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Optimization Problems in Transportation and Logistics: A Practical Guide

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This educational guide will help students and practitioners seeking to understand the fundamentals and practice of linear programming. The exercises contained within demonstrate how to solve classical optimization problems with an emphasis on spatial analysis in supply chain management and transport logistics. All exercises describe the Python programs and optimization libraries that can be used to solve them. The first chapter introduces key concepts in linear programming and establishes a new cognitive framework to help students and practitioners set up each optimization problem. This cognitive framework organizes the decision variables, constraints, objective function, and variable bounds in a format that allows for direct application to optimization software. The second chapter introduces two types of mobility optimization problems (shortest path in a network and minimum cost tour) in the context of delivery and service planning logistics. The third chapter introduces four types of spatial optimization problems (neighborhood coverage, flow capturing, zone heterogeneity, service coverage) and provides a workflow for visualizing the optimized solutions in maps. The workflow creates decision variables from maps by using the free geographic information systems (GIS) programs QGIS and GeoDA. The fourth chapter introduces three types of spatial logistics problems (spatial distribution, flow maximization, warehouse location optimization) and demonstrates how to scale the cognitive framework in software to reach solutions. The final chapter summarizes lessons learned and provides insights about how students and practitioners can modify the Python programs and GIS workflows to solve their own optimization problem and visualize the results.

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