APPLICATIONS OF OPTIMIZATION FOR THE FOOD INDUSTRY

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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.

Keyword: *Optimization, optimal, mathematical model.*

1. 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 [1-15]. 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.

2. OPTIMIZATION PROBLEM

The general optimization problem is stated as follows:
Maximum (minimum) the function $f(x)$ with conditions:

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

$$x \in X \subset R^n. \quad (2)$$

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 = $\left\{x \in X \mid g_i(x) \le b_i, i = \overline{1,m}\right\}$ 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:

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

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

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.

3. MODEL OF OPTIMIZATION FOR THE FOOD INDUSTRY

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.

To see the application of the optimization problem to the food industry, we consider the problem of determining the necessary food portions for preschool children. Different foods contain different amounts of nutrients, vitamins and minerals. The nutritional needs of children of different ages are also different. If you know the nutrient content in each food and cost of each food, then the problem is: Let's determine the amount of that food to satisfy the nutritional needs of the child and spending level is at least. We are going to build a mathematical model of this real problem.

Consider n different foods, in which contains m different types of nutrients. Sign that:

- x_j is the need to use the *j*-th food in a day. Then the diet will be determined by the set $x=(x_1,x_2,...,x_n)$.
- a_{ij} is the *i*-th nutrient content (i = 1,…,m) in a unit of the *j*-th food (j = 1…n).
- b_i is the minimum daily requirement of the child's body for the *i*-th nutrient
- c_j is the *j*-th food reserve.
- d_j is the price of a unit of the *j*-th food.

Then the problem: Determining the amount of food to satisfy the nutritional needs of children and minimum spending level become the following problem:

$$d_1x_1+d_2x_2+...+d_nx_n \to \min$$

with conditions:

$$\begin{cases} a_{11}x_1+a_{12}x_2+...+a_{1n}x_n \geq b_1 \\ a_{21}x_1+a_{22}x_2+...+a_{2n}x_n \geq b_2 \\ ...... \\ a_{m1}x_1+a_{m2}x_2+...+a_{mn}x_n \geq b_m \\ 0 \leq x_j \leq c_j,\ j=1,2,...,n \end{cases}.$$

Solving the above optimization problem, we can determine the optimal solution is the set $x=(x_1,x_2,...,x_n)$. It is also determining the amount of type of food in a day to satisfy the nutritional needs of children.

4. CONCLUSIONS

The paper presents a method application of the optimization problem for the food industry. 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.

5. ACKNOWLEDGEMENT
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6. REFERENCES

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