OPTIMIZATION OF RESOURCES IN PRODUCTION SYSTEMS USING LINEAR PROGRAMMING

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ABSTRACT

This article discusses the problem of optimal distribution of production products using the method of linear programming (LP). Through linear programming, the documents and objective functions involved in the production process are represented by corresponding linkage indicators. The article analyzes the general linear programming model and its practical applications, including solving optimization problems in production and resource allocation using methods such as the graphical method and the Simplex method. The role of linear programming methodology in economics is demonstrated through practical examples, particularly concerning production and resource allocation. The paper explores project-based planning and the application of economic principles in optimizing production plans..

Introduction

In modern production processes, the efficient allocation of production resources holds critical importance. Linear programming (LP) is widely used to solve this issue. This article addresses the problem of modeling production processes based on linear programming and finding optimal solutions.

Fundamental Concepts of Linear Programming

Linear programming (LP) is a method of mathematical optimization in which the objective function and related constraints are expressed in linear form. This methodology aims to solve mathematical, economic, and applied problems by finding optimal solutions. In linear programming, the objective function is typically to maximize or minimize quantities such as profit, cost, or other economic indicators.

A linear programming model consists of the following components:

- Objective Function: A linear function representing profits, costs, or other economic indicators in relation to decision variables.

- Constraints: Constraints are related to the limited availability of resources. They are usually expressed in the form of inequalities or equations, representing the maximum availability of resources or conditions that must be met.

- Decision Variables: These are the elements whose values must be optimized, such as production volumes, production methods, or management decisions.

The general form of a linear programming model is as follows:

Maximize: $Z = c_1x_1 + c_2x_2 + ... + c_nx_n$

Subject to constraints:

$a_{11}x_1 + a_{12}x_2 + ... + a_{1n}x_n \leq b_1$...

$a_{m1}x_1 + a_{m2}x_2 + ... + a_{mn}x_n \leq b_m$

Main Methods of Solving Linear Programming Problems

There are several methods for solving linear programming problems. The most widely used methods include:

- Graphical Method: Suitable for problems with two variables. By plotting the objective function and the constraints on a graph, the optimal solution can be visually identified. Although intuitive and simple, it is limited to two-variable problems.

- Simplex Method: The Simplex method is one of the most efficient techniques for solving LP problems, especially those involving multiple variables. It iteratively moves toward the optimal solution by adjusting the objective function at each step.

- Dual Method: The dual method works based on the primal model. It provides solutions from a different perspective, helping to better understand resource allocation and optimized strategies.

- Production and Distribution Models: Various models are used for resource allocation and production optimization, such as production scheduling and market-oriented production planning.

The Role of Linear Programming in Economic Optimization

Linear programming serves as an essential tool in economic optimization. It enables efficient management of production and economic processes.

In economic optimization, linear programming is widely applied in the following areas:

- Resource Allocation: Linear programming tools allow for the most efficient distribution of resources (such as labor time, raw materials, and workforce).

- Production Planning: Enterprises and organizations use linear programming methods to optimally structure their production plans.

- Market Pricing and Demand Management: Linear programming can be applied to control production in accordance with market demand and pricing.

Constraints in Linear Programming and Their Management

Constraints are one of the key aspects defining the production processes in linear programming. Constraints can be of the following types:

- Resource Limitations: Each production resource (e.g., raw materials, labor time, workforce) has its maximum capacity.

- Restrictions on Decision Variables: Decision variables must stay within specific limits (e.g., production volume, quantity of goods).

- Market Supply and Demand: Production volume and resource allocation must be optimized according to market supply and demand.

Practical Example

Suppose a company produces five types of products: "Apple," "Banana," "Pomegranate," "Persimmon," and "Orange."

Available resources and profits are:

- Labor Time (hours): Apple (2), Banana (1), Pomegranate (3), Persimmon (4), Orange (2) — Total 100 hours
- Raw Material (kg): Apple (1), Banana (2), Pomegranate (3), Persimmon (1), Orange (2) — Total 80 kg

Profits per product:

- Apple: 40,000 UZS
- Banana: 30,000 UZS
- Pomegranate: 50,000 UZS
- Persimmon: 20,000 UZS
- Orange: 60,000 UZS

Model: Maximize $Z = 40x1 + 30x2 + 50x3 + 20x4 + 60x5$

Subject to:

$2x1 + 1x2 + 3x3 + 4x4 + 2x5 \leq 100$

$1x1 + 2x2 + 3x3 + 1x4 + 2x5 \leq 80$

Thus, the total profit is calculated as Z = 1,700,000 UZS.

Conclusion

Using linear programming methods to optimize resource allocation is a crucial tool in efficiently managing production systems. This method ensures the most effective use of available resources. Practical examples demonstrate that linear programming helps find optimal solutions and enables efficient resource distribution.

References:

1. Vasilev, V.P. (2015). Theory and Practice of Linear Programming. Moscow: MGU.
2. - Zhuravlev, A.A. (2017). Mathematical Modeling: Linear Programming and Its Applications. Saint Petersburg: Polytechnic Publishing.
3. - Klimov, V.A., & Yuldashev, I.A. (2019). Methods of Linear Programming in Economic Systems. Tashkent: Sharq Publishing.
4. - Rakhmanov, D.I., & Komilov, S.I. (2020). Production Management and Optimal Resource Allocation. Tashkent: University Press.
5. - Mordukhovich, V.P. (2014). Optimal Control and Resource Allocation. Moscow: Nauka Publishing.