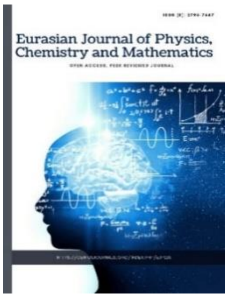

Decision Making With Fuzzy Parameters When Modeling Preferences In Biotechnological Systems

Kamolov E. R.

Senior Lecturer, Department of Mathematics and Physics
Alfraganus unversity
Tel.: +998901325895 e-mail: e.komolov@afu.uz

ABSTRACT

The modeling of preferences in biotechnological systems when making decisions with fuzzy parameters was carried out. In this case, information about the object with the help of the decision maker is described in the form of a membership function that takes its values on a set of non-negative numbers. Three groups of preference relation models are considered, such as: clear preference relations, fuzzy preference relations, linguistic preference relations.

Keywords: models of preference relations, kaolin enrichment process, modeling methods, formation of a mathematical description, models of fuzzy relations, verbal assessment of belonging, linguistic preference relations

Situational management is based on a system of semiotic models and contains means of describing, replenishing and changing situations, means of developing hypotheses about connections in situations, means of generalizing situations and separating useful generalizations from useless ones from the point of view of management. The main modes of operation of the semiotic system: the formation of a generalized model for solving a management problem and the use of the constructed model for managing an object. To formalize a model in an uncertain situation, it is necessary to create four models, the sequential interaction of which makes it possible to create conditions for the transition from describing a specific situation to determining a solution. The first model M1 (model of the structure and laws of formation of the control object) is formally represented by a dynamic situational structure (DSS), which has a vertex in which concepts can appear - sinks, where incoming concepts cease to exist; and transformation, in which the attribute characteristic of the concept changes. (13)

Sources, sinks and converters are specified by discrete automata. DSS converters have two types: informational (inputs and outputs of automatic machines) and control ones, to which control commands are sent at discrete moments in time. In the second model M2 (model of the processes of forming a generalized control model on the DSS), classes of generalized concepts are constructed for further comparison of control commands.

The model for describing situations Moc is a unique language of spatio-temporal and other relations between objects $Moc = \langle Xoc, R, \Gamma oc \rangle$, (1) where Xoc is the set of initial concepts corresponding to the characteristics of objects;

R - set of initial binary relations of a semantic nature;

Goc - rules for the formation of production concepts and relations.

The M2 model includes Mkc (a situation correlation model necessary to establish spatio-temporal and other relationships between objects in order to satisfy a given criterion):

Mkc=<Xkc, R, Гkc>, (2)

Where Xkc=Xoc,X/oc (X/oc are production concepts in the Moc model);

R- is a set of binary relations that coincide with R of the Moc model and are already pragmatic in orientation;

Гkc- is a correlation grammar represented by a system of multiplace predicates.

The M2 model includes Mob (a situation generalization model designed to divide the set of concepts formed in Mkc into classes):

]Mob=<Xob, Gob>, (3)

Where Xob is the set of concepts formed in Mkc;

Gob – generalization rules.

Mky (situation management model) is the last model included in M2:

Mky=<Kky,Гky>, (4)

Where Kky is a set of elementary control commands; Гky - rules for sequential composition of control commands.

The situational approach includes the M3 model (situation extrapolation model)

M3=<Gek, Peck(Q)>, (5)

Where Gek is a situation extrapolation grammar, which is a set of rules for the sequential transformation of situations using control commands, predicates whose applicability are generalized situations with control commands;

Pek(Q) - rules for selecting the optimal solution according to the criterion.

The latest model, M4 (the output message generation model), uses natural language terms. Situational models operate in two modes. In the M1 model building mode, a training sequence of situations and control commands is received via an external channel. In M2, the sequence in Moc is represented in a descriptive language. After working with Mkc, a set Xob is formed, which in Mob is divided into classes, each of which is assigned a specific solution from Mky during the learning process.

In control mode, situational models operate as follows. The situation recorded in M1 enters M2, in the Mkc model it is subject to the necessary truncation, and in M3 the control command to which the input situation corresponds is determined. If extrapolation is necessary, this command is sent to M1 and changes the situation. This process continues until the extrapolation interval is exhausted.(12) In the general case, several extrapolation branches are constructed, from which the most optimal one for a given criterion is selected.

A decision can be made when the goal is known. The situational approach requires presenting the goal in the form of a set of elementary solutions necessary to solve it. Moreover, the set must be complete so that, starting from any elementary set of solutions, it is always possible to build a chain of solutions that satisfies the goal.(11)

An elementary solution is represented by a triple Xi, r, Xj, where Xi and Xj are terms between which relations of action or definition are established.The triple Xi r Xj can be left- or right-determined depending on the number of objects or another group. If the number of objects of group Xi is much greater than Xj, then the elementary solution Xi r Xj is right determined based on the principle of minimizing the number of solutions. The stage of isolating elementary commands ends with compiling a list of the defining part of commands Xir for left-defined or rXj for right-defined and a list of variable commands Xi and Xj, respectively.

In the generalization model, a certain number of rules are assumed to be specified, by which the best solution is selected from the group of possible solutions obtained in the M2 model. Such rules include choosing a team with optimal mileage, maximum reliability, etc. The M3 model provides for extrapolation of situations over a given period. Let at moment t1, in situation C1, command K1ky be accepted. With its action, a change will occur in the system and event C2 will occur. Then, in accordance with the operation of the M2 model, the K2ky command will be accepted for the moment t2. Continuing this procedure until the end of the extrapolation interval, we obtain the first chain of commands. The extrapolation model must provide a mechanism for generating several such chains.

If, for example, during the operation of the M3 model, we exclude the Mob model and extrapolate from each allowed command received after the joint action of Mkc and Mky,then it is possible to construct the entire set of feasible decision chains for a given extrapolation interval. In practice, the extrapolation mechanism is built according to various heuristic rules that limit the selection of options according to various preference rules, or according to statistical modeling techniques including precise methods for searching for local extrema. When constructing models of biotechnological systems with the help of a decision maker (DM), incomplete information about an object can be described in various ways. Often this information is given in the form of a membership function that takes its values on a set of non-negative numbers. More general is the formal expression of preferences using a binary relation R, defined directly on the set of alternatives X. In this case, there are often cases when decision makers or experts find it difficult to give an unambiguous answer (yes or no) about, for example, whether alternative x is preferable to alternative y or whether alternative y is equivalent to alternative z. In such situations, pairwise compared alternatives are so poorly defined and difficult to compare that the need to make clear judgments about the objects under consideration conflicts with the high initial level of uncertainty in the decision-making problem and the “accurate” mathematical model turns out to be useless and inadequate to reality.

There is a more flexible way to formalize uncertain information when the concept of the degree of membership for any pairs (X,Y) X*Y to the (already fuzzy) relation R is introduced into the model; the function characterizes the strength of the relationship R and takes values from the interval [0,1]. Describing preferences in the form of fuzzy relationships allows you to: a) reflect the degree of confidence of the decision maker in fulfilling this preference; b) take into account qualitative information about the degree of dominance, similarity, etc., which is lost in ordinary, “clear” mathematical models.

However, one very significant limitation is imposed on models of fuzzy relations: the decision maker is required to accurately estimate the value (X,Y) for each pair of objects (X,Y) X*Y, i.e. express it as some number from [0,1]. In many situations, obtaining such accurate estimates from an expert is difficult or even impossible. Much more natural and sometimes quite sufficient for solving practical problems is a verbal assessment of the membership of an arbitrary pair (X,Y) from X*Y to the fuzzy relation R. Let us assume that in the technological process of kaolin enrichment there is a high degree of ownership (in the range of 0.8-1); average degree of membership (in the range of 0.4-0.7); low degree of membership (in the range of 0-0.3). Thus, we distinguish three groups of models of preference relations.

1. Models of clear preference relations. The expert is asked questions like “which is better – X or Y”, and the information received from him is presented in the form of a usually oriented graph, say X Y or, for example, for a finite set of alternatives X = {x1 ,x2,x3} - in the form of a matrix from 0 and 1:

	X_1	X_2	X_3
X_1	1	0	1
X_2	1	1	0
X_3	0	1	1

2. Models of fuzzy preference relations. It is assumed that the expert is able to answer the question: “To what degree is X not worse than Y?”, expressing his opinion using a certain number from the interval [0,1]. In this case, the fuzzy binary preference relation is given by a weighted graph, for example, X Y. For the above set X = {x1,x2,x3}, the fuzzy relation matrix takes the form

	X_1	X_2	X_3
X_1	1	0,3	0,6
X_2	0,9	0,7	0,3
X_3	0,2	0,6	0,8

3. Models of linguistic preference relations. In this case, the expert’s verbal answer to the question is considered how true it is that X is no worse than Y. A linguistic relation can be

characterized by a linguistically weighted graph, for example, X Y or a matrix in the cells of which linguistic truth values are constructed (table).

	X_1	X_2	X_3
X_1	Большая	Малая	Средняя
X_2	Большая	Средняя	Малая
X_3	Малая	Средняя	Большая

This verbal assessment of belonging can be interpreted as the linguistic meaning of the truth (possibility, etc.) that the compared alternatives satisfy some relations.

List Of References Used

1. Automated design of control systems. Under. ed. M. Jamshidi., C. J. Hergueta. M., Mechanical Engineering. 1989. 344 p.
2. Varfolomeev S. D. Kalyuzhny S. V. Biotechnology. Kinetic foundations of microbiological processes M. Higher school 1990, 296s
3. Anisimov S.A., Dynkin V.N., Kasovin A.D. and others. Fundamentals of technological process management. Ed. N.S. Reibman. M., Nauka, 1978, 440 p.
4. Akhmetov K.A., Bekmuratov T.F., Yakubov E.M. Automated control system for technological processes of biochemical production. Tashkent: Fan, 1977. P.60-66.
5. Akhmetov K.A., Ismailov M.A. Mathematical modeling and control of technological processes of biochemical production. Tashkent: Fan.1988.S. 96.
6. Balakirev V.S., Volodin V.M., Tsirlin A.M. Optimal control of chemical technology processes. M.: Chemistry, 1978, 384 p.
7. Bailey J., Ollis D. Fundamentals of biochemical engineering. Per. from English, in 2 parts. Part 1., M., Mir, 1989, 692 p.
8. Bailey J., Ollis D. Fundamentals of biochemical engineering. Per. from English, in 2 parts. Part 2., M., Mir, 1989, 590 p.
9. Tomashevsky V.D. Zhdanova E.F. Simulation modeling in the environment, M. Besteller.2003.416s
10. Kamolov E.R. Mathematical model of the technological process of kaolin enrichment. Young scientist. No. 27(161). S.3-7.2017
11. Kamolov E.R. The main types and types of information uncertainty characteristic of syllabic biotechnological systems. Young scientist. No. 27(161). P.33-37. 2017
12. Kamolov.E.R. “Fuzzy modeling of the process of obtaining enriched kaolin. ”, Scientific journal “Internauka”, Moscow, 2019, No. 11(93).
13. Kamolov E.R. Methodology for identifying a mathematical model. International Scientific Journal, No. 3 (79), 2020.
14. Kamolov.E.R Noanik parametli biotekhnologik tisimlarda karor kabul qilishning munosabatlar models. magazine “Problem of Informatics and Energy”, 2019 No. 3, 41-48st.