MIE1623: Healthcare engineering
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Assignment 1: Facility location

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1 Problem description

Your local regional health authority (RHA) is looking to improve access to CT scans for its inhabitants. The region has eight hospitals (where CT machines are located) and is divided into 19 census tracts, which are areas of roughly 40,000–80,000 residents. Some of these census tracts are better served than others in terms of CT scan accessibility. The RHA is instituting a major initiative to install new CT machines at some (or all) of its hospitals so that 90% of the population is within 45 minutes of a CT location. Your job is to determine the optimal number of new CT machines to install at each hospital.

2 The data

Data file `CT_location.xlsx`

Contents CT demand and travel times

Costs and limits are detailed in Table 1. The data file contains the CT demand from each census tract for last fiscal year, as well as travel times from each census tract to each hospital. Details are described in Table 2. Census tracts are numbered $1, \ldots, 19$, and CT locations (hospitals) are numbered $A, \ldots, H$. For simplicity, the travel times are obtained using the distances from the centroid of each census tract to each hospital.

3 Questions

Submit your Excel files and a brief PDF report that analyzes your findings and answers the following questions:

1. Describe your model.

Table 1: Costs and limits

Item	Cost/Limit
Maximum number of exams per year per CT machine	19,743
Annual cost to operate a CT machine	$1,700,000
Cost install a new CT machine	$1,250,000
Cost per exam	$62.26

Table 2: `CT_location.xlsx` data description

Worksheet	Column name	Information
Demand	CID	Census tract ID
	Demand	Average annual unmet demand for CT scans
TravelTime	First column (CID)	Census tract ID
	Remaining columns (CT loc)	Travel time (minutes) from each census tract to each CT location site (hospital)

   (a) What did you use for your objective function?
   (b) What are your variables?
   (c) What are your constraints?
   (d) How many binary and continuous variables and constraints does your model have?

2. Describe your solution.
   (a) Does your solution meet the target that 90% of the population is within 45 minutes of a CT machine? If not, how close did you get?
   (b) What is the 90th-percentile travel time?
   (c) What percent of the population is within 45 minutes of a CT machine?
   (d) What is the total cost?
   (e) How many new CTs should be built at each hospital?
   (f) What is the utilization of each CT machine?

3. Is the RHA's goal realistically achievable?