

IE310 Operations Research

solution

Assignment 1:

1. Problem 2.4

Yes, it is meaningful. In each week, 20.5 standard cars are produced (the remaining 0.5 car can be continued next week); 29.75 fancy car are produced (so every four weeks three full car can be produced); 0 luxury car can be produced.

2. Problem 2.7

a.

Shop	Capacity	Making times	
		Cabinet	Table
Carpentry	120	20	10
Finishing	80	15	10
Contribution		\$800	\$500

b.

Decision variable:

x_1 : cabinet produced per week

x_2 : table produced per week

max

$$800x_1 + 500x_2$$

such that

$$20x_1 + 10x_2 \leq 120$$

$$15x_1 + 10x_2 \leq 80$$

$$x_1 \geq 0$$

$$x_2 \geq 0$$

c.

Starting from Page 31, Following step 1 to step 4 (you may also see the attached excel file): optimal solution is to produce 5.33 cabinets per week, 0 table per week, with profit \$4266.67.

Note that the the second constraints is tight (all finishing shop capacity is used) and the cabinet requires 1.5 times longer to finish. However, the cabinet gives 1.6 times the profit that table gives, so we choose to only produce cabinet. The solution is also meaningful since we could continue the production in the following weeks to finish the remaining part of a cabinet. In case an integer solution is required, we could solve the Integer Program (define x_1 x_2 to be integers) to get a solution.

Another way to explain is to see from Fig.1. The optimal solution is a vertex of the feasible region (we move the objective function line in parallel and it intersects with the feasible region at one point. Note that objective function line is a line where the objective function has the same value (an indifference curve), i.e., the same objective is obtained on any point of the objective function line).

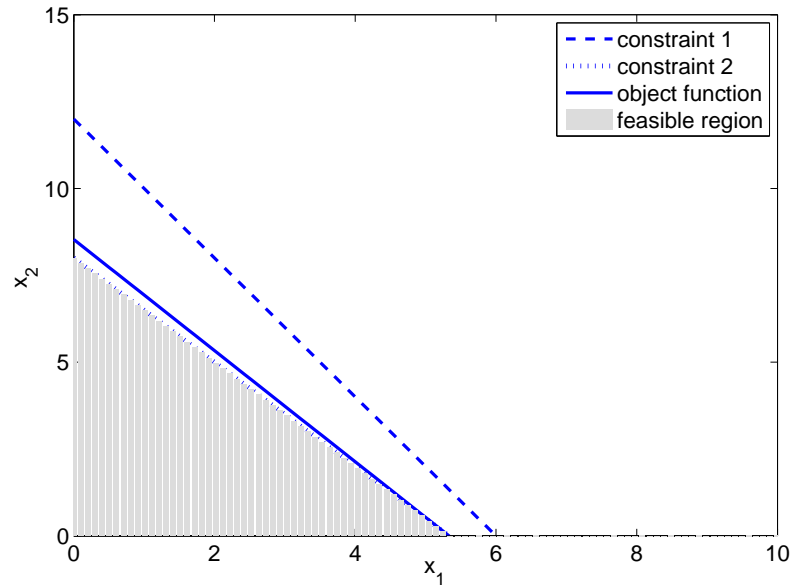


Fig. 1: Graphical Interpretation

d.

Optimal:

$$x_1 = 5, x_2 = 2, obj = \$5000$$

Changed! See excel file.

It is surprising because we need less time for cabinet, which is more profitable, but fewer cabinets will be produced now.

3. Problem Additional

You don't need to come up with a complicated model to include everything. But you need to address the model clearly enough.

Data Inputs:

the number of classes to open (e.g. 3 classes)

the periods to choose (e.g. we have 3 periods, period1 = Monday+Wed, period2 = Tuesday + Thursday, period3 = Friday), any two periods don't overlap

the set of periods that each course may choose (e.g. class1 can choose from period1 or period2, class2 can only choose period2, class3 can choose

to happen in any of the three periods)

Decision Variable:

the period to choose for each class (we can use binary variables, e.g. $x_{ij} = 1$ means class i happen in period j , $x_{ij} = 0$ otherwise)

Constraints:

Each class can only choose to happen in one permitted period. In our example, they are

$$x_{11} + x_{12} = 1$$

$$x_{22} = 1$$

$$x_{31} + x_{32} + x_{33} = 1$$

Objective:

To minimize the number of conflicted class. In our example, we are to minimize

$$\max\left\{\sum_{i=1}^3 x_{i1} - 1, 0\right\} + \max\left\{\sum_{i=1}^3 x_{i2} - 1, 0\right\} + \max\left\{\sum_{i=1}^3 x_{i3} - 1, 0\right\}$$