Wide Open Spaces

I. Abstract

The objective of this paper is to discern a correlation between post-secondary education and wealth, and equal opportunity to access outdoor spaces in Austin, Texas. Obtaining data derived from the parks departments of several localities and the Austin Business Journal, hierarchical clustering was used to determine if there existed an imbalance between areas of Austin. Information of various characteristics within a City of Austin zip code were important tools in analyzing the data. In aggregate, there exists 335 outdoor spaces spread across 43 zip codes.

II. Introduction

For more than a year, Covid-19 has created a environment in which many around the world remained in isolation from one another. In an effort to find respite, many have ventured to outdoor spaces, but for others, these spaces may be less easily experienced. The objective of this paper is to determine whether Austinites have equal opportunity to access outdoor spaces. To accomplish this objective, I used data derived from the parks departments for the City of Austin and Travis County. Moreover, the Austin Business Journal provided 2018 data specific to each zip code of relevant characteristics, such as educational attainment, median household income, and median home value.

III. Methods

Since individuals seek relaxation in a wide variety of ways, I applied a wide definition in determining an outdoor space. Within Austin, these not only include local and state parks, but also include public pools and private golf courses - totaling 335 outdoor spaces. Of these locations, 319 were obtained through the parks departments for the City of Austin and Travis County. However, the remaining 16 locations were derived individually from Google Maps and corresponding parks departments of Bee Cave and Wells Branch. Although, Bee Cave and Wells Branch are not technically within the city limits of Austin, their respective zip codes are categorized as city of Austin zip codes, thus both Bee Cave and Wells Branch were included in the data set.

The 43 zip codes for the City of Austin became a useful tool in the methodology applied to the model. This information was derived from the Austin Business Journal, which provided data of relevant characteristics, such as educational attainment, median household income, and median home value. In addition to using several of these features and data of outdoor spaces, I created an interactive variable between post-secondary educational attainment as a percentage of zip code population and median household income, mapping the outcome on Google Maps so as to discover any noticeable patterns.

To best solve the objective of this paper, I determined hierarchical clustering was the best approach. First, I created a large data set of numerical vectors, in which I then centered and scaled before applying the euclidean method to find the distances between each point. Next, I determined the Ward method was appropriate in use of hierarchical clustering as it produced a well-balanced cluster denodrogram. Lastly, I used k-means and the elbow method to find the optimal k to cut the tree, and discerned $k = 2$ would be optimal.

IV. Results

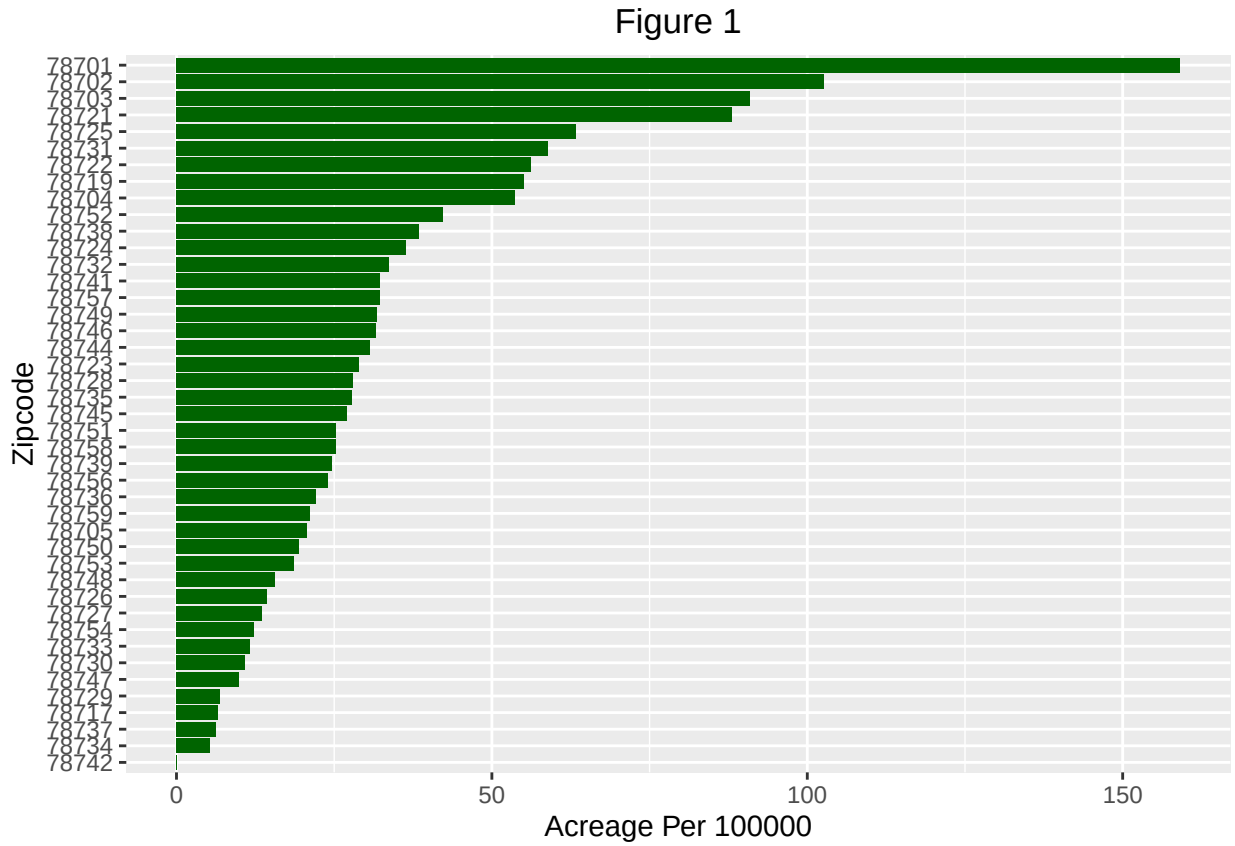


Figure 1 displays the distribution outdoor spaces in Austin measured in acreage per 100000. Zip code 78701 has the highest acreage per 100000 of 159.12 acres. Alternatively, zip code 78742 the lowest acreage per 100000 of 0 acres.

Figure 2

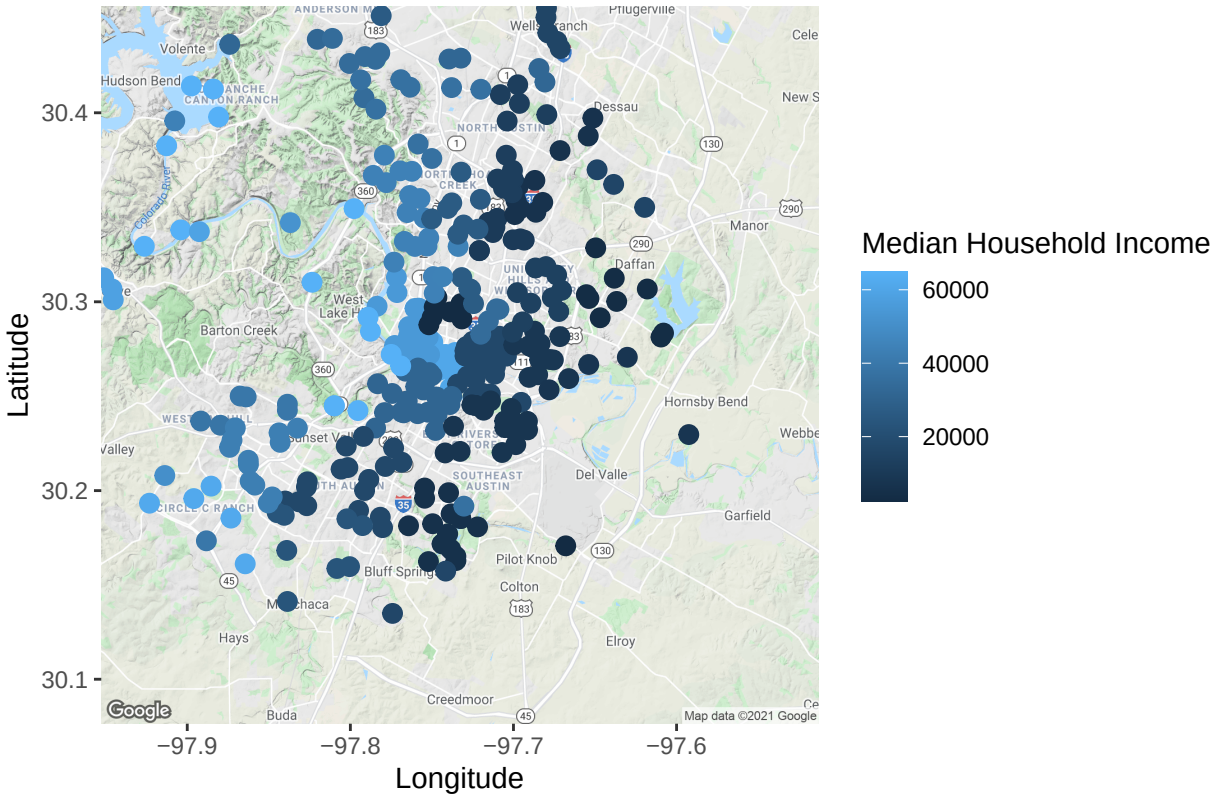
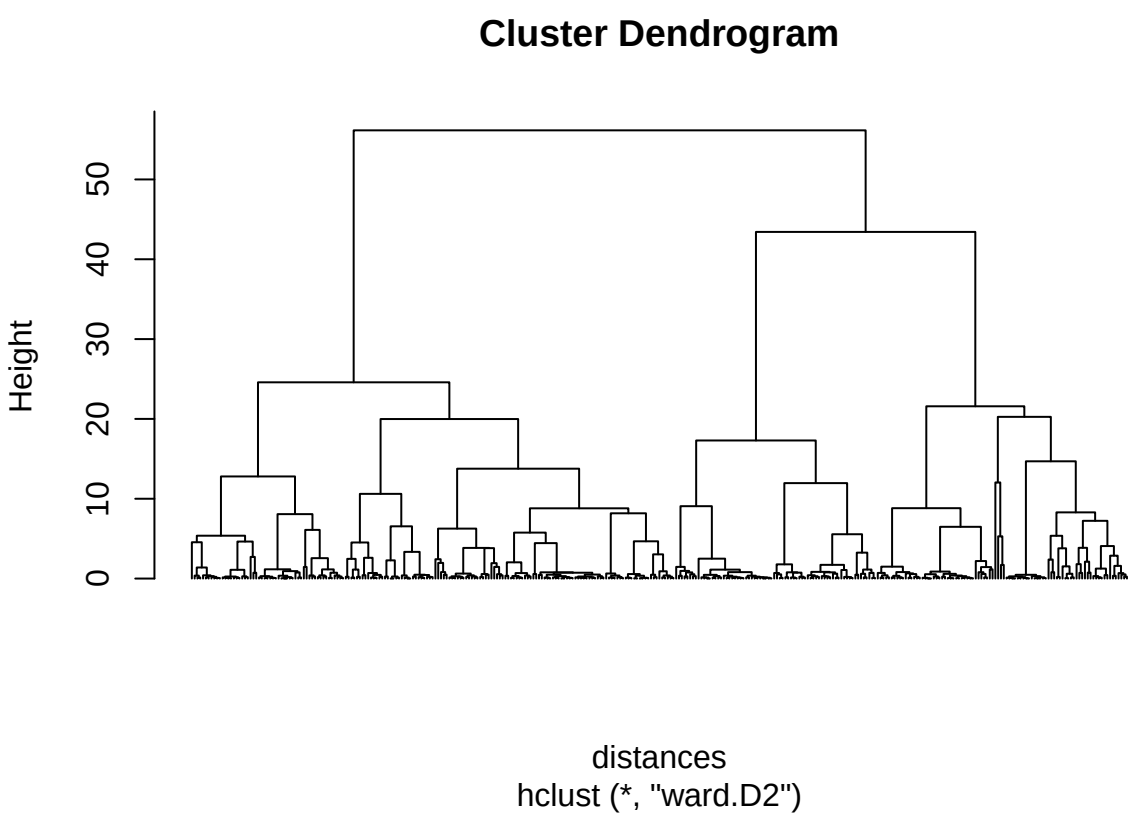
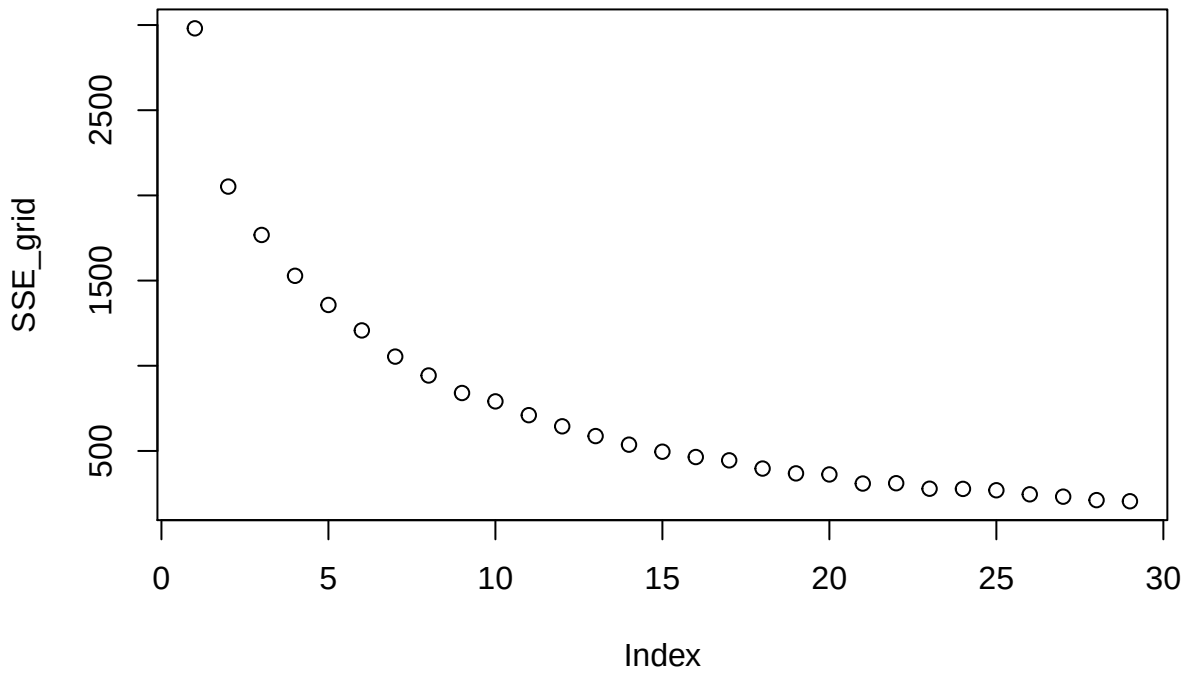


Figure 2 displays a map of Austin and the location of each recorded outdoor space. Moreover, each point displays the result of the interaction variable between post-secondary education as a percentage of population and median household income within each zip code.



Using the Ward method to implement hierarchical clustering, each location of an outdoor space is clustered in a well-balanced denodrogram.



Using k-means and the elbow method, k = 2 along the curve is observed to be optimal.

Figure 3

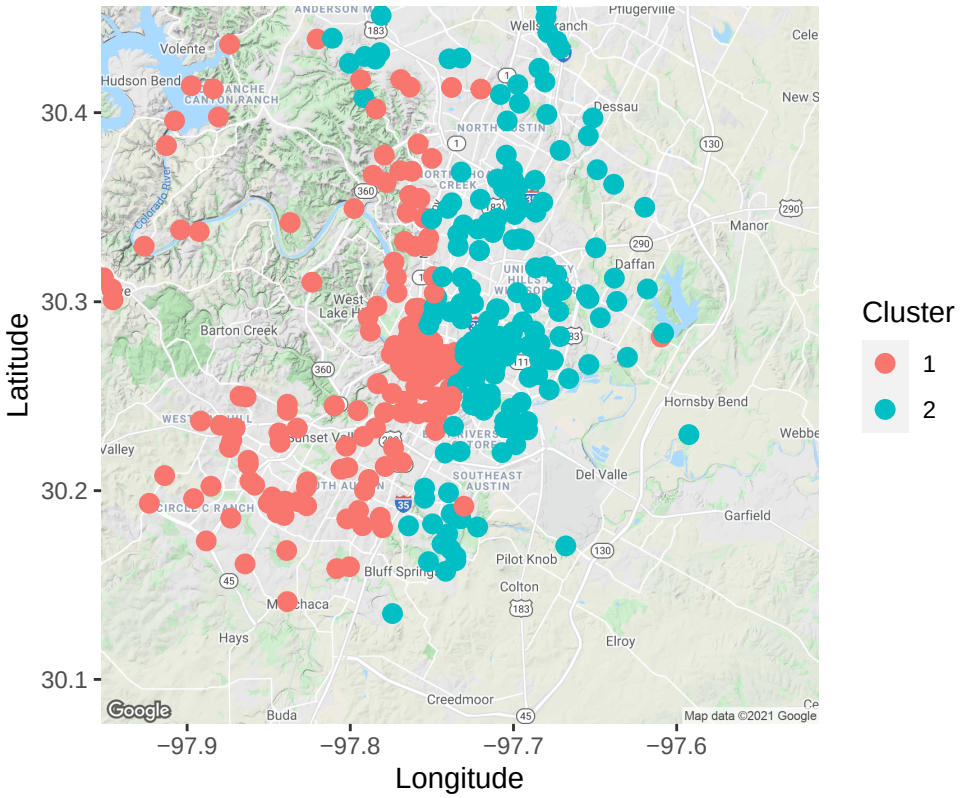


Figure 3 displays a distinguishable pattern of each location of outdoor space in terms of its respective cluster.

Table 1: Results

Cluster	Population	Number of Outdoor Spaces	Share of Outdoor Spaces	Total Acreage	Average Acreage	Acres Per 100000
1	475828	162	0.48	10601.10	65.44	2227.93
2	610446	173	0.52	8122.08	46.95	1330.52

V. Conclusion

Outdoor spaces are an important venue for many seeking relaxation, particularly during this time of Covid-19. Austinites have a wide variety of 335 these spaces spread across 43 zip codes in which to enjoy recreational activity, but equal opportunity to access outdoor spaces may be questionable. Figure 1 displays the distribution of outdoor spaces in terms of acreage per 100000. It becomes obvious upon observation that equal access to outdoor spaces are heavily reliant on the zip code in which you choose to live. By a large difference, zip code 78701 has the highest acreage per 100000 of 159.12 acres. Zip code 78702, the next highest acreage per 100000, had 102.62 acres. Alternatively, zipcode 78742 had the lowest of 0 acreage per 100000.

Figure 2, displays the outcome when plotting each location and using the interaction between post-secondary education as a percentage of population and median household income per zip code. There appears to be a pattern between East and West Austin, loosely following I-35. Hierarchical clustering was used to assist in better understanding the pattern. Once choosing an optimal k clusters of 2, plotting the results produced a much more stark pattern, as shown in Figure 3. Figure 3 displays there is a East and West divide of outdoor spaces in Austin.

Table 1 entails each clusters respective population, number of parks, percentage share of parks, total acreage, average acreage, and acres per 100000. Cluster 1 not only has a smaller total number and share of outdoor spaces, but also contains a smaller population. However, cluster 1 has a larger amount of total acreage, average acreage, and acres per 100000. Relative to cluster 2, cluster 1 has 22.1% smaller population, but 30.5% more total acreage, 39.4% higher average acreage, and 67.5% more acres per 100000. In conjunction with Figure 1 and Figure 2, there appears to be a correlation with post-secondary education and median household income with regards to access to outdoor spaces in Austin, Texas. However, this model does not prove causation as individuals with higher educational attainment levels and higher median household income may be attracted to zip codes that have more outdoor spaces.