Optimization Models
Assignment 2

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1 Motivation

In today's globalized world, efficient logistics networks are crucial for businesses to remain competitive. The placement of distribution centers significantly impacts delivery costs, time, and customer satisfaction. This problem aims to optimize the location of distribution centers to minimize the total distance covered for deliveries. By strategically placing these centers, businesses can reduce transportation costs, improve delivery times, and enhance overall operational efficiency. This optimization problem has practical applications in various industries, including retail, manufacturing, and logistics.

2 Problem Description

The objective of this optimization problem is to determine the ideal locations for a specified number of distribution centers within a given network of locations. The goal is to minimize the total distance required for transporting products from these centers to their destinations. However, this optimization must be achieved while ensuring that the capacity of each distribution center is sufficient to meet the demand of the locations it serves.

A network of locations can be represented as a graph, where each location is a node and the connections between locations are edges. Each distribution center has a defined capacity, representing the maximum amount of product it can store or handle. Additionally, each location has an associated demand, indicating the quantity of products required at that location. The distances between locations are known and can be represented as weights on the edges of the graph.

The optimization problem involves selecting the optimal locations for the specified number of distribution centers from the available candidates. The goal is to minimize the sum of the distances between each delivery location and its assigned distribution center. However, the assignment of locations to distribution centers must be made such that the total demand assigned to any distribution center does not exceed its capacity.

We will also try to incorporate the concept of non-deterministic optimisation after the above objectives are met. It will involve considering the demand of various locations as a distribution about a mean(mostly a uniform distribution), and then optimising the distribution centre locations according to it.

3 Tentative Solution Methodology

1. *Linear Programming Formulation*: Define parameters, decision variables, constraints, and objective function.

2. *Model Implementation*: Use a modeling language like Pyomo to create the model.

3. *Simulation*: Choose a suitable solver and solve the problem by giving a sample graph and parameters as input, and analyse the results for correctness.

4. *Incorporating Non-Deterministic Optimisation*: Consider the demand to be a distribution, and take appropriate measures to solve the problem.

4 Tentative Deliverables

1. *On-paper Implementation*: A mathematical formulation of the problem, including parameters, decision variables, constraints, and objective function with explanations.

2. *Code Implementation*: Python code using Pyomo or a similar modeling language to represent the problem.

3. *Results*: Application of the implemented model to example graphs, and the optimal solutions.

4. *Non-Deterministic Optimization Implementation*: The on-paper, code implementation and results of incorporating of uncertainty into the model, i.e., considering demand to be a distribution.

5 Work Distribution

Since we were only 2 people, we discussed among us, cross-verifying each other's work. We will roughly do the same amount of work.