How to Stop Gentrification with Linear Programming

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MATH 5593 - Linear Programming, Dr. Steffen Borgwardt

Introduction

Gentrification

A pattern of affluent people moving into a historically poor neighborhoods and increasing the value of properties, inevitably making it too expensive for the original population, forcing them out. [2]

Before a neighborhood is gentrified there is typically a period of *disinvestment*, that is; wages decline, buildings grow older, and businesses move out. [1]

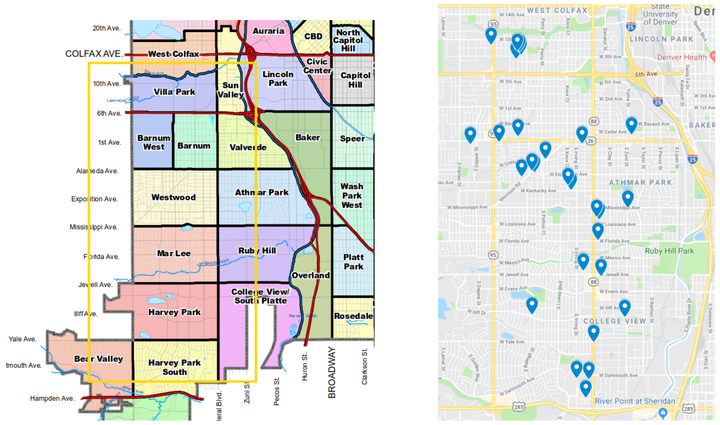
At-risk neighborhoods

Using the Denver Open Data Catalog [3], we can see which poverty-stricken neighborhoods have the oldest structures, and how the populations income has changed over the years. With this, we can see which neighborhoods might need assistance. Here are three neighborhoods which stood out, based on data from 2013-2016:

Neighborhood	Med. Struct. Age	Income growth
Barnum	79 years	-8.449%
Mar Lee	63 years	-4.950%
Harvey Park	61 years	-3.435%

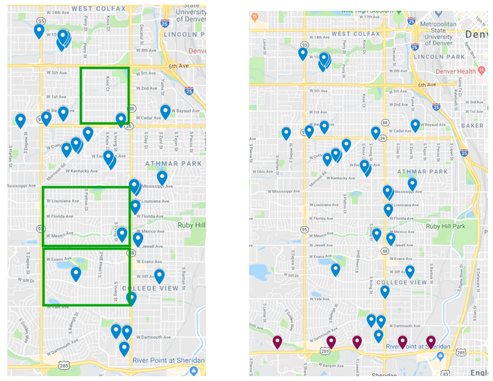
What can we do?

There are several ways to approach this [4], however we will be looking for effective places to put more affordable housing. In this case, there aren't very many affordable housing projects in Barnum, Mar Lee, or Harvey Park.



On the left is the region we will be investigating, boxed in orange, and on the right are the locations of current affordable housing projects. We'll run a program, similar to one that would find the optimal position for a new cell tower, to determine the best place to put a new housing project.

Results



The highlighted areas on the left are the neighborhoods that we had interest in in the first place. The red pins are the locations that the program came up with.

The program

$$\begin{aligned} &\text{maximize} \min_i d(x, y_i) \\ \text{subject to} \quad &-105.063312 \leq x_1 \leq -105.009367 \\ &39.653957 \leq x_2 \leq 39.732583 \end{aligned}$$

Where $x = (x_1, x_2)$ are the longitude and latitude of our new housing project, the y_i are the locations of housing projects which already exist, and $d(a, b)$ is the taxicab distance between a and b. The idea is to get as far away from the other housing projects as possible so that they cover the area better.

Conclusions and Future Work

Using Linear Programming limited my approaches here. There doesn't seem to be much to optimize with this kind of data and these kinds of questions. I was very interested in doing a "Largest Empty Circle" problem to find out which positions would have been good for more housing, though the optimization version of that problem is quite nasty. I also considered doing some k-means clustering and choosing the least dense cluster to add to.

Another thing to note is that **Denver is running out of places to gentrify**. It doesn't seem that there's too much more to study *here*, however, there are still plenty of other places that face this problem.

References

[1] Slater, Tom. "Gentrification of the City." *The New Blackwell companion to the city 1* (2011).

[2] Schrader, Megan. "As Denver's neighborhoods gentrify, the poor are pushed to new pockets of poverty." Denver Post Published: June 23, 2017. Web. November 20th 2018.

[3] `https://www.denvergov.org/opendata/dataset/city-and-county-of-denver-american-community-survey-nbrhd-2010-2014`

[4] NCDC. "Seven Policies That Could Prevent Roxbury's Gentrification." Nuestra Comunidad Development Corporation. April 14th, 2014. Web. November 20th 2018.