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GEOG176A

Does Proximity to Power Plants Correlate with Economic Characteristics?

For this project my partner, Brianna Lee, and I were interested in investigating if there is a spatial relationship between household economic characteristics and proximity to power plants in the city of Los Angeles. We were interested to see if people who live closer to power plants are characterized by lower median household income and higher unemployment, while people further from power plants have higher income and lower unemployment. This problem is important because it investigates if those who are economically vulnerable are dealt with the injustice of living near power plants. Power plants are not ideal to live near due to their production of pollution, dreary appearance, and many other reasons. Considering these factors, we wanted to observe if lower income communities are situated near power plants due to a lack of opportunity and choice. To discover if a relationship exists between proximity to power plants and economic characteristics, we obtained information on household income traits, including median income and unemployment rates at the Census tract level, in addition to locational information on power plants in Los Angeles. After mapping this information we conducted proximity analysis by measuring the number of tracts characterized by each income level/unemployment rate within one mile of power plants. We also calculated the distance between each tract and the nearest power plant. These distances and the unemployment and income values of each tract were used to create scatter plots describing the relationship between the distance to power plants and economic characteristics.

Los Angeles is home to almost four million people of diverse backgrounds. Although many communities are notable for their prosperity, such as Bel Air and Westwood, there are communities characterized by lower income and higher unemployment rates. There are also many power plants located in various areas of the city. Considering these two factors, Brianna and I wondered if a relationship exists between the location of existing power plants and the communities surrounding them. We hypothesized that areas closer to power plants consist of lower income and higher unemployment, while areas further away consist of higher income and lower unemployment. To investigate this problem we began by gathering the following data sets:

Name	Description	Link	Type of Data	Attributes used
Median Household Income (2016)	Demographic information at the Census tract level for Los Angeles County.	https://gisdata-scag.opendata.arcgis.com/datasets/865f2509d5d4450ea6bfd527596ef502_0/data	CSV file converted to shapefile: Vector points	Median Household Income (Income_Pct), Unemployment Rate (UnEmp_Rate), City_name
California Power Plants	Information on the location of power plants in California, along with attributes about each power plant.	https://gis.data.ca.gov/datasets/CAEnergy::california-power-plants	CSV file converted to shapefile: Vector points	N/A
LA County City Boundaries	Basic information on the different cities of Los Angeles County such as city names and area measurements.	https://hub.arcgis.com/datasets/lacounty::la-county-city-boundaries	Shapefile, vector polygon	CITY_NAME

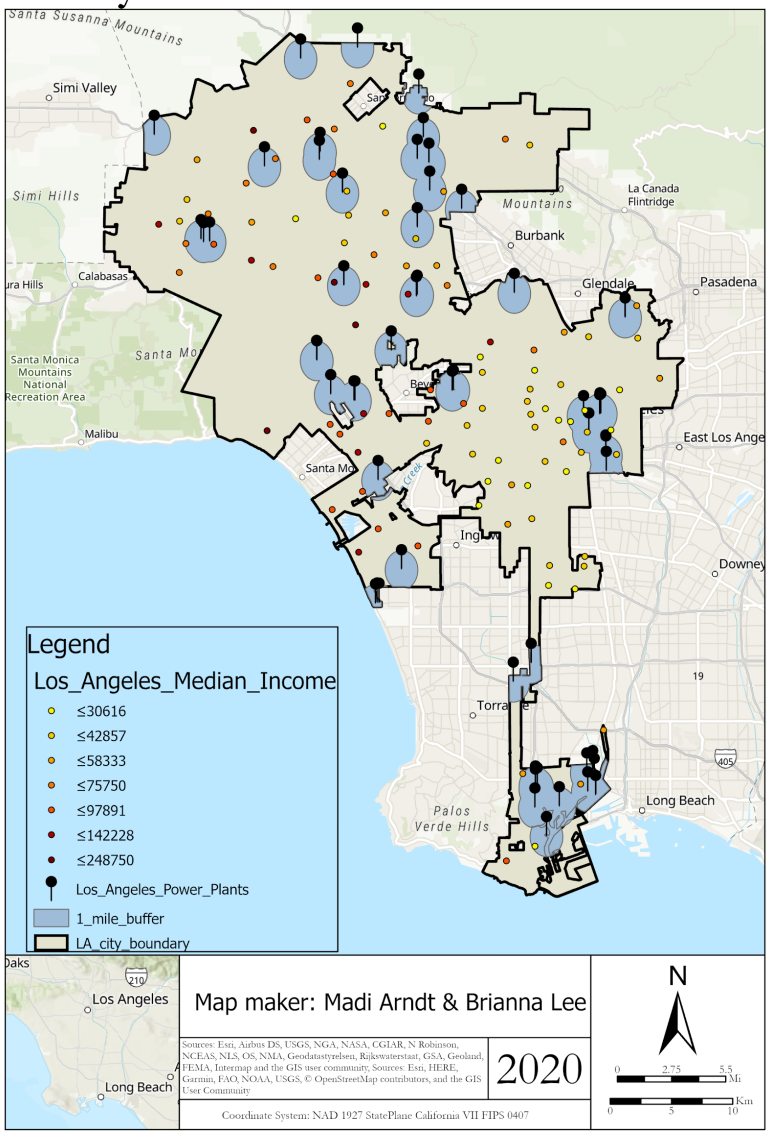
To begin, Brianna and I geocoded the “Median Household Income (2016)” and “California Power Plants” data sets onto our map using “Geocode Table” to visualize the data from these CSV files as points on our maps. We then applied operations (analysis) on the attributes of these data sets and the “LA County City Boundaries” data set to select data that applied to the city of Los Angeles (this required us to join the “California Power Plants” and “Median Household Income (2016)” attribute tables) . We used “Select By Attribute” to select the appropriate features and “Export Features” to create layers containing the selected features. Using Natural Breaks and Geometric Interval classification methods, Brianna and I categorized the median income and unemployment rate values into classes that made logical and visual sense on our maps. We then conducted spatial analysis using multiple proximity analysis operations. We used “Buffer” to create a 1 mile buffer around each power plant to observe the level of income/unemployment of tracts (points) within these zones. The larger size of the 1 mile buffer took into account that part of the buffer’s area included the power plant. Finally, we used “Generate Near Table” to create a table containing the distances between each unemployment/income point (per tract) and the nearest power plant. Using the calculated distances, we produced scatter plots showing the relationship between distance from a power plant and median income/unemployment. This step required joining the “Median Household Income (2016)” table with the table containing the different distances, in addition to creating a new field that converted the recorded distances from meters to miles.

My role in this project was to explore the relationship between median income and proximity to power plants. My tasks included producing maps to investigate this relationship, creating a pie chart to show the income classes within 1 mile of power plants, and creating a

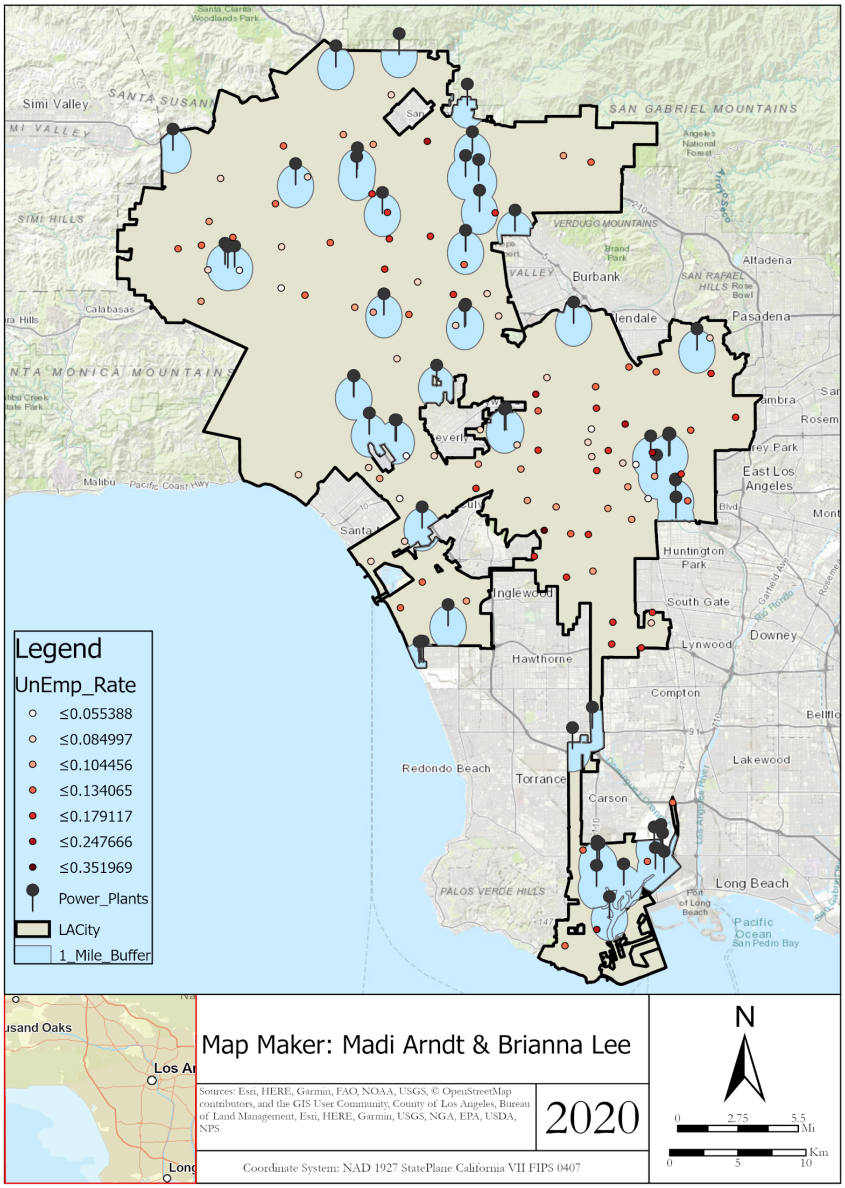
scatter plot showing the correlation between distance to the nearest power plant and median income.

The results of our project include multiple items explaining the outcome of our analysis. Our results conclude that, unlike our hypothesis, people who live closer to power plants are NOT characterized by lower income and higher unemployment. There is not much of a relationship between proximity to power plants and economic characteristics.

LA City Power Plants and Median Income

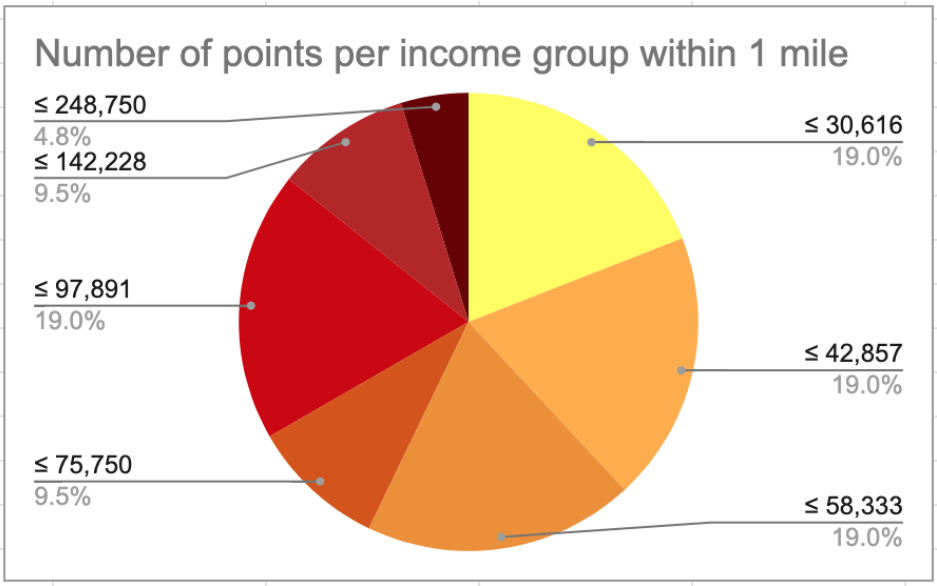


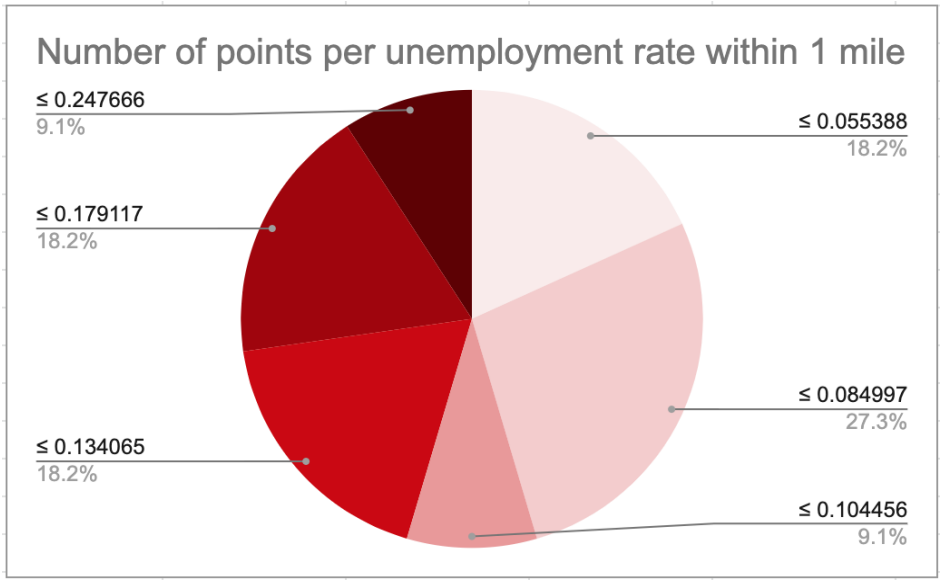
LA City Powerplants And Unemployment



The maps above display the power plants, median income levels (top), and unemployment rates (bottom) of each tract within Los Angeles. The "pin-points" represent power plants, while the colored points represent different median income levels (top) and unemployment rates (bottom). The blue polygons around each power plant represent a 1 mile buffer. The maps show that within 1 mile neither lower income and higher unemployment or

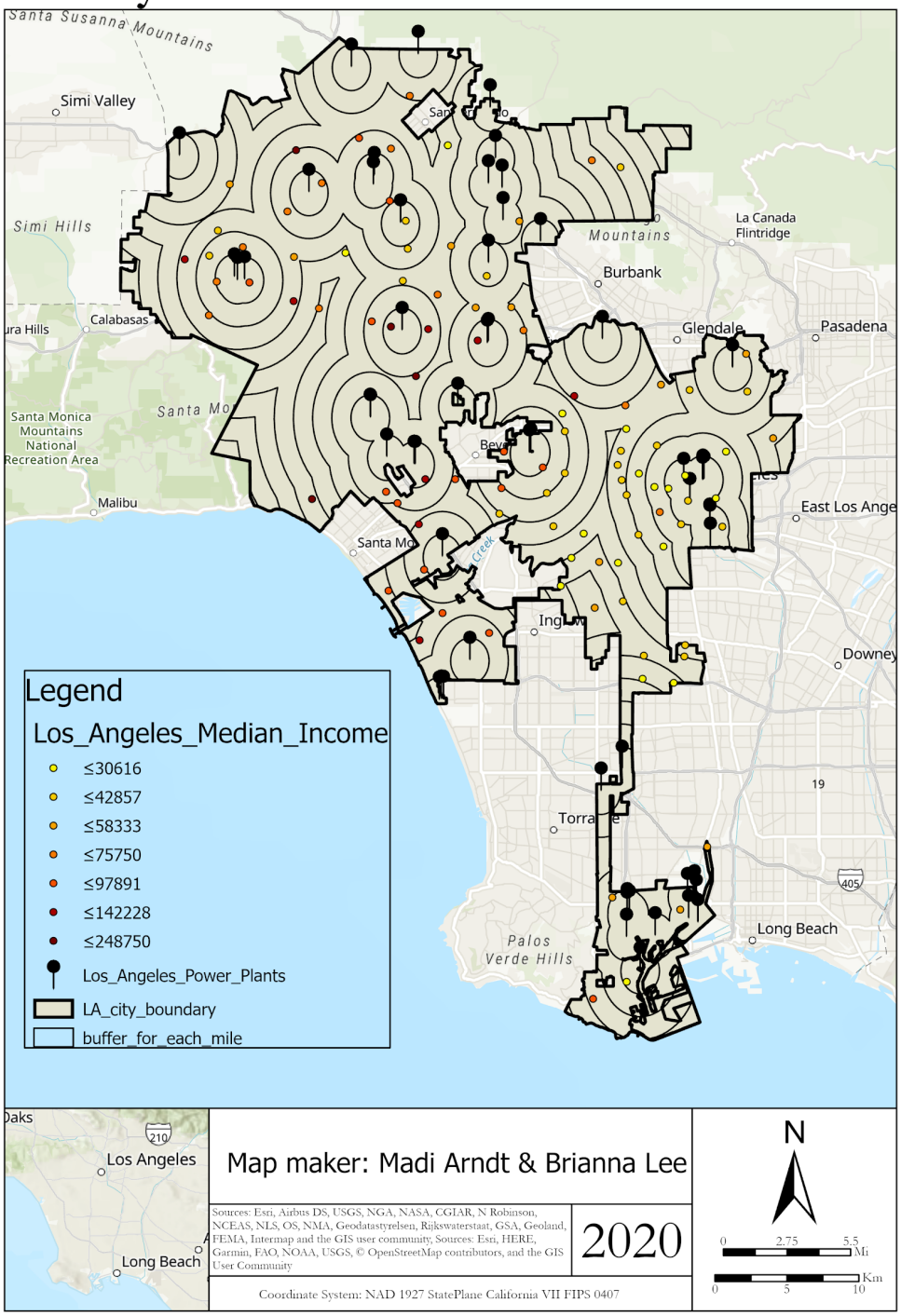
higher income and lower unemployment dominate. Instead there is a mixture of points (tracts) of different values within the buffers. This is shown in the following pie charts:



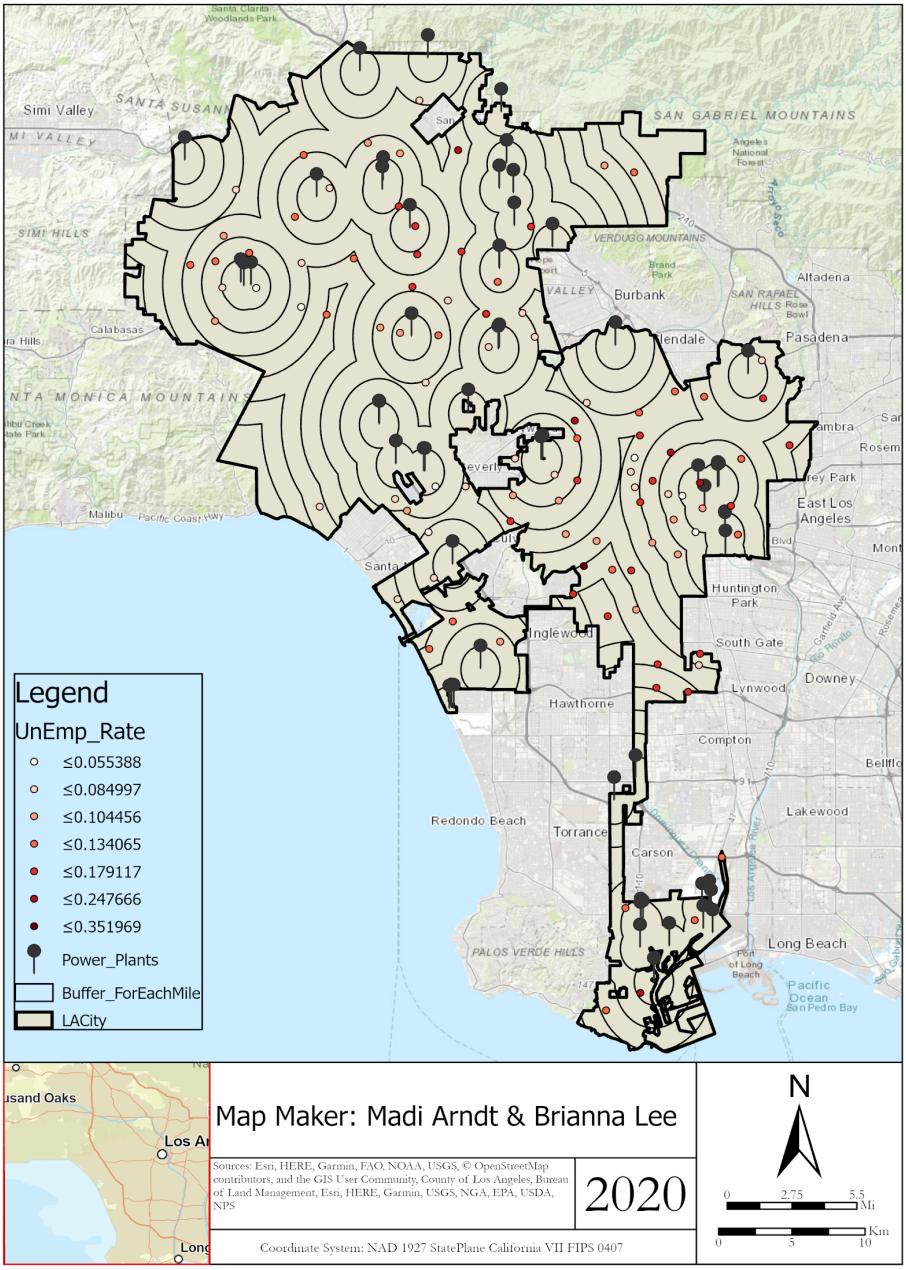


The maps and pie charts reveal that one income group or unemployment rate class does not make up a majority of the tracts within 1 mile of power plants.

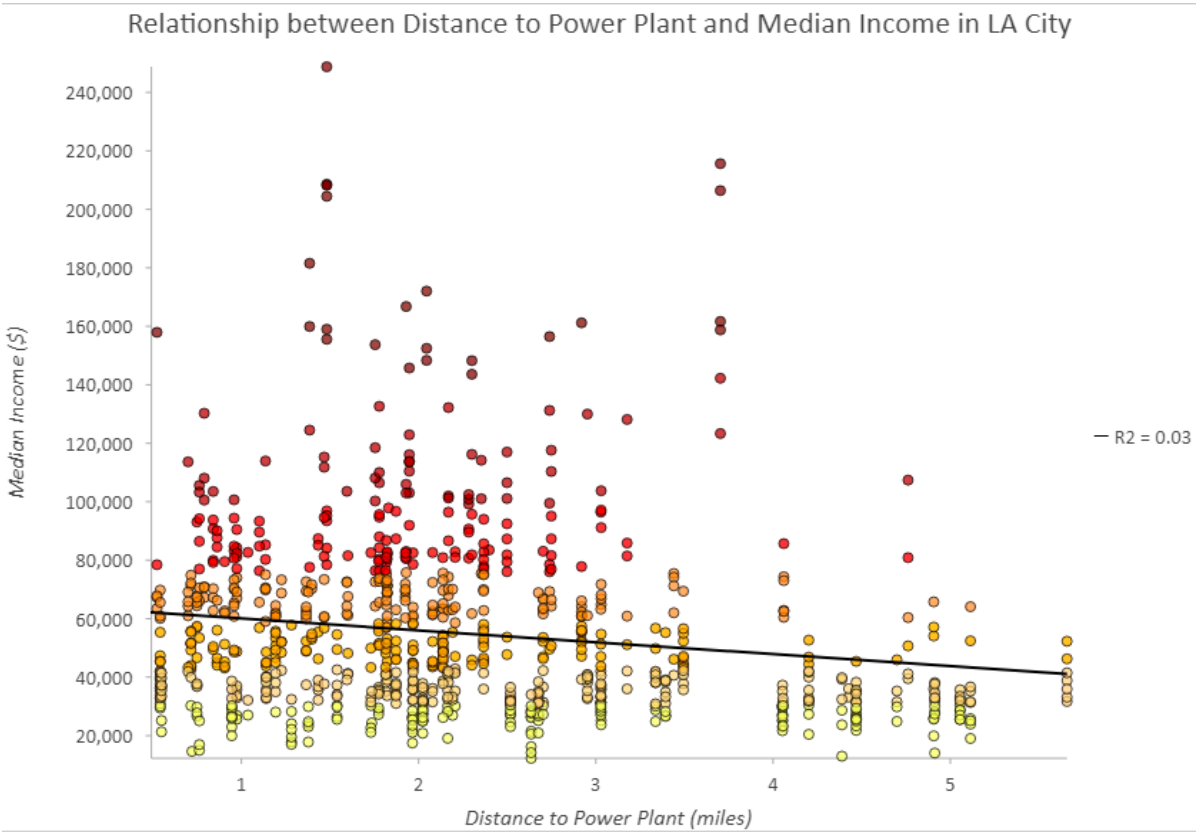
LA City Power Plants and Median Income

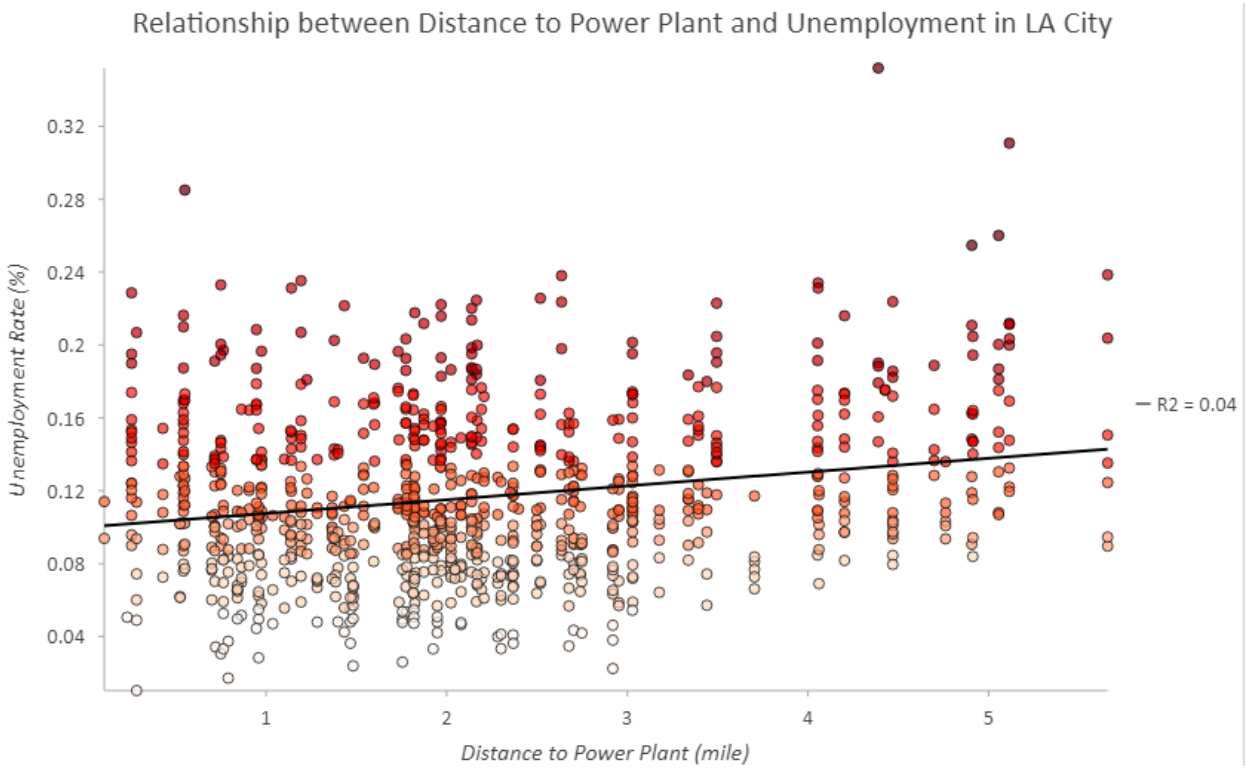


LA City Powerplants And Unemployment



The maps above include the same power plant locations and points representing median income and unemployment, but instead of including a 1 mile buffer we used multiple ring buffers to clearly show the results beyond our analysis of 1 mile. As distance increases there is variety in the median income and unemployment rates of each tract.


Relationship between Distance to Power Plant and Median Income in LA City
Median Income ($)
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
1
2
3
4
5
Distance to Power Plant (miles)
R2 = 0.03


Relationship between Distance to Power Plant and Unemployment in LA City
Unemployment Rate (%)
0.32
0.28
0.24
0.2
0.16
0.12
0.08
0.04
1
2
3
4
5
Distance to Power Plant (mile)
R2 = 0.04

The scatter plots above reflect the data from the multiple-ring buffer maps. The top shows the relationship between distance to the nearest power plant and median income and the bottom shows the relationship between distance to the nearest power plant and unemployment rate. The top plot reveals a weak negative correlation between the distance to the nearest power plant and median income. The scatter plot below reveals a weak positive correlation between the distance to the nearest power plant and unemployment rate. These outcomes oppose our hypothesis because we believed that proximity to a power plant would strongly determine the type of people (economically) that live near power plants versus further away, but instead since such weak correlations exist, the relationship between the variables is not nearly as prevalent as we assumed. Perhaps this weak correlation is a result of homeowners in Los Angeles prioritizing other factors, such as living near the beach, over living within one mile of a power plant.

Download link:

https://drive.google.com/drive/folders/1PZxXIOVHu-a2twHhPrTw92XdZrv9m3ea?usp=sharing

This project could be improved by observing additional cities within Los Angeles County, or even beyond this area, to test if the lack of a correlation between proximity to power plants and economic characteristics is unique to Los Angeles. By adding additional locations in LA County we could improve the accuracy of our results (or simply shift results due to the Modifiable Areal Unit Problem), and we could compare trends in other cities to gain a more holistic view. Using polygons to represent tracts could also benefit our project. In our study we used points which may have skewed the results in circumstances where the point representing a tract was not contained within a buffer, but may have been included within the buffer if we had used polygons.

While working on this project I learned many important lessons. One lesson was adjusting to working on a group project remotely. Zoom became a vital tool to delegate tasks and complete the project. I also learned how important it is to be creative when trying to conduct analysis and represent spatial information using ArcGIS Pro. Multiple times the analysis I planned on implementing required adjustments in order to work the way I intended. An example of this was when using the "Generate Near Table" distance information to create scatter plots. When creating the scatter plots I ran into issues with the units used to measure distance. In order to convert the units on the scatter plots from meters to miles I had to create a new field in the attribute table. It took some time to come to this realization, but is a good example of how I used the information from this quarter and applied it in a creative new way that worked with the issue at hand.

Converting the measurements for the scatter plots was not only an example of what I learned, but also one of many challenges I faced. Another challenge was addressing that our original idea of observing ALL of Los Angeles County was too broad and would have produced an extremely confusing map. I decided it would be best to narrow down the data to only include the city of Los Angeles. After discussing this with Brianna, I began narrowing the data down but this was quite complex and involved much trial and error. In addition to facing issues in this process, ArcGIS Pro often crashed on me (I learned to constantly save my work), making the process even longer and more frustrating.

If I were to do this project again I would be interested in selecting another location to conduct this analysis on. Brianna and I know a decent amount about Los Angeles, but it may be more interesting to focus on San Diego since that is a location we are both extremely familiar with given we have strong connections to the area.

Geography 176A introduces the principles and tools associated with GIS and GIScience, teaching students how to represent geographic phenomena using tools such as ArcGIS Pro. As someone involved in campus research, I can apply the information and technical skills I have learned to solve research questions from a geographical perspective. In this project I learned to apply GIS skills to solve a complex task without step-by-step instructions; this independence has prepared me for future careers.

If I were to interview for a GIS position I would explain that I am qualified because I am familiar with ArcGIS Pro and the different thought processes that go into justifying the use of certain data types, analysis tools, symbology, etc. I have experience using ArcGIS Pro to make a variety of maps that can potentially aid in decision making and improving knowledge of geographic phenomena.