Fuzzy Logic and Risk Evaluation

Abstract. Artificial intelligence has had successful applications in economics, and finance. There are different methods used as supports for decision-making processes. Nowadays the new theories of soft computing are used for these purposes. The case of use is presented on the evaluation of risk by means of fuzzy logic.

1 Introduction

The artificial intelligence plays very important roles especially in economics, and finance because it helps to reduce risk that can lead to higher profits and to success in the competitive fight. The applications in economics, and finance have specific features in comparison with others. The processes are focused on private corporate attempts at money making or decreasing expenses. The application of the fuzzy logic model is realized on the case of evaluation of rate of risk of payment of active debt. The program MATLAB® with Fuzzy Logic Toolbox is used.

2   Risk Evaluation

The application of the fuzzy logic model is realized on the case of evaluation of rate of risk of payment of active debt. The application is solved with eleven input variables, three rule blocks and one output variable with three attributes. The inputs and their attributes are: *Sex* (man, woman), *Age* (young, middle, old), *Marital status* (married, single, other), *Children* (none, one, more), *Income* (low, medium, high), *Account* (none, medium, high), *Debt* (none, medium, high), *Employment* (short, medium, long term), *Contact* with client (short, medium, long term), *Orders* (first, few, more), *Delayed payment* (none, few, more).

It presents eleven inputs where from two to three attributes are selected according to the demand of realization of project. The output from the rule box *Personal data* evaluates the personality of the client (excellent, good, bad), the rule box *Financial data* evaluates the financial situation of client (excellent, good, bad), the rule box *Quality of a client* evaluates the client from the point of view of the relation consumer - supplier (excellent, good, bad). The output variables is the *Risk of payment of active debt* with three attributes (low, medium, high).
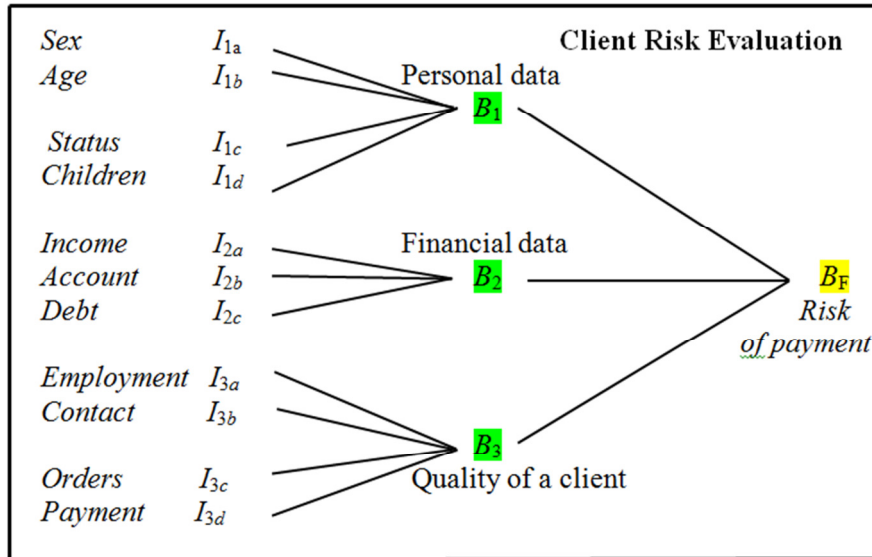
Fig. 1 Fuzzy logic – model

It is necessary to set up the membership function for all inputs and outputs. It was used the functions in the shape of Λ, Π, Z, S. The rule box must be set up with rules and their weight among inputs and outputs. The weight of rules can be changed during the process of optimization.
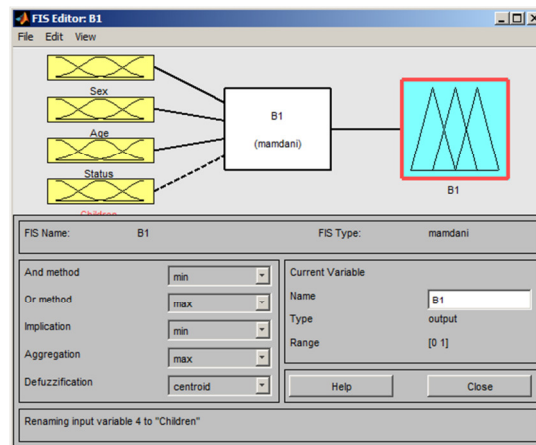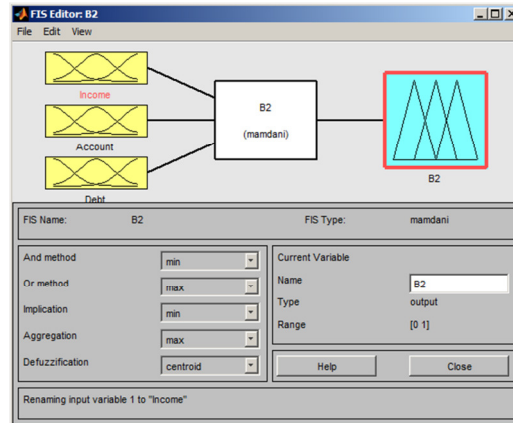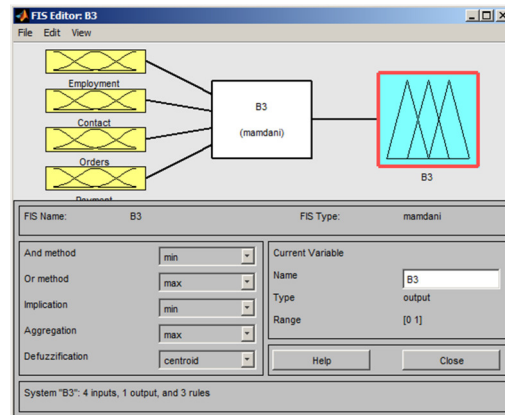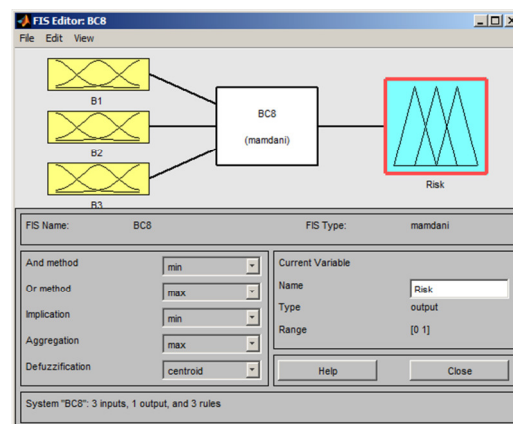

Fig. 2 Box B_1

Fig. 3 Box B_2

Fig. 4 Box B_3

Fig. 5 Box B_C

The build-up model can be used for the evaluation of the rate of risk of payment of active debt. On the basis of input values we obtain the information whether the risk of payment of active debt is low, medium or high. The course of membership function and the weight of rules DoS can be set up by means of neural network in case when the data are at disposal. The fuzzy logic model was built-up (fig.1) with box B_1 (fig.2), B_2 (fig.3), B_3 (fig.4) and B_C (fig.5).

```
clear all
B1v = readfis('B1.fis');
UdajB1 = input('Input values in the form [Sex; Age;
Status; Children]: ');
VyhB1 = evalfis(UdajB1, B1v);
B2v = readfis('B2.fis');
UdajB2 = input('Input values in the form [Income; Ac-
count, Debt]: ');
VyhB2 = evalfis(UdajB2, B2v);
B3v = readfis('B3.fis');
UdajB3 = input('Input values in the form [Employment;
Contact, Orders, Payment]: ');VyhB3 = evalfis(UdajB3,
B3v);
BFv = readfis('BC.fis');
UdajBF(1) = VyhB1;
UdajBF(2) = VyhB2;
UdajBF(3) = VyhB3;
VyhBF = evalfis(UdajBF, BFv);
if VyhBF<0.3 'Low risk'
elseif VyhBF<0.6 'Medium Risk'
else 'High risk'
end
fuzzy(BFv)
mfedit(BFv)
ruleedit(BFv)
surfview(BFv)
ruleview(BFv)
```

Prog. 1 M-file $B_C.m$

The results of the calculation are presented by inputs *Marital status, Children, Income, Account, Debt, Employment, Contact, Orders, Delayed payment* with various values. The results are Low, Medium and High risk. See Res.1. It was tested tens of cases that lead to the conclusion, that the model is usable in practice.

```
Input  values  in  the  form  [I1a;  I1b;  I1c;  I1d]:
[0.95;0.80;0.75;0.94]
Input values in the form [Sex; Age; Status; Children]:
[0;0;0;0]
Input  values  in  the  form  [Income;  Account,  Debt]:
[0;0;0]
Input values in the form [Employment; Contact, Orders,
Payment]: [0;0;0;0]
ans =Low risk

Input values in the form [Sex; Age; Status; Children]:
[0.95;0.80;0.75;0.94]
Input  values  in  the  form  [Income;  Account,  Debt]:
[0.85;0.75;0.95]
Input values in the form [Employment; Contact, Orders,
Payment]: [0.85;0.80;0.90;0.80]
ans =High risk

Input values in the form [Sex; Age; Status; Children]:
[0.5;0.5;0.5;0.5]
Input  values  in  the  form  [Income;  Account,  Debt]:
[0.5;0.5;0.5]
Input values in the form [Employment; Contact, Orders,
Payment]: [0.5;0.5;0.5;0.5]
ans = Medium risk
```

Res. 1 Results of calculation

3   Conclusions

The example mentioned above is an application of the use of fuzzy logic for decision making of investors and managers. The risk evaluation plays an important role nowadays, but such applications, both successful and unsuccessful, are not published very often because of secrecy in the highly competitive environments among firms and institutions.