Analysis of the Distance Between Socio-Economic Variables and Location of Parks in Hennepin County, MN and Milwaukee County, WI

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INTRODUCTION & OBJECTIVE

Parks offer many social benefits to communities that impact physical health, well-being, and a sense of community (Zhou & Kim, 2013). If inequalities are found in the relationship between the location of parks and different socio-economic variables, work needs to be done to improve access to parks for these communities. The goal of this project is to look for a relationship between park distance and socio-economic variables for Hennepin County, Minnesota and Milwaukee County, Wisconsin. These two counties include large populous cities with urban infrastructure and are economic and cultural centers of their states. Both counties have diverse populations with differing socioeconomic statuses. GIS can be used to find spatial relationships between parks and recreation in comparison to areas of high poverty and differing socio-economic statuses.

- **Objective:** Highlight the disparities in access to parks and recreation areas in communities with differing socio-economic statuses, especially those in areas with higher poverty rates.

STUDY AREA

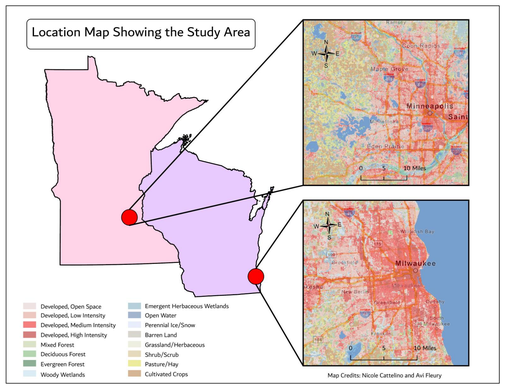

Figure 1: Study areas chosen to conduct analysis. Depicts the Land Use Land Cover of Hennepin County, MN and Milwaukee county, WI.

LITERATURE REVIEW

Existing literature shows that there is no relationship between park distance and socio-economic variables. Xiaolu Zhou and Jinki Kim compared racial/ethnic disparities and access to parks and tree canopy. They used kernel density, zonal analysis, and several other methods to get the data they needed to run a statistical analysis. The authors found that racial/ethnic minorities have less tree canopy in their neighborhoods. However, no significant differences were found in terms of access to parks (Zhou & Kim, 2013). Heo et al., 2021 compared socioeconomic inequities and access to green space and parks within Seoul, South Korea. The tools they used to get their result include regression analysis, Euclidian distance, spatial buffers, correlation analysis, and generalized linear model. To visualize their findings, they mapped urban park types and residential land covers, park accessibility index, park area, and park distance from the residential areas. From their research, the authors found no strong patterns indicating that urban parks were more accessible for socio-economically affluent groups in Seoul (Heo et al., 2021). Duncan et al., 2012 evaluated spatial relationships between neighborhood sociodemographic characteristics and walkable neighborhood amenities in Boston, Massachusetts. They used spatial autocorrelation, spearman correlations between characteristics and amenities, as well as ordinary least squares regression models as a final step. They used choropleth maps to show spatial distribution in sociodemographic characteristics and walkable amenities. These regression models and correlations did not indicate any spatial inequalities (Duncan et al., 2012). All three peer-reviewed articles used spatial analysis techniques that will be used within this project. Based on the findings of these articles, it may not be possible to find a spatial relationship between access to parks and low-income neighborhoods. More research is needed to conclude this.

DATA AND METHODOLOGY

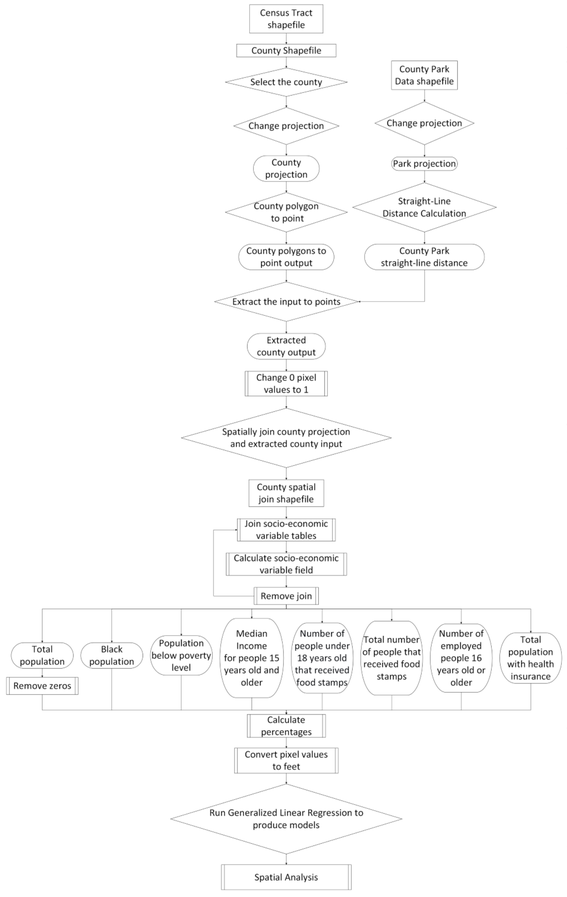

Figure 2: Methodology flow chart.

Data: We used two 2020 ACS Census Tract Polygon TIGER/Line shapefiles, one for Hennepin County and one for Milwaukee County, for our Census Bureau data. These shapefiles were originally in the NAD 1983 Geographic Coordinate System but were reprojected into a Projected Coordinate System. The other two shapefiles used for this project were found on their respective county websites and were used to define the county park polygons. These county park shapefiles were reprojected to be the same Projected Coordinate System as the Census Tract shapefiles.

Methods: The ArcGIS Pro tools used for this project include Euclidean Distance, Feature to Point, Extract Values to Point, Spatial Join, and Generalized Linear Regression (GLR).

DISCUSSION & CONCLUSIONS

Discussion:

- No significant correlation was found between park distance and our chosen socio-economic variables.
- Data was clustered and not random.
- The distribution of standardized residuals for both counties was skewed.
- Milwaukee County's Standardized Residual vs. Predicted Plot chart for all three trials were more random than Hennepin County's scatter plot.
- Hennepin County did not show any significant changes in terms of data clustering in these trials.
- R-squared values for each model and trial were essentially at 0 percent, indicating our model explains very little of the variation in our dependent variable.
- All AICc values were high, indicating none of our models captured the underlying patterns in our data.
- Regarding coefficients, there were some notable positive relationships shown in Trial #2, especially the unemployment for both counties and poverty for Hennepin County.
- In both Milwaukee County trials using the median income variable (trials 1 & 2), the probability for median income was considered statistically significant.
- VIF (Variance Inflation Factor) values in all three trials were between 1 and 5, which indicates moderate redundancy.

Conclusions:

- GLR is not the best tool to test our objective.
- Trial #2 was the best model to showcase our findings.
- Using centroids for each park and census tract is not the best method for demonstrating a possible relationship between park distance and socio-economic values.
- We did our best with the time and knowledge that we had but would change our methods if we had the chance to repeat this project.

RESULTS

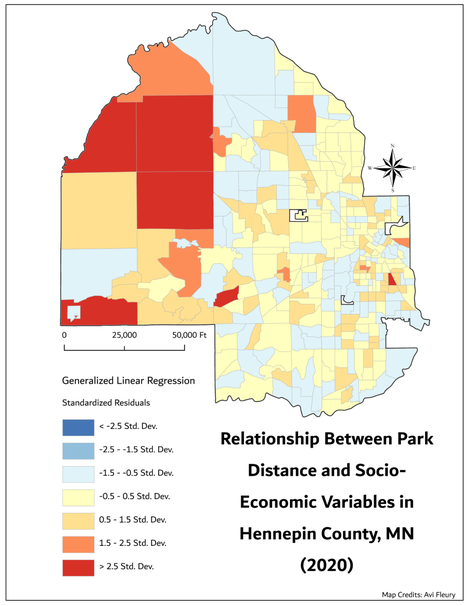

Figure 3: Choropleth map showing GLR Standard Residuals for all six socio-economic variables that were examined in comparison to park distance in Hennepin County, MN (2020).

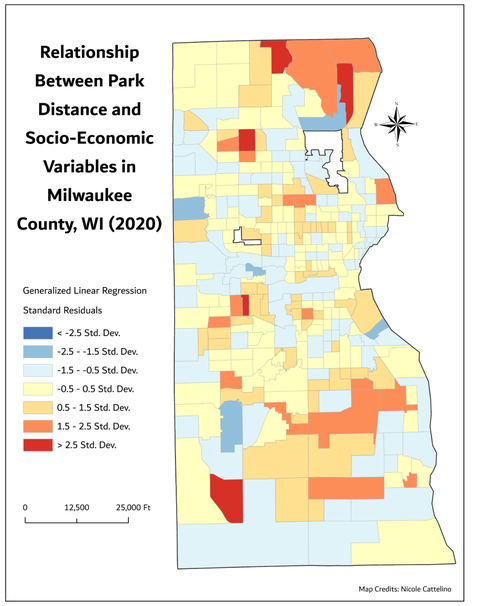

Figure 4: Choropleth map showing GLR Standard Residuals for all six socio-economic variables that were examined in comparison to park distance in Milwaukee County, WI (2020).

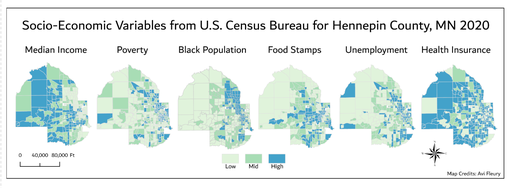

Figure 5: Choropleth maps showing the six chosen socio-economic variables for Hennepin County, MN (2020).

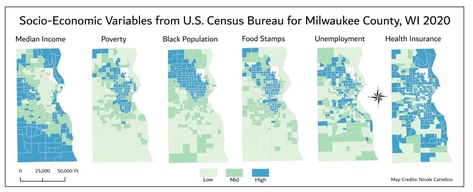

Figure 6: Choropleth maps showing the six chosen socio-economic variables for Milwaukee County, WI (2020).

Table 1: Results for GLR Trial #1 for Hennepin County.
Trial 1 – Hennepin County – R-squared value: 0.002354; AICc Value: 6255.666979

Variables	Coefficient	Probability	VIF
Median Income	0.009325	0.557475	1.581528
Poverty	49.418581	0.385811	1.581528

Table 2: Results for GLR Trial #1 for Milwaukee County.
Trial 1 – Milwaukee County – R-squared Value: 0.016623; AICc Value: 5853.552876

Variables	Coefficient	Probability	VIF
Median Income	0.068683	0.036851	2.309486
Poverty	29.582626	0.280638	2.309486

Table 3: Results for GLR Trial #2 for Hennepin County.
Trial 2 – Hennepin County – R-squared value: 0.014817; AICc Value: 6259.912178

Variables	Coefficient	Probability	VIF
Median Income	0.000937	0.957490	1.936131
Poverty	80.358740	0.231440	2.193952
Black Population	-35.888644	0.057077	2.027413
Food Stamps	-13.393397	0.547215	1.054571
Unemployment	93.439926	0.494804	1.539731
Health Insurance	3.880898	0.971525	1.050186

Table 4: Results for GLR Trial #2 for Milwaukee County.
Trial 2 – Milwaukee County – R-squared Value: 0.032730; AICc Value: 5857.010988

Variables	Coefficient	Probability	VIF
Median Income	0.093251	0.009320	2.739973
Poverty	-8.810812	0.791845	3.439431
Black Population	-5.381587	0.648346	2.239850
Food Stamps	57.912537	0.065264	4.347027
Unemployment	92.873163	0.574066	1.357493
Health Insurance	37.603492	0.618548	1.031621

Table 5: Results for GLR Trial #3 for Hennepin County.
Trial 3 – Hennepin County – R-squared value: 0.009788; AICc Value: 6257.375629

Variables	Coefficient	Probability	VIF
Black Population	-24.096977	0.111905	1.313172
Food Stamps	-12.230677	0.581973	1.052748
Unemployment	162.246363	0.193445	1.278340
Health Insurance	15.669634	0.883344	1.013876

Table 6: Results for GLR Trial #3 for Milwaukee County.
Trial 3 – Milwaukee County – R-squared Value: 0.003981; AICc Value: 5861.499358

Variables	Coefficient	Probability	VIF
Black Population	-6.539204	0.583445	2.236573
Food Stamps	7.523636	0.736495	2.165208
Unemployment	29.064512	0.860604	1.332687
Health Insurance	65.827468	0.384768	1.013764

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