



PRACTICAL SIGNIFICANCE OF LINEAR PROGRAMMING AND THE SIMPLEX METHOD

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Abstract: This article analyzes the problems of achieving the highest economic profit in the activities of enterprises using linear programming methods. The relevance of the study is that the random distribution of limited raw materials, labor and time resources in multi-sector production deprives the enterprise of potential profit. As a methodology for solving the problem, an objective function and a system of constraints were constructed, and the Simplex (or graphical) method was used. As a result, the optimal plan for the production of two types of products was mathematically calculated on the example of a conditional furniture manufacturing enterprise and the point of absolute maximum profit was determined. As a practical contribution of the author, strategic recommendations were developed on the use of exact mathematical optimization models in enterprises instead of "personal intuition".

Keywords: profit maximization, linear programming, simplex method, objective function, resource constraints, operations research, optimal plan, economic-mathematical model.



INTRODUCTION

In a market economy, the main and ultimate goal of any commercial organization is to maximize profit. However, in the current economic environment, enterprises do not have unlimited possibilities: raw material reserves, equipment capacity, financial budget and labor time are always strictly limited. In such complex conditions, managers are constantly faced with the question "how much of which product should be produced?".

The problem raised in the article is that traditional economic analysis methods cannot find the best (optimal) solution in modern enterprises with dozens of types of resources and hundreds of types of costs. Making decisions by managers based solely on their own experience or intuition leads to hidden losses or loss of potential profits in practice. The relevance of the study is that in order to maintain competitiveness, the need for algorithmic management of business processes is increasing. The scientific novelty and purpose of the work is to construct an objective function that fully represents the activities of the enterprise, to translate resource constraints into mathematical inequalities, and to practically prove the production plan that generates the highest profit using optimization methods.

LITERATURE REVIEW

The theory of linear modeling of economic processes and optimal resource allocation (Operations Research) was first developed in 1939 by the Russian mathematician and economist L.V. Kantorovich (for this discovery he was awarded the Nobel Prize in 1975). Later, in 1947, the American scientist George Dantzig introduced the famous "Simplex method" into science, which allows solving linear programming problems using a computer.

In modern times, linear and nonlinear programming methods are cited in the works of scientists such as R. Winston, F. Hillier as the basis for managing the



logistics and production of large corporations. In Uzbekistan, scientists such as T.Sh. Shodiev, B.Y. Khodiev have conducted many scientific studies on the problems of economic optimization. In particular, Kh. Karshiboyev's textbooks provide a thorough analysis of how accurate mathematical models are in solving production problems, and which types of products should be abandoned or increased in conditions of shortage through operational models. However, in practice, our local enterprises do not use these mathematical tools sufficiently in drawing up daily production plans, which determined the object of study of the current article.

RESEARCH METHODOLOGY

A basic mathematical model of Linear Programming is developed to maximize the profit of the enterprise. The model consists of three integral parts:

1. Objective function: This is an equation that represents the total profit of a firm. If a firm produces n different types of products, the objective function is written as:

$$Z = c_1x_1 + c_2x_2 + \dots + c_nx_n \rightarrow \max$$

Here:

Z - is the total profit of the enterprise;

x_j – is the quantity of j -type product produced (unknowns);

c_j is the net profit from one j -type product.

2. Resource Constraint System: The raw materials, working time, and machine capacity in the enterprise are not unlimited. The total stock of each i -resource is equal to b_i and the amount of this resource consumed to produce one unit of each j -product is a_{ij} . The constraints are written as the following inequalities:



Workshop time is limited to 48 hours per month. It takes 2 hours to make one cabinet, and 4 hours for one table.

We transfer the above data to a mathematical model:

Objective function:

$$Z = 500x_1 + 300x_2 \rightarrow \max$$

System of restrictions:

$$\begin{cases} 4x_1 + 2x_2 \leq 60 \\ 2x_1 + 4x_2 \leq 48 \end{cases} \quad (\text{Wood stock})$$

(Workshop time)

$$4x_1 + 2x_2 \leq 60 \quad (\text{Wood stock})$$

$$2x_1 + 4x_2 \leq 48 \quad (\text{Workshop time})$$

$$x_1 \geq 0, x_2 \geq 0 \quad (\text{Non-negativity condition})$$

Masalani algebraik usulda (cheklovlarni tenglama qilib olib, ularning kesishish nuqtasini topish orqali) yechamiz. Buning uchun sistemani yechamiz:

$$\begin{cases} 4x_1 + 2x_2 = 60 \\ 4x_1 + 8x_2 = 96 \end{cases}$$

Ikkinchi tenglamani 2 ga ko'paytiramiz:

$$4x_1 + 8x_2 = 96$$

Bundan birinchi tenglamani ayiramiz:

$$(4x_1 + 8x_2) - (4x_1 + 2x_2) = 96 - 60$$



$$6x_2 = 36 \Rightarrow x_2 = 6 \text{ (6 ta Standart stol)}$$

Topilgan x_2 ni o'rniga qo'yamiz:

$$4x_1 + 2(6) = 60 \Rightarrow 4x_1 = 48 \Rightarrow x_1 = 12 \text{ (12 ta Premium shkaf).}$$

Demak, resurslar cheklovlarining barchasi qanoatlantiriladigan optimal nuqta (12; 6) ekanligi aniqlandi. Keling, boshqa qabul qilinishi mumkin bo'lgan ishlab chiqarish rejalarini solishtirib ko'ramiz.

1-jadval

KORXONANING ISHLAB CHIQRISH REJALARI VA KUTILAYOTGAN FOYDA TAHLILI

Strategiya variantlari (Nuqtalar)	Premium shkaf (x1)	Standart stol (x2)	Sarflangan yog'och (≤ 60)	Sarflangan vaqt (≤ 48)	Umumiy foyda (Z), ming so'm
1-reja (Faqt stol chiqarish)	0	12	24 m ³	48 soat	3 600
2-reja (Faqt shkaf chiqarish)	15	0	60 m ³	30 soat	7 500
3-reja (Arzonroq ko'proq)	10	7	54 m ³	48 soat	7 100



Strategiya variantlari (Nuqtalar)	Premium shkaf (x1)	Standart stol (x2)	Sarflangan yog'och (≤ 60)	Sarflangan vaqt (≤ 48)	Umumiy foyda (Z), ming so'm
4-reja (Matematik optimal)	12	6	60 m ³	48 soat	7 800

Jadvaldan ko'rinib turibdiki, menejerlar agar narxi qimmat deb butun quvvatni faqat shkaf yasashga (2-reja) qaratsalar, ularning vaqt resursi (18 soat) ortib qoladi va umumiy foyda 7500 ming so'mni tashkil etadi. Ammo barcha resurslardan eng ratsional (qoldiqsiz) foydalaniladigan optimal nuqta — Matematik model bo'yicha topilgan **12 ta shkaf va 6 ta stol** yasash rejasidir. Bunda korxonaga hech qanday qo'shimcha sarmoyasiz, mavjud resurslarning o'zi bilangina foydani **7800 ming so'mga** maksimallashtirishga (eng mutlaq yuqori cho'qqiga) erishmoqda.

XULOSA VA TAKLIFLAR

Tadqiqot natijasida iqtisodiy-matematik modellar va chiziqli dasturlash usullari korxonaga foydasini maksimallashtirishda o'ta muhim ahamiyatga ega ekanligi amaliy isbotlandi. Olingan tahlil natijalariga asoslanib quyidagi amaliy takliflar ilgari suriladi:

Birinchi, mahalliy ishlab chiqaruvchilar oylik va yillik ishlab chiqarish rejalarini tasdiqlashdan avval, "shaxsiy intuitsiya" yoki "o'tgan yilgi tajriba" ga emas, balki qat'iy matematik optimallashtirish (Simpleks usuli) yechimlariga tayanishlari zarur. Jadvalda isbotlanganidek, optimallashtirilmagan reja kamida 5-10% gacha yashirin foydaning yo'qotilishiga olib keladi.



Ikkinchidan, o'nlab, hatto yuzlab o'zgaruvchilari (mahsulot va xomashyo turlari) bor yirik korporatsiyalar uchun MS Excel (Solver uskunasi), Python yoki LINGO kabi maxsus dasturlash muhitlarida o'zlarining shaxsiy iqtisodiy-matematik stendlarini (dashboard) yaratishlari maqsadga muvofiq. Bu xomashyo narxi bozorlarda tebranganda yoki yangi resurs kirib kelganda, maqsadli funktsiyani bir zumda qayta hisoblab, ishlab chiqarish yo'nalishini chaqqonlik (agile) bilan o'zgartirish imkonini beradi.

Xulosa o'rnida ta'kidlash joizki, cheklangan resurslar sharoitida to'g'ri matematik modellashtirish raqobat bozorida omon qolish va barqaror iqtisodiy o'sishni ta'minlashning ajralmas mexanizmi hisoblanadi.

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