Fifth Int. Conf. on IFSs, Sofia, 22-23 Sept. 2001
NIFS 7 (2001), 4, 70-72

On an application of the intuitionistic fuzzy approach in economic models

Peter Vassilev[1], Cecilia Temponi[2] and Vladik Kreinovich[3]
[1] N. Copernic No. 17, Sofia-1113, Bulgaria
[2] Southwest Texas State University, San Marcos, Texas 78666, USA
e-mail: ct01@swt.edu
[3]Department of Computer Science, University of Texas at El Paso
El Paso, TX 79968, USA, vladik@cs.utep.edu

Introduction

Economic – financial relations within an environment of globalization are undergoing a spectacular change. The classical concepts are concentrated in calculation of economic viability of investments in an economic system governed by certainty.

They become inoperative being unable to incorporate the uncertainty of our reality.

In our work we stop our attention on modelling of two very important steps of investment process - selection and analysis of financial products for investment.

Selection of investment object

In a general event the decision to invest in an object is based on a finite number of "criteria" or "decision elements" which are diverse by their nature and therefore require different measurement units.

The consideration of this aspect which have an influence in the decision to invest will give rise to set of criteria E_1 with elements $\{a_1, a_2, ..., a_x\}$. Normally these criteria belong to different spheres and are collected by means of many information channels. As an example as criteria for the decision on the acquisition of industrial equipment could be considered elements such as the life of the machine, its degree of capitalization, financial conditions, economic viability, quality of technical assistance, etc.

These criteria are useful in order to "reason" on the convenience of acquiring a number also finite of "investment objects" in order to obtain the desired objectives. Thus appears the second set of elements $E_2 = \{b_1, b_2, ..., b_y\}$.

We assume that there are z experts $E_3 = \{c_1, c_2, ..., c_z\}$ and the degree to which each object complies with the respective criteria according to the opinion of the each expert will be expressed by the values

$$\mathcal{A} = \{(A_{q,r,s}, B_{q,r,s}) \mid q = 1, 2, ..., x;\ r = 1, 2, ..., y;\ s = 1, 2, ..., z\},$$

where $A_{q,r,s}, B_{q,r,s}$ are degrees of confidence and of non-confidence of s-th expert that r-th object satisfies q-th criterion and

$$A_{q,r,s}, B_{q,r,s} \in [0, 1] \text{ and } A_{q,r,s} + B_{q,r,s} \leq 1$$

(cf. [1]).

Analysis of financial products for investment

To take on an investment process with any guarantee of success means not only an in depth financial knowledge of the company, but also of the financial environment in order to obtain the necessary means for making external payments. This leads to an analy sis of the financial products available for making payments arising from the decision to invest, which are offered by different financial institutions. The procedure normally include as a first step collection of information about the products offered by the different banks and other credit institutions. Once the initially possible products are on the table, they have to be analyzed if they posses and to what degree, the necessary characteristics or properties for the investment process. This is a task which means a certain knowledge of the condition under which the investment program should develop, from the beginning to the end. These characteristics could be for example:
flexibility in time availability;
compatibility of the financial costs with the needs of investment;
agreement of the financial institution with the project;
adequacy of the grace period to the estimate of collections arising from the investment, etc.

The assignment of the corresponding characteristic or properties to each of the financial products can take place in a very different ways. For our purposes we would construct a intuitionistic fuzzy sub-set for each of the financial products, the referential of which would be the set of characteristic or properties, assessed by an expert. If we have p possible products $P_1, P_2, ..., P_p$ related to objects, that are elements of E_2, and m characteristic or properties have been considered, $C_1, C_2, ..., C_m$ by n experts $F_1, F_2, ..., F_n$ (the same of different than the mentioned above experts $c_1, c_2, ...m, c_z$) we would obtain the values

$$\mathcal{B} = \{(C_{i,r,k,l}, D_{i,j,k,l}) \mid i = 1, 2, ..., p;\ r = 1, 2, ..., y;\ k = 1, 2, ..., m;\ l = 1, 2, ..., n\},$$

where $C_{i,r,k,l}, D_{i,r,k,l}$ are degrees of confidence and of non-confidence of l-th expert that i-th product, related to r-th object satisfies k-th criterion and

$$C_{i,r,k,l}, D_{i,r,k,l} \in [0, 1] \text{ and } C_{i,r,k,l} + D_{i,r,k,l} \leq 1$$

(cf. [1]).

Intuitionostic fuzzy interpretation

We shall use the algorithms, discussed in [1]. For the elements of set $calA$ we can determine the following sets

$$\mathcal{C} = \{< \overline{A}_r, \overline{B}_r > \mid r = 1, 2, ..., y\},$$

where the couples satisfy:

$$< \overline{A}_r, \overline{B}_r > = < \frac{\sum_{q,s} A_{q,r,s}}{xz}, \frac{\sum_{q,s} B_{q,r,s}}{xz} >,$$

and

$$\mathcal{D} = \{< \overline{C}_r, \overline{D}_r > \mid r = 1, 2, ..., y\},$$

where the couples satisfy:

$$< \overline{C}_r, \overline{D}_r > = < \frac{\sum_{i,k,l} C_{i,r,k,l}}{pmn}, \frac{\sum_{i,k,l} D_{i,r,k,l}}{pmn} > .$$

The elements of set $\mathcal{C}$ determine the agregated estimation for the objects from technical point of view, while the elements of set $\mathcal{D}$ determine the agregated estimation for the objects from financial point of view. If we suppose that the technical criteria have bigger priotities, then we can obtain the final estimations in the form of the elements of set

$$\mathcal{F} = \{< G_r, H_r > \mid r = 1, 2, ..., y\},$$

where

$$< G_r, H_r > = F_{\overline{C}_r, \overline{D}_r}(< \overline{A}_r, \overline{A}_r >), \ r = 1, 2, ..., y,$$

where intuitionistic fuzzy modal operator $F_{a,b}$ $(a, b \in [0, 1], a + b \leq 1)$ is defined over the intuitionistic fuzzy couple $< c, d >$ (i.e., $c, d \in [0, 1], c + d \leq 1$) as follows:

$$F_{a,b}(< c, d >) = < c + a.(1 - c - d), d + b.(1 - c - d) > .$$

Now, using relation

$$< a, b > \leq < c, d > \text{ iff } a \leq c \text{ and } b \geq d$$

we can determine the couple

$$< G_{r_0}, H_{r_0} > = < \max_{1 \leq r \leq y} G_r, \min_{1 \leq r \leq y} H_r >,$$

that corresponds to the best object estimation.

Reference:

[1] Atanassov, K. Intuitionistic Fuzzy sets. Sprimger, Heidelberg, 1999.