# Set cover problem optimization

by MAJDI Karim

24 septembre 2020

- Introduction
- 2 Problem presentation
- Mathematical model
- Simulation
- Simulation

Set cover problem optimization

- Introduction
- 2 Problem presentation
- Mathematical model
- 4 Simulation
- Simulation



#### Introduction

This work is done in the context of optimization problems. We show that it's possible to model a common problem of putting hospitals together to cover a wide area,(serve a wide area where people are in need to go to the nearest hospital), as an optimization problem.

- Introduction
- Problem presentation
- Mathematical model
- 4 Simulation
- Simulation

# Présentation du problème

Set cover problem

suppose we have the set: I=1,2,...m and a collection of subsets of  $I=\{P_1,P_2,....P_n\}$  où  $P_j$  is a subset of I,for j in  $J=\{1,2...n\}$ , a subset  $J^*$  c J, define a cover I if  $\cup F_j \in JP_j = I$ . a positif cost is associated to each  $j \in J$ . The aim of this problem is to determine a cover whose cost is minimum.

- Introduction
- Problem presentation
- Mathematical model
- 4 Simulation
- Simulation

#### Mathematical Model

The mathematical formulations is done using a vector of binary values :

$$Min z = \sum_{j=1}^{n} C_{j} X_{j}$$

$$\sum_{j=1}^{n} T_{ij} X_{j} \ge 1, \forall i$$

$$X_{j} = (0; 1), \forall j$$
(1)

Set cover problem optimization

- Mathematical model
- Simulation



#### Tools used



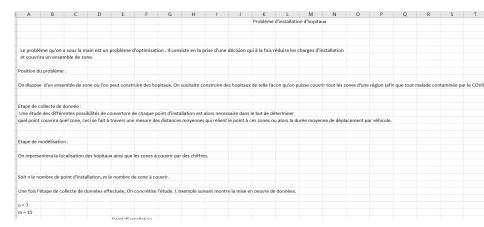


- Introduction
- Problem presentation
- Mathematical model
- 4 Simulation
- Simulation



We thought about modeling the problem of building hospitals as set cover problem, we basically have 7 locations where we might build hospital, each location serves certain zones in the example below we have 15 zones to cover. The matrix represents the data that we need to collect beforehand, columns represents the covers zones by the possibility. The encoding used here follows the one-hot method, a possibility i (column i) that covers the zone j (row j) will have the matrix element row i, columns j equal, 0 if the row i (zone i) isn't covered by the column j. the decision variables are presented at the bottom, the configuration of the matrix shown in the results slide (0,1,0,1,1,0,0). In the excel file we could just edit the matrix element, the decision variable would be updated automatically







#### Results

15	0	1	0	0	0	0	1	1	>:	=
14	1	0	0	0	1	0	0	1	>:	=
13	0	1	0	1	0	0	0	2	>:	=
12	1	1	0	0	0	0	0	1	>:	=
11	0	0	1	1	0	0	0	1	>:	=
10	0	1	0	0	0	0	1	1	>:	=
9	0	1	1	1	0	1	0	2	>:	-
8	1	0	0	1	0	1	1	1	>:	-
7	0	0	0	0	1	0	0	1	>:	-
6	0	0	0	1	1	0	1	2	>:	-
5	0	0	1	0	1	1	0	1	>:	-
4	1	1	0	1	0	0	1	2	>:	=
3	0	0	1	1	0	0	0	1	>:	-
2	1	1	1	1	0	0	1	2	>:	
1	1	0	1	0	1	1	0	1	>:	_
Zones	1	2	3	Point d'installation		6	7	Nombre de points choisis couvrant la zone		
m = 15			n-		**					
n = 7										

