Bakırköy Municipality
Earthquake Preparedness
Case Study

Deadline: April 30th, 2024

PART- I

Bakırköy Municipality

Bakırköy Municipality is one of the biggest municipalities in Istanbul in terms of both surface area and population. Although the official population count of the municipality is around 210.000 (Turkish Statistical Institute, 2009), it goes up to 2 million at day time as it has an important role in Istanbul's economy and stands in the center of other municipalities. Therefore, any serious destruction that might occur would be a considerable threat to the socio-economic development sustainability of Turkey. Moreover, a possible earthquake can cause multitudinous human loss because of high population density inside the municipality borders. Hence, Bakırköy Municipality has been involved in numerous projects to take precautions and decrease any risk concerning the situation.

Bakırköy Disaster Coordination Center (BAKOM) aims to recover the effects of the disaster as much as possible by coordinating the units that belong to the municipality and other related civil service groups inside the Bakırköy County before and after a disaster. After a disaster occurs, County Rescue and Aid Committee members meet at the crisis center. Crises Center makes decisions and instructs BAKOM. In this structure, the role of Bakırköy Municipality is managing its own resources and providing support for other civil groups.

You, as a team, are assigned to the earthquake planning project conducted by BAKOM. The project consists of three main parts,

1. In advance action planning
2. Status Detection
3. Resource Assignment

Team members:

BAKOM EARTHQUAKE CASE PART 1

Question 1:

There are 93 districts which have to receive service. You are given the distances between these districts, the population of each district, and the risk coefficient of each link that connects the districts (if the risk coefficient is high then the probability that the link is out of use is also high.)

The municipality plans to open distribution centers for basic aid. Since the roads may be damaged, people may walk to those distribution centers from districts.

a) Assume the municipality will open 5 distribution centers. Give a mathematical model that determines the locations of DC's while minimizing the longest distance (R) that a person needs to travel to reach a DC. Remember that each district should be covered by at least one DC. Give your findings (results).
b) Now assume the municipality decides that each district should be covered by at least two DCs within a range(R) with at most p DCs. Use the R value that you have found in part a). How do you model this situation? Give your findings (results).
c) Conduct a sensitivity analysis on the number of distribution centers (p) for part b) and give your results (corresponding R values).
d) Consider part a) again. But this time assume the municipality also wants to consider the risk of destruction of the roads. (1=remains perfectly, 0=totally demolished) So, they want each district can access the DC that they are assigned to, using a link with a risk coefficient greater than 0,7. Again, minimize the longest distance (R) that a person needs to travel to reach a DC.

Question 2:

a) Emergency Response Center (ERC) considers using motorcycles right after an earthquake in order to have an idea about the status of districts in Bakırköy after the earthquake within 2 hour time. According to plan, each node should be visited by a motorcycle right after the earthquake. Assume the motorcycles are located in ERC (node #1 of the data set) and they can travel 30 km/h on the average. Find the minimum number of motorcycles to be used. Report the routes for each motorcycle.
b) Now conduct a sensitivity analysis on part a. Decrease the total visit time from 2 hours to 1 hour with increments 0.25 hrs. Note the # of motorcycles required for each step.
c) Now we want to relocate the ERC. Among the distribution centers that you open in Q1 part a, where do you move ERC. Use the number of motorcycles that you have found in part a.
d) Now assume we can locate the motorcycles in more than one DC's. (Still you will choose the motorcycle locations from Q1 part a) How many motorcycles should locate in which DC's, in order to visit all districts in 1 hour this time?