

CHAPTER 1

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 several different types of optimization problems, such as:

- **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.

FIXME expand this chapter with examples of calculus optimization using min max from previous chapter

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

APPENDIX A

Answers to Exercises



INDEX

optimization, 1