

# Optimization

Optimization is a branch of mathematics that involves finding the best solution from all feasible solutions. In the field of operations research, optimization plays a crucial role. Whether it is minimizing costs, maximizing profits, or reducing the time taken to perform a task, optimization techniques are employed to make decisions effectively and efficiently.

## 1.1 Optimization Problems

An optimization problem consists of maximizing or minimizing a real function by systematically choosing the values of real or integer variables from within an allowed set. This function is known as the objective function.

A standard form of an optimization problem is:

$$\underset{x}{\text{minimize}} \quad f(x) \quad \text{subject to} \quad g_i(x) \leq 0, ; i = 1, \dots, m \quad h_j(x) = 0, ; j = 1, \dots, p$$

where

- $f(x)$  is the objective function,
- $g_i(x) \leq 0$  are the inequality constraints,
- $h_j(x) = 0$  are the equality constraints.

## 1.2 Types of Optimization Problems

There are different types of optimization problems, including but not limited to:

- **Linear Programming:** The objective function and the constraints are all linear.
- **Integer Programming:** The solution space is restricted to integer values.
- **Nonlinear Programming:** The objective function and/or the constraints are nonlinear.
- **Stochastic Programming:** The objective function and/or constraints involve random variables.

These problems are solved using different techniques and algorithms, many of which are a subject of active research.

### 1.3 Applications

Optimization techniques have a wide variety of applications in many fields such as economics, engineering, transportation, and scheduling problems.

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*This is a draft chapter from the Kontinua Project. Please see our website (<https://kontinua.org/>) for more details.*

# Answers to Exercises





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