

Assignment 1

INDU 323 Operations Research I
Winter 2024

Note:

- If your model does not run, you won't receive any marks.
- An answer without justification in the code will not be accepted.
- You have to submit at least one notebook containing all the code to answer all the questions. You can write the answers to the questions inside that notebook. Please note that the marker should be able to run the model to see the solution for each question easily, i.e., he or she shouldn't be changing values in your code to run it.

Problem

Tired of constantly losing money, the *Powerful of the Mountain* company decides to call in an expert to help them design a daily production plan that will maximize their profits.

The company manufactures three types of pencils: red, blue, and white. Each pencil must go through two different processes before it is ready to be sold. The relevant information is presented in the table below:

Color	processing time 1 (min/unit)	processing time 2 (min/unit)	Profit (\$/unit)
Red	0.8	1.8	1.9
Blue	1.3	0.5	1.1
White	1.1	1.3	2.8

Now, the company has two machines, one for each process, with some restrictions. First, they can only be used for a limited amount of time per day. Additionally, there is a constraint on the number of white pencils that can be processed due to a specific chemical used only for that product. This information is summarized in the table below:

Machine	time capacity (hours/day)	capacity to process white pencils (units/day)
1	6.5	150
2	5.8	220

Assuming that:

- Process 2 cannot start until all pencils have finished process 1. However, there is no time wasted between the end of process 1 and the beginning of process 2.
- The production plant operates from 8:00 to 17:00.
- It is possible to produce incomplete pencils.

Using the tools presented during the lab, code the mathematical model to solve this problem and answer the following questions. Note that marks will be reduced if the mathematical model itself doesn't make sense. Extra marks can be awarded for adding the right – theoretical- comment to the right constraint (three options – hints from the duals).

Questions

1. What is the optimal production plan and what is the profit for that solution? If needed, round up to 2 decimals.
2. An increase in the demand for blue pencils raised its profit by 30%. Please answer the questions of point 1 once again. If needed, round up to 2 decimals.
3. With the profit in point 1 for blue pencils, calculate the dual variables. Please explain the meaning of the results.
4. Since green is the best color in the world, the company wants to see if it is a good idea to include that pencil in their production. Assuming that all the capacities remain the same and that the parameters are as follows, please explain what would be your advice to the company's CEO. For blue pencils, use the profit of point 1.

Color	processing time 1 (min/unit)	processing time 2 (min/unit)	Profit (\$/unit)
Green	0.7	1.2	0.4