Examining Park Space and Demographics Using GIS within Minneapolis and Saint Paul, Minnesota

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Abstract

Park locations are an important part of any community. Parks contribute to the lives of individual residents in multiple ways. The distribution of parks promotes overall public health providing space for physical activity as well as social interaction. Park locations and park density vary across a city and the access to park areas is both hindered and aided by the man-made surroundings that provide the setting for human activity. Census demographic data provide information on social, economic, and housing characteristics. Understanding where parks are located in the different parts of an urban area in relation to demographic data can be used to determine if a correlation exists between demographics and park space. In this study, a GIS analysis was undertaken in order to help understand spatial patterns contributing to a correlation between park space and people.

Introduction

Park Benefits

Park spaces can be found in almost every city in the United States. Park users benefit in many different ways including both mental and physical rewards. An example is improved physical fitness from activity taking place within park and trail spaces. Research concludes as more people partake in regular physical activity, the result is a positive influence on overall public health (Frank and Engelke, 2001). According to the Centers for Disease Control (CDC) and Prevention, only twenty-five percent of American adults partake in the CDC suggested levels of physical activity (CDC, 2008). In order to combat problems caused by the lack of physical exercise, it is important to understand how the "built" environment affects the exercise habits of people. The built environment is referred to in this study as the man-made surroundings that provide the setting for human activity. The extent of this built environment can be viewed as large public spaces such as parks or an individual's personal space. Land use and transportation factors are important aspects when considering park spaces and trails, but understanding how planning for future locations of these features can be improved still needs work (Frank and Engelke, 2001).

This project focuses on park spaces defined as areas of land within or near a city that are preserved and utilized for ornamental and/or recreational purposes. Green space is another term that has become popular and is defined in this study as outdoor areas that contain a large amount of vegetation. Other important park-like areas in this study include trail corridors and parkways. Trail corridors are great locations for walking and biking. Parkways provide more green space than typical streets and in

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some cases provide trails and recreational uses. All of the park-like areas just mentioned will henceforth be referred to solely as parks for the purposes of this study.

At the beginning of the twentieth century, a majority of citizens in the United States lived in rural parts of the country and in small towns. These areas being close to wide open spaces gave people better access to the land. More presently, in the early twenty-first century, eighty-five percent of the population now lives within cities and metropolitan areas making it difficult to access open space. Following the Second World War as populations began to flow to the suburbs, the vision of grand parks such as Central Park in New York and others shifted away from being a necessity. Cities lost resources to create new less grand parks, and suburbs became filled with curved roads broken up by shopping centers and parking lots (Sherer, 2003).

Over the past few decades however local governments as well as civic groups across the nation have reenergized run-down city parks. Parkways and greenways have been created along streams, lakes, and rivers. Old railroad beds have been turned into valuable trails seeing new life while serving a great purpose. Concerns now exist that with the present economic situation, that funding for maintaining park spaces will be reduced and threaten the existing parks while limiting resources for new locations (Sherer, 2003).

Parks and other recreational spaces offer users access to areas in which physical activity is welcomed and encouraged. Research suggests physical activity must take place in an actual physical space which the built environment can either support or discourage (Forsyth et al., 2006). Research is seeking to develop evidence for developing a relationship between the built environment and physical activity. Study areas include the following criteria: land use, zoning, urban design, walkability, parks, and trails. Technology is believed to promote inactivity. Television, the internet, and other devises keep individuals indoors and inactive. However, technology is steadily becoming part of the solution too. GIS has for a long time been used by researchers to monitor the built environment. The Twin Cities Walking Study utilized survey data along with an extensive GIS in order to produce a more robust method of modeling. The project used GIS measures such as road networking and velocity to better portray the study area (Hillier, 2008).

Recent studies also have found the distance to different types of open spaces have a relationship with home value in an area. Normally home values increase with proximity to these park spaces though the actual effect of these spaces on property values depend also upon neighborhood characteristics. In a study within the Twin Cities, suburban residents did not place as high a value on open spaces as did those in urban areas. With individuals living in densely populated urban areas, finding a place to recreate is very desirable and important to everyday life (Anderson and West, 2006). Similar to the pattern noted in the Twin Cities suburban areas, a study within the City of Rochester, Minnesota found that residential property around urban parks was not valued higher than property away from parks. Residents in Rochester had easy access to natural areas outside of the city. Therefore parks within Rochester were not viewed as destinations to escape urban distractions such as vehicle traffic and congested areas (Buffington, 1999).

City parks are a great way for users to escape the noise and distractions of traffic and crowded areas. Parks are also a place for social activities. Recreation, relaxation, and family gatherings are quite common in these areas and contribute to the vitality of a community. Urban parks are also a way for a community to improve the aesthetic qualities of their environment and at the same time guard the valuable natural resources found in the area. Parks can also contribute to the safety of the community by providing places of recreation away from non-pedestrian friendly locations such as busy streets, major intersections, and crossings that lack adequate signage.

The parks in Minneapolis and Saint Paul offer many different types of options to visitors. Regional, community, and neighborhood parks alike can be found in both areas offering a mix in not only size but also amenities. Regional parks are defined as spaces over one hundred acres in size (Bonsignore, 2003). These parks tend to be more nature oriented. Community parks are anywhere from twenty-five to one hundred acres in size. These parks can offer amenities including athletics, picnicking and natural areas. Neighborhood parks are those small sections of land consisting of twenty-five acres or less. These parks are the most common in the study area featuring athletic courts, walking, paths, and picnic areas (Bonsignore, 2003).

The City of Minneapolis is known for its prime parkland. The park system features over 6,400 acres of land and water. The parks includes features such as recreation centers, lakes, ponds, wading pools, water parks, beaches, sports fields, tennis courts, skate parks, and gardens. There are also fishing piers, boat launches, parkways, dog areas, and golf courses (City of Minneapolis, 2009). The City of Saint Paul features one hundred seventy parks and open spaces. The area also includes over one hundred miles of trails. Other amenities include a zoo, a conservatory, recreation centers, golf courses, and also indoor/outdoor aquatic facilities (City of Saint Paul, 2009). Parks in the two cities combined add to the value of the area and are visited by thousands of visitors each year.

Park locations and sizes within the City of Minneapolis and within the City of Saint Paul can be more clearly understood by utilizing a GIS. A GIS can also be used to determine how parks are distributed in relation to their environment. Environmental data can be combined in a GIS for spatial analysis to better portray the park/environment relationship (Seeger, 2006).

Data

Prior to statistical and spatial analysis of the data in this study, some initial steps had to be undertaken. These steps included data collection, data layer creation, and table creation for statistical analysis.

Data Collection

The data used in the analysis and mapping for this project was obtained from the MetroGIS DataFinder application, the Minnesota Department of Natural Resources Data Deli, the United States Census Bureau website, the City of Minneapolis, and the City of Saint Paul. From these sources an inclusive dataset was assembled to examine and assess the spatial layout of the park locations in the City of Minneapolis and the City of Saint Paul.

City Base Data

Base data utilized in this project included jurisdictional boundaries of the cities of Minneapolis and Saint Paul, Minnesota. Other datasets included lake and river polygon data, trail locations, census tract data and census block group data.

A portion of these layers were used for spatial reference in the project in mapping park location analysis results. The census block group and tract data were the sources of demographic data. These data were used in performing statistical analysis on the study area people traits. No major alteration of the datasets was performed other than clipping each to the extent of the two cities.

Park Locations

Park locations were provided by the cities of Minneapolis and Saint Paul in shapefile format. The polygons represent property owned by each city and include attribute data featuring park names, classifications, and sizes in acres. It is important to note that the park property included land used not only for parks but also included land used for trails and parkways. The park location data did not include green spaces found on non-public land. The data also did not include park amenities such as equipment, conditions, and specific features unique to each park. Since this study involved examining public park locations, private parcels of land were not included in the analysis.

Census Block Group and Tract Data

In order to evaluate demographic data within the study area, the need for census data emerged. The data was obtained from the United States Census of Population and Housing website. The Census Bureau provides data on demographics and economy and makes data readily available via the internet (United States Census Bureau, 2009a). The block group and tract boundaries were downloaded in order to map demographic data for subsequent analyses. These two census levels were chosen based on study of the hierarchy for the 2000 census (Figure 1). The levels of the tract and block group were identified as good demographic and spatial units. Both block groups and tracts were used in this study to determine if one level revealed a finding that the other did not. Because block groups (circa 800 people) are more disaggregated there was more focus on that level compared to the tract (circa 4000 people). The smaller units of census data depicted a more descriptive format when mapped.

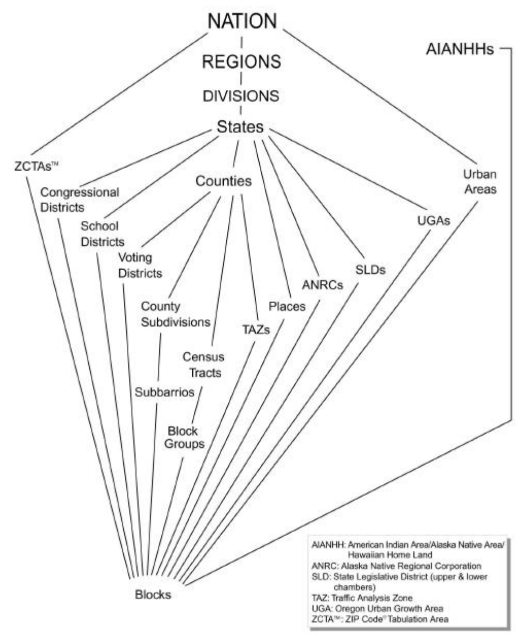

Figure 1. Census 2000 hierarchy (United States Census Bureau, 2009a).

Summary File Three Census Data

The Summary File Three (SF3) format from the United States 2000 Census was downloaded for the study area. These files provided information relating to the social, economic, and housing characteristics of the City of Minneapolis and the City of Saint Paul. The data within the files was assembled from a sample of approximately nineteen million homes that participated in the long-form edition of the 2000 Census (approximately one out of every six households) (United States Census Bureau, 2009b).

Important variables from the SF3 files were identified for analysis for their value in describing aspects of the social, economic, and housing data of the area. Census demographic variables of interest for this study included the following six categories:

- Median household income in 1999
- Median value of owner-occupied housing units
- Poverty as the number of families below the poverty level.
- Public Assistance as the total population of households receiving public assistance.
- Unemployment as the total population of individuals ages 16 and above.
- Race broken down into subclasses by White Caucasian, Asian, African American, and combined. The subclasses were defined by having at least a sixty percent share of the census geography.

The SF3 files were downloaded at the tract and block group level. MetroGIS provided a subset for the SF3 files at the tract level online. Initial tract data were downloaded from the MetroGIS website in dbase file format. These files were imported into ArcGIS and later joined to the corresponding tract polygon data. The downloaded census data arrived divided into housing and economic portions of census information. Data related to race was not included in the data provided by MetroGIS at the tract level. Spatial and statistical analysis on race was conducted solely at the block group level. The block group SF3 data described above was queried from the U.S. Census Bureau website for both Hennepin and Ramsey Counties. The SF3 data needed at the block level could either be downloaded by each block group or at the county level. By downloading both Hennepin and Ramsey Counties, the study area data for the City of Minneapolis and the City of Saint Paul was obtained. This data included all the text files containing the demographic information for the categories chosen for the study pertaining to the SF3 dataset.

Methods

Discussions within this section describe the methods of selecting census variables and park locations for analysis.

City Base Data

The base data used in this project included: jurisdictional boundaries for the study area, lakes, rivers, trails, and also census boundaries. The original shapefiles were exported to the project geodatabase and later clipped to the defined study area for use in mapping and analysis. Created feature class layers were also separated into feature datasets not only for organization, but also to ensure the same coordinate system was being applied.

Park Locations

Park property shapefiles were combined for both the City of Minneapolis and the City of Saint Paul by using the union tool in ArcGIS. The shapefile produced from this union was exported into the project geodatabase. Attribute fields were calculated for the park layer. Attributes included the total acres encompassing each polygon. This was done because there were multiple polygons within the dataset that were essentially the same park yet each polygon had the same numerical area listed for each polygon record. Therefore a new area calculation was necessary to more accurately reflect the amount of space each park polygon consisted of. The park polygons were also separated into which jurisdiction each fell into (Minneapolis or Saint Paul). Figure 2 illustrates the layout of the study area and park locations.

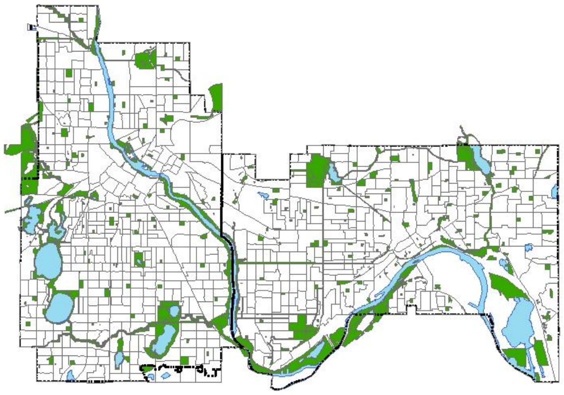

Figure 2. Park locations represented in the City of Minneapolis (on the left) and the City of Saint Paul, (on the right). The thin black lines represent census block group boundaries, while blue features represent lakes and rivers. This and all map depictions are shown at a distance across the two cities representing approximately 16 miles east to west.

Census Data

Once the tract and block group layers were developed and saved to the geodatabase, the demographic data were joined to the census geography layers.

Study Variables

The six variables used from Summary File 3 data were chosen to reflect important aspects of the social, economic, and housing data. Studies have shown how the distribution of physical activity as well as access to built areas may be linked to socioeconomic demographics (Moore et al., 2008). Census variables used in this study included: median household income in 1999, median value of owner-occupied housing units, families below poverty level, public assistance as the total population of households receiving public assistance, unemployment status and race. These demographics were examined in order to determine if a correlation existed between park spaces and demographic variables.

Tract Data

First, the Summary File 3 files at the tract level were joined to the census tract geography. This was accomplished by adding the dbase files for the economic and housing files to the project geodatabase. A unique field within the tract polygon layer was used to join to the same field in the corresponding demographic data. The output for this join was exported as a new layer in the geodatabase. In total, 203 tracts were included for analysis in the study area. The table for this new layer was also exported into an excel spreadsheet for statistical analysis. The tract data was used as a comparison against the block group data for the statistical analysis. The tract data did not include information related to race. Statistical analysis related to race was completed only at the block group level. The tract data was not used in spatial analysis as the more disaggregated block group data was available and provided a more descriptive visualization.

Block Group Data

The next census level of demographic data to be processed was the block group data. The data files downloaded from the census website contained all of the social, economic, and housing variables within the SF3 format. Accompanying documentation described which variables were stored in which files. The files were renamed given a text file, (.txt) extension and then imported into a template Access database provided from the Census Bureau. Because the data files were segmented by county, this process had to be completed twice, once for Hennepin County and again for Ramsey County. Hennepin County included the data for the City of Minneapolis while the data for Ramsey County contained the data for the City of Saint Paul. With the appropriate files imported into the new database, they were combined by merging into one. The resulting tables were then exported to the project geodatabase.

Once imported into the geodatabase the demographic data needed to be joined to the corresponding block group polygons. A field was added to each block group data table that combined geographic identification codes to form a unique location identification field. A join was then executed based on this identification field to add the block group demographic data to the block group polygon dataset. The result of this operation produced a feature layer of the block groups in the study area with fields of information containing demographic data for each polygon. The total number of block groups within the study area was 657.

Analysis

Spatial Analysis

In order to get an idea of where people were located in relation to parks, the first analysis was to perform spatial analysis in an attempt to visualize the representation of the data. A population density raster layer was created. Using the ArcGIS 9.3 Spatial Analyst kernel density tool, a raster layer with a cell size of twenty-five meters was generated. The inputs for this layer included the centroid of each census block group polygon and the total population associated with that location. The search radius for this analysis was one kilometer which gave an output of people per square kilometer (Figure 3). The density layer depicted portions of the study area with higher population densities. The higher density areas were located in close proximity to the downtown areas.

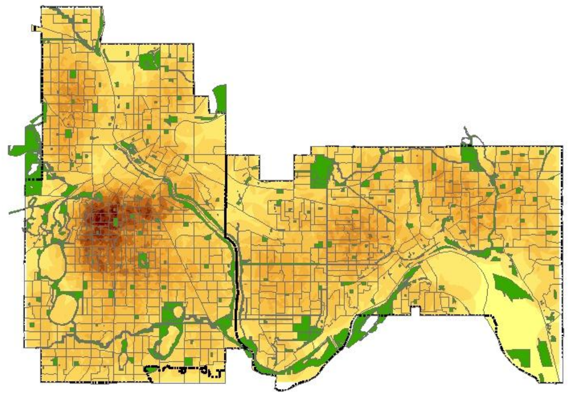

Figure 3. Dark brownish areas represent areas of higher population density (8,000 people per square kilometer; lighter shades represent lower population density (1,000 people per square kilometer). Parks are depicted as green polygons and blue represents water.

Next, a distance to parks raster layer was created. The resulting grid had a cell size of twenty-five meters (Figure 4). By examining the distance to park layer, the distribution of parks appear to be evenly dispersed throughout the study area.

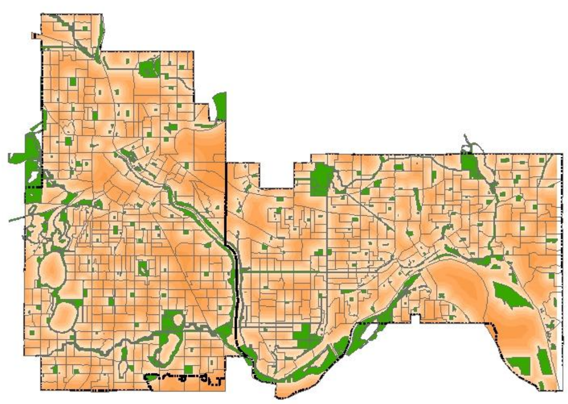

Figure 4. Lighter shades represent shorter distances to parks (100 meters) while darker shades depict farther distances to parks (1,000 meters). Parks are shown in green.

The demographic variables (median household income, median value of owner-occupied housing units, families below poverty level, public assistance, unemployment and race) were also mapped using graduated colors. These maps are shown in Figures 5 through 10. Each demographic variable was mapped with ten classes by the natural breaks method with the exception of the race layer. The race layer was created by designating the census block as being predominantly one race if that race made up more than sixty percent of the total population. The sixty percent criterion was chosen as representative of a strong majority. Correlation and Student's t tests analyses were calculated to evaluate how demographic variables related to the size and number of park locations.

Statistical Analysis

Analyses were completed to identify if correlation existed between the demographic variables and the park sizes as well as between the demographic variables and the number of parks. This was accomplished by exporting the tract and block group data sets from the project geodatabase into Microsoft Excel. The mean was then calculated for each demographic variable. This value was then used to segment the park sizes and the number of parks to those above and below this mean. This was done for median household income in 1999, median value of owner-occupied housing units, families below poverty level, public assistance as the total population of households receiving public assistance, unemployment and race. A two-sample independent t-test was then undertaken for each variable by using the segmented park sizes and number of parks. The t-test was used to test for the equality of the two population means.

The Pearson's Parametric Correlation Coefficient was used to determine the strength of relationships between variables. Each of the six demographic variables of interest was related to park size and the number of parks in this manner. Once again these variables included: median household income, median value of owner-occupied housing units, families below poverty level, public assistance, unemployment and race.

Results

Spatial Analysis

The spatial analysis methods used in this study included developing a population density layer as well as a distance to park layer. In Figure 3, the population density appeared to be lower in areas of larger parks especially along the Mississippi River and in southwest Minneapolis. Alternatively, the distance to parks layer in Figure 4 shows the actual dispersion of parks was quite uniform when taking into account the entire study area. By clipping the layer to the study area boundary, the mean distance to parks in this analysis was 271 meters or approximately 0.17 miles.

The demographic variables were also mapped in order to visually identify correlations between park sizes, park locations and the census demographics. The variables mapped included median household income (Figure 5), median value of owner occupied housing units (Figure 6), families below poverty level (Figure 7), total population with public assistance (Figure 8), unemployment (Figure 9), and race (Figure 10).

Comparing household income and median home value in Figures 5 and 6, there were areas where the two variables were quite similar in dispersion. These included the following:

- Nokomis Neighborhood in South Minneapolis

- Highland Park area in Saint Paul, located in the central southern portion of the study area
- Southwest Minneapolis
- North through the Calhoun Isle neighborhoods in Minneapolis.

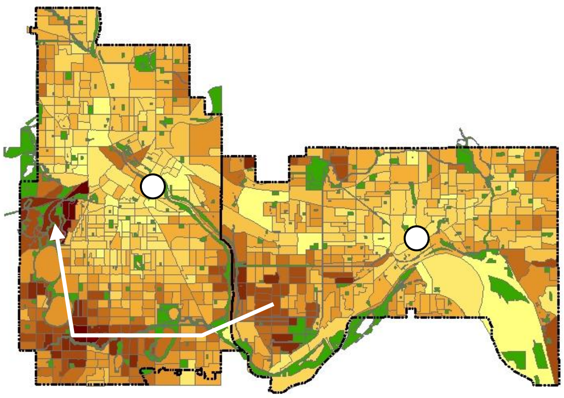

Figure 5. Median Household Income, dark brown representing block groups with higher income and light yellow as lower income. White circles depict the locations of downtown Minneapolis on the left and downtown Saint Paul on the right.

The neighborhoods just noted above are found in the southern portion of Figures 5 and 6 in the south-central part of the study area. Following the white arrows in both Figures 5 and 6, this area extends to the western edge of the City of Minneapolis and then north following Minnehaha Creek. Within these areas, both household income and median home value show higher values as opposed to areas such as downtown regions shown as white circles in Figure 5. It is worthy to note that these areas also feature larger park spaces that are primarily located around bodies of water.

Comparing park sizes to areas of higher numbers of families below the poverty level and higher total public assistance respectively (Figures 7 and 8), park sizes were smaller but for the most part were evenly dispersed throughout the area.

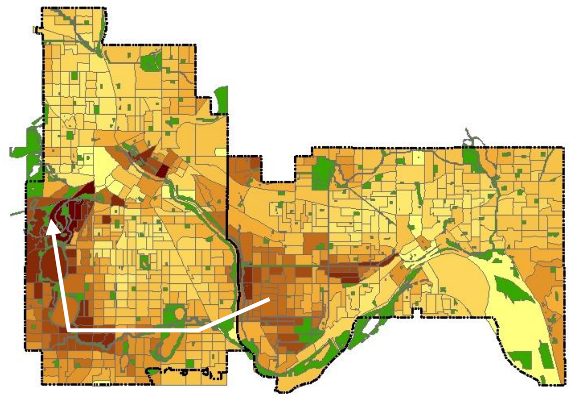

Figure 6. Median Value of Owner Occupied Housing Units, dark brown depicting higher home values versus the lighter yellow areas of lower home values.

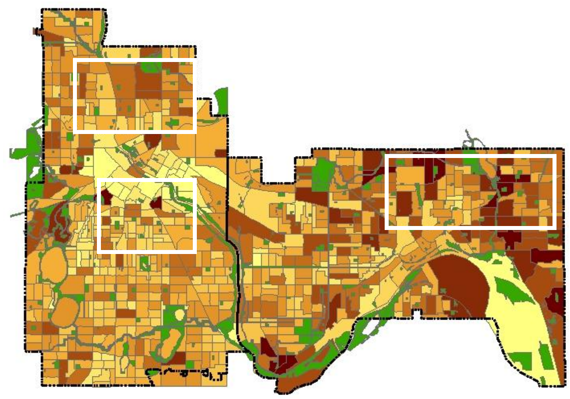

Figure 7. Poverty Level with dark brown representing block groups with a higher number of families below the poverty level. Boxed areas show areas with smaller parks that are dispersed.

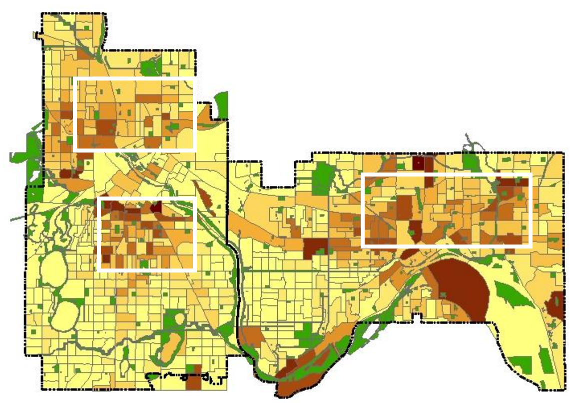

Figure 8. Total Population with Public Assistance where dark brown shows the block groups with more public assistance than the lighter areas.

These areas included areas directly south of downtown Minneapolis, north of Minneapolis as well as the northern portion of Saint Paul (See boxed areas in Figure 7 and in Figure 8).

Unemployment (Figure 9) shows areas where unemployment was higher in 1999. Unemployment was a more evenly distributed demographic variable examined, even more so than for home value and income just noted above.

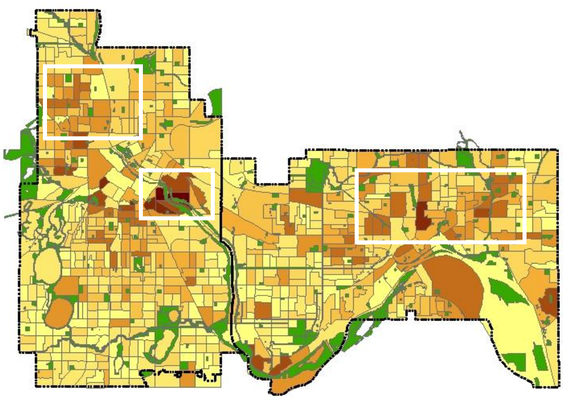

Figure 9. Unemployment shown to be higher in block groups that are darker brown. Examples are boxed in white.

While there are areas in north Minneapolis and north Saint Paul that had higher values (boxed areas in Figure 9), these were more dispersed than those of household income and home value.

Figure 10 shows block groups that have sixty percent or more of one race. Again, sixty percent was chosen as indicative of a strong majority, not just a simple majority. Depicted as light green in Figure 10, White-Caucasian majority block groups represent two-thirds of the study area. African-American majority block groups are shown as purple polygons while Asian majority block groups are depicted as pink polygons in Figure 10. Block groups without a one race sixty percent majority are shown as yellow polygons in Figure 10. The block groups without a one race majority represent one-fourth of the study area.

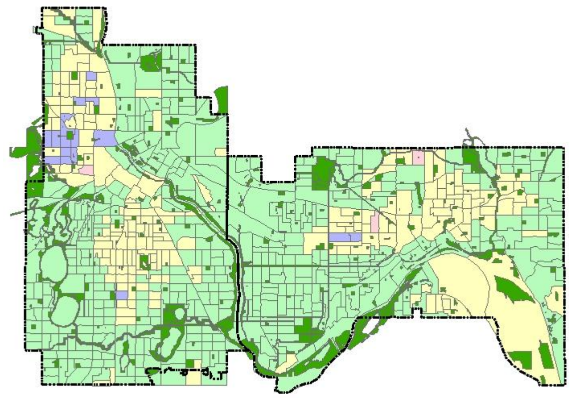

Figure 10. Race classified into White-Caucasian in light green, African American in purple, Asian in pink. Areas in yellow do not have a one race sixty percent majority.

Statistical Analysis

In order to get an idea of the amount of park space and the number of parks available in relation to selected demographic variables, the mean values of each variable were used to segment park areas and the number of parks. This was undertaken to determine the average park areas and the average number of parks above and below each mean. Table 1 shows the data pertaining to block groups. Table 2 shows the data related to tracts. On average, census block groups with higher household incomes, higher home values, fewer families below the poverty level, higher unemployment levels and with lower populations utilizing public assistance had slightly larger mean park space per block group and tract. Households at the block group level with incomes greater than $43,132 had an average of 3.7 more acres of park space and an average of 0.2 more parks than those below $43,132. Households at the tract level with incomes above $38,988 had an average of 29.5 more acres of park space than those below $38,988. The number of parks for tracts above $38,988 was 2.5 versus that of 2 for tracts with incomes below $38,988.

Table 1. Demographic variables and mean park size (acres) and number of parks per block group (n=657). Values are segmented for each variable. The average park size and number of parks above and below the mean are presented here.

Median Household Income	Mean Park Acres	Number of Parks
Above $43,132	11.8	1.1
Below $43,132	8.1	0.9
t-Statistic	1.613	1.903*
Median Value Owner Occupied Housing Units		
Above $119,972	11.6	1.2
Below $119,972	8.5	0.9
t-Statistic	1.347	3.065**
Families Below Poverty Level		
Above 24.5	6.9	0.9
Below 24.5	10.9	1.1
t-Statistic	-1.790*	-1.707*
Total Population with Public Assistance		
Above 30.6	9.4	1.0
Below 30.6	9.7	1.0
t-Statistic	-0.137	0.194
Total Population Unemployed		
Above 32.4	10.4	1.1
Below 32.4	9.2	1.0
t-Statistic	0.437	0.241
Race		
White-Caucasian		
Above 673.7	13.3	1.3
Below 673.7	6.5	0.8
t-Statistic	2.887**	4.938**
African-American		
Above 151.9	7.1	0.9
Below 151.9	10.9	1.1
t-Statistic	-1.740*	-2.026*
Asian		
Above 90.3	8.2	1.1
Below 90.3	10.2	1.0
t-Statistic	-0.842	0.617

a * is significant at the 0.05 level, ** is significant at the 0.01 level

Census block groups and tracts with higher household incomes and higher home values had slightly more parks. Also in Table 1, the total population unemployed above 32.4 per block group had 1.2 more acres of park space. With regards to race, block groups with a White-Caucasian population above 673.7 had 13.3 acres of parks versus that of 6.5 acres for below 673.7 for a population. Both African-American and Asian majority block groups had less access to park areas with more park acres below each variables mean.

Table 2. Demographic variables and mean park size (acres) and number of parks per tract (n=203). Values are segmented and for each variable, the average park size above and below the mean are presented here.

Median Household Income	Mean Park Acres	Number of Parks
Above $38,988	47.5	2.5
Below $38,988	18	2
t-Statistic	3.681**	1.934*
Median Value Owner Occupied Housing Units		
Above $121,054	46.5	2.3
Below $121,054	23.1	2.1
t-Statistic	2.48**	1.95*
Families Below Poverty Level		
Above 79.4	25.6	1.9
Below 79.4	35.3	2.4
t-Statistic	-1.29	-1.73*
Total Population with Public Assistance		
Above 99.3	22.8	2
Below 99.3	37.5	2.4
t-Statistic	-2.067*	-1.253
Total Population Unemployed		
Above 105.3	34	2.2
Below 105.3	29.5	2.2
t-Statistic	0.545	-0.098

a * is significant at the 0.05 level, ** is significant at the 0.01 level

The t-statistic values calculated for each variable at the block group and tract levels are shown in Table 1 (block groups) and Table 2 (tracts). The 0.05 critical one-tailed t-value for block groups with a sample size of 657 was 1.647. For the 0.01 alpha error rate it was 2.333. The 0.05 critical one-tailed t-value for tracts with a sample size of 203 was 1.653. For the 0.01 alpha error rate it was 2.345. Any t-statistic above or equal to the critical value indicated the mean values for the variables compared were not equal and one was statistically significantly larger at either 0.05 or 0.01 error rate as noted per each in Tables 1 and 2.

Looking at Table 1, for median household income, the t-statistic for mean park acres was 1.613. This value is less than the critical value of 1.647 thus indicating no significant difference between the mean park acres above and below $43,132. In Table 2, the t-statistic for household income for mean park acres was 3.681. This value is greater than the alpha critical value of 2.345 so would indicate a strong significant difference in mean park acres above and below $38,988. The number of parks for median home value at the block group level also resulted in a highly statistically significant difference. At the block group level, the number of families below the poverty level resulted in a significant difference for the mean park acres and the number of parks with slightly more parks available on the higher income side. In Table 2, for families below the poverty level there was a significant difference for the number of parks. Families below the poverty level had statistically equal average park sizes but a statistically significant access to more parks. Block groups and tracts with a higher unemployed population had a larger mean park size and more parks, although differences were not statistically significant. The t-statistic in Table 1 for White-Caucasian majority block groups was highly significant for both the mean park acres and the number of parks with a larger park size and greater number above 674 people. Block groups with a lower African-American population had a significant difference in the average park size and the number of parks. Block groups with an African-American population below 152 had larger park sizes and a greater number of parks. Block groups with Asian populations above and below 90 people had statistically equal average park sizes and number of parks.

Table 3 shows a summary of the r-values obtained using the Pearson Parametric Correlation. A table of critical values for the correlation coefficient was utilized to determine the significance of the r-values calculated in this study. The 0.05 critical one-tailed r-value for tracts with an n of 203 was 0.116. For the 0.01 alpha error rate it was 0.164. R-values at the tract level above 0.116 were determined to be significant and values above 0.164 were determined to be highly statistically significant.

Table 3. R- values for each demographic variable at the tract and block group level. R-values were calculated comparing each demographic variable with park acres and the number of park locations.

	Park Acres	Number of Parks
Median Household Income	**R-Value**	**R-Value**
Tracts	0.290**	0.211**
Block Groups	0.094*	0.126**
Median Value Owner Occupied Housing Units		
Tracts	0.138*	0.182**
Block Groups	0.098**	0.194**
Families Below Poverty Level		
Tracts	-0.051	0.020
Block Groups	-0.046	-0.018
Total Population with Public Assistance		
Tracts	-0.041	0.030
Block Groups	-0.005	0.005
Total Population Unemployed		
Tracts	0.044	0.065
Block Groups	0.021	0.022
Race - Block Groups		
White-Caucasian	0.190**	0.250**
African-American	-0.067*	-0.079*
Asian	-0.011	0.043

a * is significant at the 0.05 level, ** is significant at the 0.01 level

The 0.05 critical one-tailed r-value for block groups with an n of 600 was 0.067. For the 0.01 alpha error rate it was 0.095. R-values at the block group level above 0.067 were found to be significant and values above

0.095 were found to be highly statistically significant.

Looking at Table 3, the highest r-value attained was with median household income at 0.290 at the tract level for park acres. The r-value of 0.290 and the r-value of 0.211 for the number of parks were both highly statistically significant. The r-values for median home value also were found to be highly statistically significant with the exception of park acres at the tract level. The r-values for White-Caucasian majority block groups were highly significant for both park acres and the number of parks.

Discussion

Initially it was believed that a correlation could be identified by visually and statistically inspecting park sizes, the number of parks and demographics. By initially performing a visual inspection of park locations and sizes in relation to the census demographics, areas with higher/lower values of the demographic variables were found in certain areas with larger parks. Some results of the two-sample independent t-tests did show a significant difference in the means above and below the mean census variables. Block groups and tracts with higher median household income, higher median home value, fewer families below the poverty level, fewer people with public assistance and higher populations of White-Caucasians had more park acres as well as a higher number of parks. These results were not surprising when compared to the results from the visual inspection of the spatial analysis. An unexpected result came from block groups and tracts with a higher unemployed population. These areas actually had slightly more mean park acres and a greater number of parks. Looking back to Figure 9, unemployment was a more evenly distributed demographic variable when compared to either household income or median home value.

The Pearson Parametric Correlation did not reveal any strong relationships between park sizes and the demographic variables nor between the number of parks and the demographic variables. The number of block groups and tracts used in the analysis was high enough to obtain significant r-values. However, taking into consideration the entire study area and the small parks that are dispersed throughout, statistically no high correlation values were identified. Reasons for not finding high correlation values could be that only park spaces owned by the City of Minneapolis and the City of Saint Paul were used in this study. This was a decision made prior to analysis in the interest of the overall scope of the project. Park access in terms of entry points to parks, pedestrian pathways to parks, and the walkability of neighborhoods surrounding parks were not included in the study. Park features such as playground equipment or paved trails were also not included. Amenities may be a key factor in evaluating a correlation as well as how much use a park receives in a given year.

If totaled, the number of parks that were studied for both block groups and tracts would be greater than the actual number of parks. Not all of the park locations identified in this study fit entirely within one tract or one block group. Some parks reached across multiple block group and tract boundaries thus were counted more than once.

It is important to note that along with a visual interpretation of the demographic variables, a statistical approach was used to assess the relationship between the variables. In this case it was determined that within the City of Minneapolis and the City of Saint Paul no strong correlation was found to exist between park acres, the number of parks and the chosen census demographics using the Pearson Parametric Correlation. While no large correlation value was found in this study, there is value in making that determination as it helped to understand the distribution of parks.

Conclusion

Researching and studying park locations by attempting to connect to socio-economic variables is a task that can be accomplished in different ways. The goal of which is to determine if a correlation exists which is reasonable and useful in understanding relationships. Determining where locations may be in need of more park space based on research of this nature could be beneficial in planning for future parks as well as maintaining existing parks. Considering the health benefits and community value parks add studying where parks are found in relationship to demographics can improve decision making on what parks need to be improved or where new parks should be located to ensure equal access.

Suggestions for Future Research

This study used a subset of demographic data available from the U.S. Census Bureau. Future studies could utilize more of this data and also apply to different study areas. It would also be of interest to apply park amenities to a study of this nature. By weighing each park by what features it has to offer, a new aspect for comparison would be created. Not only would park size be compared but also what individual parks have to offer. Different parks have different features and applying a weight to each along with performing a linear correlation to census data could reveal other trends not identified within the scope of this project. Are parks with certain features found in neighborhoods with higher income or higher home value? There are certainly other variables that could be applied to future studies on this topic. When the 2010 census is completed it would also be interesting to compare results utilizing the Summary File 3 data from the latest census to determine if the findings are different.

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