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Applications of Optimization for Problem of Energy Balance and Power Source Planning

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Abstract:. *In recent years, optimization methods have been widely and effectively applied in economics, engineering, transportation, information technology, and many other scientific disciplines. This article will systematize a real-life model that needs the help of Mathematics to solve production cost problems in business to clarify the relationship between Mathematics and practice*

Keywords: *Optimization, Optimal, Mathematical model, Power source planning*

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I. INTRODUCTION

Currently, the direction of scientific research to serve practice and solve problems arising in practice is of great interest. One of the most interested directions is the field of mathematical optimization [1-17]. When planning production and design based on optimization principles, it will save costs in terms of capital, raw materials, time and labor while increasing efficiency, productivity and quality of work. Therefore, the problem is to model real-world problems into optimization problems. Then, the results of the optimization problem will give us the most reasonable production plan in practice

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II. OPTIMIZATION PROBLEM

The general optimization problem is stated as follows:

Maximum (minimum) the function $f(x)$ with conditions:

$$g_i(x) \le b_i, \; i = \overline{1, m} \tag{1}$$

$$x \in X \subset R^n . \tag{2}$$

Inequalities in the system (1) can be replaced by equality or inequality in the opposite direction.

Then, the function $f(x)$ is called the objective function, the functions $g_i(x)$ are called the binding function. Each inequality (or equality) in the system (1) is called a binding.

Domain D = $\left\{ x \in X \,\middle|\, g_i(x) \le b_i, i = \overline{1, m} \right\}$ is called the bound domain (or acceptable domain). Each $x \in D$ is called an alternative (or an acceptable solution). An option $x^* \in D$ is the maximum (or minimum) of the objective function, it means:

$f(x^*) \ge f(x), \forall x \in D$ (with the problem of maximization)

$f(x^*) \le f(x), \forall x \in D$ (with the problem of minimization)

is called the optimal solution. Then the value of $f(x^*)$ is called the optimal value of the problem. Solving an optimization problem is finding the optimal solution x^*.

Optimization problems (are known as mathematical programming) are divided into several categories: Linear programming (the objective function and the constraint functions are linear), nonlinear programming (the objective function and the constraint functions, at least one function is nonlinear), dynamical programming (Objects are considered as multi-stage processes) …. Optimization theory has given many methods to find the optimal solution depending on each problem. However, Linear programming is a problem that is fully studied in both theory and practice because: simple linear model to be able to apply, many other programming problems (original programming, nonlinear programming) can be approximated with high accuracy by a series of linear programming problems.

III. MODEL OF OPTIMIZATION FOR THE PROBLEM OF ENERGY BALANCE AND POWER SOURCE PLANNING

The modeling process of a real-world system consists of four steps:

Step 1: Build a qualitative model for the problem. In this step, we often state the model in words, in diagrams and give the conditions to be satisfied and the goals to be achieved.

Step 2: Describe the qualitative model through mathematical language. Specifically, it is necessary to determine the objective function (the most important) and express the conditions and constraints in the form of equations and inequalities.

Step 3: Use appropriate mathematical tools to solve the problem given in step 2. Sometimes, the actual problems are large, so when solving, it is necessary to program the algorithm in an appropriate programming language. appropriate, let the computer run and output the results.

Step 4: Analyse and verify the results in step 3, then consider whether to apply the results of the model in practice.

In the energy industry, the electricity industry is very focused. When solving the problem of electrification in an area with many different energy sources, we need to choose a reasonable way to distribute the types of power plants (thermal power, hydroelectricity, solar energy, wind energy...) suitable for the region with the lowest cost. We can consider the following real problem: Develop a plan to arrange power plants into the energy system of the region, in which it is necessary to ensure: standard power value is A, predetermined peak power is B and predetermined full-year energy production is C; expenditures on capital construction do not exceed D.

Assume that the natural conditions of the area allow the survey to build any type which among *n* types of power plants. Put x_i is the number of factories of type i; a_i is the standard capacity of a factory of type *i*; b_i is the peak capacity of a factory of type *i*; c_i is the energy produced by a factory of type *i*; d_i is the expenditure on the basic construction of a factory of type *i*; f_i is the total annual energy consumption (service and control) for a factory of type *i*.

So the mathematical model of the problem becomes:

Finding the number x_i so that $L = \sum_{i=1}^{n} f_i x_i \to \min$

with conditions: $$\begin{cases} \sum_{i=1}^{n} a_i x_i \geq A ; \sum_{i=1}^{n} b_i x_i \geq B \\ \sum_{i=1}^{n} c_i x_i \geq C ; \sum_{i=1}^{n} d_i x_i \leq D \\ x_i \geq 0, i = 1..n \end{cases} .$$

Solving the above optimization problem, we can determine the optimal solution is the set $(f_1, f_2, ..., f_n)$. It is the same option that the total energy consumption of the whole year for each factory of type *i* is the least.

IV. CONCLUSION

The paper presents a method application of the optimization problem for the problem of energy balance and power source planning. This further elucidates the two-way intimate relationship between mathematics and practice and the important role of mathematics in practice. In the future, the author's follow-up studies will carry out research on optimization for the processes occurring in the engineering process.

Conflict of interest

The author declares no conflict of interest.

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