Analyzing the Impact of the Light Rail on Seattle Average Weekday Daily Traffic Since its Inception

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1 Abstract

In order to determine the impact of the Light Rail on surrounding traffic density in Seattle, we conducted a study on the years 2008, 2013, and 2018, analyzing the statistical significance of Average Weekday Daily Traffic (AWDT) changes. Based on whether or not we are able to identify a significant difference, we were then planning to extrapolate our findings to areas where Light Rail extensions were planned, and then determining whether or not the Light Rail would have a significant enough impact on traffic to determine if the expansion of the Light Rail is worth the cost. Ultimately, we were unable to complete the second phase of our project; however, we were able to identify whether or not there were statistically significant changes in traffic density within areas of the Light Rail's influence.

By creating three different maps featuring traffic data from 2008 (one year before the Light Rail was built), 2013 (four years after opening), and 2018 (most recent traffic data available), we were able to determine through the use of Z-Tests and Analysis Tools that ultimately, the Light Rail may have had a statistically significant impact on traffic density in Seattle. The Z-Scores and P-Values we calculated were deemed to be statistically significant, therefore allowing us to reject our null hypothesis (see section 2, Methodology). However, the data showed that there was a statistically significant increase in surrounding traffic density, not the decrease we anticipated. These results should be considered within the context of Seattle and how it has changed over time. We believe this increase is likely due to population growth within the city, as it is somewhat illogical to assert that the Light Rail has led to an increase in traffic (without consulting sources). As such, we can not definitively assert, using our methods, that the Light Rail has reduced the AWDT in Seattle over time.

The structure of our paper is as follows: we first discuss our methods for map creation and our hypotheses in Methodology. Following this, we display our steps for the Single Sample

Z tests and the results of these calculations in the Findings section. Finally, we interpret our findings in Conclusions, discuss the various challenges each group member encountered during the study in Challenges, and present our finalized maps in Maps and Figures.

2 Methodology

Once we collected all of our necessary shape files and data, our first step was to pare down the number of streets in our 2013 and 2018 traffic shapefiles to match those in 2008. We noticed that the 2013 and 2018 shapefiles had a significantly larger number of streets (and by extension, counts of average weekday traffic), so removing streets that did not match the 2008 shapefile was a step to control the variable and keep error from this factor minimal.

Following this, we removed any and all inactive or planned Link Rail Lines and Link Rail Stations from our map to ensure our findings were not muddled with data that may or may not be accurate. This also constrained our area of research to Seattle only and not out of city bounds (such as East or Lynnwood Link future extensions, or the Tacoma Link).

Continuing forward, we created buffer zones around each Link Station and along each Link Rail segment to identify an area of influence of the Light Rail. We created a 1 mile buffer around the Stations (to simulate walking distance), and a 3/4 mile buffer around the Rail segments. Once we merged all the buffers, we used the Clip tool to identify all Roads in Seattle that were within the Light Rail's area of influence.

We then created separate layers for Influenced Roads and Uninfluenced Roads, edited the symbology to display AWDT, classified this visualization by Standard Deviations (to make the information comparable) and edited the Display and Symbology settings to make the data interpretable and visually appealing. We did this for the 2008 map as well, one year prior to service beginning, in order to identify areas where the Light Rail would be having an impact on in the future. This simplified our comparison of impact between 2008 and 2013, 2018.

From there, we conducted Z-Tests to compare the AWDT of Influenced Roads in the years of interest (2013 and 2018) to the AWDT of the same roads in 2008 to determine if there was a significant difference. We established our hypothesis as such:

H(o): The Light Rail has had no Statistically Significant impact on AWDT within its area of influence.

H(a): The Light Rail has had a Statistically Significant impact on AWDT within its area of influence.

3 Findings

We conducted 2 different Single Sample Z tests (at a significance level of 0.05) to identify any sort of significant difference. The formula is shown below:

$$Z = \frac{x - u}{\sigma/\sqrt{N}}$$

where:

- x is the mean of the sample that we are comparing to the general population
- u is the mean of the general population
- σ is the Standard Deviation of the overall population
- N is the number of observations

We compared the AWDT of Influenced Streets in 2018 to Influence Streets in 2008 (Even though the Light Rail was not constructed at this time, we identified which streets would be the influenced ones to establish a better basis for comparison), and AWDT of Influenced Streets in 2013 to Influenced Streets in 2008. Both of these calculations were made to identify whether or not there was a Statistically Significant Change in AWDT over time. Our findings are stored in Table 1.

Z-Score Test Results

Test/Year	Z-Score	P-Value	Interpretation
2008-2013	FILL	$<$ FILL	FILL
2008-2018	60.215	< 0.00001	Statistically significant increase

Table 1: Data Table of Z Test Findings.

4 Conclusions and Future Work

Based on our findings in Section 3 (Findings, Figure 1), we are able to conclude that there was a significant change in AWDT on influenced streets between 2008 and 2018, therefore allowing to reject our null hypothesis (since our p-value was lower than our critical value of 0.05). However, the change was positive, meaning that there was a significant increase in

traffic. Though this is not what we were searching for, we still were able to determine there has been some change in traffic over change in time.

It is unlikely that the Light Rail has caused traffic to increase, so even though there was a significant change, it may be due to other outside factors. Population could have increased, there could be more jobs available, there could be more households with cars; in general there are many factors that could explain why AWDT has increased.

Based on this information, even though we are able to reject our null hypothesis, logically speaking we can not fully accept our alternative hypothesis that just the Light Rail alone has caused a statistically significant change in AWDT in Seattle.

This study was constrained heavily due to time and factors outside of the class's control, but there is room for future work and to improve on the base of this study. Several directions can be taken to expand the research:

1. Expand upon the years which we analyze traffic, or include more samples of AWDT in between the years 2008-2018,
2. Apply ACS data of Census Tracts within the area of influence, to study increases in population, jobs, or vehicle ownership/method of transportation over the 10-year period,
3. Perform more complex methods of statistical analysis or related relevant analyses to confirm what we found,
4. Compare to similar research of the subject if it exists, and
5. Extrapolate and apply to future Link extensions (as originally planned at the start of this project).

Though our project was cut short, this area of research is important for metro areas such as Seattle. Standardizing a more polished technique could allow others to quickly apply similar analyses to other cities, or repeat in the future for the Seattle area.

5 Challenges

5.1 Uday

The biggest challenge I faced personally was when it came time to analyze our data to draw conclusions. From the beginning I was aware that we would be using Statistical Tests to determine significance, but figuring out exactly which test to use and what our values would

be took some time. Beyond that, meeting in person only twice per week really slowed down the progress of our project since, for many steps of the project, there were several options and methods we could have taken, and we all wanted to stay on the same page so we were producing consistent products.

5.2 Darren

We faced a few challenges while we carried out this project. Aside from circumstances outside of everyone's control, I think the greatest challenge I faced was map aesthetics and formatting, and results interpretation. Designing maps that are dense with information and that have complex color schemes can be difficult, but it is a vital skill and necessary for presentation. We were able to come up with a color and symbol scheme that fit appropriately, with much tweaking first. Determining appropriate buffers was also a slight difficulty at first. Finally, interpreting our results was a challenge, as we initially performed our Z-Score tests inappropriately, but working together we fixed major errors, and we seemed to have gotten the analysis back on track.

5.3 Jason

The biggest challenge I faced when working on this project was to find data that was compatible in an ArcGIS platform for all 3 dates that we examined. For example, it was frustrating trying to analyze our results when the shapefiles for the different years had changed over time without explanation. Similar to what Uday mentioned before, working remotely towards the end of this quarter was difficult at times because it changed the methods of communication in our group. Because we were working on producing three separate maps, I felt that it was important for us to all be on the same page in creating the final product, which is a lot more of a challenge when working remotely.

6 Maps and Figures

INSERT 2013 AND 2018 MAPS HERE ONCE OBTAINED

7 Works Cited

INSERT WORKS CITED FOR DATA SOURCES? HER

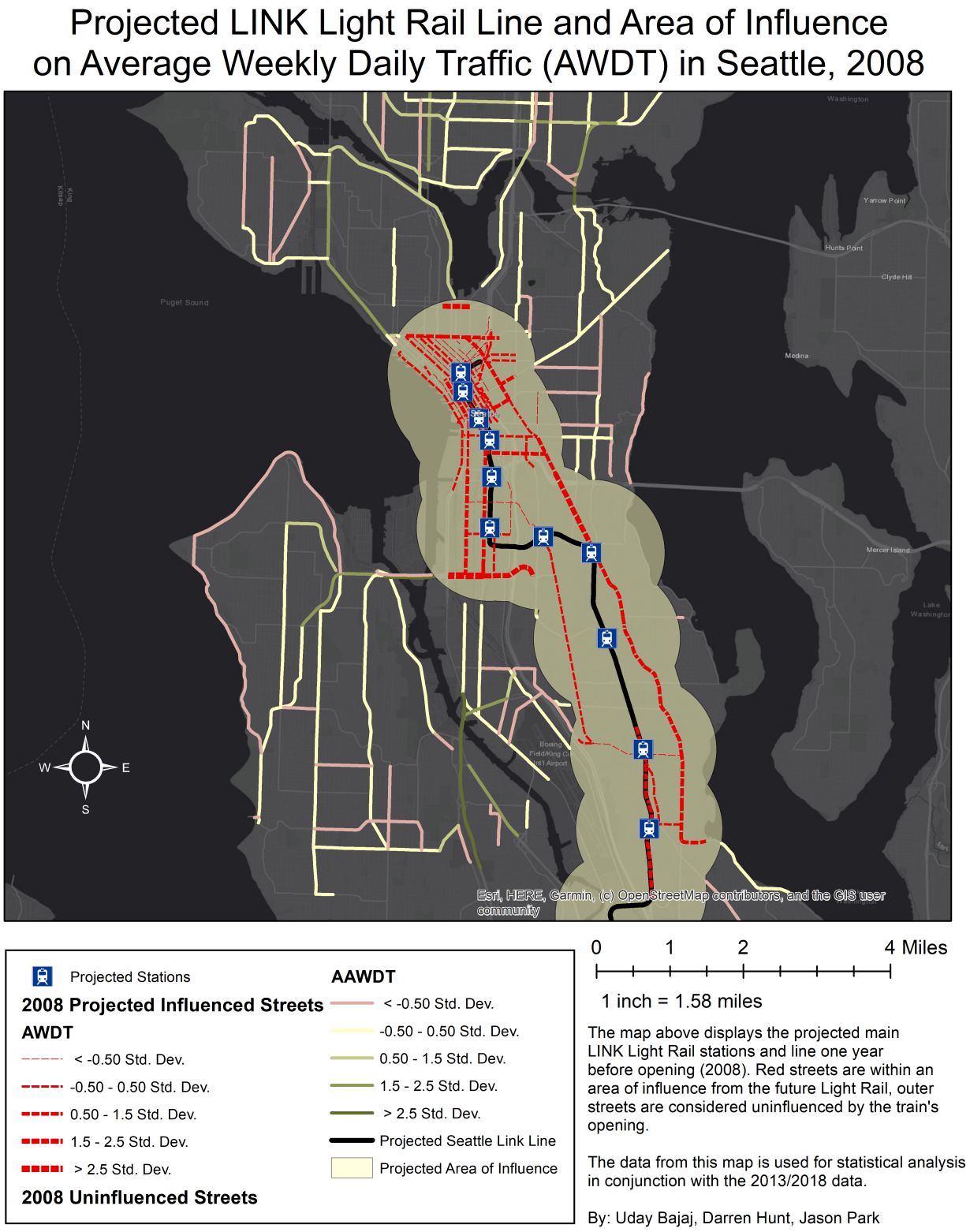

Figure 1: Map of traffic density in Seattle, 2008, with area of influence outlined by planned Light Rail route and stations.