Livable Streets: Infrastructure Group D

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CS 506: Data Science Tools and Applications

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Introduction:

The project that our group undertook was given to us by LivableStreets Alliance, who work to create a better living space and environment for people living in the Boston area. The main goal of this project is to connect open spaces, infrastructure, and displacement meaningfully through data analysis. This type of project should ideally find out what type of relationship, if any, marked bus lanes, parks, and greenways have with relation to displacement in the zones they are located. There were multiple groups assigned to this project, and so they were split into two categories: one group focused on greenways/parks and the other focused on bike/bus lanes. Our group was assigned to focus on greenways and parks.

In order to connect greenways to any potential displacement, we decided to look primarily at data from Boston.gov; first to find out if any displacement had occurred in any of the Boston neighborhoods, and if it did, to find out how much it had affected that area. Secondly we looked at open space data, to see which locations had more parks and to identify greenways. For the sake of this endeavor a "greenway" was defined as such: "off-street, landscaped, linear park spaces with a transportation component (like a multi-use path)". In order to properly and efficiently distinguish between greenways and more general green spaces we referred to the data from Boston Green Links.

The concept of connecting greenways to displacement is important in the context of city planning and could potentially influence policy making decisions. For example, if it can be shown that there is a causative relationship between greenways and displacement, that can be used to prevent the creation of any new ones. At the same time, if we were to find that there is no cause and effect relation between them, but displacement still seems to be occurring, it could be a sign that there are other contributing factors that are worth examining. According to LivableStreets Alliance this is an important undertaking because at the current moment there is national data that supports a correlation between train stops and displacement. However, there has been little or no analysis of Boston specific data. On top of that, where there has been data gathered and examined, the focal point has been about the effects of train stops, as opposed to bike lanes, bus lanes, parks, or greenways. This type of information is very important for an organization such as LivableStreets Alliance to have, but also for the city of Boston in general. Without it, they have to generalize or make assumptions based on national data, and can only approach the creation of new policies with personal anecdotal information or their own biases.

Base Analysis:

Over the course of our analysis we were tasked with answering the following four questions:

1. What is the correlation between the creation of greenways and new parks and displacement in Boston?

To answer this question we began by looking at census data from Boston.gov in order to get data on how much the population of different neighborhoods has changed. We had two data sets for this: the most recent and the second most recent census reports. Both datasets included information on different demographics categorized by race. Due to the similar nature of these two sets, it was fairly straightforward to combine them: We made a list of the names of different Boston neighborhoods and combined the entries in the datasets where the names matched. This allowed us to create multiple new features based on the difference between the two censuses, namely the change in population for the White, Hispanic, African American, and Asian populations. Any remaining people got placed into the "other" category. There was also one for the total population change, regardless of race.

It is important to note that while a change in population may be indicative of displacement, they are not exactly the same thing. Displacement is more specifically when people are forced to move out of a certain location to, in this case, make room for new projects such as greenways. If a zone experienced a decrease in population that would be a sign that maybe displacement had taken place and those people were forced to move, but it also could be the case that the locations with no change, or even an increase in population, also experienced displacement. In these cases, people of a certain demographic or of lower socioeconomic status would be forced to move and then other people took their place. This is the primary reason we examined data on different races, but we also looked at the change in median housing price of different neighborhoods in Boston as well. This housing data is important because, while we would expect a steady increase due to inflation and an improving economy, any rapid increase in housing prices would be a sign that gentrification had occurred there. Gentrification is a process where a location is made "nicer" or the cost of living otherwise increases, displacing lower income families while allowing higher income households to replace them. This is vital to our analysis because we wouldn't be able to identify this type of displacement based on just population data alone.

To identify a location where this might be taking place we compared the changing housing price rate of different Boston neighborhoods to the rate for Boston as a whole. If a specific area experienced a significant increase during the same time period without a major increase for the rest of Boston it would show that something had happened in that neighborhood which had a large impact on the housing prices. We will go further into detail later in this section.

We also had to gather data on parks and greenways as well. For this we again referred to Boston.gov, specifically the open spaces tree canopy metrics. Unlike for the population data, we were able to gather what we needed from this dataset alone, so it didn't require any merging, but it did provide lots of information, some less necessary than others. Thus, we had to do some pre-processing to make sure that the locations lined up with the ones we had data on for their populations. The open space data did have location names, but some places were labeled differently, and others were excluded entirely. For the sake of this project we were only able to focus on those locations that appeared in both data sets, but we were able to use the ones labeled differently by simply renaming them so that they lined up better. There is some downside to this, because certain greenspaces were too large and ended up being in multiple neighborhoods at once. There was no way to tell which portion of the space was in which neighborhood, so we just had to classify it as the entire thing for each one. This means that the numbers for total acreage for each zone may be slightly larger than the actual values.

From just analyzing this data we were able to correlate the number of acres of greenspace in each neighborhood, to the corresponding change in population. The results can be seen in the following figures:

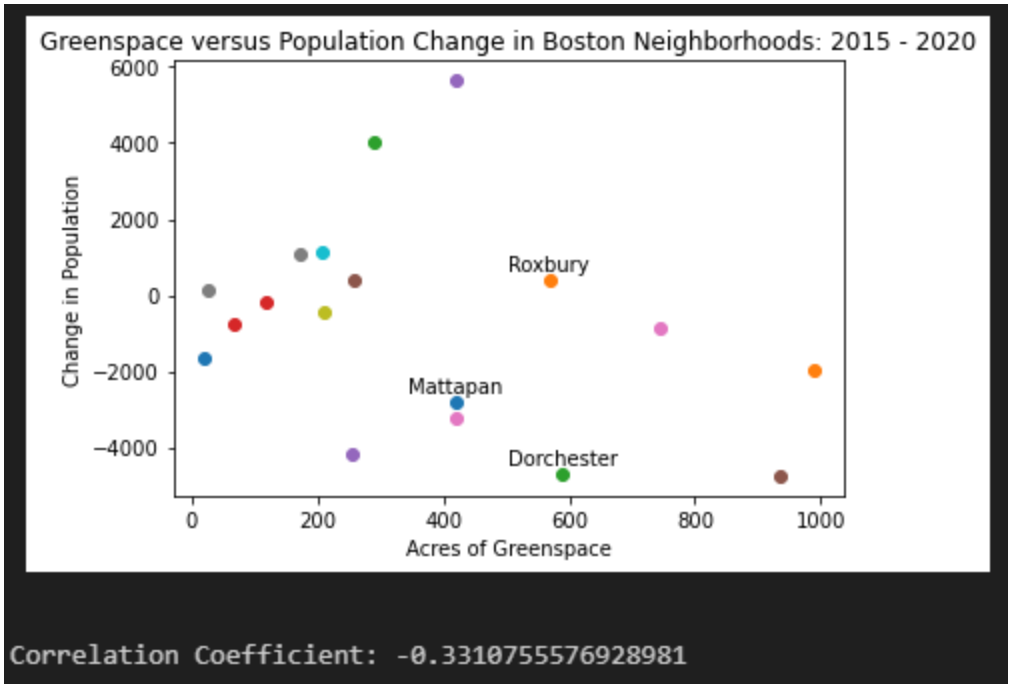


Figure 1. Greenspace versus Population Change in Boston Neighborhoods 2015 - 2020

This graph shows the acres of greenspace in Boston neighborhoods with respect to the change in total population between 2015 and 2020. Each neighborhood is represented by a single dot on the graph, with Mattapan, Roxbury, and Dorchester being labeled as they are focus locations. The correlation coefficient between these two features is slightly negative.

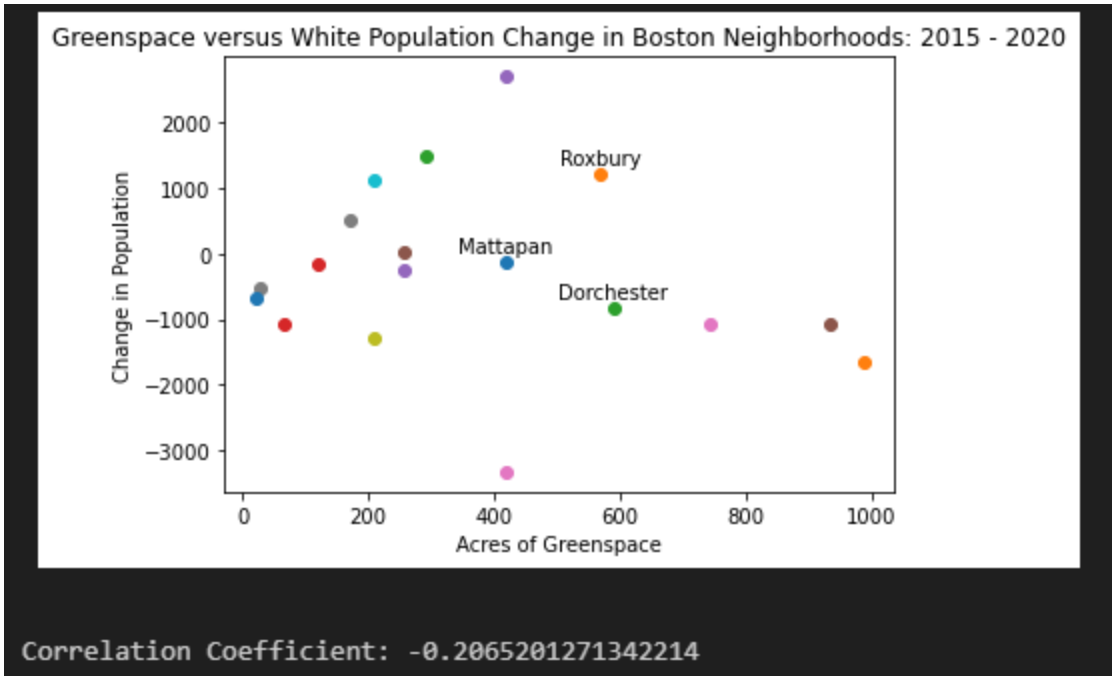


Figure 2. Greenspace versus White Population Change in Boston Neighborhoods: 2015 - 2020

This graph shows the acres of greenspace in Boston neighborhoods with respect to the change in the white population between 2015 and 2020. Each neighborhood is represented by a single dot on the graph, with Mattapan, Roxbury, and Dorchester being labeled as they are focus locations. The correlation coefficient between these two features is slightly negative.

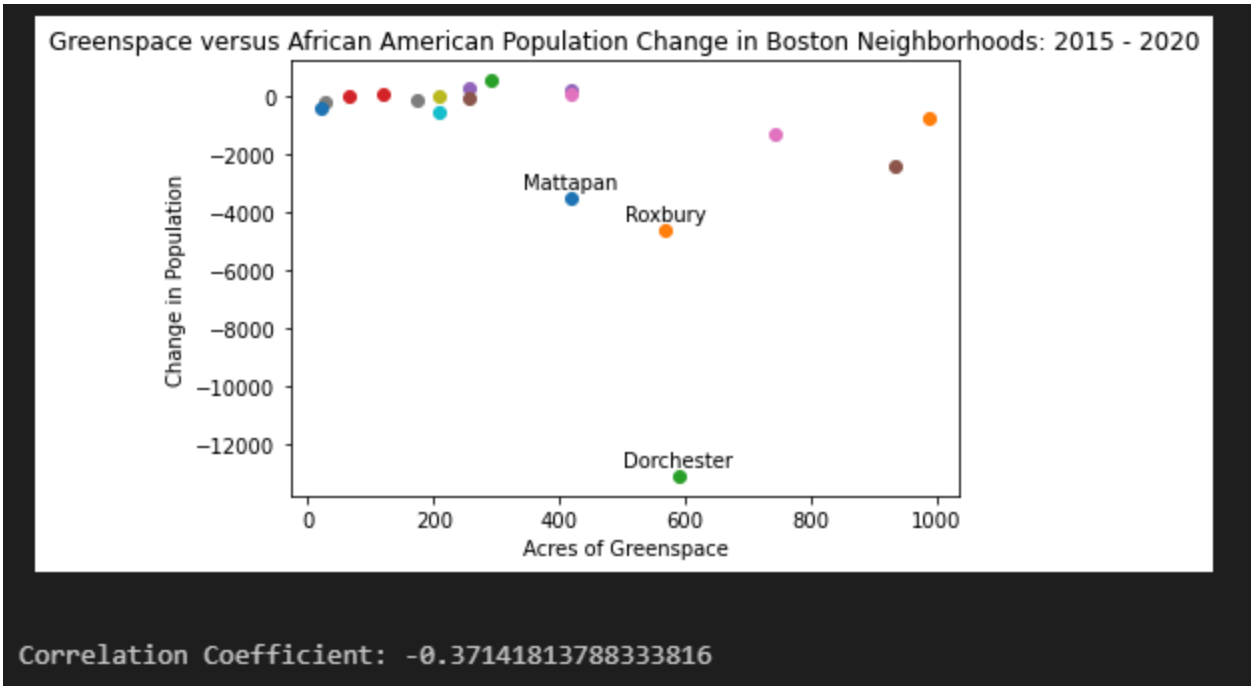


Figure 3. Greenspace versus African American Population Change in Boston Neighborhoods: 2015 - 2020

This graph shows the acres of greenspace in Boston neighborhoods with respect to the change in the african american population between 2015 and 2020. Each neighborhood is represented by a single dot on the graph, with Mattapan, Roxbury, and Dorchester being labeled as they are focus locations. The correlation coefficient between these two features is slightly negative.

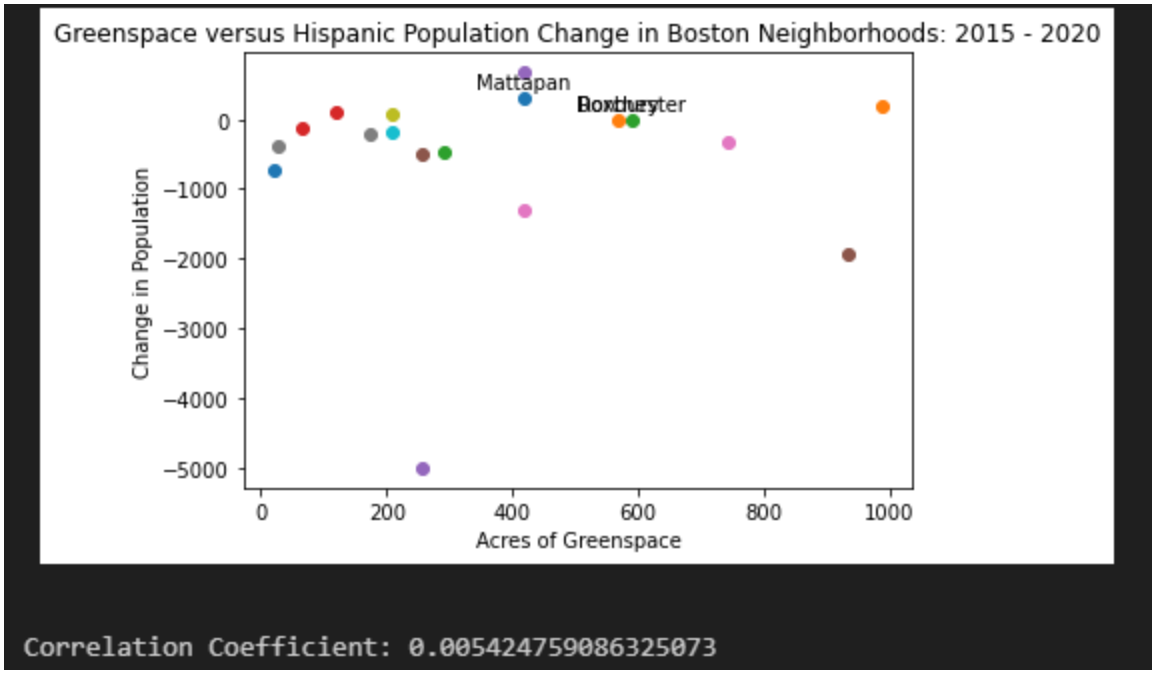


Figure 4. Greenspace versus Hispanic Population Change in Boston Neighborhoods: 2015 - 2020

This graph shows the acres of greenspace in Boston neighborhoods with respect to the change in the hispanic population between 2015 and 2020. Each neighborhood is represented by a single dot on the graph, with Mattapan, Roxbury, and Dorchester being labeled as they are focus locations. The correlation coefficient between these two features is essentially zero.

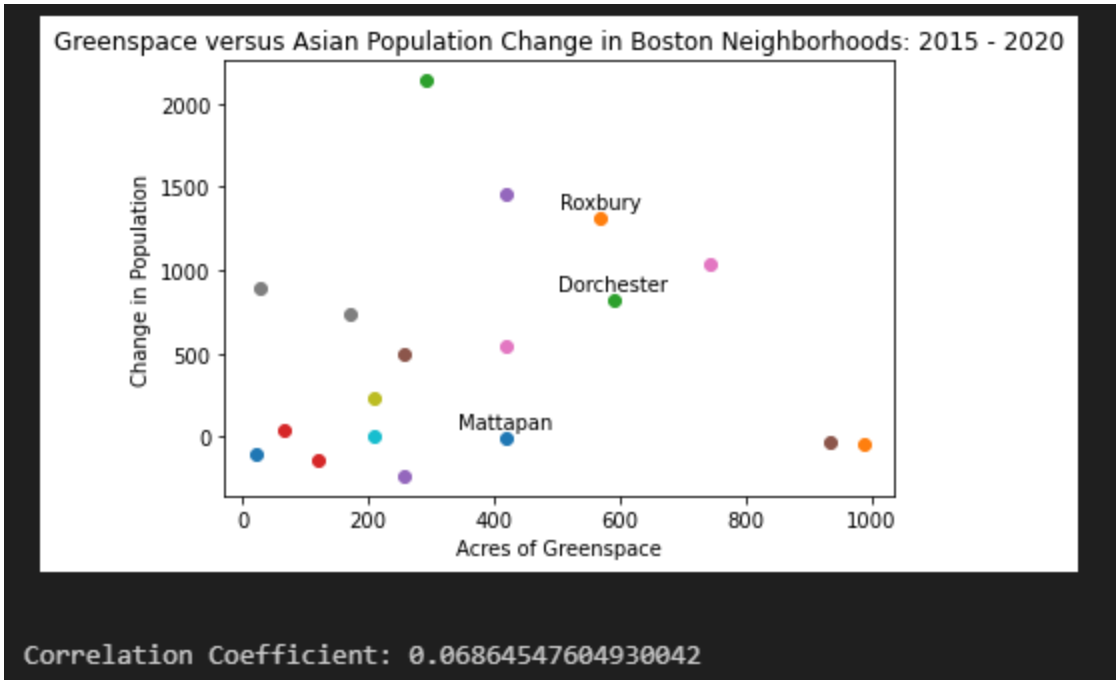


Figure 5. Greenspace versus Asian Population Change in Boston Neighborhoods: 2015 - 2020

This graph shows the acres of greenspace in Boston neighborhoods with respect to the change in the asian population between 2015 and 2020. Each neighborhood is represented by a single dot on the graph, with Mattapan, Roxbury, and Dorchester being labeled as they are focus locations. The correlation coefficient between these two features is essentially zero.

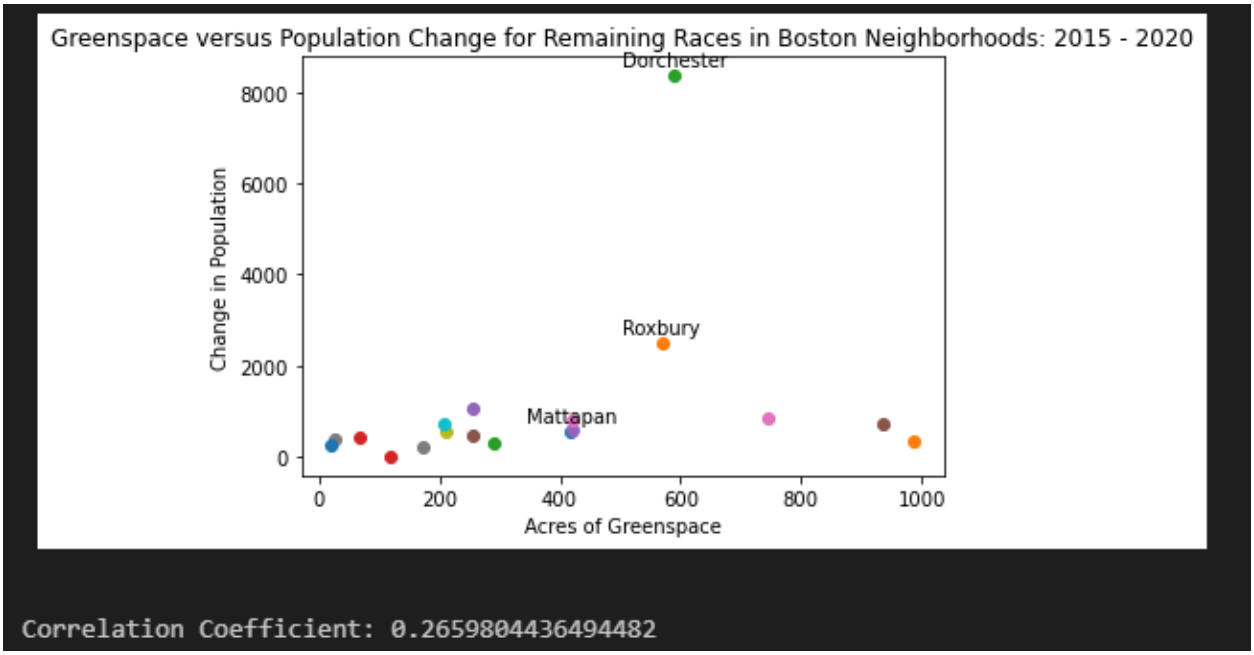


Figure 6. Greenspace versus Population Change for Remaining Races in Boston Neighborhoods: 2015 - 2020

This graph shows the acres of greenspace in Boston neighborhoods with respect to the change in the population of races not included in the demographics for Figure 2 through 5 between 2015 and 2020. Each neighborhood is represented by a single dot on the graph, with Mattapan, Roxbury, and Dorchester being labeled as they are focus locations. The correlation coefficient between these two features is slightly positive.

When it comes to just greenways it was a little more difficult. There was not any meaningful data on greenways in the Boston area, especially none that was grouped by neighborhood. However, the greenways were also included as part of the open space data, so we just had to sort through it to find them. To accomplish this we referred to Boston Green Links to gather the names of currently completed and in-progress greenways in Boston. This gave us the names of seven completed greenways and five in-progress ones. From there, we were able to comb through the open space document and extract just the ones corresponding to greenways. This new data was able to yield the following figure:

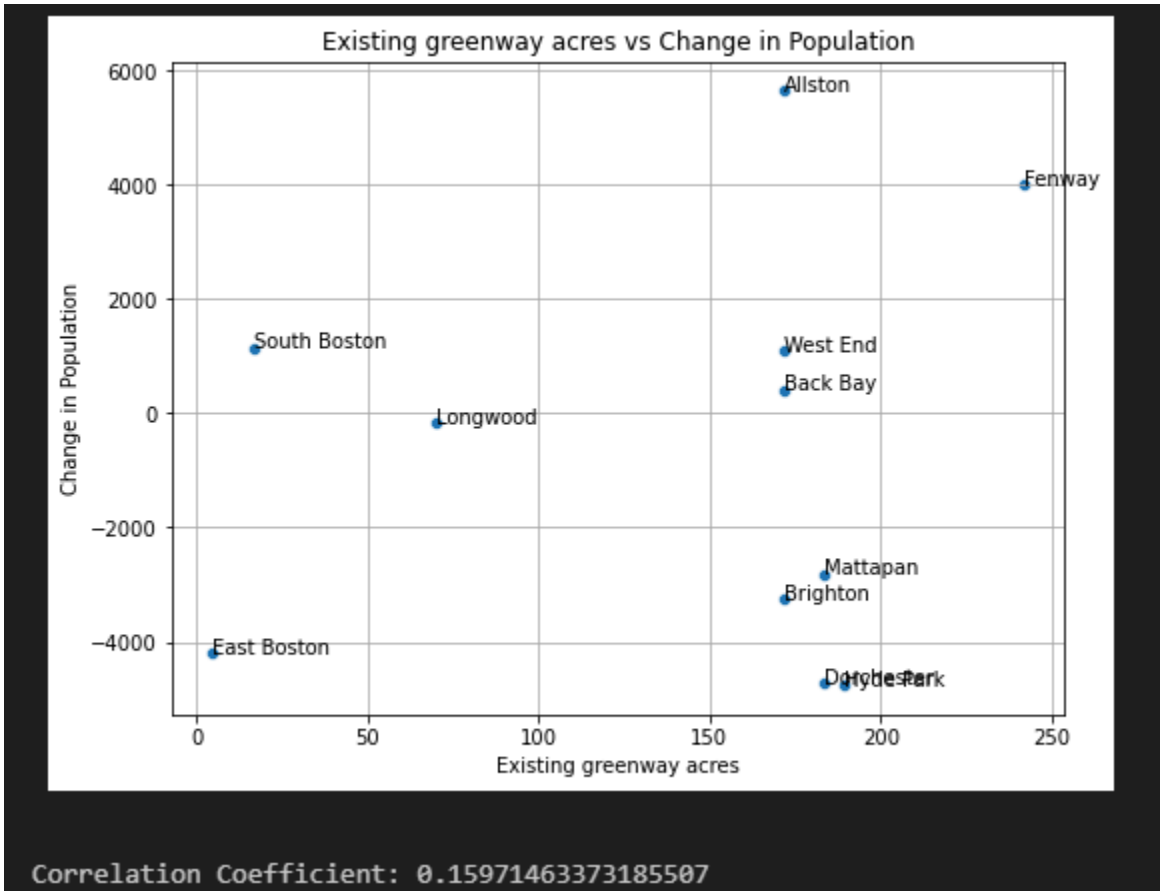


Figure 7. Existing Greenway Acres vs Change in Population

This graph shows the acres of existing greenways in Boston neighborhoods with respect to the change in the total population between 2015 and 2020. Each neighborhood is represented by a single labeled dot on the graph. The correlation coefficient between these two features is slightly positive.

As mentioned earlier, displacement is not the same as change in population, so we also took into account housing prices to determine whether or not gentrification has occurred. The client wanted to focus specifically on three neighborhoods: Mattapan, Roxbury, and Dorchester, so we analyzed the rate of change in median housing prices to those of Boston. Below are the graphs that we created.

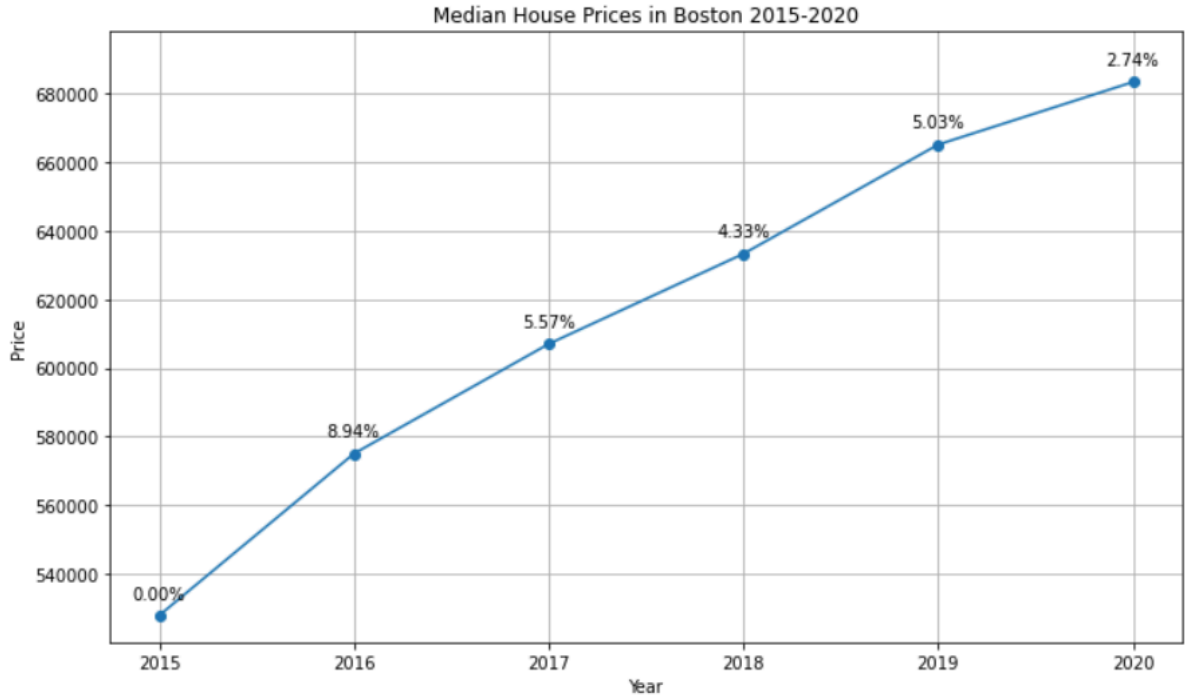


Figure 8: Change in Median House Prices in Boston 2015-2020

This graph shows how the median house prices in the city of Boston changed throughout 2015-2020 as well as the percent change compared to the previous year.

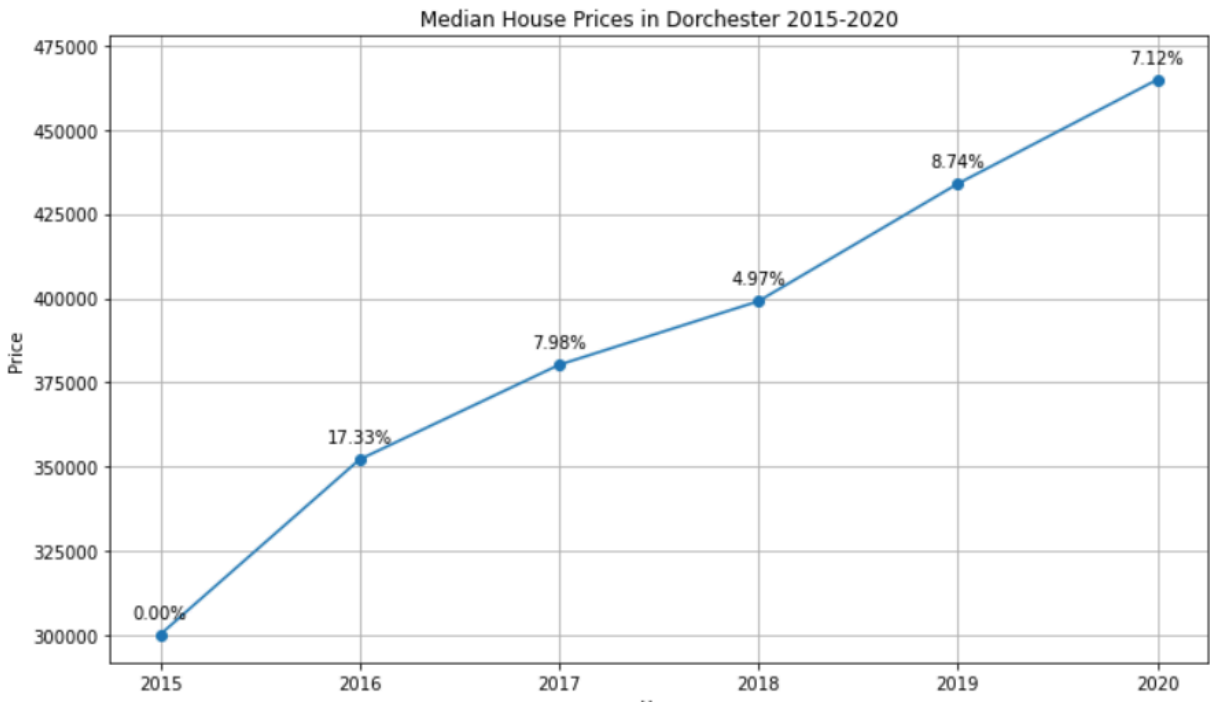


Figure 9: Change in Median House Prices in Dorchester 2015-2020

This graph shows how the median house prices in Dorchester changed throughout 2015-2020 as well as the percent change compared to the previous year.

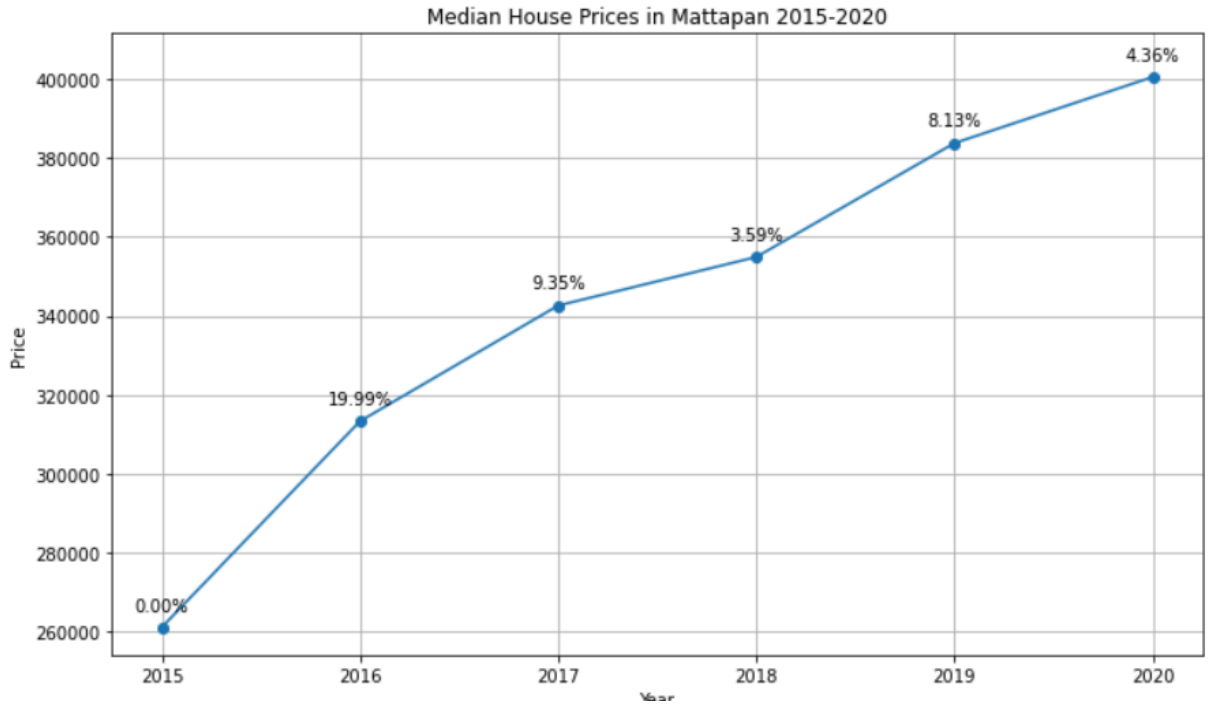


Figure 10: Change in Median House Prices in Mattapan 2015-2020

This graph shows how the median house prices in Mattapan changed throughout 2015-2020 as well as the percent change compared to the previous year.

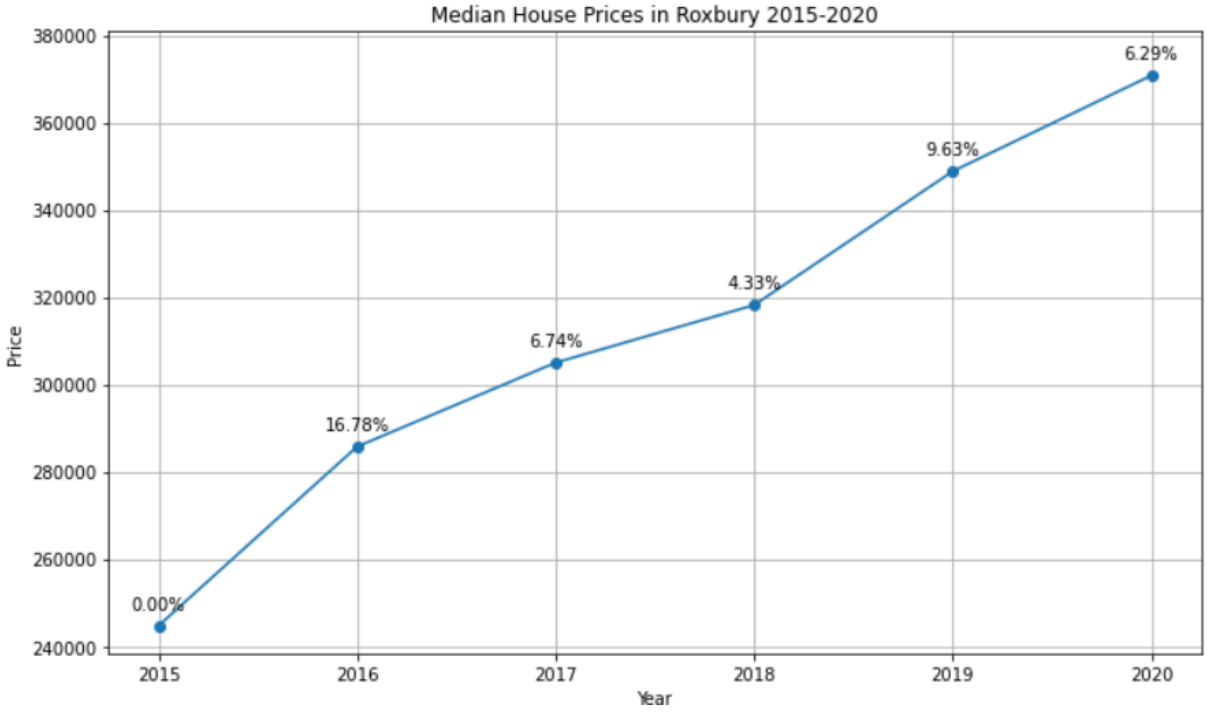


Figure 11: Change in Median House Prices in Roxbury 2015-2020

This graph shows how the median house prices in Roxbury changed throughout 2015-2020 as well as the percent change compared to the previous year.

When comparing the graphs of these neighborhoods to that of Boston, we can notice significant differences in the rate of change for some of the years. Looking at 2015-2016, Boston had an increase of 8.94% while Dorchester, Mattapan, and Roxbury saw an increase of 17.33%, 19.99%, and 16.78%, respectively. This is the first indication that gentrification has happened in these neighborhoods because the rate at which housing prices are changing in these neighborhoods are a lot higher than that of Boston as a whole. Then from 2016-2018, the percent change in housing prices seem to be fairly similar, so nothing to note there. Then in 2018-2019 and 2019-2020, we once again start to see the pattern of these neighborhoods having a significantly increased rate of change compared to that of Boston. In addition to the differences in percent change, we also noticed that the starting value of the houses in Boston was also significantly higher than the three neighborhoods. If we take a look at the housing prices in 2015 we can see that the median house price for Boston is around $535,000 while Dorchester, Mattapan, and Roxbury are $300,000, $260,000, and $243,000 respectively. This means that these neighborhoods generally consist of lower income households compared to the city of Boston as a whole, and since the rate of change is increasing more rapidly in these neighborhoods, it once again hints that gentrification could be at play.

In conclusion, it appears as though there is little correlation between the creation of new parks and greenways in Boston, and a change in population. Overall, it seems if there is any correlation it is slightly negative, meaning that these new additions to the neighborhoods are causing a decrease in population. This decrease in population could indicate gentrification, so we looked into the housing prices and concluded that gentrification seemed to have happened in some of the lower income neighborhoods we analyzed, specifically Mattapan, Dorchester, and Roxbury. We noticed that in these neighborhoods, the housing prices were increasing at a faster rate than the rate in Boston as a whole, indicating that gentrification seems to be happening. It is also important to note that there is the issue of dealing with very little data when it comes to greenways, as Boston does not have many at the current moment, so we cannot say for a fact that greenways are causing displacement, but there definitely seems to be a correlation.

2. What can we learn and apply to projects in Dorchester, Roxbury, and Mattapan?

There isn't any reason to believe that these locations would behave vastly differently compared to our conclusions drawn from the Boston neighborhoods as a whole. This means that when it comes to projects that may happen in Dorchester, Roxbury, or Mattapan, we can argue that while there still needs to be more data to draw any causal conclusions, there is a correlation between building new greenways/parks and an increase in displacement. We would urge them to at least consider this as an important factor when deciding on any new locations for projects.

To dive deeper into the problem of displacement, we researched greenways from other cities to see what was done to prevent green gentrification in those areas. The reason for this is because there is not a lot of data on greenways in Boston, so we decided to look into other cities. We looked at a study done by the University of Utah and UCLA Institute of the Environment and Sustainability where they identified 27 large park development projects in marginalized neighborhoods in 19 different cities. In this study, they described various anti-displacement strategies that could be used when implementing greenways. One strategy for low income families was to implement tax freezes and create down-payment assistance for them. However, this may bring challenges as it will depend heavily on private sector developers, nonprofits and public housing organizations, and park funding agencies. This is why getting cooperation should be done in the planning stages of the greenway rather than after it is built. Another strategy that was mentioned was first source hiring ordinances. This is a solid solution because when greenways are built, new jobs will be created and using first source hiring will ensure that low-income residents will have the opportunity to increase their earnings and prevent them from being pushed out. Another city that we looked into was Brooklyn, New York, specifically Greenpoint. A case study was done on Greenpoint to explore how environmental projects were implemented and they noted that the residents and business owners of Greenpoint advocated for a strategy known as "just green enough." This is a strategy where you implement a project that is not too large, to the point where it will cause green gentrification. Later on in this report, we talk about how greenway size actually affects displacement, so this is why the "just green enough" strategy could be applied to neighborhoods in Boston.

3. Are there factors with which you can establish a correlative relationship to displacement?

From our earlier analysis we have two potential factors, acres of greenspace and acres of existing greenways. These relationships can be seen in Figure 1 and 7, respectively. In addition to that, we also created several other new features for the purpose of our analysis. Those being the ratio of greenway acres to total greenspace acres, the ratio of greenway acres to population, and simply the presence of greenways (as opposed to anything to do with their size or how many). We were able to create all of these features using the datasets mentioned earlier, and used them to produce the following figures:

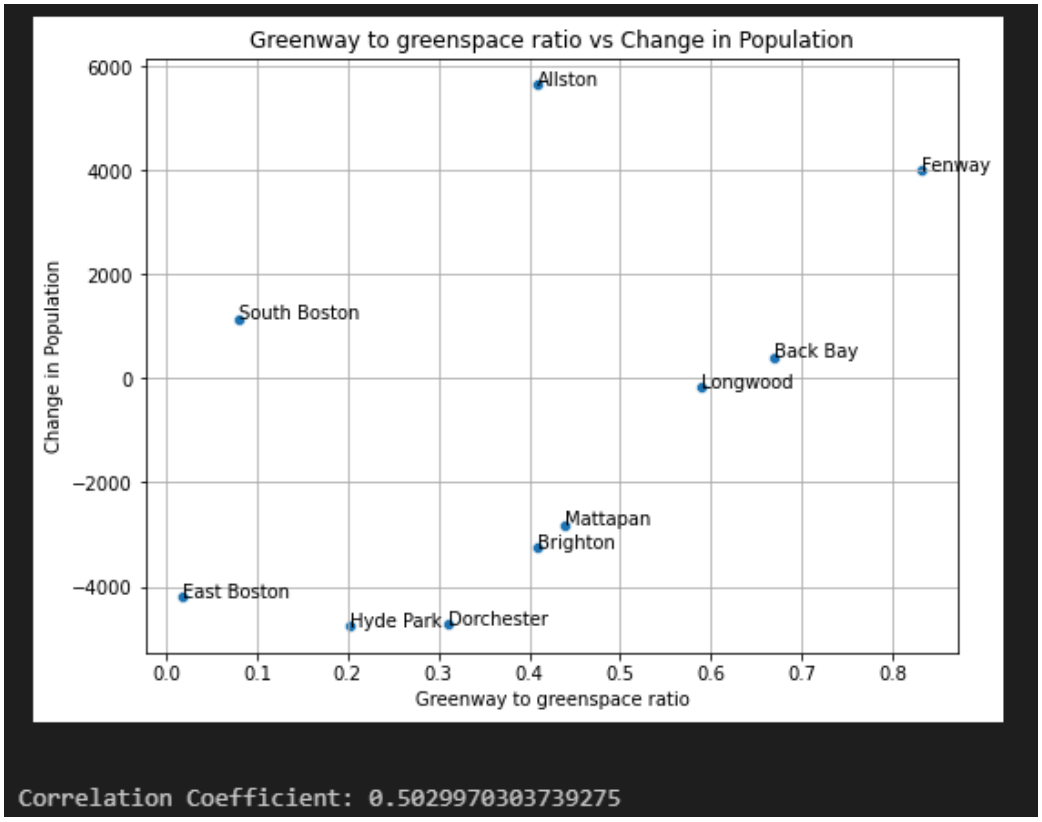


Figure 12. Greenway to Greenspace Ratio vs Change in Population

This graph shows the acres of existing greenways divided by the acres of total greenspace in Boston neighborhoods with respect to the change in the total population between 2015 and 2020. The ratio is always between 0 and 1 due to the fact that the total greenspace includes the greenway acres as well. Each neighborhood is represented by a single labeled dot on the graph. The correlation coefficient between these two features is moderately positive.

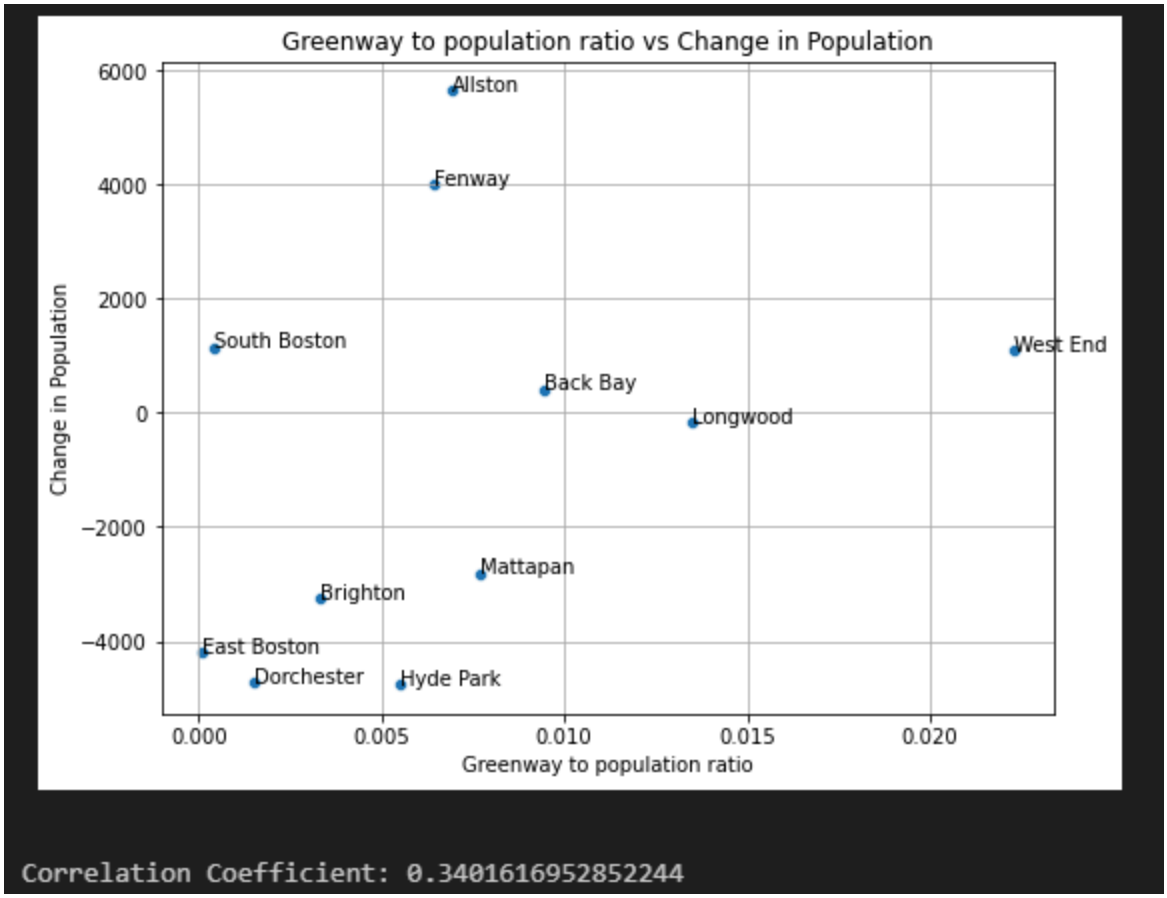


Figure 13. Greenway to Population Ratio vs Change in Population

This graph shows the acres of existing greenways divided by the total population in Boston neighborhoods with respect to the change in the total population between 2015 and 2020. Each neighborhood is represented by a single labeled dot on the graph. The correlation coefficient between these two features is slightly positive.

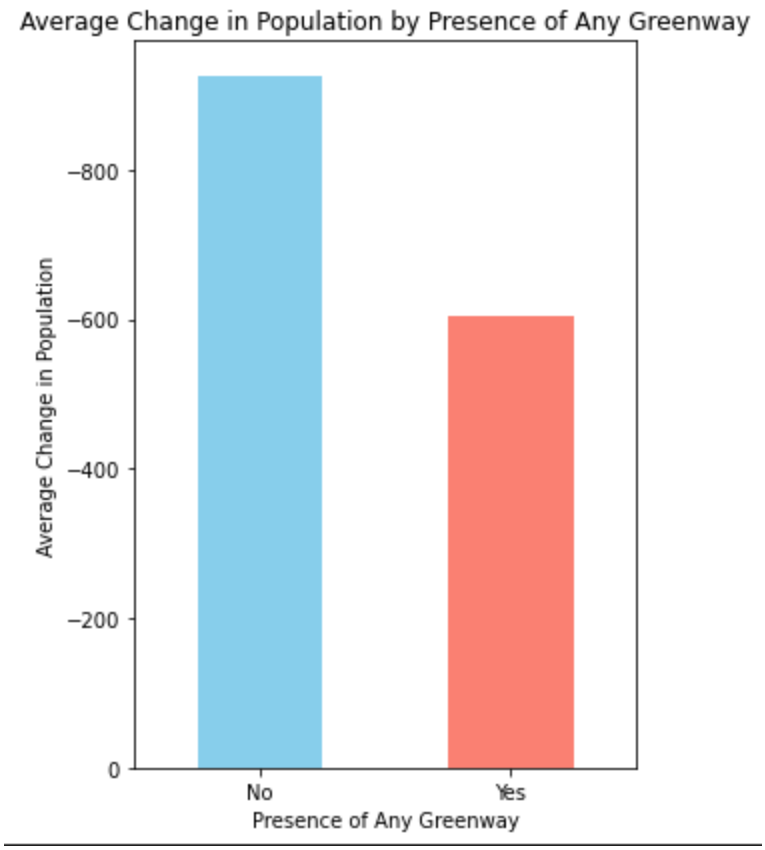


Figure 14. Average Change in Population by Presence of Any Greenway

This graph shows the average change in population for Boston neighborhoods split into two groups: ones that contained an existing or in progress greenway ("Yes" group), and ones that did not. Both groups experienced, on average, a decrease in population, but those that had greenways appeared to experience less.

Analyzing these figures, we can see that the addition of more greenways seem to generally increase the population of a neighborhood or decrease the rate at which people are leaving. We believe that this is a sign that the neighborhood is becoming more appealing, which then attracts newcomers, which brings the risk of displacement in marginalized communities. Figure 12 suggests that if you add a greenway to a neighborhood that does not already have a lot of greenspace, it is more likely to increase the desirability of said neighborhood, which in turn increases the risk of displacement. Figure 13 has a very slight positive correlation, but it may suggest that adding a greenway to a neighborhood with lower population will increase its desirability more. Then in figure 14, we see that neighborhoods with greenways see less people moving out, once again backing up the point that the neighborhood is more desirable.

4. Of the factors you found, what has the strongest relationship with displacement? Do you believe the evidence is strong enough to suggest that it is causative? Why or why not?

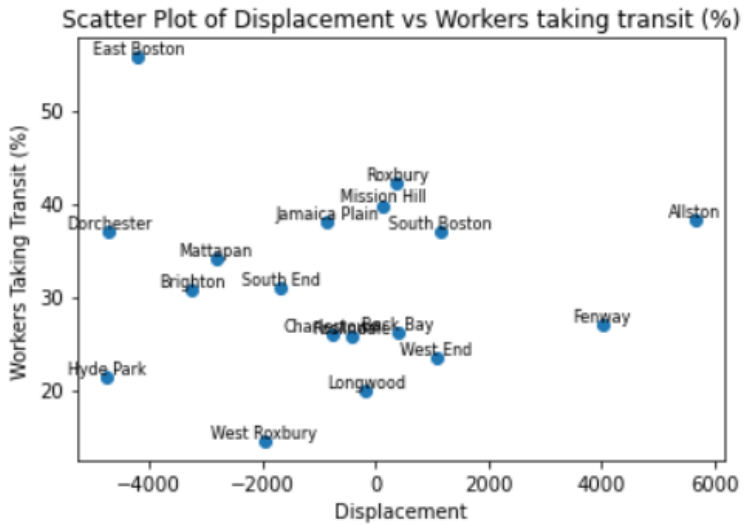
The factor with the strongest relationship to displacement was the ratio of greenway acres to greenspace acres. This suggests that if any factors have a causative relationship, it would be that a higher proportion of greenways relative to general greenspaces in a given neighborhood causes more people to move to that location. However, it would be a stronger argument to say that none of the factors have a causal relationship with displacement. Nothing had a correlation coefficient at or higher than 0.6 (or -0.6 / lower), and any correlation could be attributed to a third party factor influencing both the creation of the greenways and their size, as well as the changing population. Another factor to consider is the sample size. There simply is not a lot of available data about greenways and their effects right now, so it is hard to draw meaningful conclusions. For those reasons we would conclude that while there does seem to be a correlation between greenways/parks and displacement, at most they are a factor contributing to it, but they do not directly cause displacement.

Extension Analysis:

Our team has chosen to extend our analysis with two questions, 1. “What aspects of neighborhoods may increase their vulnerability to gentrification and affect their adaptability to green ways projects?” and 2. “How do greenways affect a community’s health and quality of life?”. In our mid-semester report and presentation, we already spoke a bit on how to prevent green gentrification, so to continue our research, we decided to shift our focus to the aspects of neighborhoods that may increase their vulnerability to gentrification. This can provide useful insights in regards to the location of a greenway during planning stages. Before a city decides to add a greenway, they can analyze these factors and determine whether the neighborhood will be at risk of gentrification. In addition to this, we have concluded from our data that greenways positively correlate with displacement, so we also wanted to analyze other ways that greenways can potentially affect a community, specifically the health and quality of life of the community.

1. “What aspects of neighborhoods may increase their vulnerability to gentrification and affect their adaptability to green ways projects?”

Looking at our first extension question, we wanted to analyze more factors that could potentially affect the vulnerability of a community in terms of gentrification, beyond our base analysis. In our research into this topic, we found a document titled “Mapping Susceptibility to Gentrification: The Early Warning Toolkit”. This study was done by the University of California Berkeley, where they look into the communities within the greater California San Francisco Bay Area. Within the study, they stated some proven indicators of the susceptibility of said communities, alongside whether those effects had positive or negative effects on gentrification. Of those, we looked primarily at 2 of the top 10 indicators that had the highest effect positively or negatively, specifically the percentage of non-family households and the percentage of workers taking public transit. To be clear, a non-family household is a household where a person is living alone or is sharing with people whom they are not related to. We have added a third feature to analyze what we think could be another possible cause of susceptibility to gentrification, households with at least one vehicle. Of course, all cities are different, but by looking at these indicators and researching their prevalence within Boston we can hope to find some indicators that also apply to Boston and find some defenses against gentrification. Below are some graphs we created:

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Correlation coefficient: -0.05466012835196248
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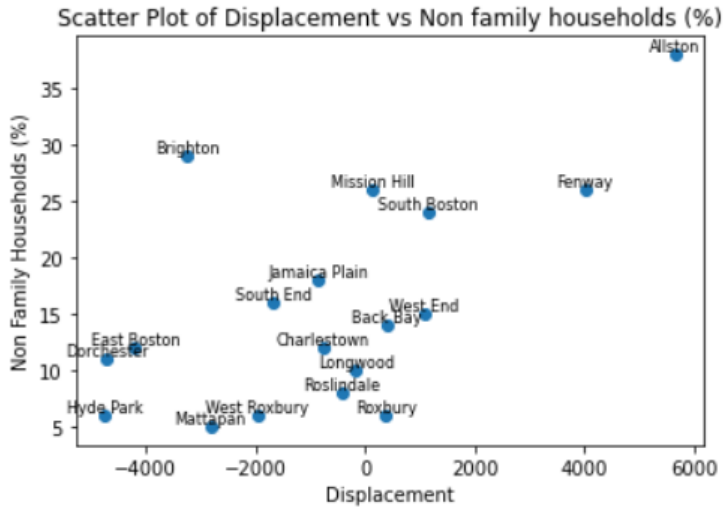
Figure 15

The plot displays the displacement compared to the percentage of workers taking transit in each neighborhood in Boston. For neighborhoods with lower percentages of workers taking transit, there is a slight trend towards negative displacement. However, there is nearly no correlation.

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Correlation coefficient: 0.6024038470969112
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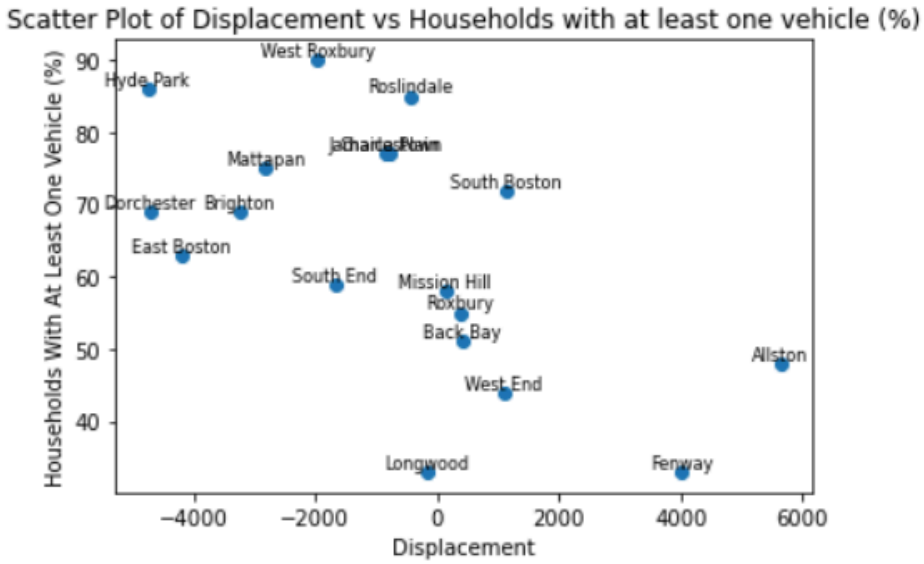
Figure 16

This plot displays the displacement compared to the percentage of non-family households in each neighborhood in Boston. The lower percentage there is for a neighborhood with households with non-family households, the less displacement there is. Inversely, higher percentages lean towards more displacement.

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Correlation coefficient: -0.5915720140437521
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Figure 17

This plot displays the displacement compared to the percentage of households with at least one vehicle in each neighborhood in Boston. The higher percentage there is for a neighborhood with households with at least one vehicle, the less displacement there is. Inversely, lower percentages lean towards more displacement.

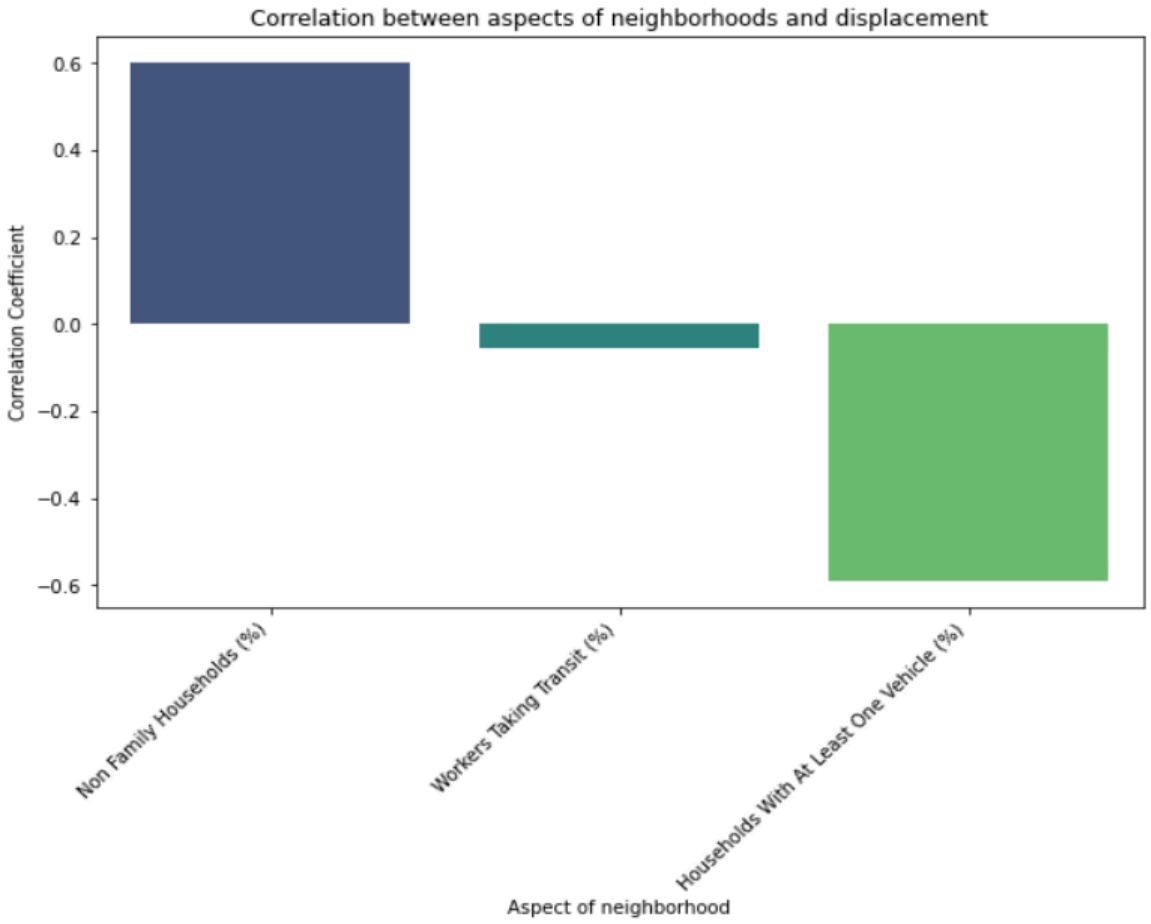


Figure 18

This plot depicts the correlation coefficients between displacement and the chosen susceptibility features. We can see with the percentages of each feature that non-family households have a positive correlation with displacement while workers taking transit and households with at least one vehicle have a negative correlation. With the correlation coefficient of workers taking transit, there is a very small correlation between displacement and the feature.

Based on our own data and analysis, we found that there are more factors that affect gentrification potential for a neighborhood. From the two indicators we chose to research for the UC Berkeley study (Non-Family Households % and Workers Taking Transit %), we found that there is a solid correlation between the prevalence of non-family households in a community and displacement. This is in line with the study results, which also showed greater gentrification based on that indicator. For the other indicator, workers taking transit, the study stated that it also had similar findings in terms of greater gentrification based on it. However our result showed a very small negative correlation with displacement within Boston neighborhoods. The correlation coefficient was nearly zero, so there may not be any correlation in Boston. More importantly, the study did its research in the San Francisco Greater Bay Area, which does have a very different geography and Boston is a much more walkable city than San Francisco. Therefore, the correlation between the indicator and displacement is not necessarily incorrect when it comes to Boston's unique situation. Finally, our third wildcard indicator that we chose to analyze, households with at least one vehicle, resulted in a negative correlation with displacement. This makes sense due to the fact that if many households do not own a vehicle, it suggests that it is of a lower income neighborhood, meaning the area is more likely to be underdeveloped which would be more attractive to developers and investors for low property value. It should be noted that in this question, there are many confounding factors that could affect the results, most importantly the natural need for people to move into city centers due to economic and career goals. Overall, it seems that there is no one best way to prevent green gentrification in our at-risk communities, but there are many layered correlations that could provide some insight on how we should go about it.

2. “How do greenways affect a community’s health and quality of life?”

Our second extension question dealt with the impact of greenways on the health of the surrounding neighborhood and community. We wanted to explore this question further as greenways are known to improve quality of life. UMass Amherst released an article titled “New England Greenway: Greenway Significance” in which they delve into how greenways enhance livability and quality of life in neighborhoods. In a study by NC State University titled “How Parks and Green Spaces Can Improve Your Health,” professors Lincoln Larson and Aaron Hipp discuss how greenspaces can impact one's well being by promoting physical health and reduced stress for better mental health. We were aware that the existence of greenways are connected to better mental and physical health so we gathered data on the health of different neighborhoods to help us see if there really was a correlation.

The health data we gathered came from the Boston Public Health Commission. Their reports looked at provisional mortality, life expectancy, diabetes, heart disease, asthma, cancer, maternal and infant health, and mental health among different races, ethnicities, and neighborhoods which we focused on. We sifted through the reports and began moving the data into data frames so we could more easily parse and study them. However, some of the reports didn’t have data that was important to us. We were mainly concerned with the rate of a disease/occurrence rather than say the hospitalizations for example. This led us to not include information on provisional mortality, heart disease, and cancer. The neighborhoods in the report lined up almost identically to the locations we have been studying for the projects which was nice. However, Mission Hill and Longwood were not part of the reports so we were forced to not include them in our analysis. We created a new data frame with each location’s greenway acres and the data from the reports and made an initial correlation graph seen below:

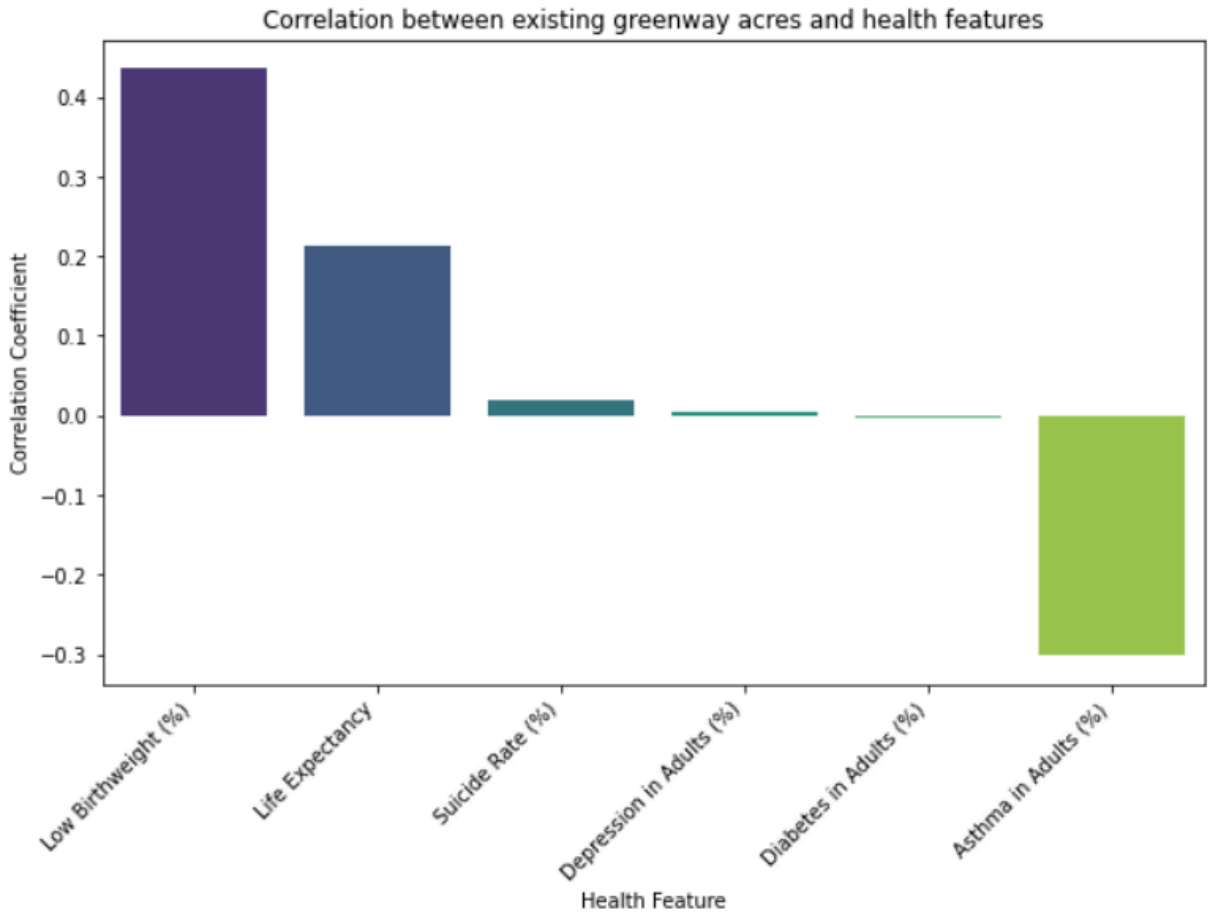
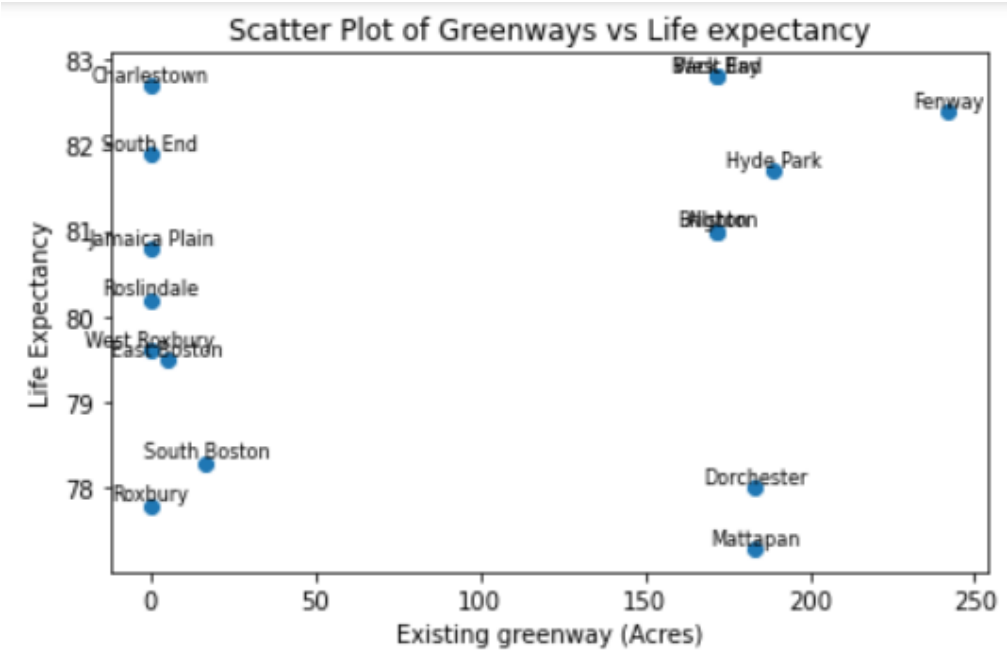


Figure 19. Correlation with Greeways in acres

This plot depicts the correlation coefficients between greenways and the health features. In the graph, there is a positive correlation with low birth weight and life expectancy and a negative correlation with asthma.

As seen by the graph above, there is some correlation between the health features and the acres of greenways. To more accurately and precisely see the relationships, we made scatter plots for each feature and compared them to the amount of greenspace and greenway. These next set of graphs will depict the relationship between greenways and the health features. However, it is important to note that many neighborhoods have 0 acres of greenways. So our graphs will look a bit weird as a correlation will be made with those neighborhoods that have no greenways, but it's more important to focus on the neighborhoods that actually have some amount of greenway. Specifically Charlestown, South End, Jamaica Plane, Roslindale, West Roxbury, and Roxbury should be ignored for this portion:

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Correlation coefficient: 0.21337863402541443
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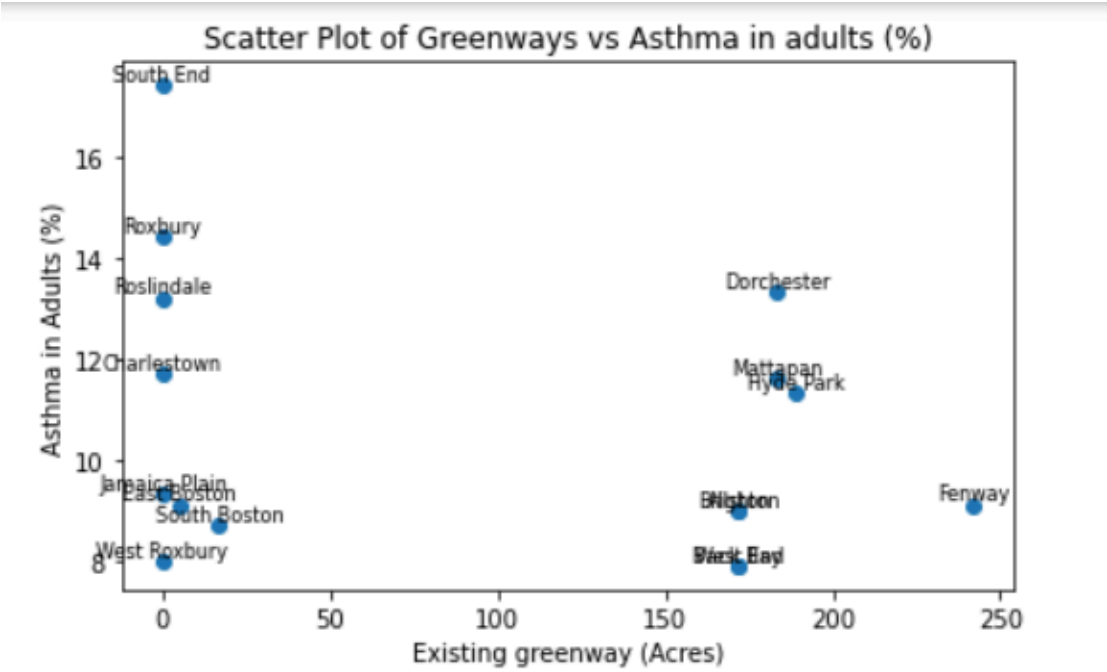
Figure 20: Greenway vs Life Expectancy

Plot depicts the amount of greenway a neighborhood has compared to the life expectancy in the neighborhood. Each neighborhood is depicted as a dot and just like in the correlation graph in Figure 19, it can be seen that there is a slight positive correlation as areas with higher amounts of greenways have higher life expectancies. But, it is important to note that some areas with 0 greenways also have high life expectancies so it is hard to make a true correlation between the two features.



Correlation coefficient: -0.3008024209115852

Figure 21: Greenway vs Asthma

Plot depicts the amount of greenway a neighborhood has compared to the rate of asthma of adults in the neighborhood. Each neighborhood is depicted as a dot and just like in the correlation graph in Figure 19, it can be seen that there is a negative correlation as areas with higher amounts of greenways have lower rates of asthma. But, it is important to note that some areas with 0 greenways also have low asthma rates so it is hard to make a true correlation between the two features.

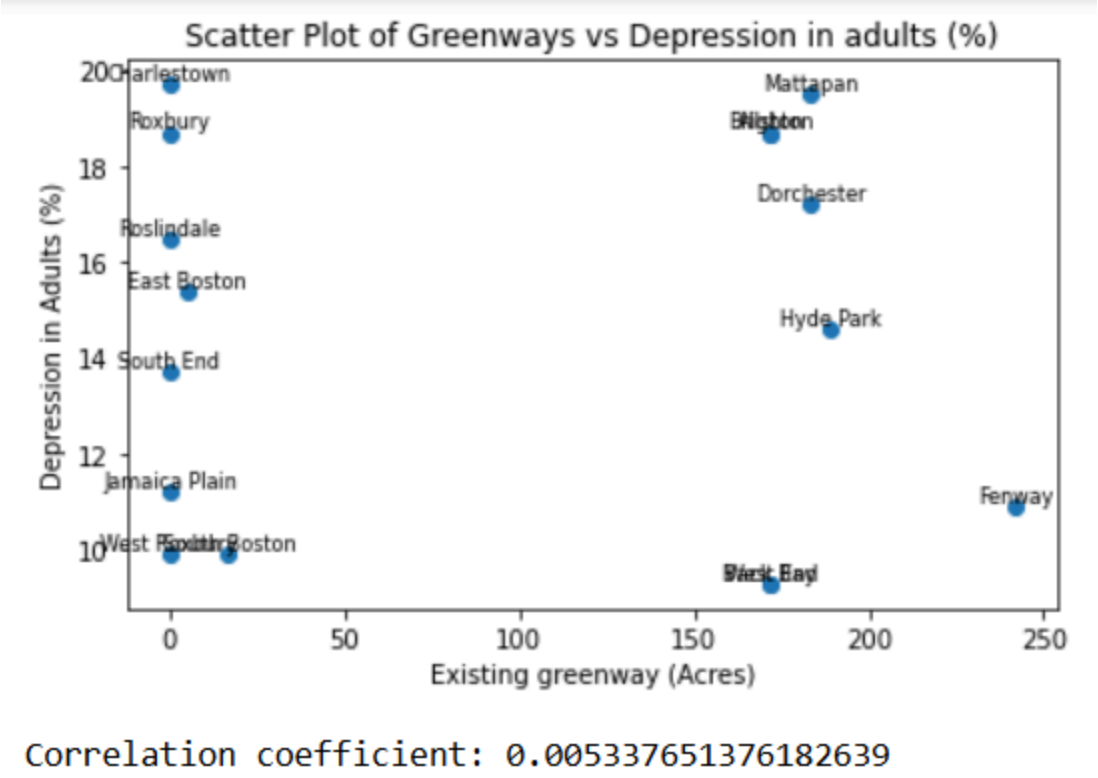
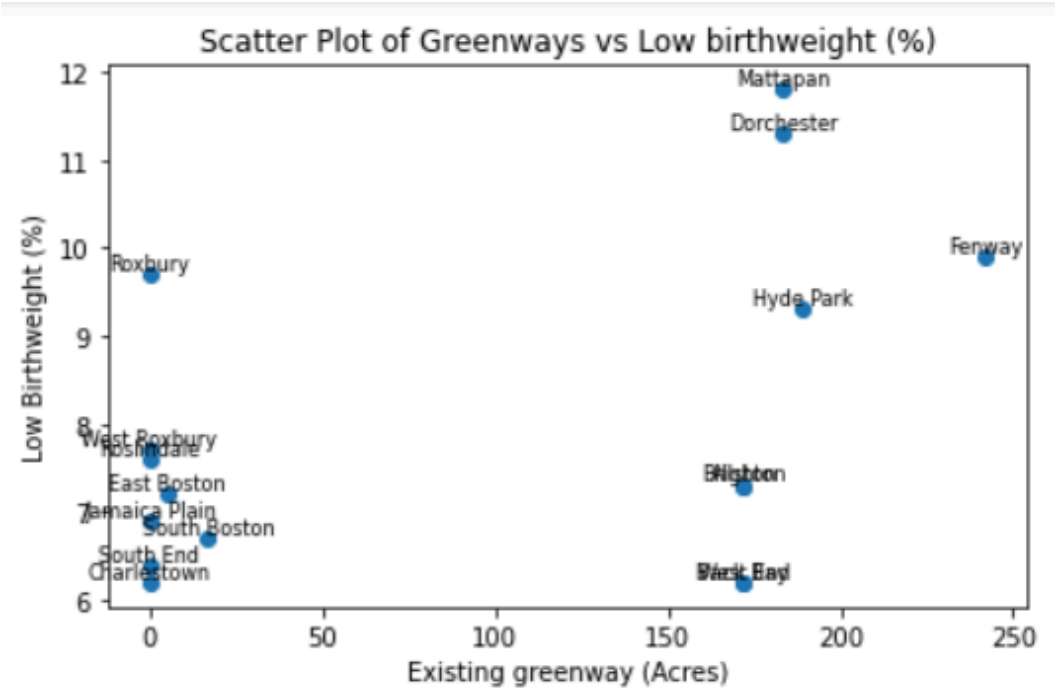


Figure 22: Greenway vs Depression

Plot depicts the amount of greenway a neighborhood has compared to the rate of depression of adults in the neighborhood. Each neighborhood is depicted as a dot and just like in the correlation graph in Figure 19, it can be seen that there is no correlation as areas with high or low greenways have high and low rates of depression.



Correlation coefficient: 0.4356536099738873

Figure 23: Greenway vs Low Birthweight

Plot depicts the amount of greenway a neighborhood has compared to the rate of low birth weights of infants in the neighborhood. Each neighborhood is depicted as a dot and just like in the correlation graph in Figure 19, it can be seen that there is a slight positive correlation as areas with higher amounts of greenways have higher rates of low birth weights. However, it is important to note that there are many areas with high greenway acres and low rates of low birthweight.

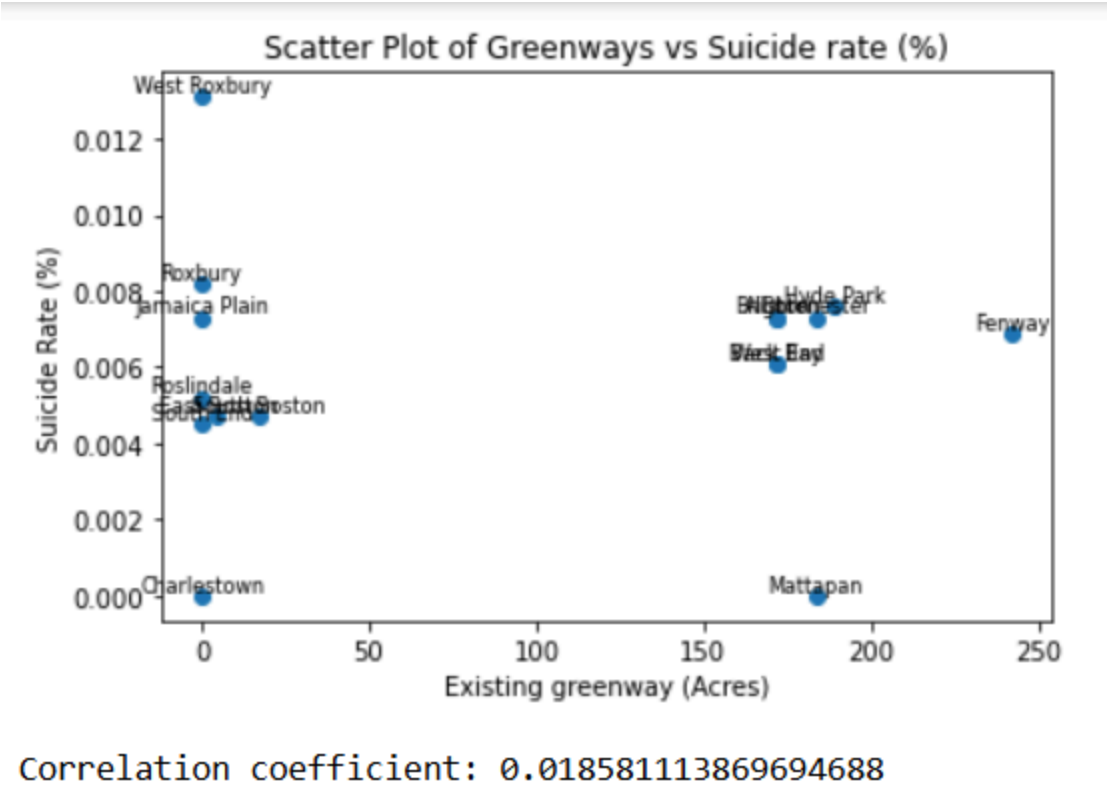
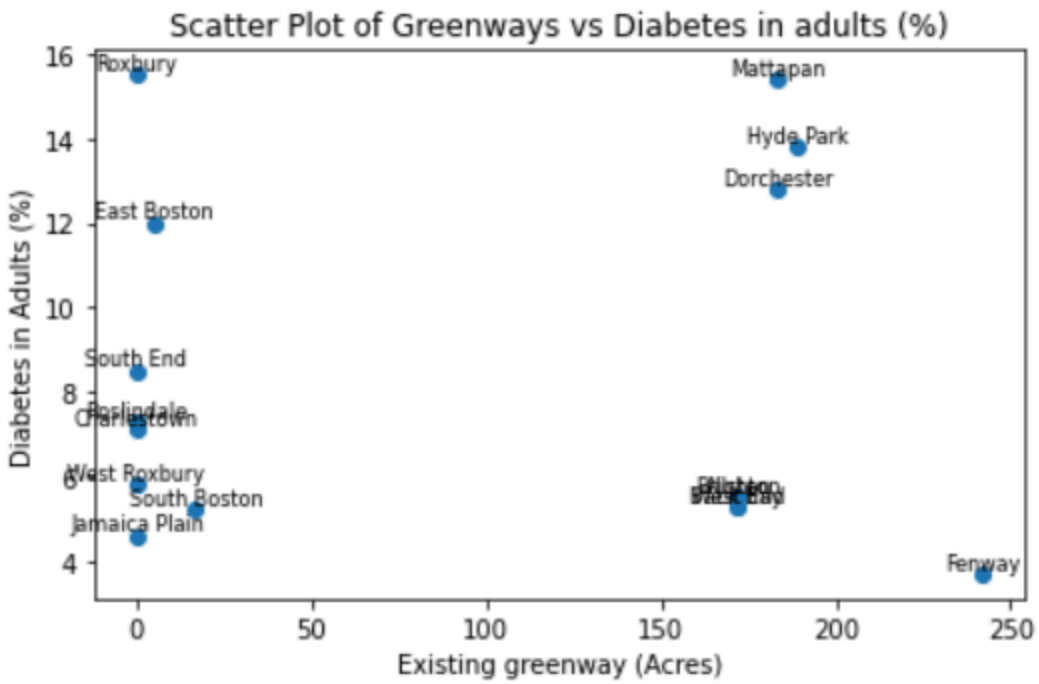


Figure 24: Greenway vs Suicide

Plot depicts the amount of greenway a neighborhood has compared to the rate of suicide of adults in the neighborhood. Each neighborhood is depicted as a dot and just like in the correlation graph in Figure 19, it can be seen that there is no correlation as areas with high or low greenways have high and low rates of suicide.

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Correlation coefficient: -0.0034859072163973825
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Figure 25: Greenway vs Diabetes

Plot depicts the amount of greenway a neighborhood has compared to the rate of diabetes of adults in the neighborhood. Each neighborhood is depicted as a dot and just like in the correlation graph in Figure 19, it can be seen that there is no correlation as areas with high or low greenways have high and low rates of diabetes.

Based on the figures and graphs we have made, it is hard to make concrete conclusions. For greenways, the task is a bit tricky due to many neighborhoods having no greenways. This does throw our graphs and correlations off a bit so even if we can see positive or negative correlations, it's still very hard to determine if there really is correlation in the first place. Overall, we can see some connection between the existence of greenways and health factors. However, we cannot say one affects the other solely. There are bound to be many other factors that can affect one's health rather than the amount of greenways they live around so we cannot for sure say that greenways directly affects health, but it plays a role in it. To add to this, we noticed that greenways and low birthweight were positively correlated, which we thought was strange. We dug deeper into this and found that the birthweight of babies has been decreasing in general. According to Boston Children's Hospital, "The overall rate of these very small babies is increasing, primarily because of the increase in multiple birth babies, who tend to be born earlier

and weigh less." We also found out that another reason for the increasing rate of low birthweight is the soaring rate of cesarean deliveries. Cesarean deliveries cause the baby to be delivered earlier, hence lower birth weight. Although many correlations can be seen, it is hard for us to concretely draw firm conclusions due to lack of data skewing our calculations and the lack of other factors that may increase or decrease the health factors of a person.

Due to this lack of data in Boston, we once again decided to look into studies related to greenways and health in other cities. One study was done on the Swamp Rabbit Trail in Greenville, South Carolina where 1,148 people who used the trail were surveyed. We created a chart that demonstrates the reasons for using the trail and found that the majority of people used the greenway to exercise. This suggests that greenways are a positive addition to communities regarding health because exercise is positively correlated with physical health. Implementing greenways also creates environments where people can walk, bike, or any other physical activity, so it would make sense that adding greenways promotes better health in communities. Once again, these studies were not done in Boston, so we cannot say with certainty that adding more greenways in Boston will result in better health.

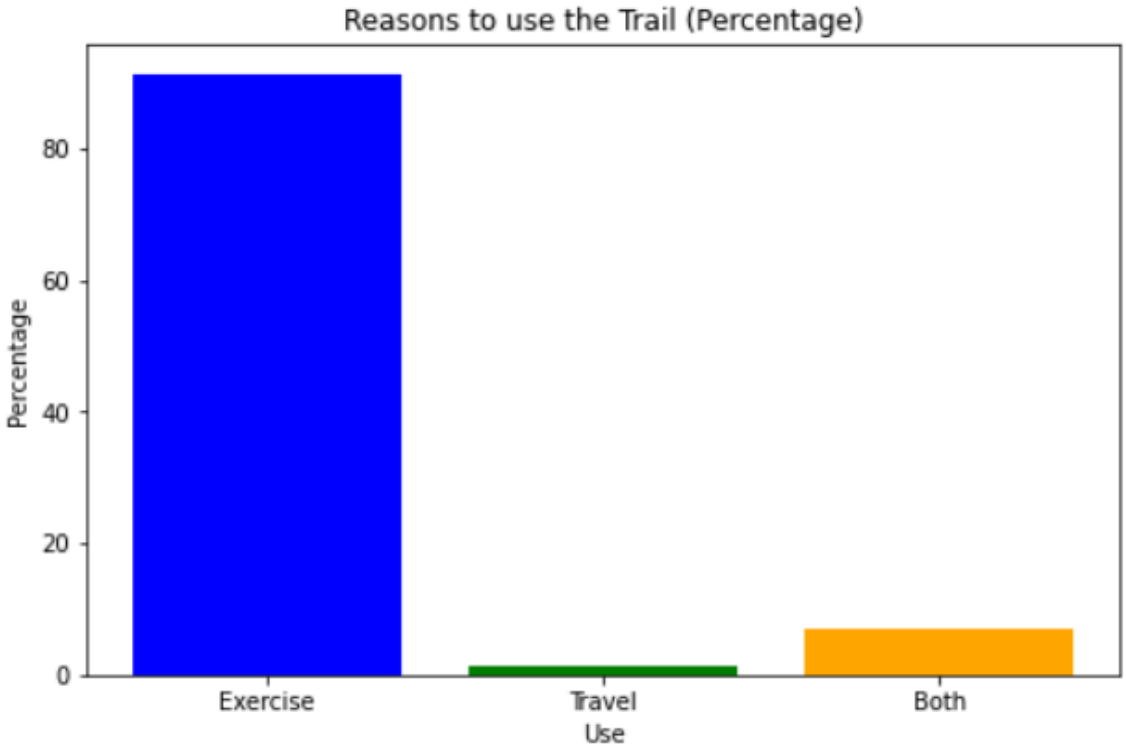

Figure 26: Reasons to use the Swamp Rabbit Trail

This bar chart was based on the answers of 1,148 surveys and shows how people used the Swamp Rabbit Trail.

Future Scope:

Looking into the future of this study, there are many different possible areas to look into and many extensions that would reinforce our research findings. One problem we faced relating to greenways was the fact that many neighborhoods did not have any of them at all. Hopefully if more analysis is done in the future relating to greenways, there exists greenways in more neighborhoods.

Another possible direction for this study is more qualitative analysis via focus groups and interviews with residents/community leaders who live near or are potentially affected by greenways and the potential gentrification of the area. This question of green gentrification is as much of a community involvement question as it is a socio-economic issue with many nuanced factors. By gaining insight qualitatively, it will allow us to contextualize our quantitative analysis to understand how these green projects shape the community and its social networks. Alongside that, from our research on how to prevent green gentrification, we found strong evidence to support the idea of the "just green enough" (JRE) ideology when constructing these projects. JRE focuses on providing targeted and small scale green improvement projects to communities based on its needs. By engaging with the communities without green projects, future research could provide a platform for marginalized communities to share their concerns, aspirations, and needs. Qualitative data paired with quantitative analysis of other green projects is the best way to study green gentrification and its prevention.

In terms of extending the qualitative side of the research, there could be more focus on how greenways affect the community. Some possible features that could be analyzed include: increase of youth population after a green project is finished (Do these projects encourage families to have children?) or change in child obesity (Do these greenways encourage exercise in younger people?). Overall, looking more into the positive (or negative) effects of these green initiatives in tandem with displacement metrics could provide helpful insight on how to best develop these projects for the betterment of the community.

Work Contributions by Person:

Ben - Searched for useful datasets online. Pre-processed data for analysis. Created the jupyter notebook that was used to analyze the data. Created the graphs for changes in population. Made the cover page / format for the report, and contributed 20 pages.

Andrew - Helped describe figures depicting data for early insights. Created powerpoint and added graphs to help the presenters. For the final report, I tackled extension question 2 on how greenways/greenspaces affect the health of the people in the neighborhoods. Found, parsed and deciphered data to be able to create all graphs and draw conclusions from. Contributed 10+ pages.

Alvis - Searched and analyzed datasets regarding housing prices. Created graphs for housing prices and the second extension question. Looked at additional studies in other cities to learn more about greenways. Created extension question 1. Created readme for github. Contributed to 10+ pages in this report.

Mo - Created extension questions. Gathered data sets and studies for answering extension question 1. Created plots, and graphs of data in correlation with displacement. Wrote analysis for said plots and graphs. Wrote future scope. Contributed in 10+ pages.

William - Helped gather data sets and studies for answering extension question 1. Assisted with creating plots, and graphs of data in correlation with displacement. Wrote analysis for plots and graphs. Contributed in 10 pages.

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