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USE OF MATHEMATICAL SOFTWARE PACKAGES IN SOLVING LINEAR PROGRAMMING PROBLEMS

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Abstract
This article discusses some of the ways to solve the optimization problem with the help of modern computer technology. Powered objective job and its steps of the solution with the help of Excel and Mathcad.

Keywords: optimization target function, the minimum value, maximum value, linear programming.

Introduction

A very wide class of problems consists of optimization problems or, as they are also called, extremal problems. Typically, solving them involves a lot of calculations, making them difficult to solve manually. In optimization problems, it is required to find the values of parameters or functions that realize the maximum or minimum of some quantity dependent on them, for example:

$$z=f(x_1, x_2, \dots, x_n) \quad (1)$$

often under additional conditions-inequalities:

$$\varphi_i (x_1, x_2, \dots, x_n) \leq 0 \; (i=1,2,\dots,m) \quad (2)$$

The restaurant prepares three types of signature dishes (Dish A, Dish B and Dish C) using three types of ingredients (Ingredient 1, Ingredient 2 and Ingredient 3). The consumption of ingredients in grams per dish is given by the following table:

Ingredient type	Dish A	Dish B	Dish C	Daily receipts
Ingredient 1	20	50	10	5000
Ingredient 2	20	0	40	4000
Ingredient 3	20	10	10	4000

Every day the restaurant receives 5 kg of ingredient 1 and 4 kg of ingredients of types 2 and 3. What is the optimal ratio of daily production of dishes of various types if the production capacity of the restaurant allows the use of the entire stock of incoming products?

Solution: To solve the problem, we introduce the following notation: let x_1, be the daily output of dish A; x_2 – daily release of dish B; x_3 – daily release of dish C. Let’s create an objective function – it consists in the cost of dishes released by the restaurant: $Z=100\, x_1+200\, x_2+300\, x_3$

Let's determine the existing restrictions (guided by the table):

1. $20\, x_1+50\, x_2+10\, x_3 \leq 5000$;

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2. $20\ x_1 + 0\ x_2 + 40\ x_3 \leq 4000$;
3. $20\ x_1 + 10\ x_2 + 10\ x_3 \leq 4000$.

In addition, since it is impossible to sell part of a dish and the number of dishes cannot be negative. Now you can start solving the problem on your computer. Open a new worksheet (Insert ► Sheet).

1. In cells A2, A3 and A4, enter the daily supply of products - the numbers 5000, 4000 and 4000, respectively.
2. In cells C1, D1 and El, enter the initial values of the unknowns x1, x2 and x3 (zeros) - in the future, the values of these cells will be selected automatically.
3. In the cells of the range C2:E4 we will place a table of ingredients consumption.
4. В ячейках B2:B4 укажем формулы для расчета расхода ингредиентов по видам. В ячейке B2 формула будет иметь вид *=$C$1*C2 + $D$1*D2 + $E$1*E2,* а остальные формулы можно получить методом автозаполнения (копирования).
5. In cells B2:B4 we indicate formulas for calculating the consumption of ingredients by type. In cell B2, the formula will look like *=$C$1*C2 + $D$1*D2 + $E$1*E2*, and the rest of the formulas can be obtained by autofilling (copying).
6. In cell Fl, enter the objective function formula =100*(C1 + D1 + E1). The result of entering data into the worksheet is shown in Fig. 1.

Fig. 1. Result of data entry

	A	B	C	D	E	F
1			0	0	0	0
2	5000	0	20	50	10	
3	4000	0	20	0	40	
4	4000	0	20	10	10	
5						

7. Give the command Tools ► Search for a solution – the “Search for a solution” dialog box will open.
8. In the Set target cell with the mouse field, select the cell containing the value to be optimized (F1) (Fig. 2). Set the Equal switch to the maximum value position.
9. In the field Changing cells with the mouse, we will set the range of selected parameters (unknown *x{*) - C1:E1.
10. To define a set of restrictions, click on the Add button. In the Add Constraint dialog box, in the Cell Link field, use the mouse to specify the range B2:B4. As a condition, set the range B2:B4 in the Limit by mouse field. This condition indicates that the daily consumption of ingredients should not exceed reserves.

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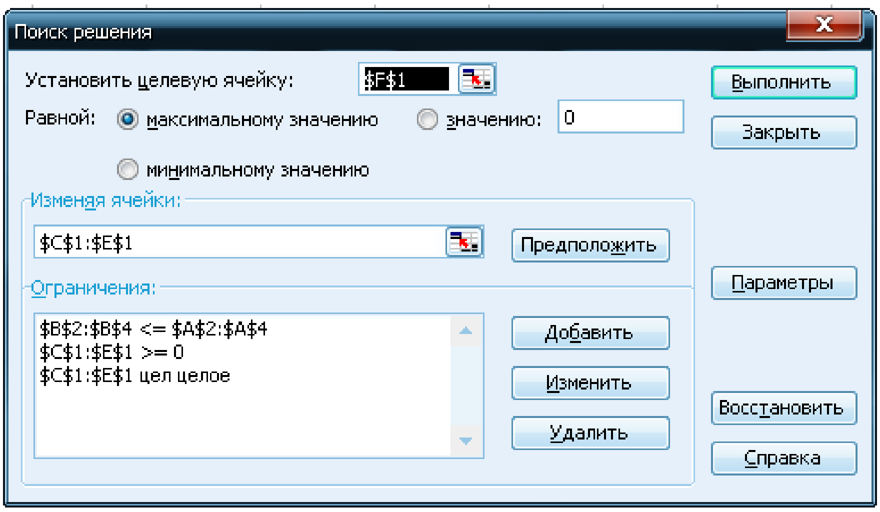

Fig.2. Example of filling out the "Search for a solution" dialog box

11. Click on the Add button again. In the Cell Link field, indicate the range *C1:E1*. As a condition, set the number 0 in the Limit field. This condition indicates that the number of dishes to be prepared is non-negative. Click on the *OK* button.
12. Click on the Add button again. In the Cell Link field, indicate the range C1:E1. As a condition, select the target item. This condition does not allow the production of dish shares. Click on the OK and Execute button. When optimization is complete, the Solution Search Results dialog box opens.

Set the Parameter values switch to Save the solution found, and then click the OK button.

The result will be an optimal set of variables (the optimal number of signature dishes to be prepared) under these restrictions (with a given number of ingredients): dish A - 0 servings (x1), dish B - 80 servings (x2) and dish C - 100 servings (x3). In this case, the total cost of dishes (Z) will be maximum and equal to 46,000 rubles. (Fig. 5).

	A	B	C	D	E	F
1			0,00	80,00	100,00	46000
2	5000	5000	20	50	10	
3	4000	4000	20	0	40	
4	4000	1800	20	10	10	

Fig.5. Calculation result from the example

Today, this problem can be solved using the Mathcad application package. To solve linear programming problems in Mathcad, you can use the maximize and minimize functions. This process is developed in the following steps:

1. The target function will be written: f(x,y)=<type of function>.
2. The Given keyword is written.
3. A system of inequalities and restrictions is introduced.
4. The maximize or minimize functions are sent to some new variable.
5. Variable := the solution to the problem is obtained.
6. To calculate the value of the objective function you need to enter f(p0,p1):= .

In conclusion, we can say that today we can use modern software to solve economic problems. They all provide the opportunity to achieve results in different ways.

The above results show that the two methods are effective and this shows that they can be implemented in various types of linear programming.

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