

A research project to analysis food insecurity and digital divide indicators in the city of Philadelphia to inform and spatially identify the potential locations for establishing food and Wi-Fi network.

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1. INTRODUCTION

This paper is written as a part of my capstone project, a component of my master's in urban spatial analytics the University of Pennsylvania.

According to the Philadelphia government nearly “17% of trash sent to the landfill is wasted food. This adds up to around 116 million pounds of food waste coming from commercial properties such as restaurants and other food service establishments.”[1] While we have this copious amounts of food going to waste, on the other hand there is huge population suffering from food insecurity. It's reported that in one in four (22.4%) households are facing food insecurity in Philadelphia, which is well above the national average of 16.5% for all households with children. [2] The project will establish a network of sites, where underprivileged people can gain free access to internet and get free meals. Food is one the basic necessities for a human being and in current day and age, people need access to internet and technology to equip and inform themselves of current skills, information etc to navigate through life.

In the first step, three types of broad datasets will be collected. The first one is wi-fi resources datasets. That will help in identifying the location of existing internet locations and the conditions. The second one is existing infrastructure like parks, parking lots, libraries, current meal locations points. These data sets will help inform where the sites of this network can be locations to get the best coverage across the cities and easy reach for people. The existing meal sites help informing the decisions of how far from them should these new sites be located. The third one is census datasets, it will give us demography data and let us know the information about the tracts. Various indicators like, median household income, women and children population, homeless shelters, education, median rent, poverty to name a few would help identify our target users.

Building on the analysis of the source, users and infrastructure is analysis, we would be drawing data on a host of public spaces, like parks, public libraries, churches, public parking lots to name a few to set up the network.

As the project develops and collects data from these sites, it would be able to produce a community-level grid that can be reproduced into many other areas and also and also be able to predict the extent of usage of the sites and if these any site is under serving or overcrowded or in case of natural calamity, the network can easily adjust itself to suit the needs.

2. LITERATURE STUDY

a. Food insecurity

Hunger and starvation though are conditions caused by lack of access to food are very often easily mistaken as similar and used generically. They are very distinct, and degrees of conditions caused due to lack of access to food due to various reason. According to Food and Agriculture Organization (FAO) of United Nations, anyone who doesn't have regular access to healthy food for their development and growth is said to be food insecure. The inaccessibility could be due to multitude of reasons like physically lacking fresh produce stores around to fresh food or lacking financial capabilities to purchase food on a regular basis, poverty or unemployment or lack of access to healthcare facilities or racial discrimination. Food insecurity can be experienced at different levels of severity. In 2020, an estimated 1 in 8 Americans were food insecure, equating to over 38 million Americans, including almost 12 million children.[3]

Food insecurity according on FAO



FAO states a person being hungry as a sensation of discomfort caused due to lack of food momentarily while food insecurity is caused due to lack of accessibility to resources or means to afford food at a household level. Food insecurity sounds like could be closely related to poverty, but not everyone below poverty line is always experiencing it, people who do not have access to healthy and nutritious food for overall development of their health due to lack of access to fresh food are also considered to be insecure. In most cases people in low-income brackets, no education, unemployment, people of colour facing discrimination to opportunities, women, children, and senior citizens are at higher risk. These social issues in culmination are determinants of “conditions in the environments in which people are born, live, learn, work, play, worship and age that affect a wide range of health, functioning and quality-of-life outcomes and risks.” [4]

Philadelphia part of Feeding America, is a small organisation working towards rescuing food and distributing to people in need quotes that ‘throughout the nation, about 12 percent of people are food insecure — lacking enough food in a year to lead a healthy life, according to data from Feeding America in Chicago, the largest hunger-relief nonprofit in the country. In Philadelphia, it’s 21 percent. In North Philadelphia, food insecurity runs as high as 30 percent.’ [5] It’s one of the organisations that work in tandem with City of Philadelphia in providing free meals to those in need.

b. Digital literacy

Asking my colleagues and reading about it on the internet, I got a myriad of varying answers of what people perceive it as. According to American Library Association (ALA) digital literacy is "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills." [6] In today’s day and age where everything is on the internet or technologically driven, it is almost a primal requirement to

know and have the skills to navigate through them, be it for school, securing a job or to even get information regarding governmental programs. Like information literacy, digital literacy requires skills in locating and using information and in critical thinking. Beyond that, however, digital literacy involves knowing digital tools and using them in communicative, collaborative ways through social engagement. ALA's Digital Literacy Task Force defines digital literacy as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills." [7]

One may wonder how digital literacy helps or even more fundamentally what caused this disparity in communities. It was estimated that around 42 million Americans, prior to covid did not have the means to setting up broadband. Due to covid that divide only further aggerated since onset of covid and subsequent preventive methods such as series of mandatory lockdowns, a lot of people were either laid off or faced pay cuts. This led to them being barely being able to afford essentials such as food, rent etc., and very obviously not being able to pay bills for mobile phones or broadband. This causes digital divide: which is fundamentally a divide caused between demographics or regions that can access Information and Communications Technology and those who couldn't.

"Digital literacy builds upon the concept of digital divide to indicate the ability not just to access digital infrastructure, but also to utilize it." [8]

c. Food wastage

"Up to 40 percent of the food in the United States is never eaten" [9]

"Food takes up more space in US landfills than anything else" [10]

"17% of trash sent to the landfill is wasted food" [11]

We often find ourselves checking expiration dates on labels at grocery stores, a slight blemish on product is considered lower quality, restaurants preparing quantities and portions larger than required to keep up the trends, leftovers at home being tossed away but rarely do we stop a moment to empathy and appreciate countless people who would more than happy take this very food that we just rejected or trashed because they don't have the means to afford it or could simply be a meal they have been longing for days, after starving but not having the means to afford it and yet somehow we almost very mindless reject it on a daily basis. "Most wasted food ends up in landfills, where it generates methane, a greenhouse gas that is up to 86 times more powerful than carbon dioxide." [12]

Food ending in landfills that add compound to the other greenhouses gases, is said to be amounting to 8% of the total greenhouse gases emitted. Besides of this, the resources to produce food like fuel, fertilisers, water, manpower, to pack it and food miles they are packed with as often food we consume is rarely grown locally rather imported from various parts of the country or the tropical countries.

"In the United States, food waste is estimated at between 30–40 percent of the food supply. This figure, based on estimates from USDA's Economic Research Service of 31 percent food loss at the retail and consumer levels, corresponded to approximately 133 billion pounds and \$161 billion worth of food in 2010." [13]

Having understood the terms and the gravity of the situations, let move on to understand what the different datasets are we will be using, who specifically would be our target users, data sources, the analysis and finally the results to establish these networks.

3. DATA

a. Users

Every good project first needs to really understand and establish its users and their needs, like wise this project before diving into the particulars of what the project is really going to be and how it would done, has establish a broad idea of the kind users it would be targeting or more importantly would be benefitable to. The user categories are to great extent informed by the demographics that city of Philadelphia's free meal and food programs target and on types of people that face food insecurity and digital divide. On a comprehensive scale, the user categories would target demographics based on lack or minimal access to education, low or no income, no job or low household income which generally indicate that a person is either struggling financially or required aid to get access to one of the basic amenities such as food. The users don't necessarily have to be in need of both food and internet, they could need either of the two or both as well.



ERIK

Age: 41yrs.

Education:

Highschool
Background

Homeless
Needs

Meals regularly
and govt programs



Suzan

Age: 69 yrs.

Education

School dropout
Background

Living alone
Needs:

Community



MAX

Age: 13 yrs.

Education

8th Grade
Background

Household with no
consistent income
Needs



Miriam

Age: 39 yrs.

Education

Grad
Background

Income < \$20000
and single mother
Needs

Internet to look up
govt. programs &
meals for 2



Trey

Age: 23 yrs.

Education

Attending
community college
Background

Doing part time
jobs and studying
Needs

Access to internet



Household of 4
Mother, Father
And 2 kids in K-12

Background:

Household income
< \$30000, one of
the parents lost job
recently

Needs:

Regularly meals
Internet to apply

The categories are: The homeless: people who don't have basic amenities, don't have access to regular healthy and decent food and could potentially benefit from free meals, they could also be in need to know what the governmental programs are there to help their situations. So access to internet could be of help to them as well; the elderly: people in their older years and surviving on minimal savings and don't have a steady income; children to teenagers coming from families with single parent or no household with no steady income and don't have access to healthy food in their developmental years and need access to internet to participate and complete their assignments for schools; adults looking for jobs or in between jobs and don't have access to broadband at home and could benefit from internet access to develop skills and apply for jobs; young adults juggling between parttime jobs and education who need access to internet to pursue jobs and finally families struggling financially to provide for their families. Based on broad understanding of the target users, I further explored the census data to extract the groups or variables that would encompass these users and narrowed down on these.

- "B19013_001E", Median household income in the past 12 months
- "B25058_001E", Median contract rent
- "B14007F_019E", Total not enrolled in school
- "B15003_001E", Total educational attainment for the population 25 years and over
- "B15003_002E", Total no schooling completed educational attainment for the population 25 years and over

Having sorted who the users are, the next step was to understand where these potential network sites would be located at. For this, I explored the options of looking at public spaces that are easily accessible and have or are within 100m distance to existing public Wi-Fi spots which would help this project build on, in its initial stages on infrastructure that is already existing in the city. This

would help in rolling out the project with less fiscal constraints and leverage the infrastructure that is present currently.

The public spaces that have been narrowed down and used for this project are public parks and recreations spaces, public libraries with free Wi-Fi and public parking lots. These spaces would allow and be able to host parking of meal van or station while also be able to accommodate users coming to either avail internet services or free food. Having said that, there are two more data sets I have considered which are existing infrastructure but more in the sense of understanding how to leverage on these to their maximum potential. One is the existing Wi-Fi stops around the cite, and other is the existing meal sites that City of Philadelphia and other private organisations provide. City of Philadelphia provides free food and means as a means to supplement the existing food pantry network to students, senior citizens, residents experiencing homelessness and hunger and to residents (without proof of ID or income). It's vital to take into account these sites as I won't want to overlap sites in my network with the existing sites and also helps my project really look for areas where there is a need that the existing food distribution programs do not cater to currently.

b. Data sources

All the data was sourced was from open data Philly website, which is an open data source.

Community Parking - <https://philapark.org/lots/> [14]

Parks and rec - <https://www.opendataphilly.org/dataset/ppr-districts> [15]

Existing food distribution sites - <https://www.phila.gov/food/> [16] and

<https://www.philabundance.org/find-food/food-map/> [17]

Free Library <https://libwww.freelibrary.org/locations/service/wifi-access> [18]

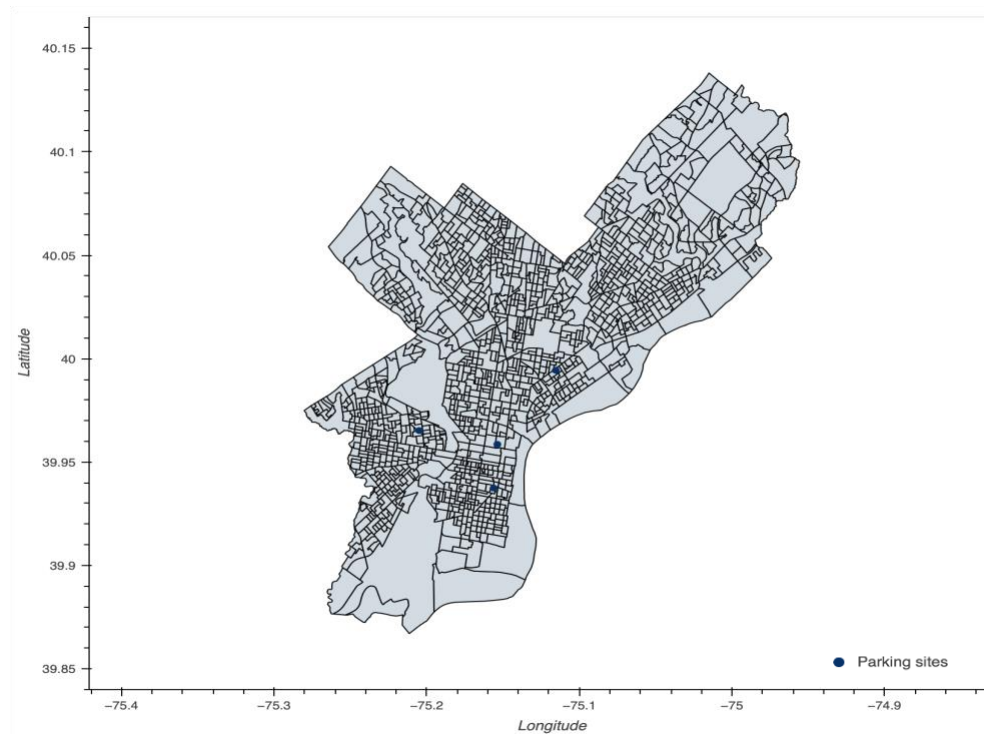
Free Wi-Fi

[https://phl.maps.arcgis.com/apps/webappviewer/index.html?id=928cdaef12994bd1b3968da825a](https://phl.maps.arcgis.com/apps/webappviewer/index.html?id=928cdaef12994bd1b3968da825a71a1a)

[71a1a](#)[19]

c. Data extraction and cleaning

Community Parking

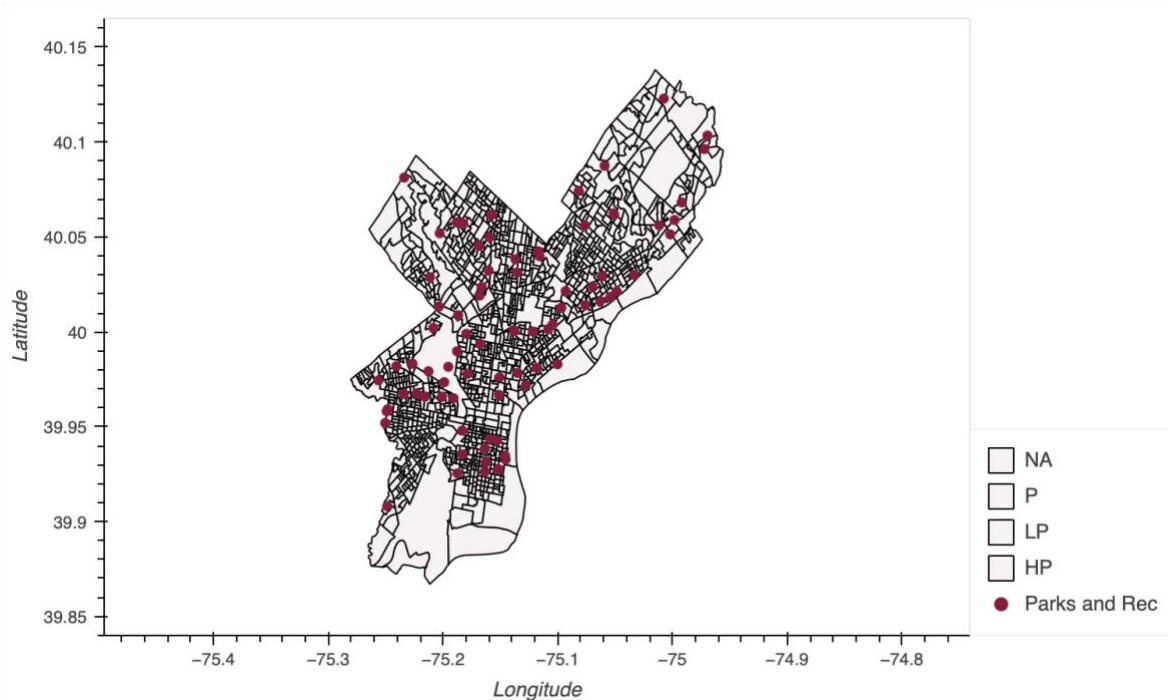


The required data on website was static, I used Python library called 'request' to extract all the data from the website and further used python library 'beautiful soup' to sort the extracted data to filter only the addresses of the parking lots.

Parks and Recreation

The data was available in a csv format from the open data Philly website. The csv file was further cleaned of the unnecessary columns. In this data set I was particularly interested in parks or

recreational sites having a building with public Wi-Fi.



Existing food distribution sites - <https://www.phila.gov/food/> and

<https://www.philabundance.org/find-food/food-map/>

Data regarding the existing food and meal distribution was extracted from two websites, City of Philadelphia and Philabundance. The required data available on the city of Philadelphia website was dynamic and was not able to extract the data unless clicked on each individual site to expand and provide with further details of the meal site such as locations, eligibility etc. In order to overcome this, I used Python library “selenium” which enables to me automate some of the above steps in order to extract the data and save it as a csv file. The same was done with Philabundance website, which also further required ‘beautiful soup’ to filter the desired details.



City of Philadelphia meal sites



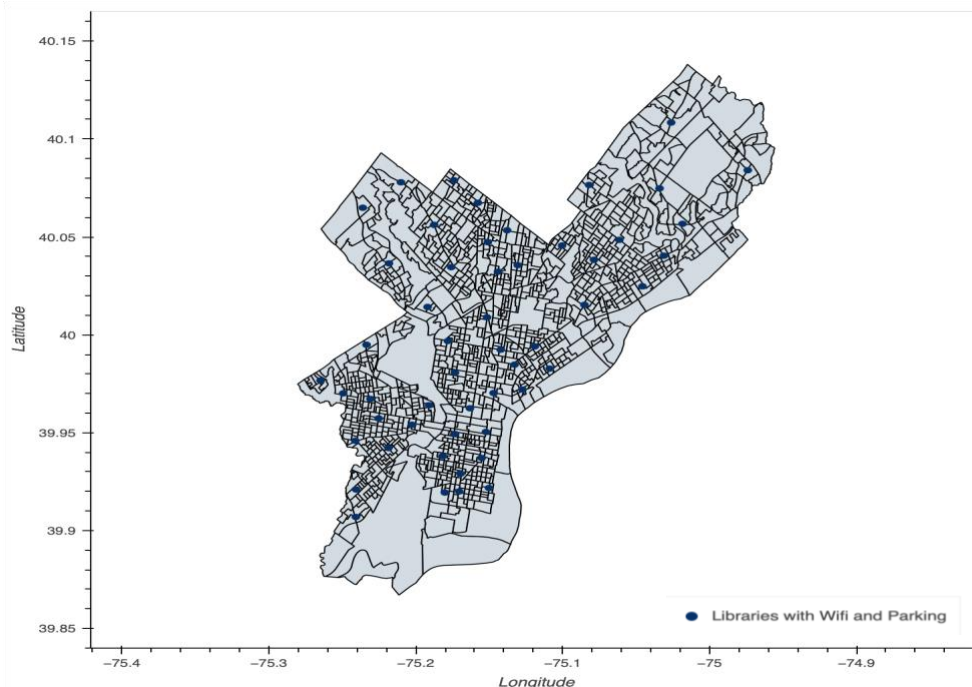
Philabundance meals sites

Free Library

Extracting free libraires with Wi-Fi was similar to data extraction that of community parking as it as had static content too. I used Python library called ‘request’ to extract all the data from the website and further used python library ‘beautiful soup’ to sort the extracted data to filter only the addresses of the libraries. In this data.

Free Wi-Fi

The required content was dynamic, so similar to food distribution sites, the same process was replicated using ‘selenium’ and ‘beautiful soup’



Census

Used 'cenpy' Python library in order to extract shape geometry coordinates of all the census tracts pertaining to city of Philadelphia. Information regarding variables (or parameters) were also called in this step.

B19013_001E - Median household income in the past 12 months

B25058_001E - Median contract rent

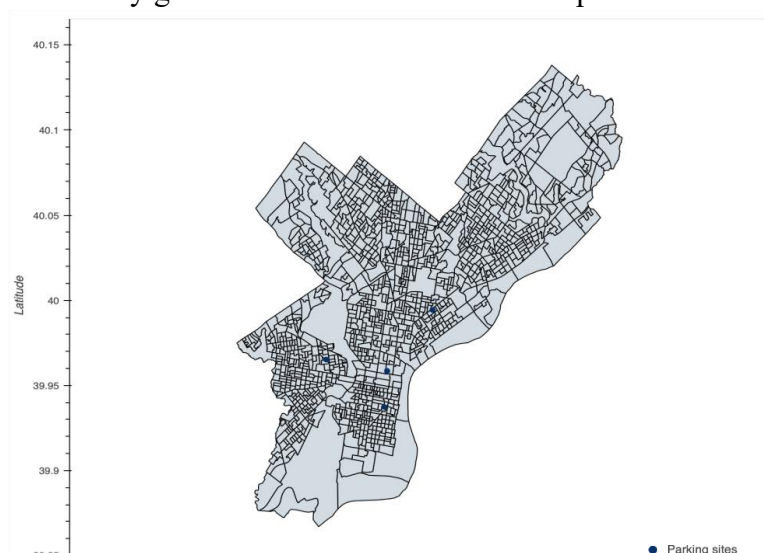
B14007F_019E – Total not enrolled in school

B15003_001E – Total educational attainment for the population 25 years and over

B15003_002E - No schooling completed educational attainment for the population

4. Analysis

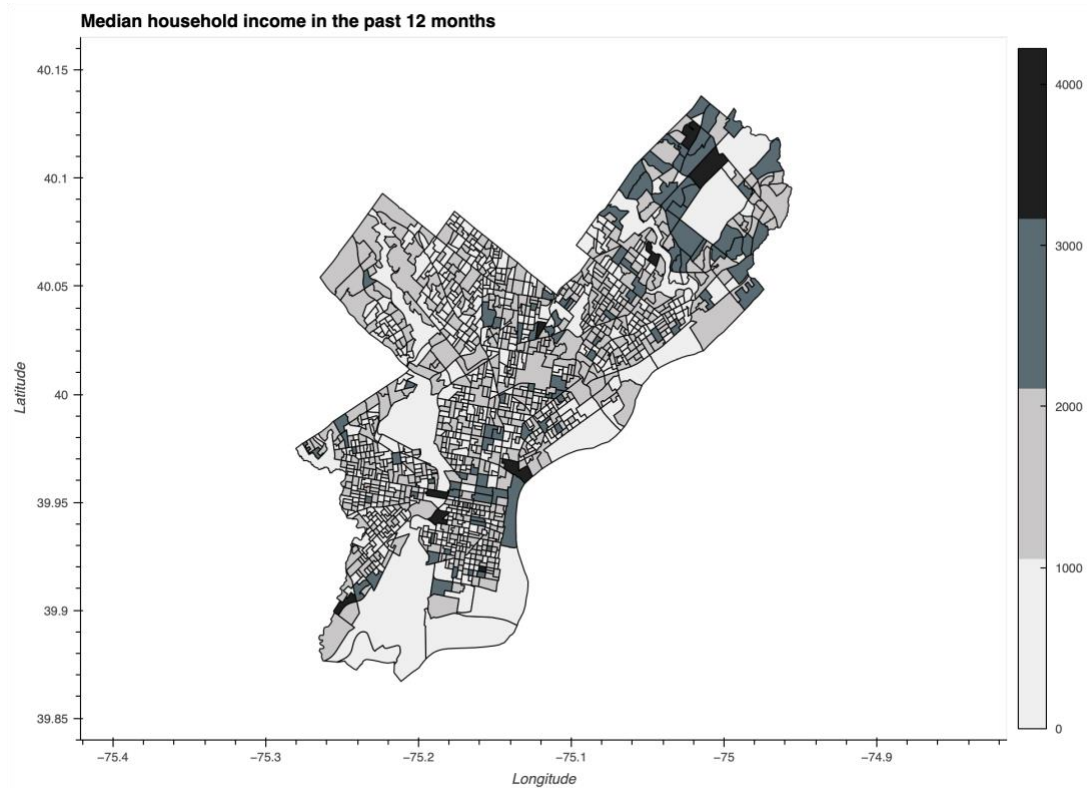
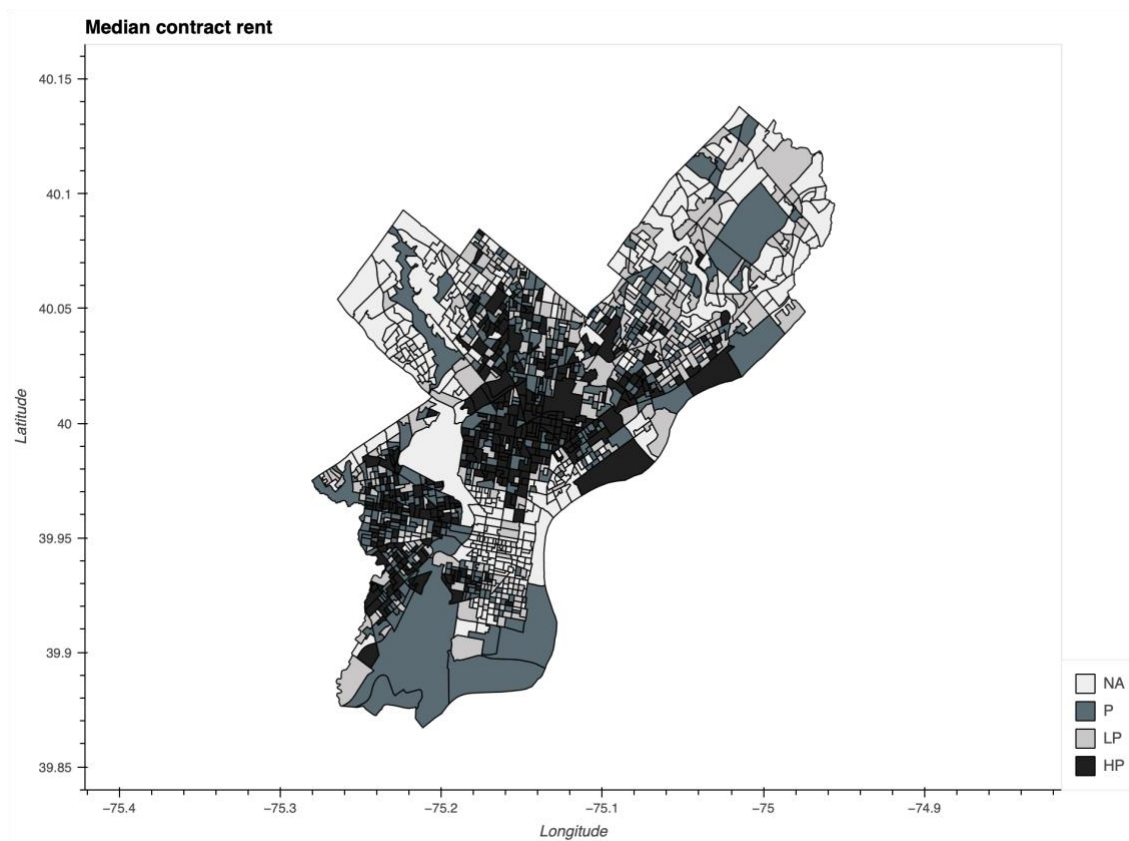
Google Maps API was used to get the latitudinal and longitudinal details to supplement the addresses of all the data that was extracted. Once all the data points had latitudinal and longitudinal information, all the parking lots, parks and rec were taken to examine their proximity to existing free meal and food distribution locations with 2km radius of their location and public Wi-Fi access within 100m of their locations. This was done to make sure potential network sites are not in too close proximity to the existing meal and food distribution sites to enable better coverage across the city, also to leverage the existing Wi-Fi infrastructure instead of having to establish a new infrastructure. This finally gave a consolidated data base of potential network sites.





a. Census analysis

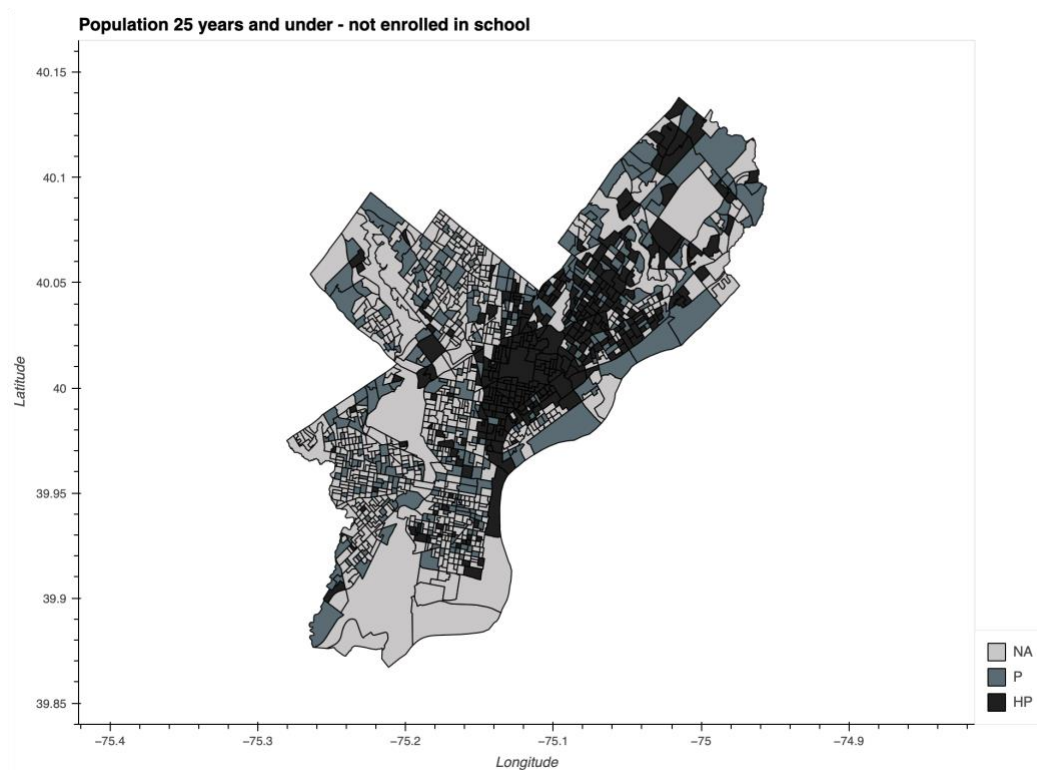
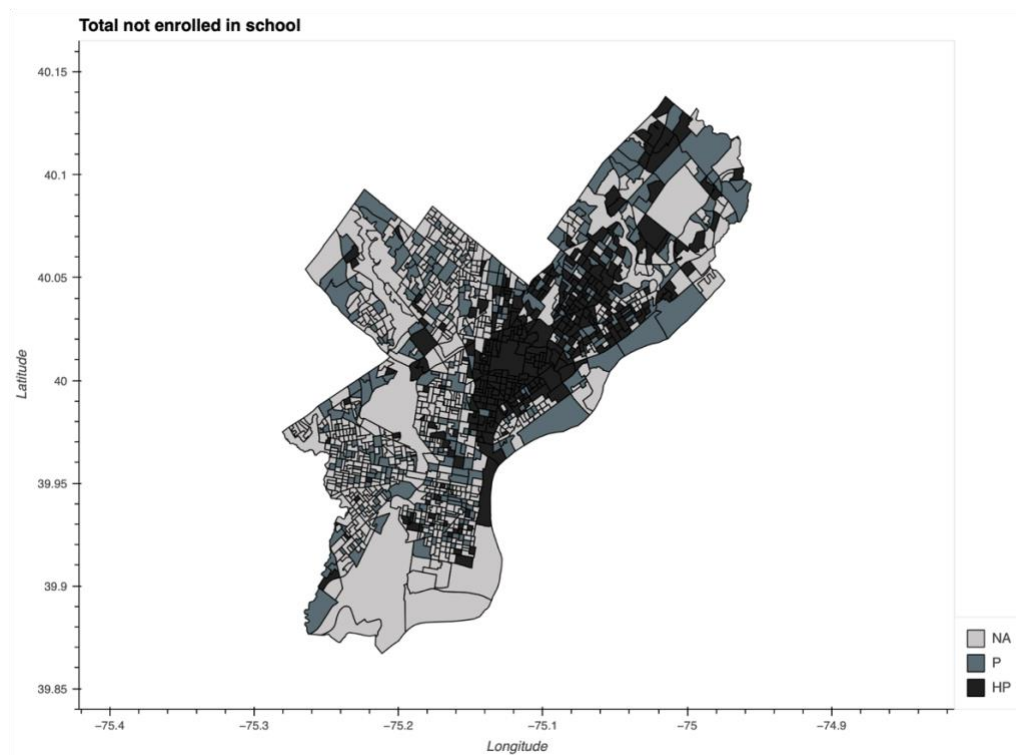
Median household income was a very important indicator as it shows people's income which invariably tells us about their affordability and can give an vague idea of if they could be facing challenges affording healthy food or access to internet. From this map, we can tell that for most of the city high income areas are concentrated around center city and northern most regions. and the lowest range of income households are distributed around the city.

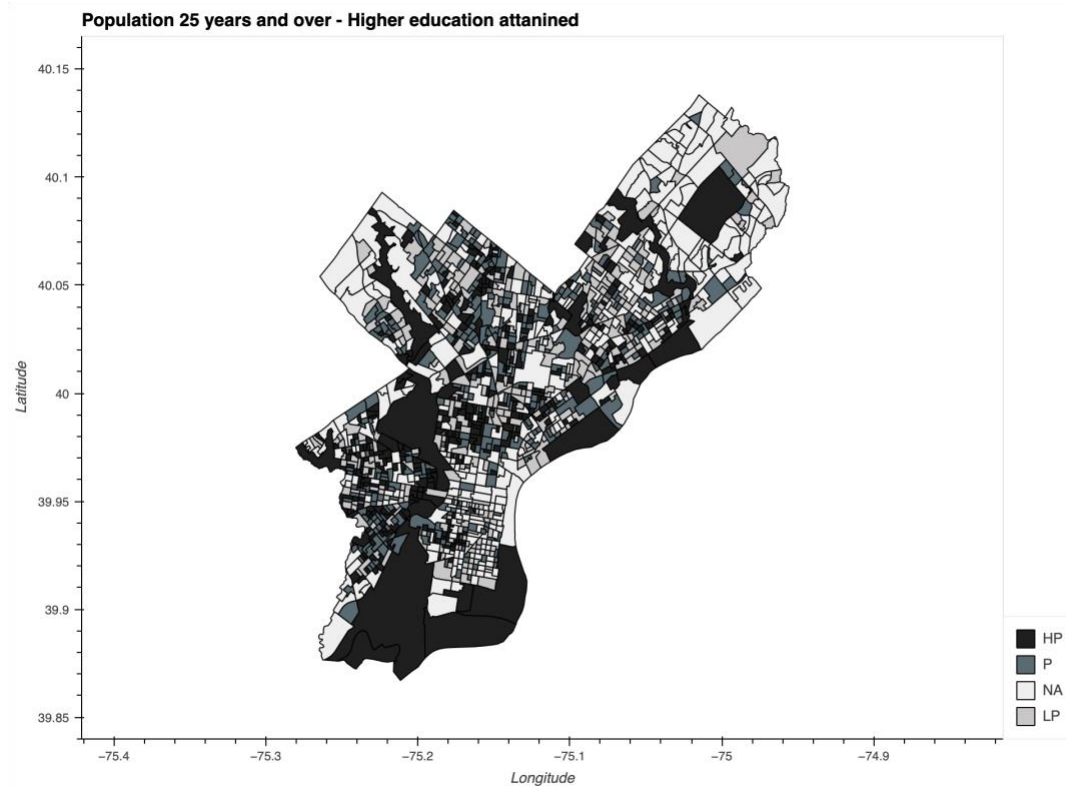


b. Process and ranking

To understand which tracts were in dire need of these network points we categorised the census tracts as 'High Priority', 'Priority', 'Low Priority' and 'Not required(N/A)' for each of the variables. On the basis of the distribution of the data, I divided the data into 4 parts for example for 'B25058_001E' - Median contract rent min-25% value range comes under "High Priority" 25%-50% value range is "priority", 50%-75% value range is 'low Priority' and 75%-Max is "Not required(N/A)" as people in this range pay a high medium contract rent and won't need any network points in these tracts.

Education being one of the important factors to define a person is able to hold a steady employment or not, it was important to analyse education attainment in both adults over and under 25 years. If a region or household with children are not enrolled in school, it could directly relate to the household or parents not being able to afford enrolling children into school due to lack of financial means, which could also make children and the parents vulnerable to food insecurity and children in their developmental years need nutritious and healthy food for cognitively fully developing hence this is a variable or parameter of at most importance to target household with children that could be facing food insecurity. If someone over 25 years was not enrolled in school could mean that they are highly likely to not being able to have a steady income and might be facing food insecurity due to lack of money.

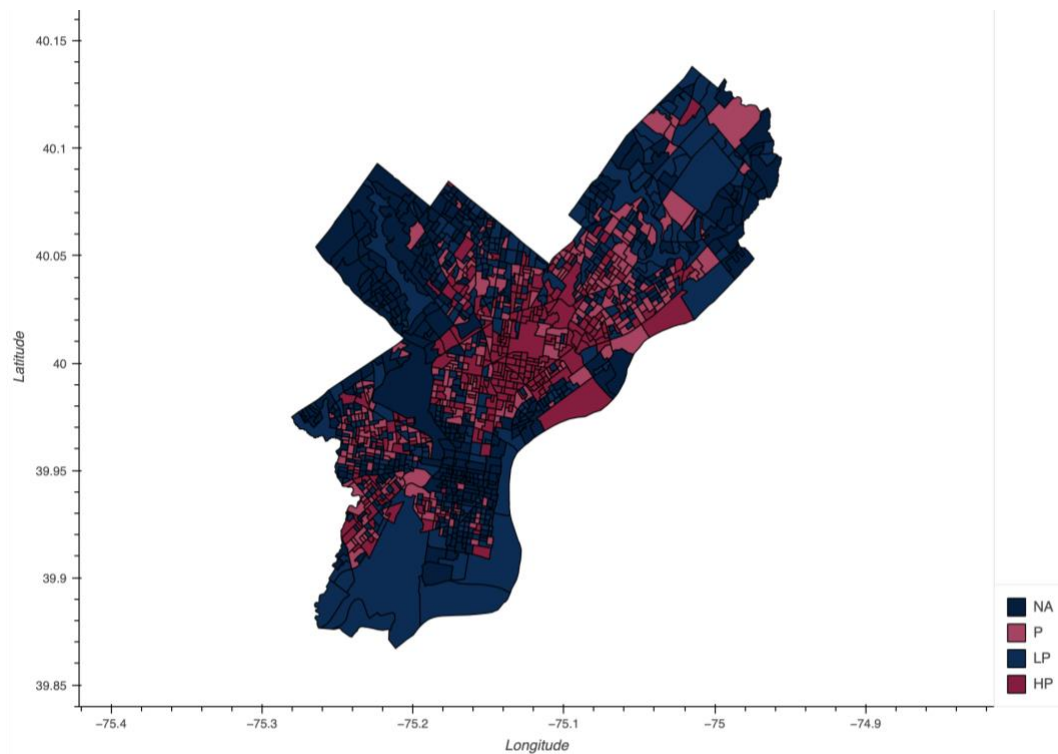




c. Cumulative ranking

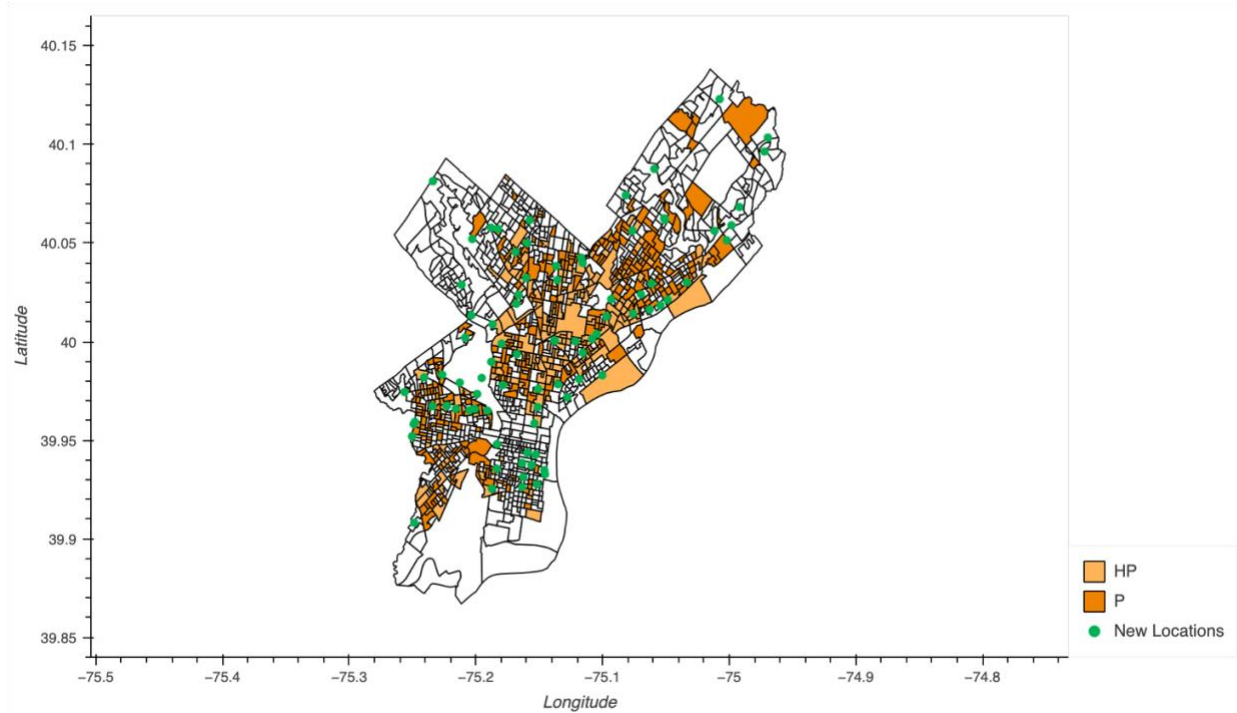
With the help of above categories, we further evaluate the census tracts and divide them into four broad rankings as 'High Priority', 'Priority', 'Low Priority' and 'Not required(N/A)'. To do this we start with assigning points to every category as High Priority = 10', 'Priority = 5', 'Low Priority = 1' and 'Not required(N/A) = 0'. With this we were able to gauge over all requirement for each census tract according to these parameters. After this we focus on the distribution of the potential

network sites in high priority and priority regions.



5. RESULTS

My final analysis of the project is that there are numerous tracts that are in need for meal sites but lack of one, but there also tracts that are in need, but my network sites don't cover. Besides of covering tracts that need these sites, there are sites in tracts that don't need are in low priority as well, which can be either disregarded or can be used to supplement their neighbouring tracts where either that are not covered in the network or need more than one site to cater to their needs. Tracts that are in high priority or priority but are not covered by my network will tackled in a different way beyond just scouting for public parking lots or parks etc., but potentially looking at street corners or public/private empty lots, nonprofit organisations working for children and women welfare or care centers where people are more like to approach to avail their facilities, which also increases the visibility of these networking sites, subsequently maximise their usage.



One very stark outcome from the analysis of the existing meal sites is the concentration of the distribution points being mostly around center city, which gives my project plenty of scope to be developed and executed into a valuable solution in scouting for sites in the areas where there are no existing meal sites. Another very valuable insight was the lack of public Wi-Fi locations outside of center city, except for a handful of them which makes a drawback in tackling low digital literacy rates in tracts where there is a dire need.

6. NEXT STEPS

This project can be further developed by analyzing the total population of each tract and estimating how many people can a single network site accommodate based on factors such as size of the site, facilities at the site and the proximity of the site to food sources. This will help estimate the number of new sites that truly will be required in each tract to meet the demand.

To finally round the project to start implementing it, last but a very critical step is sourcing the food from restaurants, grocery stores, cafes, and other food collection establishments. For this, we need to first list and analyse participating restaurants, how much food can be sourced, what the demand is for the current food insecurity in Philadelphia.

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