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SUPPORT SYSTEMS FOR DECISION AND NEGOTIATION PROCESSES

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THE CHARACTERISTIC FUNCTION AND EXPERT SYSTEM CONSTRUCTIONS DETERMINING PROBABLE SUCCESS IN THE COMPETITION TENDERS

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ABSTRACT. A fuzzy logic is applied in constructing different forms characteristic functions,as well as,in the data consistency in the computer-aided control systems at decision-making moment under conditions formalized with dificulty. In the case of software development both specialized software, and expert systems the fuzzy sets theory is used for the facilitation of decision-making in conditions of risk and uncertainty. This paper dealts with the approaches using the tools for constructing the characteristic function, an expert system which is employed for the determination of an increase of price value on an advanced to tenders proposals.

KEYWORDS: Competition tenders; business game; decision-making; expert system; fuzzy logic; characteristic function.

1. Introduction

We shall state briefly the studied problem. Many papers deal with the tenders strategy task and probabilistic models are examined in most of them. The probabilistic models determine the chance of success in the competition tenders. The probabilistic models and the received results application enable decision - makers /DM/ in tenders to determine the gain probability in the bidding /competition/.

Before the tenders begin, enterprise evaluate expenses of production on the execution of a particular order, then they increase the price to regain expenses concerned with the constant costs of an enterprise, the technical-economic proposal preparation and so on to get some profit in the end. When an enterprise strives for gain in the bidding urgently, presenting its own proposal with low increase of price, it has a chance of success close to 100 per cent. Otherwise, when an increase of price is very high, the probability of gain in the bidding goes to zero. It is clear that between these two extreme positions there are such proposals with an increase of price which probability of gain in the competition takes on values within the limits of 0 and 100 per cent. For the first time this approach has been observed by Friedman (Hartis and Mc Caffer, 1983). It has been based on plotting a curve of probabilities distribution being a frequency of gains in the tenders which depends upon offered price.

2. The characteristic function and expert system constructions

This work seeks to construct the decision making support expert system for probability success determination in competition tenders. A fuzzy logic is the main facility used in such kind software construction. In fuzzy models construction linguistic variables are of great importance. Using them you can formalize qualitative information about decision making object represented in wordy form by experts. It is necessary to determine the fuzzy values and design an argument system in inference operation execution for the expert systems construction based on linguistic variables, an so for the beginning there is a logic to construct "increase of price size" characteristic function for the problem under review. It is evident that external and internal limitations of the competition tenders implicitly are included in numeric matrix constructed on the basis of expert demand.

In this paper the linguistic variable is used for assessment of increase of price value, that is $W = \langle \text{"Value"}, T, X \rangle$, where $T = \{ \text{"very low"}, \text{"low"}, \text{" mean"}, \text{"high"}, \text{"very high"} \}$, is a term which is linguistic variable set W ; $X = \{9.0; 9.25; 9.5; 9.75; 10.0; 10.25; 10.5; 10.75; 11.0\}$ is basic variable set W. And the term "very low" is specified by fuzzy variable $\langle$"very low, $X, C_1\rangle$, the term "low" by<"low", X, C_2 > and etc. Then the characteristic functions $MC_1(X)$, $MC_2(X)$, $MC_3(X)$, $MC_4(X)$, $MC_5(X)$ of the appropriate fuzzy sets are constructed by indirect method and the expert demand maximum errors are defined(i.e. errors assumed by an expert in pairwise comparasion matrix forming). Then, using the rules expert system has, the characteristic functions describing linguistic variable "gain probability in competition tenders" value is constructed. It is evident that the term "very low" gain probability in the competition tenders is consistent with the term "very high" increase of price, "low" probability -"high" increase of price and so on. A characteristic function plot of "increase of price size" set is shown in Figure.

The universal scale construction is a supple instrument having adequate reaction external changes of this process conditions. In that way there is no need to make a new expert demand.Under external changes in this paper we mean varying market conditions i.e. the relationship of orders amount and amount of enterprises taking part in the bidding . If an expert evaluates market situation correctly, the increase of price forming according to universal scale will be rather exact that is why the gain probability will be rather high. The universal scales for "increase of price" and "gain probability" are formed for each of given orders, since they differ in amount and in execution time.

Let define the truth values for some statements used while solving the problem concerned with the probability of order receipting in the competition staged as tenders. The characteristic function of standard fuzzy truth values in accordance with the Baldwin approach (Klir and Folger, 1988), are used. In this approach the characteristic functions of basic fuzzy truth values, such as "true" , "false" etc. as a function in the form $[0,1] \to [0,1]$, are defined.

These values are presented by curves denoted respectively: fairly true; true; very true; fairly false; false; very false; absolutely false; uncertainly; very false.

For example, the fuzzy truth valve appropriate to the term "true" must be defined by the following characteristic function :

M "true" (v) =v, ∀ $v \in [0,1]$, and M "false" (v) =1-v, ∀ $v \in [0,1]$.

Let present "market conditions" by the set of terms in the form: $T_1(\beta)$ =<"very faveurable conditions", "faveurable conditions", "considerably better than normal conditions", "better than normal conditions", "normal conditions", "werse than normal conditions", "considerably worse than normal conditions", "unfaveurable conditions", " quite unfavourable conditions" > .

And market conditions θ are presented with the function θ= = f (m,n) , where m is amount of enterprises taking part in the competition tenders, n is amount of orders introduced to the tenders.

In short notation linguistic variables $T_1(\beta)$ may be shown as follows: $T_1(\beta)$ = < V.F.M.C., F.M.C., C.B.N.M.C., B.N.M.C., N.M.C., W.N.M.C., C.W.N.M.C., U.M.C., Q.U.M.C. > and:

$$\text{V.F.M.C.} \Leftrightarrow n\uparrow\uparrow \wedge m\downarrow\downarrow \;;\; \text{F.M.C.} \Leftrightarrow (n\uparrow \wedge m\downarrow\downarrow) \vee (n\uparrow\uparrow \wedge m\downarrow);$$

$$\text{C.B.N.M.C.} \Leftrightarrow (n_{me} \wedge m\downarrow\downarrow) \vee (n\uparrow \wedge m\downarrow) \vee (n\uparrow\uparrow \wedge m_{me});$$

$$\text{B.N.M.C.} \Leftrightarrow (n\downarrow \wedge m\downarrow\downarrow) \vee (n_{me} \wedge m\downarrow) \vee (n\uparrow \wedge m_{me}) \vee (n\uparrow\uparrow \wedge m\uparrow);$$

$$\text{N.M.C.} \Leftrightarrow (n\downarrow\downarrow \wedge m\downarrow\downarrow) \vee (n\downarrow \wedge m\downarrow) \vee (n_{me} \wedge m_{me}) \vee (n\uparrow \wedge m\uparrow) \vee (n\uparrow\uparrow \wedge m\uparrow\uparrow);$$

$$\text{W.N.M.C.} \Leftrightarrow (n\downarrow\downarrow \wedge m\downarrow) \vee (n\downarrow \wedge m_{me}) \vee (n_{me} \wedge m\uparrow) \vee (n\uparrow \wedge m\uparrow\uparrow);$$

$$\text{C.B.N.M.C.} \Leftrightarrow (n\downarrow\downarrow \wedge m_{me}) \vee (n\downarrow \wedge m\uparrow) \vee (n_{me} \wedge m\uparrow\uparrow);$$

$$\text{U.M.C.} \Leftrightarrow (n\downarrow\downarrow \wedge m\uparrow) \vee (n\downarrow \wedge m\uparrow\uparrow) \;;\; \text{Q.U.M.C.} \Leftrightarrow n\downarrow\downarrow \wedge m\uparrow\uparrow .$$

Then, $X_1 = \{(n\uparrow\uparrow \wedge m\downarrow\downarrow), \ldots, (n\downarrow\downarrow \wedge m\uparrow\uparrow)$. And the sign " ↑↑ ", " ↑ ", " me ", " ↓ ", " ↓↓ " which are the linguistic variables in the form "very high", "high", "mean", "low", "very low" corresponding to the values m and n . Let an increase of price value in the limit of (N_D , N_G) and expenses of production of separate enterprises realizing the orders are constant. If the increase of price value a little more than mean and there is favourable market conditions, the gain probability in bidding is about 0,8. Then the proposition "probable success in the competition tenders" is fairly true (true, very true , fairly false, false, very false) and has following truth according to the Baldwin approach 0.9 (0.8; 0.67; 0.47; 0.21; 0.06) , respectively.

Similarly to determination of market conditions an enterprise state in the function of production expanses and increase of price /extra charge/ (or only expanses of production taking "increase" as control) is defined.

To help decision-makers in determination probable success value in bidding at representable by him proposals, a minor expert system has been designed. This system uses logic rules of deductions in the following form:

<IF extra charge grows, THEN success probability slows down >

<IF extra charge reduces THEN success probability grows >

<IF market conditions become worse THEN extra charge reduces >

<IF market conditions become better THEN extra charge grows >

The expert system realizes a series of reasonongs using essential relations of probability theory during its work with the knowledge base rules. During probabilistic analysis of values the DM interested in linguistic variables such as "reduces", "grows" and so on with reference to the value "extra charge" are examined. For the linguistic variables analysis conditional probability formulas and factors of confidence are used and probability values in calculation are determined according to the concrete situation.

4. Concluding remarks

For the problem the software has been designed in dialog mode in the form of business game, simulating production-financial activites of competing with each other enterprises. The received results analysis has been carried out on the basic of the different behaviour strategies of the game participants with Wald, Hurwicz, Laplace, Savage principles application and thier variations.

Business game has been used for enterprises leaders acquaintance with the basic market mechanism expressed by the relation: demand , proposal and price, as well as, decision making under circumstances of uncertainty.

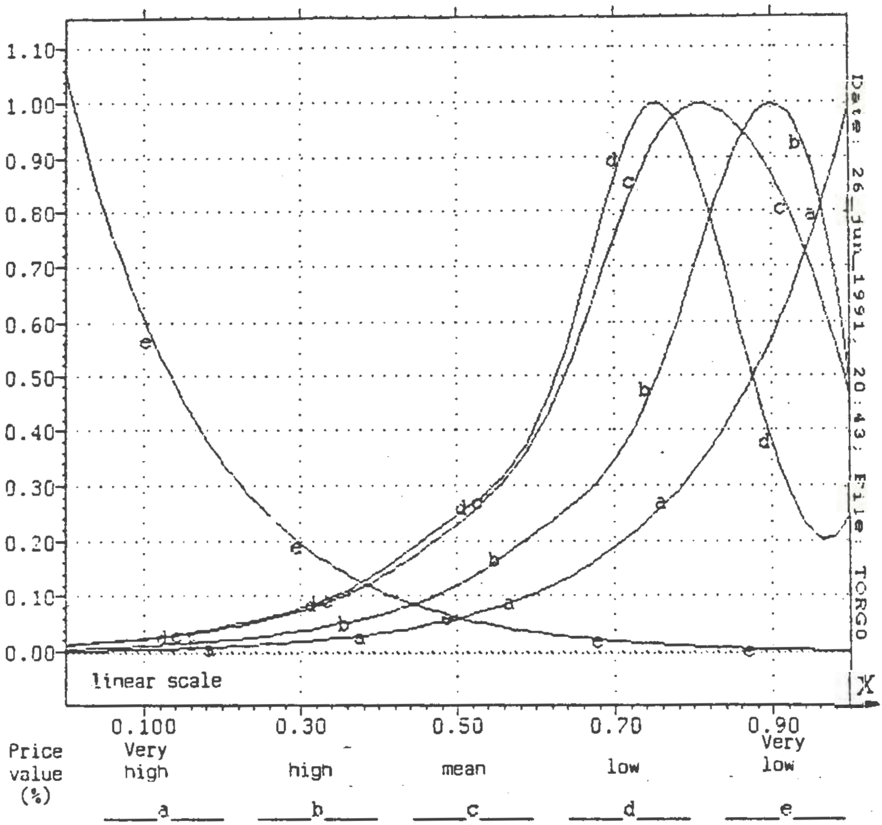

Fig. Characteristic function "increase of price size" set.

The system has been realized at IBM 370/148 and IBM PC/AT in improvement of professional skill centres and a number of Polish enterprises.

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