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**A PRACTICAL AND SIMPLE MANNER OF EVALUATION
OF THE EFFICACY OF IMPROVEMENT METHOD
IN CASE OF UNFAVOURABLE ECONOMIC SITUATIONS
ON THE BASIS OF FUZZY SET THEORY**

Abstract. In the paper there is proposed a simple mathematical model following from the considerations included in the theoretical papers concerning the evaluation of medical and other therapies on the ground of fuzzy sets based on lattices [2001–2004]. The method allows to introduce into the evaluation procedure a convenient scale of the valuation results followed by proposed improvement methods. In the scale one finds both the positive and negative opinions.

For calculation purposes one needs to construct a table containing a list of symptoms, critical for an economic event and a list of proposed improvement methods. When the table has been constructed and filled out with numbers of the valuation scale, in the final stage one needs to use the proposed simple calculation formula for a fuzzy set which allows us to state a value of relation between the improvement method used and symptoms of economic depression. As a result, it is possible to obtain a proposal for the most efficacious improvement method for a given economic problem.

Keywords: economic depression, evaluation of improvement methods, application of lattice value fuzzy sets

Mathematics Subject Classification (2000): 03E72, 03E75, 03C30, 60A99.

I. INTRODUCTION

In each life domain different means and methods are used for the achievement of the intended aim. In each of the applied methods used for solving particular problems, we are interested in an evaluation of our activities and qualification of the best method assuring the efficacy, e.g. a medical therapy or an improvement of an undesirable state of economy. The evaluation of improvement activities or therapy is, as a rule, presented verbally. Therefore, it is convenient to consider the problem of the analysis of our procedure in the evaluation of proposed activities from the fuzzy set theory point of view. Up till now, most attention was given to the evaluation of medical therapy methods but the structure of the problem analysis can be referred to any situation in which we wish to obtain an improvement.

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In the paper there is proposed a simple mathematical model following from the considerations included in the theoretical papers concerning the evaluation of medical and other therapies on the ground of fuzzy sets based on lattices [2001–2004]. The method allows to introduce into the evaluation procedure a convenient scale of the valuation results followed by proposed improvement methods. In the scale one finds both positive and negative opinions. An advantage of the method proposed, as opposed to statistical methods, is that there is no necessity to rely extensive data and the checking of the obtained improvement is possible for each considered event e.g. economic depression.

II. PROCEDURE OF TREATMENT

The procedure of proposed treatment starts with the construction of a table of improvement for an event considered, e.g. economic crisis, a decrease in labor productivity in a company etc.

For calculation purposes we make a list of symptoms or other significant agents, characteristic for an investigated economic event. The **symptoms** are described verbally but are noted on the list by symbols, e.g. S_1, S_2, \dots . They are, for example, in the case of economic crisis: unemployment (reduction of labor places), lower production, decrease in the sale of products etc. We make a list of the possible improvement means which should to save the existing unfavourable situation. Let us name these means as the **therapy**. They are also defined verbally but for the convenience and abbreviation we denote them by symbols T_1, T_2, \dots . The experts can propose in this case some different methods according to the need and investigated problem.

The symptoms in the list can be assigned their *weights* in the given economic problem entity in accordance with the economic knowledge and experience of the expert carrying out the treatment. The weights w of the values 2 or 3 have significant influence on the result of calculations. In general one does not use the greater values as 3.

We take the following scale of appreciation of the efficacy of the improving means on the selected symptoms. The same improving means can act in different degree on different symptoms.

- If the means in question has no effect on the considered symptom, its effectiveness is assumed to be equal 1.
- Positive impact of the means on the symptom is graded from 2 to 10.
- Harmful impact of the means is graded from 0 to 0.9 where value 0 is assigned when the effect is extremely negative, i.e. particularly damaging, and values 0.8, 0.9 mean slight harmfulness.

The detailed grading of the means or therapy effectiveness in fighting a given symptom is the following:

perfect	10
nearly perfect	9
very high	8
high	7
higher than sufficient	6
sufficient	5
nearly sufficient	4
low	3
very low	2
none	1

Negative effectiveness is graded similarly:

slightly negative (weakly marked)	0.9
marked	0.8
weakly disadvantageous	0.7–0.6
disadvantageous	0.5
strongly disadvantageous	0.4 – 0.3
harmful	0.2 – 0.1
damaging	0

It is essential that the problem under consideration should have a table illustrating the examined dependences. In the table we place an appreciation (the appreciation of an expert). For example:

	S_1	S_2	...
T_1	6	8	...
T_2	7	5	...

The quantities in the table are the values of the relationship between the improvement and the symptoms:

$$R: T \times S \rightarrow R (T, S).$$

We construct a fuzzy set $A(T)$ that values for particular improvement methods are calculated according to the formula

$$A(T_i) = \prod_{j=1} R((T_i, S_j))^{w_j}, \quad i = 1, 2, \dots$$

which, after appropriate calculations, leads to the column matrix

$$\begin{matrix} A(T_1) \\ A(T_2) \\ \vdots \end{matrix}$$

whose elements are the results of the calculations. The number of improvements (therapies) as well as of the symptoms to be taken into account are set by the expert. The weights w_j in the exponent of the formula above have to be determined by the expert earlier.

III. FINAL REMARKS

The greatest value in the column matrix allows to decide which improvement (therapy) is the best for a given investigated problem suffering from a given defect.

The procedure described above can be illustrated with a practical life example.

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PRAKTYCZNY I PROSTY SPOSÓB OCENY SKUTECZNOŚCI METOD NAPRAWY WADLIWYCH STANÓW EKONOMICZNYCH W OPARCIU O TEORIĘ ZBIORÓW ROZMYTYCH

W pracy proponuje się prosty model matematyczny wynikający z rozważań zawartych w pracach teoretycznych dotyczących oceny terapii, niekoniecznie lekowej, w oparciu o zbiory rozmyte wsparte na kratkach (2001–2004). Metoda ta pozwala wprowadzić do oceny postępowania wygodną skalę ocen działania zaproponowanego sposobu naprawczego, w której zawarte są zarówno oceny pozytywne jak i negatywne.

Dla celów obliczeniowych konieczne jest utworzenie tablicy zawierającej spis objawów krytycznych dla zjawiska ekonomicznego (gospodarczego) oraz spis proponowanych sposobów naprawczych. Po skonstruowaniu takiej tablicy i wypełnieniu jej wartościami ze skali ocen trzeba posłużyć się w końcowym etapie zaproponowanym prostym wzorem obliczeniowym dla zbioru rozmytego, który pozwala ustalić wartość relacji (związku) między stosowaną metodą naprawczą a objawami kryzysu gospodarczego (ekonomicznego). W efekcie pozwala to uzyskać propozycję najlepszej metody naprawczej dla danego problemu ekonomicznego.

