

Indian Institute of Technology, Kharagpur
Department of Industrial & Systems Engineering

Spring 2022-23
IM29204: Operations Research Laboratory
L-T-P : 0-0-3, Credits - 2

Lab Assignment – 5

Maximum Marks: 10

Instructions:

1. Attempt **all Questions**.
 2. All questions carry **equal** marks.
 3. Assume any missing data suitably and state all your assumptions clearly.
 4. You need to make this submission via **MS teams**.
 5. The usage of **mobile phones** and **internet** during the lab hours is **strictly prohibited** unless specially instructed.
 6. Write your name and roll number inside the file. Name your file as: Your Roll No_Name. For example, if your Roll No. is 10IM9999 and your name is Ravi, then you should name your file as: **10IM9999_Ravi**
 7. Submission Deadline – The file must be submitted during the lab hours. **Assignments submitted after due date and time will NOT be evaluated.**
 8. Do not submit multiple files for same assignment. In case of multiple files compress them in one “.zip” file and then submit.
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Problem 1. Consider selecting doctors for various clinics located at different geographical locations. A doctor may or may not be available for a given clinic, depending on her/his availability. In addition, each doctor can be hired for a consultancy cost that also depends on her/his qualifications. The problem consists of selecting a set of doctors for various clinics, while minimizing the total consultancy cost. The key idea in modeling this problem is to associate a 0/1 variable with each doctor to represent whether the doctor is hired. To make sure that all the clinics meet their requirement, it is sufficient to choose at least one doctor per clinic. Formulate this integer programming problem and find the optimal set of doctors that should be selected to meet the requirements of clinics in order to minimize the consultancy cost using CPLEX-OPL.

- a) Create model (.mod) and data (.dat) files to solve the above problem on CPLEX-OPL.
- b) Find the optimal solution and the corresponding best objective function value.
- c) Display the solution into ‘Scripting log’ in the following format:

Doctors= {<X> <X>.....<X>}

Use the following data for above Problem 1.

Number of doctors = 25

Clinics = {Hijli, Kalaikunda, IIT Kharagpur, Medinipur, Prem Bazar, Kharagpur Railway Station, Malancha, Gol Bazar, Gate Bazar, Inda}

Consultancy Cost = [2, 2, 1, 1, 3, 1, 2, 4, 2, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, 4, 4, 5, 5, 7]

| Doctors | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Hijli | ✓ | | | | | | | | ✓ | | | | | | | | | | ✓ | | | ✓ | | | |
| Kalaikunda | | ✓ | | | | | | | | | | ✓ | | | ✓ | | | | ✓ | | ✓ | | ✓ | | |
| IIT Kharagpur | | | ✓ | | | | | | | ✓ | | | | | | | | | ✓ | | | | | ✓ | |
| Medinipur | | | | ✓ | | | | | | | | | | | | | | | | ✓ | | | | | ✓ |
| Prem Bazar | | | | | ✓ | | | | | | ✓ | | | | | ✓ | | | | | | ✓ | ✓ | | |
| Kharagpur Railway Station | | | | | | ✓ | | | | | | | | | | | | | | ✓ | | | | ✓ | |
| Malancha | | | | | | | ✓ | | | | | ✓ | | | | | ✓ | | | | | | | | ✓ |
| Gol Bazar | | | | | | | | ✓ | | | | | | | | | ✓ | | | ✓ | | ✓ | ✓ | | |
| Gate Bazar | | | | | | | | | ✓ | | | | ✓ | ✓ | | | | | | | | | | | |
| Inda | | | | | | | | | | ✓ | | | | | | | | | | | ✓ | | | | ✓ |

‘✓’: signifies the availability of a particular doctor for a given clinic.

Problem 2. A wood company manufactures table, chair, door, window. Each product requires a number of hours of labor and a certain amount of wood, and the company has a limited capacity of both. In addition, all of these products can be manufactured only by renting an appropriate machine. The profit on the products (excluding the cost of renting the machine) are also known. Formulate this integer programming problem and find the optimal production quantity for each product and appropriate machines that should be selected in order to maximize the profit using CPLEX-OPL.

- Create model (.mod) and data (.dat) files to solve the above problem on CPLEX-OPL.
- Find the optimal solution and the corresponding best objective function value.

Use the following data for above Problem 2.

| | | | | |
|-------------------------------|--------|--------|-------|---------|
| Products: | Table | chair | door | window |
| Machines: | Mtable | Mchair | Mdoor | Mwindow |
| Rent cost of machines: | 100 | 150 | 200 | 250 |
| Profit: | 7 | 8 | 7 | 9 |

Capacity:

| | | |
|-------------------|-------|------|
| Resources: | Labor | Wood |
| Capacity: | 180 | 170 |

Requirement:

| | | | | |
|--------------|---------------|---------------|--------------|----------------|
| | Mtable | Mchair | Mdoor | Mwindow |
| Labor | 4 | 3 | 7 | 5 |
| Wood | 6 | 5 | 3 | 6 |