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The Concept of Mathematical Models of Economic Problems

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Annotation: The subject, its components and a brief history of the development of the discipline "Mathematical Programming". The concept of mathematical models of economic problems. The model of the task of using raw materials. The task model of the consumer basket.

Keywords: Management, enterprises, tasks, precise mathematical methods, computer technologies.

The development of modern society is characterized by an increase in the technical level, a complication of the organizational structure of production, a deepening of the social division of labor, and high demands on planning methods and economic management.

Due to the fact that currently enterprises, research institutes, industries, production associations, etc. are complex complexes uniting a large staff and equipped with sophisticated equipment, the work of an entire apparatus is required to manage enterprises. The fulfillment of such a task, in turn, leads to the widespread use of precise mathematical methods and modern computer technologies.

At the behest of time, in the middle of the twentieth century, a science called "Operations Research" arose. The reason for naming this science in this way is that it is a scientific theory that gives the basis for the management apparatus to draw the right conclusions by analyzing each of its movements (operations) to achieve the goals facing the enterprise. According to the Russian mathematician-economist L.V.Kantorovich, operations research is a branch of science that teaches the ways of proper management of production processes.

One of the main parts of the mathematical apparatus used in the study of operations is mathematical programming.

One of the main conditions for the further development of the economy is the implementation of numerical analysis in it, based on mathematical methods and new computer technologies, and making economic decisions on this basis. The science that teaches methods suitable for such tasks is mathematical programming.

Mathematical programming, like mathematics, has a long history, and its non-classical branches were formed in the 30-40 years of the twentieth century. Being one of the directions of mathematics, it mainly helps to find the best, expedient (optimal) solution to economic problems with a multivariate solution.

The components of mathematical programming are linear, nonlinear and dynamic programming. For the first time, the formulation of the linear programming problem in the form of a proposal for drawing up an optimal transportation plan that minimizes the total mileage was given by the Soviet economist A.N.Tolstoy in 1930. In 1939, L.V.Kantorovich began a systematic study of linear programming problems and the development of general methods for solving them.

In 1941, Hitchcock set a transportation task. The main method for solving linear programming problems, the simplex method, was published in 1949 by D. Danzig. In the same year, L.V.Kantorovich, together with M.K.Gavurin, developed the method of potentials, which is used in solving transport problems.

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And in 1951, the work of Kuhn and Tucker was published, which provides necessary and sufficient optimality conditions for solving nonlinear problems. In addition, B. also made a great contribution to the development of mathematical programming.Egervari, V.S.Nemchinov, A.L.Lurie, D.B.Yudin, R.Bellman, L.Ford, S.Gass and others.

The subject of mathematical programming is mathematical models describing economic processes related to an enterprise, firm, market, production association, branches of the national economy, the entire national economy, as well as methods for optimal solution of related tasks.

Mathematical models have been used in economics since ancient times. For example, one of the first models used in economics was proposed in 1758 by F.Ken's model of reproduction.

A mathematical model of an economic task is a description using mathematical formulas of the basic conditions and goals of this task.

Before solving any economic problem using mathematical programming methods, you should build a mathematical model of it; in other words, you need to express the boundary conditions and goals of this economic problem through mathematical formulas. To build a mathematical model of any problem, you should:

1. having studied the economic meaning of the task, determine its main conditions and purpose;
2. identify the unknowns in the problem;
3. express the conditions of the problem in terms of algebraic equations or inequalities;
4. Express the goal of the task through the function.

In general, the mathematical model of a mathematical programming problem has the following form:

Find the extremum of $f(x_1, x_2, \ldots, x_n)$, a function satisfying the conditions

$$g_i(x_1, x_2, \ldots, x_n) \le b_i \quad (i = 1,2,\ldots,m).$$

Here: f , g_i , — given functions, b_i — arbitrary positive numbers.

If all functions are linear, then this problem is a linear programming problem.

If any of the functions is nonlinear, then this model expresses the problem of nonlinear programming.

If the functions depend on time and the solution of the problem is considered as a multi-stage process, then this model expresses the task of dynamic programming.

Now, as an example, let's give the process of building a mathematical model of several simple economic problems.

Suppose that three types of raw materials are used for the manufacture of two types of products: S_1, S_2 and S_3.. The stocks of raw materials, the number of units of raw materials spent on the manufacture of a unit of production, as well as the amount of profit received from the sale of a unit of production are shown in Table 1.1.

T a b l I c a 1.1

Type of raw materials	Stock of raw materials	The number of units of raw materials used to manufacture a unit of production	
		P_1	P_2
S_1	20	2	5
S_2	40	8	5

S_3	30	5	6
Profit per unit of production, sum		500	400

It is necessary to draw up such a production plan in order to maximize profit during its implementation.

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