLAB Description for Rules:-

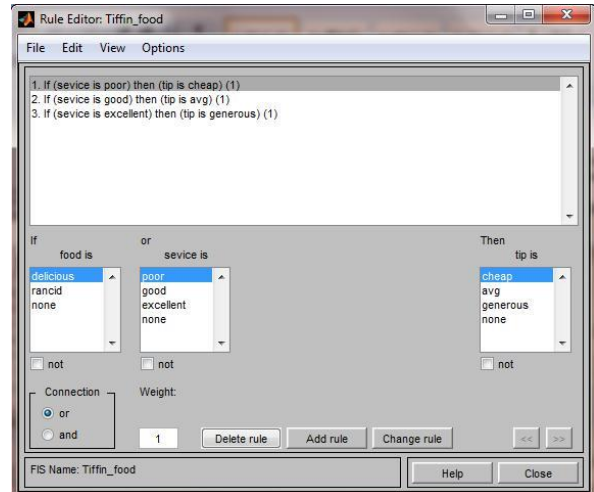


Fig:-Rule Editor Window

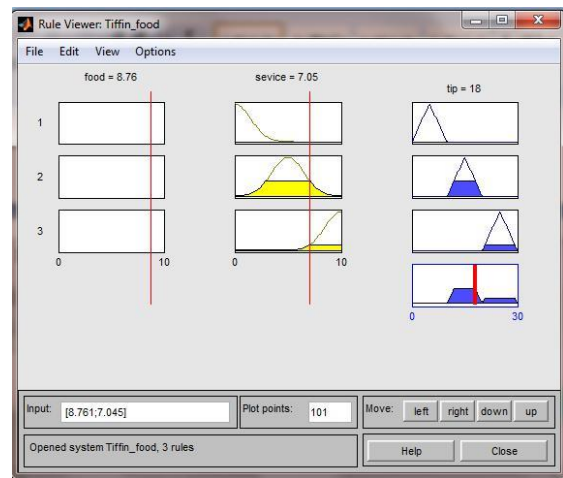


Fig:-Rule viewer Window

Code:-

The code is shown below is the editor window from the MATLAB workspace. It provides the relation between the quality of service, quality of food and tip. This appears when in the command window we simulate the Tiffin_food.fis file. Which is saved work of the fuzzy logic example Tiffin food problem.

```
[System]
Name='Tiffin_food'
Type='mamdani'
```

Version=2.0

NumInputs=2

NumOutputs=1

NumRules=3

```

AndMethod='min'
OrMethod='max'
ImpMethod='min'
AggMethod='max'
DefuzzMethod='centroid'

[Input1]
Name='food'
Range=[0 10]
NumMFs=2
MF1='delicious':'trapmf',[7 8 10 10]
MF2='rancid':'trapmf',[0 0 1 3]

[Input2]
Name='sevice'
Range=[0 10]
NumMFs=3
MF1='poor':'gaussmf',[1.5 0]

MF2='good':'gaussmf',[1.5 5]
MF3='excellent':'gaussmf',[1.5 10]

[Output1]
Name='tip'
Range=[0 30]
NumMFs=3
MF1='cheap':'trimf',[0 5 10]

MF2='avg':'trimf',[10 15 20]
MF3='generous':'trimf',[20 25 30]

[Rules]
0 1, 1 (1) : 2
0 2, 2 (1) : 2
0 3, 3 (1) : 2

```

Simulation:- In the real world, The hardware of an object for any project or idea cannot be designed at all time, so the blueprint of that object can be designed in imaginations. The simulation is the same process for create a blueprint of an object in the imagination or in human reasoning. It provides the interfacing between the blueprint and the real world needed.

In the FIS features for the Tiffin food problem ,there are two input and an output linguistic variables are present. The visualization of the blueprint of that particular output is shown in the *Surface viewer window*.

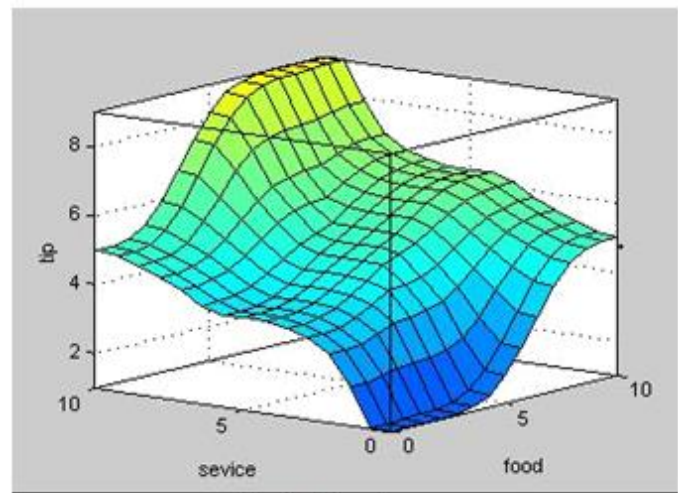


Fig: Surface viewer

III. CONCLUSION AND FUTURE SCOPE

In this we have given the brief introduction of the fuzzy logic toolbox interfacing with MATLAB simulation. By MATLAB example, we have described the all overview of Fuzzy logic using current features. The fuzzy logic helps to recognize an environment for human reasoning with help of the control algorithm. The fuzzy logic is based on the multiple valued operations and gives the value between “0 and 1” (partially true).

The purpose of this paper is to get suggestions and supports form our peers based on the current approach. We are aiming to include all the features bases on the documentation research for this useful toolbox.

The fuzzy logic toolkit is easy available and widely used for the research areas like as Fuzzy logic in Human reasoning, Artificial intelligence, Control system and other research areas.

REFERENCES

- [1] Afzal, M. J., Ashraf, M. W., Tayyaba, S., Khalid,M., & Afzulpurkar, N., 2018. Sinusoidal Microchannel with Descending Curves for Varicose Veins Implantation.Micromachines 9(2): 59.
- [2] L.A. Zadeh, "Fuzzy sets", Information and Control, 8 (3), 1965, pp. 338—353.
- [3] MATLAB Fuzzy Logic Toolbox
<http://www.mathworks.com/products/fuzzylogic/> (live on 28th Feb 2011)
- [4] R Development Core Team; —R: A Language and Environment for Statistical ComputingI, R Foundation for Statistical Computing, Vienna,Austria, ISBN: 3-900051-07-0, URL: <http://www.R-project.org>, 2011.

- [5] Aksoylu,S.,and Dursun,Y,. (2011), Pazarda Rekabetçi Üstünlük Aracı Olarak Hedef Maliyetleme,Sosyal Bilimler Dergisi Sayı:11,358-370,p.362.
- [6] Baral,G.,(2016). Cost-Value-Profit Analysis and Target Costing with Fuzzy Logic Theory,Mediterranean Journal of Social Sciences,
- [7] Birgili.,E.,Sekmen.,F.,Esen.,S.,(2013). Bulanık Mantık Yaklaşımı ile Finansal Yöntem Uygulamaları: Bir Literatür Taraması, Uluslararası Yönetim ve İşletme Dergisi, 9. pp.121-136.
- [8] Feng, F., Li, C., Davvaz, B., and Ali, M. I. (2010). Soft sets combined with fuzzy sets and rough sets: a tentative approach. *Soft Computing*, 14(9), pp. 899-911.
- [9] C. Wagner and H. Hagra, "Towards general type-2 fuzzy logic systemsbased on zSlices," *IEEE Transactions Fuzzy Systems*, vol. 18, no. 4, pp. 637-660, August 2010.
- [10]M. Alonso, "Knowledge discovery by Compensatory Fuzzy Logic predicates using a Metaheuristic approach", *Eureka, Fourth International Workshop Proceedings*, 2013.
- [11]Tayyaba, S., Afzal, M. J., Ashraf, M. W., Sarwar, G., & Afzulpurkar, N., 2016. Simulation of flow control in straight microchannels using fuzzy logic. 2016 International Conference on Computing, Electronic and Electrical Engineering (ICE Cube), IEEE.
- [12]Mrugesh. L. Shah, Prarthan. D. Mehta, "Classification of vehicles using adaptive neuro fuzzy inference system", *Electrical, Electronics and Computer Science (SCEECS), 2014 IEEE Students' Conference, 2014, Page(s): 1 – 6.*
- [13]MATLAB File Help: Ruleview. "Go to online doc for ruleview". Internal hyperlink in the MATLAB Fuzzy Tool Box FIS Editor.
- [14]Z. Zhi, H. Lisheng, "Performance assessment for the water level control system in steam generator of the nuclear power plant", "IEEE/CCC". Pp.5842-5847, July 2011.
- [15]D. Su, K. Ren, J. Luo, C. He, L. Wang, X. Zhang, "Programmed and simulation of the fuzzy control list in fuzzy control", "IEEE/WCICA", pp.1935-1940, July 2010.