

The Green Line's Impact on Housing Prices in Frogtown

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1 Introduction

A new light rail system connecting downtown Minneapolis and Saint Paul, the Green Line, began operation in the summer of 2014. The Green Line, which had been under construction since late 2010, is seen by many as fairly successful in terms of usage and efficiency (Hudson 2014). However, some residents of Frogtown, a neighborhood through which the Green Line runs, have shown concern that the construction of this new rail system has raised property and rent values in the surrounding areas, potentially forcing residents out of their homes and neighborhoods. While it is true that housing and rent prices have been increasing in this neighborhood, it is possible that this is due to economic recovery and inflation, rather than the construction of the new light rail system, in which case these concerns are unfounded. If sufficient evidence is found supporting that the construction of the Green Line led to inflation in rent and property prices in surrounding neighborhoods, actions such as price ceilings or subsidized housing for qualified residents could be taken in order to combat the rising prices.

Our team has gathered rent, housing and demographic data in 11 communities in Minneapolis and 17 neighborhoods in St. Paul from sources such as city-data.com and the U.S. Census Bureau in hopes of resolving these concerns. While some prior investigations had been done on this topic by local newspapers, such as The Daily Planet (Gerrard), such studies were fairly narrow in scope. In the body of this report, we will begin by discussing our data collection methods and limitations in Section 1, then summarize the information collected in Section 2. In Section 3, we will discuss our findings and present our analysis in three phases. The first part will involve the big picture of property value trends in the Twin Cities over time, while the second part will examine trends in neighborhoods, specifically Frogtown, before and after construction began on the Green Line in December 2010. The third part will look closely at average property values before and after construction began in Frogtown and neighborhoods similar to Frogtown in demographics, some that have the Green Line and some that don't. The third part of the analysis should give a clear picture of whether average property values are increasing in Frogtown due to the Green Line or other factors.

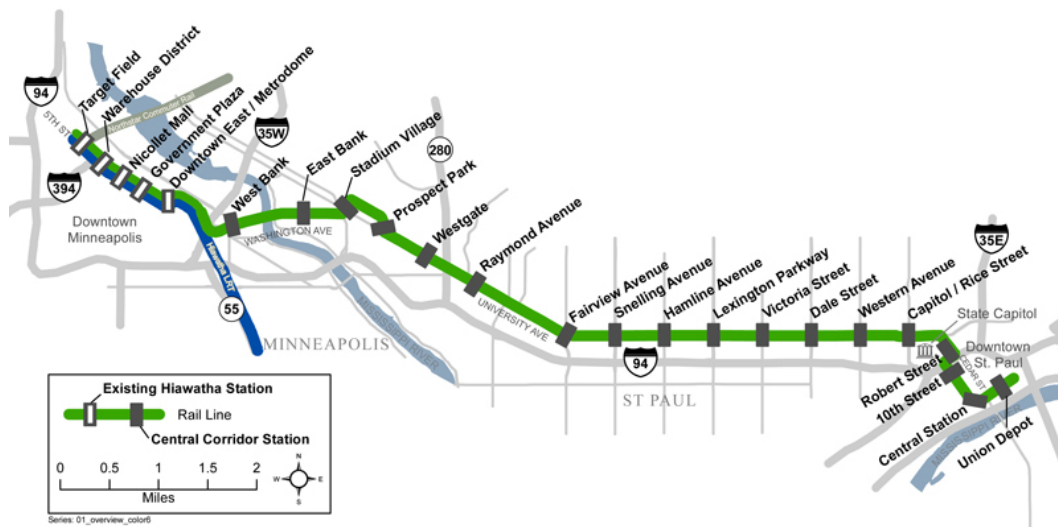


Figure 1: Map of Green Line in St. Paul and Minneapolis.

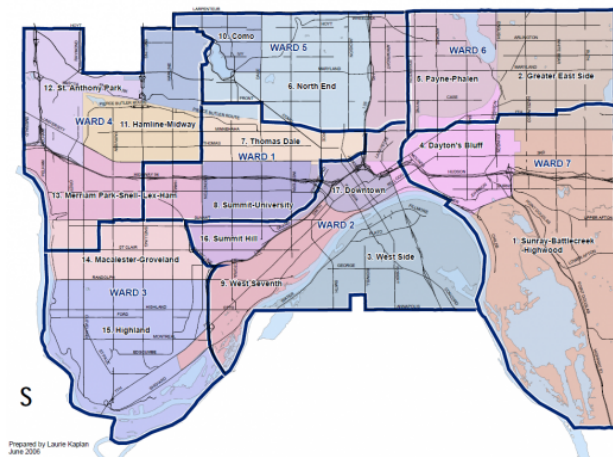


Figure 2: Map of neighborhoods in St. Paul.

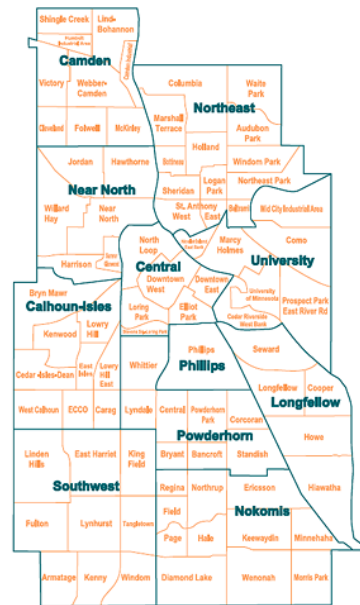


Figure 3: Map of communities in Minneapolis.

2 Data Collection

2.1 Methods and Limitations

The data collected covers 28 neighborhoods in St. Paul and Minneapolis, and encompasses population density, population, average property value from the years 2005 to 2014, average rent for the years 2011 to 2014, racial demographics such as percent white, Hispanic, African-American, and others. Other statistics such as median age, crime rate, household income, cost of living index, and unemployment rate were also included. Our data sources include areavibes.com, from which employment and income statistics were taken; the U.S. Census bureau, from which demographic information was taken; city-data.com, from which data on rent prices, as well as certain demographics, were taken; and zillow.com, from which data on property values were taken.

As with any data collection process, our data has limits in its potency. First, because the Green Line has only been in operation since the summer of 2014, we do not have sufficient data to fully assess the impact of the Green Line on housing prices. Thus, in this paper we only analyze the effect of the Green Line's construction (which started in late 2010) on housing prices. Second, rent data is only available from 2011 to the present, which makes establishing a trend in rent data relative to the Green Line's construction rather difficult. As an alternative, we evaluate the relationship between trend in property values from 2005 to 2014. Third, our data reflect the average property value of each neighborhood. As a result, they fail to account for the difference in property values based on the properties' locations relative to the Green Line. Fourth, our data is gathered from secondary sources, which do not always have all the information desired for holistic trends. Specifically, we decided to collect data for communities in Minneapolis instead of neighborhoods because of the large number of neighborhoods there. However, certain larger communities in Minneapolis did not have property value data available from our sources. Thus, property value data for the smaller neighborhoods within these larger communities were averaged to obtain the rent data for these communities. Fifth, while we try to collect as much data as possible for individual variables from one source, we sometimes needed to use multiple sources in order to get all of the required data, which can lead to inconsistencies

due to differentiation in data collection methods or results. Finally, our demographics data, while from a reputable source, is not entirely up to date, due to the last census being taken in 2010.

2.2 Summary

Population density (Figure 4) can influence the demand for housing in a neighborhood, which could affect the frequency and magnitude of rent and housing price increases. The median population densities for all neighborhoods in Minneapolis and St. Paul (Figure 4) in 2010 is 6532 people per square mile. The spread of population density (Figure 4) among neighborhoods in the Twin Cities is from 3,456 to 13,000 people per square mile. Frogtown is in the mid-to-high range of population densities, with 8,019 people per square mile, which may indicate that there is an above-average demand for housing in the Frogtown neighborhood. The data collected is summarized in Figure 4. Other figures detailing neighborhood data can be found in the appendix.

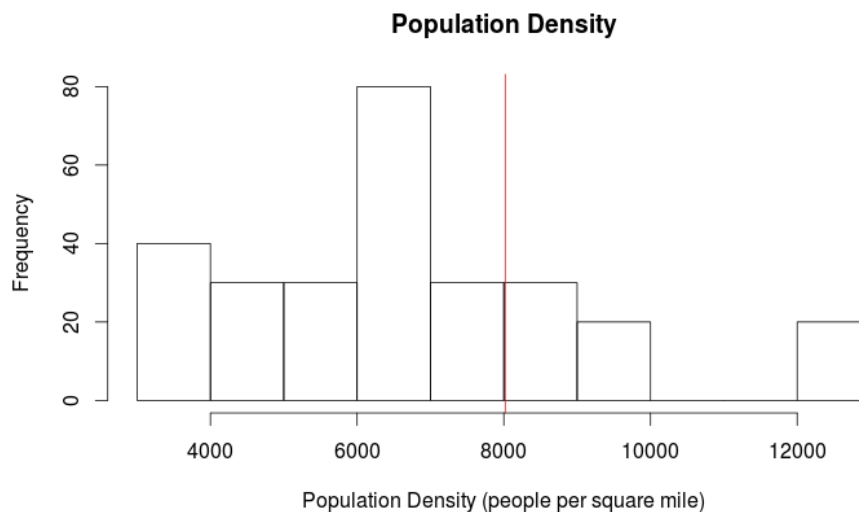


Figure 4: Distribution of population density of neighborhoods in the Twin Cities in 2010. Frogtown's population density is marked by the red line.

In order to determine if there is a significant change in property value (Figure 5) in Frogtown with the presence of the Green Line, the distribution in average property values throughout all neighborhoods must first be explored. The histogram of average property value for the most recent data, 2014, is shown below in Figure 5.

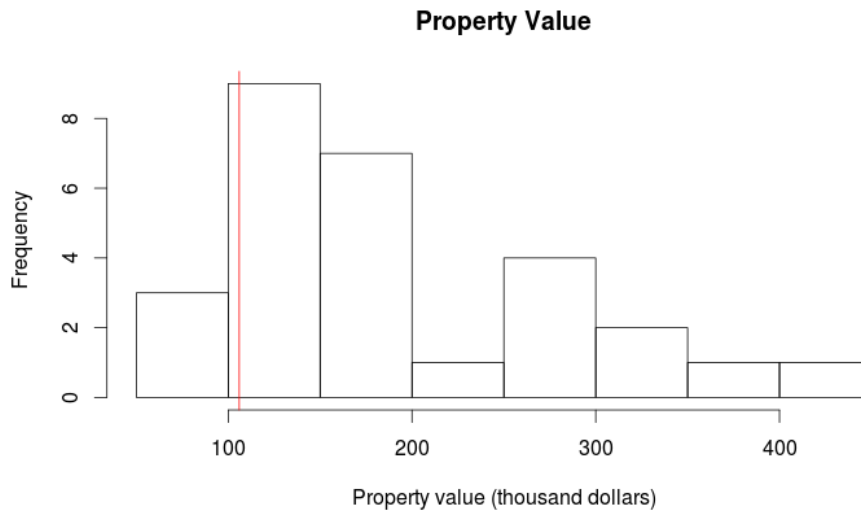


Figure 5: Distribution of property values of neighborhoods in the Twin Cities in 2014, with Frogtown’s property value marked by the red line.

Property values from 2014 are skewed by a few neighborhoods with abnormally high property values, namely Summit Hill, Southwest, Central, and Calhoun Isles. The large spread of the data in Figure 4 indicates that there is a high level of variability in average property value from neighborhood to neighborhood. The Twin Cities’ median property value in 2014 is \$165,300, while Frogtown’s property value is \$106,000, indicating that Frogtown is in the low range of property values.

3 Results

Our goal is to provide a better overall picture of what is happening to property values in Frogtown relative to other similar neighborhoods before and after construction began on the Green Line. Some questions we set out to answer include: “Does Frogtown show a significant overall increase in property values?”, “Do property value trends in Frogtown vary before and after construction of the Green Line began?”, and “How does the rate of change of property value in Frogtown compare to the rate of change in other similar neighborhoods pre- and post-construction date?” We broke our results down into three sections. First, property value

trends from 2005-2014 in the Twin Cities and Frogtown were analyzed to help observe the overall trend and to help determine if Frogtown's increase in property value could simply be explained by general economic recovery. Next, we evaluated property values in Frogtown and all neighborhoods with and without the Green Line before and after construction began on the Green Line to determine if the construction of the Green Line influenced property value in general. Finally, property values in Frogtown before and after construction began are compared to property values in a few similar neighborhoods before and after construction began to analyze the impact, if any, of the Green Line's construction on property values.

3.1 Big Picture: property value trends in the Twin Cities and Frogtown 2005-2014 relative to economic situation

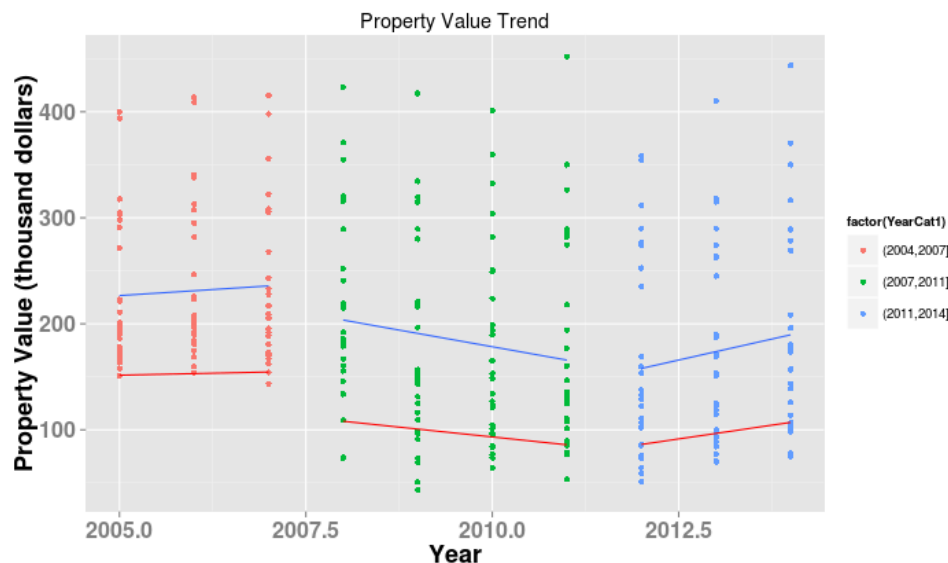


Figure 6: Trends in property values in the Twin Cities (blue lines) and Frogtown (red lines) through pre-recession (red dots), recession (green dots), and post-recession (blue dots). Each dot represents property value of one neighborhood in a particular year.

As discussed in the introduction, some residents of Frogtown have expressed concerns about the increase in property values that might threaten many people's ability to afford housing. However, is the observed increase actually an effect of the Green Line? To answer this question, we looked at the changes in property value trend in the Twin Cities and in Frogtown

comparatively and individually. We investigated these trends in three time periods, categorized based on the economic situation: pre-recession from 2005 to 2007, recession from 2008 to 2010, and post-recession from 2011 to 2014.

According to Figure 6, there seems to be a reasonable correlation between property values of the Twin Cities and Frogtown and the economic situation. Property values increased during pre-recession, decreased during recession and increased again during post-recession. To quantify these observations, we fitted models for property values in the Twin Cities and Frogtown to determine the rate of property value change in each time period where there is a different economic tendency. According to our models, pre-recession, the Twin Cities' average property value increased by \$4,545 per year; while during recession, it decreased by \$12,588 per year: reasonably under the impact of the housing market crash. During post-recession, property value increased by \$15,859 per year. This is marginally significant with a p-value of 0.21, meaning there is a 21% chance of observing this degree of increase or greater in Twin Cities property value if there were actually no significant change.

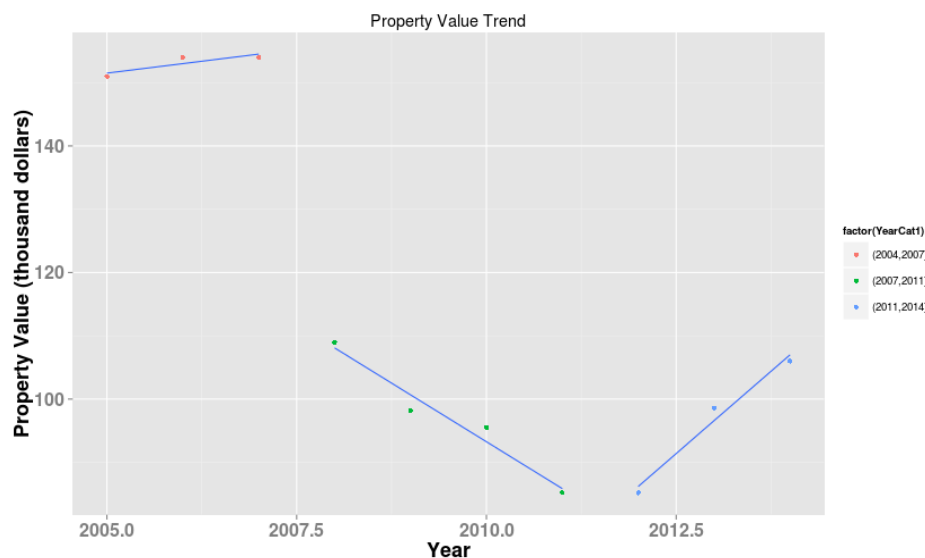


Figure 7: Trends in property values in Frogtown through pre-recession (red dots), recession (green dots), and post-recession (blue dots).

Similar trends are true for property values in Frogtown (Figure 7). Before the recession, property value in Frogtown increased at a rate of \$1,500 per year; while during the recession, it

decreased annually by \$7,410. During the post-recession period from 2012 to 2014, on average, annual property value in Frogtown increased by \$10,400, with marginal significance ($P=.105$). On average, Frogtown's rate of increase in property value is slower than rate of increase in property value of the Twin Cities. However, since Frogtown's changes in property value across three periods of time are all slower than changes in the Twin Cities, this test does not show us much more than a correlation in general property value trends in Frogtown and the Twin Cities.

To overcome this shortcoming of our first model, we fitted another model to compare rate of increase in property value pre-recession and post-recession within Twin Cities and Frogtown individually. According to this test, rate of increase post-recession is approximately \$11,000 higher than rate pre-recession for the Twin Cities. However, this difference in rate of increase in property value of Twin Cities is not statistically significant. On the other hand, every year after recession, property value in Frogtown increases by \$8,900 faster than before recession, with statistical significance ($P=.016$). With this test, we were able to identify a significant difference between property value trends in Frogtown and the Twin Cities post-recession that is likely an effect of factors other than economic recovery. Equally important, we considered our results from a more practical perspective. For Frogtown's residents, the \$10,400 increase in average property value every year post-recession is equivalent to 30% of their average annual household income of \$33,099 (based on the 2010 census). The rate before recession is \$1,500 annually, or around 5% of average household income. Practically, if the current rate of increase in property value continues, after 3 or 4 years the increase in property value will be higher than residents' average annual income.

Through these initial analyses, we were able to observe similar, general trends in property value in both the Twin Cities and Frogtown across three time periods--pre-recession, recession, and post-recession. This indicates a strong correlation between property value trends in all neighborhoods and the economic situation. In addition, a statistically and practically higher rate of increase in property value post-recession compared to pre-recession was observed for Frogtown, but not for the Twin Cities. This observation in the property value trend suggests that economic recovery alone does not explain some variations in property value in Frogtown. The observation can also be alarming as it correlates with the fear of losing housing affordability for

Frogtown's residents. However, these initial findings are observational and inefficient to reflect the influence, if any, that the Green Line has on property values. In the next sections, we will discuss in more details whether this worrisome trend in property value is related to the construction of the Green Line.

3.2 Property value trends in Neighborhoods with and without the Green Line relative to the construction of the Green Line

While we have established marginally significant evidence that housing prices in Frogtown are higher after the construction of the Green Line than before, questions remain as to whether this trend is present in other neighborhoods. Using property values from all neighborhoods, we created a plot to visualize rates of change before and after the construction of the Green Line. Figure 8 is a density plot that shows the percent change in property values for every neighborhood in the Twin Cities before and after construction began (eg .4 = 40% rate of increase).

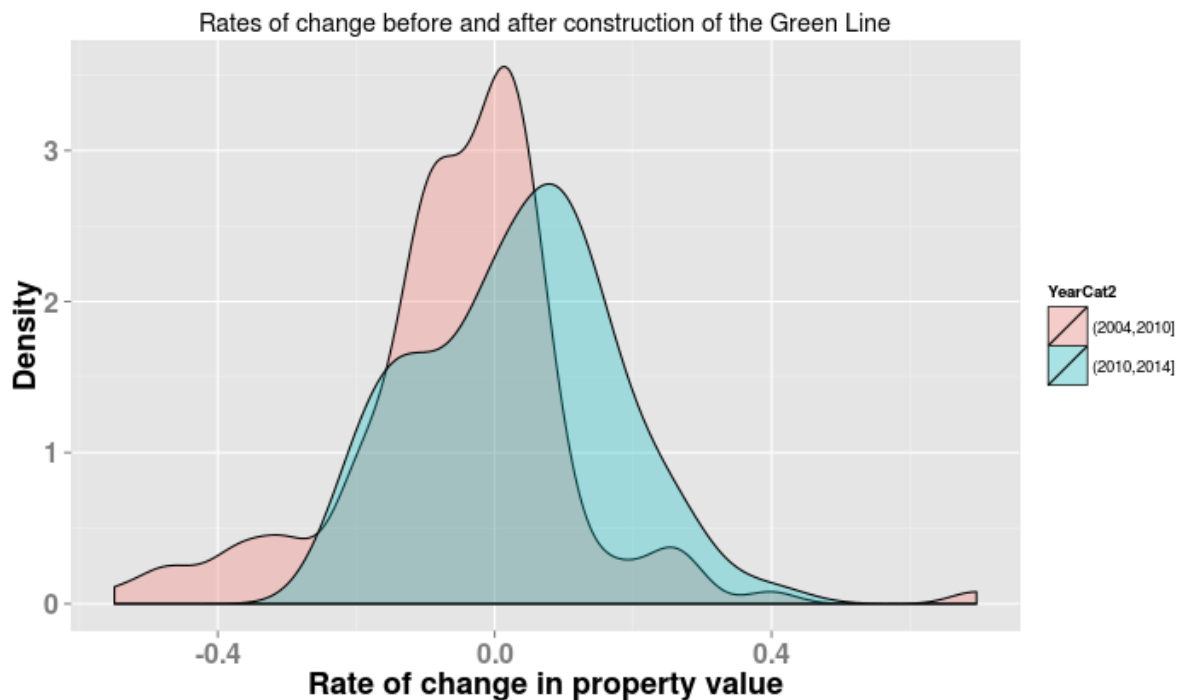


Figure 8: Distribution of rates of change in property values before and after the construction of the Green Line in 2010 for all neighborhoods in the Twin Cities.

With some outliers present, Figure 11 shows higher rates, in general, after the construction of the Green Line.

Next, we wanted to investigate the property values in Green Line neighborhoods and non-Green Line neighborhoods after construction to see the difference in the property values. Figure 9 gives property values for light rail and non-light rail neighborhoods after construction.

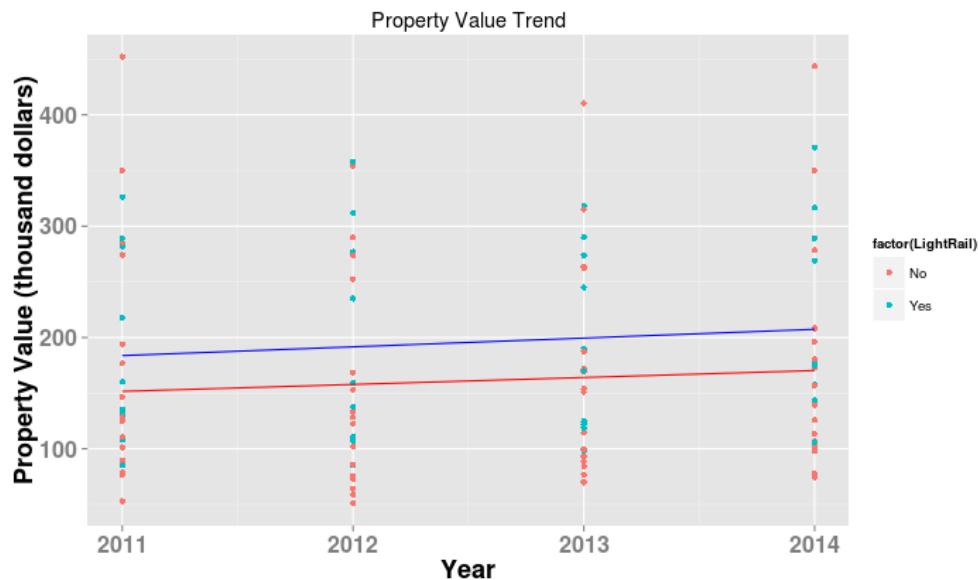


Figure 9: Property value increases after construction on the Green Line began for light rail neighborhoods (blue line) and non-light rail neighborhoods (red line).

The following linear model is representative of Figure 9.

$$\text{Property Value} = -12394902 + 6239 \cdot \text{Year} - 3238514(\text{if Light Rail is Present}) + 1626 \cdot \text{Year} (\text{if Light Rail is Present})$$

The linear model indicates that, if the Green Line is present, property value is predicted to increase \$1,626 more on average per year than neighborhoods that do not have the Green Line running through them after the construction of the Green Line began. While not statistically significant or visually noticeable in Figure 9, this difference in property value's increase based on location of the Green Line is practically significant. Considering that there are a small number

of data points to evaluate after construction began, it will be difficult to establish statistical significance. However, there does appear to be a practically larger increase in property values each year after construction of the Green Line began in neighborhoods surrounding the Green Line, as the rates have risen enough that they could account for a significant portion of residents' income, as mentioned in section 3.1.

Since the construction of the Green Line coincides almost exactly with the beginning of economic recovery from the recession, it is not immediately clear whether the dramatic increase in housing prices in Frogtown from 2011 to 2014 is due to economic recovery or the insertion of the Green Line. In the next section, we will further break down the data and compare the rate of change of property value in Frogtown and other similar neighborhoods that do not have the Green Line to determine if there is enough evidence to conclude that the Green Line, and not purely economic recovery, is spurring the housing price increase in Frogtown.

3.3 Frogtown compared to other neighborhoods

The previous analysis groups all neighborhoods into one of two categories - those with light rail and those without. Below, we break this down into neighborhood-specific conclusions. Figure 10 illustrates the observed property values for each individual neighborhood in our study.



Figure 10: Average property values in each neighborhood from 2005 to 2014.

Looking at Figure 10, Thomas-Dale has the lowest property values of all neighborhoods where light rail is present. It is also apparent that there are four neighborhoods with light rail and four without that are on the upper end of the spectrum when it comes to property values. Because there are fewer neighborhoods with light rail, this suggests that a higher proportion of neighborhoods with light rail have higher property values. Finally, notice that there are quite a few light rail neighborhoods with property values drastically different from Frogtown's which, as such, are incomparable to Frogtown.

Instead of comparing Frogtown to all of the neighborhoods, we decided to compare Frogtown to a few select neighborhoods that are similar to Frogtown in terms of cost of living, property value, and demographics. These neighborhoods are Hamline-Midway, Dayton's Bluff, North End, and Payne Phalen. We begin with Hamline-Midway (Figure 11).

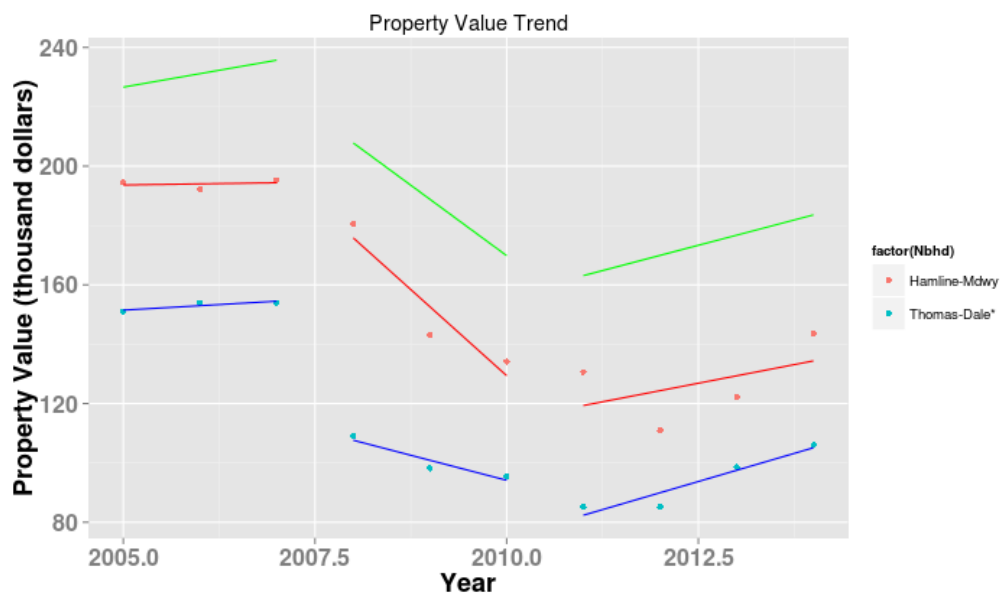


Figure 11: Average property values of all Twin City neighborhoods combined (green line), Frogtown neighborhood (blue line), and Hamline-Midway (red line) from 2005 to 2014.

We compare Hamline-Midway to Frogtown because both neighborhoods share similar population, the most similar property values, and the presence of the Green Line. Frogtown had lower property values than both Hamline-Midway and the Twin Cities for all observed time frames: pre-recession, pre-construction recession, and post-construction. Both neighborhoods

with the presence of the light rail have a similar pattern of change throughout these time frames. Now, we will investigate the difference in property value trends between Frogtown and similar neighborhoods that do not have the Green Line: Dayton's Bluff, North End, and Payne Phalen.

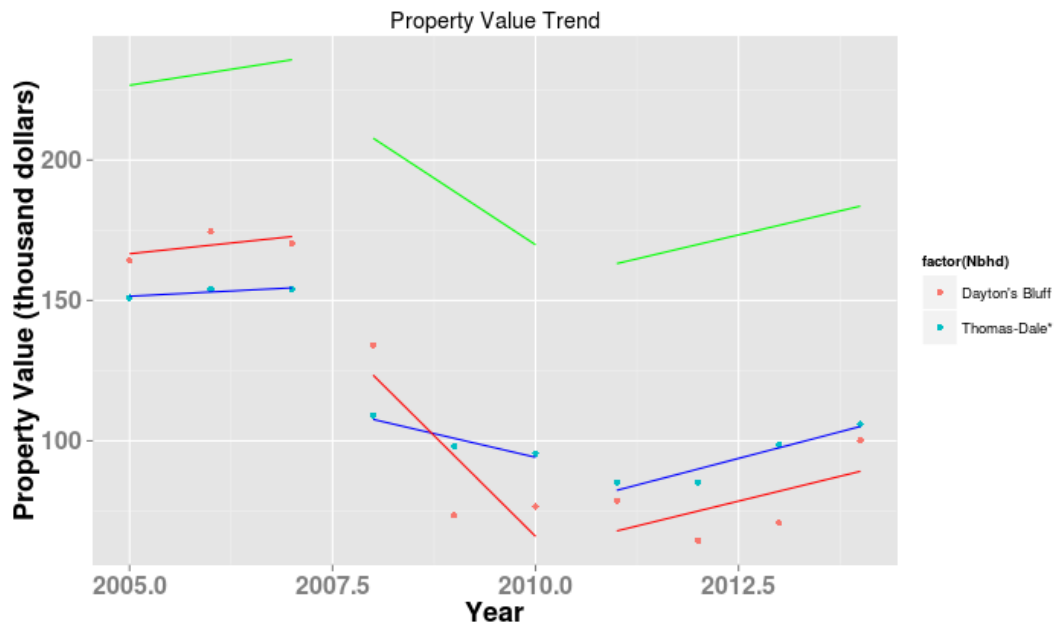


Figure 12: Average property values of all Twin City neighborhoods combined (green line), Frogtown neighborhood (blue line), and Dayton's Bluff neighborhood (red line) from 2005 to 2014.

Dayton's Bluff shares similar rent, property value pre-construction, median age and cost of living statistics with Frogtown. The Green Line is present in Frogtown, but not in Dayton's Bluff. During the recession, property values in Dayton's Bluff decreased drastically, falling below Frogtown (Figure 12). This change presents evidence that the light rail may have had a positive effect on the change in property values in Green Line neighborhoods. Frogtown displays that it has a more stable trend of property values than Dayton's Bluff throughout each time frame. Frogtown has higher property values than Dayton's Bluff after construction, increasing at a rate that is greater than in years pre-construction.



Figure 13: Average property values of all Twin City neighborhoods combined (green line), Frogtown neighborhood (blue line), and North End neighborhood (red line) from 2005 to 2014.

North End shares similar property value pre-construction, percentage of white residents, unemployment rate, and cost of living with Frogtown. Frogtown's property value begins below North End and proceeds to rise above North End around 2010 (Figure 13), showing the same trend that occurred in Figure 12. Frogtown has lower property values than North End during pre-recession, but displays more stable property values pre-recession and pre-construction. Frogtown has higher property values after construction, increasing at a rate that is greater than in years pre-construction.

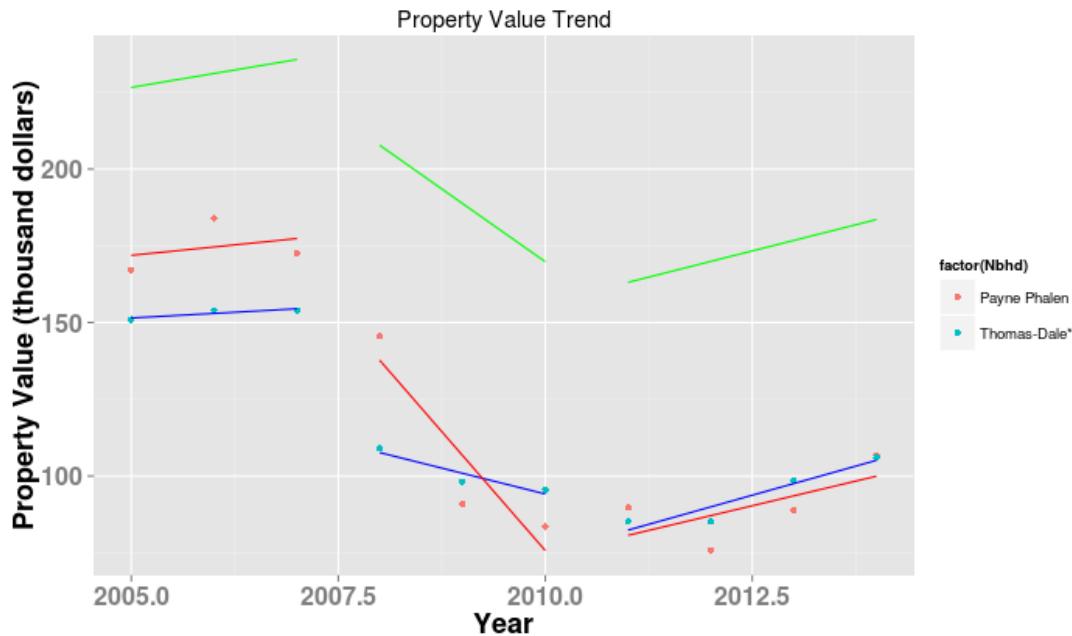


Figure 14: Average property values of all Twin City neighborhoods combined (green line), Frogtown neighborhood (blue line), and Payne Phalen neighborhood (red line) from 2005 to 2014.

Payne Phalen shares similar property value, percentage of white and foreign born residents, median age, and cost of living statistics. The comparison of property values in Figure 14 shows the same pattern as Figures 12 and 13, with Frogtown's housing prices remaining more stable than Payne Phalen during the recession and continuing to rise above Payne Phalen after construction. This change in property values of two similar neighborhoods, that differ mainly by presence of light rail, presents evidence that the light rail may affect surrounding neighborhoods similarly. Frogtown has higher property values than Payne Phalen after construction began, increasing at a rate that is greater than in years pre-construction.

4 Conclusion

From the previous analysis, we can see that Frogtown's property value trends tend to be more stable than those of other neighborhoods. We also observed that, for Frogtown, there is a significant difference between the property value trends from before the market crash to after construction began. Before the recession, Frogtown's property values were increasing at a rate of

\$1,500 a year, whereas after construction began, that rate jumps to \$10,400 a year. Though we don't have enough data points to establish statistical significance, this fact has practical significance, as the rate at which property values are increasing in Frogtown has jumped by almost 700 percent since the light rail began construction. Seeing that Frogtown tends to have very stable property values, this massive increase of property values per year is very surprising and would suggest that the Green Line is, in fact, having a practically significant impact on housing prices in Frogtown.

In summary, the following trends and conclusions are vital observations to take away from the data collection and analysis:

- Prices in Frogtown and other Green Line neighborhoods appear to be more stable than non-Green Line neighborhoods.
- After construction, property values in Green Line neighborhoods increased at a higher rate (\$1626) than non-Green Line neighborhoods.
- The rate of property value increase in Frogtown (\$10,400) is equivalent to more than 30% of the residents' average annual income (\$33099).
- While not statistically significant, the property value increase observed in Frogtown combined with the similar trends in other Green Line neighborhoods leads us to believe that the Green Line might have some effect on property values in Frogtown.

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Appendix

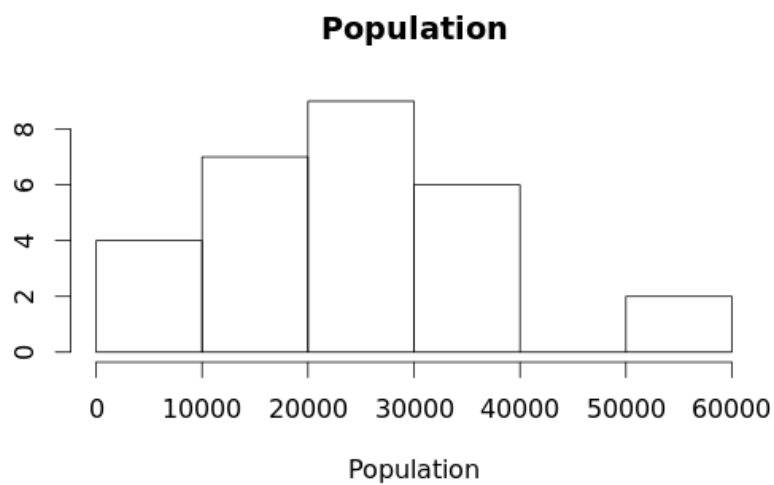
All variables in this data set that were not detailed in the body of this report are included below. Each quantitative variable is summarized in table with a five number summary, followed by a histogram in order to visualize the distribution of the variable. Categorical variables are characterized by a table with a count of the variables in each category and followed by a bar graph showing the quantity of occurrences of each categorical variable as the y-axis.

Demographic Statistics

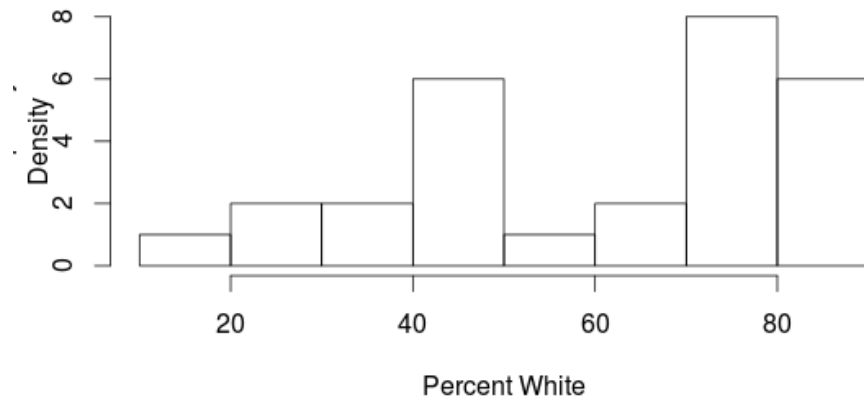
Table 2: Summary of demographics of the Twin Cities in 2010.

Demographic	Minimum	Median	Mean	Maximum	Standard Deviation	Frogtown Value	Source
Population Density (People Per Square Mile)	3456	6532	6727	13000	2400.944	8019	www.city-data.com
Population	7650	22590	24430	56830	12569.62	13741	www.mncompass.org
Percentage White	17.10	69.25	86.20	60.21	22.31	21	www.mncompass.org
Percentage Hispanic	2.000	7.250	78.100	12.089	15.133	9	www.mncompass.org
Percentage African-American	3.000	12.900	51.600	15.955	11.616	33	www.mncompass.org
Percentage Asian	1.500	4.750	33.000	10.024	9.811	33	www.mncompass.org
Percentage Native American	0	0.710	6.400	1.010	1.326	1	www.mncompass.org

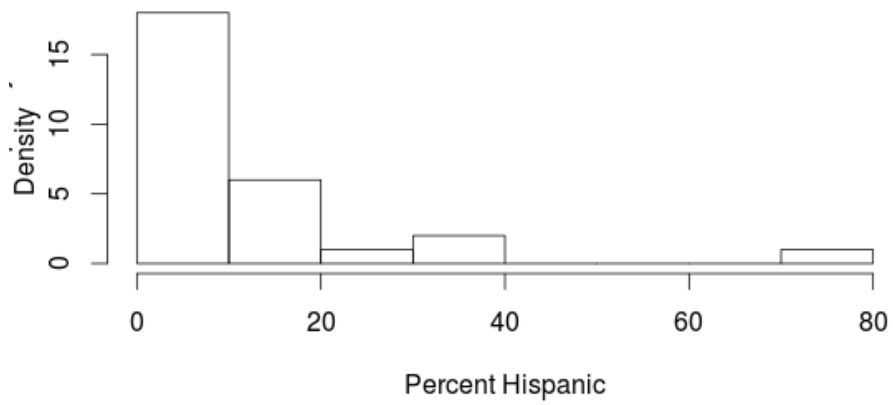
Percentage Mixed Race	2.000	3.650	7.800	3.817	1.342	4	www.mncompass.org
Percentage Other	0.000	0.375	7.700	1.064	1.669	0	www.mncompass.org
Percentage Foreign-Born	6.00	14.35	33.70	15.21	7.90	30.5	www.mncompass.org
Median Age	25.40	33.40	38.70	33.53	3.49	34.79	www.mncompass.org
Crime Rate	.01926	.05307	.05110	.08545	0.018448	0.06623	www.areavibes.com
Avg. Household Income	24398	46734	85628	49928	15229	33099	www.areavibes.com
Cost of Living Index	91.00	96.00	114.50	97.76	8.31	92	www.areavibes.com
Unemployment Rate	0.000	7.300	23.900	7.649	4.158	9.1	www.areavibes.com



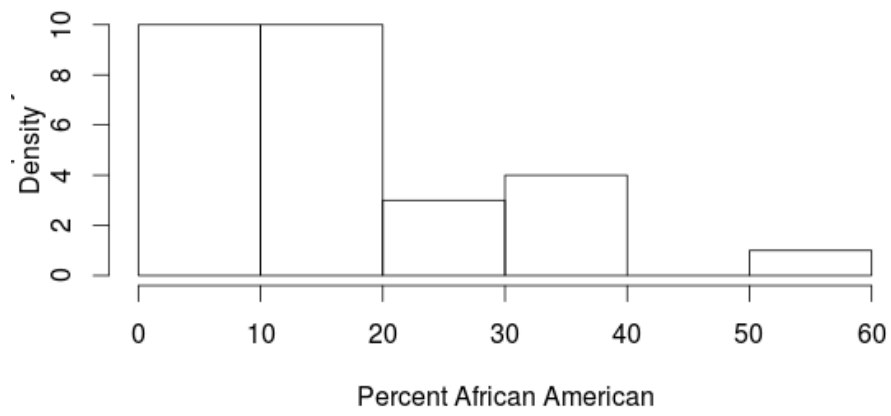
Percent White



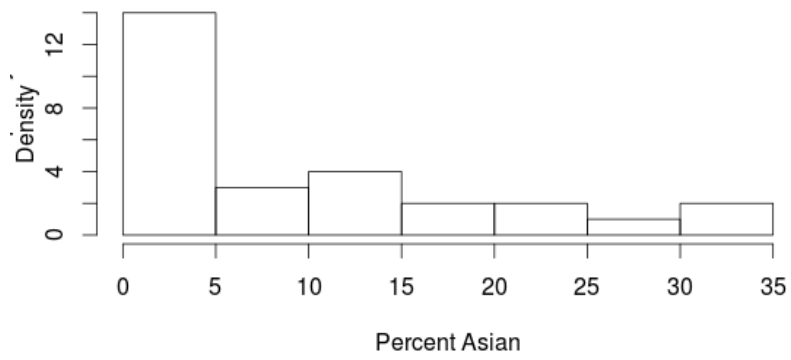
Percent Hispanic



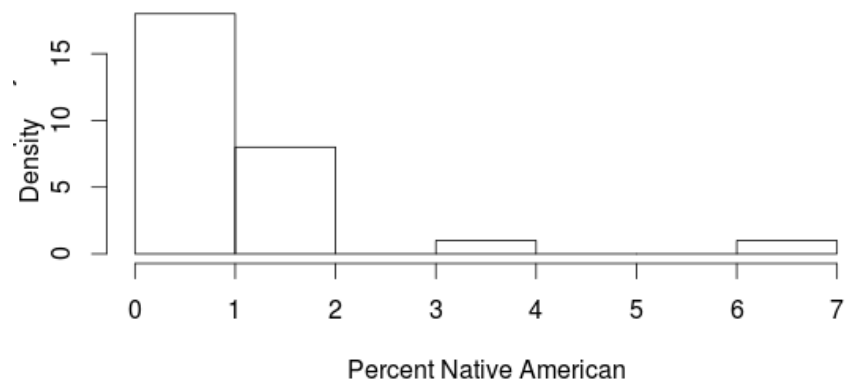
Percent African American



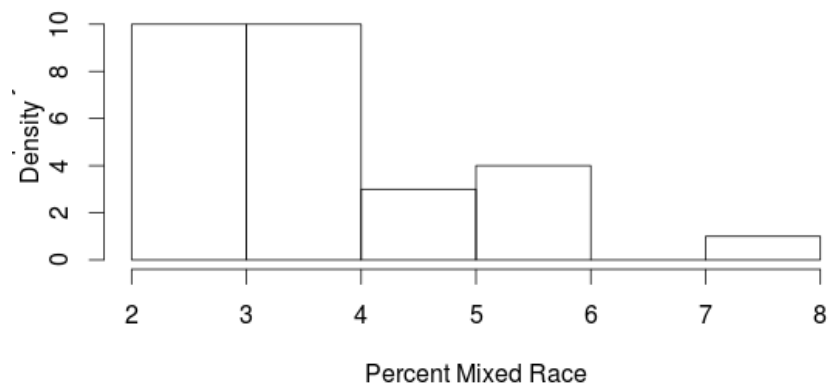
Percent Asian

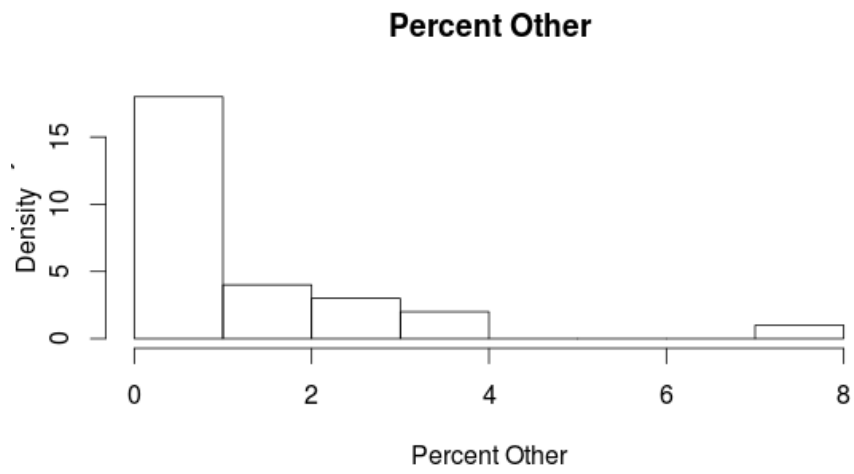


Percent Native American

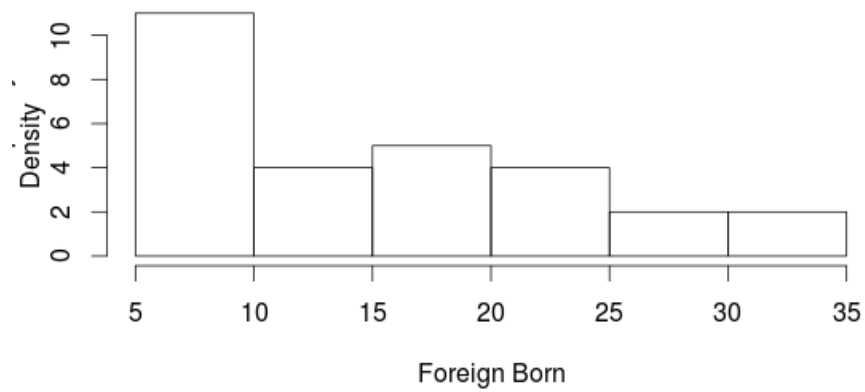


Percent Mixed Race

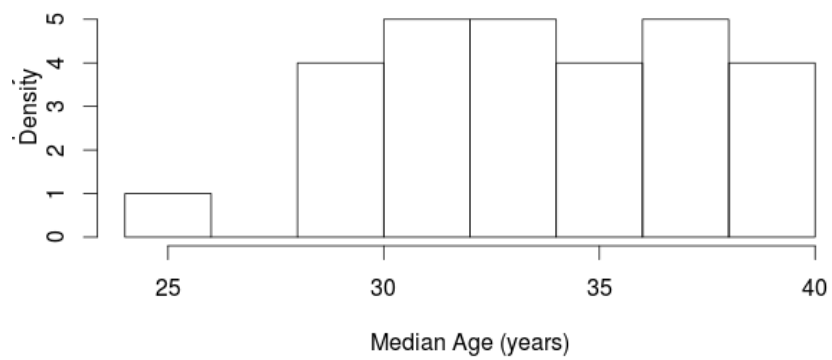


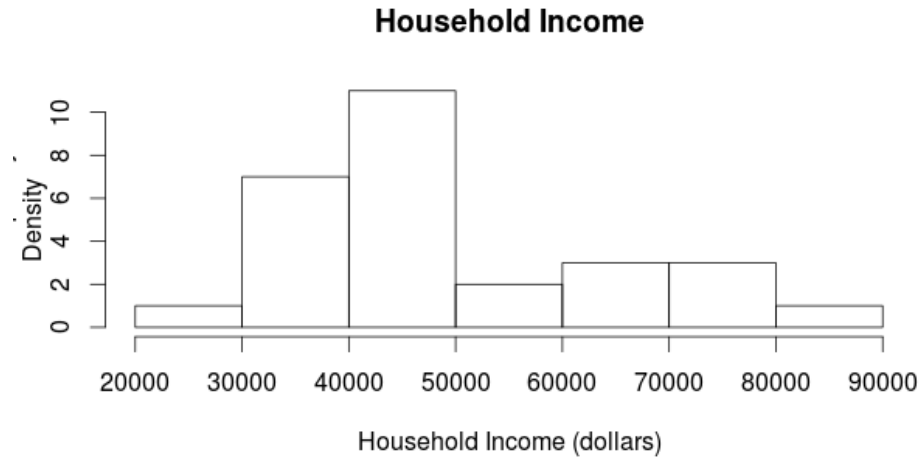
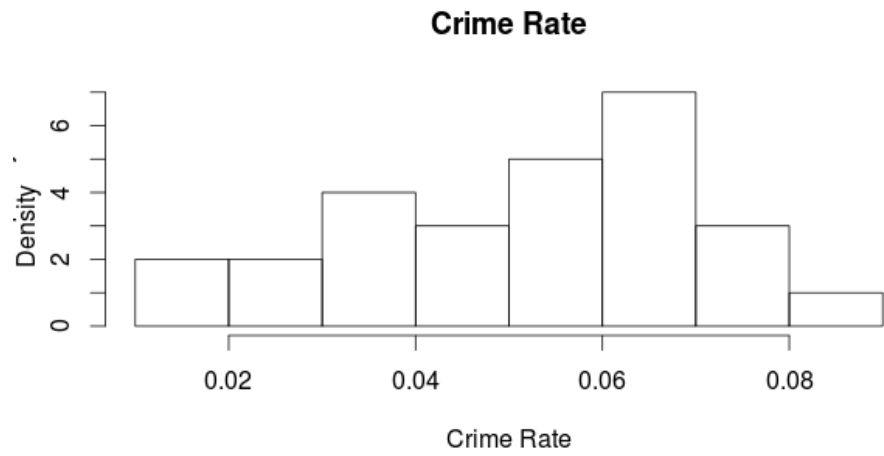


Percent Foreign Born



Median Age



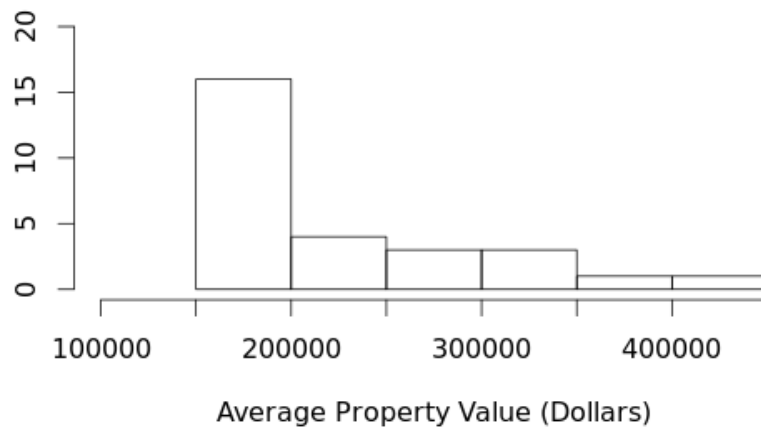


Property Values

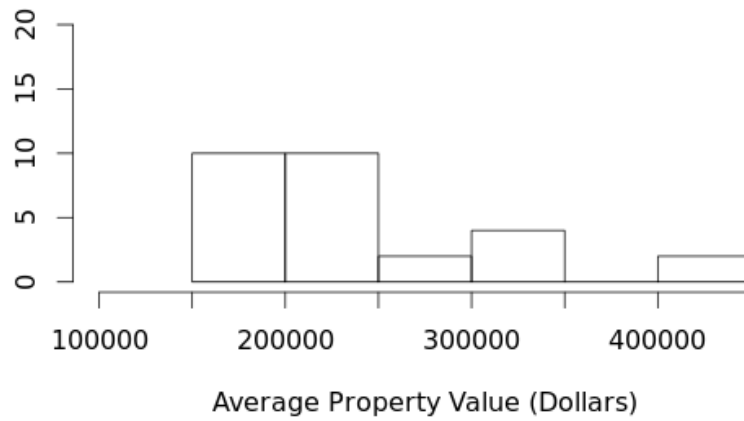
Table 3: Summary of property values of neighborhoods in the Twin Cities from 2005 to 2014.

Year	Minimum	Median	Mean	Maximum	Standard Deviation	Frogtown Value
2005	151000	195000	223800	400100	70269.54	151000
2006	154000	206400	236900	413600	72182.62	154000
2007	143600	205600	232900	277400	74256.21	154000
2008	73190	184800	213100	423300	88547.9	109000
2009	43370	151000	178200	417400	97177.33	98200
2010	64050	150900	175100	400800	93371.5	95500
2011	53100	133400	172200	452300	99998.49	85200
2012	69700	152500	172400	410500	91184.06	98200
2013	69700	152500	172400	410500	91184.06	98600
2014	74680	165300	191300	443900	97595.64	10600

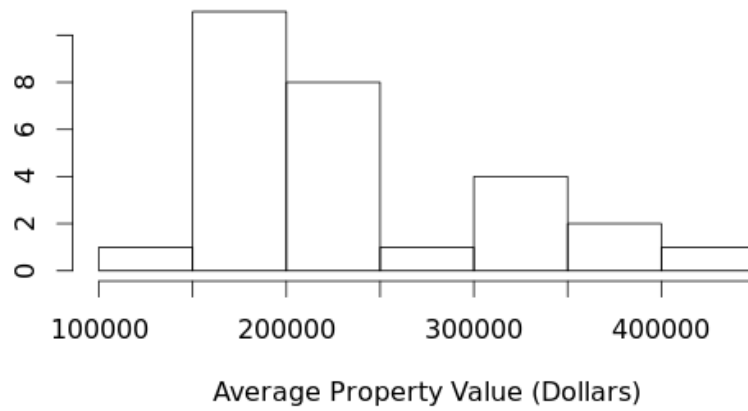
Average Property Value for 2005



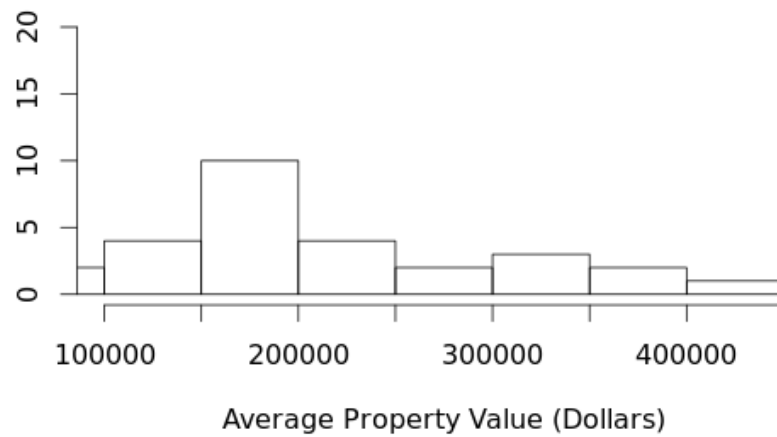
Average Property Value for 2006



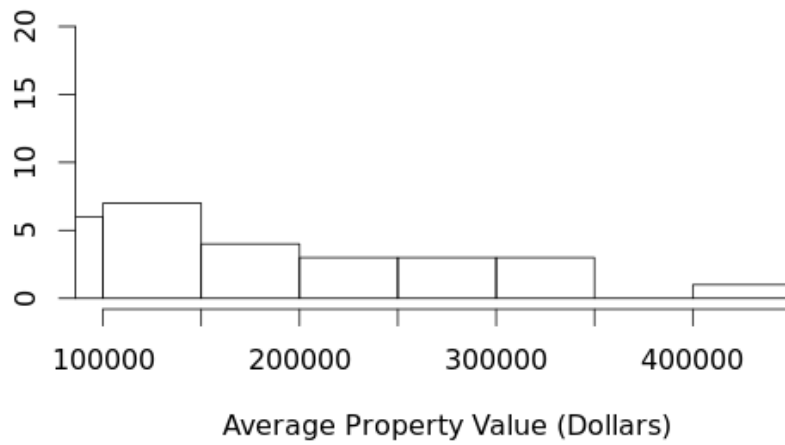
Average Property Value for 2007



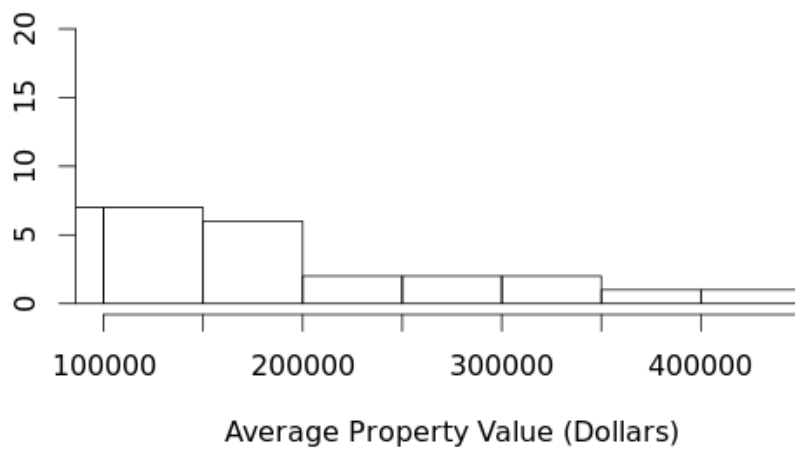
Average Property Value for 2008



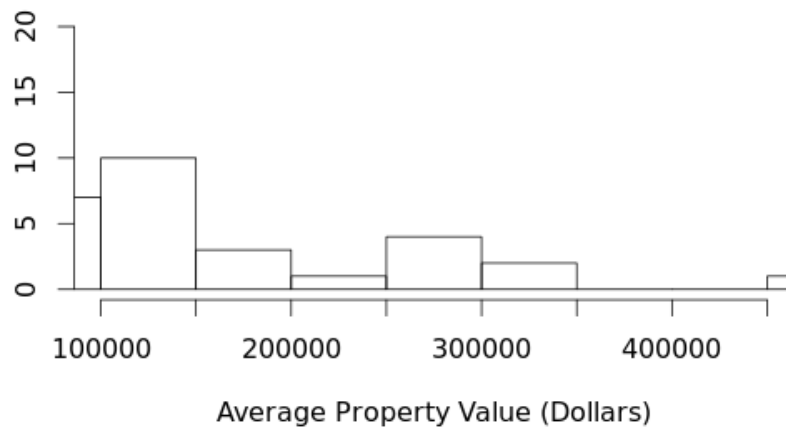
Average Property Value for 2009



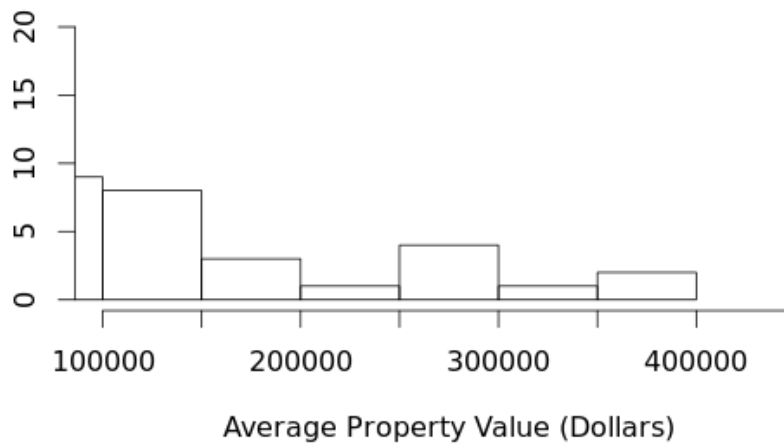
Average Property Value for 2010



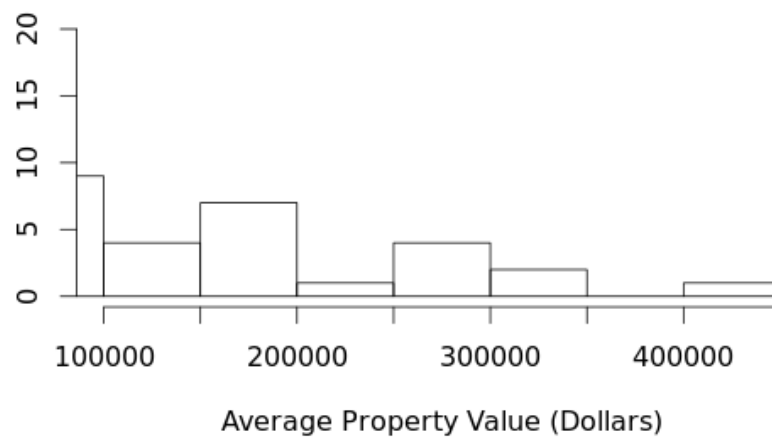
Average Property Value for 2011



Average Property Value for 2012



Average Property Value for 2013

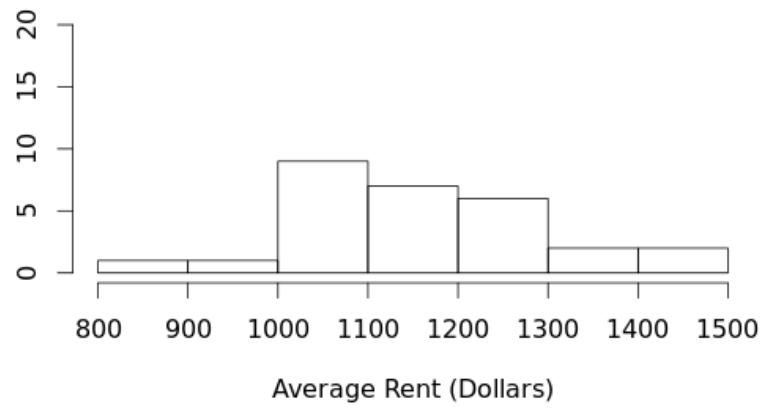


Average Rent

Table 4: Summary of rents of neighborhoods in the Twin Cities from 2011 to 2014.

Year	Minimum	Median	Mean	Maximum	Standard Deviation	Frogtown Value
2011	885	1144	1158	1431	128.4955	1047
2012	915	1245	1289	1734	180.4364	1124
2013	69700	152500	172400	410500	91184.06	1148
2014	944	1353	1383	1859	197.3598	1204

Average Rent Value for 2011



Average Rent Value for 2013

