Locating fire stations in Gainesville, FL

Prepared as part of the

Introduction to Operations Research Course
University of Arkansas

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Overview:

For this project we decided to work on locating Fire Stations in Gainesville , FL. The overall goal of the project was to minimize the distance from each node to the nearest fire station. Fire stations involve minimizing time of arrival, since some minutes of difference could save lives or avoid big fires.
Fire stations should be located very strategically.

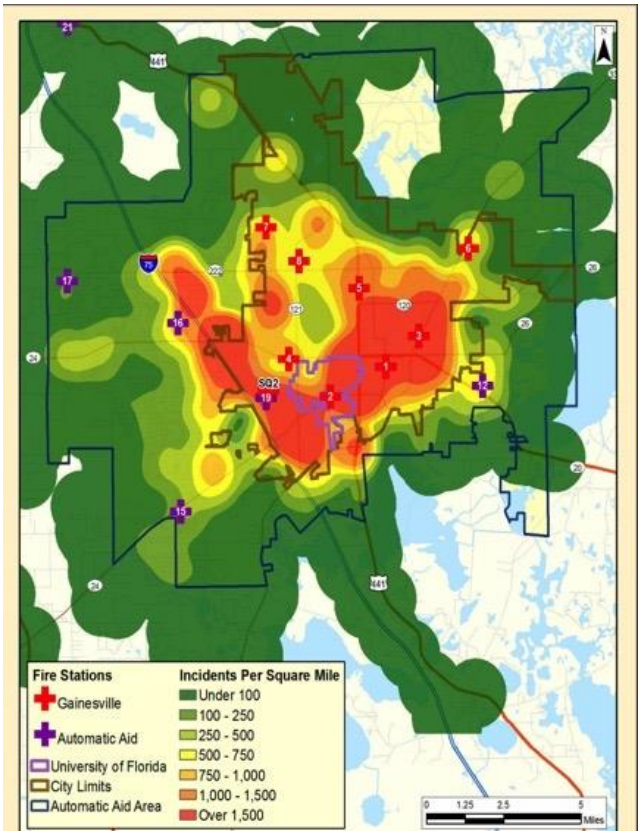

Figure 1 : Population density Gainesville, FL.

The decisions made were based on how to divide our map to have enough demand nodes. We also must make the decision of where to place a potential facility based on Figure 1. This map shows population density and important areas such as University of Florida.

Next, we placed potential facilities on an empty map and tried to minimize the maximum distance from node 1 to its assigned facility. We used calc maps to get all of the information we needed and came up with 11 possible location.

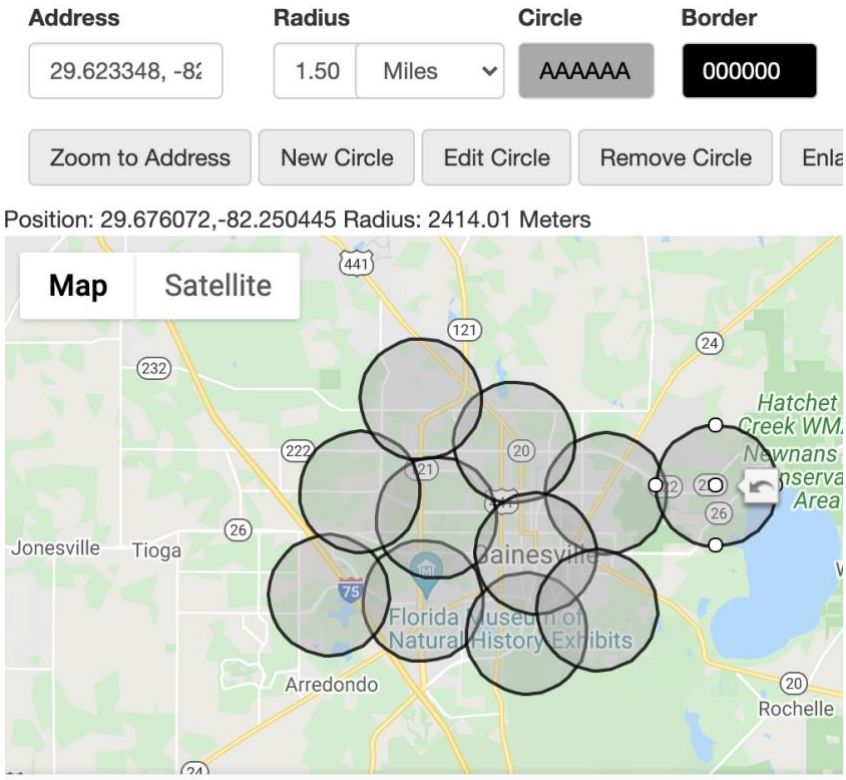

Figure 2 : Potential facilities

Figure 2 shows the potential locations for each fire stations, and the radius between them. We tried to optimize these distances and placed the locations on strategic areas, taking into consideration different factor that may affect these. After doing some research we understood that the number and location of fire stations in a community is normally based on the distance between stations, the population served, and the threats at particular locations (Gay, W., & Siegel, A., 1987, pp. 3). All of these factors were taken into consideration when placing the potential locations.

Model and Data:

To formulate our optimization model, we used the P-Median model. We identified the indices, parameters, variables, and constraints accordingly. To gather data for this project, we calculated the distances between node j to its assigned facility. We used calc maps as well and calculated these distances with straight lines. To gather data about our demand vector, we based our data on the ranges that Figure 1 provides. For this we did not use accurate data. We used random data.

Analysis:

With all the data we needed and support of technology we came up with nodes suggested by AMPL/CPLEX. The suggested nodes were 1, 2, 5, 6, 7, 8, 9, 10, 11. We found the coordinates for these locations:

node	**coordinates**
1	29.763194, -82.394333
2	29.722361, -82.366139
5	29.693359, -82.333793
6	29.673788, -82.397365
7	29.669164, -82.291732
8	29.682804, -82.229470
9	29.658760, -82.334837
10	29.634148, -82.411599
11	29.630548, -82.370529

We plotted the coordinates and added a circle with radius of 1.5. The solution is optimal. However, we noticed that if we change the parameter of a possible number of potential facilities, we could potentially get another feasible solution. We would need to compare various changes into the constraints to find the most accurate. When analyzing the result AMPL gave, we believe it is reasonable. We referenced the actual fire stations in Gainesville, and multiple of our nodes are in a close location to what we got.

References:

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