

ASSIGNMENT 5

Documentation - Fuzzy Inference System

Q1. Select only three input variables from the four and justify why you took those variables into account. (Use the dataset given in 'Values.csv' only to identify important input parameters)

Graph / Diagram showing why we chose this.

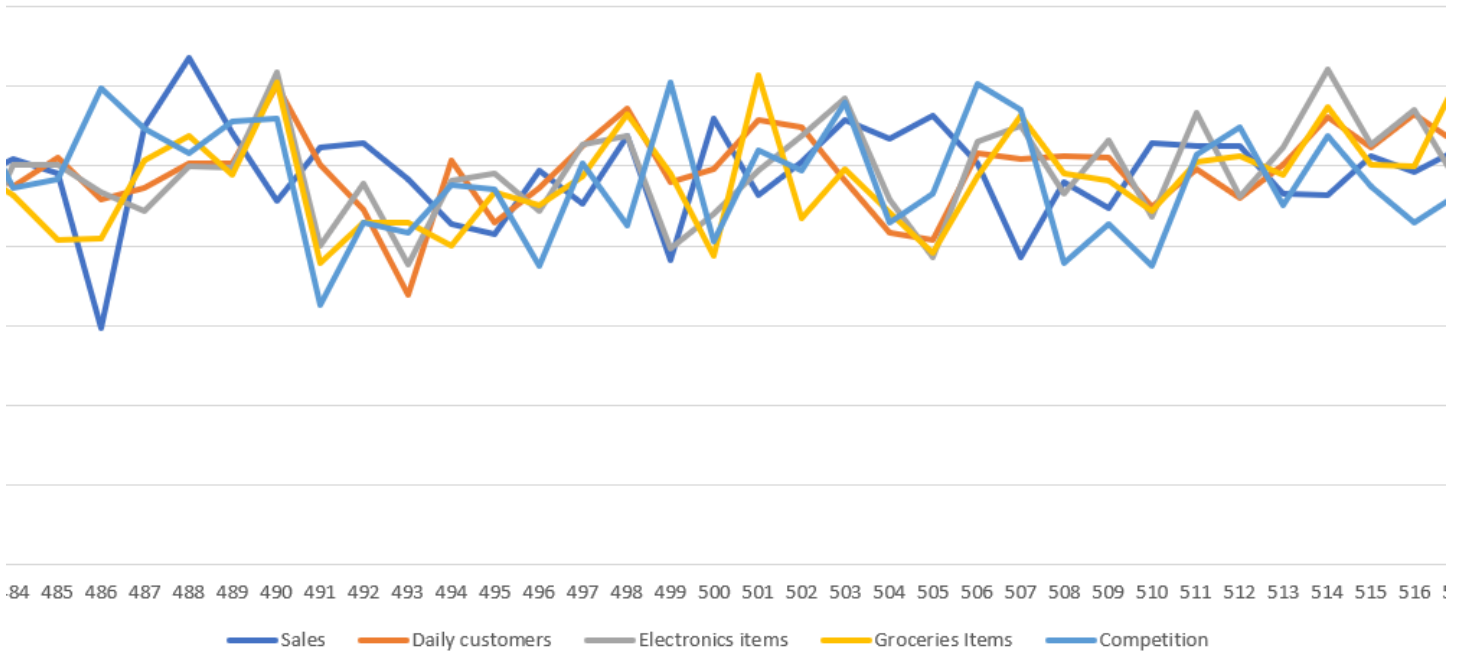
We performed some analysis on the data contained in the CSV file.

First, we calculated the variance of each field and obtained the following result.

	Sales	Daily customers	Electronics items	Groceries Items	Competition
Variance	1.548449	0.934770156	1.375041242	1.151579859	1.510970804

Using this data, we discovered that the field with the least variance is Daily customers. As a result, we decided to disregard the daily customers field because lower variance indicates that the values in the daily customer field are closer to the mean and will not contribute significantly to the outcome.

We confirmed this by plotting the graph against sales, and we concluded that sales are primarily influenced by competition and are least influenced by daily customers.



Q2. Define linguistic variables - (3 inputs) and performance (1 output) and the corresponding fuzzy membership functions.

1. Input Variables :

1.1. Groceries-items: Options of groceries in the store.

Range [0,10]

Linguistic Variable	Membership Functions	
	Shape	Parameters
lessOptions	Gauss2mf	[1.131 -1.513 1.24 0.01808]
averageOptions	Gauss2mf	[0.693 4.736 0.4657 5.077]
highOptions	Gauss2mf	[1.406 9.816 1.427 10.65]

1.2. Electronics-items : Options of Electronic items in the store.

Range [0,10]

Linguistic Variable	Membership Functions	
	Shape	Parameters
lessOptions	Gauss2mf	[1.132 -1.097 1.132 0.4031]
averageOptions	Gauss2mf	[0.6998 4.614 0.3416 5.761]
highOptions	Gauss2mf	[1.417 9.927 1.417 10.76]

1.3. Competition : Whether the market is more competitive or less.

Range [0,10]

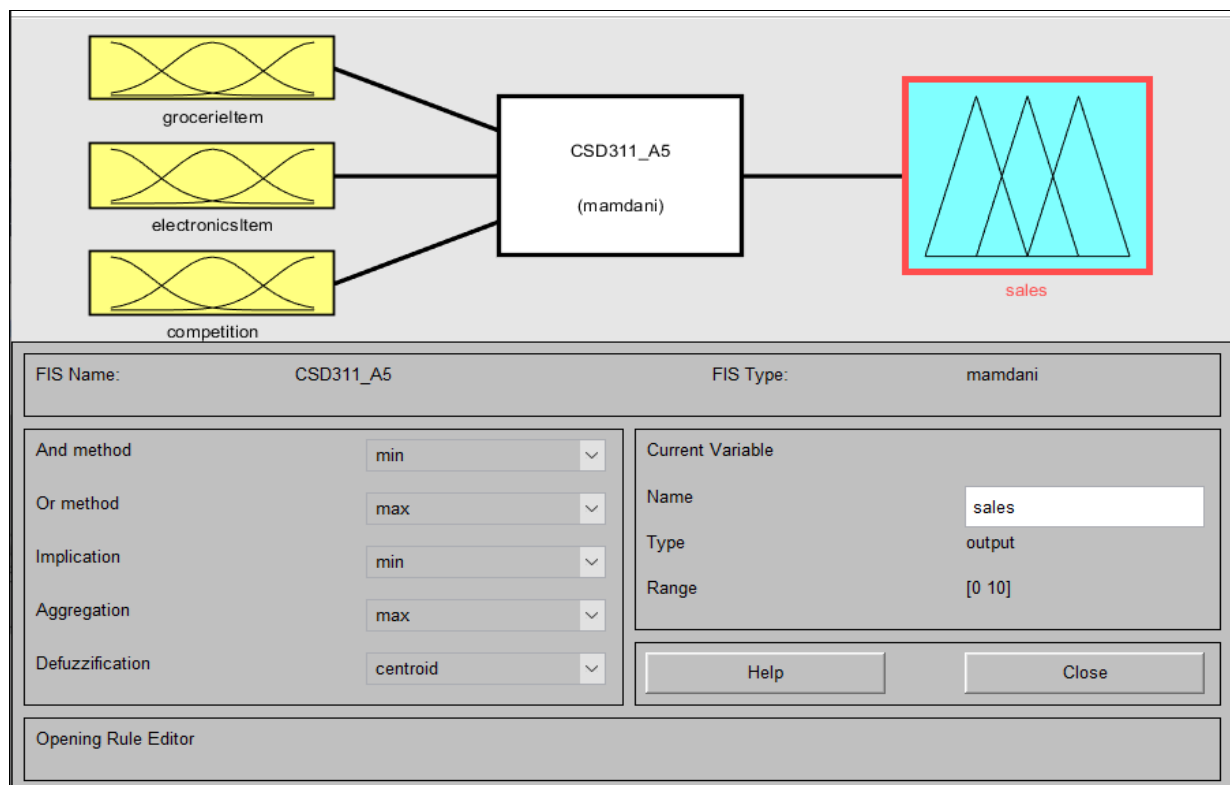
Linguistic Variable	Membership Functions	
	Shape	Parameters
lessCompetition	Gauss2mf	[1.416 -1.781 1.416 -0.948]
averageCompetition	Gauss2mf	[0.8357 4.754 0.6155 5.181]
highCompetition	Gauss2mf	[1.081 9.647 1.081 11.27]

2. Output variable :

2.1. Sales rating :

Range [0,10]

Linguistic Variable	Membership Functions	
	Shape	Parameters
lowSales	gauss2mf	[1.133 -0.7506 0.8036 0.5322]
averageSales	gauss2mf	[0.6468 4.562 0.6519 5.422]
highSales	gauss2mf	[1.13 10.41 1.131 11.91]



Q3. Define a Fuzzy rule base (min 12 appropriate rules) that seems to be suitable for the given system.

1. If (groceriesItem is highOptions) and (electronicsItem is highOptions) and (competition is lowCompetition) then (sales is highSales) (1)
2. If (groceriesItem is highOptions) and (electronicsItem is highOptions) and (competition is averageCompetition) then (sales is highSales) (1)
3. If (groceriesItem is highOptions) and (electronicsItem is highOptions) and (competition is highCompetition) then (sales is lowSales) (1)
4. If (groceriesItem is highOptions) and (electronicsItem is averageOptions) and (competition is lowCompetition) then (sales is averageSales) (1)
5. If (groceriesItem is highOptions) and (electronicsItem is averageOptions) and (competition is averageCompetition) then (sales is averageSales) (1)
6. If (groceriesItem is highOptions) and (electronicsItem is averageOptions) and (competition is highCompetition) then (sales is lowSales) (1)
7. If (groceriesItem is highOptions) and (electronicsItem is lessOptions) and (competition is lowCompetition) then (sales is averageSales) (1)
8. If (groceriesItem is highOptions) and (electronicsItem is lessOptions) and (competition is averageCompetition) then (sales is averageSales) (1)
9. If (groceriesItem is highOptions) and (electronicsItem is lessOptions) and (competition is highCompetition) then (sales is lowSales) (1)
10. If (groceriesItem is averageOptions) and (electronicsItem is highOptions) and (competition is lowCompetition) then (sales is highSales) (1)
11. If (groceriesItem is averageOptions) and (electronicsItem is highOptions) and (competition is averageCompetition) then (sales is averageSales) (1)
12. If (groceriesItem is averageOptions) and (electronicsItem is highOptions) and (competition is highCompetition) then (sales is averageSales) (1)
13. If (groceriesItem is averageOptions) and (electronicsItem is averageOptions) and (competition is lowCompetition) then (sales is highSales) (1)
14. If (groceriesItem is averageOptions) and (electronicsItem is averageOptions) and (competition is averageCompetition) then (sales is averageSales) (1)
15. If (groceriesItem is averageOptions) and (electronicsItem is averageOptions) and (competition is highCompetition) then (sales is lowSales) (1)
16. If (groceriesItem is averageOptions) and (electronicsItem is lessOptions) and (competition is lowCompetition) then (sales is averageSales) (1)
17. If (groceriesItem is averageOptions) and (electronicsItem is lessOptions) and (competition is averageCompetition) then (sales is lowSales) (1)
18. If (groceriesItem is averageOptions) and (electronicsItem is lessOptions) and (competition is highCompetition) then (sales is lowSales) (1)
19. If (groceriesItem is lessOptions) and (electronicsItem is highOptions) and (competition is lowCompetition) then (sales is highSales) (1)
20. If (groceriesItem is lessOptions) and (electronicsItem is highOptions) and (competition is averageCompetition) then (sales is averageSales) (1)
21. If (groceriesItem is lessOptions) and (electronicsItem is highOptions) and (competition is highCompetition) then (sales is averageSales) (1)

Q4. Develop FIS using MATLAB to compute the sales rating.

4. Code -

[System]

Name='CSD311_A5'

Type='mamdani'

Version=2.0

NumInputs=3

NumOutputs=1

NumRules=27

AndMethod='min'

OrMethod='max'

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

[Input1]

Name='groceriesItem'
Range=[0 10]
NumMFs=3
MF1='lessOptions':gauss2mf,[1.131 -1.513 1.24 0.01808]
MF2='averageOptions':gauss2mf,[0.693 4.736 0.4657 5.077]
MF3='highOptions':gauss2mf,[1.406 9.816 1.427 10.65]

[Input2]

Name='electronicsItem'
Range=[0 10]
NumMFs=3
MF1='lessOptions':gauss2mf,[1.132 -1.097 1.132 0.4031]
MF2='averageOptions':gauss2mf,[0.6998 4.614 0.3416 5.761]
MF3='highOptions':gauss2mf,[1.417 9.927 1.417 10.76]

[Input3]

Name='competition'
Range=[0 10]
NumMFs=3
MF1='lowCompetition':gauss2mf,[1.416 -1.781 1.416 -0.948]
MF2='averageCompetition':gauss2mf,[0.8357 4.754 0.6155 5.181]
MF3='highCompetition':gauss2mf,[1.081 9.647 1.081 11.27]

[Output1]

Name='sales'
Range=[0 10]
NumMFs=3
MF1='lowSales':gauss2mf,[1.133 -0.7506 0.8036 0.5322]

MF2='averageSales':gauss2mf, [0.6468 4.562 0.6519 5.422]

MF3='highSales':gauss2mf, [1.13 10.41 1.131 11.91]

[Rules]

3 3 1, 3 (1) : 1

3 3 2, 3 (1) : 1

3 3 3, 1 (1) : 1

3 2 1, 2 (1) : 1

3 2 2, 2 (1) : 1

3 2 3, 1 (1) : 1

3 1 1, 2 (1) : 1

3 1 2, 2 (1) : 1

3 1 3, 1 (1) : 1

2 3 1, 3 (1) : 1

2 3 2, 2 (1) : 1

2 3 3, 2 (1) : 1

2 2 1, 3 (1) : 1

2 2 2, 2 (1) : 1

2 2 3, 1 (1) : 1

2 1 1, 2 (1) : 1

2 1 2, 1 (1) : 1

2 1 3, 1 (1) : 1

1 3 1, 3 (1) : 1

1 3 2, 2 (1) : 1

1 3 3, 2 (1) : 1

1 2 1, 3 (1) : 1

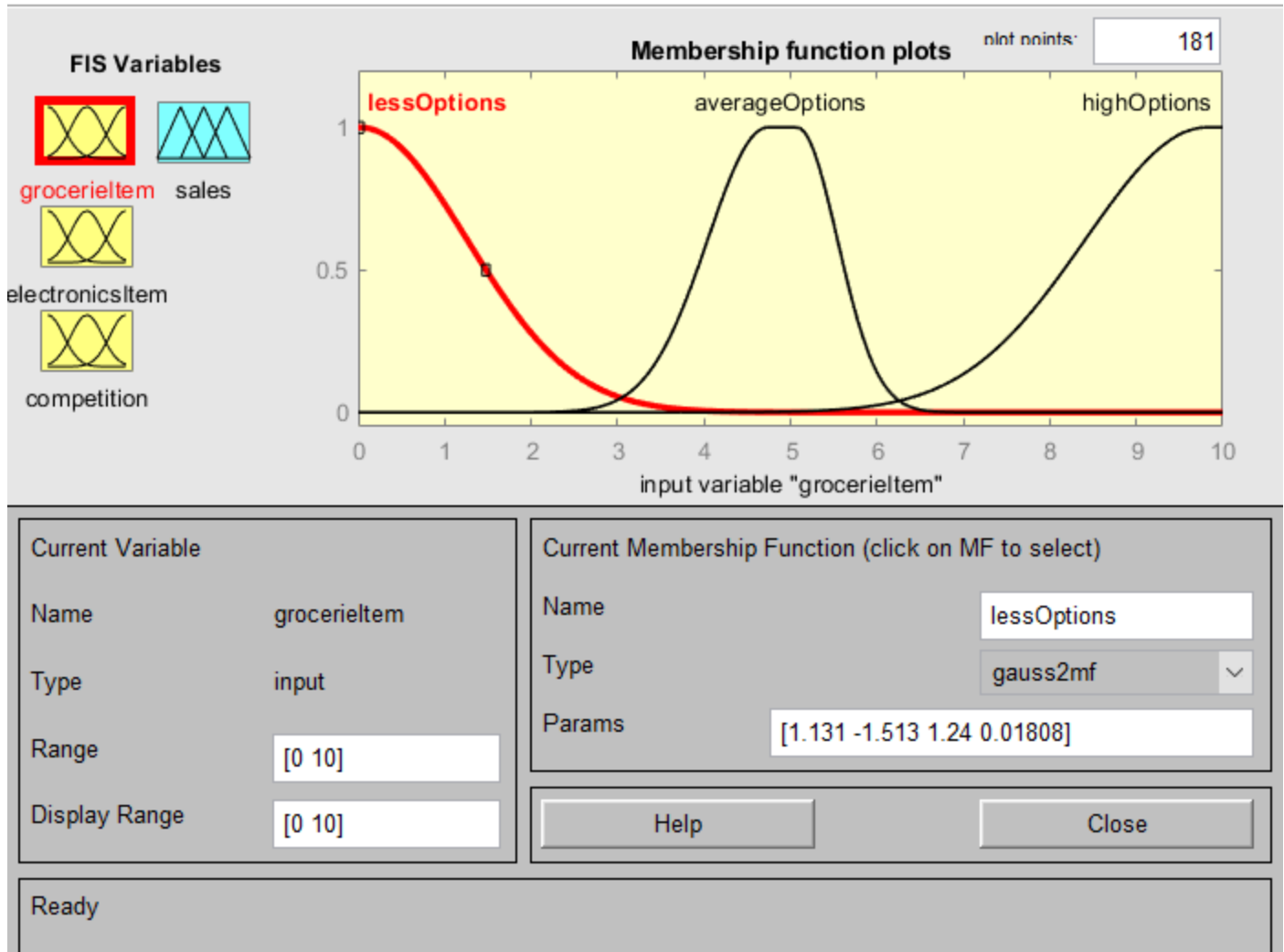
1 2 2, 2 (1) : 1

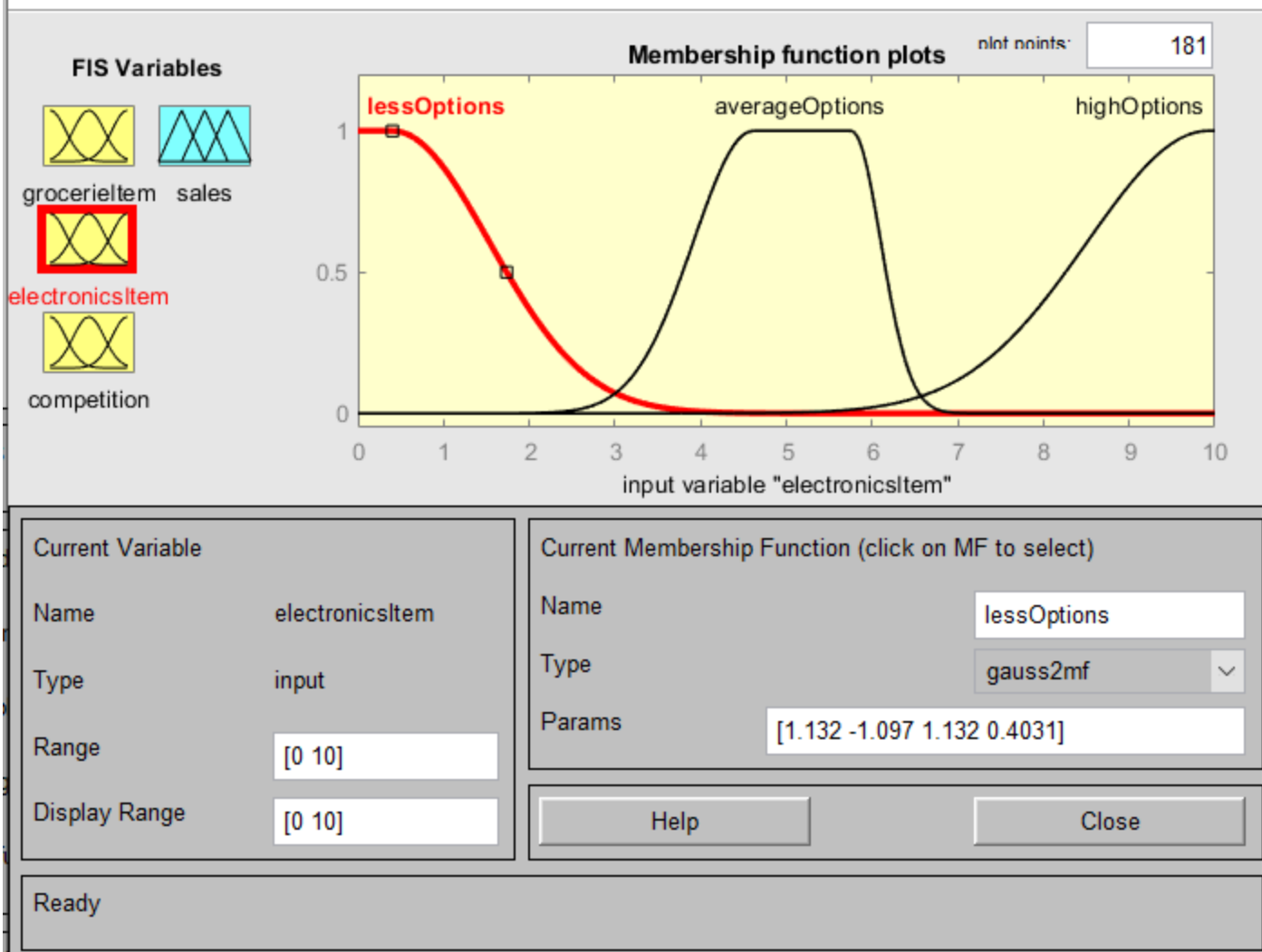
1 2 3, 1 (1) : 1

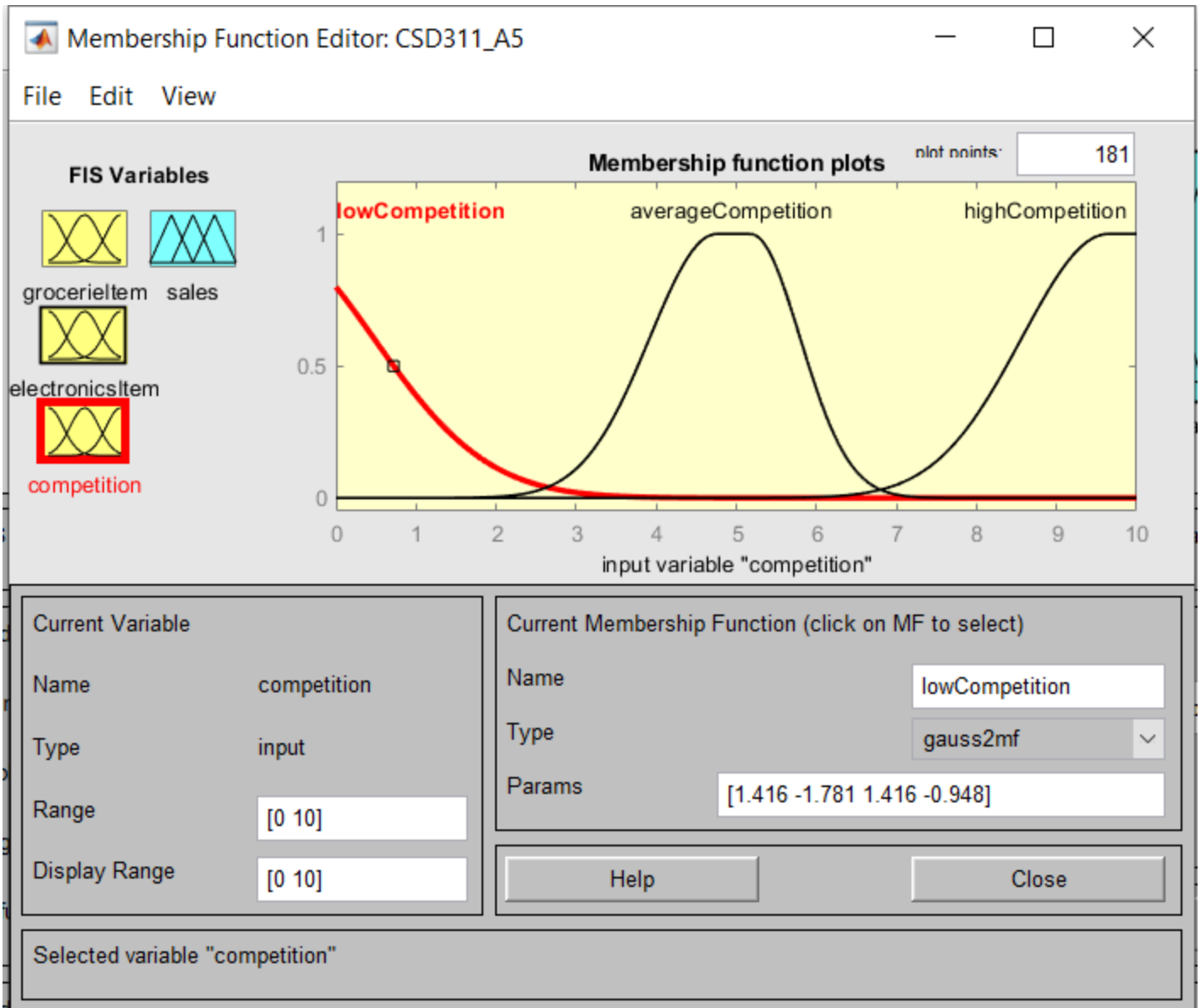
1 1 1, 2 (1) : 1

1 1 2, 1 (1) : 1

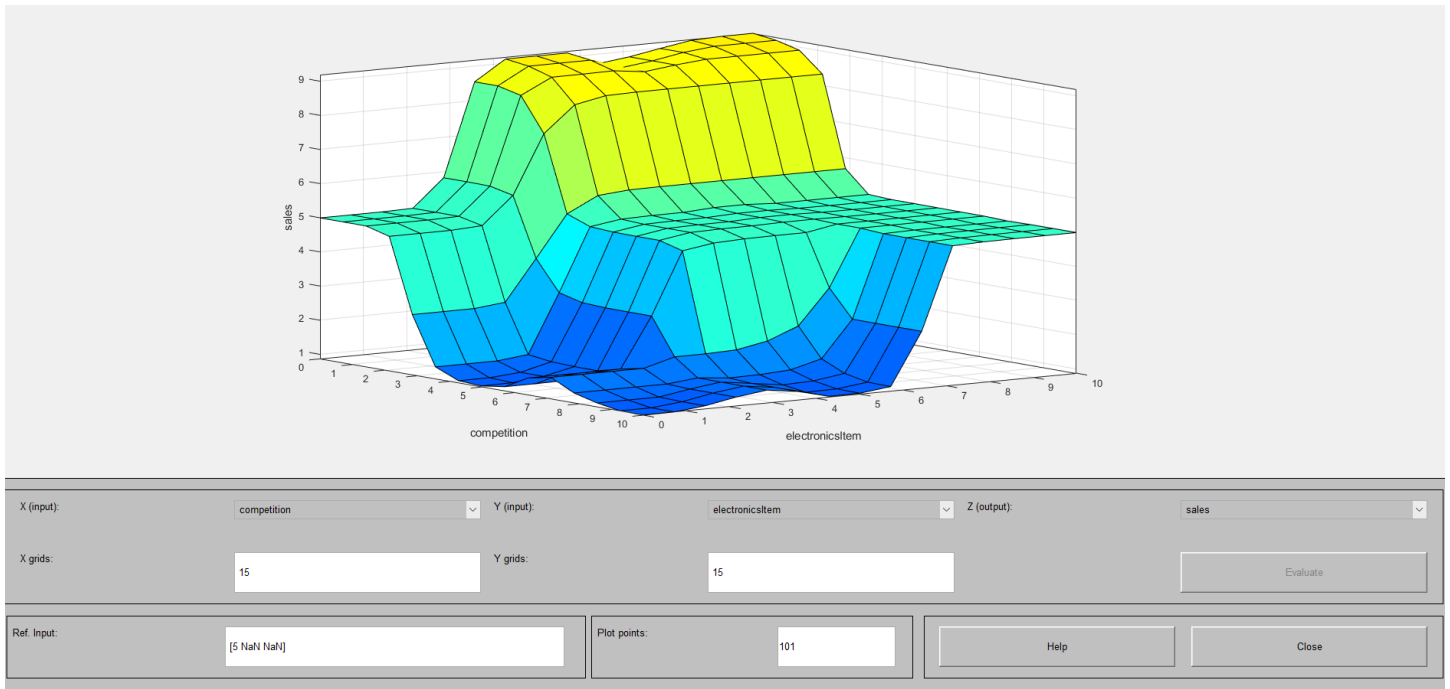
1 1 3, 1 (1) : 1







Graph -

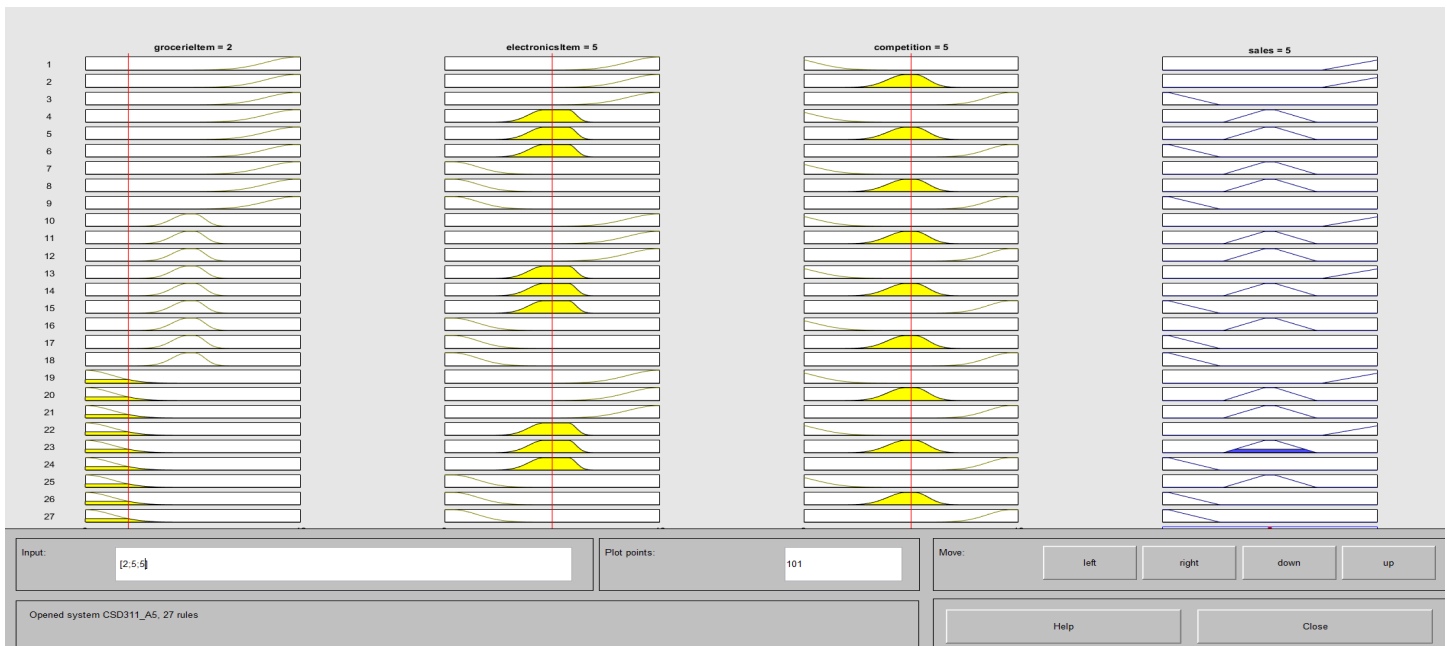


Where Sales(output) is on Z-axis, competition(input) is on X-axis and Electronic Items(input) is on Y-axis.

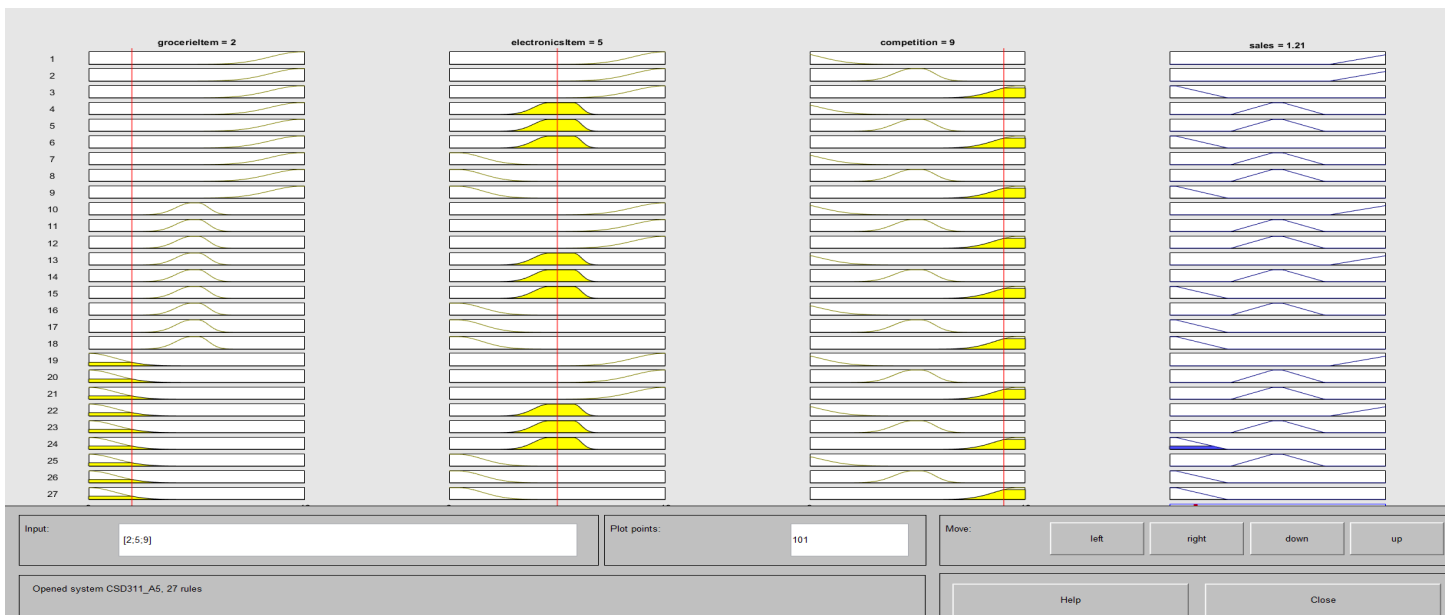
Q5. Prepare 5 test data and execute FIS and display output.

5. Output(Test Data) -

- [2;5;5] - 5



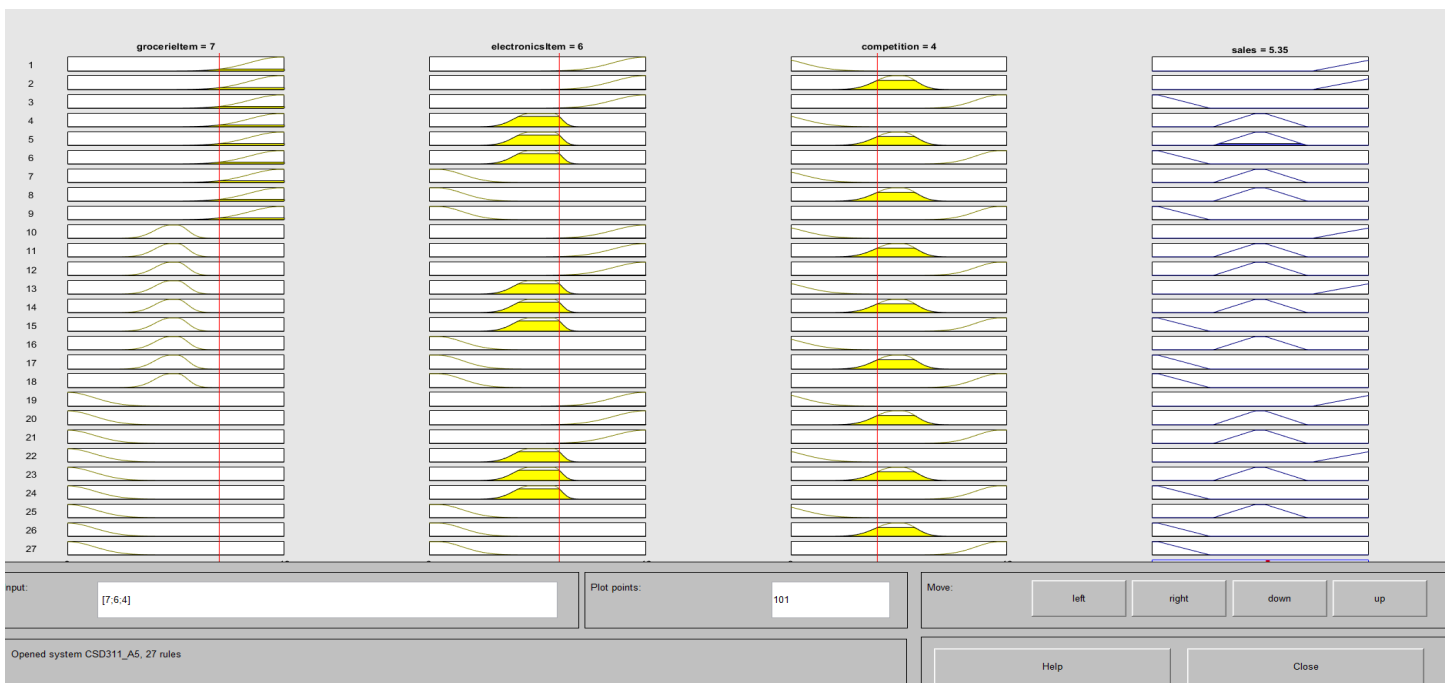
- [2;5;9] - 1.21



- [9;9;5] - 9.17



- [7;6;4] - 5.35



- **[3;9;3] - 5.7**



- **[10;10;10] - 0.067**



6. Contributions -

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