

Room Type Distribution of Airbnb Listings in Buncombe County, North Carolina

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1. The Problem

Airbnb is an “internet-based service firm” that capitalizes on charging guests and hosts of short for short-term rental stays. Since its founding year in 2008, Airbnb has served over 50 million guests and has a market capitalization eclipsing over 30 billion USD¹. The first prototype launched in San Francisco and then quickly expanded rapidly to major cities around the world; as of now, there are over 100,000 cities with active Airbnb listings². As of 2020, there are approximately seven million properties listed worldwide. Revenue for the company is derived by charging guests 9-12% service fee as well as charging the host 3% to cover payment processing fees. The appeal of Airbnb over traditional short-term stays like hotels is the low-cost and nontraditional accommodations. However, the arrival of increasing Airbnb listings raises concerns about negative impacts on local housing costs, quality of life in residential neighborhoods, and employment quality in the hospitality industry³⁻⁴.

A recent cost-based analysis of Airbnb showed that an increased presence of Airbnb listings causes changes within the local housing supply, which in turn can cause significant price increases. The introduction and expansion of Airbnb in New York City showed a correlation to the nearly 400 dollars average housing cost raise seen in recent years. A Texas-based Airbnb study showed a difference in state coverage between traditional accommodations, like hotels, and Airbnb listing. In short, traditional accommodations have comprehensive coverage throughout the state of Texas and has pockets of highly dense airways correlating to urban regions. However, Airbnb listing has spotty coverage across Texas but has a broader coverage range across the metro area, including residential suburban regions². This study aims to explore the relationship between housing costs, poverty, and the spatial trend of Airbnb listings in Asheville, North Carolina. My hypothesis is that entire home apartment listings will dominate lower-income and high housing cost regions. In addition, I expect the distribution of Airbnb listings in Buncombe County, North Carolina, to follow previously reported trends. Airbnb listing data will be evaluated using North Carolina 2016 US Census tract data. Microsoft Excel will be utilized to depict and calculate total listing data for each variable.

2. Data Collection

Table 1. Layer Information Gathered

Layer Name	Data Type	Source	Spatial Reference	Metadata Info
Ashville_City_limits	Vector- Polygon Shapefile	The City of Ashville North Carolina Open Data	GCS WGS 1984	Outline of the city limits for Ashville, NC
nc_counties	Vector- Polygon Shapefile	North Carlina Department of Environmental Quality Online GIS	GCS NAD 1983	The layer features all 100 counties of North Carolina without shorelines included.
Census ACS 2016 Median Monthly Housing Cost	Vector- Polygon Shapefile	The City of Ashville North Carolina Open Data	GCS WGS 1984	American Community Survey from 2011-1015 - Median Monthly Housing Cost in Buncombe County
Buncombe County Streets	Vector- Line Shapefile	The City of Ashville North Carolina Open Data	GCS WGS 1984	Road locations and names in Buncombe County, North Carolina
Census ACS 2016 Poverty Status by Tract	Vector- Polygon Shapefile	The City of Ashville North Carolina Open Data	GCS WGS 1984	Percent Below Poverty in Buncombe County.
North Carolina (NC) Parks	Vector- Polygon Shapefile	ArcGIS Online Open Data- User: egwest	GCS WGS 1984	National and State Parks and Forests in NC
Ashville, NC Airbnb Listing	Microsoft Excel File (xlsx)	Inside Airbnb	----n./a-----	Latitude, longitude, and type of listing information was provided – October 19 2020
US Counties	Vector- Polygon Shapefile	ArcGIS Online Open Data	GCS WGS 1984	County and State Boundaries for the Continental United States (2017)

The data acquired by this study is described in Table 1. For the Buncombe County US 2016 Census data the extracted zip files were not altered. The North Carolina county layer was transformed from GCS NAD 1983 to GCS WGS 1984.

3. Data Preprocessing

Importing Excel Data to ArcMap: The Airbnb listing data utilized by this study was originally in excel file format. The following procedure was applied to convert the excel file to a shape file:

- 1) Remove empty cells and unnecessary data.
 - a. The data removed from the excel file was user reviews, average night stay, host name, host id, listing name and availability status.
- 2) The file was then converted to CSV (**Figure 1**).

A	B	C	D	E
latitude	longitude	room_type		
35.65146	-82.6279	Private room		
35.59779	-82.5554	Entire home/apt		
35.6067	-82.5556	Entire home/apt		
35.57864	-82.5958	Entire home/apt		
35.61442	-82.5413	Private room		
35.61856	-82.5528	Entire home/apt		
35.58345	-82.5971	Private room		
35.59635	-82.5066	Private room		
35.61929	-82.4811	Entire home/apt		
35.55537	-82.5354	Entire home/apt		
35.64453	-82.5259	Entire home/apt		
35.58217	-82.6	Entire home/apt		
35.49111	-82.4844	Entire home/apt		
35.60182	-82.5617	Entire home/apt		
35.56118	-82.5778	Entire home/apt		
35.60371	-82.5562	Private room		
35.61115	-82.5438	Entire home/apt		
35.60075	-82.5539	Entire home/apt		

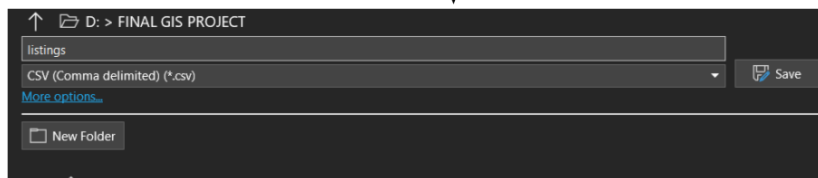


Figure 1. Modified excel (xlsx) file exported as a CSV file

- 3 The file must be added to ArcGIS via the add data button to convert the CSV file to XY Data.
- 4 Right-click on the Airbnb listing layer name. Click on the Display XY Button in the resulting menu. This button will convert the CSV file to XY Data. This process is depicted in **Figure 2**.
- 5 In the Display XY Data Tool select the appropriate attributes to correspond to the X and Y field. The listing data provided uses longitude as the x field and latitude as the Y field. This allows for the visualization of each listing. Choose the appropriate coordinate system; in this case, GCS WGS 1984 was selected.

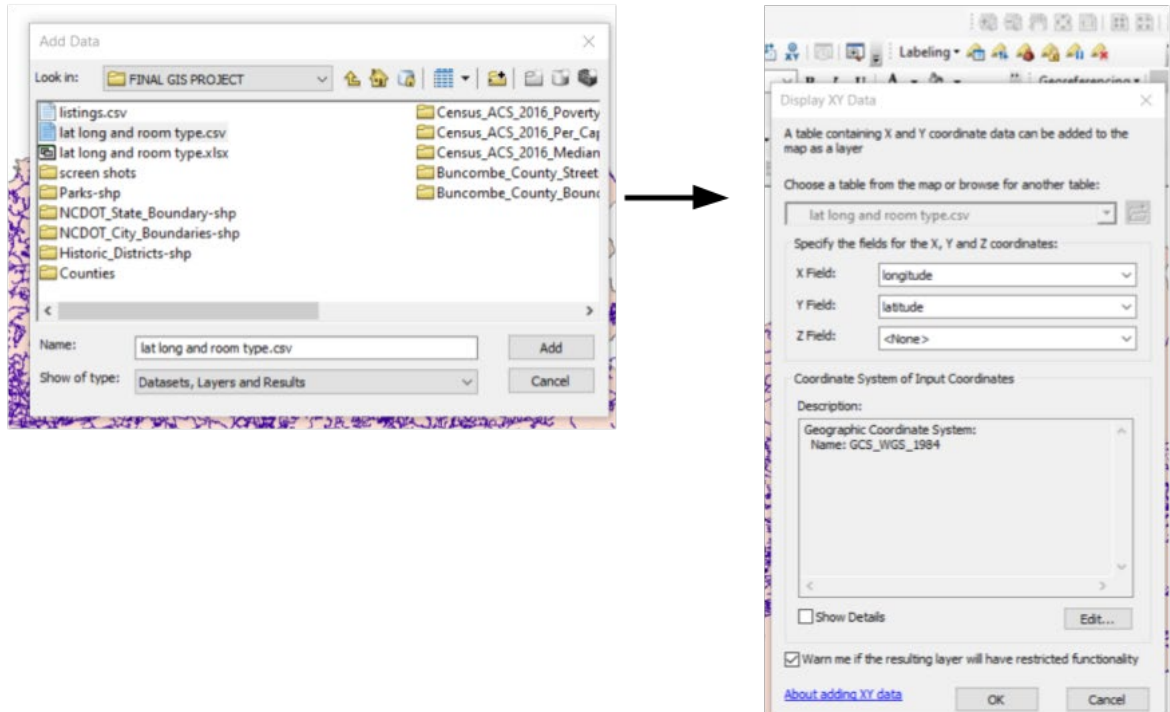


Figure 2. Converting the listing CSV file into XY data in ArcGIS

- 6 The XY data layer created cannot be queried or altered. The layer must be exported to a shapefile.
 - a. Right-click on the listing XY layer
 - b. Click on Data and then Export Data to create a shapefile (Figure 3). An Export Data dialog window will result.
 - c. Export all features from the layer and use the same coordinate system as the layer's source data. This process will create a new feature class.
 - d. After converting to a shapefile, delete the original CSV data layer and the XY listing layer.

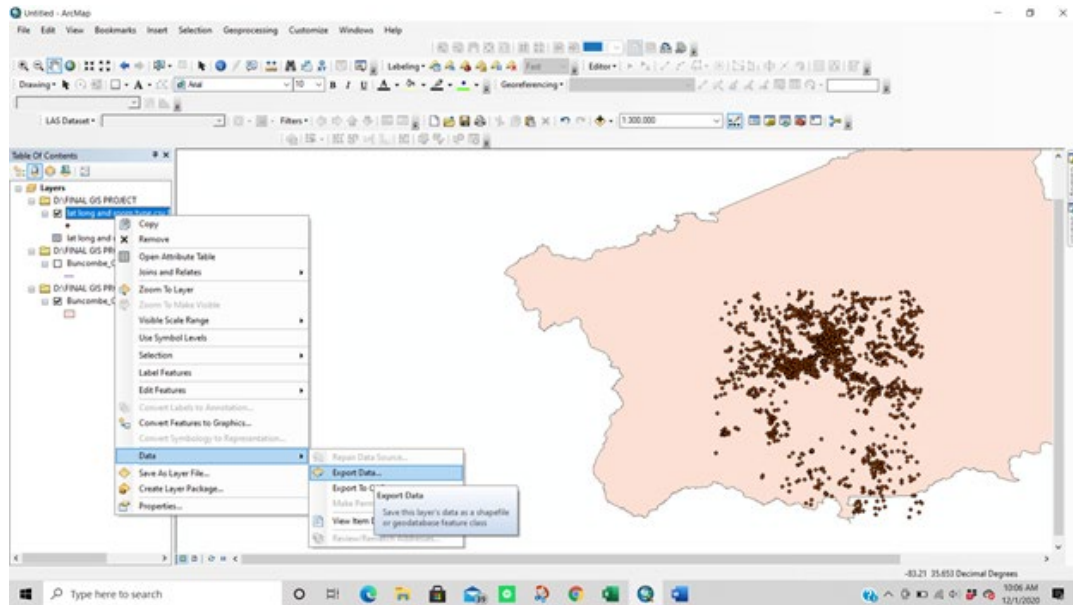


Figure 3. Converting XY Airbnb listing layer into a new shapefile (feature class)

- 7 The symbology of the new feature class should be altered to depict the different listing types. Right click on the layer name → click Properties → In the symbology tab click on the categories side bar → click on unique values → in the drop-down menu select room type → click on add all values and then change the symbology to an appropriate color scheme
 - a. This study used the Dark Glazes color ramp

Downloaded Data: No other preprocessing technique was used for the shapefiles employed in the study. All shapefiles other than the North Carolina county layer already had the appropriate coordinate system projection. The shapefile utilized were compressed files and had to be extracted prior to being added into the ArcCatalog folder for this project.

4. ArcGIS Processing

4.1 Median Monthly Housing Data:

1. Use the Symbology tab to change the Median Monthly Housing ranges
 - a. Click on the Symbology tab of the layer. Under the 'Quantities' section change the field value to median_mon. The default classification scheme uses equal intervals as the division for ranges.
 - b. Change the classification scheme by clicking on the classify button. This button allows the user to change the classification scheme based on method and number of classes.
- Figure 4.** illustrates the classification scheme used for the Median Monthly Housing layer.

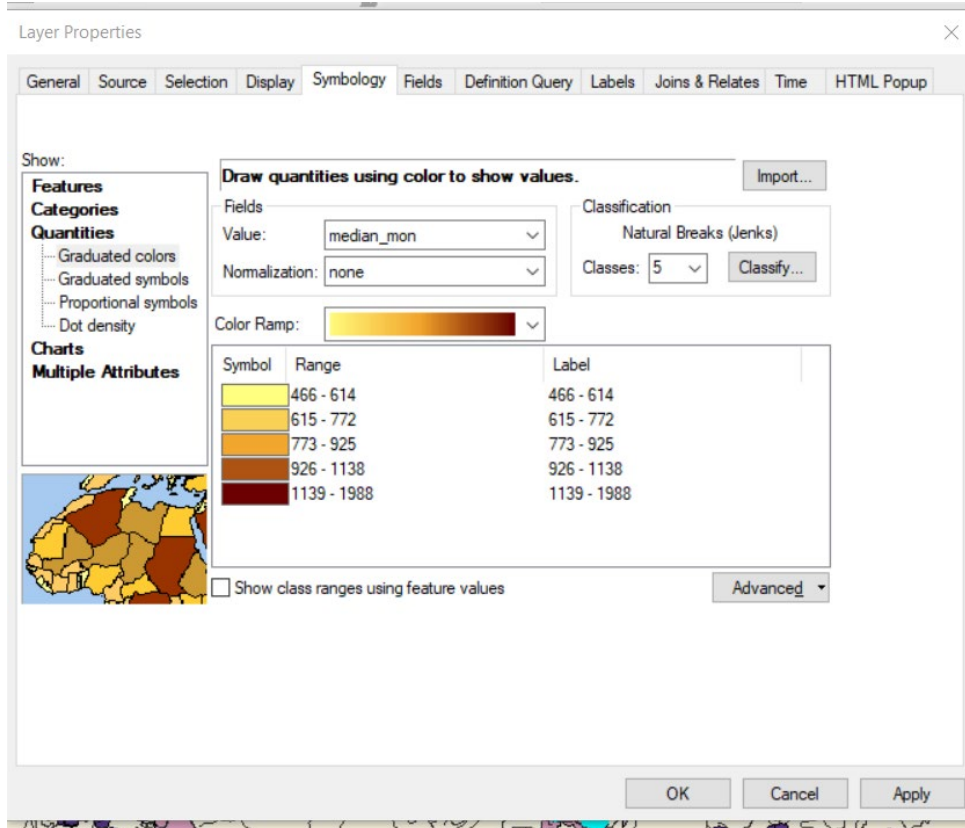


Figure 4. Classification scheme used to depict the median monthly income census tract data.

2. Use the Selection tool to quantify the total listing type for each median monthly income class
 - a. “Select by Attribute” tool for selecting individual median monthly income classes
 - i. Use the Selection Tab at the top of the directory panel and click on the “Select by Attributes” tool (**Figure 5**)

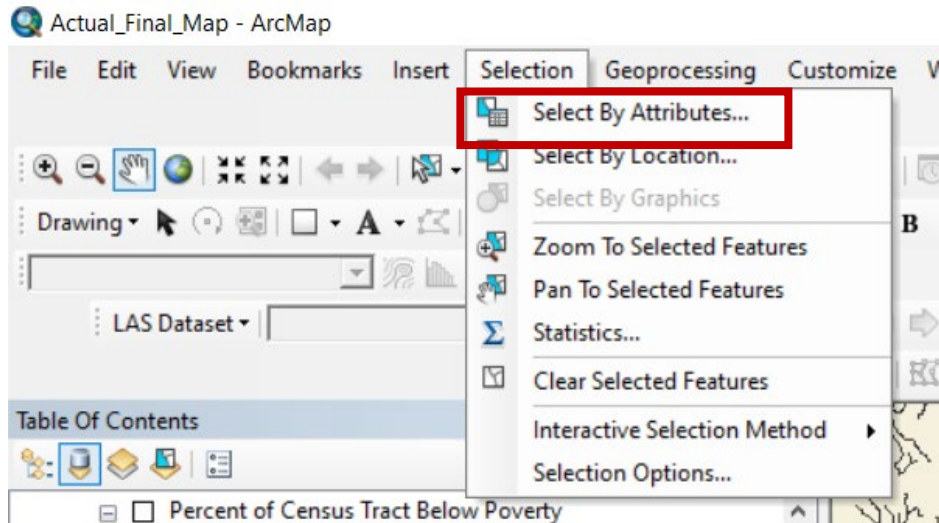


Figure 5. Select by Attribute tool is located under the Selection dropdown menu.

- ii. Choose the Median Monthly Housing layer to perform the selection against
- iii. Select the median_mon field and click “Unique Values” to create a query expression that selects for the census tracts that are in each specific monthly housing range.
- iv. Use the expression building tools \geq and \leq to select a specific housing range. The expressions used to select for each range are shown in Table 2.

Table 2. Query Expressions Used to Select for Specific housing Cost Ranges

Range in USD	Expression
466-614	"median_mon" \geq 466 AND "median_mon" \leq 614
615-772	"median_mon" \geq 615 AND "median_mon" \leq 722
773-925	"median_mon" \geq 772 AND "median_mon" \leq 925
926-1138	"median_mon" \geq 925 AND "median_mon" \leq 1138
1139-1988	"median_mon" \geq 1138 AND "median_mon" \leq 1988

- v. Each range has to be selected for in order to use the select by location tool to quantify Airbnb listings per selected census tract. A successful query expression for the 466-614 USD median monthly housing cost range is shown in **figure 6**.

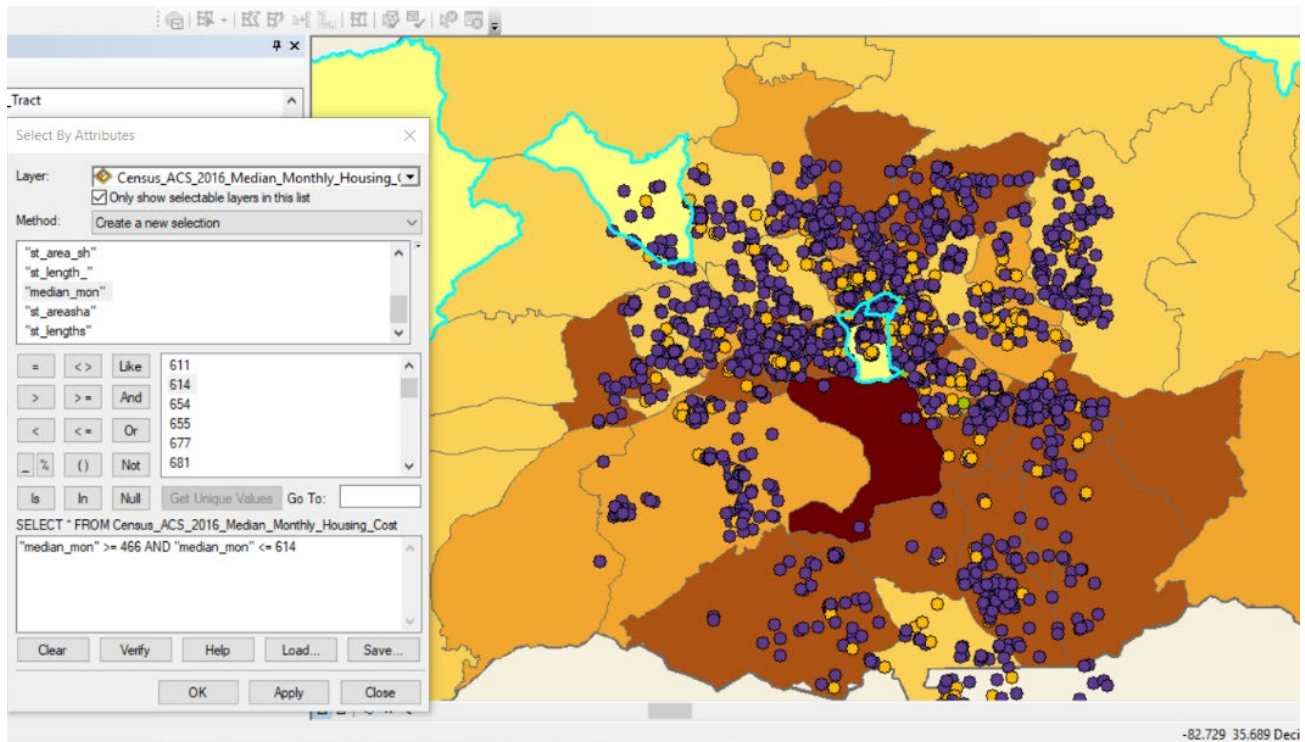


Figure 6. Using the Select by Attribute tool to select for specific census tracts that fall in between the classified ranges

- b. “Select by Location” tool for selecting Airbnb listings within the selected income ranges
 - i. Use the Selection Tab at the top of the directory panel and click on the “Select by Location” tool
 - ii. Choose the “select features from” selection method in the dialog box
 - iii. In the Target Layer(s) selection box, select for the Airbnb listing shapefile
 - iv. Choose the Census ACS 2016 Median Monthly Housing Cost layer as the source layer
 - v. Use the dropdown menu to select the “are completely within the source layer feature” in order to specify the spatial selection method for the target layer.
 - vi. Click apply. Selection of Airbnb listings using this method for the 466-614 USD median monthly housing cost range is shown in **figure 7**.
 - vii. This process was completed for every Median Monthly Housing Cost range.

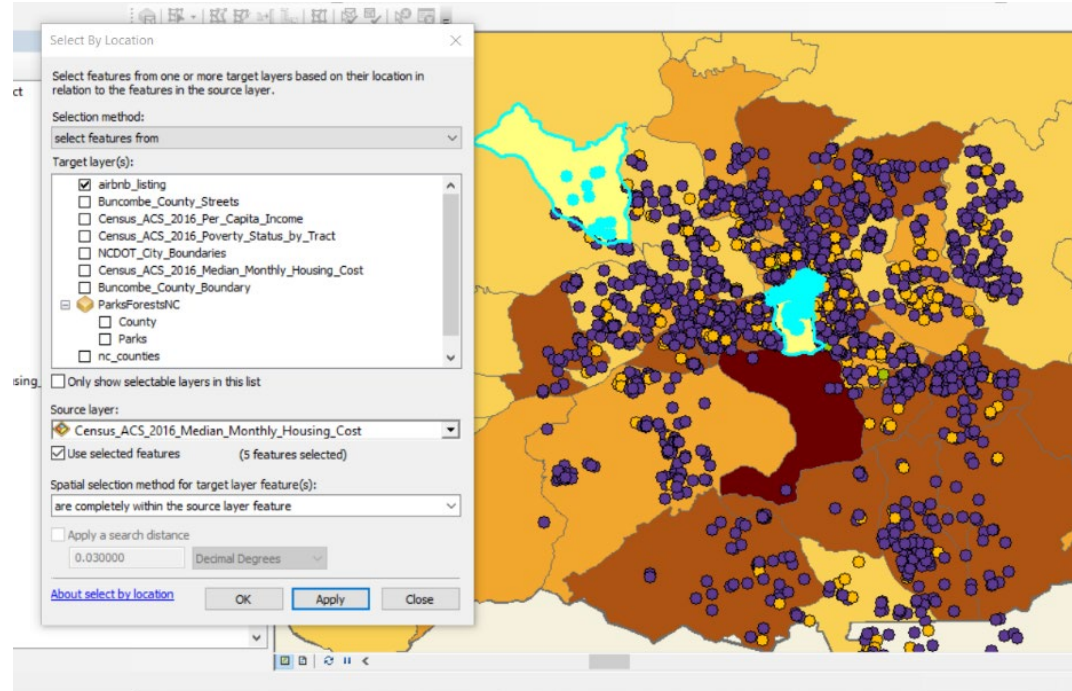


Figure 7. Using the Select by Location tool to select for Airbnb listing within the selected census tracts.

- c. Summarizing Airbnb listing type for each attribute
 - i. Right click on the Airbnb Listing layer name and click attribute table.
 - ii. Summarize the selected Airbnb listings and export to excel.
 - iii. A 2D bar graph was made to summarize the difference of listing type (Entire home/apartment, Hotel, Private Room, and Shared room).

4.2 Census ACS 2016 Poverty Status by Tract Data:

3. Use the Symbology tab to change the Census ACS 2016 Poverty Status by Tract layer
 - a. Right click on the layer name to change the symbology of the layer. Change the default unique value type from total population to percent below poverty.
 - b. Right click on the label heading under the unique value tab. The number format dialog box will change the default decimal values to percent values, this is shown in **Figure 8**.

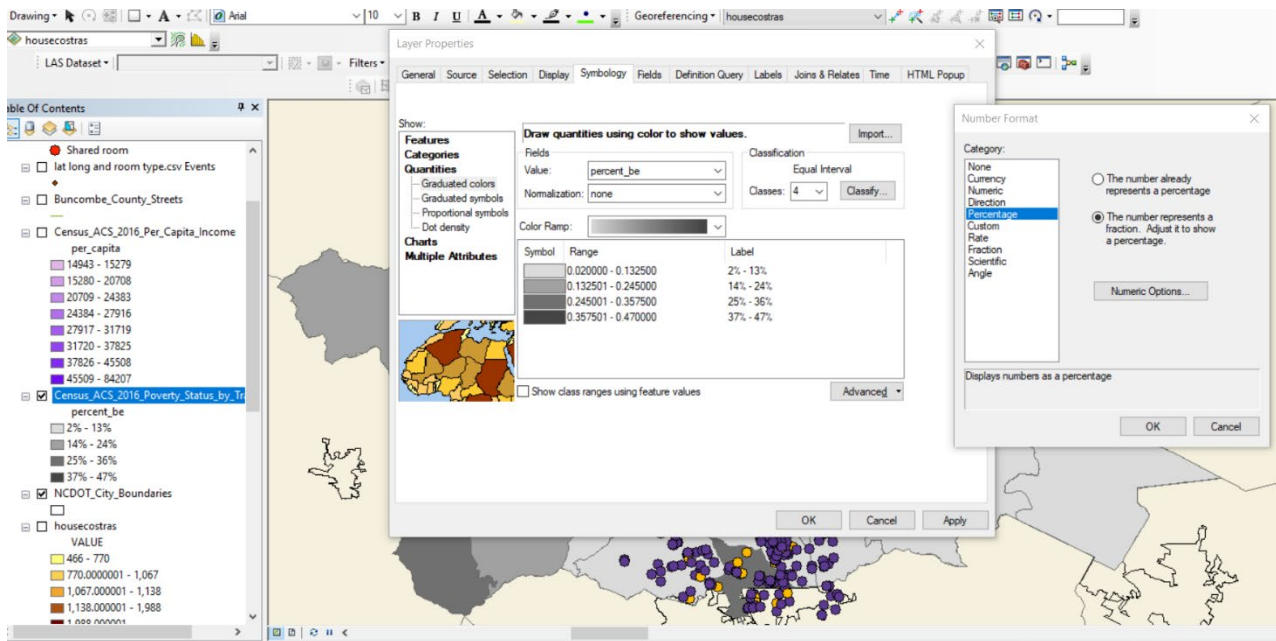


Figure 8. Changing the symbology to depict percent population that live below the poverty line. Percent is calculated by the population within each corresponding census tract.

4. Use the Selection tool to quantify the total listing type for percent range of census tract below poverty.

c. The procedure for selection follows the steps in 2a for utilizing the “Select by Attribute” tool for selecting percent of population living below the poverty line.

d. **Table 3** shows the query expression used to select census tracts that corresponds to the specific classes of percent below poverty.

Table 3. Query Expressions for Select by Attribute tool for Percent Below Poverty Layer.

Range	Expression
2-13%	percent_be" >= 0.02 AND "percent_be" <= 0.12 for)
14-24%	percent_be" >= 12.03 AND "percent_be " <= .249
25-36%	"percent_be" >= 0.25 AND "percent_be" <= 0.28999999999999998
37-47%	7)percent_be" >= 12.03 AND "percent_be " <= .249

e. The procedure used to employ the “Select by Location” tool for selecting Airbnb listings within the selected percent below poverty classification followed the detailed steps previously described in 2b. The source layer is the only setting that changes (**Figure 9**)

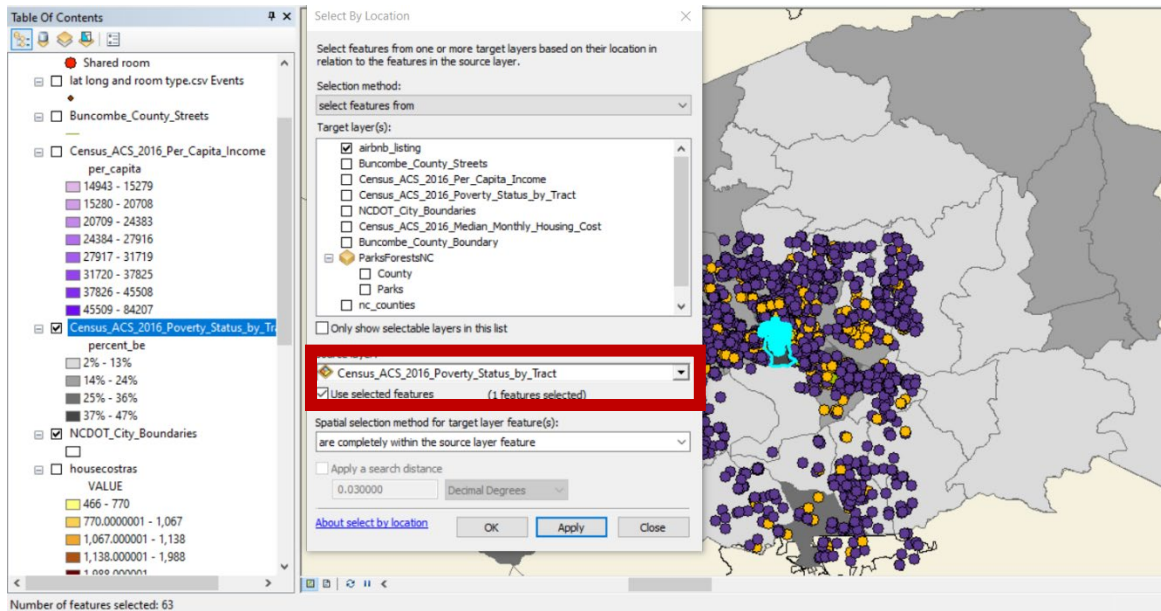


Figure 9. Alterations made to previously described steps 2b are depicted by the red box

f. Summarizing statistics were calculated following the steps in 2c.

5. Using the “Select by Location” tool to investigate Airbnb listing coverage across Buncombe County
 - a. The following layers will be activated to depict any observed trends: Asheville, NC Airbnb Listing and Asheville City Limits
 - b. As previously mentioned, the only alteration necessary to select for Airbnb listings inside a specific layer is changing the source layer name.
 - i. **Figure 10.** highlights the parameters necessary to employ the “Select by Location” tool to summarize total listings inside and outside Asheville city limits
 - ii. **Figure 11.** illustrates the resulting summary table after selection

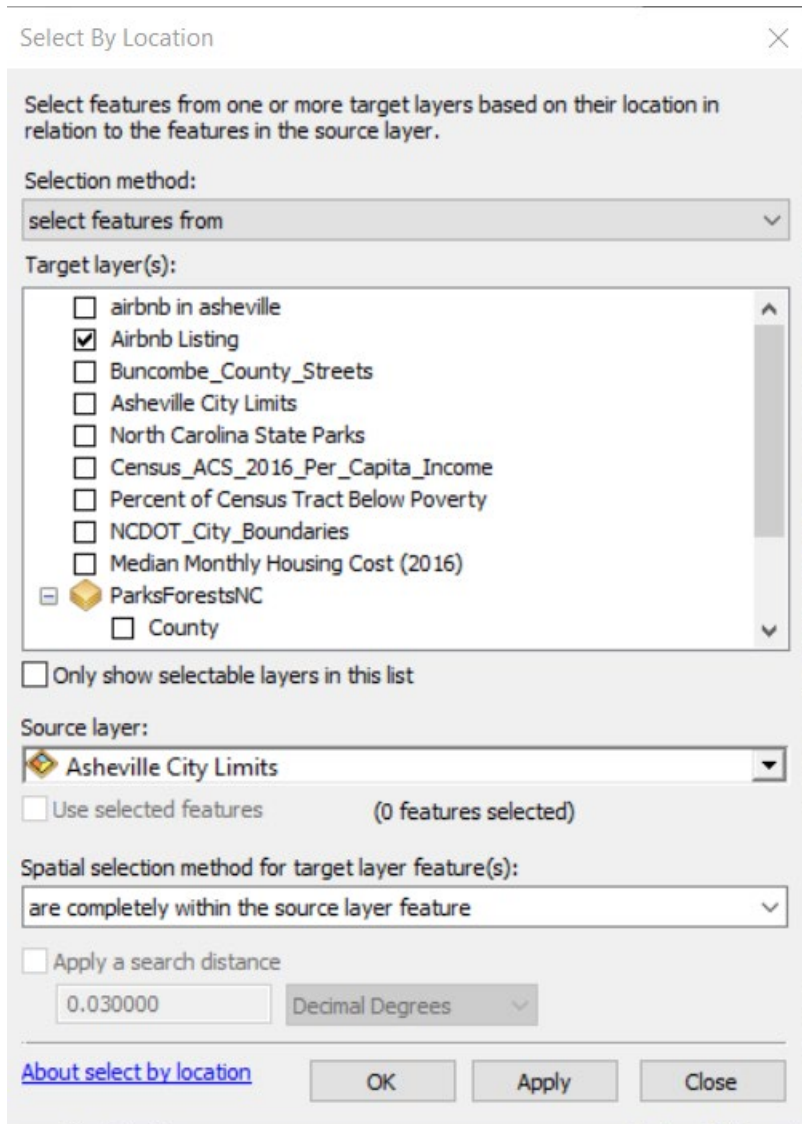


Figure 10. Utilizing the Select by Location to measure total listing inside and outside Asheville City Limits

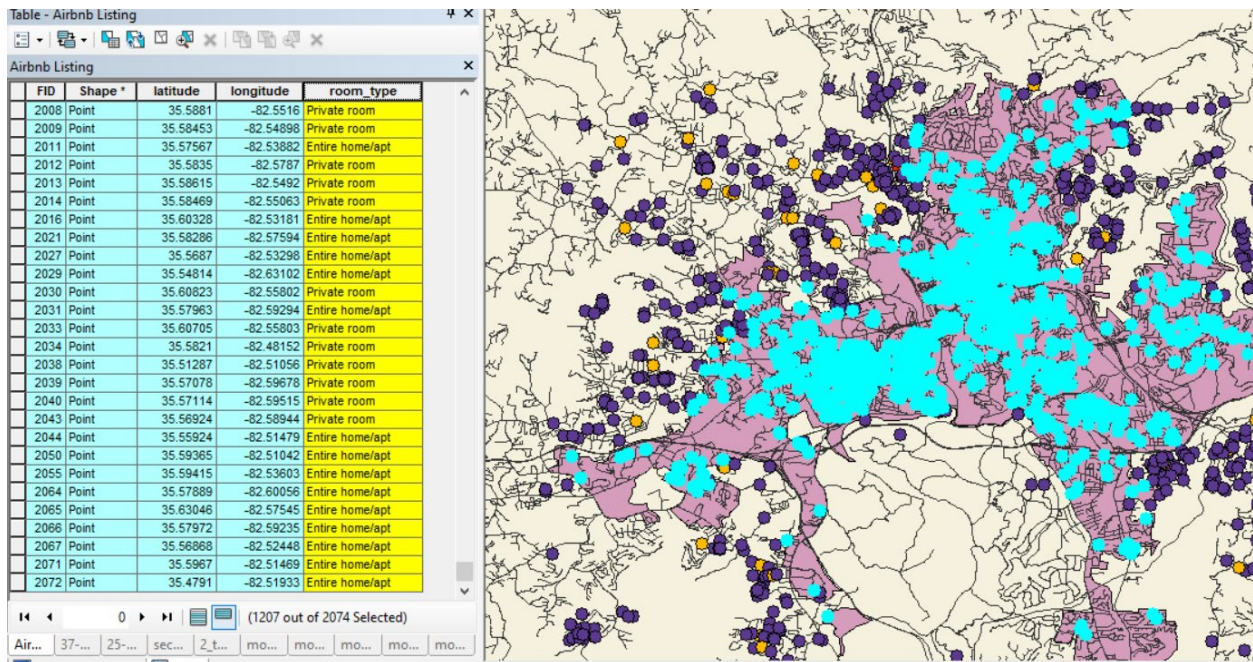


Figure 11. Summary Table of selected Airbnb listings within the city limits of Asheville

6. Investigating Buncombe county Airbnb listings in relation to recreation activities (State and National Parks)
 - a. Clipping the North Carolina State and National Park layer to the North Carolina State Boundary layer
 - i. The clip coverage (analysis) tool was used to clip the park features from the NC Park layer based on the NC State boundary layer
 - ii. The layer used for input features was the Parks shapefile from the NC Park folder (**Figure 12**)
 - iii. The NC State boundary layer was used to define the clipping features of the new shapefile (**Figure 12**)

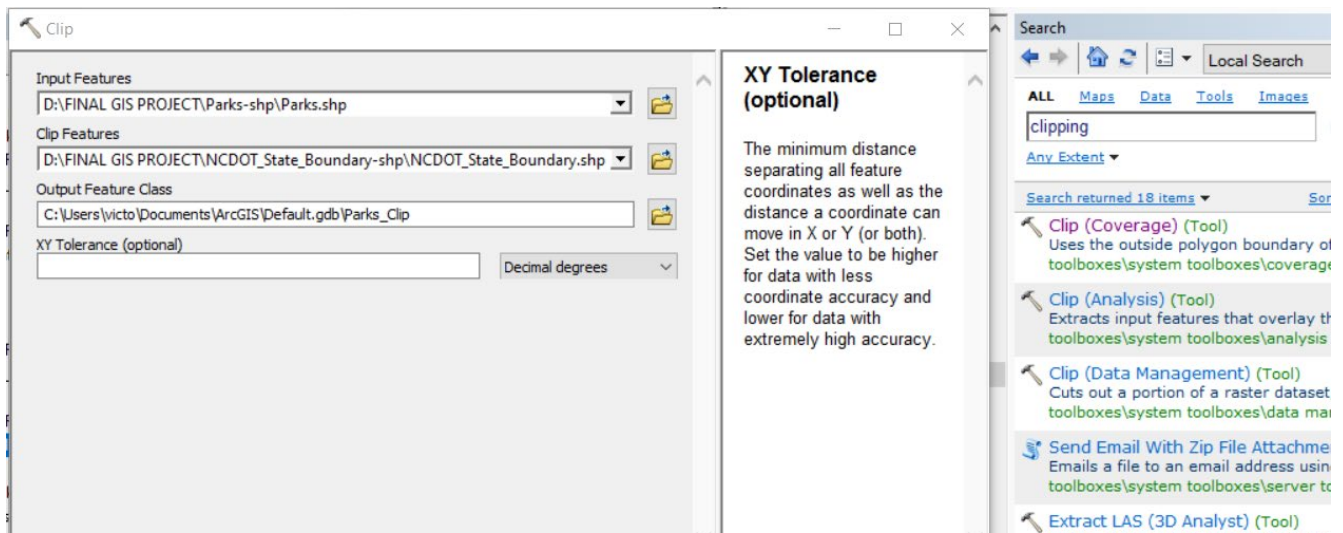


Figure 12. Clipping features used to create a new shapefile that contains state and national parks within the State of North Carolina

- b. The visual distribution of Airbnb listings in respect to national and state park regions was investigated. There was no observed trend in the distribution, this can be seen in **Figure 13**.

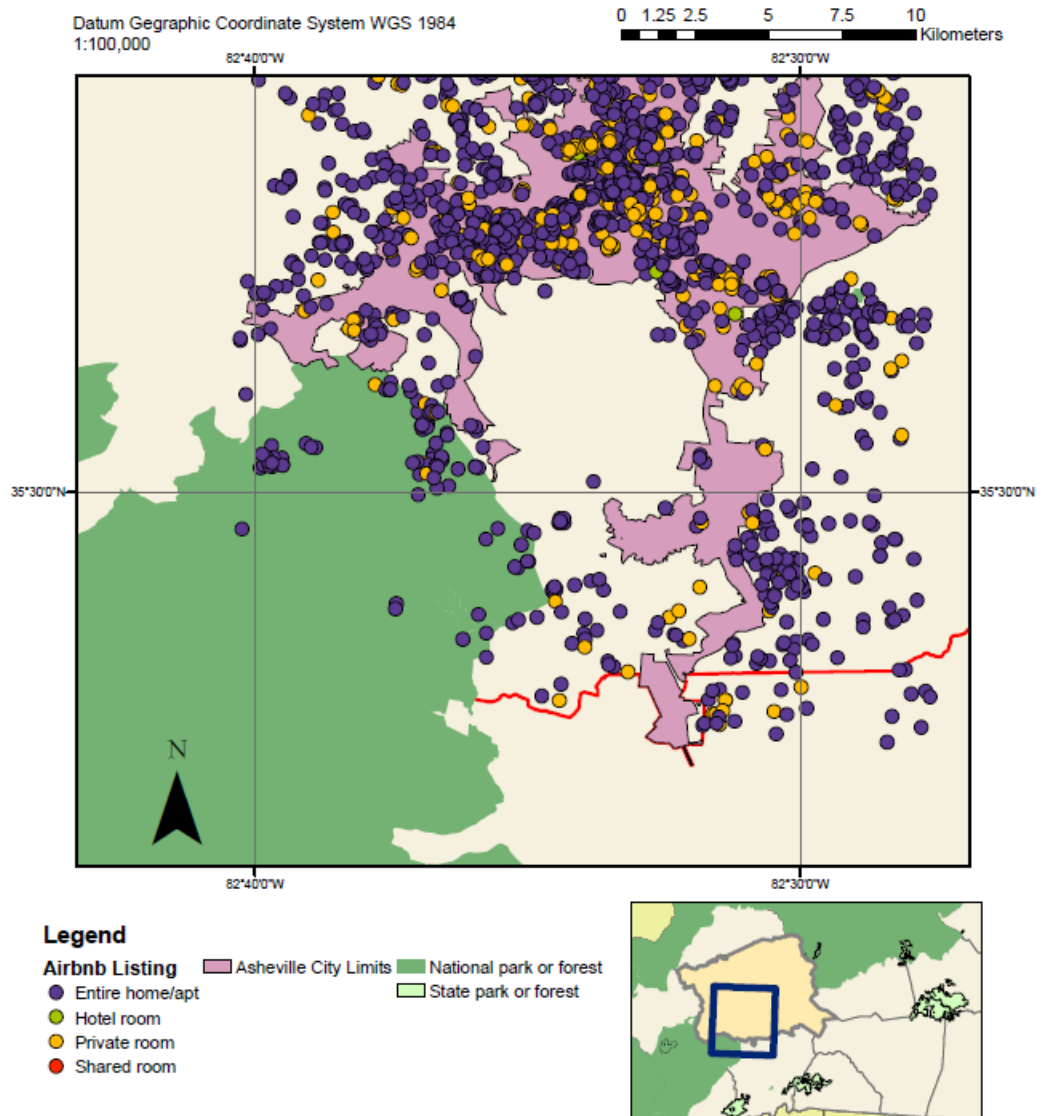


Figure 13. Distributions of Airbnb listings near National and State Parks in Buncombe County

5. Results

Airbnb Listing Distribution and Median Monthly Housing Cost for Buncombe County, NC

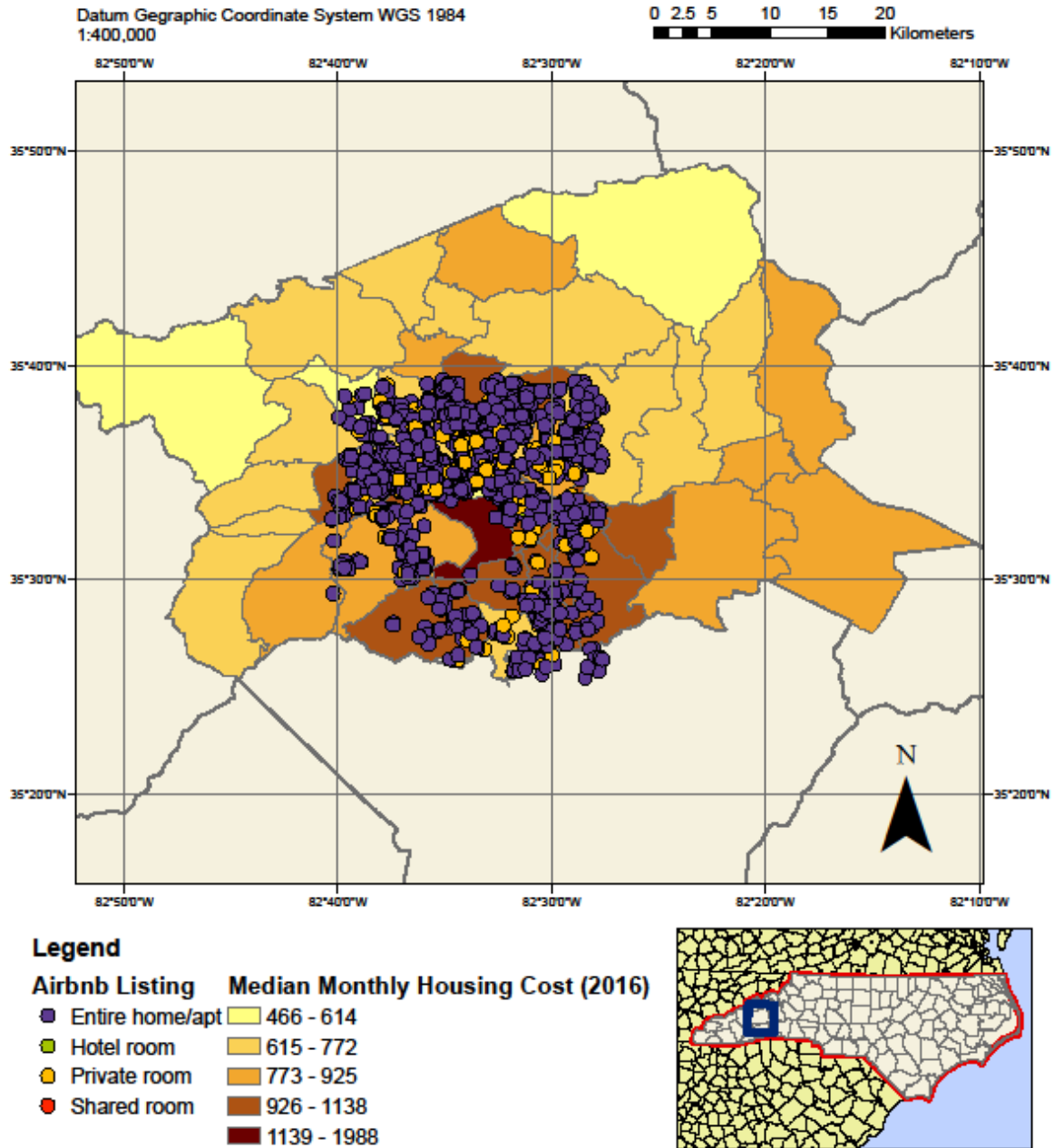


Figure 14. Airbnb Listing Distribution and Medial Monthly Housing Cost for Buncombe County, NC. There were 3281 total Airbnb listings.

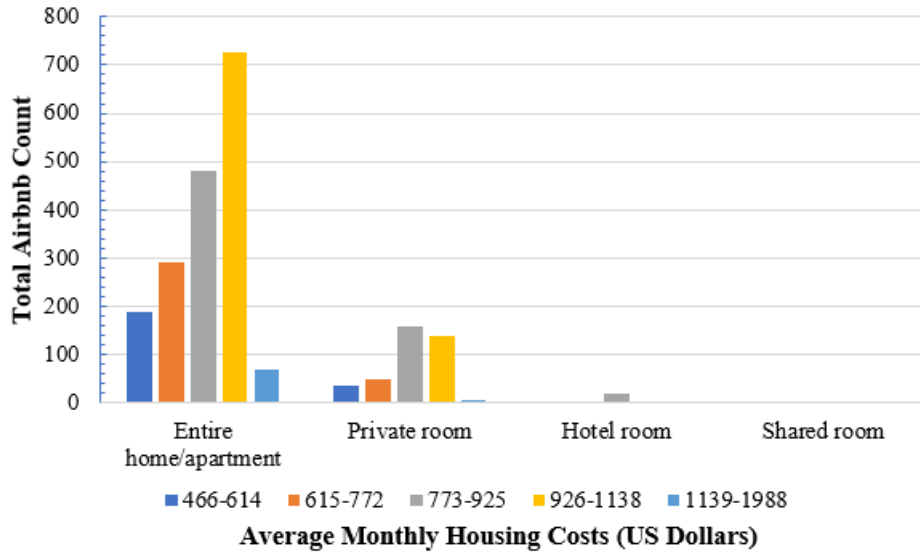


Figure 15. The Distribution of Different Room types in Relation to the Average Monthly Housing Costs for Buncombe County, NC

Airbnb Listing Distribution and Percent Below Poverty for Buncombe County, NC

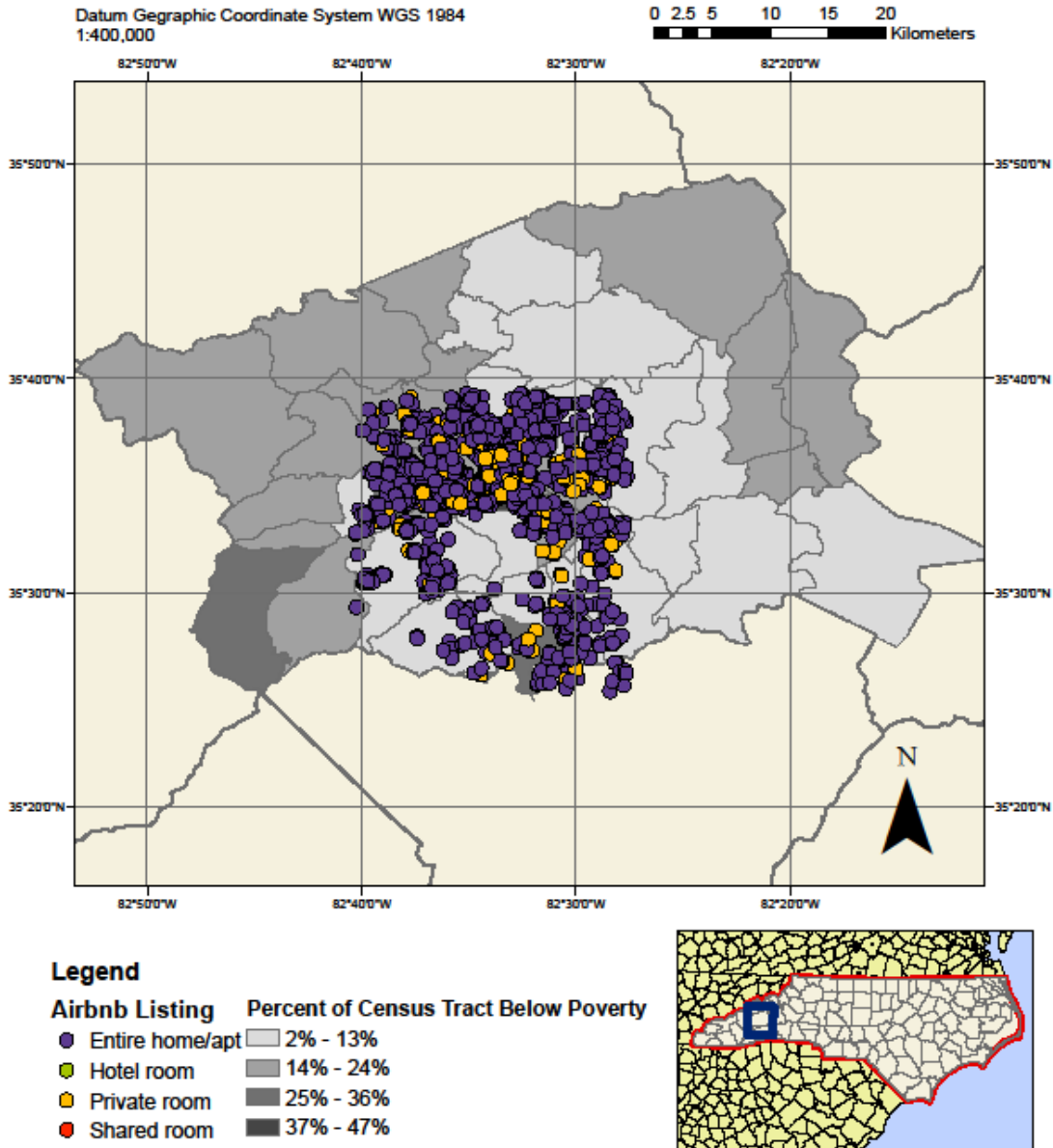


Figure 16. Airbnb Listing Distribution and Percent Population Below Poverty for Buncombe County, NC. There were 3281 total Airbnb listings.

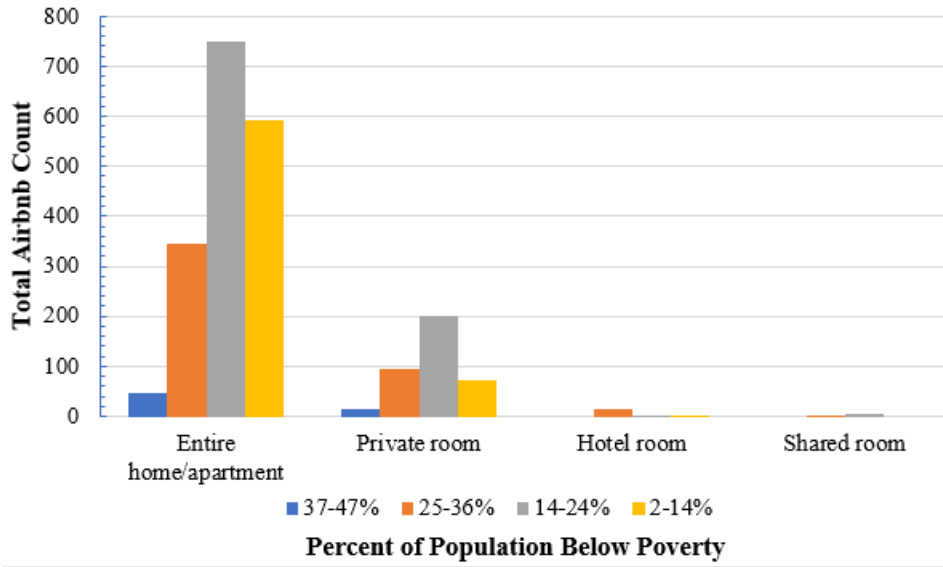


Figure 17. The Distribution of Different Room types in Relation to the Percent of Population Living Below the Poverty Line for Buncombe County, NC

Airbnb Listing Distribution Inside Asheville, NC City Limits

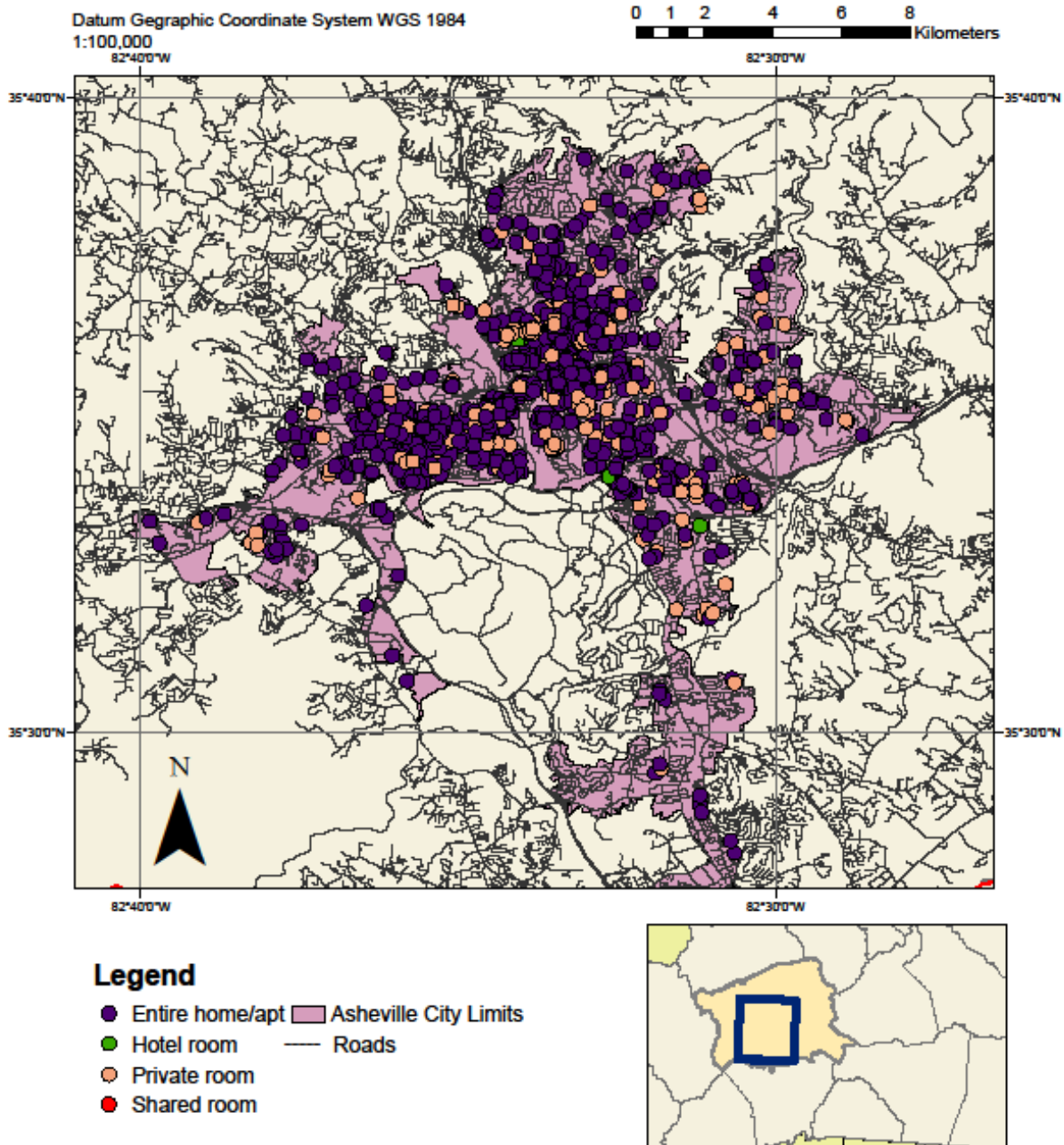


Figure 18. Distribution of Airbnb listings inside the city limits of Asheville, NC.

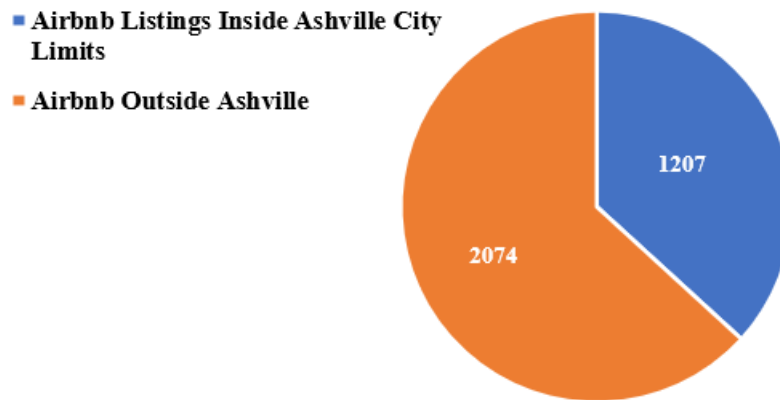


Figure 19. The number of Airbnb listings inside Asheville City Limits and total listings in Buncombe County, NC

6. Conclusion

A potential cost imposed by an increase in Airbnb listings is in the form of higher housing costs for residents. Entire house/apartment listings are detrimental as they decrease the supply of long-term housing options and increase housing costs for potential residents. There are more entire home/apartment listings in low to mid-range monthly housing cost tracts (**Figure 14**). In regions where the average monthly housing costs range from 926-1138 USD, entire home/apartment listings are dominant (**Figure 15**). This suggests that users that once lived in a high/mid monthly housing cost region are no longer long-term dwellers. More impoverished census tracts are less likely to use Airbnb as a form of income (**Figure 16**). Entire home apartment listings are more likely to be posted by users in wealthier areas. Regions where a high (37-47%) population of residents live below the poverty line, earning an annual income of less than 25,465, are less likely to list a full house/apartment on Airbnb (**Figure 17**). In general, Asheville residents that pay an average monthly rent between 926-1138 and residents in regions where the percent of the population living under poverty is from 14-24%, are the residents most affected by the increased usage of Airbnb in Buncombe County, NC.

The spatial distribution of Airbnb postings in Buncombe County follows similar trends observed in recent studies. Airbnb listings are more dominant in more suburban residential areas that lie on the outskirts of the Asheville city limits (**Figures 18-19**). There is a dense cluster of the entire home and apartment listings near Asheville's downtown region (**Figure 18**). Buncombe County is a unique geographic area. Asheville, NC, is known as a picturesque mountain town for tourists. Not only is there a lively downtown area but the county has direct access to the Blue Ridge Mountain range. However, there is no spatial relationship between Airbnb listings and close access to national and state parks (**Figure 13**).

Through the application of ArcGIS, I was able to illustrate and quantify the relationship between different Airbnb Listing types and socioeconomic factors. “Internet-based service firms,” like Airbnb, are becoming more prominent today. However, these services can indirectly and directly impact the livelihood of residents. Future work should research the average availability date for entire homes/apartments in Asheville, NC, and monitor the monthly housing cost increase in Buncombe, NC, as Airbnb popularity soars.

7. Citations

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