

Subscribe to DeepL Pro to edit this document.  
Visit [www.DeepL.com/pro](https://www.deepl.com/pro?cta=edit-document) for more information.

**Problem 1. (optimal utilization of resources).**

The factory has a certain amount of resources at its disposal: labor (80 people/day), raw materials (480 кг ) and equipment (130 machines/hour). The factory can produce four types of carpets. It is required to find such an output plan, at which the total cost of production will be maximized if the consumption rates and unit price for each type of product are given in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Resources | Resource consumption rates per unit of product | | | | Availability of resources |
| "Winter" rug | The Fairy Tale rug | Silhouette rug | "Smoky" rug |
| Labor | 7 | 2 | 2 | 6 | 80 |
| Raw materials | 5 | 8 | 4 | 3 | 480 |
| Equipment | 2 | 4 | 1 | 8 | 130 |
| Price per unit of product (thousand rubles) | 3 | 4 | 3 | 1 |  |

I. Formulate an economic-mathematical model of the problem and, using *Solution Search*, find the optimal output plan at which the total cost of production will be maximized.

II. Using the *Solution Search* protocols, analyze the obtained optimal solution to the original problem:

1. Are all types of carpets profitable to produce?
2. Analyze the use of resources in the optimal plan.

III. Analyze the obtained solution for sensitivity.

**1. The first objective of the sensitivity analysis is:** by how much can resource stocks be reduced or increased?

1. By how much can the stock of some resource be reduced while maintaining the obtained optimal value of the target function.
2. By how much can the stock of some resource be increased to improve the obtained optimal value of the target function.
3. How will the total cost and output plan change when the stock of the resource "labor" is increased by 12 units.
4. Try changing the resource constraints so that all resources become scarce.

**2. The second objective of the sensitivity analysis is: an** increase in which resource is most beneficial?

1. Find out the value of an additional unit of each type of resource.
2. Let the cost of additional labor 1100 rubles/day, and the cost of an additional hour of equipment 50 rubles. Increase of which resource will be economically advantageous to get more profit.
3. Will it be economically feasible to increase the equipment operating time if the cost of an additional hour of equipment operation is 350 rubles.

**3. the third task of sensitivity analysis:** within what limits is it acceptable to change the coefficients of the target function? (The coefficients of the target function are determined by prices for finished products).

1. Determine the interval of change in the profit from the sale of each model of carpet in which the optimal solution remains unchanged (you need to determine the range of change (increase or decrease) of one or another coefficient of the target function).
2. How much will profits decrease if, despite the optimal solution, one carpet of the first type is included in the plan? The same question if the plan includes a fourth type of carpet.

Use the sustainability report to answer the questions

**Task 2.**

The company manufactures three models of electronic relays. Each model requires two assembly stages. The time (in min.) required for assembly at each stage is given in the table below.

|  |  |  |
| --- | --- | --- |
| Product | Stage 1 | Stage 2 |
| Model *A* | 2,5 | 2,0 |
| Model *B* | 1,8 | 1,6 |
| Model *C* | 2,0 | 2,2 |
| Resource | 450 | 450 |

The equipment at each stage runs 7.5 hours per day. The manager wants to maximize profit for the next 5 working days. Model *A* yields a profit of 82.5 rubles per unit; model *B,* 70.0 rubles; model *C,* 78.0 rubles. The firm can sell everything it produces and, in addition, it has a paid order for 60 pieces of products (20 pieces of each type of device) for the next week.

1. What should be the optimal production plan?
2. Are all types of models profitable to produce?
3. If there is an unprofitable model, what changes must be made to make its production profitable?
4. Try to change something in pricing or increase equipment hours (through overtime) so that all models become profitable.
5. Suppose you can set 2 overtime hours for one of the stages. Which stage should you assign these overtime hours to in order to get the most profit?

Use the sustainability report to answer questions 3 and 4