Unit- IV

- Constrained optimization techniques –lagrangian Constrained optimization-application to utility maximization –linear- programming –graphical method and simplex method

Meaning

- **constrained optimization** (in some contexts called **constraint optimization**) is the process of optimizing an objective function with respect to some variables in the presence of constraints on those variables.
- **Constrained optimization problems** are **problems** for which a function is to be minimized or maximized subject to **constraints**
- **Constrained optimization models** have **three major components**: decision variables, objective function, and **constraints**.

Meaning

- In mathematics, computer science and economics, an **optimization problem** is the problem of finding the *best* solution from all feasible solutions.
- Optimization problems can be divided into two categories, depending on whether the variables are continuous or discrete:
- An optimization problem with discrete variables is known as a *discrete optimization*, in which an object such as an integer, permutation or graph must be found from a countable set.
- A problem with continuous variables is known as a *continuous optimization*, in which an optimal value from a continuous function must be found. They can include constrained problems and multimodal problems.

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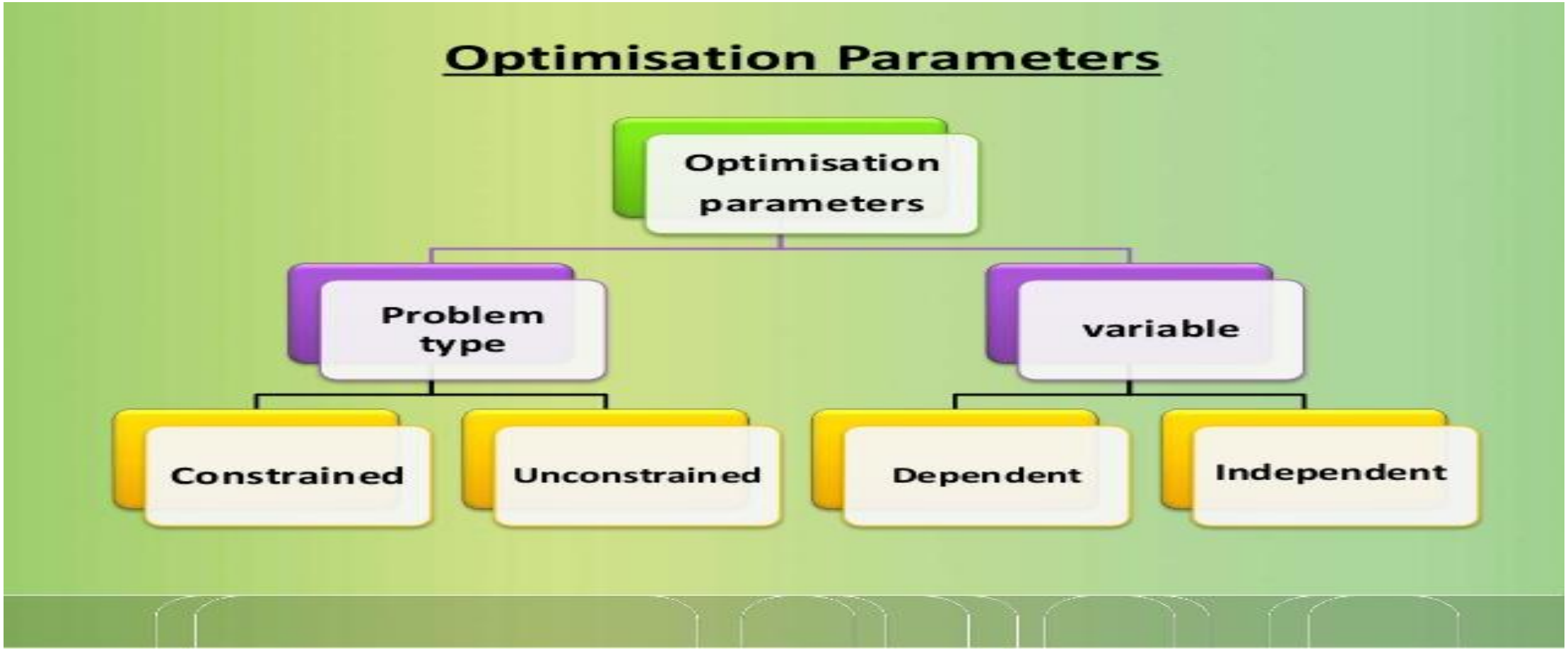

Optimisation Parameters
Optimisation parameters
Problem type
variable
Constrained
Unconstrained
Dependent
Independent

Lagrange ….

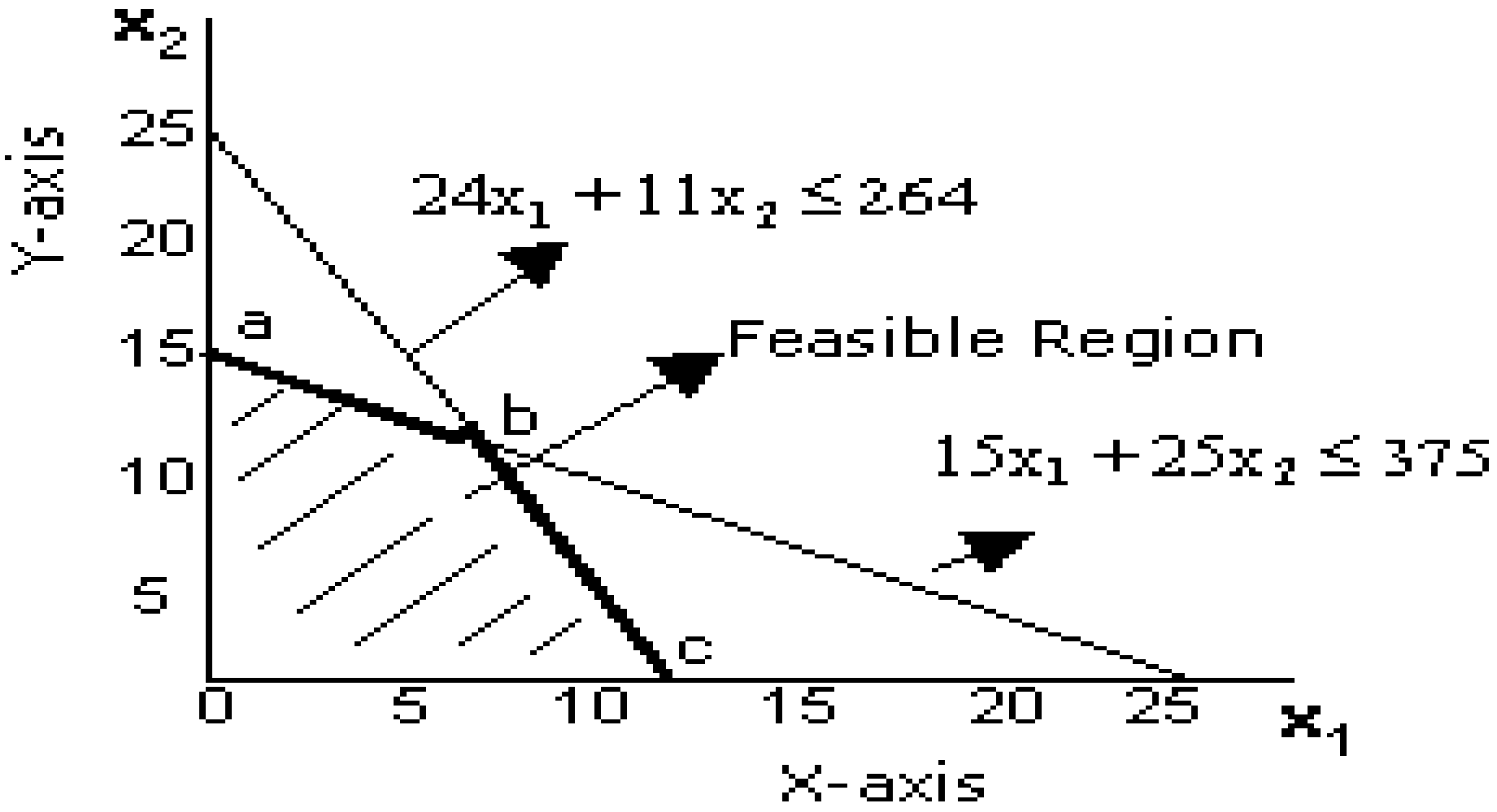
- In mathematical optimization, the **method of Lagrange multipliers** is a strategy for finding the local maxima and minima of a function subject to equality constraints .
- It is named after the mathematician Joseph-Louis Lagrange. The basic idea is to convert a constrained problem into a form such that the derivative test of an unconstrained problem can still be applied. The relationship between the gradient of the function and gradients of the constraints rather naturally leads to a reformulation of the original problem, known as the **Lagrangian function**

Cont…

- The relationship between the gradient of the function and gradients of the constraints rather naturally leads to a reformulation of the original problem, known as the **Lagrangian function**
- **Lagrange multipliers** are **used in** multivariable calculus to find maxima and minima of a function subject to constraints

Graphical method of linear programming

- **graphical method** of **linear programming** is used to solve problems by finding the highest or lowest point of intersection between the objective function line and the feasible region on a graph.
- Step 1: Define Constraints
- Step 2: Define the Objective Function
- Step 3: Plot the constraints on a graph paper
- Step 4: Highlight the feasible region on the graph
- Step 5: Plot the objective function on the graph
- Step 6: Find the optimum point
- Step 7: Find the coordinates of the optimum point


x_2
25
20
15
10
5
Y-axis
$24x_1 + 11x_2 \leq 264$
a
Feasible Region
b
$15x_1 + 25x_2 \leq 375$
c
0
5
10
15
20
25
x_1
X-axis

Simplex method

- **Simplex method**, Standard technique in linear programming for solving an optimization problem, typically one involving a function and several constraints expressed as inequalities.
- Simplex method is an approach to solving linear programming models by hand using slack variables, tableaus, and pivot variables as a means to finding the optimal **solution** of an optimization problem. Simplex tableau is used to perform row operations on the linear programming model as well as for checking optimality

Difference

- (1) Graphical method can be used only when two variables are in model; simplex can handle any dimensions.
- (2) Graphical method must evaluate all corner points (if the corner point method is used); simplex checks a lesser number of corners.

References

- https://en.wikipedia.org/wiki/Mathematics
- https://www.britannica.com/science/optimization
- https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L4slides.pdf