Project Title

Traffic Congestion Analysis

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Keywords

Traffic, Transportation, Geographical Information Systems, Rialto, Data Science, Streetlight Data

Brief Description of Problem

As we recover from the pandemic, traffic congestion has attracted the attention of the San Bernardino County. The Western Riverside Council of Governments hopes to better understand traffic congestion in the region by studying recent travel surveys and roadside sensor data provided by Streetlight Data (with travel patterns between origins and destinations). Focusing on the most prevalent trip routes and WRCOG's analysis in the Western Riverside region, we seek to answer questions such as: who's causing the congestion in Rialto, SB County, and California as a whole? What are the most congested routes? etc. The goal of the project is to better understand traffic patterns and plan for future road development.
 (WRCOG https://www.wrcog.us/)

Software/Tools

StreetLight Data, ArcGIS, Python, Microsoft Excel

Project Summary and Results

Intro: Cars help us go from point A to B, but oftentimes other vehicles slow us down from reaching our destination. This is also known as traffic, traffic is a disease that plagues the freeways of Southern California, more specifically, the Western Riverside Region. The Western Riverside Council of Government also known as WRCOG is determined to figure out the outstanding causes of their traffic issues. We focused heavily on the study of Rialto, California while using tools such as ESRI Living Atlas and Streetlight Data. During this fellowship, we aimed to address questions such as: who is creating the congestion in this region? Which routes are the busiest? And What can we do about it? Overall, the project's objective is to understand traffic patterns better and create a solution in the form of better road development.

Methods: For our project, we decided to focus on 3 different type of trips: Rialto to Rialto, Rialto to another city within San Bernardino County, and Rialto to the other 3 counties (Los Angeles, Riverside, and Orange) We obtained our data using Streetlight Data, a big data transportation analytics software. Streetlight was chosen as our data vendor because they support the Trip to/from Pre-set Geography analysis necessary for our project. Data in Streetlight. is collected through pings of mobile devices. When a pinging stops, this is considered as the end of the trip. Our Streetlight data analysis resulted in 4,406,200 data points. The software used for this project included Streetlight, ArcGIS, Python, and Excel. For obtaining the data, Streetlight Data and ArcGIS were mainly used. In order to obtain the San Bernardino County city block groups in the form of CSV files, Excel was used, and for the actual Data Analysis, Python and ArcGIS were used. Data was obtained by first uploading a shapefile of Rialto, CA to Streetlight Data and then performing a Trip to/from Pre-set Geography analysis. The Shapefile of Rialto, CA was created using ArcGIS. A "Select by Location" query was performed where the target layers were the USA census BGs and the source layer was the Rialto, CA boundary. The spatial selection method was chosen as "have their centroid within source". This essentially creates a "lookup" table that corresponds census BG GEOIDs to our boundary. Zipped shapefile was then uploaded as a zone set. Streetlight Analysis was then performed; key parts of the analysis were the basic info, time periods, zones, and add-ons. For basic information, the country was selected as USA, the distance was in miles, the mode of travel was all vehicles, and the output type was Streetlight index. The time periods covered various day ranges throughout the week and day part time ranges. The Preset geography was selected as 2020 US Census Block Group and the zone was the Rialto zone set.

Analysis: The StreetLight analysis results showed a distribution of the block group traffic percentages for the 52 Block Group zones in Rialto as well as the top 10,000 Percentage Block Group zones going to and from the Rialto zones. Although StreetLight can visually and graphically show these Block Group distributions through their Viz3D software, it is still necessary to take the data out of StreetLight and merge it with other City and County identifying tables to aggregate the block groups percentages and yield more concrete results. Using ArcGIS and the Pandas library in Python, it is possible to combine the attribute tables of shapefiles with the "Big Data" that StreetLight produces. First, block groups must first be assigned to a City depending on if their centroid was located in a City's borders. After assigning each appropriate block group to a City in San Bernardino County, dummy variables can be formed to identify each of the Block Group's city. Using common identifiers of the Block Groups, as well as City codes, (i.e. FIPS or GEOID codes), this table can be merged with the StreetLight Trip Percentage tables to have tables that contain Block Groups and their corresponding Cities and Traffic Percentages. If necessary, County codes must also be merged, if the City table did not contain County information. Afterwards, grouping by each unique City, aggregating the sums of the block groups traffic percentages in All-Day parts from Rialto block group zones, PM parts from Rialto block group zones, and PM parts to Rialto block group zones yields all the information for the dataframe containing the Cities, and Counties, and their average corresponding traffic percentages for each time slot. Further extending this analysis, merging the Trip Purpose table (containing over 4 million rows) with the City-identifying table and averaging each of the Purpose proportions yields the ratio of a City's trip's purposes. Once that ratio is found, multiplying the Traffic Percentages by the corresponding ratio percentages produces the true volume percentage of trips for each varying Trip Purpose.

Results: The results found in All-Day averages were that almost 90% (89.59%) of the trips from Rialto stayed in San Bernardino County, and neighboring counties yielded less than a percentage of the total Trip Volume Percentages, aside from Riverside which was in between 2-2.5% of the Trip Volume. Additionally, the Top 5 destinations Rialto had were all neighboring cities, with the exception of Unincorporated towns and cities (which still neighbors Rialto, but encompasses a much larger portion of San Bernardino county). These cities and locations were Fontana (14.2%), San Bernardino (11.7%), Unincorporated (8.17%), Colton (4.62%) and Rialto itself (44.2). These results highlight the majority of trips staying in Rialto city, while other trips were to neighboring cities; these results place more weight to the flows of traffic on local roads and highways to neighboring cities than to other Counties on a day to day basis. On a more granular level, the results from the Trip Purpose percentages, showed that all of the Top 5

destinations were mostly a trip from Home to another location (~0.50 - 0.62 proportion of trips), with the following purpose being a Non-Home based trip (~0.27 - 0.38 proportion of trips), making the last portion of trip purposes being Home to Work (~0.09 - 0.12 proportion of trips). These results place more weight on local trips, i.e. grocery trips, trips to the bank, etc. over a daily commute to work as the larger proportion of trips are attributed to that purpose. These results placed an insight to what should be considered when creating decisions on transportation options to and from Rialto, but can still be broken down into more granular parts for a finer understanding.

Conclusion: The highest percentage of trips made were within Rialto (44.27%). City officials should think of policies in suburban areas that support efficient mobility within Rialto. Since the next highest percentage of trips was made to Fontana (14.12%), the city of Rialto should come up with new transportation policies to better connect Rialto and Fontana. Trips from Rialto to San Bernardino County made up the highest percentage (89.59%). Additional work should be done by district legislatures to build more transportation networks within San Bernardino county. For trip types in Rialto, home to other and home made up the highest percentage (25.2%). Urban developers and housing development projects must take into consideration how to build transportation networks to enhance the mobility of people within Rialto. Future scopes of study may include the following topics: traffic patterns during pre-Covid Time times vs. now and Traffic congestion patterns in specific cities of interest in the surrounding counties we analyzed.