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SOLVE A LINEAR PROGRAMMING PROBLEM IN MICROSOFT EXCEL USING THE SOLUTION SEARCH MODULE

SHONAZAROV SOATMURAT QULMURODOVICH
Teacher, Department of Applied Mathematics and Informatics, Termez State University,
E-mail: sshon1989@mail.ru

BOZOROV ASQAR KHAITMUROTOVICH
Teacher, Department of Applied Mathematics and Informatics, Termez State University,
E-mail:asqarbozorov1990@gmail.com

ABSTRACT:

Having studied the algorithms for "manual" solution of linear programming problems, it is useful to get acquainted with a way to simplify this process. It is clear that the more difficult the task, the more variables and conditions it contains, the more tedious and longer it takes to solve it. In such cases, it is convenient to use special mathematical packages, or the MS Excel program available to many. The standard way to solve a linear programming problem is to create a product in MS Excel using the Search for Solutions application. The most optimal solution for solving this problem is a very effective method that has been developed and used.

KEYWORDS: Linear model, daily profit, Search for a solution, Objective function, Solution Search Results, Optimal production plan

INTRODUCTION:

If in any system (economic, organizational, military, etc.) there are not enough available resources for the effective implementation of each of the planned works, then the so-called distribution tasks arise. The goal of solving the distribution problem is to find the optimal distribution of resources for jobs. Optimal allocation can mean, for example, minimizing the total costs associated with performing work, or maximizing the resulting total income.

To solve such problems, methods of mathematical programming are used. Mathematical programming is a branch of mathematics that develops methods for finding the extreme values of a function whose arguments are constrained. The word "programming" is borrowed from foreign literature, where it is used in the sense of "planning".

The simplest and best studied among the problems of mathematical programming are linear programming problems.

MS Excel contains the "Search for a solution" module that allows you to search for optimal solutions, including solving linear, integer, nonlinear and stochastic programming problems.

MAIN PART:

The standard method for solving a linear programming problem is the so-called simplex method. If the number of variables is not very large, you can use the Add-in “Search for a solution” from MS Excel (see 2.5 above)

TYPICAL TASK:

The workshop can produce two types of products: cabinets and TV stands. Each cabinet consumes 3.5 m of standard chipboard, 1 m of front glass and 1 man-day of labor. For the curbstone -1m chipboard, 2 m glass and 1 man-

day of labor. Profit from the sale of 1 cabinet is 200 USD. e., and 1 pedestal -100 e. Material and labor resources are limited: 150 workers work in the workshop, more than 350 m of chipboard and more than 240 m of glass cannot be consumed per day. How many cabinets and cabinets should a shop produce to maximize profits?

Decision variables	**Objective function**
x_1 - number of cabinets x_2 - the number of pedestals produced daily	$P = 200x_1 + 100x_2 \rightarrow max$ Workshop daily profit
Limitations	
$\begin{cases} 3{,}5x_1 + x_2 \leq 350 \\ x_1 + 2x_2 \leq 240 \\ x_1 + x_2 \leq 150 \end{cases}$	

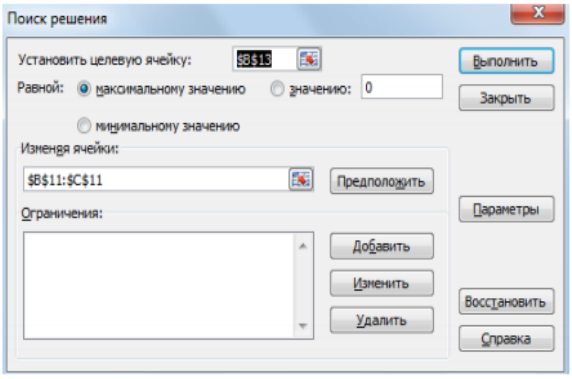
DECISION:

Let's formalize the problem (we will make a mathematical model of this situation).

2. We organize the data on the MS-Excel sheet as shown in Fig:

	A	B	C	D	E
1	Оптимальный план производства мебельного цеха.				
2					
3		Расход ресурса на 1 ед. прод.			
4	Ресурс	Шкафы	Тумбы	Запасы	
5	ДСП	3,5	1	350	
6	Стекло	1	2	240	
7	Чел/дни	1	1	150	
8	Прибыль от продажи ед. прод.	200	100		
9					
10	План производства	X1	X2		
11					
12					
13	Прибыль	=СУММПРОИЗВ(B8:C8;B11:C11)			
14					
15	Ограничения	Расход ресурса	Вид неравенства	Запас ресурса	
16	ДСП	=B5*B11+C5*C11	<=	=D5	
17	Стекло	=B6*B11+C6*C11	<=	=D6	
18	Чел/дни	=B7*B11+C7*C11	<=	=D7	
19					
20					
21					
22					

3. Select the menu item "Service" "Search for a solution". A window will appear entitled Finding a Solution:

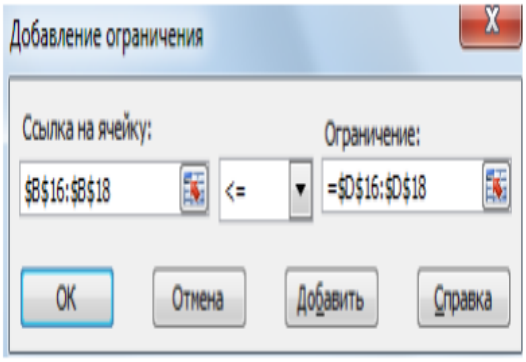


a) In the window field "Set target cell" mark the cell B13;

b) Set the switch to "Equal to maximum value";

c) In the field of the window "Changing cells" mark cells B11: C11;

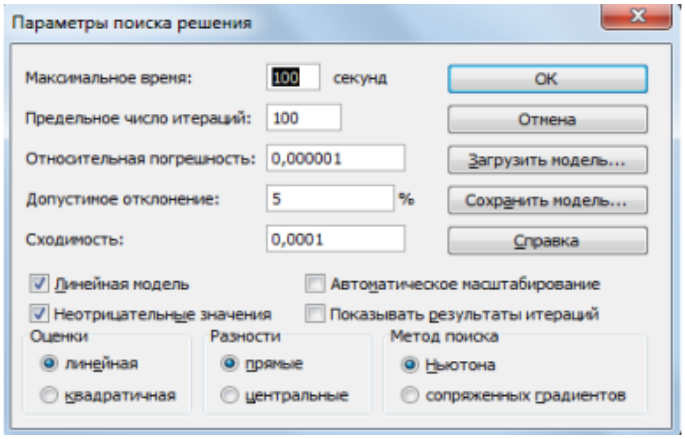
d) Add restrictions by clicking on the "Add" button.



In the "Add restriction" window that appears, click in the "Cell reference" field, and then mark cells B16: B18, select the restriction sign and mark cells D16: D18 containing resource restrictions.

4. Click on the "Options" button:

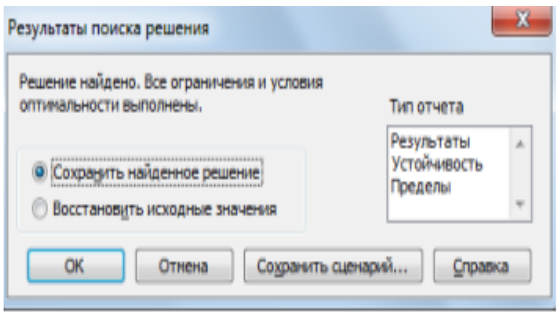
The Solution Search Options window appears, allowing you to (but not necessary) to change numerous parameters.



We are interested in whether the checkboxes "Linear model" and "Non-negative values" are checked (constraints x1, x2 ≥ 0 are set here). If not, install them, click on the Ok button and return to the "Search for a solution" window.

5. Click on the "Run" button:

The MS-Excel optimization program searches for a solution, and then the "Solution Search Results" window appears.



Read the program message in this window. If everything is done correctly, the program will report: "The solution has been found. All constraints and optimality conditions have been met." The MS-Excel sheet view corresponding to the optimal solution is shown in Fig.

	A	B	C	D	E
1	Оптимальный план производства мебельного цеха.				
2					
3		Расход ресурса на 1 ед. прод.			
4	Ресурс	Шкафы	Тумбы	Запасы	
5	ДСП	3,5	1	350	
6	Стекло	1	2	240	
7	Чел/дни	1	1	150	
8	Прибыль от продажи ед.	200	100		
9					
10	План производс	X1	X2		
11		80	70		
12					
13	Прибыль	23000			
14					
15	Ограничения	Расход ресурса	Вид неравен	Запас ресурса	
16	ДСП	350	<=	350	
17	Стекло	220	<=	240	
18	Чел/дни	150	<=	150	
19					

RESULTS AND DISCUSSION:

Make sure that the radio button in the "Solution search results" window is in the "Save found value" position, click on the Ok button and read the answer in cells B11: C11. Cells D16: D18 contain the resource values that are required to obtain the optimal plan.

If you incorrectly set the sign of restrictions, entered incorrect formulas for the objective function or for the restrictions and the optimization program cannot find a solution, the following messages will appear in the window:

“Target cell values do not converge” or
"Search cannot find a solution" or
"The conditions of the linear model are not met."
Answer. In the production of 80 cabinets and 70 cabinets per day, the maximum profit is reached, equal to 23,000 USD.

CONCLUSIONS:

The program will select the optimal solution and show it in the required cells, calculate the value of the objective function. If necessary, you can build reports to analyze the solution to the problem.

All these stages with explanations and screenshots are discussed in more detail below

in examples on different linear programming problems - study, look for similar ones, solve.

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