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FUZZY MODELS OF DECISION MAKING IN THE TASKS OF PROGNOSTICATION RELATIONSHIPS IN SOCIAL GROUPS

Abstract.there had been considered the methodic for building fuzzy models in the tasks of prognostication relationships in social groups. There had been suggested the description of uncertainties which arise during generation of information from people on the basis of fuzzy sets.

Key words: *fuzzy model, social group, relationships, fuzzy logic system.*

Introduction

Rapid development of information technologies, using global computer net Internet, which widened access to search and processing of information, created fundamentally new conditions for professional activity of specialists in different spheres. At the same time, this raised requirements to the creation of psychologically comfortable labor conditions in groups of people, activity of which is aimed at meeting common objective.

It is known [1], that psychologists and specialists in sociology, who work in social groups and research mutual relations between people, face with the task of prognostication of their future development. Specialists in psychology research the phenomenon of appearance of definite system of knowledge which is formed when the man experiences special object of reality during communication process. Communication process usually takes place in condition of definite situation, namely in work environment with the presence of other people, with the availability of external and internal factors. The above influences further development of relations between people who make up social group. This initiates many different tasks of prognostication of mutual relations in groups of people. For example, successful joining the group by a newcomer or prognostication of mutual activity of two specialists who work together to solve difficult task etc. Such tasks relate to number of tasks for evaluation of compatibility “individual- individual” and “group- individual”, the solution of which requires the use of sociometric methodic[2]. This methodic usually uses the results of polls or questionnaires with further processing on the statistical base. It is known however that during poles there appear different kinds of uncertainties, so called “No-factors” [3]. This caused wide usage of intellectual technologies for solving tasks, related to simulation of relationships in the groups. Within the frameworks of these technologies it is appropriate to use apparatus of fuzzy sets to describe uncertainties, which arise during receiving information from people with further processing using methods of fuzzy logic [5].

Task setting

Let us set the task to develop the methodic for building fuzzy models in the tasks of prognostication of mutual relations between people in social groups which stipulate for their coordinated and efficient activity.

Research technique

For convenient solution of the set task we devide the main task into subtasks, namely: we consider the task of prognostication of state of joining the group by a person with further generalization of this task (for the case of prognostication of state of mutual relations between people in the group). Following the recommendations of sociometric methodic[2] for the solution of similar tasks we conduct researches in groups of not less then 10 people on condition that the group exists a year or two.

We suggest the methodic for building fuzzy models taking into account the procedures of knowledge extraction from experts and respondents who are members of the groups of people, participating in researches.

For the solution of the task of joining the group by a newcomer, it is necessary to select a set of

qualities {xi} upon the expert's recommendation, which may influence the development of relationships between the man and other members of the group. That set has to be compared with the set of possible states, with the help of some logic conclusion {yj}, which characterize the possible state of adaptation of the man to the new staff. The procedure of receiving knowledge from people and building fuzzy sets for terms of variables from set {xi} is a very important component of this process. For convenience of the forthcoming statistical calculations we will name the above qualities {xi} as the input linguistic variables.

Building of fuzzy model we will divide into stages, necessary during the solution of the set task. Their description is give below:

Step 1. Introduction of dependance:

$$Y = f_y(x_1, x_2, ...x_n), \tag{1}$$

where $(x_1, x_2, ...x_n)$ – input variables (in this task– set of qualities with the help of which the expert characterizes a person as the future member of the group); Y – output value, meaning of which belongs to the range of evaluations of state of compatibility of relations "individual - group"; f_y – approximating function.

Here the phasification takes place – building fuzzy sets for terms of linguistic evaluation of input parameters.

Step 2. Building procedures for knowledge extraction, using polls with further processing of received data with the help of algorithm, shown in [6]. According to this algorithm, the process of poll includes the procedure of painting part of the ten-point scale on the basis of thermometer principle [5]. In such a way the information, relating to characteristic of a person, who in future will become group member, is received from people. Sample of poll results for the variable «emotionality» with terms: the 1-st term– usual, the 2-d term – stable, the 3-d term – redundant – is shown in fig. 1.

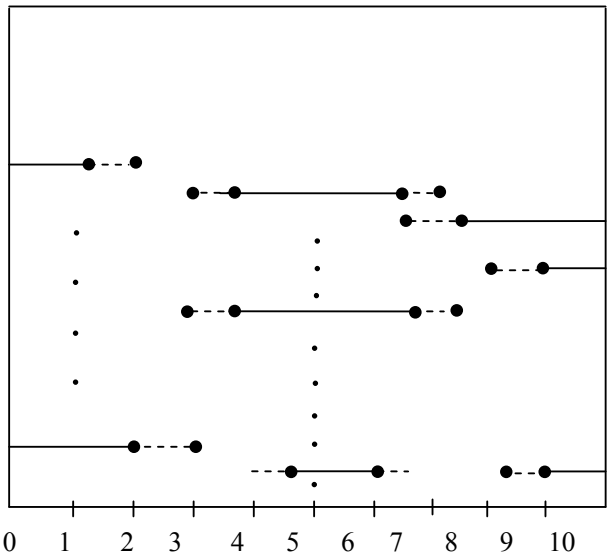

Рис. 1. Results of painting the part of ten-point scale by the respondents during polls (left column– the 1-st term; middle column – the 2-nd term; right column– the 3-d term) for input variable

Step 3. Building fuzzy knowledge basis. For the solution of tasks as set, there has to be built two or some data bases. Answers of expert (experts) and group members on the basis of the rule "if… then" taking into account linguistic evaluations of input variables and their combinations shall be entered on the fuzzy knowledge base. For decision making in the task of prognostication of joining group be a person there has to built fuzzy logic system (FLS-advisor) which may have two matrix of knowledge, namely: the first one will belong to the expert with the own opinion on the given

person and his adaptation to the group, and the second represents the opinion of the group members. Number of rules, consequents and anzendents in the rules are set by an expert in this sphere. Knowledge bases have similar dimensions, however right parts of logical equations which are the results of knowledge base processing with the help of fuzzy logic may be different since they reflect opinions of different people, answering questions

Step 4. Building membership function. In majority of systems of fuzzy logic conclusion, the membership function of linguistic terms for input variables are built with the help of methods described in [5] on the basis of information received from an expert or group of experts. Building membership function for "FLS-advisor" is realized with the help of data, received in the result of polls. Fig. 1. shows the fragment of initial data for building membership function for the terms of input variable "emotionality".

For building membership function of the term «stable», which had the triangular form, we use mathematical relations [6]:

Values of coordinate of maximum of membership function to the term «stable» shall be calculated according to the formula:

$$\overline{m} = \frac{1}{N}\sum_{i=1}^{N}\frac{l_i + r_i}{2}, \tag{2}$$

where l_i and r_i – correspondingly left and right ends of the segment, which takes the central part on the figure 1; N – number of respondents, participating in polls; values of left l and right r coordinates of triangle base is calculated according to the formula:

$$l = 2\bar{l} - \overline{m}, \tag{3}$$

$$r = 2\bar{r} - \overline{m}, \tag{4}$$

where $\bar{l} = \frac{1}{N}\sum_{i=1}^{N} l_i$ – statistical average for the value of left end of the segment;

$\bar{r} = \frac{1}{N}\sum_{i=1}^{N} r_i$ – statistical average for the value of right end of the segment;

If in the calculations of values l and r we take into consideration the average quadratic deviation (σ) (for segments' ends l_i and r_i correspondingly), we receive interval functions of memberships [4] for the terms of input variables . Fig. 2 shows the example of such functions for the variable "emotionality"(a(x)).

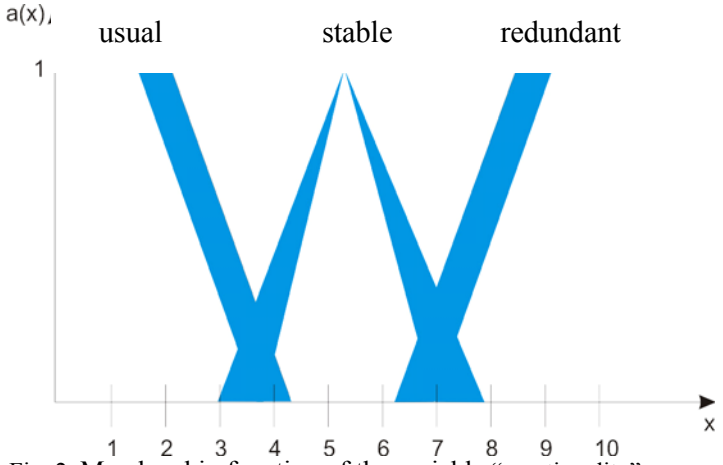

Fig. 2. Membership function of the variable "emotionality"

Step 5. Fuzzy logic conclusion.

Fuzzy logic conclusion is an approximation of the dependence with the help of fuzzy knowledge base and operation with fuzzy sets .

In this case, on the basis of two or some matrixes we will realize number of fuzzy logical systems which, in aggregate, make up fuzzy logical system – advisor. "FLS-advisor" with the similar input data may have outputs with different values. The outputs values will be further processed with the help of decision making procedures, the choice of which belongs to an expert.

Step 6. Dephasefication . obtaining simulation results.

We conduct dephasefication by transferring fuzzy set in number. This procedure in case of using fuzzy sets of the first and the second types has to be conducted with the help of algorithms shown in [4]. Dephasefication procedure is a procedure of obtaining decision with the help of fuzzy model.

Step 7. Using the dephasefication results. Making decision of the basis of simulation results.

Fuzzy simulation allows to build fuzzy logic system (''FLS-advisor'') with some matrix of knowledge , which will execute the function of advisor on questions of prognostication of state of relationships in the groups. Value, produced by '' FLS-advisor'' will allow to compare different points of view and make a decision.

Generalisation of the prognostication task, state of relationships «individual -group», that is prognostication of relationships between the person and the group in which it will work, in case of prognostication of the state of relationships of the type "individual- individual" , stipulates for the creation of fuzzy logic system of the type "many inputs – many outputs" [4]. Such a system has some number of matrix of knowledge with the help of which the opinions of all members of the group is taken into consideration.

Sample of prognostication results of the state of relationships between the individual and the group

The given task uses the experimental results of the researches, conducted in the groups of students of the faculty of computer systems and nets of Vinnytsia National technical University. There had been selected the groups where the students were given the task to master the technique of work in computer environment under condition of total co-ordination between group members with conflict-free relationships.

For building fuzzy model there had been introduced linguistic variables with the following terms:

x_1 – organizational abilities (low(H), average (C), high (B));

x_2 – connectivity (weak (СЛ), average (С), strong (СА));

x_3 – emotionality (usual (О), stable (СТ), significant (З));

x_4 – intellectual level (low(H), average (C), high (B).

Number of introduced variables and choose of terms for variables is predetermined by terminology, recommended by experts and is no burdensome for those students, participating in polls. Fuzzy logic system will solve the approximation task of dependence between the state of relationships between the student and the group of students.

For the output variable Y – «state of compatibility» joining of newcomer there had been introduced the following terms : negative (Н), neutral (НН), positive (П). The next step of building the model is creation of matrix of fuzzy knowledge. There are two matrixes in this task : the first one is an expert (specialist in the sphere of psychology), and the secod matrix of knowledge will contain the answers of group members to the questions , composed by the psychologist. Matrix of knowledge will determine the system of logical statements of the following type:

«If x_1=С, and x_2=С, and x_3=СТ, and x_4=С , then y_c =НН»,
«If x_1=С, и x_2=С, and x_3=СТ, and x_4=С, then y_e = П »,

Which connect the values of input parameters x_1, x_2, x_3, x_4 with output parameters y_c (students point of view) and y_e (expert point of view).

For the solution of the set task on the input of the fuzzy logic system

(FLS-advisor) there has to be submitted specific number of vectors , each of which represents in aggregate the qualities of the person , which will work with the group. Result of work'' FLS-advisor'' – is the independent opinion of an expert (on fig. 3 – marked 1) and group members (on fig. 3 – marked 2) about the state of compatibility of a man and a group. For the obviousness of the experiment there had been used ten-point scale (from the state of compatibility with the evaluation of zerro up to 10 points – positive value of compatibility state for the future group member); abscissa fixes numbers of experiments, ordinate axis fixes the state of compatibility. Algorithm of decision making consists in choosing an experiment with the possible narrowest interval or may consist in calculation of average value, which may be considered as the point of consent. In case of using fuzzy sets of the second type, each output of '' FLS-advisor'' will be a specific corridor with high bound and low bound. Decision making in this case requires using algorithm for decrease in type of fuzzy sets [4].

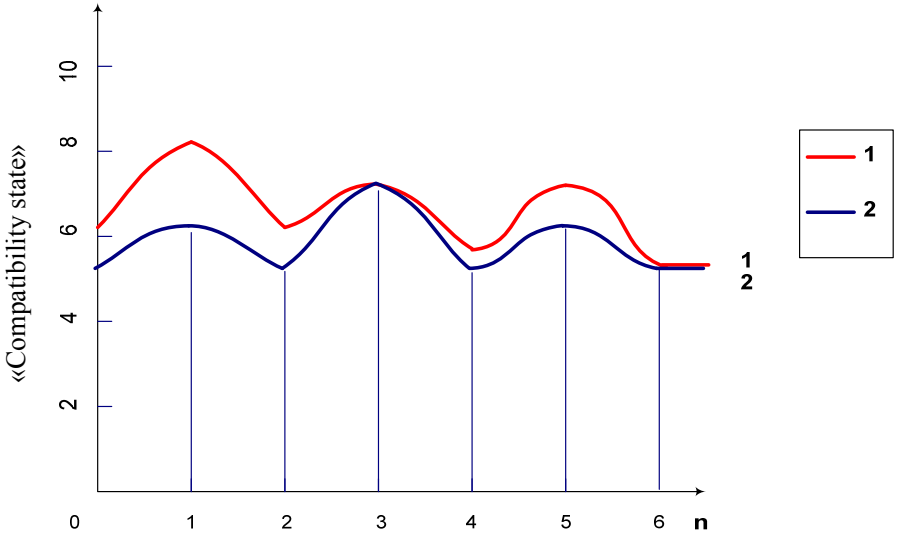

Fig. 3. Results of the experiment

Final decision is to be made by an expert. With the availability of significant discrepancies the experimental researches are to be repeated. The selection of the candidate for entering the group, which value of the segment of y-coordinate to the point of co-ordination with the expert, following the results of system work, is the maximum, may be suggested as the decision to be made by an expert.

Conclusions

There had been suggested the methodic for building fuzzy models in the tasks of prognostication relationships in social groups of people. There had been described uncertainties which arise during generation of information from people on the basis of fuzzy.

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