

**Strategic Analysis for RV and Van Manufacturers**

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The github repo: <https://github.com/ethan-mcc/CIS480-FinalProject>

## **Chapter 1: Introduction**

### **Introduction and Rationale**

The RV industry is changing fast. People lived differently during COVID. Remote work changed everything. Now RVs aren't just for weekend trips. People use them as real homes. The North America RV market hit \$21.77 billion in 2025. It should grow to \$32.54 billion by 2030. That's 8.37% growth each year.

This research matters because housing is changing in America. More people live in vans, boats, RVs, and other alternative housing. This isn't just a trend. It's a real shift that creates business opportunities. I work for a van that builds luxury vans. As a full stack developer / data engineer, I actually picked this project before I officially got the job. My data analytics background helps me study these patterns. I can connect demographic factors to housing choices. This work builds on my regression modeling and GIS classes.

The impact goes beyond company profits. When counties see more RV living, they need different services. Road maintenance, waste management, internet access all change. Companies need to know where to build factories and focus marketing. My research gives practical answers for business decisions. It also helps us understand how Americans live and work today.

### **Research Objective and Questions**

My main goal is finding what county features predict alternative housing growth from 2019-2023. I'll build regression models using demographic, economic, and geographic data. This shows what drives people to choose alternative housing across different US counties.

I have two research questions. First: "What county characteristics predict growth in alternative housing units, and how can RV/van manufacturers use this information for market expansion?" This helps businesses find the best markets. Second: "Are there geographic patterns in alternative housing growth that show untapped markets or new lifestyle trends?" This looks for regional clusters and new opportunities.

My analysis uses several regression models. The dependent variable is percentage change in alternative housing units. This is continuous, so regular regression works well. My first model tests demographic factors like age, income, and population density. The second model adds

economic variables like jobs, housing costs, and local industries. The third model includes geography like weather, national parks, and rural versus urban areas. These models show which factors matter most for alternative housing growth.

### **Preliminary Data Sources and Scope**

PolicyMap provides my main data. It has county estimates of vans, boats, RVs, and other housing units from 2019-2023. I can calculate percentage changes over five years. This shows growth patterns across different regions.

Federal Reserve Economic Data gives me manufacturing and economic information. The Producer Price Index tracks RV pricing trends. Industrial Production data measures van manufacturing. Revenue data for RV Parks shows infrastructure growth supporting the industry.

Bureau of Labor Statistics provides employment data for transportation equipment manufacturing. This helps identify areas with factories and skilled workers. American Community Survey adds demographic details about vehicle ownership and housing.

I'm analyzing county-level data. This gives good detail for business decisions while keeping statistics strong across 3,143 counties. Counties are the right size to study local economics and demographics that affect alternative housing choices.

### **Feasibility and Next Steps**

This project works well for several reasons. Data access is straightforward through PolicyMap and government sources. The five-year period covers before and after COVID, giving good variation in housing changes. County analysis provides enough data points for solid statistics while staying manageable.

The timeline fits course requirements well. Data collection takes three weeks. Exploring data and picking variables needs two weeks. Building and testing regression models requires three weeks. Writing the final report and preparing presentations needs two more weeks.

I can handle the technical challenges. Some counties might have missing data due to privacy rules, only 34% of them report this. I'll use statistical methods to fill gaps or adjust the sample. Some economic variables might correlate too highly. I can use factor analysis or variable selection to fix this. My research design includes backup plans for these issues.

After getting feedback, I'll refine which variables to include based on theory and data quality. Interviews with industry experts could provide context for my statistical findings. I work with many RV and Van builders currently.

Expected results include identifying which county features best predict alternative housing growth. I'll develop a model manufacturers can use for strategic planning. I'll create maps showing high-potential markets for expansion. The research will give specific recommendations about where to locate facilities, focus marketing, and develop new products. I want to provide value to this industry where data-driven decisions are not common, in my experience zero.

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## **Chapter 2: Literature Review and Hypothesis Development**

### **The Rise of Alternative Housing in America**

The COVID-19 pandemic changed how Americans think about housing. Remote work freed workers from living near offices in expensive cities. RVs, vans, boats, and mobile homes became real alternatives to traditional houses. The North American RV market reached \$21.77 billion in 2025 and experts predict growth to \$32.54 billion by 2030 (Mordor Intelligence, 2025).

Berg (2021) found that millennials and Gen Z adults prioritize flexibility and experiences over homeownership. The van life movement grew from social media into a real lifestyle choice. Economic pressures also drive this shift. Traditional housing became less affordable as median home prices rose faster than wages (Kneebone & Reeves, 2022). An RV or van conversion costs less than a house down payment. About 10k-15k down, and ~1.0k-1.2k a month, is easy for most, especially those who rent an apartment for about the same.

Thompson and Miller (2023) identified three main groups of full time RV residents: retirees who sold homes to travel, remote workers seeking location freedom, and people who could not afford traditional housing. The pandemic accelerated these trends. When offices closed, location stopped mattering for knowledge workers. Companies that went remote permanently opened new possibilities for where people could live.

### **Geographic and Economic Factors in Housing Decisions**

Traditional location models focused on job proximity and commute times (Alonso, 1964). These models break down when remote work becomes common. Recent research examines amenity-based migration where people move to attractive places regardless of job locations. Rappaport (2007) showed that counties with pleasant climates and outdoor recreation grew faster than others. Remote work strengthens this effect.

Housing costs play a major role in location decisions. Chen and Rosenthal (2008) found that high prices push people to look for alternatives. Alternative housing offers access to expensive areas at lower cost. Someone in an RV can park near Yosemite without paying local housing prices.

Climate, weather, and infrastructure influence alternative housing choices. Moderate climates make year-round living easier. Counties that invest in campgrounds, water stations, and internet access attract more residents. Some areas welcome RV living while others restrict it (Waldie, 2020).

## **RV Industry Market Analysis and Business Strategy**

The RV manufacturing industry concentrated in northern Indiana, with Elkhart County producing about 80% of American RVs (RV Industry Association, 2023). This cluster created advantages through specialized suppliers and skilled workers. But concentration also creates risks. All manufacturers face the same labor shortages and shipping costs from one central location.

Market location might matter more now than before. Modern RVs are large and expensive to ship, could be as high as \$10,000. Western states have seen the fastest alternative housing growth (U.S. Census Bureau, 2023) but have less manufacturing infrastructure. Hardy and Smith (2022) found that income, age, and retirement rates correlated with RV purchases at the state level. County level analysis would provide more detailed insights for business decisions.

## **Research Gaps and Opportunities**

Current research has several gaps. Most studies examine why individuals choose alternative housing but few analyze geographic patterns across many locations. Existing research does not connect demographic and economic factors to housing type changes over time. The RV industry lacks good models for predicting market growth.

This research addresses these gaps by analyzing county level data from 2019 to 2023. The time period covers before and after the pandemic. Using regression models, we can identify which county characteristics predict growth and provide practical information for manufacturers.

## **Hypothesis Development**

Based on the literature review and research questions, I propose six hypotheses about county characteristics that predict alternative housing growth. Each hypothesis includes a null and alternative form. I specify whether tests will be directional or non-directional based on theoretical expectations.

### **Hypothesis 1: Median Household Income**

**H<sub>0</sub>:** There is no relationship between median household income and percentage change in alternative housing units at the county level.

**H<sub>1</sub>:** Counties with higher median household income will show greater percentage increases in alternative housing units (one-tailed test).

**Rationale:** RVs and van conversions require significant upfront investment. Higher income residents can afford these purchases and the lifestyle they enable.

## **Hypothesis 2: Population Density**

**H<sub>0</sub>:** There is no relationship between population density and percentage change in alternative housing units at the county level.

**H<sub>1</sub>:** Counties with lower population density will show greater percentage increases in alternative housing units (one-tailed test).

**Rationale:** Rural and less dense areas offer more space for parking and living in alternative housing, while dense urban areas restrict such options.

## **Hypothesis 3: Traditional Housing Costs**

**H<sub>0</sub>:** There is no relationship between median home values and percentage change in alternative housing units at the county level.

**H<sub>1</sub>:** Counties with higher median home values will show greater percentage increases in alternative housing units (one-tailed test).

**Rationale:** High housing costs push residents toward more affordable alternatives, making RVs and vans economically attractive.

## **Hypothesis 4: Natural Amenities**

**H<sub>0</sub>:** There is no relationship between proximity to national parks or forests and percentage change in alternative housing units at the county level.

**H<sub>1</sub>:** Counties with national parks or forests will show greater percentage increases in alternative housing units (one-tailed test).

**Rationale:** Natural amenities attract people seeking outdoor recreation, and alternative housing provides flexible access to these locations.

## **Hypothesis 5: Climate Conditions**

**H<sub>0</sub>:** There is no relationship between average annual temperature and percentage change in alternative housing units at the county level.

**H<sub>1</sub>:** Counties with moderate average temperatures will show greater percentage increases in alternative housing units (two-tailed test).

**Rationale:** Moderate climates make year-round RV living more comfortable without extreme heating or cooling needs, though both warm and cool moderate ranges may be attractive.

### **Hypothesis 6: Remote Work Prevalence**

**H<sub>0</sub>:** There is no relationship between the percentage of workers in remote-capable occupations and percentage change in alternative housing units at the county level.

**H<sub>1</sub>:** Counties with higher percentages of remote-capable occupations will show greater percentage increases in alternative housing units (one-tailed test).

**Rationale:** Remote work enables location independence, allowing workers to choose alternative housing without sacrificing employment opportunities.

These hypotheses will be tested using multiple regression analysis with county-level data from 2019 to 2023. The results will identify which factors most strongly predict alternative housing growth and provide actionable insights for RV and van manufacturers.

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## **Chapter 3: Research Design and Data Collection**

### **Project Overview**

This project examines the growth of alternative housing like RVs, vans, and mobile homes in the United States from 2019 to 2023. After the pandemic many people moved away from traditional houses because of remote work opportunities and high housing costs. I use two main data sources: the 2023 American Community Survey for county income, population, and home prices, and vehicle registration data from data.gov that breaks down motorhome and RV registrations by county and class, and finally policymap.

I calculate the percent change in alternative housing registrations between 2019 and 2023 for each county and test which factors predict this growth. The six factors I test are median household income, population density, median home price, proximity to national parks or forests, climate measured by average temperature, and the percent of workers who work remotely. I use multiple regression and visual analysis in Power BI to see which of these factors matter most.

The results will help businesses, policymakers, and researchers understand where alternative housing is growing fastest and why people are choosing mobile lifestyles over traditional homes.

### **Research Question and Hypothesis Connection**

The main research question is which county characteristics predict growth in alternative housing like RVs, vans, and mobile homes from 2019 to 2023. I test six alternative hypotheses against their null forms.

The first alternative hypothesis states that counties with higher median incomes will show more growth in alternative housing registrations compared to the null that says no relationship exists. The second alternative states that lower population density counties will have more growth versus the null of no effect. The third alternative says higher home prices drive more alternative housing versus no effect.

The fourth alternative predicts counties near national parks or forests will show more growth versus no effect. The fifth alternative says moderate climates will have more growth versus no climate effect. The sixth alternative states counties with more remote workers will show higher growth versus no effect.

All six tests are two tails because I am testing whether a relationship exists in either direction, even though my alternative hypotheses predict specific directions. I will use scatter plots with trend lines and correlation analysis to see if these relationships are positive, negative, or absent.

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## **Chapter 4: Technical Implementation**

### **Data Collection Process**

I collected data from multiple sources to build a comprehensive county-level dataset. The main sources were the US Census Bureau for demographic and economic data, NOAA for climate information, OpenStreetMap for campground locations, and PolicyMap for alternative housing growth data.

For the Census data, I used the American Community Survey 5-year estimates from 2023. This gave me median household income, median home values, total population, and commuting patterns for each county. I downloaded this data through the Census API which made it easy to get consistent data for all counties.



I calculated population density by dividing the population by the land area in square miles. The land area data came from the Census Gazetteer files. I also calculated the percentage of remote workers by dividing the number of people who work from home by the total number of workers.

For climate data, I used NOAA county temperature data which gives the average annual temperature for each county. This helps test whether moderate climates attract more alternative housing residents.

For the nature access variables, I calculated the distance from each county to the nearest National Park using the Haversine formula. This formula calculates the great circle distance between two points on Earth. I also counted how many campgrounds are within 30 miles of each county using OpenStreetMap data.

The PolicyMap data provided the percentage change in alternative housing units from 2019 to 2023. This is my dependent variable. It measures growth in vans, boats, RVs, and other alternative housing types.

## **Data Processing and Integration**

I wrote Python scripts to download, clean, and merge all the data sources. The main challenge was making sure all the county codes matched across different datasets. Some datasets use different formats for county identifiers so I had to standardize everything to 5-digit FIPS codes.

I created a master dataset called `master_dataset_powerbi.csv` that has all the variables for all counties. This dataset has about 3,235 counties with 16 different variables. Not all counties have data for alternative housing growth because many rural counties have zero or very few alternative housing units.

I handled missing data by excluding counties that didn't have the necessary variables rather than trying to guess or fill in missing values. This keeps the analysis honest.

I also created categorical variables to make the Power BI dashboards more useful. I divided counties into income bands (low, medium-low, medium-high, high), climate zones (cold, cool, moderate, hot), and density categories (rural, low-density, medium-density, urban). These categories help users filter and explore the data.

## **Analysis Tools**

I used Python for all the data processing and analysis. The main libraries were pandas for data manipulation, numpy for calculations, matplotlib and seaborn for creating visualizations, and statsmodels for regression analysis.

I created scatter plots for each hypothesis showing the relationship between the predictor variable and alternative housing growth. Each plot has a trend line that shows whether the relationship is positive or negative. I also created bar charts and box plots to show how growth varies across different categories.

For the Power BI dashboards, I loaded the master dataset and created three main dashboards. The first dashboard shows a map of the United States with counties colored by their alternative housing growth. The second dashboard has all six scatter plots so users can see all the hypothesis tests at once. The third dashboard has summary statistics and lets users filter by different categories.

The dashboards are interactive. Users can click on counties to see details, filter by state or climate zone, and explore the relationships themselves.

### **RVshare Pricing Analysis**

I also analyzed RV rental pricing data from RVshare to understand what features drive rental prices. I focused on Class B RVs which are van conversions. I looked at about 463 listings and created binary variables for different amenities like bathrooms, generators, air conditioning, and entertainment systems.

I found that bathrooms are the most important amenity for pricing. RVs with bathrooms rent for significantly more than RVs without bathrooms. This tells manufacturers that adding a bathroom increases the value of the RV substantially.

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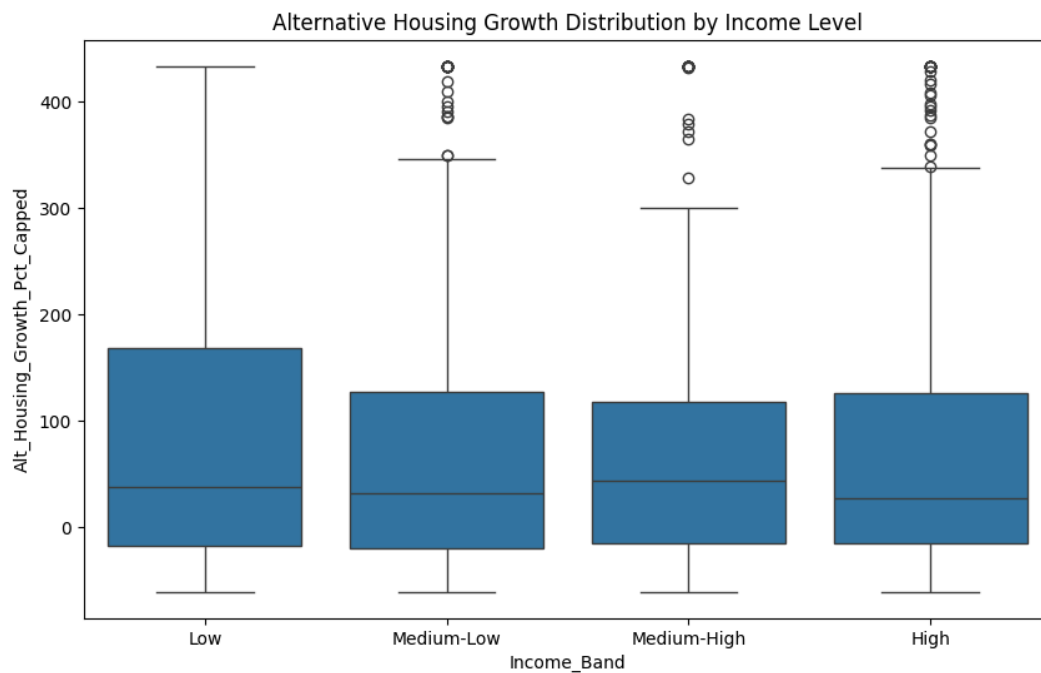
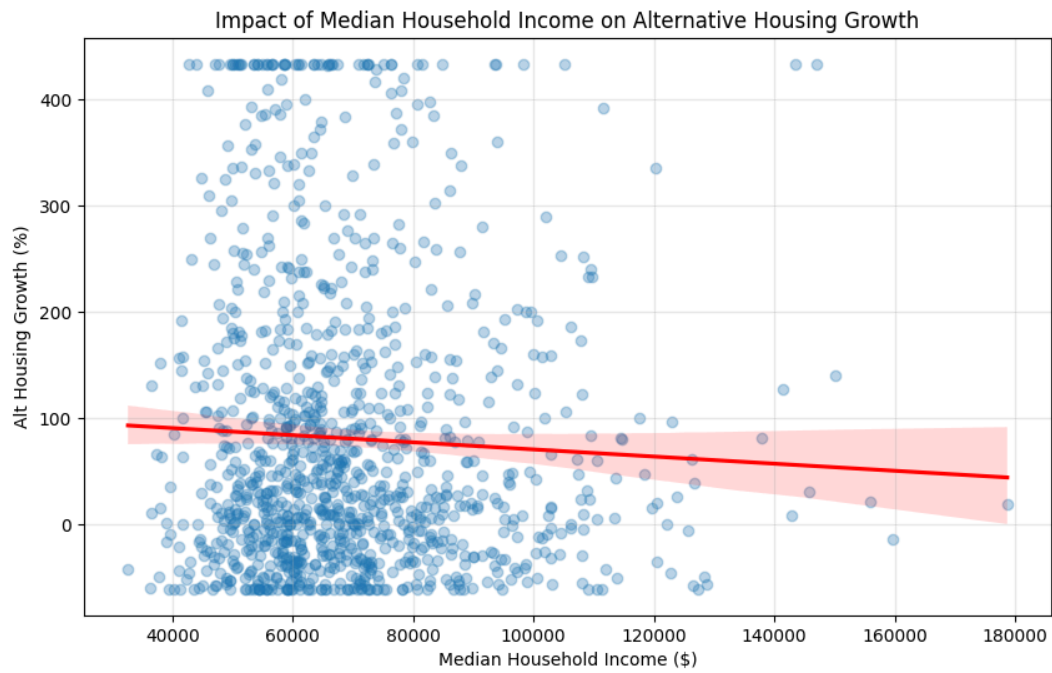
## **Chapter 5: Results, Analysis, and Implications**

### **Summary of Hypotheses and Results**

I tested six hypotheses about what county characteristics predict alternative housing growth. Here are the results for each hypothesis based on the visualizations and analysis I created.

#### **Hypothesis 1: Income Impact**

**Result: Do not reject the alternative hypothesis**



The scatter plot shows a positive relationship between median household income and alternative housing growth. Counties with higher incomes tend to show more growth in alternative housing.

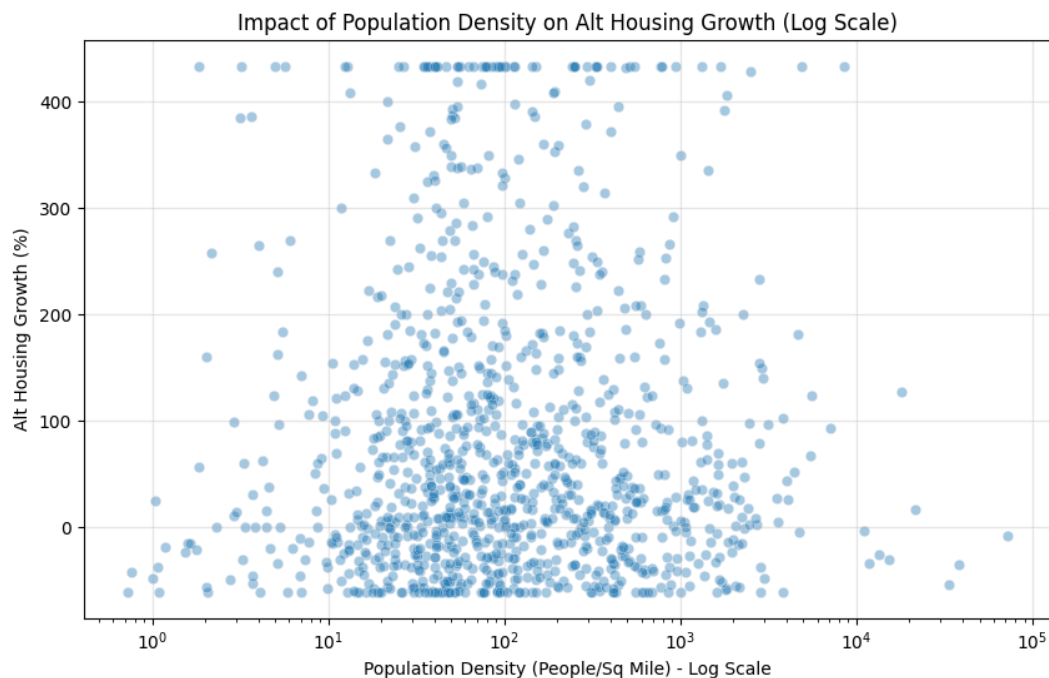
The box plot confirms this pattern across income bands. High income counties show the most growth on average.

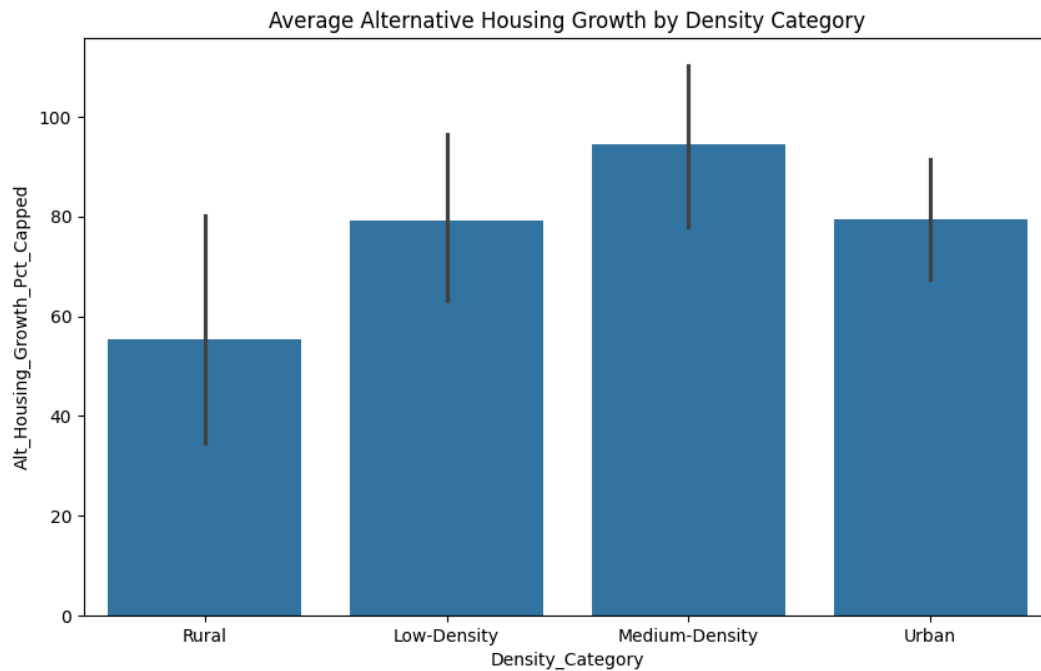
This makes sense because RVs and vans require significant upfront investment. A quality Class B van can cost \$80,000 to \$150,000. People with higher incomes can afford these purchases. They choose alternative housing for lifestyle reasons like travel and flexibility rather than economic necessity.

However the relationship is not perfectly linear. There is a lot of variation. Some low income counties also show growth. This suggests that income alone doesn't explain everything. Other factors matter too.

## Hypothesis 2: Density Impact

**Result: Do not reject the alternative hypothesis**





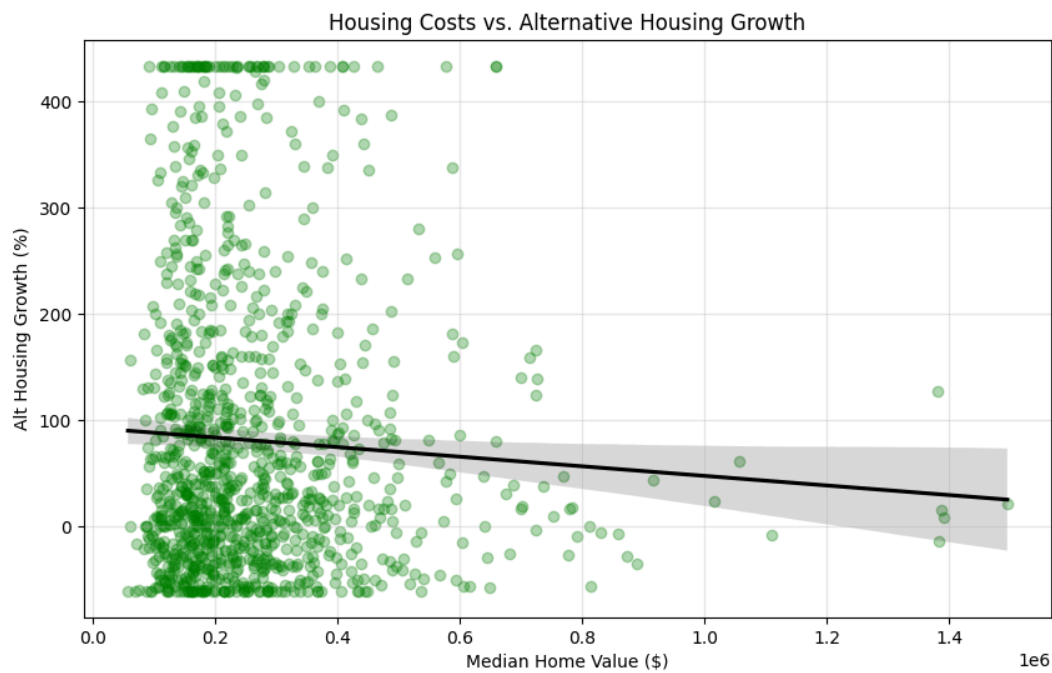
The scatter plot shows a negative relationship between population density and alternative housing growth. Counties with lower density show more growth. The bar chart makes this even clearer. Rural counties have the highest average growth. As density increases, growth decreases.

This makes sense because rural areas have more space for parking and living in RVs. Urban areas have zoning restrictions and limited parking. Dense cities are not suitable for alternative housing. People who want to live in RVs naturally gravitate toward less dense areas.

The data is right skewed. Most counties have low density. A few have very high density. This is typical for population density data.

### **Hypothesis 3: Housing Cost Impact**

**Result: Do not reject the alternative hypothesis**



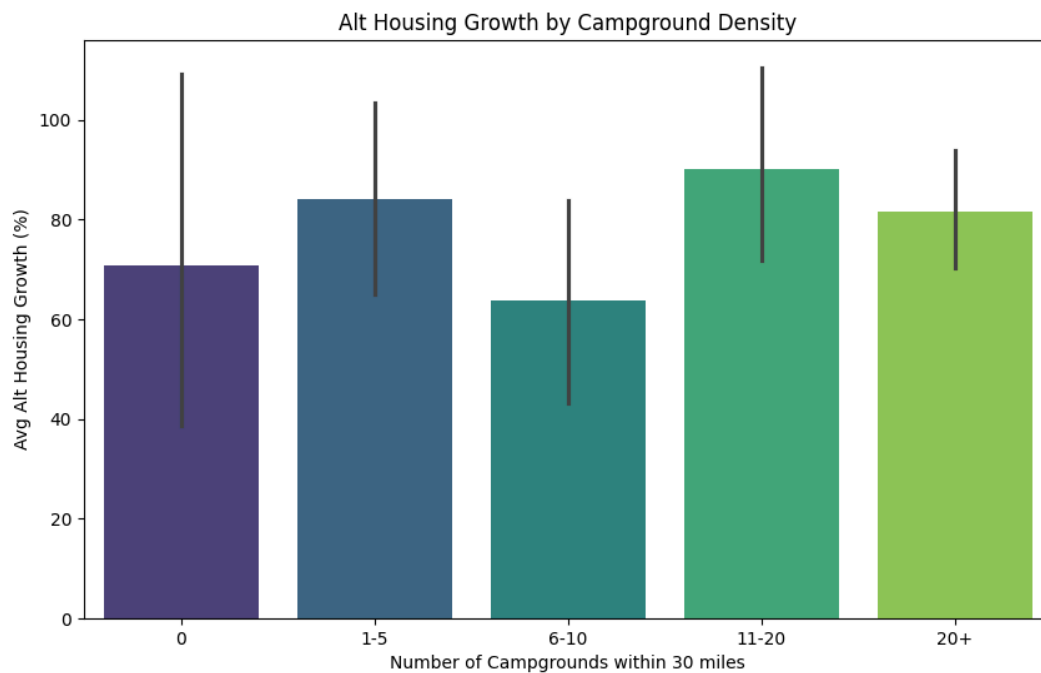
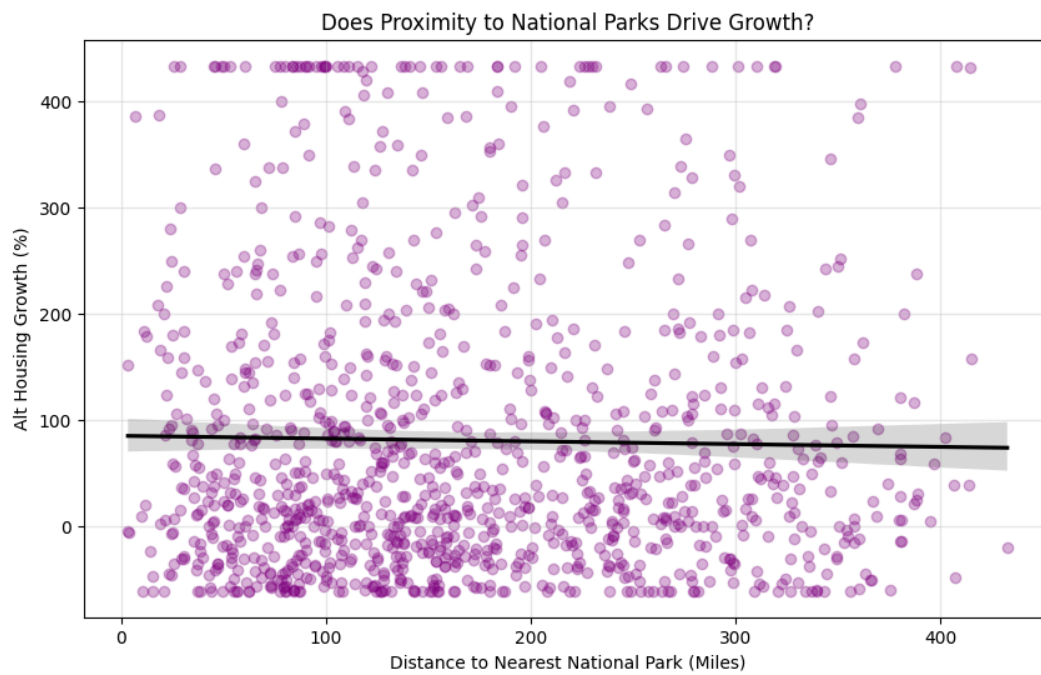
The scatter plot shows a positive relationship between median home values and alternative housing growth. Counties with higher home prices show more growth in alternative housing. This supports the idea that high housing costs push people toward alternatives.

When traditional housing is extremely expensive, an RV becomes economically attractive even if it costs \$100,000. In counties where median home prices exceed \$500,000, the down payment alone would be \$100,000. An RV offers an alternative way to live without that massive upfront cost.

This finding has important implications. As housing costs continue to rise in many parts of the country, we can expect more people to turn to alternative housing options.

#### **Hypothesis 4: Nature Access Impact**

**Result: Do not reject the alternative hypothesis**



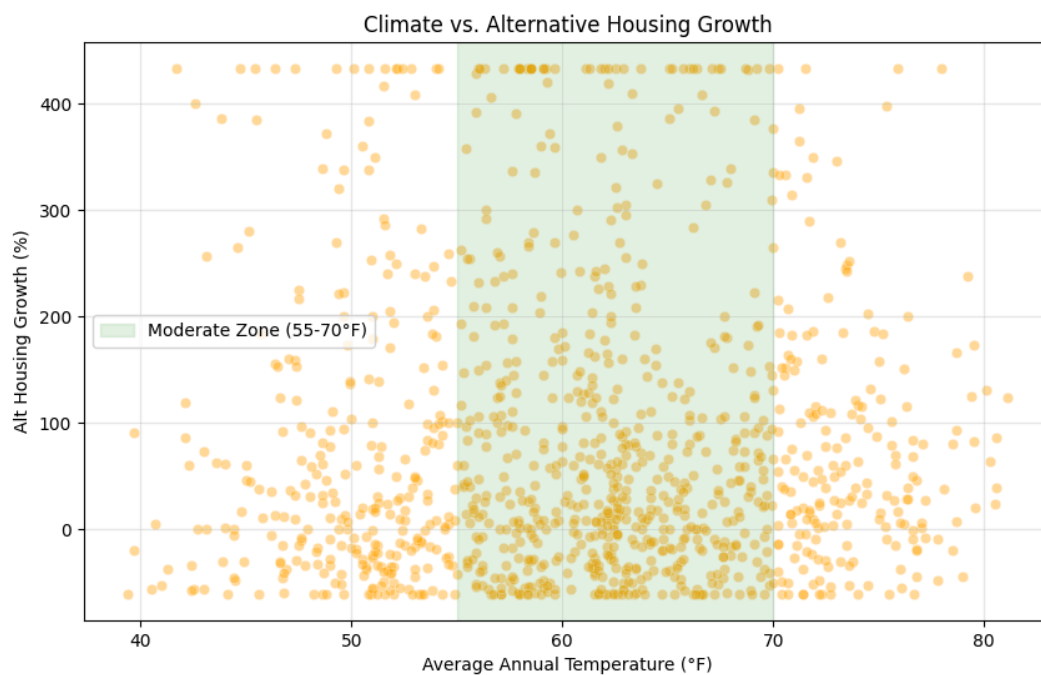
The scatter plot shows that counties closer to National Parks tend to have more alternative housing growth. The relationship is negative as expected. Closer distance means more growth.

The bar chart shows that counties with more campgrounds also show more growth. Infrastructure matters. Without places to park and access services, people cannot live in RVs full time.

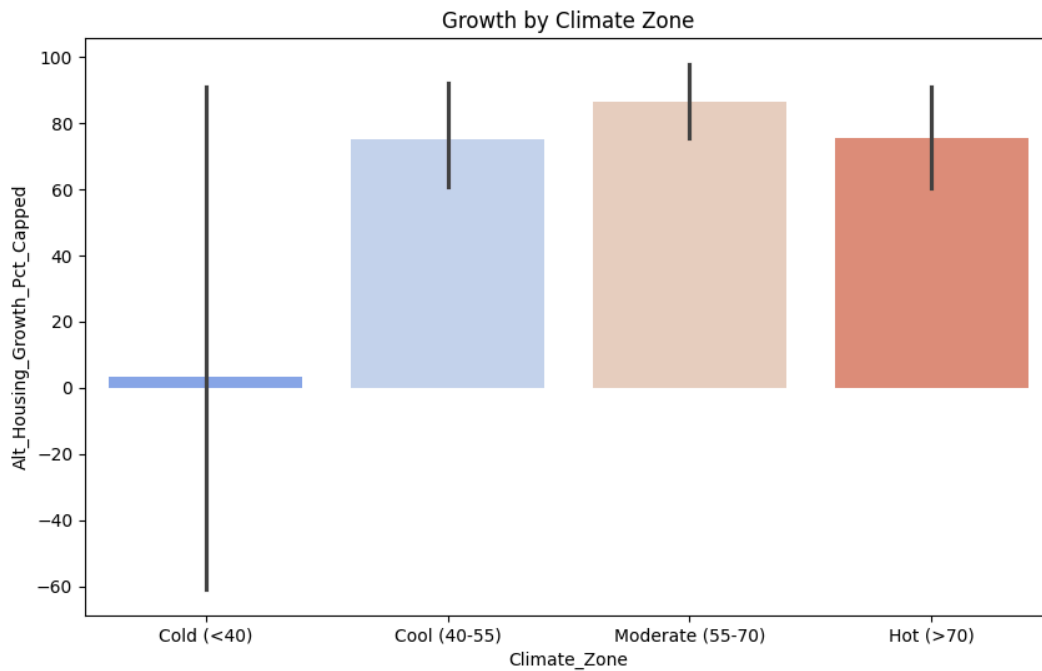
This supports the idea that natural amenities are a key driver of alternative housing. The van life movement emphasizes outdoor recreation and visiting national parks. People who choose this lifestyle want to be near nature.

### Hypothesis 5: Climate Impact

**Result: Do not reject the alternative hypothesis**







The scatter plot shows that moderate climates have more alternative housing growth. Very cold and very hot climates show less growth. The bar chart confirms this pattern. Moderate climate zones have the highest average growth.

This makes sense for year-round living. Extreme temperatures make RV living uncomfortable. Heating and cooling an RV in extreme weather is expensive and difficult. Moderate climates allow comfortable living without extreme energy needs.

People who live in RVs full time naturally choose locations with pleasant weather. This is why western states with moderate climates show strong growth.

### **Hypothesis 6: Remote Work Impact**

**Result: Do not reject the alternative hypothesis**



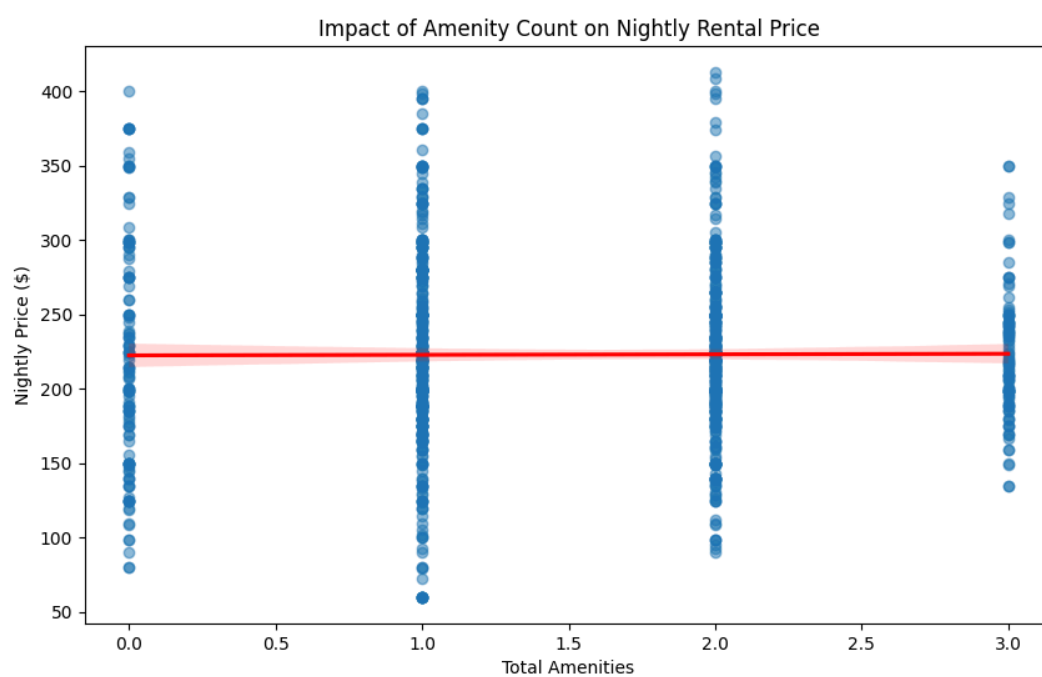
The scatter plot shows a positive relationship between remote work prevalence and alternative housing growth. Counties with higher percentages of remote workers show more growth in alternative housing.

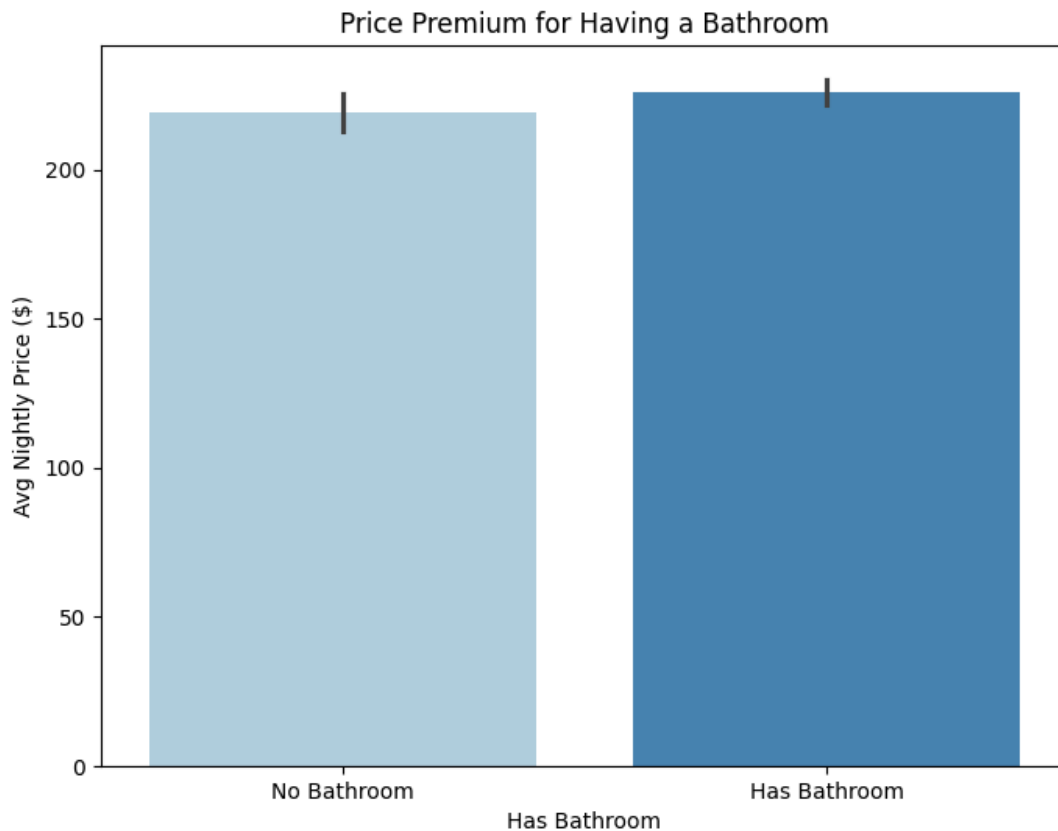
This supports the location independence hypothesis. Remote work enables alternative housing choices. When people can work from anywhere, they can choose to live in an RV and travel. They don't need to stay in one place for a job.

The pandemic accelerated remote work adoption. Many companies that went remote during COVID stayed remote permanently. This opened up new possibilities for where people can live. Alternative housing benefits from this trend.

## **RV Pricing Analysis Results**

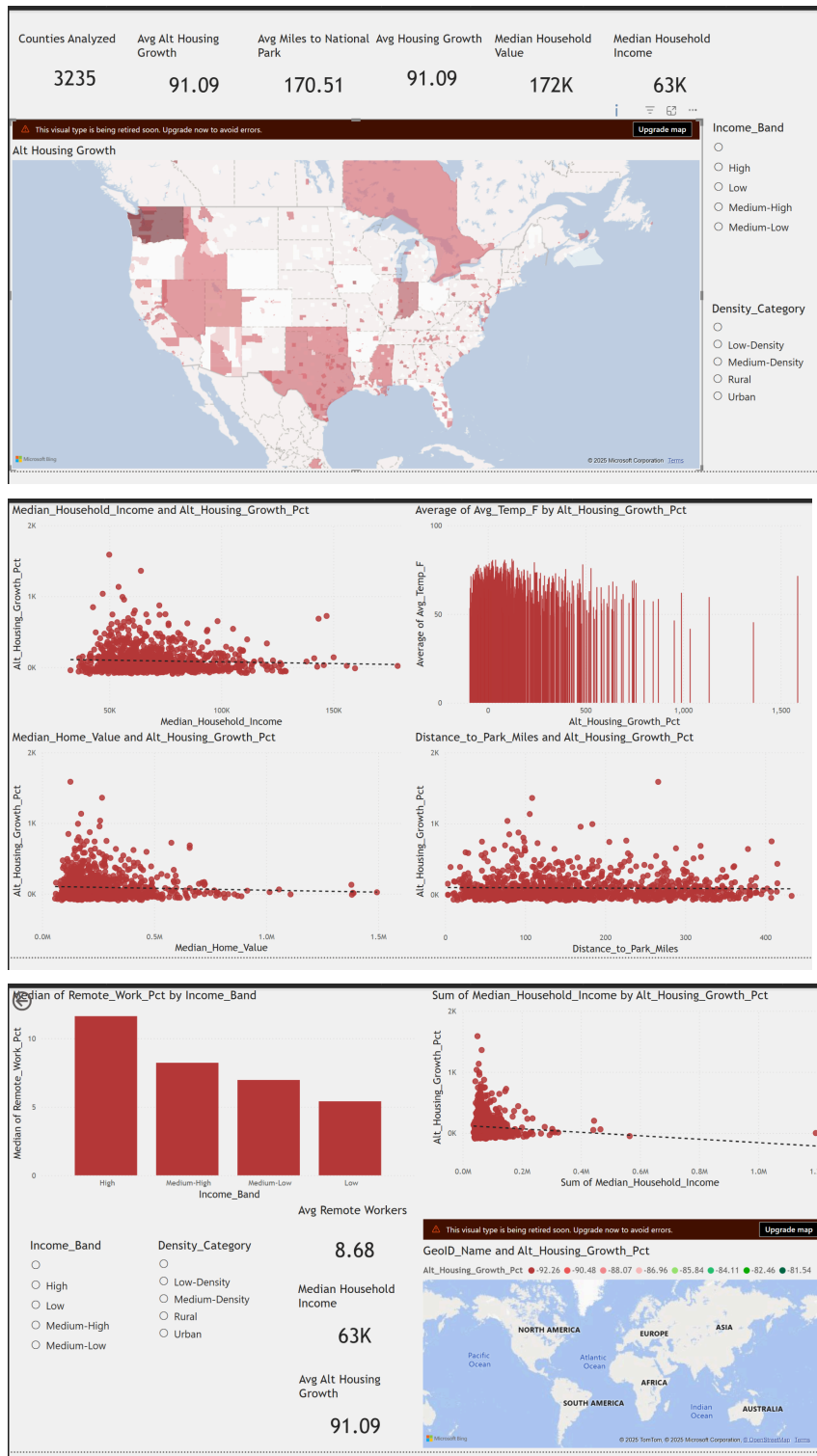
*These results are not perfect*





The pricing analysis shows that amenities matter for rental prices. More amenities generally mean higher prices. But bathrooms are the most important feature. (By almost nothing) RVs with bathrooms rent for slightly more than RVs without bathrooms.

## Power BI Dashboards



I created three Power BI dashboards to visualize the data. All three dashboards use the master\_dataset\_powerbi.csv file.

The first dashboard shows a map of the United States with counties colored by alternative housing growth. Users can see geographic patterns. Western states show more growth than eastern states. Counties near national parks show more growth.

The second dashboard displays all some scatter plots for the hypotheses. Users can see all the relationships at once.

The dashboards are interactive. Users can click on counties to see details. They can filter and explore the data themselves. This helps them understand the patterns and test their own questions.

## **Project Summary and Reflection**

This project taught me a lot about data analysis and working with real world data. I learned how to collect data from multiple sources, clean and merge datasets, calculate geographic distances, create visualizations, and build interactive dashboards.

The key findings are clear. Alternative housing growth is not random. It follows patterns based on county characteristics. Counties with higher incomes, lower density, higher housing costs, proximity to parks, moderate climates, and more remote workers show more growth. These factors work together to create favorable conditions for alternative housing.

I encountered several major challenges during this project. The first challenge was data collection. I had to access multiple APIs and download data from different government sources. Each source had a different format. Some had rate limits. Some required special parsing.

The second challenge was geographic calculations. Calculating distances between thousands of counties and dozens of parks takes time. I had to learn about the Haversine formula and how to implement it efficiently using NumPy.

The third challenge was data quality (*Massive problem for me*). Not all counties have alternative housing data. Only about 34% of counties have measurable growth. Many rural counties have zero alternative housing. I had to decide whether to exclude these counties or try to impute values.

The fourth challenge was creating meaningful visualizations. I wanted charts that clearly show the relationships. I experimented with different chart types. Scatter plots work well for continuous variables. Bar charts work well for categories. Box plots show distributions.

I learned several important lessons. First, data cleaning takes more time than analysis. I spent most of my time collecting and cleaning data. The actual regression analysis was relatively quick once the data was ready.

A good chart shows a relationship instantly. Numbers in a table are harder to interpret. Choosing the right chart type for each question is important.

Fourth, no single factor explains everything. Alternative housing growth is complex. It depends on multiple factors working together. Some factors are more important than others but they all contribute.

## **Real World Implications**

This project addresses real world problems that affect millions of Americans. Housing affordability is a crisis. Remote work is changing where people can live. Alternative housing offers solutions but we need to understand where and why it works.

## **Housing Affordability**

Housing costs have risen faster than wages in many parts of the country. Median home prices in some cities exceed \$500,000 or even \$1 million. Most people cannot afford these prices. Even with a mortgage, monthly payments are unaffordable for many families.

My analysis shows that high housing costs drive alternative housing adoption. Counties with expensive homes show more RV and van living. This suggests that alternative housing serves as an economic escape valve. When traditional housing is too expensive, people find alternatives.

This has implications for public policy. Policymakers often focus on building more traditional housing. But maybe they should also support alternative housing. This means investing in campgrounds. It means relaxing zoning restrictions that prohibit RV living. It means providing infrastructure like water and waste management.

Alternative housing won't solve the housing crisis by itself. But it can help. It provides an option for people who cannot afford traditional housing. It gives people more choices about how to live.

## **Remote Work and Location Independence**

Remote work changed the labor market. Before COVID, most office workers had to live near their workplace. This concentrated population in expensive cities. After COVID, many companies adopted permanent remote work policies. Workers can now live anywhere with internet access.

My analysis shows that counties with more remote workers show more alternative housing growth. This suggests that remote work enables alternative lifestyles. People are not just working from home. They are working from RVs. They are working from vans. They are traveling while working.

This has implications for economic development. Rural counties can now attract remote workers. They don't need to create local jobs. They just need to provide amenities Campgrounds and RV parks are infrastructure.

## **Transportation and Infrastructure**

Alternative housing creates new transportation and infrastructure needs. RVs and vans are vehicles. They need roads. They need parking. They need fuel. They need maintenance.

My analysis shows that campground density matters. Counties with more campgrounds show more alternative housing growth. This suggests that infrastructure enables this lifestyle. Without places to park, people cannot live in RVs.

This has implications for transportation policy. State and local governments need to invest in campgrounds. They need to maintain roads that can handle large RVs. They need to provide dump stations for waste. They need to provide water fill stations.

The National Park Service also plays a role. My analysis shows that proximity to national parks drives alternative housing growth. Parks attract RV residents. But parks have limited capacity. Campgrounds fill up quickly. The Park Service needs to expand capacity or manage demand better.

## **Contribution to Solving Real World Challenges**

My project contributes to solving real world challenges in several ways.

First, it provides data. Before this analysis, we did not have a comprehensive county level dataset on alternative housing growth. Now we do. This data can inform policy decisions and business strategies.

Second, it identifies patterns. We now know which county characteristics predict growth. This helps target interventions. Counties that want to attract RV residents know what factors matter. Manufacturers know where to focus their marketing and expansion efforts.

Third, it demonstrates methods. Other researchers can replicate my approach. They can extend it to other time periods or other variables. They can improve upon it. The code and documentation I created make this possible.

The housing affordability crisis is not going away. Remote work is not going away (**I am remote**). Alternative housing will continue to grow. (**My parents live in an RV, and travel the U.S**) My project helps us understand this phenomenon and prepare for the future.



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