UNIVERSITY OF HEIDELBERG
Institute of Computer Science
Discrete and Combinatorial Optimization

Improving Access to Facilities

Abstract: This project is concerned with the problem of improving clients' access to facilities. The problem is being considered in a new light by combining two existing approaches to improving accessibility. The first approach considers the locations of the facilities while the second approach considers the connections between clients and facilities. In this project we consider both facility locations and client-facility connections with the goal of optimally improving accessibilty.

Facility Location

The field in its present form began in the 1960s. Facility location is concerned with optimally locating facilties among clients. The clients have fixed locations and the facilities are to be located so that they can best serve the clients. Usually this means locating the facilities so that they are somehow "near" the clients.

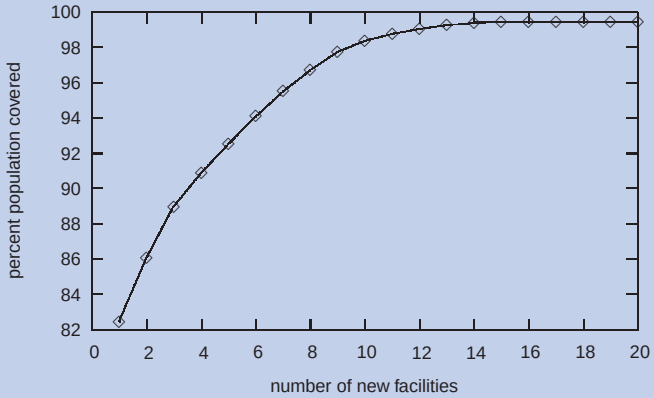
Terminology

- facility - an entity that serves clients; facilities may be already existing and have fixed locations, or the problem may be to locate new facilities
- client - users / customers of facilities; clients have fixed locations
- travel cost - a measure of the cost of getting from one location to another; could be in units of distance, time, or something else

Applications

- Public facility location, e.g., schools, fire stations
- Private facility location, e.g., warehouses, retail outlets
- Size selection for manufacturing, e.g., steel ingots, clothing
- Chip manufacturing
- Medical diagnosis
- Satellite orbits

Increase in Coverage as More Facilities are Built



This graph shows how the coverage of a population (the percentage of the population with a facility within 10 kilometers in this case) can increase as more facilities are built. The data shown are from a preliminary model for the Nouna location problem (at right).

Reverse Facility Location

The field began in the early 1990s. In a reverse facility location problem, the facilities have fixed locations and the goal is to improve accessibility by improving the travel costs. In a real-world problem, this could correspond to building new roads, upgrading the bandwidth of a network connection, etc.

Combining Facility Location and Reverse Facility Location

In this project we consider a new kind of problem which is a combination of facilty location and reverse facility location problems. In our problem, the goal is to improve accesibility, and this may be done by both locating new facilities as well as improving the travel costs on the existing network.

Inputs

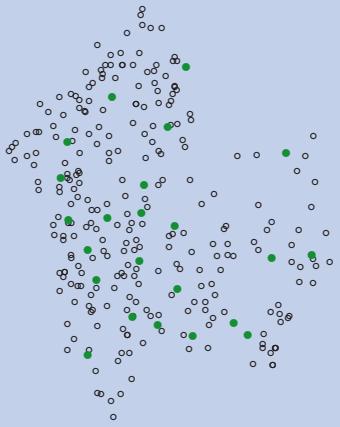
- Graph whose nodes are clients, facilities, and potential facility locations, and whose edges, weighted with travel cost, are the connections between locations
- Populations at client nodes
- Facility capacities
- Information on how and which connections may be improved
- Monetary cost of building facilities and improving connections
- Budget (total amount of money which may be spent)

Outputs

- Facilities to build and connections to improve
- Assignment of clients to facilities

An Application: Health Facilities in Nouna district, Burkina Faso, Africa

- 275,000 inhabitants, 290 villages
- 23 existing health facilities (green dots)
- Roads in poor condition
- Some roads unusable during the rainy season
- Means of transportation: foot, bicycle, donkey
- Many people lack basic health care
- Current accessibility is far from optimal
- Goal: Improve access to health facilities in Nouna district, Burkina Faso



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