Introduction to Mathematical Optimization and Mixed-Integer Programming

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Overview

- Mathematical optimization
- Mixed-integer programming
  - Traveling salesman problem
  - Portfolio optimization

Overview of mathematical optimization

Mixed-Integer Programming (MIP)

$$\begin{aligned} \max \quad & f(x) \\ s.t. \quad & g(x) \leq 0 \\ & x \in \mathbb{R} \times \mathbb{Z} \end{aligned}$$

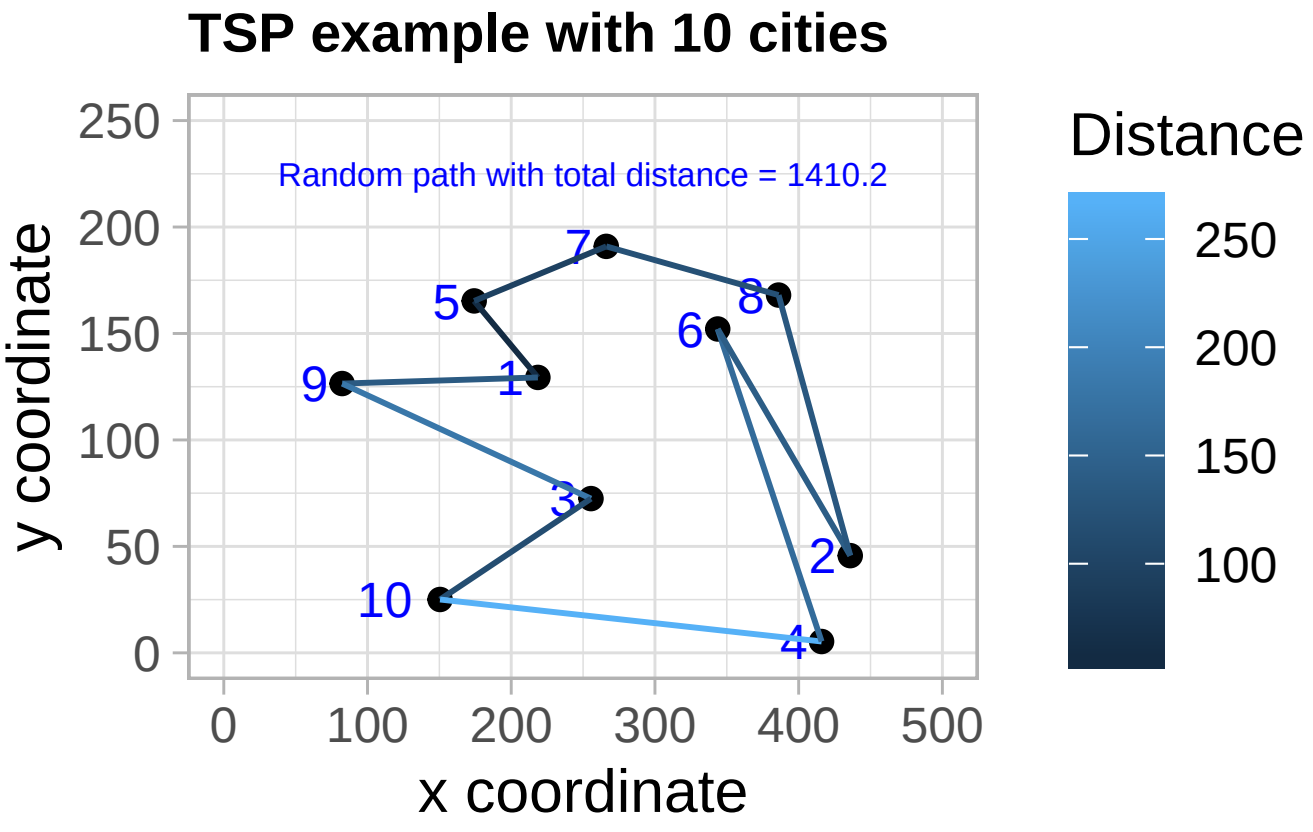
Portfolio Optimization

Traveling salesman problem (TSP)

- Problem definition (from wikipedia)

The travelling salesman problem (TSP) asks the following question: Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city exactly once and returns to the origin city?

Example of a random tour



- Brute-force approach takes $O(n!)$, that is $3,628,800$ for $n = 10$

Formulate TSP as a MIP