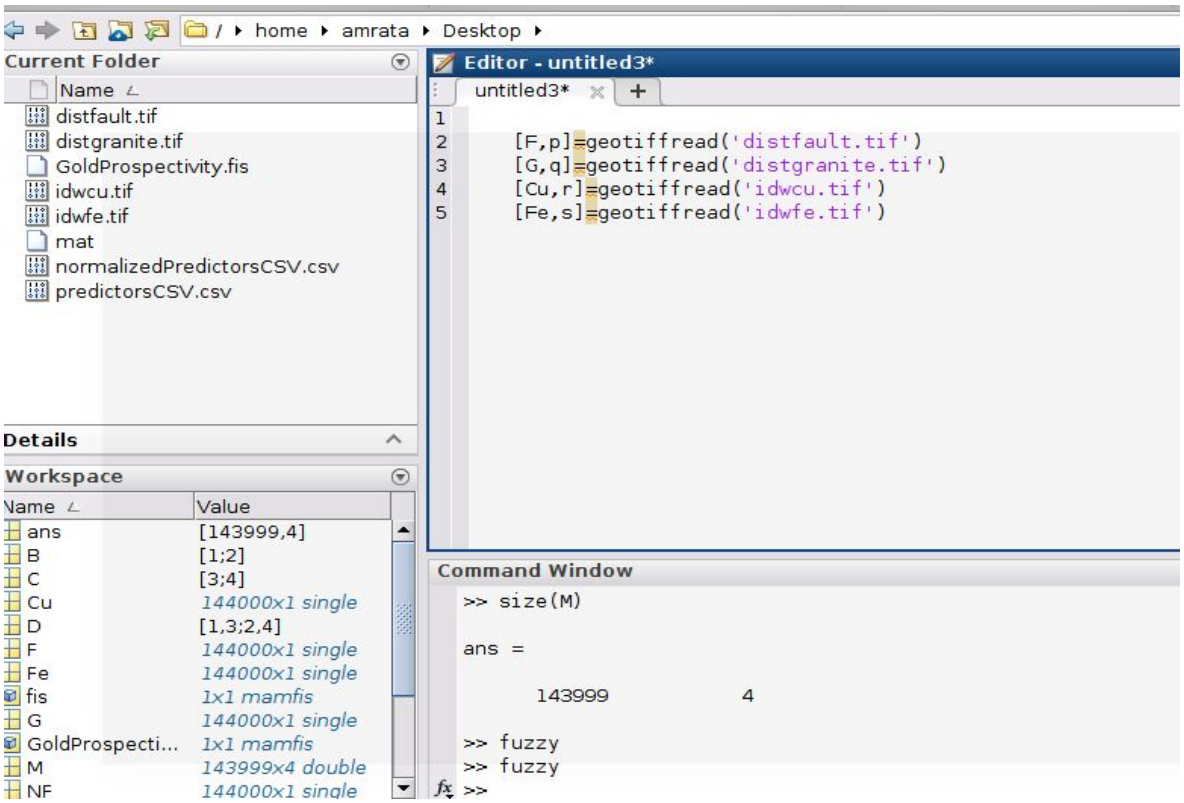
Gold Prospectivity using Fuzzy Inference Systems

Following steps were followed to visualize gold prospectivity

1) **ArcGis Process**
    a) Copper and Iron values were generated using IDW by filtering out negative values from GeoChem Shape files
    b) Euclidean distance to fault and granite was generated
    c) All the above 4 raster files i.e interpolated copper & iron, distance to granite and fault were exported to tiff file.

2) **Matlab Process**
    a) All the four tiff files were read in matlab using **geotiffread** function respectively
    b) And combined column wise using **horzcat** function and saved as csv



3) **Python Process**
    a) Data was normalized using scikit-learn library
    b) And visualized using matplotlib library to identify the spread of data
    c) And normalized data was saved in csv file back

jupyter DataPreprocessingGoldProspectivity Last Checkpoint: 2 hours ago (autosaved)

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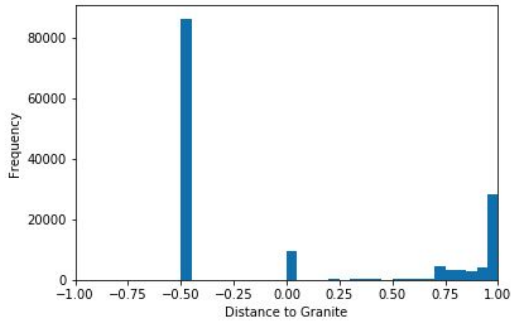
Run Code

In [41]:
```
import numpy as np
from sklearn import preprocessing
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
```

In [42]:
```
# Loading dataset
dataframe = pd.read_csv("./predictorsCSV.csv")
normalizedDF = preprocessing.normalize(dataframe)
```

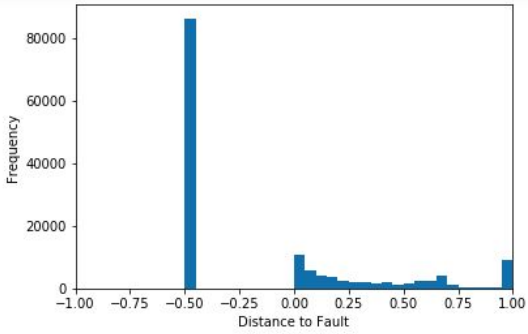
In [70]:
```
granite=normalizedDF[:,0]
plt.hist(granite,  bins=30)
plt.ylabel('Frequency');
plt.xlabel('Distance to Granite');
plt.xlim((-1,1))
```

Out[70]: (-1, 1)

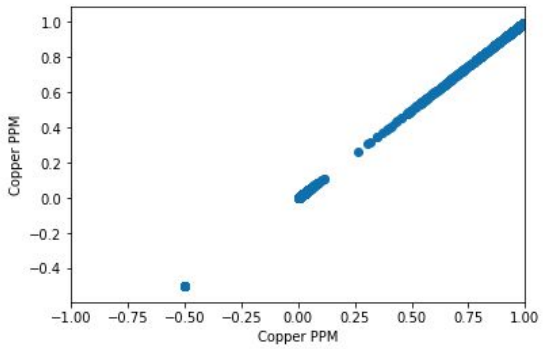


In [71]:
```
fault=normalizedDF[:,1]
plt.hist(fault,  bins=30)
plt.ylabel('Frequency');
plt.xlabel('Distance to Fault');
plt.xlim((-1,1))
```

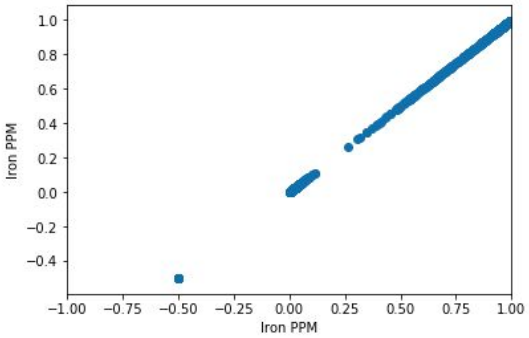
Out[71]: (-1, 1)



In [75]:
```
copper=normalizedDF[:,2]
plt.scatter(copper, copper)
plt.xlabel('Copper PPM')
plt.ylabel('Copper PPM')
plt.xlim((-1,1))
plt.show()
```



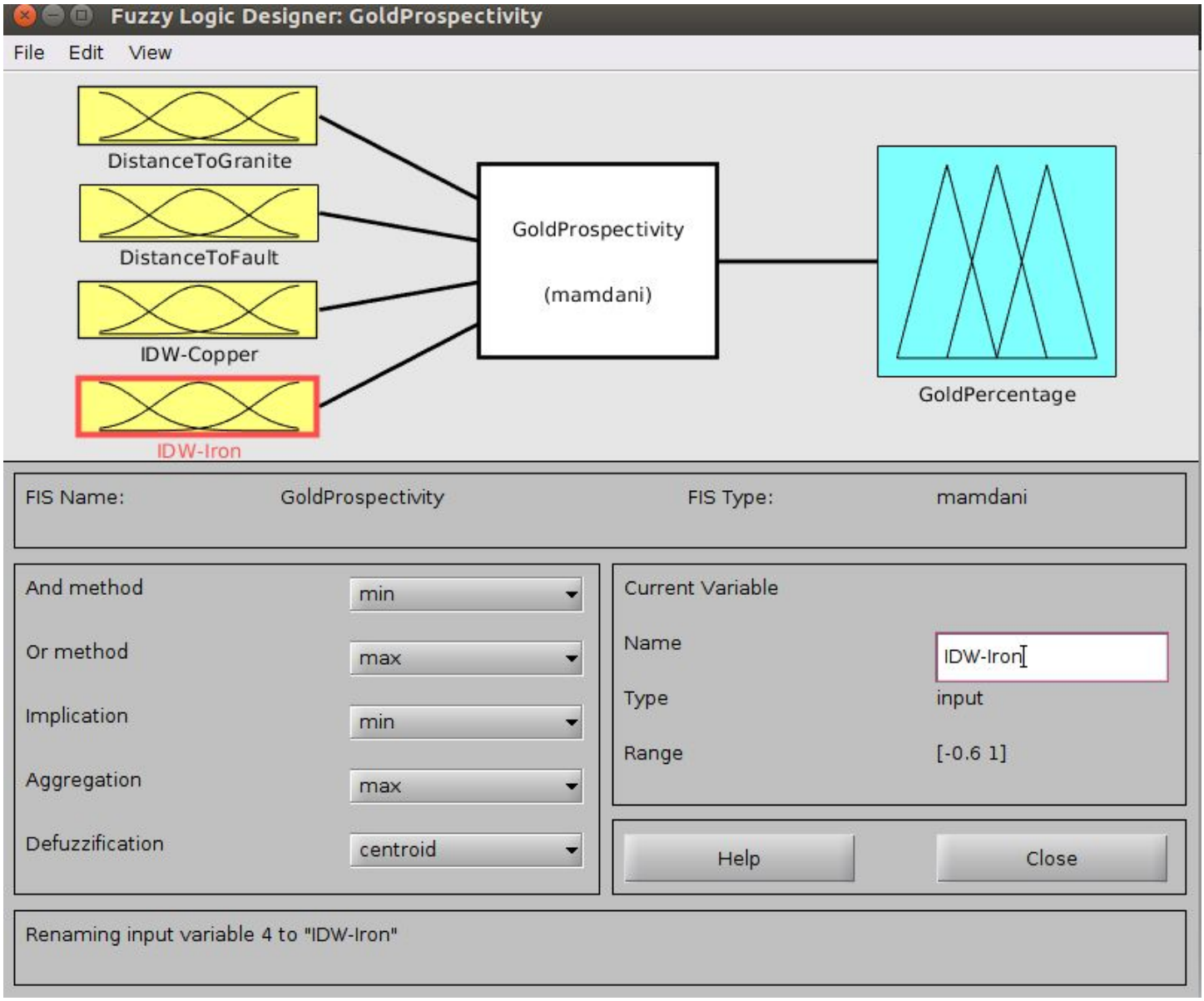
In [76]:
```
iron=normalizedDF[:,3]
plt.scatter(copper, copper)
plt.xlabel('Iron PPM')
plt.ylabel('Iron PPM')
plt.xlim((-1,1))
plt.show()
```



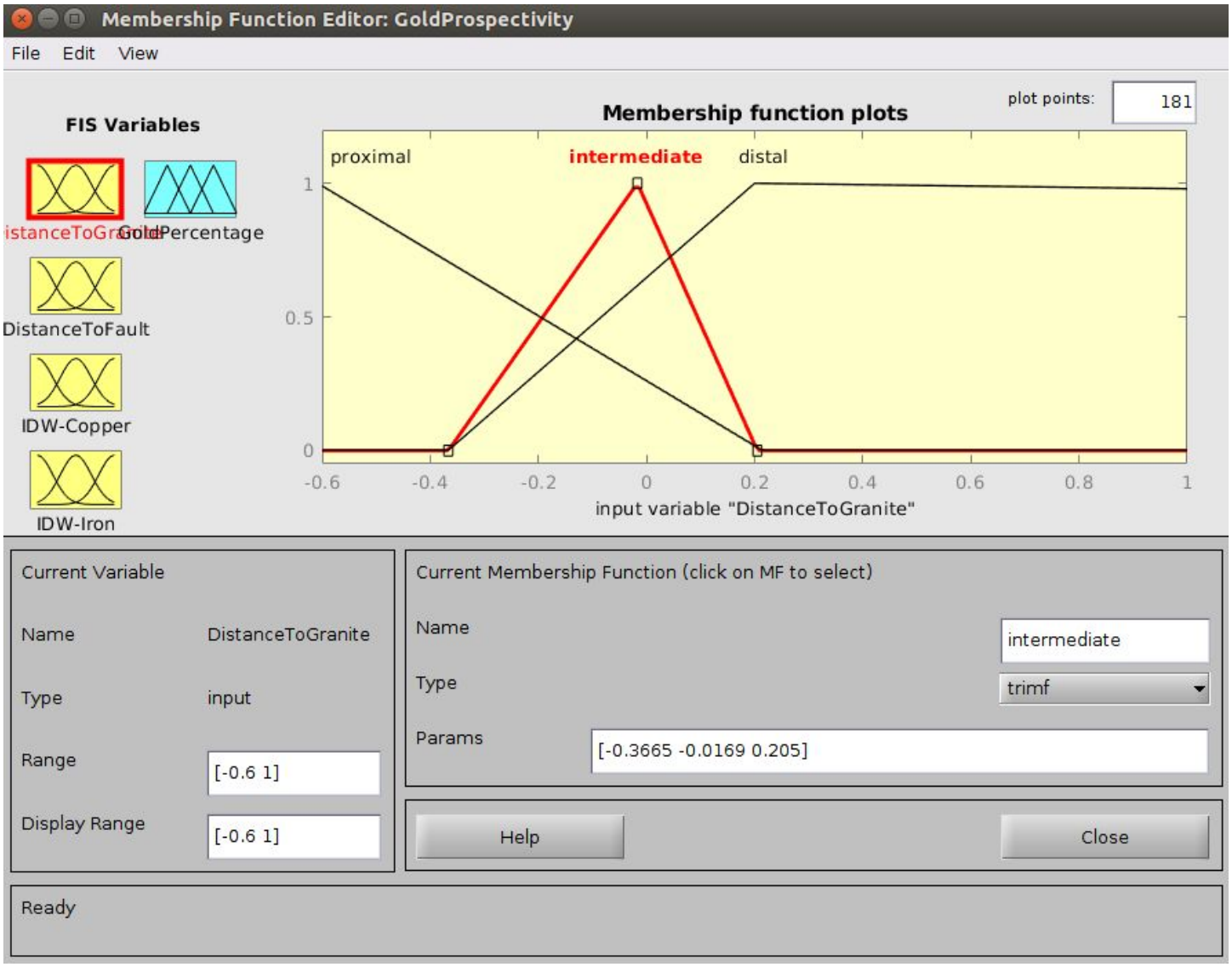
In [78]:
```
np.savetxt("normalizedPredictorsCSV.csv", normalizedDF, delimiter=",")
```

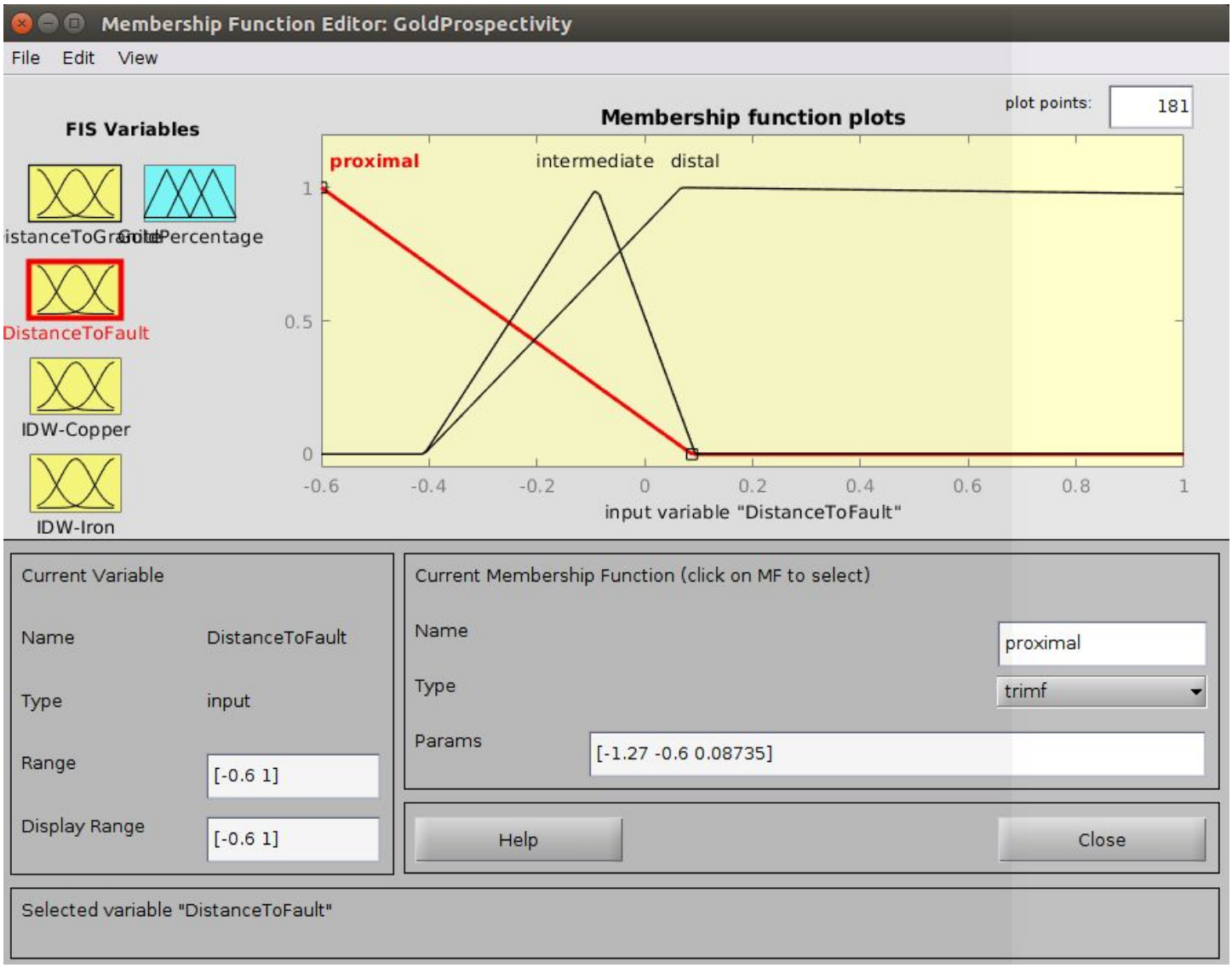
4) Matlab Process Again

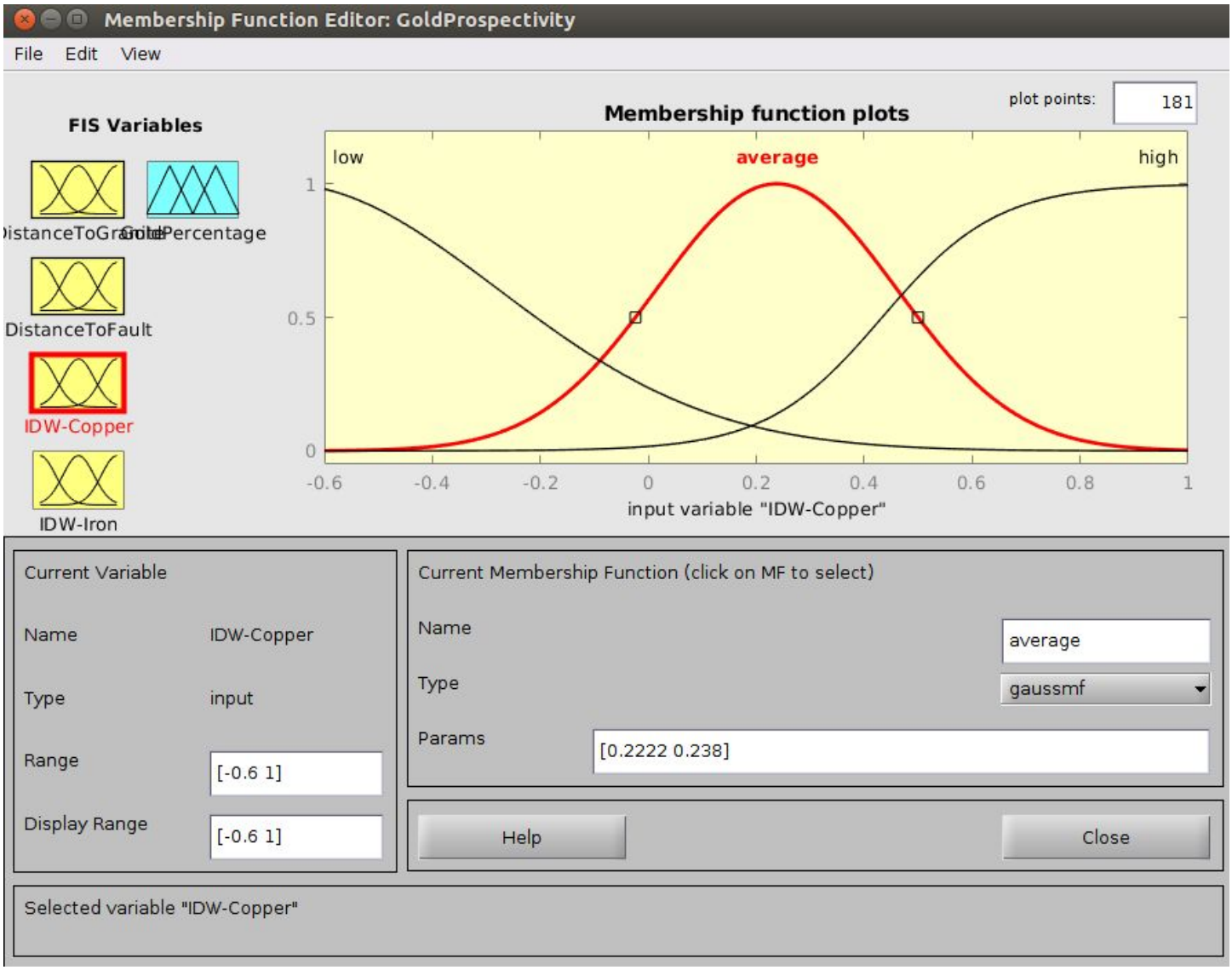
1. Fuzzy Toolbox was used to generate fuzzy system as shown below

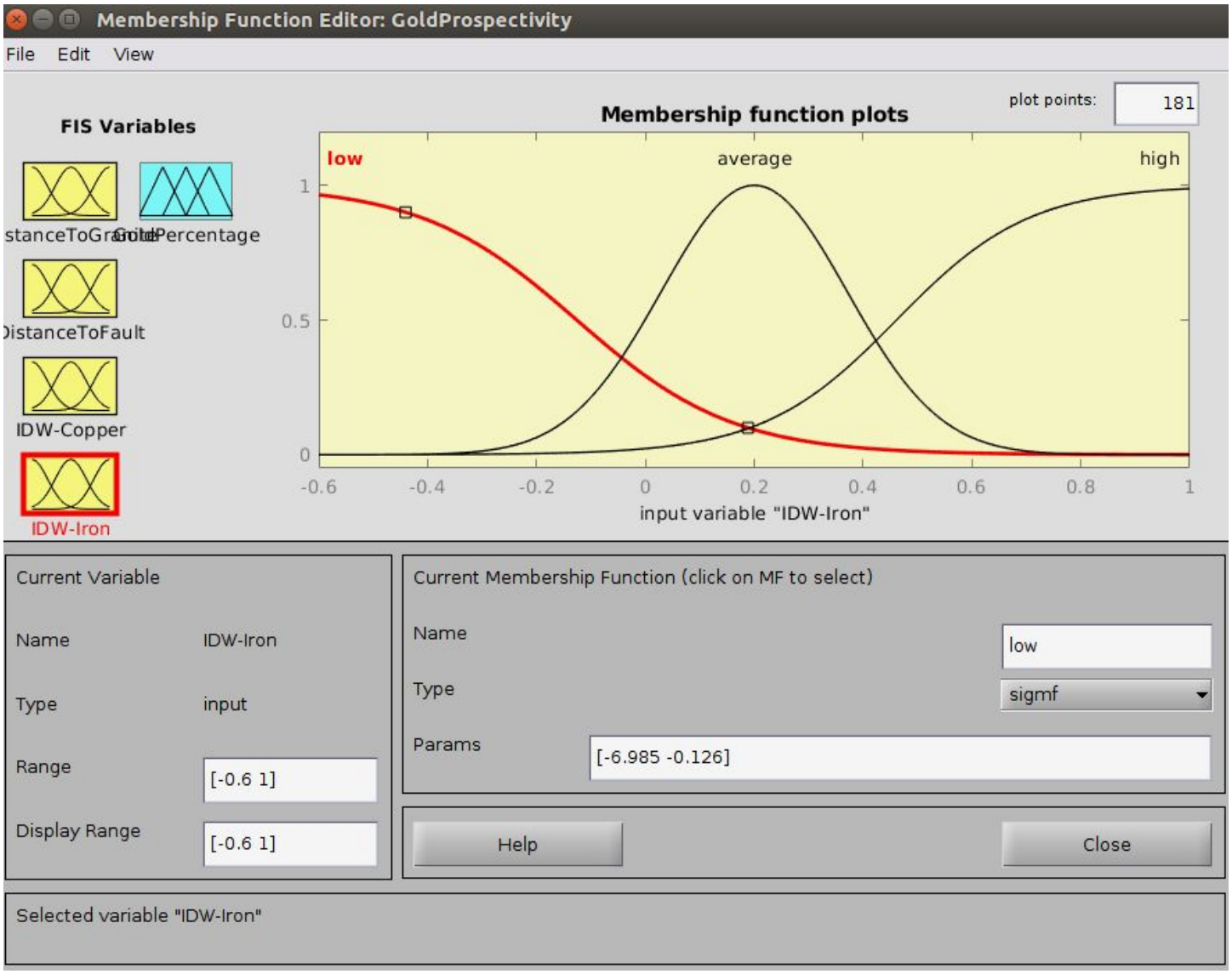

Fuzzy Logic Designer: GoldProspectivity
File
Edit
View
DistanceToGranite
DistanceToFault
IDW-Copper
IDW-Iron
GoldProspectivity
(mamdani)
GoldPercentage
FIS Name:
GoldProspectivity
FIS Type:
mamdani
And method
min
Or method
max
Implication
min
Aggregation
max
Defuzzification
centroid
Current Variable
Name
IDW-Iron
Type
input
Range
[-0.6 1]
Help
Close
Renaming input variable 4 to "IDW-Iron"

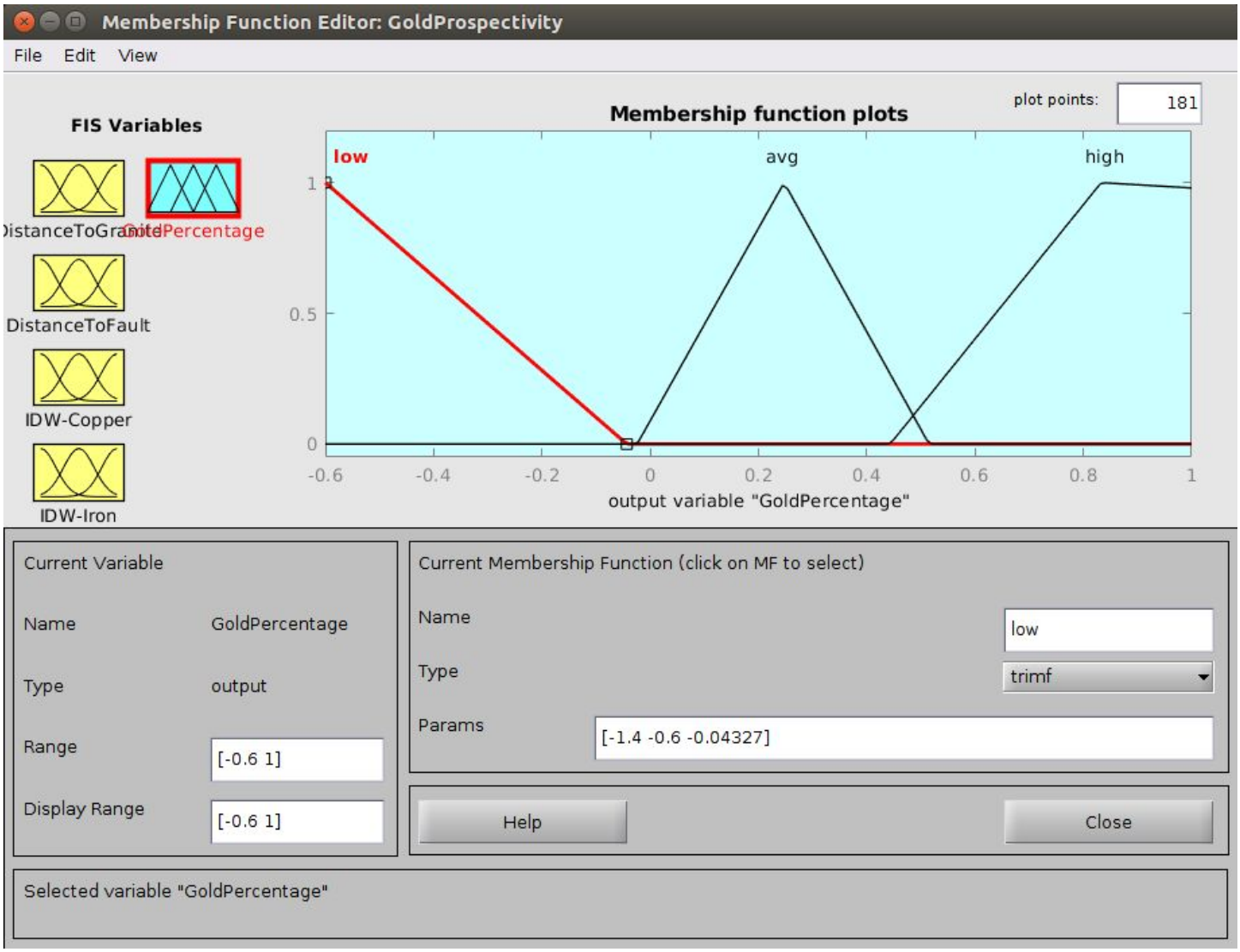
Here the range [-0.6 1] is taken by checking the normalized data, the data was from [-0.5, 1] but many points were lying at that -0.5 edge so I took the range as [-0.6,1]



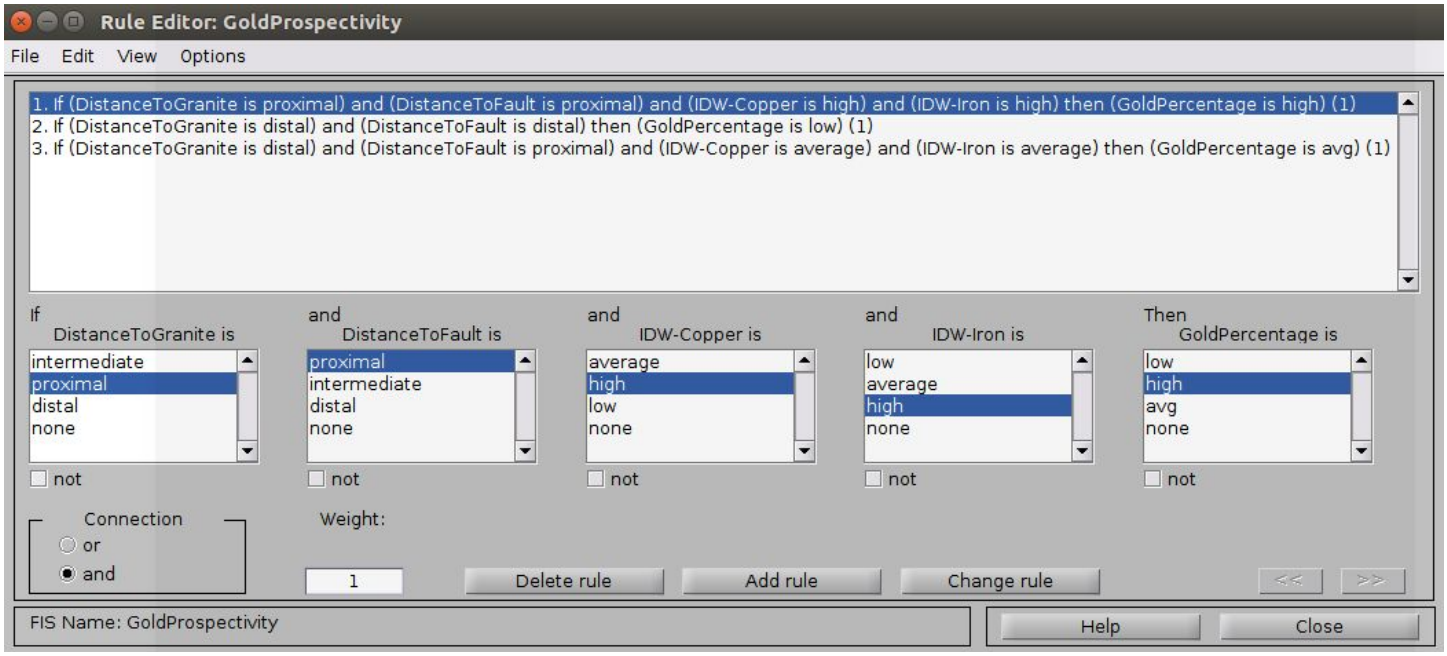

Membership Function Editor: GoldProspectivity
File
Edit
View
FIS Variables
istanceToGra
GoldPercentage
DistanceToFault
IDW-Copper
IDW-Iron
Membership function plots
plot points:
181
proximal
intermediate
distal
1
0.5
0
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
input variable "DistanceToFault"
Current Variable
Name
DistanceToFault
Type
input
Range
[-0.6 1]
Display Range
[-0.6 1]
Current Membership Function (click on MF to select)
Name
proximal
Type
trimf
Params
[-1.27 -0.6 0.08735]
Help
Close
Selected variable "DistanceToFault"


Membership Function Editor: GoldProspectivity
File Edit View
FIS Variables
DistanceToGrabenPercentage
DistanceToFault
IDW-Copper
IDW-Iron
Membership function plots
plot points:
181
low
average
high
1
0.5
0
-0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 1
input variable "IDW-Copper"
Current Variable
Name
IDW-Copper
Type
input
Range
[-0.6 1]
Display Range
[-0.6 1]
Current Membership Function (click on MF to select)
Name
average
Type
gaussmf
Params
[0.2222 0.238]
Help
Close
Selected variable "IDW-Copper"


Membership Function Editor: GoldProspectivity
File Edit View
FIS Variables
stanceToGra
GoldPercentage
DistanceToFault
IDW-Copper
IDW-Iron
Membership function plots
plot points:
181
low
average
high
1
0.5
0
-0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 1
input variable "IDW-Iron"
Current Variable
Name
IDW-Iron
Type
input
Range
[-0.6 1]
Display Range
[-0.6 1]
Current Membership Function (click on MF to select)
Name
low
Type
sigmf
Params
[-6.985 -0.126]
Help
Close
Selected variable "IDW-Iron"



Three fuzzy rules were used as shown below :



This Rule Viewer gives the approximate idea of gold prospectivity depending upon various values of Distance to Granite, Distance to Fault and Copper and Iron values.

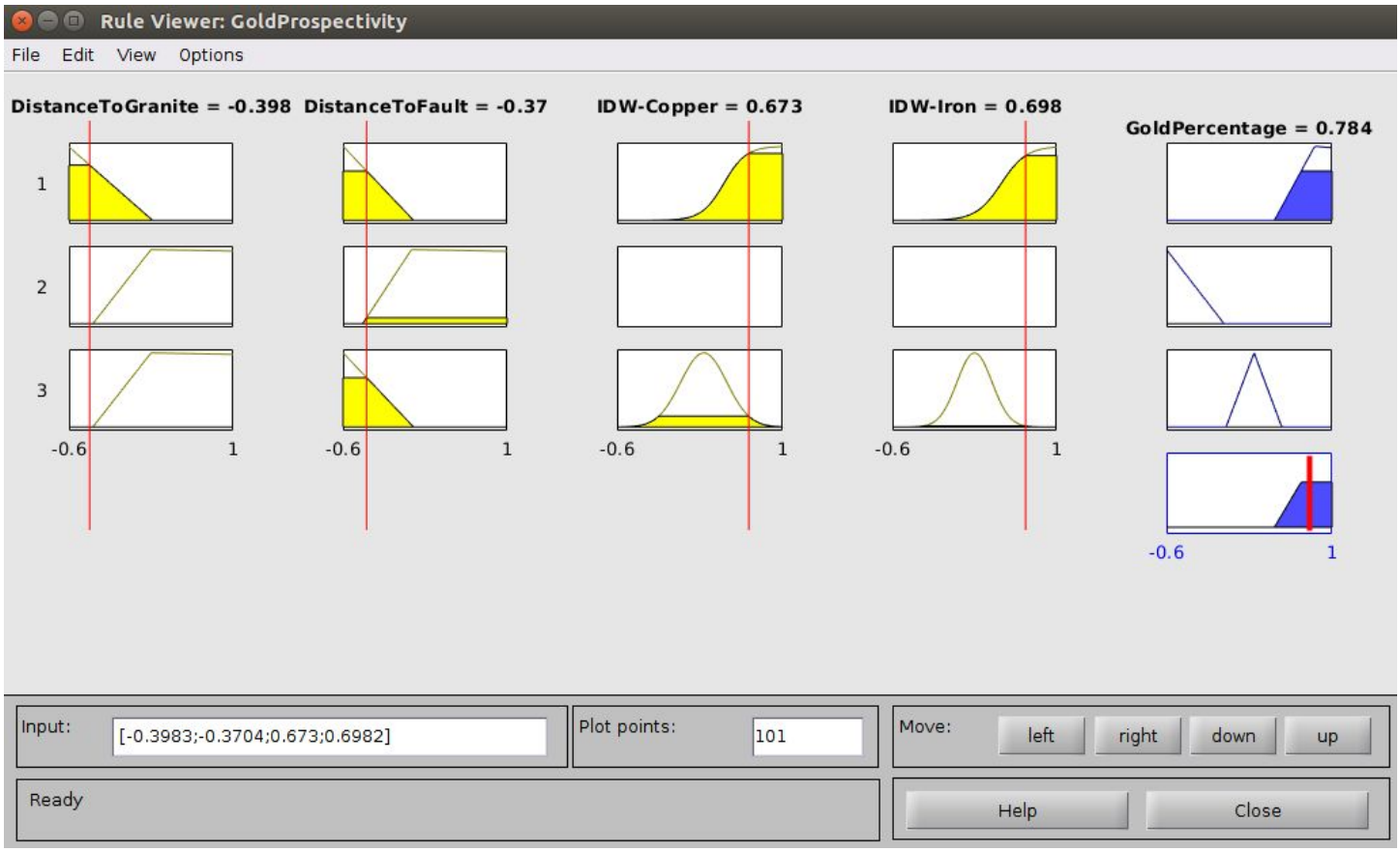


Fig. shows high potential for gold given the respective values

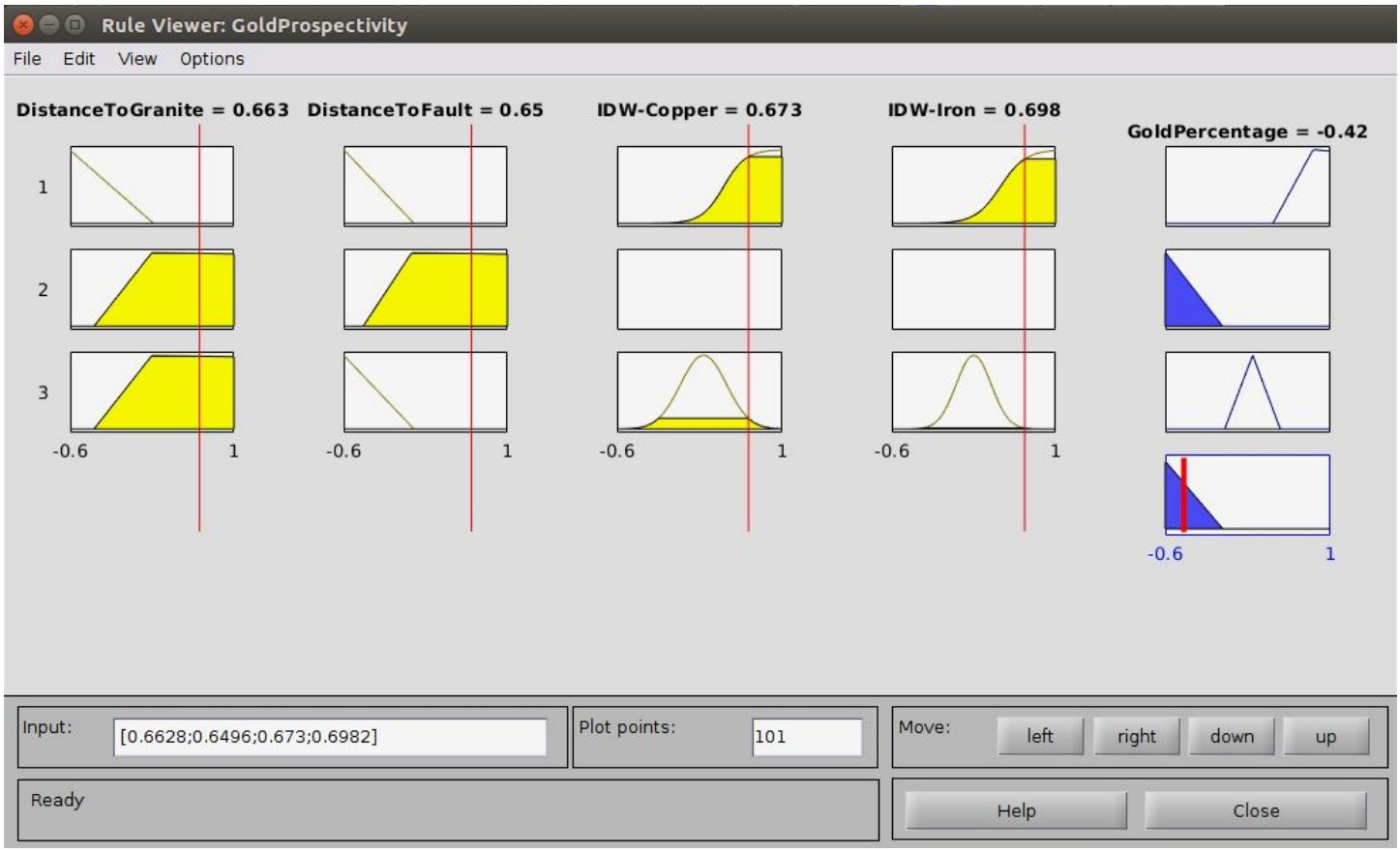


Fig. shows low potential for gold given the respective values

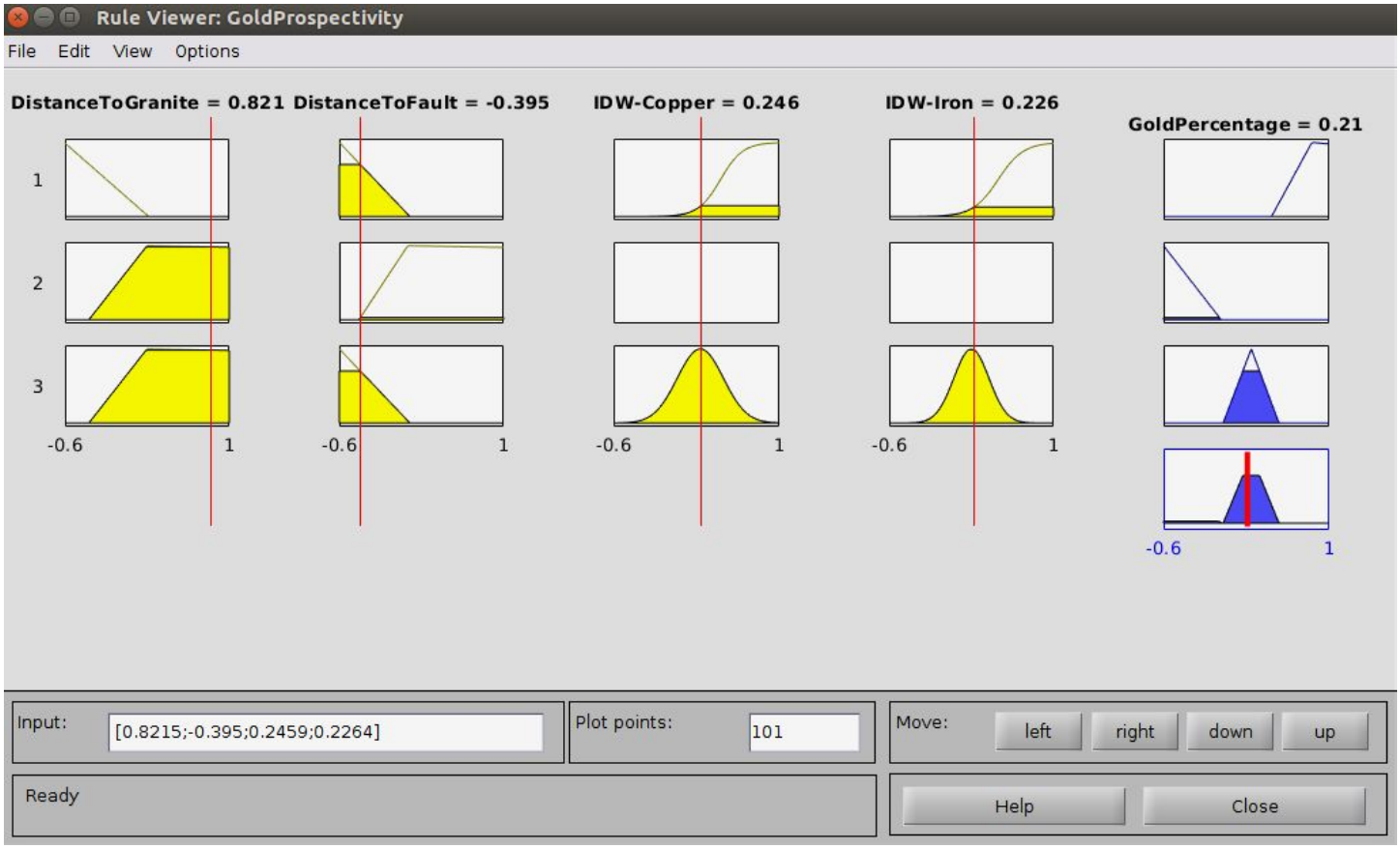


Fig. shows average potential for gold given the respective values