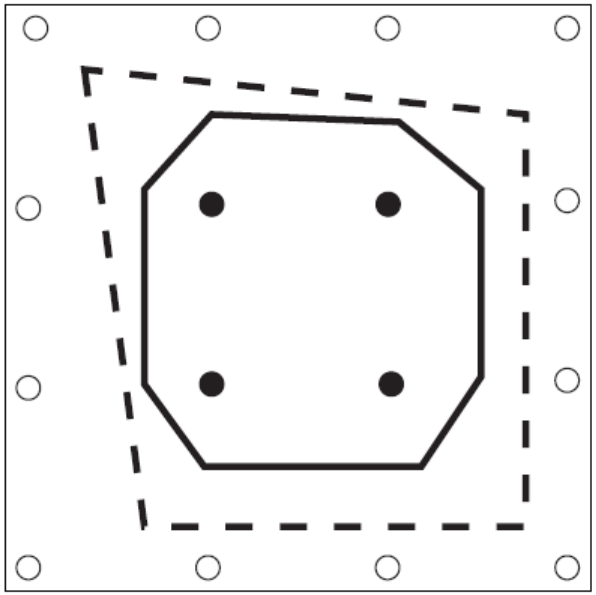
Optimization

Lecture 7.2

M.EIC - 2021.2022



Linear Programming

INTEGER AND MIXED INTEGER LINEAR EXERCISES

Exercise 1

Consider a budget allocation problem where $30 million is available for a number of projects listed below. The investment required in each project along with the expected return in terms of utility is also given.

Project Name	Project Cost ($ million)	Expected Utility
1. After school program	6	18
2 Road security	18	16
3 Crime reduction	10	12
4 Road extension	9	25
5. Child care facility	4	14

i. The problem is to find which projects should be financed in order to maximize the total expected utility not exceeding the budget limitation.

ii. Now suppose there are additional conditions in selecting the projects. Write the constraints for these conditions.
   - Any two of the first four projects must be undertaken.
   - Projects 1 and 3 must be taken simultaneously or not taken at all.
   - Project 1 will be undertaken only if project 5 is undertaken but project 5 is not conditional on project 1 (that means, you can have project 5 without project 1, but you cannot have project 1 unless project 5 is undertaken).

Exercise 2

- A certain paint can be produced using four different production processes. The processing cost of each litre in any of the four available processes, the maximum capacity of each process, and the set-up costs are given below.

Process	Set-up Cost ($)	Processing Cost($/litre)	Capacity (litre)
P1	5000	0.6	20000
P2	6000	0.5	15000
P3	10000	0.4	40000
P4	6000	0.3	25000

- Assume that a daily demand of 45000 litres must be fulfilled.
- Formulate the problem as an integer programming model to determine the daily production schedule in order to minimize total costs.

Exercise 3

Consider the following mathematical programming model.
Minimize Z = 3x1 – 2x2 + 4x3
Subject to:

$x1 + 2x2 + 4x3 \geq 22$ (1)
$2x1 + 3x2 - x3 \geq 20$ (2)
$3x1 + x2 + 2x3 \geq 18$ (3)
$2x1 - x2 + 3x3 \geq 17$ (4)

Use integer programming techniques to express the following:
i. At least three of the constraints must hold.
ii. No more than any single constraint must hold.
iii. No more than any two constraints must hold.