The Third International Conference "Problems of Cybernetics and Informatics"
September 6-8, 2010, Baku, Azerbaijan. Section #3 "Modeling and Identification"
www.pci2010.science.az/3/24.pdf

PRINCIPLES OF APPLYING MATHEMATICAL MODELS IN CONFLICT THEORY

Hashim Shimiyev

Baku State University, Baku, Azerbaijan
shimiyev@mail.ru

The application of mathematical methods in many fields of human activities creates great opportunities for researchers to work with new productive agents. Yet the possession of merely normal mathematics perception of human beings in their practical activities does not let them every time to resolve any applied problems successfully. It raises the question of studying the methods of the setting of mathematical problems, arising in actual practical situations.

The essence of the problem is the turning of the "actual world (globe)" into the mathematical language (mathematization), and by means of this, acquiring deeper insight into its most important specifics, as well as stating certain opinions on the future of events. The general identity of such an approach is mathematical modeling.

In a broad sense, mathematical modeling is regarded as the art (skill) of applying mathematics.

The several directions of the mathematical analyzing of conflicts are accepted as major directions:

1. Drafting universal mathematical models to resolve conflict situations
2. Application of complex systems in conflict situations
3. Conflicts in technical ergatic, exactly, "human-machine" systems
4. Drafting mathematical models in biological systems. Exactly, mathematical models in these systems for the mutual relationship of "predator and prey"
5. Optimization of human activity in conflicts

The method of mathematical modeling is largely used to research conflicts, which are the indication of relations among groups and states. It is explained by the difficulty and complexity of the experimental study of such conflicts.

The mathematical model of a conflict is considered as the system of relationships (dependencies) formed among its characteristics. The characteristics of a conflict mean parameters and variables. The parameters of the model reflect the external parameters of the conflict. Parameters are also called the weak variable characteristics of the conflict. And the variables are defined as major characteristics. The changing of these values of the conflict constitutes the main purpose of the modeling. The use of mathematical models to research conflicts dates from the mid-20^{th} century. It is very difficult to describe the exact classification of mathematical models being used in conflict resolution nowadays. Typical mathematical models being used in conflict resolution are the followings: probability distributions, the statistical research of dependencies, Markov chains, expedient action models, theoretical models and imitation models.

- Probability distributions represent the simple method of the description of variables.
- The statistical research of dependencies is the class of models, which are broadly applied to study social events. This mainly includes regression models.
- Markov chains describe such a mechanism of the distribution dynamics, where the future of a state depends merely on the current state of a conflict, but not its previous states. The major parameter of the Markov chain is the transition probability of a statistical individual (in our case, opponent) from one state to another one during fixed time. Every act (transition) brings particular win (loss). All of these constitute the total win (loss).

- Expedient action models represent the use of target functions for the analysis, prediction and planning of social processes. These models are usually described as target functions and mathematical programming problems with limitations. Nowadays, this direction is pointed towards the modeling of the expedient mutual actions of social objects, and determining the possibility of the emergence of conflicts.
- Theoretical models are considered for the logical analysis of conceptions with any content, when the measurement of major parameters and variables becomes difficult.
- Imitation models represent a class of models, which are realized as algorithms and programs for computers, and may be analyzed since they represent complex dependencies. Imitation models are the means of machine experiment. This method of modeling is used to research the development of emerging conflicts.

Describing the role of mathematics completely in the progression of many disciplines and the fields of practical activity is a problem which can not be resolved each time. After drafting the mathematical model of real life processes, this model should be simplified and then studied. It is necessary to underline, that the mathematization of disciplines should never exclude observation and experiment from the process of perception. Because they are the main components of the comprehensive and accurate studying of events and processes in the world surrounding us. Based on the views expressed above, we may conclude that, it is possible to obtain an opportunity to describe previously known experimental facts, state new compliances, forecast events and thus, manage them by the support of the advanced mathematical theory. Furthermore, the mathematization of our knowledge plays a significant role in discovering a specific mathematical apparatus providing the complete and exact description of events and processes, that interest us, besides facilitating the use of ready mathematical methods and conclusions.

And mathematical models can be divided into three main classes having close connection with each other:

1. Deterministic models. These are models being studied as equalities or inequalities describing the action of a political system. Such models are named description models.
2. Optimization models. These models resolve the problem of finding the maxima or minima of certain expressions under the circumstances described above. These expressions may be presented in algebraic or integral forms. There is specific theory, i.e. game theory dealing with optimization problems relating to conflict situations. We will primarily deal with these problems. Since optimization describes the best style of the action, these models are called normative models.
3. Probability (stochastic) models. These models are described as equalities or inequalities too. But the quality distinguishing these models from others is the existence of the notion (meaning) of possibility at this point. For example, at this point the expected value may be considered. And decision-making theory, a branch of optimization, handles with the maximization problem of the average value of utility. Thus, we also have to deal with possibility expressions and limitations within the framework of optimization problems.

References

1. Анцупов А.Я., Шипилов А.И. Конфликтология. М.: ЮНИТИ, 1999 (in Russian).
2. H.V.Shimiyev, R.T.Pashayev. Mathematical modeling and principle of system approach in conflict theory. First International Conference on Soft Computing and Computing with Words in System Analysis, Decision and Control, Antalya, Turkey, June 6-8 2001.
3. H.V.Şimiyev. Münaqişələr nəzəriyyəsində qərarlaşdırılmış optimum prinsipi. Bakı, Bilgi dərgisi, Fizika, riyaziyyat, yer elmləri, № 2, 2002 (in Azeri).