The Impact of Environmental and Aesthetic Factors on Riverine Property Values.

Edward F. Hartwick
Michigan State University

<u>Property Values</u>

Why Look At These Variables?

There are a substantial number of factors that can influence the value of a residential property. Factors such as the size of the house, the acreage of the property, the quality of neighborhood, and visual attractiveness of a property all have a contributing influence on how a property is valuated. Previous studies have shown that properties with at least a partial view of water tend to be valued higher than those without. Benson, et al. (1998) compared property values in Washington state and found that even the poorest ocean-views added 8% to the market price of a home. Similarly, Seiler, et al. (2001) found that residential properties with a lake view had significantly higher values than those without one. Additionally, numerous other studies have also shown results that proximity to bodies of water will increase property values (Darling, 1973; Gillard, 1981 for example).

However, even with properties having higher values along bodies of water, there is still a large amount of variation in property values. Figure 1 shows a subset of this paper's study area, indicating the wide variety of property values along the study rivers. It is the purpose of this paper to examine the aesthetic and environmental qualities of these properties that result in this variation of property values. These properties, or factors, have been put into four categories: Neighborhood Characteristics, Flood Plain, Scenic Value, and Proximity to Industry.

The quality of the neighborhood that a property resides in is widely accepted as being an influence on property values. Ioannides (2002) investigated home maintenance behavior and found that an individual's home maintenance practices are influenced by those of their neighbors. Research conducted by Spivack (1991) also suggests that ownership patterns and vacancies are the quite influential in the amount of maintenance and upkeep conducted on a property. The condition that a home is in is an obvious factor in influencing its final value.

A property's location relative to a flood plain can also influence its value. The higher risk of flood results in an increased number of flood insurance policies issued in these areas which adds to the cost of owning a home in these areas. Even though flood insurance is subsidized through the National Flood Insurance Program (NFIP), this, along with the risk of damage to personal possessions due to flood, may be seen as deterring factors in owning a home in a flood plain. Bartosova, et al. (1999) have examined these effects and found flood plains lower the values of properties located within them. Similarly, Troy and Romm (2003) found that property values inside of flood plains were 4.2% lower on average than those outside of flood plains.

Scenic amenity, or scenic value, also plays a role in the final valuation of a property. In general, properties with a nice view tend to draw more in the marketplace. Previous research by Benson, et al. (1998), studying properties with a view of water, and Garrod and Willis (1992), studying properties with view of wood lots, have found that a scenic view increases the value of nearby properties.

The final variable examined in this study is a property's proximity to industrial areas. Industrial areas are typically thought of has adding noise or air pollution to an area, or in general, being unattractive and unappealing to live near. This is supported in the literature by Espey and Lopez (2000) who studied the effects of airport noise pollution on housing prices and found that those with higher noise levels sold for roughly

$2,400 less than those in quieter areas. Further aesthetic influence of industry on property values is seen in a study by Delaney and Timmons (1992) that concludes that areas near high voltage power lines are found to, on average, have a market value of about 10% less than comparable properties that are farther away.

The Study Area

The areas to be studied in this paper are the major riverine areas inside of Ingham County, Michigan. The riverine areas are those areas that influenced by the Grand River, the Red Cedar River, and the Sycamore Creek in Ingham County. Ingham County was chosen because of its diversity in the variables that we wish to study. The county contains one of the largest cities in Michigan and outside of the metropolitan area, is mostly rural farm country. The three rivers selected for the study were chosen because they are the largest and most influential in the county.

The bounds of the study area were decided to be a 500-foot buffer around the 100-year flood event zone for these rivers. This was chosen because it was reasonable to believe that no areas outside of this 500-foot buffer would likely be influenced by the rivers and therefore be considered riverine areas. The properties parcels used in this study were selected as being wholly contained by this 500-foot buffer.

Expected Findings

The purpose of this study is to examine the reasons why property values vary greatly along riverine areas and which of the variables described are more influential. The author hypothesizes that each of the factors have an equal weight in influencing the property values, however, the negative aspects will outweigh the positive aspects in a mixed setting. This is to say that given a property that scores moderately on three of the four factors, a low score in the fourth factor would have more influence in determining the overall value than a high score in that factor.

Measuring the Variables

Residential Properties

The dependant variable in this study is the assessed property value of the residential properties within our defined study area. The dataset was obtained in two parts, one from the Ingham County Equalization/Tax Mapping Department which provided all parcels and information for areas outside of the city boundaries of Lansing, Michigan, and the other part which contained all parcels within Lansing from the City of Lansing Assessor's Office. These parcel datasets were then merged to form a full county dataset and then those parcels that were fully contained within the study bounds were queried and exported into a single dataset.

That dataset, however, represented the entirety of property parcels within the study area where the study calls for only residential properties. At this point, the author went through all of the properties in the study area and decided, based upon name of the owner and familiarity with the locations of these properties, if the property was likely to be residential or not. Those properties that remained in question after the initial survey were inspected on site as to whether they were residential. Understandably, this method most likely resulted in some properties being included or excluded by error, but it is the determination of this author that these errors were not significant enough to impact the integrity of the study.

Flood Plains

In this study, the flood plain is defined by the 1-percent-annual-chance flood (or 100-year flood) boundaries as described by the U.S. Federal Emergency Management Agency (FEMA). This represents the area of land that has a 1% or greater chance of being flooded in any given year (FEMA 2002). These areas have the potential to impact property values not only because of the increased risk of property damage due to flood, but also because the added cost of purchasing flood insurance. The flood zone areas were obtained from the Flood Insurance Rate Maps (FIRMs) that were produced by FEMA and distributed in digital format by the Michigan Center for Geographic Information.

Once acquired, the 100-year flood event zones were extracted from the FIRM dataset and clipped to the study boundaries inside of a GIS. From there, the residential properties were overlaid and given a flood plain value based upon their positioning relative to the flood zone. Those areas completely contained within the flood zone were given a low value and those properties completely outside of the flood zone were given a high value. A moderate value was assigned to those properties that were partially inside of the flood zone because of the chance that flood insurance may not be required or if it is, it may be at a reduced rate.

Scenic Value

As previously mentioned, scenic value can be an important part of determining the assessment of a property. As important as it is, it is also difficult to quantify in a measurable number because it is based heavily in opinion and inherently subjective. With this in mind, a visual inspection of the entire study area was decided to be the most effective way to objectively quantify each area. The variable was measured on a scale from one to five, five being the best looking areas. During this "windshield survey," the author took into consideration the general length of the view and the overall attractiveness of the area, all the while keeping in mind the question of whether an average person might find this place scenic. Attributes such as large amounts of vegetative undergrowth, being inside of an area of depressed elevation or limited view (whether man-made or natural), or the general unattractiveness of an area would detract from a score where in contrast attributes such as mature trees, unobstructed views of the river, and areas with more open space nearby would tend to score higher. These values were measured on a block-to-block, and sometimes even a property-to-property basis and their scores input into the GIS.

Neighborhood Characteristics

To describe the aspects of the neighborhood in which the property resides, the author used an average of three variables he derived from the 2000 U.S. Census data. The first of these variables is the percentage of owner occupied homes. The reasoning behind the use of this variable is that those areas with higher home ownership rates are more likely to have more improvements done on their homes than rental properties would and maintenance of the property is likely to be more frequent. The homeowner also has more of a vested interest in interacting and maintaining the neighborhood that he/she lives in order to make their property more attractive to prospective buyers if the need to sell ever arises.

The second variable is the percentage of vacant homes. As a general rule, vacant homes are less likely to be maintained as well as occupied homes are. This can lead to a less attractive look to the neighborhood, especially as the number of vacant homes in an area increases. A high number of vacant homes may also be an indicator of a neighborhood that has other, less measurable, qualities that would keep people from wanting to live in the area.

The final variable that was included in the neighborhood characteristic is the median age of the homes in the area. The reasoning behind the inclusion of this variable is that neighborhoods with newer homes are more likely to be in better condition. This is based in the idea that a lower median home age means a newer neighborhood with more attractive neighborhood qualities and less of a chance of neglect.

To quantify this, each of the neighborhood variables was collected at the Block Group level for the entire county. These were then categorized into five quantiles and each was given a rank between one and five (five being best). Of the 195 block groups, three were excluded because they contained no homes at all. These were then overlaid with the properties in the study area and the neighborhood characteristic assigned to each property. The characteristics were then averaged (rounding to the nearest integer) to make a final neighborhood characteristic value.

Industrial Proximity

The final variable in the study is the proximity to industrial areas. The concept behind using this variable is that those properties that are closer to industry would suffer in value because taking up residence near industrial areas is generally considered less than desirable. The locations of these sites were gathered during the "windshield survey" done to determine the scenic value of the areas. The data is comprised of 63 points, within and near the study, area that were what could be termed as noticeable industrial areas. "Noticeable industrial areas" are areas that were industrial in nature or could be assumed industrial by a reasonable person even though their specific function may not be specifically classified as industrial. Some examples of these areas would be manufacturing plants, warehouses, junk yards, gravel pits, or any other place whose activity may be unattractive in either sight, sound, smell or as a health hazard.

In order to measure the effect of these areas on the properties, the impact of a single industrial area was not considered to extend beyond four city blocks away from the site. In terms of physical distance, this is approximately 2000 feet. It is a given that all city blocks are not exactly the same size, however, inside of the study area they are typically between 400 and 500 feet square. This was divided up into five categories in 500 foot increments, the closest (0-500 feet) getting the smallest value and the farthest (2000 feet and farther) getting the highest values. As with the other variables, this was then overlaid with the properties in the study area and the respective values assigned to each property. Properties had to be completely contained within one of the range increments before a value was assigned.

The Final Dataset

The final product of the data collection was a dataset of 6,758 parcels that are fully contained within a 500 foot buffer around the designated 100-year flood event zone along the Grand River, Red Cedar River, and Sycamore Creek in Ingham County, Michigan. Each parcel had assigned to it a unique ID, an assessed value given by the local assessor/equalization office, a flood plain value, a scenic value, a neighborhood characteristic value, an industrial proximity value, and a final "locational quality" value that is described in the following section. Figure 2 illustrates the locations of these properties, the bounds of the study area, and the rivers in our study area.

The Locational Quality Value

In order to study the combined effects of these variables on the property values in the study area, the need arose for a cumulative index. This index, which will be referred to as the locational quality value, consists of an un-weighted sum of all the measures of the variables described in the previous sections. Insuring that no one variable had more significance in the locational quality value than any other was done by constructing all of the variables to be categorized on a scale of one to five. The only variable that was not able to be categorized like this was the flood plain value, but this was resolved by assigning one to the properties within the flood plain, three to properties lying on the flood plain boundaries, and assigning a value of five to those areas completely outside of the flood plain. The reason for not using a weight in this study was that there was no apparent reason as to why any one of these variables would be more likely to influence the property values than any other.

The resulting locational quality value represents what the author believes to be a comprehensive ordinal index of an individual property's positive qualities. The locational quality value has a range between 4 and 20, where 4 represents properties lacking any good qualities and 20 represents the best of the best. Table 1 shows a listing of these locational quality values and the number of properties that have each value.

Table 1: Property Values Grouped by Locational Quality Value

Locational quality	N	Mean(in $)	Median(in $)
4	0	0	0
5	71	34,032	19,500
6	302	19,456	17,450
7	267	24,916	19,000
8	329	44,755	22,700
9	277	34,746	21,800
10	385	38,693	25,600
11	411	47,799	30,500
12	559	55,550	43,600
13	686	49,000	43,600
14	580	67,718	55,350
15	579	83,498	66,900
16	718	76,274	62,600
17	846	90,257	79,250
18	330	102,651	88,850
19	378	106,802	95,600
20	40	177,927	203,050

Comparing the Values

Now that the properties have been determined, their values and compiled an index to measure them against the question turns to how we are going to compare these values. Because the locational quality value is ordinal in nature, it would make sense to order the property values as well and perform a Spearman ranked-order correlation test. This test also helps to eliminate any problems that may arise due to the wide variation in the property values.

However, the large number of ties that would be presented due to the fact that a ranked dataset with over 6,700 values was compared to an index of only 16 values is concerning. A large number of ties in a ranked-order correlation can reduce the significance of the findings. So therefore, it was decided to do a standard Differences of Means Test, or t-test, to show correlation between our index and the median value of the data as they are grouped by locational quality value. The median values were chosen because they would be least likely to be influenced by the wide variation of the dataset or its non-Gaussian properties. If the results of both tests are consistent with each other, it is possible to say with confidence that they accurately represent the data in this study.

Ranked-Order Results

After compilation of the data inside of the GIS, the data was exported into a table to be read into the statistical software, R. The property values were assigned an ordered rank, one being the least valuable property, two being the second least valuable and so on. A correlation was then run between the locational quality value of the property and its value rank. This correlation resulted in a coefficient value of 0.64, meaning that there is a moderate positive correlation between the property value rank and the locational quality value. This is an indicator that the locational quality value has meaning because a strong positive correlation in this situation, a high locational quality value should be associated with a high-numbered property rank.

Difference of Means Test Results

Following this test, the data were then grouped by their associated locational quality value and the median value of each group was calculated. A t-test correlation was run and resulted in a correlation coefficient of 0.978 with a 95% confidence interval of 0.992 to 0.937. This shows a very strong positive correlation between the medians of each locational quality group and the locational quality value itself which supports the previous test results that there is meaning associated with the locational quality value in relation to the property values in the study area.

Final Thoughts

The results of the statistical tests performed on the relationship between the property values and the locational quality value indicate that there is a correlation between good neighborhood characteristics, proximity to industry, location relative to a flood zone, scenic amenities, and a higher assessed value of a residential property within a riverine area. The box plot included in Figure 3, however, visually suggests that the negative aspects of these variables may weigh in heavier than positive aspects as an influence on the assessed value as indicated by the ranked values being slower to move away from zero when they are associated with a lower locational quality value. This is also indicated in the slow rise in the median ranks in Figure 4 and the slow rise in actual property values as indicated in Figure 5. This conclusion that negative effects are more influential also helps to explain the moderate value in the ranked-order correlation seen in the previous section, as the correlation looks for a linear relationship between the two variables where there appears to actually be a curve.

The possibility, however, exists that this may be an artifact of the way that the index was constructed and that, in fact, the factors presented may not have equal weights. To count for this, the locational quality value was recalculated four separate times, each time multiplying a different value by a factor of two, thus doubling their influence over the locational quality index. The results of these re-weightings are shown by box plots in Figures 6-9 and by their median values alone in Figures 10-13. Each of these show roughly the same type of curve associated the previous locational quality values, with exception of Figures 7 and 11. These figures represent the locational quality values with high weights placed on the flood plains. The overall trend persists, however, it seems to be less regular. A possible explanation of this may be an over-estimation of the distance at which the rivers actually influence property values. Figure 14 shows a box plot of the property values in relation to the value of the flood plain factor. This indicates a peak in median property values at a value of three in the flood plain factor. This suggests that the influence of the river on higher overall property values may end closer to the boundaries of the 100-year flood event zone than the study boundaries of 500 feet beyond the zone. In order to be thorough, the weights were also adjusted a second time, giving each of the factors three times the influence of the others and it yielded very similar results.

In conclusion, it appears that the hypothesis that negative aspects of environmental and aesthetic factors have more weight upon the final property value than positive factors is true. The high correlations between the index and the property values along with the slow rise of the median property values is comparison to the locational quality index supports this assumption. The adjustment of the weights in the index also supports the hypothesis in indicating that the index itself is not likely to be flawed due to factors having unequal influence.

Bibliography

Bartošová, A., D.E. Clark, V. Novotny, K.S. Taylor (1999) Using GIS to Evaluate the Effects of Flood Risk on Residential Property Values. *Proc. Environmental Problem Solving with Geographical Information Systems: A National Conference*, U.S. EPA, September 22-24, 1999, Cincinnati, Ohio

Benson, E. D., J. L. Hansen, A. L. Schwartz, G. T. Smersh, (1998) Pricing Residential Amenities: The Value of a View. *The Journal of Real Estate Finances and Economics* 16:1, 55-73.

Darling, A., (1973) Measuring Benefits Generated by Urban Water Parks. *Land Economics* 49:1, 207-217.

Delaney, C.J., D. Timmons, (1992) High Voltage Power Lines: Do They Affect Residential Property Value? *Journal of Real Estate Research* 7:3, 315-330.

Epsey, M., H. Lopez, (2000) The Impact of Airport Noise and Proximity on Residential Property Values. *Growth and Change* 31:3, 408-419.

Federal Emergency Management Agency, (2002) National Flood Insurance Program Description. Obtained from www.fema.gov.

Garrod, G. D., K. G. Willis, (1992) The Environmental Economic Impact of Woodland: A Two-Stage Hedonic Price Model of The Amenity Value of Forest in Britain. *Applied Economics* 24, 715-728.

Gillard, Q., (1981) The Effects of Environmental Amenities on House Values: The Example of a View Lot. *The Professional Geographer* 33:2, 216-220.

Ioannides, Y., (2002) Residential Neighborhood Effects. *Regional Science and Urban Economics* 32:2, 145-165.

Seiler, M. J., M. T. Bond, V. L. Seiler, (2001) The Impact of World Class Great Lakes Water Views on Residential Property Values. *The Appraisal Journal* 69:3, 287-295.

Spivack, R., (1991) The Determinants of Housing Maintenance and Upkeep: A Case Study of Providence, Rhode Island. *Applied Economics* 23, 636-646.

Troy, A., J. Romm, (2004) Assessing the Price Effects of Flood Hazard Disclosure under the California Natural Hazard Disclosure Law (AB 1195). *Journal of Environmental Planning and Management* 47:1, 137-162.

Figures and Maps

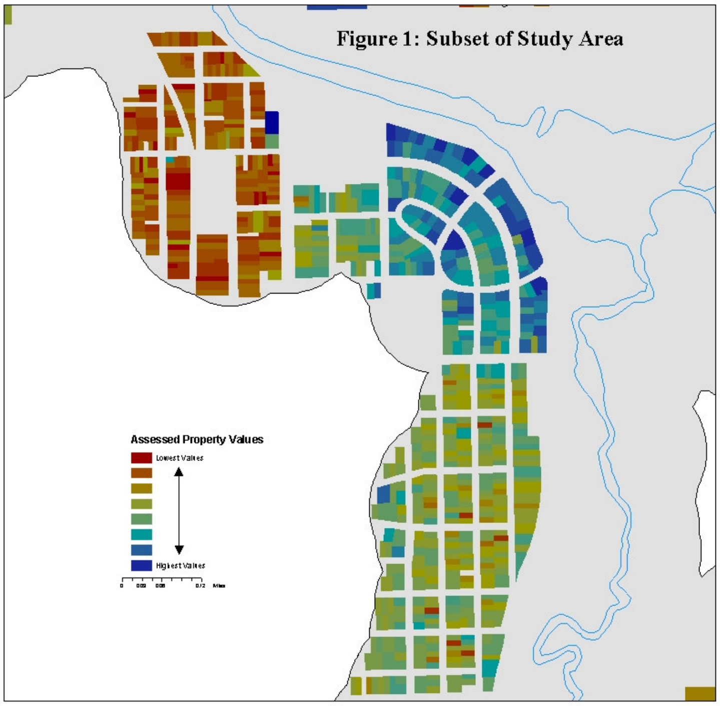


Figure 1: Subset of Study Area

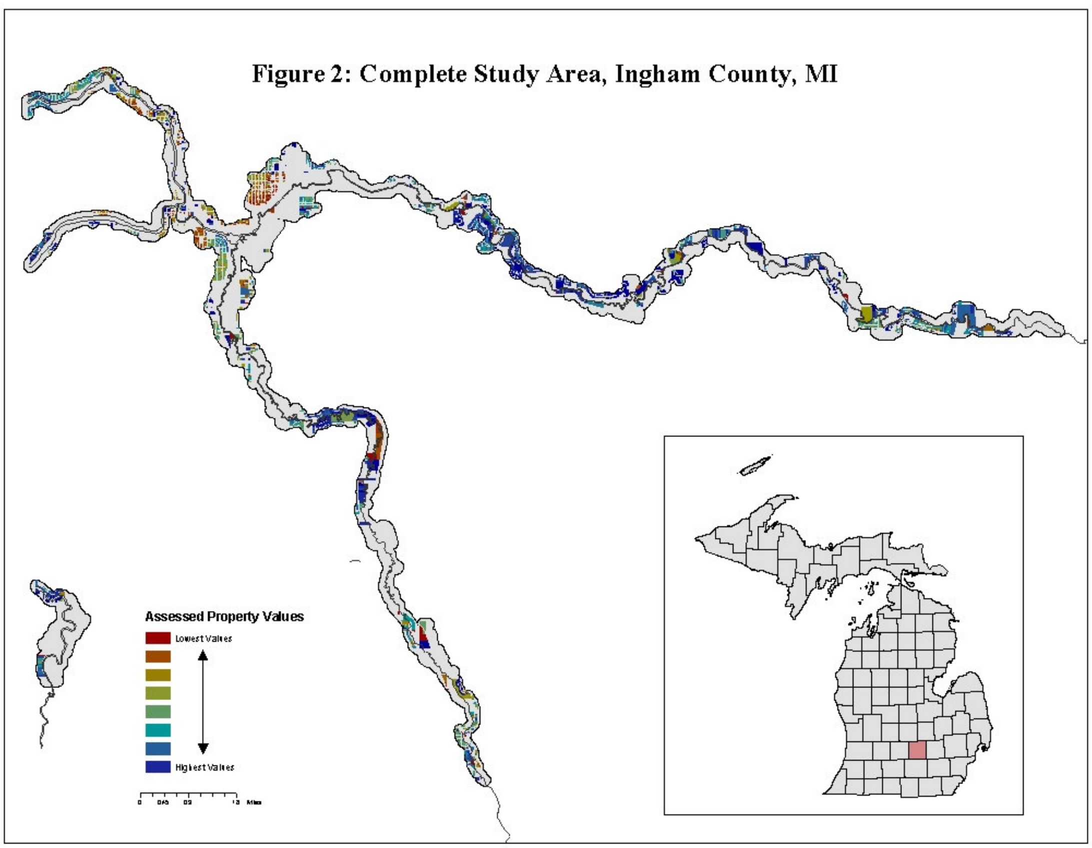


Figure 2: Complete Study Area, Ingham County, MI

Figure 3: Assessed Rank and Goodness Value

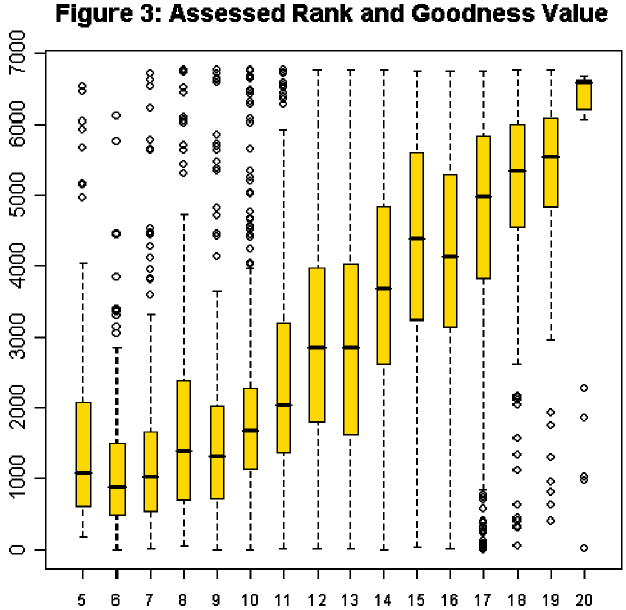


Figure 4: Median Value Rank by Goodness Value

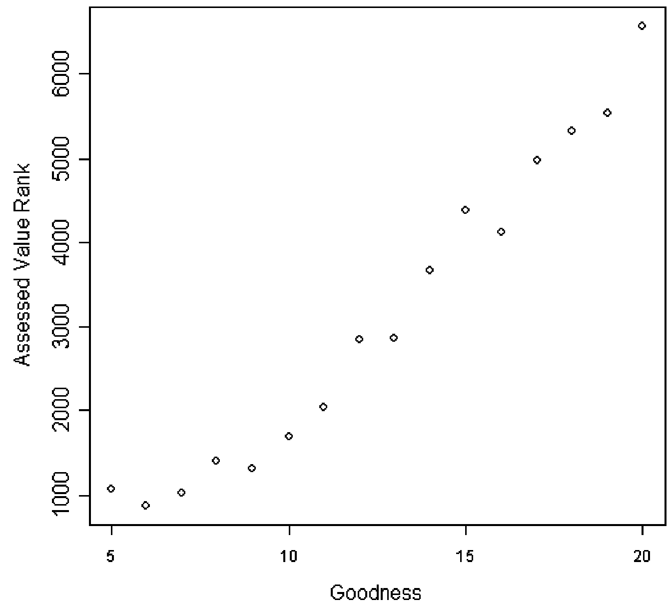


Figure 5: Median Assessed Value by Goodness Value

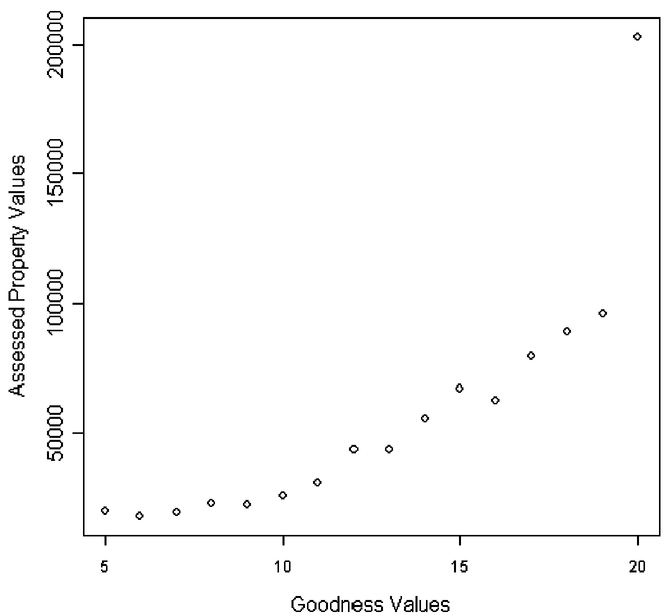


Figure 6: Assessed Rank and Neighborhood Heavy Index

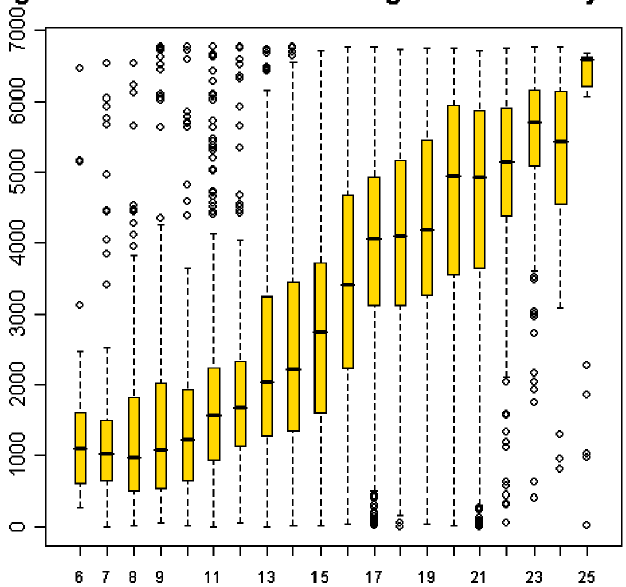


Figure 7: Assessed Rank and Flood Plain Heavy Index

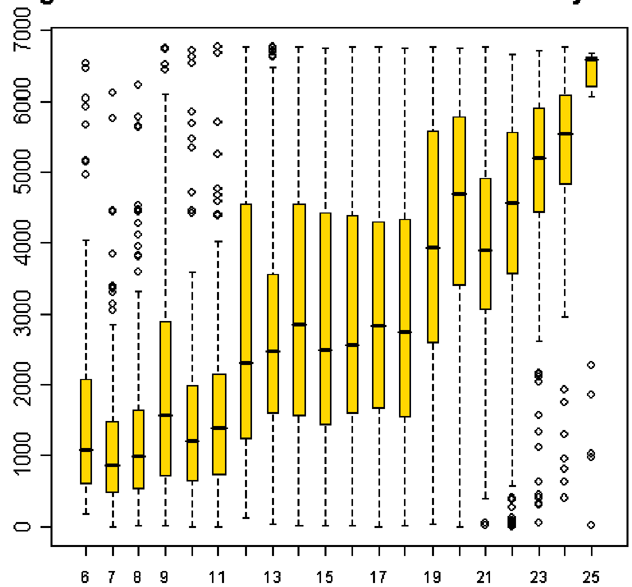


Figure 8: Assessed Rank and Industry Heavy Index

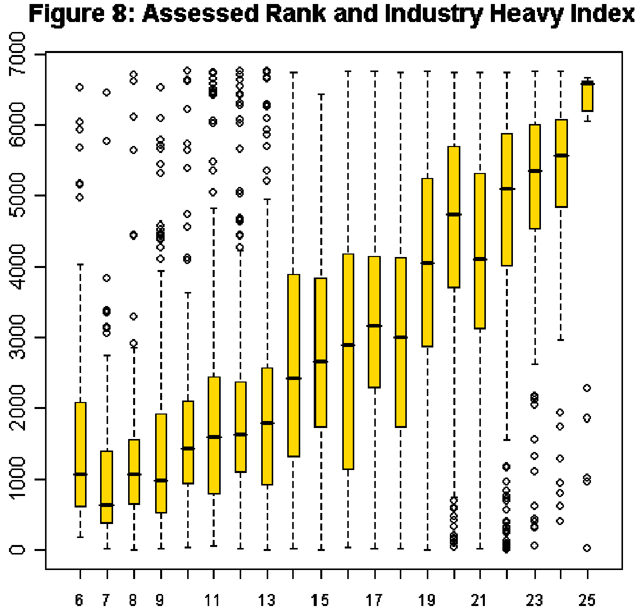


Figure 9: Assessed Rank and Scenic Heavy Index

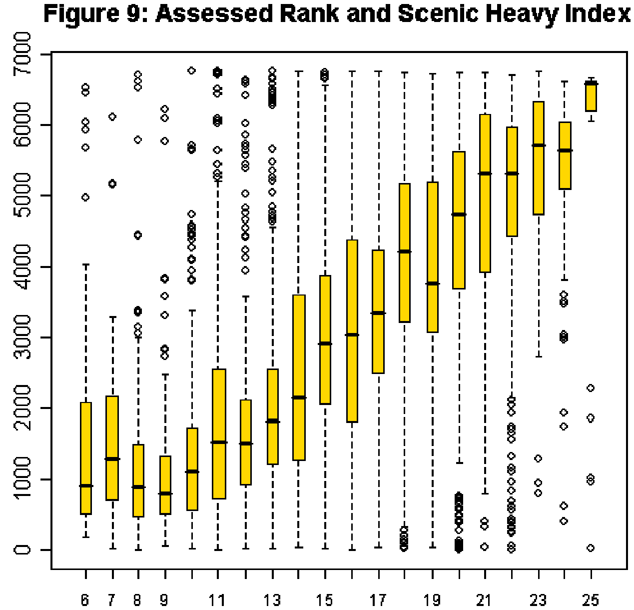


Figure 10: Assessed Value by Neighborhood Heavy Inde:

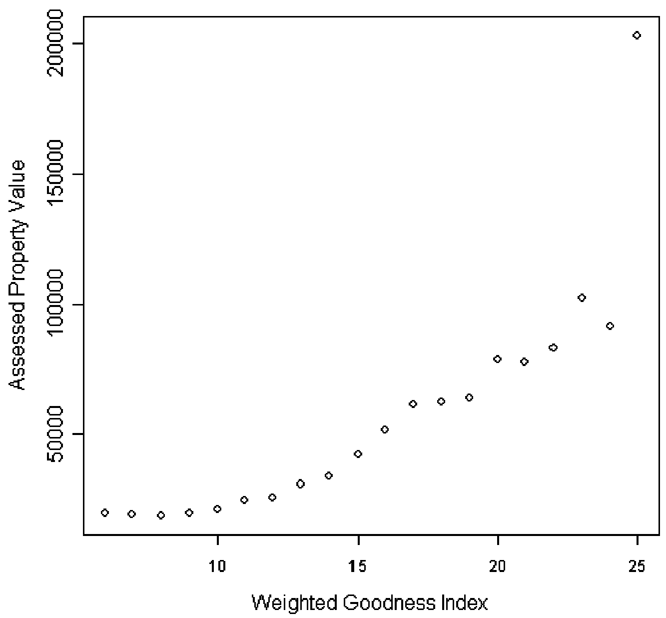


Figure 11: Assessed Value by Flood Plain Heavy Index

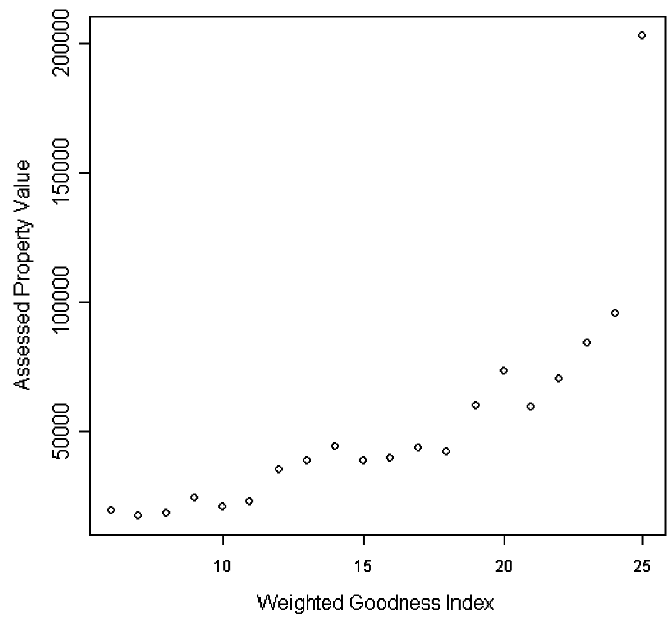


Figure 12: Assessed Value by Industry Heavy Index

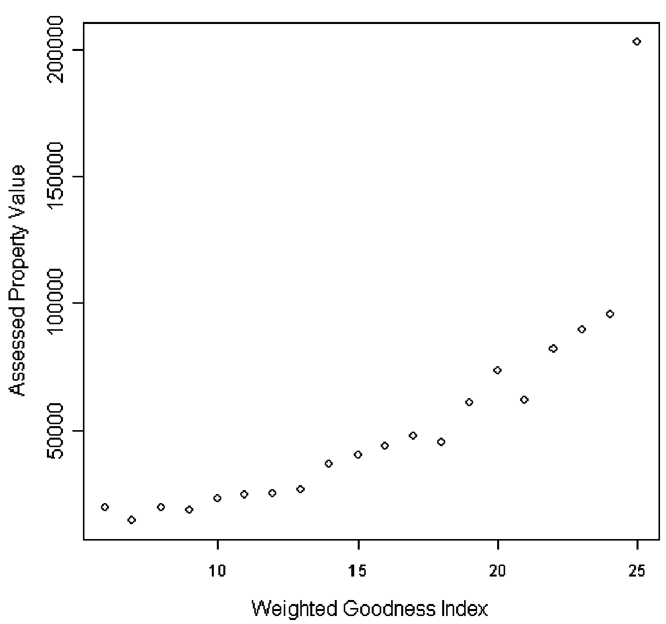
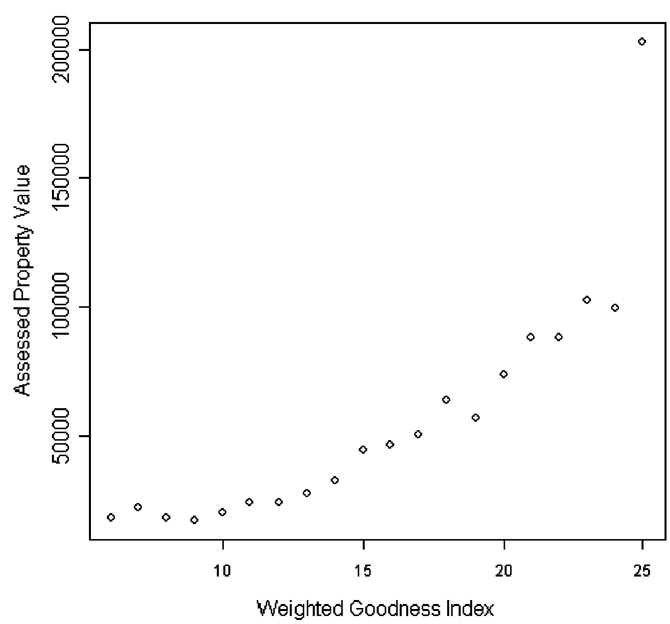


Figure 13: Assessed Value by Scenic Heavy Index



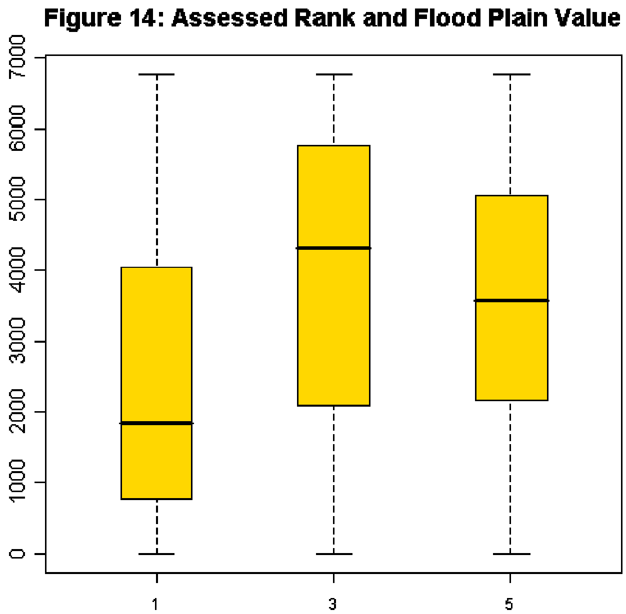


Figure 14: Assessed Rank and Flood Plain Value
0
1000
2000
3000
4000
5000
6000
7000
1
3
5