Grocery Store Access via Public Buses in the City of Los Angeles, CA

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Abstract

Urban environments are home to people of all socioeconomic backgrounds. While many people in the Los Angeles area are above the poverty line, there are many more living in poverty. Lower income people and families have a more difficult time getting access to fresh food, whether from not having enough time to shop and cook, or not having a grocery store nearby with easy access. Public transportation is an easy way to get around a city with no car and on a budget. Equal access to fresh food for a healthy diet is a high concern, especially those who live in food deserts where fresh food is difficult to come by. This project assessed the proximity of grocery stores to bus stops in the city of Los Angeles and approximated their accessibility. There were three input options for walking distances from the bus stops: short, medium, or far. The results show that throughout the city of Los Angeles, there are many grocery store options within all input walking distances that people of any background can have access to.

Introduction

Large metropolitan cities house some of the greatest diversity of people from all different socioeconomic backgrounds. Those who live under the poverty line or work at various times, including nights, do not have equal access to grocery stores or stores where they can purchase fresh foods to be able to maintain a healthy diet (Widener, et al., 2017). In Los Angeles, there are many food deserts, or areas where there are little to no grocery stores or access to fresh foods typically in low-income neighborhoods. These neighborhoods also commonly host more fast-food restaurants than surrounding wealthier neighborhoods. This leads to an unhealthier diet and therefore lifestyle for many people living in poverty. The food people consume can be largely influenced by environmental cues and purchasing patterns, so when there are more fast-food restaurants than grocery stores, many will gravitate towards food that is quick, cheap, and unhealthy rather than find a grocery store to buy fresh food and cook

(Fielding & Simon, 2011). In most major cities, there are a plethora of public transportation that one can take, including buses. There are bus stops in most neighborhoods, regardless of socioeconomic level, meaning people of all backgrounds most likely have access to public transportation.

For those without a car, public transportation is the best option for getting access to fresh food. While there is still a cost associated with taking a bus, the cost is much cheaper than ride share services and allows people to haul groceries. While the Los Angeles Metropolitan area consists of many cities, including many low-income cities immediately surrounding Los Angeles City, the scope of this project will only include bus stops servicing the city of Los Angeles, rather than the County of Los Angeles and beyond. The city of Los Angeles is home millions of people and just focusing on the city boundaries will give a reasonable estimate to grocery store access from bus stops throughout the county. This project focuses on creating a buffer around bus stops and providing a list of grocery stores based on the provided distance in the city of Los Angeles.

Materials/Methods

There are three datasets used in this project. The first dataset is the city boundaries for Los Angeles County found from data.lacounty.gov, where the city of Los Angeles boundary can be extracted from into a new vector polygon layer. The second dataset is the bus stops vector polygon layer, sourced from develop.metro.net. Since this bus stops layer is for all of Los Angeles County, an extra geoprocessing step needs to be taken such that the analysis is for only bus stops within the city of Los Angeles limits and not the county. The third dataset is the grocery store locations, found on data.lacity.org, and is a vector point layer containing the names and addresses of all known grocery store locations within the city limits.

The coding portion of this project was done in Jupyter notebook in ArcGIS Pro, then later transferred Python IDLE shell. The use of Jupyter notebook is to be able to visually analyze the results and output of the code. After starting a new notebook, the first step was to import arcpy and os, then set the workspace using the code *arcpy.env.workspace* and setting a path file. For this project, a new folder was created consisting of datasets and output shapefiles created for this project. Once the parameters and environments were set, the next step was select the polygons that pertain to Los Angeles city, from the city boundaries layer. This was completed using the arcpy function *Select*, where the city boundaries layer is used as the input layer and *where* clause is defined as "city" equals 254, or the number given to Los Angeles city polygons in the metadata. After the tool has completed, there is a new shapefile consisting of only Los Angeles city boundaries, entitled "LA_city_boundary", then the output of the tool is printed. To ensure the shapefile consists of only polygons with the city boundaries, a for loop was created to print all rows in the "city" column and "city_id" column, then the loop was printed. In order to use the for loop properly, a search cursor was used to be able to single out columns that are to be used in the loop.

```
GET city boundary data from file.
SET variables for select analysis.
ARCYPY.SELECT features for the boundary of Los Angeles City.
Save new output file.
ARCPY.SEARCH for specific attributes relating to the city of Los Angeles from above file.
Set variables for FOR loop
FOR each Los Angeles is attribute
   PRINT selected attribute list
ENDFOR.
```

The next step is to clip the bus stop layer to the city boundary layer. As aforementioned, the bus stop layer is for all of Los Angeles County, so this step uses another arcpy function, *clip.* For this tool, the input feature layer is the bus stops, the clip feature is the newly created city boundary layer, and the output shapefile is entitled "BusStops_LA". The output layer is then printed to be able to visually see the results. Once the clip is completed, the analysis portion begins. Since the project is to analyze grocery stores within a certain distance of bus stops, the geoprocessing tool that would work best for this analysis is a buffer. A buffer of varying sizes would allow more customization with user input depending on how far someone would want to walk. Instead of asking the user to input a numerical distance, pre-determined distances are used, and the user will select one of three options: short, medium, or far. This allows for more simplicity on the users end and more simple code. The three options, calculated in degrees are 0.01, 0.025, and 0.04 for short, medium, and far, respectively. These distances equate to one street block, a few street blocks, and many street blocks. For this analysis, the input() function, a conditional statement, and the arcpy *buffer* tool, are all used. The first step is to ask for the user input, then write the conditional depending on what the user has entered, then embedding the buffer tool into each condition, changing the distance for each. The output will create a new polygon shapefile called "BusStops_Buffer" and will vary in area depending on the distance selected.

```
INPUT distance from bus stops.
IF distance is short
    ARCPY.BUFFER determined short distance THEN
    PRINT resulting list of grocery stores within buffer
    Save the created output shapefile.
ELSE IF the input distance is medium
    ARCPY.BUFFER determined medium distance THEN
    PRINT resulting list of grocery stores within buffer
    Save the created output file.
ELSE IF the input distance is far
    ARCPY.BUFFER determined far distance THEN
    PRINT resulting list of grocery stores within buffer
    Save the created output file.
ELSE the distance is not usable.
```

The last geoprocessing tool used is the arcpy *intersect* tool. These tools finds where grocery stores intersect with the bus stop buffer area and gives an output shapefile layer, called "stores_bus_intersect", containing all grocery stores that lie within the buffer. The input features for the intersect tool were the grocery store shapefile and the bus buffer that was created in the previous step. For more interaction with the user, another input is used to ask the user for a grocery store name and the function will return a bus stop number related to that grocery store. Since there are thousands of grocery stores within the buffers, a short example is provided using one selected store. To create the output, a search cursor is used to be able to draw information about grocery stores and their related bus stop. A for loop is then created with a conditional statement stating if this particular grocery store (i.e., Ralphs #266) is entered, then print its related bus stop (i.e., "Bus Stop #2668). A *break* statement is added post *if* statement to stop the code from continuously printing the bus number. If one were to want to ask for multiple inputs for many conditions, the input() function can be moved into the loop and the user can therefore ask about multiple grocery stores separately and know which bus stop to get off at for each of the stores.

```
GET buffer and grocery store files.
ARCPY.INTERSECT grocery stores in the buffer.
PRINT results to a new shapefile.
Set variables for search cursor and for loop
ARCPY.SEARCH for the store name column.
INPUT a grocery store name.
FOR grocery store input in the store name column
    IF the input name is Ralph's THEN
    PRINT corresponding nearest bus stop
    BREAK loop
ELSE input a different store name
ENDFOR.
```

Results

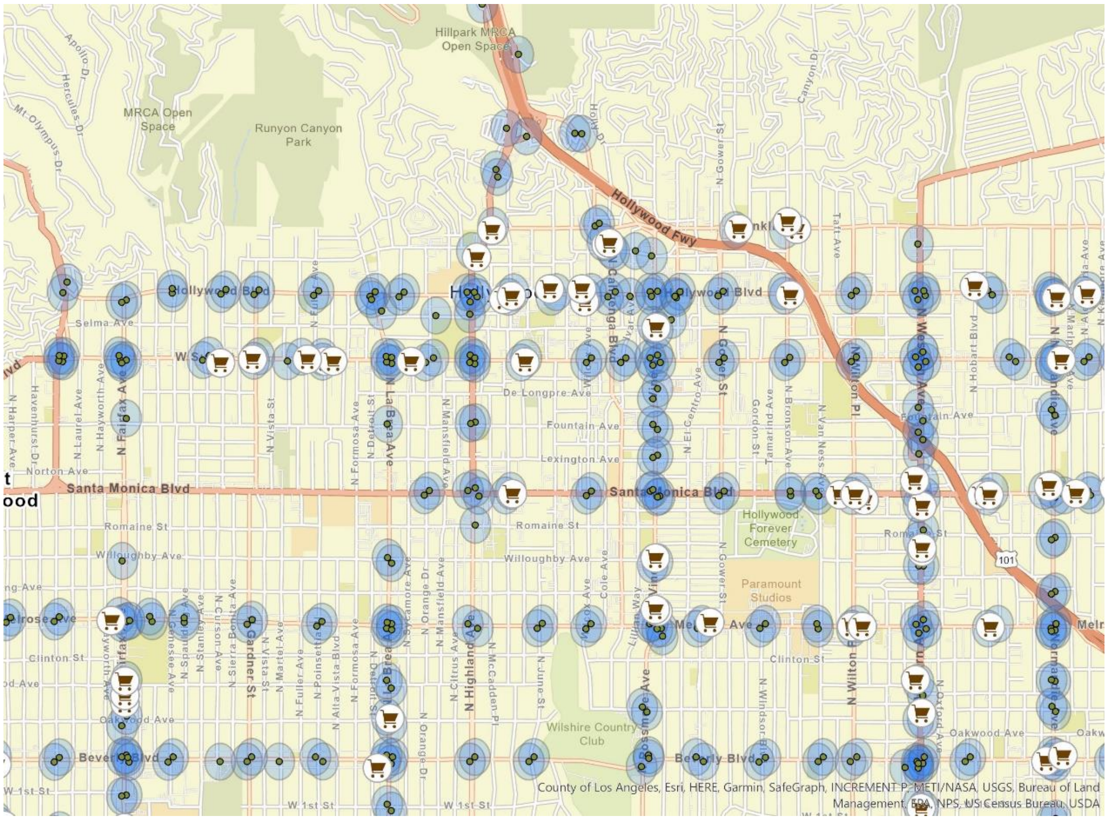

Image 1: “Short” buffer distance from bus stops with intersecting grocery stores

The example area chosen of the final result was of the Hollywood area, an area where bus stops are abundant but are not too dense, such as in downtown Los Angeles. All images included are of the same area, the only difference being Image 1 has the point layer of the bus stops included. This addition in Image 1 is to show the exact location of the bus stops but to not overcrowd the following images. In Image 1, the short distance of 0.01 decimal degrees equates to approximately one block of walking distance, which means the grocery stores seen in this buffer distance most likely have a bus stop next to the parking lot. These stores would be a great option for those who cannot walk far or are handicap. In just this small sample area, there are many options available.

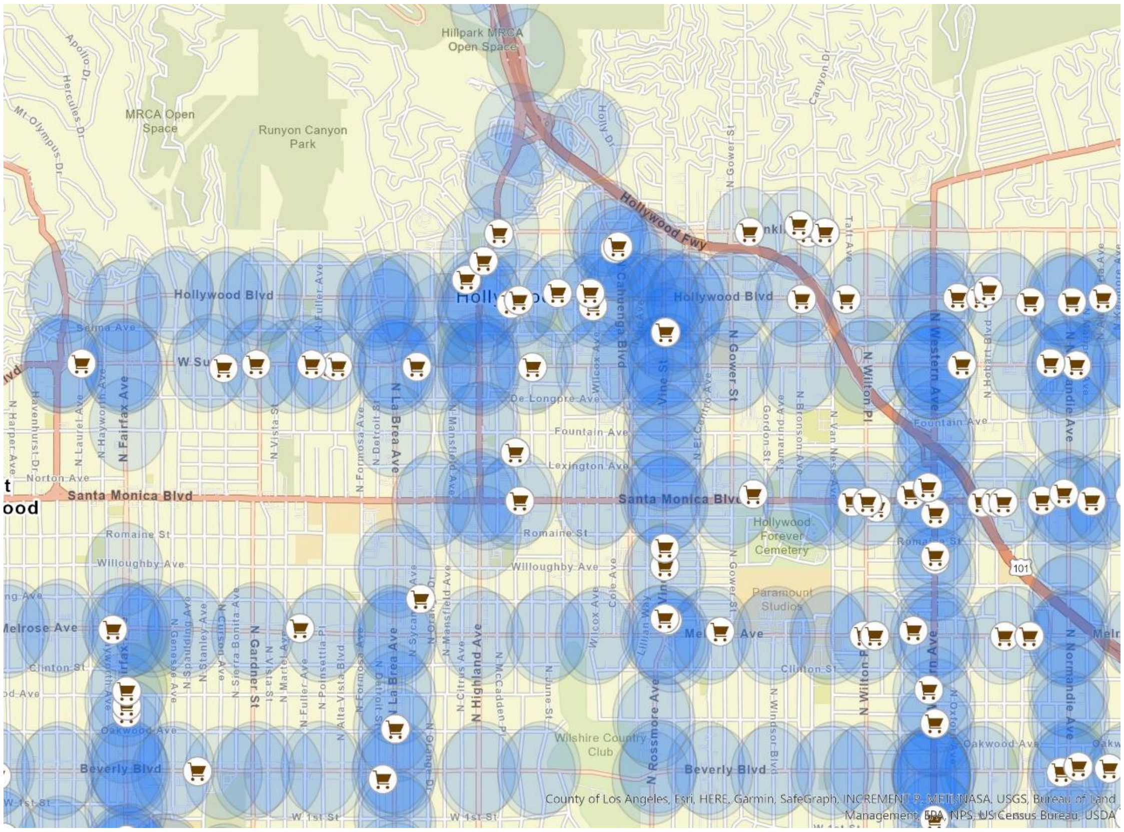

Image 2: “Medium” buffer distance from bus stops with intersecting grocery stores

Image 2 shows the medium buffer distance of 0.025 decimal degrees, which is a range of about two and a half blocks. As shown, there are quite a few more store options than the grocery stores within the short buffer. With the medium distance, there is also more overlap between the buffer distances, especially in the western Hollywood Boulevard section where the medium distance has double the amount of possible grocery stores. With this distance, dispersity of grocery stores is becoming more noticeable. When analyzing the map, there are sections of road that have no grocery stores, or a very little amount of grocery stores for dozens of blocks. This area of Los Angeles is mixed with many homes and businesses, meaning not everyone will have a nearby grocery store to shop at. This disparity can mostly be seen along Beverly Boulevard, along the southern portion of the sample area.

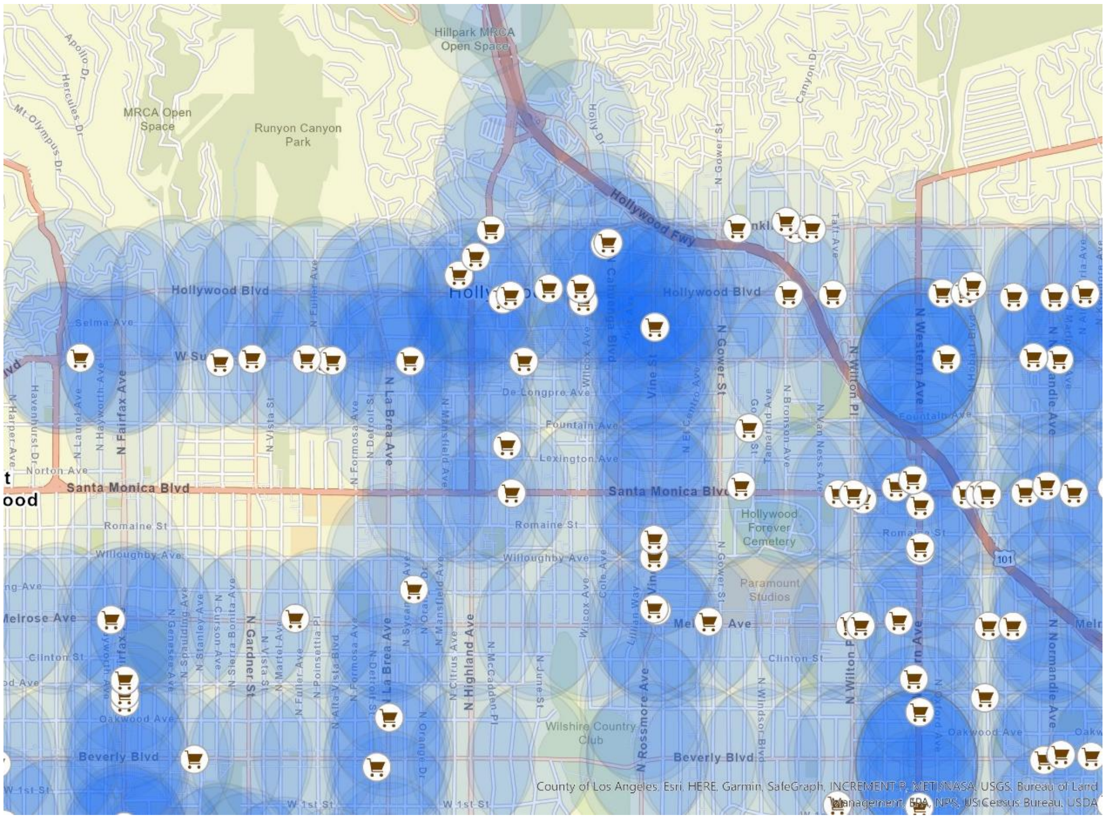

Image 3: “Far” distance buffer with intersecting grocery stores

Image 3 depicts the far buffer distance from bus stops of 0.04 decimal degrees, which equates to about three and a half blocks. Similarly, to the medium distance, the far distance has about the same amount of grocery stores in this sample area. The slight differences in amount of grocery stores can be seen on some of the smaller streets in the west side of the image where medium buffer could not reach. Along the south portion of the sample area, noted above as Beverly Boulevard, there is only one grocery store that has been included within the buffer range, showing that the area does not have many grocery store options. After analyzing the grocery stores within the buffer distances, this sample area is similar to what you would see throughout the rest of the city. The only exception would be downtown Los Angeles, where there are a lot of bus stops and also many grocery stores. Throughout the city, there are areas with a high amount of grocery stores and areas where there are no stores nearby bus stops. Regardless of how far one wants to walk once getting off of the bus, there are many options for all three distances. While this outcome may not directly show individual grocery store names or bus stop numbers, access to grocery stores from bus stops is feasible.

Discussion/Conclusion

The results find that there is a great amount of grocery stores within walking distance to many bus stops in Los Angeles. This analysis provides clarity on the conversation about equal access to fresh foods. While there are many demographic variables not included in this project, such as income and population, the results show that within the city of Los Angeles boundaries, accessing grocery stores is attainable through public buses. If someone would only want to walk a short distance across a parking lot to a grocery store, there are many bus stops that would allow that. Though the outcomes prove promising, there are many factors in which this project can be improved upon. Due to the simplicity, there were many beneficial factors that were not considered in this project. The code provided for this project deals mostly with user input in which problems could arise if a user does not know the exact name of a store. There are currently over a hundred bus routes offered in Los Angeles County, many of them crossing over into the city of Los Angeles. Without already knowing the bus route of the resulting bus stop number, it could be very difficult to find both the stop and the store. The results mainly lie a foundation to many future research regarding access to grocery stores.

For future research, the project can be modified by updating the code to allow for input of any grocery store, rather than just the one current selection, or example store provided in this project. Another modifier could also be including all of Los Angeles County, as many areas and cities surrounding the Los Angeles city border are impoverished with less access to public transportation. The initial bus stop layer used in this project contained well over twelve-thousand points consisting of every bus stop in Los Angeles County and was reduced to the Los Angeles city limits for the purpose of this project. Using the whole county dataset with demographic data, it would be interesting to conduct a project comparing lower income neighborhoods throughout the county and find if access to grocery stores varies among these neighborhoods. Eating healthy and having a balanced diet is something that every person should have the opportunity to attain. Food deserts, where fast-food is the most abundant type of food, are common in lower income communities. Based upon the findings, those who live in food-deserts can obtain grocery store access, even though they may not have a car. The use of public transportation allows people from all socioeconomic backgrounds to have equal access to a healthy, balanced diet.

References

Fielding, J.E., Simon, P.A. (2011). Food Deserts or Food Swamps? Comment on "Fast Food Restaurants and Food Stores" Arch *Intern Med*, 171(13):1171–1172, doi:10.1001/archinternmed.2011.279

Widener, J.M., et.al. (2017). How do changes in the daily food and transportation environments affect grocery store accessibility? *Applied Geography*, 83(46-62), https://doi.org/10.1016/j.apgeog.2017.03.018.