



Trends in Maryland House Prices: A Study in Multivariate Regression



Annabelle (Anna) Eyler

Hood College Mathematics Department

Abstract

The objective for this project was to investigate the cost drivers in Maryland residential building prices. In this, I report the process of gathering and cleaning this large data set of property assessment records. With a focus on statistical analysis of patterns in the data, my findings result from both a descriptive component and a modeling component using regression techniques. Through the use of R, multilevel modeling was used to compose a model for residential cost drivers.

Introduction

The data from this research is from the twenty-six counties in Maryland. Maryland is quite diverse in what each county contains: from population and land usage to locations of large cities to proximity to Washington D.C. As a state, it contains a population of 5,773,522 on 9,707 square miles of land. Highlighted in Figure 1 are three specific counties used: Garrett, Montgomery, and Frederick.

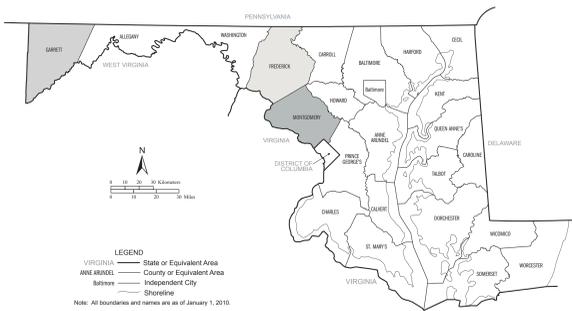


Figure 1: Map of Maryland Counties [US Census Bureau]

Garrett county, located at what is commonly referred to as the “panhandle” or narrow region, is located in western Maryland. The population of this rural county is 30,907 people within approximately 647 square miles of land, and borders Pennsylvania and West Virginia. While there are no large cities, Garrett county is known for forests and mountains as well as smaller towns compared to the rest of the state.

Montgomery county is a more rural county in Maryland. Not only does this county border our nation’s capital, it is also connected to public transit options and hosts corporate headquarters and medical facilities. With five colleges based in Montgomery county and multiple other college satellite campuses housed, there are different large cities in the county. According to the last census, this county has a population of 971,777 over 491 square miles of land.

Frederick county encompasses rural, suburban, and urban areas while also bordering Pennsylvania and Virginia. Being within driving distance of Washington D.C., there are multiple cities that act as subdivisions of more population dense counties. Frederick is the largest county of the state in terms of land at 660 square miles with a population of 233,385. Frederick county also has a decent amount of farmland around the county with small towns dispersed in clumps.[US Census Bureau]

Current Events and Economy Impact Housing Sales

Originally the research goal was to see if there was a noticeable impact on the housing market with the economic volatility being reported during the COVID-19 pandemic.[The Daily Record] After further investigation, there was not enough data to make supported models or relations on house process impacted by COVID-19. To see how the economy status impacts the housing market, I began to investigate data surrounding the Great Recession, which was recorded to be most severe from 2007 through 2009. To see market trends before, during, and after the recession, my models focused on years 1990 through February 2020.

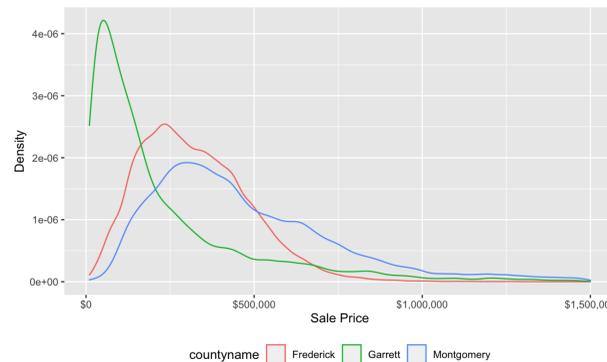


Figure 2: Sale Price Density by County

Characteristic Impact Over the Years

There were over 60 variables recorded for each of the housing sale records. Through making many models and comparing the accuracy when adding variables, a model was created to approximate housing sales. In my current regression model, I use square footage, number of full baths, number of half baths, number of fireplaces, and land area that the property resides on to approximate the sale price of houses. After investigating the data, a typical house in Frederick county was used to standardize and recenter the data for all of the counties for equal comparison. The Standard house was set to have 2100 square feet, two full bathrooms, one half bathroom, one quarter acre of land, and one fireplace. While this may not be the typical house in all of the Maryland counties, this was the standard selected for meaningful interpretations of the resulting graphs. In Figure 3, we see each model parameter after centering on the typical characteristics described above plotted by year to see the change over time.

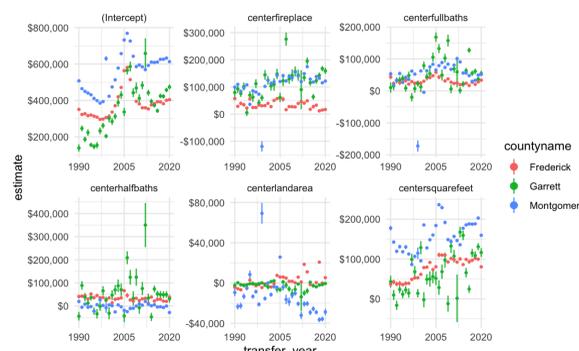


Figure 3: Plot of Variables Colored by County

Results and Conclusion

When looking at Figure 3, we see that there are noticeable differences between the three counties. The first being the accuracy of the overall intercepts for approximating the sale prices. The regression model prices houses in Montgomery county highest, followed by Frederick county and Garrett county respectively. This correlates with the price density differential in Figure 2. In the intercept model that shows the model approximation, there is a clear peak in all three of the counties around years 2006 through 2010. While these are not the exact years that are commonly defined as the timing of the Great Recession, it can be noted that there is a significant correlation between the timing of the two events.

We also see that after the time of the Great Recession, specifically after 2010, that there is a steady increase in the approximation in house sales. One may think that this is inflation, yet using the R package titled blscrapeR, inflation was accounted for given the year that the house was sold. One would logically attribute this increase to market growth and changes in the economy.

Future Work

While my research course is not yet defined, I would like to:

- gain access to data over the past year, with a sufficient amount of data to perform calculations on housing sales impacted by the COVID-19 pandemic
- perform a more in depth analysis on counties in Maryland that do not behave similarly to others, including Garrett county given it’s span of variability in results when comparing years
- investigate increase in price after inflation adjustment seen in Figure 3 from the years 2010-2020.

References

- Bednar, Adam. “MD. Real Estate Shows Symptoms of COVID-19 Slowdown.” Maryland Daily Record, 13 Apr. 2020, [thedailyrecord.com/2020/04/13/md-real-estate-shows-symptoms-of-covid-19-slowdown/](https://www.thedailyrecord.com/2020/04/13/md-real-estate-shows-symptoms-of-covid-19-slowdown/).
- Gelman, Andrew, et al. Regression and Other Stories. Cambridge University Press, 2020.
- US Census Bureau. “Maryland: 2010, Population and Housing Unit Counts.” 2010 Census of Population and Housing, CPH-2-22, July 2012, pp. 11, 15, 18, Appendix E., www.census.gov/prod/cen2010/cph-2-22.pdf.

Contact Information

Anna Eyler, email address: ame10@hood.edu
Hood College Frederick, MD