

## **Housing Rental Analysis**

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DATA 230 – Data Visualization

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December 06, 2022

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## 1. Introduction

Data visualization is a graphical depiction of data that facilitates human information interpretation and insight-gathering. Making it easier to see trends in the dataset is the primary objective. The following actions to enhance data knowledge are better-understood thanks to visuals, which is another advantage. A house rental dataset was chosen for this project to explore, evaluate, and obtain insights. The dataset was visualized using Tableau 2022.2, which will help create bar charts, line graphs, scatter plots, geospatial and tables. There are specific steps to be adhered to before visualizing the data:

- Have a clear understanding of the objective and goal of this project by asking the right questions.
- Prepare the data by cleaning, checking for nulls, removing duplicate observations, dealing with missing values, and checking for data types.
- Analyze the data to pick charts or graphs to convey the information to the stakeholders.
- Share the obtained insights with the stakeholders and act on them.

The objective of this project is to find out the regions in the USA that have a higher rental price and what kind of amenities drive the increase in the rental price of the house. The steps will be followed to attain the information to help the organization build its rental company.

## 2. Dataset Description

The dataset for this project was found on Kaggle, created by user Rekib Ahmed. The domain of this dataset is public and was initially collected by Austin Reese collected the dataset on 2020-01-07; the dataset source was Craigslist.org. The dataset contains records of the house,

rental price, and different characteristics such as the number of bedrooms, bathrooms, parking, and laundry available that will help determine the cost of the rental house.

It comprises 265190 house records with 22 columns. Analyzing such factors and identifying trends can help develop business decisions that will help stakeholders make informed decisions. Figure 1 below shows a sample of the records present in the housing rental data.

**Figure 1**

### Rental Dataset

<b>id</b>	<b>url</b>	<b>region</b>	<b>region_url</b>	<b>price</b>	<b>type</b>	<b>sqfeet</b>	<b>beds</b>	<b>baths</b>	<b>cats_allowed</b>	<b>dogs_allowed</b>	<b>smoking_allowed</b>	<b>wheelchair_access</b>	<b>electric_vehicle_charge</b>	<b>comes_furnished</b>	<b>laundry_options</b>	<b>parking_options</b>	<b>image_url</b>	<b>description</b>	<b>lat</b>	<b>long</b>	<b>state</b>	
703961605	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	1199	apartment	1908	3	2	1	1	1	1	0	0	0	0	0	laundry on site	street parking	<a href="https://images.craigslist.org/00LO1_80pNw">https://images.craigslist.org/00LO1_80pNw</a>	Apartments In Birmingham AL Welcome to 10	33.4226	-86.7065	al
7041570853	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	1120	apartment	1319	3	2	1	1	1	1	0	0	0	0	0	laundry on site	off-street parking	<a href="https://images.craigslist.org/00707_ur7y9">https://images.craigslist.org/00707_ur7y9</a>	Find Your Way to Haven Apartment Homes C	33.3755	-86.8045	al
7041566934	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	825	apartment	1133	1	1.5	1	1	1	1	0	0	0	0	0	laundry on site	street parking	<a href="https://images.craigslist.org/00h0h_b78d">https://images.craigslist.org/00h0h_b78d</a>	Apartments In Birmingham AL Welcome to 10	33.4226	-86.7065	al
7041566936	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	800	apartment	927	1	1	1	1	1	1	0	0	0	0	0	laundry on site	street parking	<a href="https://images.craigslist.org/00808_6ghz8">https://images.craigslist.org/00808_6ghz8</a>	Apartments In Birmingham AL Welcome to 10	33.4226	-86.7065	al
7041566888	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	785	apartment	1047	2	1	1	1	1	1	0	0	0	0	0	laundry on site	street parking	<a href="https://images.craigslist.org/00j0y_21c0f">https://images.craigslist.org/00j0y_21c0f</a>	Apartments In Birmingham AL Welcome to 10	33.4226	-86.7065	al
7041566888	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	900	apartment	1298	2	2	1	1	1	1	0	0	0	0	0	laundry on site	street parking	<a href="https://images.craigslist.org/00606_g791c">https://images.craigslist.org/00606_g791c</a>	Apartments In Birmingham AL Welcome to 10	33.4226	-86.7065	al
7041566702	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	925	apartment	1350	2	2	1	1	1	1	0	0	0	0	0	laundry on site	street parking	<a href="https://images.craigslist.org/00505_cA83">https://images.craigslist.org/00505_cA83</a>	Apartments In Birmingham AL Welcome to 10	33.4226	-86.7065	al
7041564185	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	1085	house	2308	3	2	1	1	0	0	0	0	0	0	0	w/d hookups		<a href="https://images.craigslist.org/00000_g4BE">https://images.craigslist.org/00000_g4BE</a>	This is a NEW and LARGE 3BR, 2BTH renovation!!!	33.0969	-86.7601	al
7041560353	<a href="https://bham.craigslist.org/birmingham">https://bham.craigslist.org/birmingham</a>	1269	apartment	1156	3	2	1	1	1	1	0	0	0	0	0	w/d in unit		<a href="https://images.craigslist.org/00a0a_ITBgt">https://images.craigslist.org/00a0a_ITBgt</a>	Perfect Location and a Perfect Price!!! Come	33.4237	-86.8015	al

The sample of the rental dataset in figure 1 gives an idea of the values in each column.

Figure 2 shows the list of columns that are present in the dataset.

**Figure 2**

### Columns Present in Rental Dataset

```
rental_csv.columns
Index(['id', 'url', 'region', 'region_url', 'price', 'type', 'sqfeet', 'beds',
       'baths', 'cats_allowed', 'dogs_allowed', 'smoking_allowed',
       'wheelchair_access', 'electric_vehicle_charge', 'comes_furnished',
       'laundry_options', 'parking_options', 'image_url', 'description', 'lat',
       'long', 'state'],
      dtype='object')
```

A list of all the columns present in the dataset is explained,

1. Id: Listing id
2. url: Listing URL
3. region: Craigslist region

4. region\_url: Region URL
5. price: Rent per month (Target Column)
6. type: Housing type
7. sqfeet: Total square footage
8. beds: Number of bedrooms
9. baths: Number of bathrooms
10. cats\_allowed: Cats allowed Boolean (1 = yes, 0 = no)
11. dogs\_allowed: Dogs allowed Boolean (1 = yes, 0 = no)
12. smoking\_allowed: Smoking allowed Boolean (1 = yes, 0 = no)
13. wheelchair\_access: Has wheelchair access Boolean (1 = yes, 0 = no)
14. electric\_vehicle\_charge: Has electric vehicle charger Boolean (1 = yes, 0 = no)
15. comes\_furnished: Comes with furniture Boolean (1 = yes, 0 = no)
16. laundry\_options: Laundry options available
17. parking\_options: Parking options available
18. image\_url: Image URL
19. description: Description by the poster
20. lat: Latitude
21. long: Longitude
22. state: State of listing

### 3. Data Pre-Processing

This section will cover the steps followed in cleaning the data, which can later be used to gain insights and information that the organization can implement. As the initial step in analyzing the raw data, a check on the dataset information to see the data types and non-null

counts to get a better understanding of the dataset. Figure 3 shows the information regarding the datatype and count of each column.

### Figure 3

#### Rental Dataset Information

```
rental_csv.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 265226 entries, 0 to 265225
Data columns (total 22 columns):
 #   Column           Non-Null Count  Dtype  
--- 
 0   id               265226 non-null   int64  
 1   url              265226 non-null   object  
 2   region            265226 non-null   object  
 3   region_url        265226 non-null   object  
 4   price             265226 non-null   int64  
 5   type              265226 non-null   object  
 6   sqfeet            265226 non-null   int64  
 7   beds              265226 non-null   int64  
 8   baths              265226 non-null   float64 
 9   cats_allowed      265226 non-null   int64  
 10  dogs_allowed      265226 non-null   int64  
 11  smoking_allowed   265226 non-null   int64  
 12  wheelchair_access 265226 non-null   int64  
 13  electric_vehicle_charge 265226 non-null   int64  
 14  comes_furnished   265226 non-null   int64  
 15  laundry_options    210911 non-null   object  
 16  parking_options    170086 non-null   object  
 17  image_url          265226 non-null   object  
 18  description         265224 non-null   object  
 19  lat                263806 non-null   float64 
 20  long               263806 non-null   float64 
 21  state              265224 non-null   object  
dtypes: float64(3), int64(10), object(9)
memory usage: 44.5+ MB
```

From the initial analysis, some points that needed to be addressed during the pre-processing step were handling the nulls and checking for the data types of attributes and redundant data. The following sections will cover how to handle such cases that adhere to the dataset. So before pre-processing, the overall record count needs to be checked. Figure 4 depicts the total number of records and columns that are present in the rental dataset before pre-processing.

## Figure 4

Record Count before Pre-Processing

```
print('The number of records present in the rental dataset:')
rental_csv.shape

The number of records present in the rental dataset:
(265226, 22)
```

### 3.1. Handling Null Values

This section covers the handling of nulls in the dataset. From the initial analysis of the dataset, specific attributes have less value count. So, now exploring these attributes further in detail, one can see the feature of parking options has the highest number of null values, followed by laundry options. When looking at these two features, the value present are categorical, and filling them up with the highest mode is not a suitable option since the data is large and rich; they can be removed to attain better insights.

The next set of features, such as description, latitude, and longitude, cannot be filled with values such as mean or median. So, these records will also be removed. Figure 5 depicts the count of null records present in the rental dataset.

## Figure 5

Count of Nulls in Rental Dataset

```
print('The list of fields containing null values :')
result.loc[(result["number_of_nulls"]>0)]
```

The list of fields containing null values :

	number_of_nulls
laundry_options	54315
parking_options	95140
description	2
lat	1420
long	1420
state	2

As mentioned above, these records were removed from the dataset. Figure 6 below shows the nulls that were present in the dataset were handled.

### **Figure 6**

Count of Nulls after Pre-Processing

	number_of_nulls
id	0
url	0
region	0
region_url	0
price	0
type	0
sqfeet	0
beds	0
baths	0
cats_allowed	0
dogs_allowed	0
smoking_allowed	0
wheelchair_access	0
electric_vehicle_charge	0
comes_furnished	0
laundry_options	0
parking_options	0
image_url	0
description	0
lat	0
long	0
state	0

The Null records have been removed

### **3.2. Handling Redundant data**

The data redundancy present in the dataset can affect the integrity of the data since the same data is current multiple times can cause inconsistencies in the results obtained. The duplicates present in the data could be because of insertion, deletion, or updating anomalies due to human error. Hence needs to be addressed. Figure 7 shows the number of duplicates that are present in the dataset.

### Figure 7

Number of Duplicates in the Dataset

```
print('The number of Duplicates present :',new_rental.duplicated().sum())
```

```
The number of Duplicates present : 30
```

The redundant records were removed to get better results from the data. Figure 8 shows the current dataset having no duplicates, which shows this issue has been addressed.

### Figure 8

Number of Duplicates after Removal

```
print('The number of Duplicates present :',rental.duplicated().sum())
```

```
The number of Duplicates present : 0
```

### 3.3. Handling Data type

The dataset consists of 22 attributes. The data type plays a vital role during data analysis, and if any issues with the data type are to be addressed. It was essential to handle them because they tell how the computer should interpret these values. The attribute price was assigned as an integer, which was updated to float. The other features showing the amenities, such as cats and dogs allowed, electric charging available, whether it comes furnished and whether smoking is permitted, had values of 0 or 1. These values were represented as integers; hence all these features were converted to Boolean. Figures 9 and 10 depict the data types of the attributes present in the dataset before and after they were handled. Checking this and formatting will help evaluate the records and make the best of the features to attain further insights into the patterns and trends.

## Figure 9

### Datatype of the Rental Dataset

The datatypes of the columns in rental:

```

id                      int64
url                     object
region                  object
region_url               object
price                   int64
type                    object
sqfeet                  int64
beds                    int64
baths                   float64
cats_allowed            int64
dogs_allowed             int64
smoking_allowed          int64
wheelchair_access        int64
electric_vehicle_charge int64
comes_furnished          int64
laundry_options           object
parking_options           object
image_url                object
description              object
lat                      float64
long                     float64
state                    object
dtype: object

```

## Figure 10

### The data type of the Rental Dataset after Pre-Processing

---

The datatypes of the columns in rental dataset after :

```

id                      int64
url                     object
region                  object
region_url               object
price                   float64
type                    object
sqfeet                  int64
beds                    int64
baths                   float64
cats_allowed            bool
dogs_allowed             bool
smoking_allowed          bool
wheelchair_access        bool
electric_vehicle_charge bool
comes_furnished          bool
laundry_options           object
parking_options           object
image_url                object
description              object
lat                      float64
long                     float64
state                    object
dtype: object

```

The record count after all the pre-processing steps is shown in figure 11 below. The data after all the cleaning can now be used to attain insights by plotting graphs and charts.

### **Figure 11**

Final data count after Pre-Processing

```
print('The number of records present in the rental dataset after all pre-processing: ')
rental.shape
The number of records present in the rental dataset:
(164283, 22)
```

## **4. Tableau Visualization Overview**

This section will cover the different analyses of the clean data after preprocessing. These visualizations were put together using Tableau 2022.2. Visualizing the data can help convey the information to the user and stakeholders. It will also help identify the trends and patterns in large datasets.

### **4.1. Main Page**

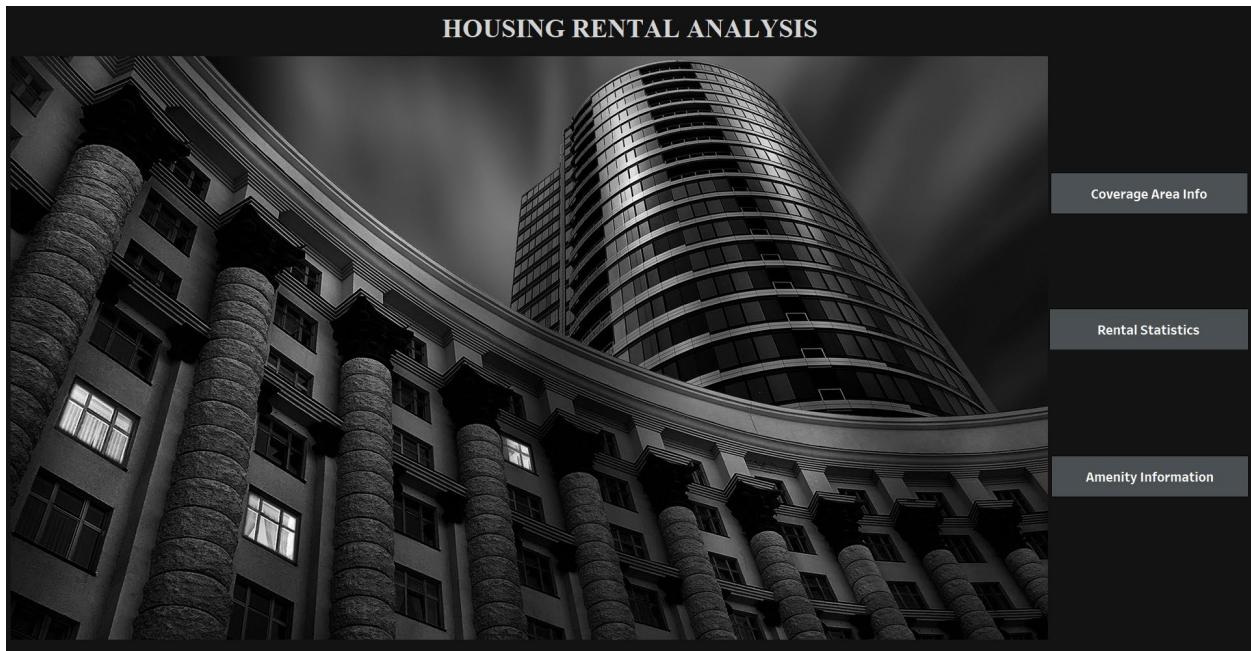
A dashboard was created to act as a homepage, so the user will allow the user to check analysis on a different set of information effectively. This dashboard contains buttons that will help the user navigate varying dashboards with information related to housing rental and other characteristics that play a role in determining the price.

This project aimed to help users and stakeholders understand the various reasons behind the price set for a particular house. The three buttons contain information on the coverage area or square foot analysis of all the data in the dataset. The second button shows the information related to the price and other information regarding the rental properties. Lastly, the amenities

button shows the information related to the features present in the house. Figure 12 shows the main page of the housing rental analysis.

**Figure 12**

Homepage of Housing Rental Analysis



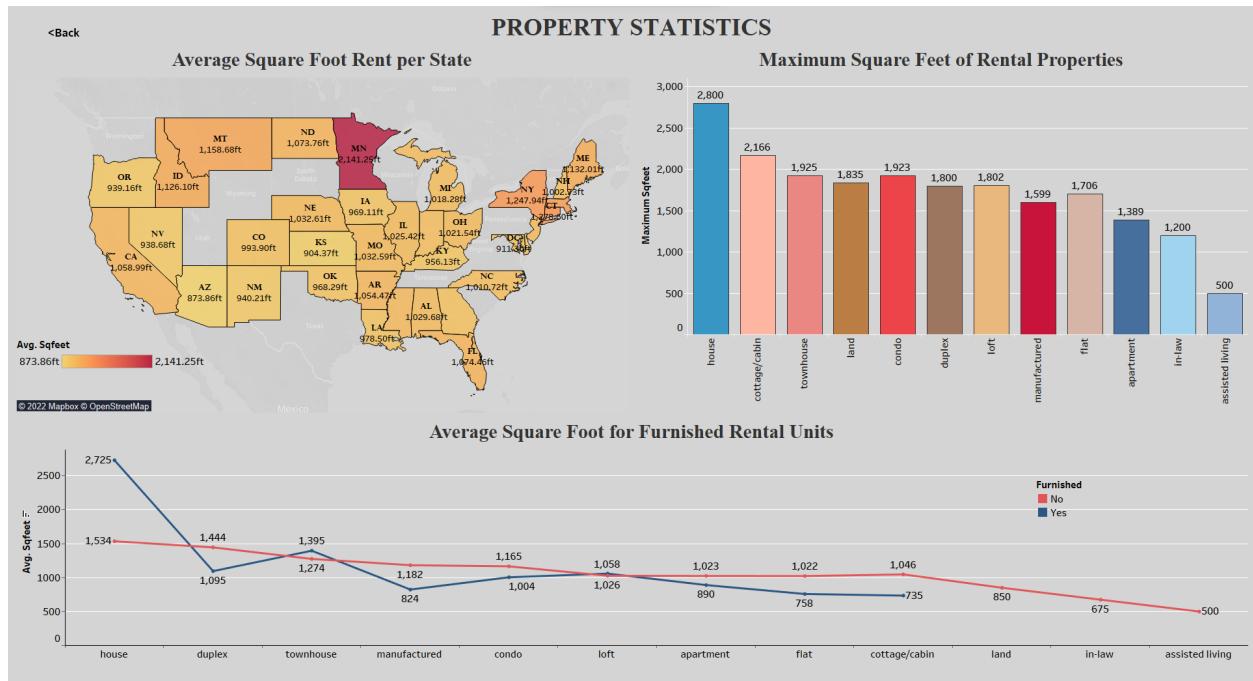
## 4.2. Coverage Area Information

This dashboard talks about the square foot analysis of the different housing properties in the USA. The properties present in this dataset are houses, cottages, townhouses, land, condo, lots, flats, duplexes, assisted living, and apartments. Figure 13 shows all the charts in the dashboard. The current charts are:

1. Geospatial chart depicting average square foot analysis of all the properties
2. Bar graph showing the minimum square feet in all the properties available for rent.
3. The Line chart compares the average square feet of different properties based on whether they come furnished.

**Figure 13**

### Coverage Area Information



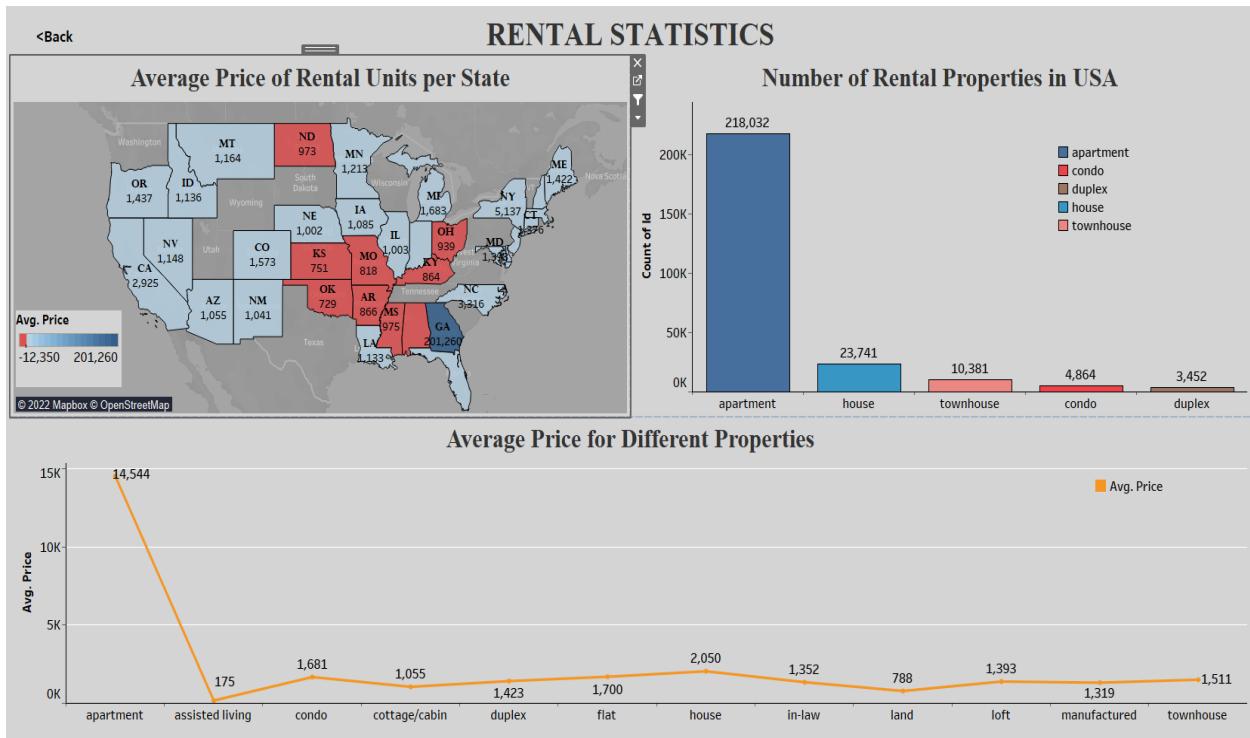
### 4.3. Rental Statistics

Following the previous one, this dashboard shows the price analysis of properties all over the USA. . In terms of the user, one can understand the budget associated with renting a type of property, which will also open other opportunities they can investigate. These charts will help convey information about the price range attached to different kinds of properties. This will help the user or stakeholders gain insights into what can be done. Figure 14 depicts the dashboard that shows the information on the rental statistics to the dataset. The chart shown is:

1. The line chart shows the average price of different properties, and
2. Bar chart showing the top 5 rental properties and the number of available accommodations.
3. The geospatial chart shows the average price all over the USA.

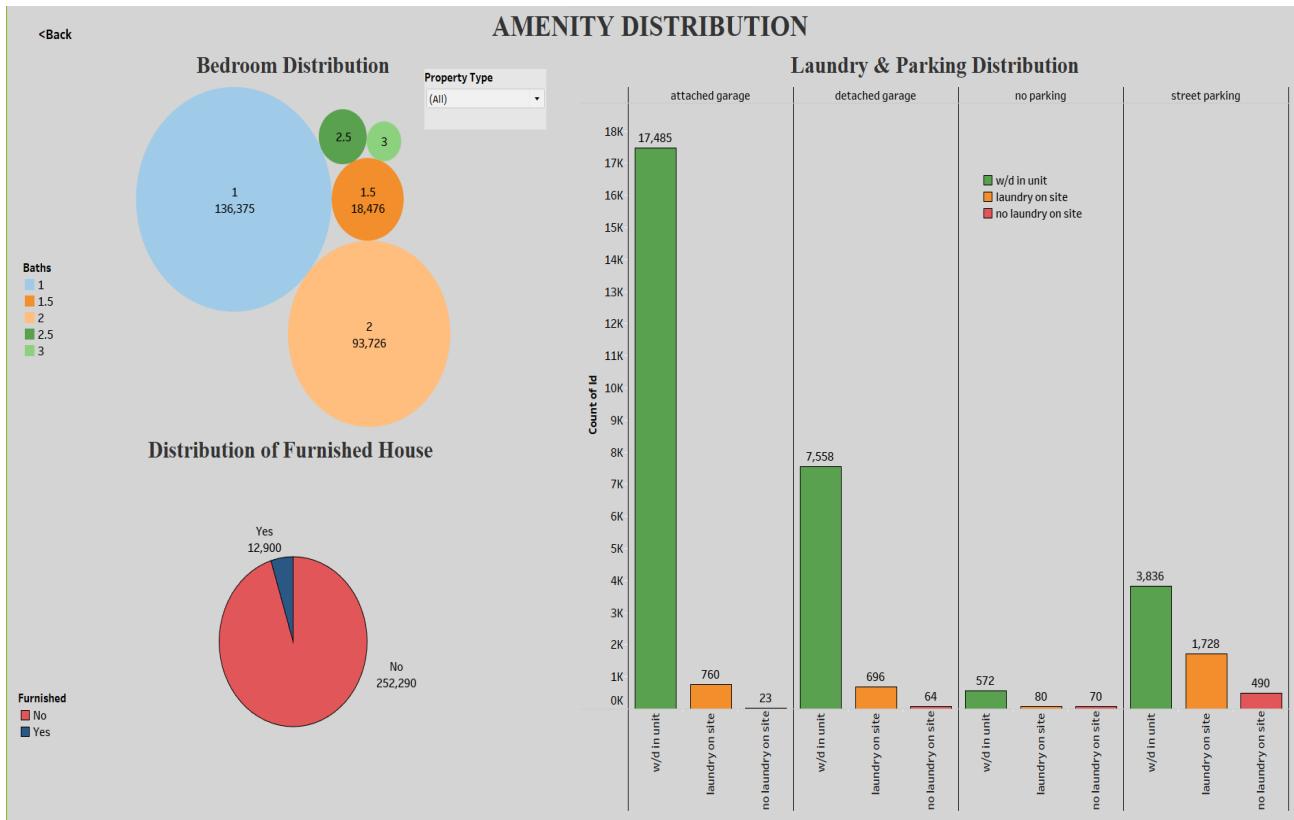
**Figure 14**

## Rental Statistics



**Figure 15**

### Property Distribution based on Amenities



## 5. Graphic Design Principles

This section will cover the different graphic design principles adopted when the visualization was created. The set rules need to be adhered to develop a practical and attractive chart. These principles work together to create a visually appealing and functional design for the user.

***Text and Typography*** - The chart's title and the dashboard title use the font Times New Roman, and the size was reduced based on the hierarchy, making it visually appealing to the user. This

will make the dashboard look clean, which will further help convey the information. Figures 12 to 14 show the text and typography incorporated into the dashboards.

**Color Theory and Color Use -** This principle plays a significant role in visualization as it can highlight pieces of information and help users differentiate the points. When choosing colors for the chart, it was ensured to maintain specific standards such that people who are visually impaired would also be able to read the charts and attain information. The color chosen was also light, and the background was kept light so that the user's attention was not drawn away from the charts. Figures 12 to 14 show the color incorporated into the dashboards and chart.

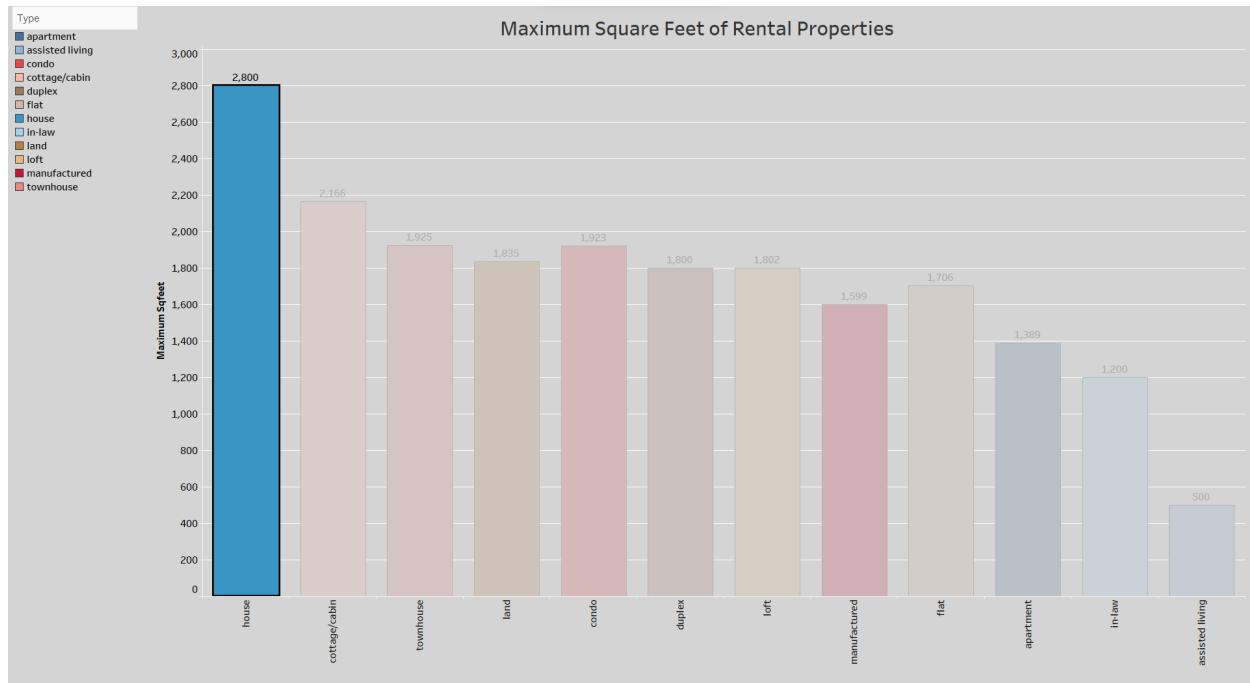
**Layout and White Space -** The charts were arranged clearly and cohesively, ensuring the space was utilized in the best way possible. The charts were placed so that negative space could be avoided. The placement of the charts was also done in a certain way, so the dashboard has a flow of information in order, making it easier for the user to interpret the data. Figures 12 to 14 show how the charts were arranged and how the space was utilized.

**Consistency and Design Vocabulary –** The consistency among the data should be maintained; the information can be given through charts but providing the correct title and vocabulary usage can make it easier for the information delivered to reach the user. Figures 12 to 14 show the vocabulary and consistency in the data presented.

**Visual Encoding -** Visual encoding can be implemented to emphasize the information in charts to ensure the data points stand out. For the chart to make important information stand out, encoding can be done in the chart to highlight trends and patterns, making it easier for stakeholders or users to understand the dataset. Figures 16 and 17 show some of the visual encoding done to the charts.

**Figure 16**

### Visual Encoding – Maximum Square Feet of Rental Properties

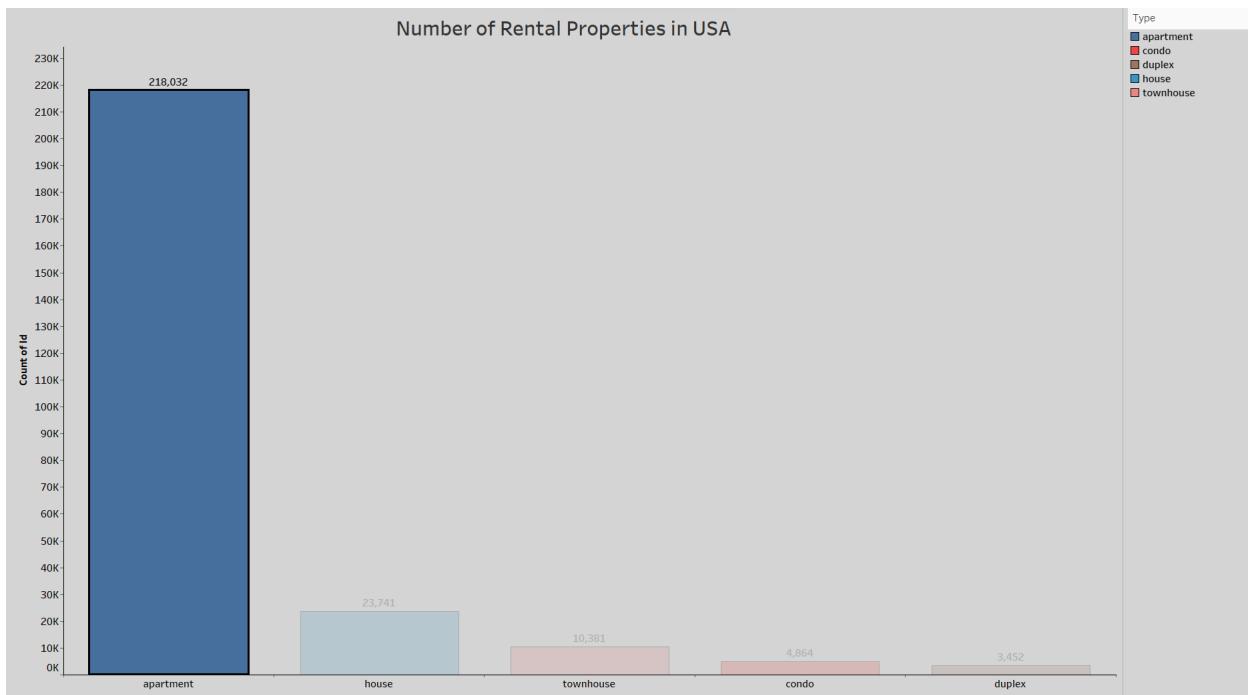


The visual encoding performed in this dashboard shown in figure 16 bar chart showing the maximum square feet will highlight the property with the highest among them. By highlighting this, we can convey information to the user about the property that is the highest. This value highlighting can be easily undone by clicking near the bar chart.

Figure 17 shows a similar form of visual encoding showing the number of rental properties being done in the dashboard. Here the bar chart highlights the highly available properties for that state. Hence, by adding visual encoding to the charts, we can help convey information more clearly. This process will allow the user to remember the necessary information clearly. This enables information to understand better and helps the user focus on critical insights.

**Figure 17**

## Visual Encoding – Number of Rental Properties



## 5. Cognitive Models

The cognitive model help describes how people's thought and perceptions can influence how information is perceived. This project uses a top-down approach where we begin with the most general information and move toward the more specific ones. These perceptions will help set the base on the expectation and idea of the results that can be achieved.

This approach will help the brain fill in the blanks on essential information and prepare it for the following details. This approach was used as people are used to taking the lead constantly, which will help streamline the insights and focus, so it quickly makes sense. Since this approach covers the basics, this will help influence how the details will be interpreted. In this

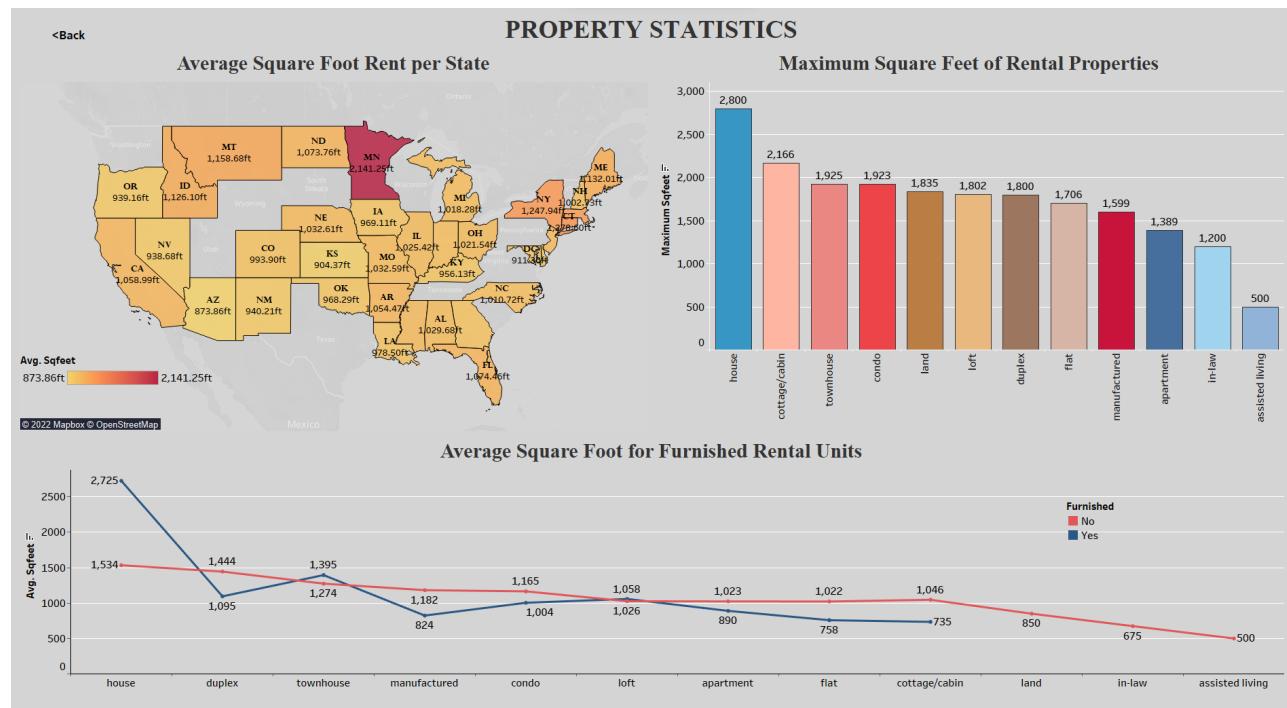
project, the basis of all the features and characteristics plays a role in choosing the right rental property for the user.

The home page shown in figure 12 will be the user preface, and by clicking on the button, the user will be navigated to the user to corresponding statistics. This way, the user will have a clear understanding of all kinds of information that the user might need to make conclusions.

Cognitive models will help us provide basic information and drive the user to in-depth details on the analysis. Achieving this was made more accessible by applying a different filter in the dashboard to narrow down the information to the user's need. Figure 18 below shows the dashboard's full view without applying any filter. Figure 19 depicts the use of the geospatial map as a filter to customize the details of the other charts to the corresponding information of the state of California.

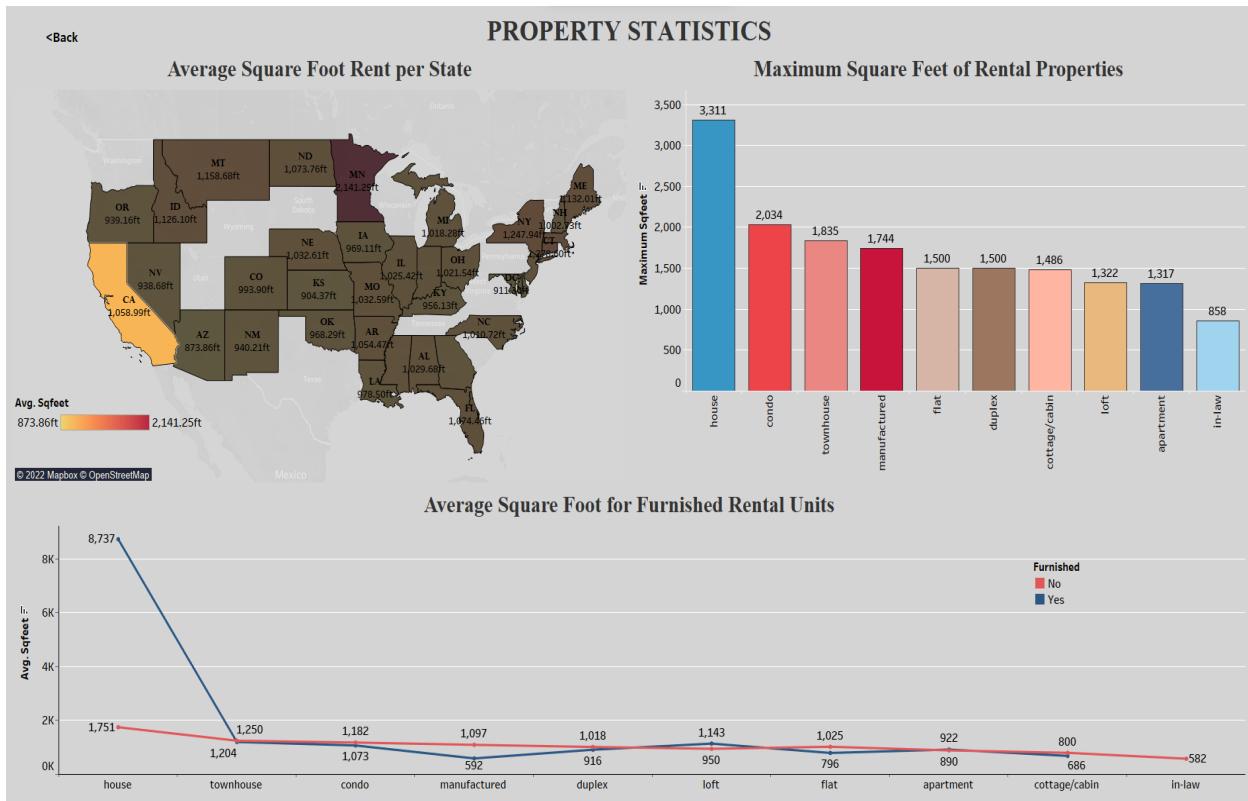
**Figure 18**

### Property Statistics



**Figure 19**

### Property Statistics – Use of Filter

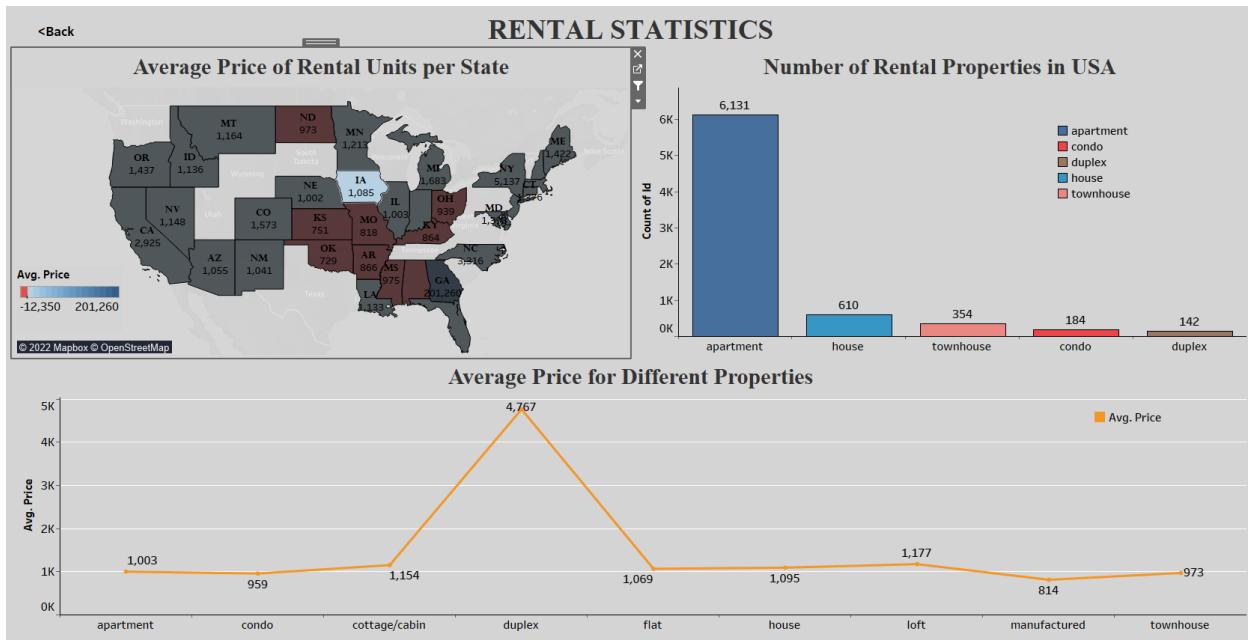


Similarly, the same was applied to the rental statistics dashboard, where one can filter out information to their need by clicking on the states in the geospatial map. Figure 20 shows the use of the filter option in the dashboard.

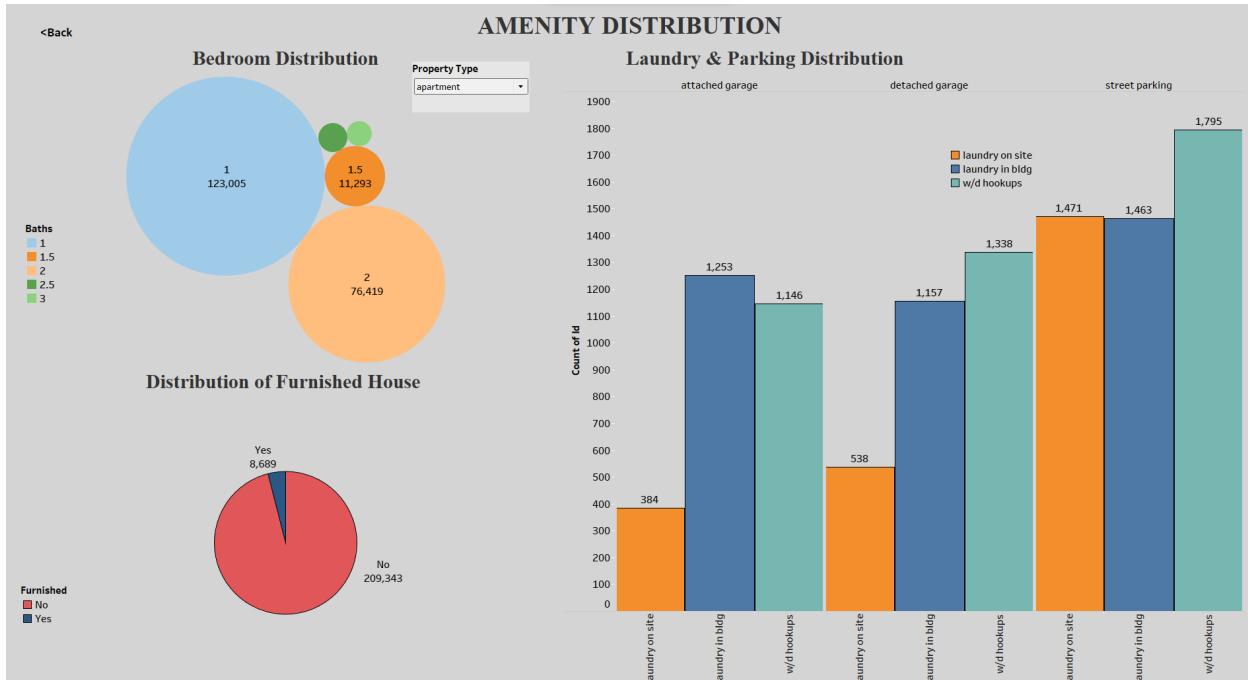
The following dashboard, a part of this project, contains information about the amenities in the different rental properties. In this dashboard, a filter was applied using a dropdown menu where the user can select the property type they want to analyze and gain more information about. Figure 21 shows the dashboard where the property type is selected as the apartment. There are a few other options to choose from. The property types available in the dataset are flat, land, condo, apartment, assisted living, house, in-law, loft, townhouse, manufactured, cottage, and duplex.

**Figure 20**

## Rental Statistics – Use of Filter

**Figure 21**

## Amenity Statistics – Use of Filter



## 6. Gestalt Principles

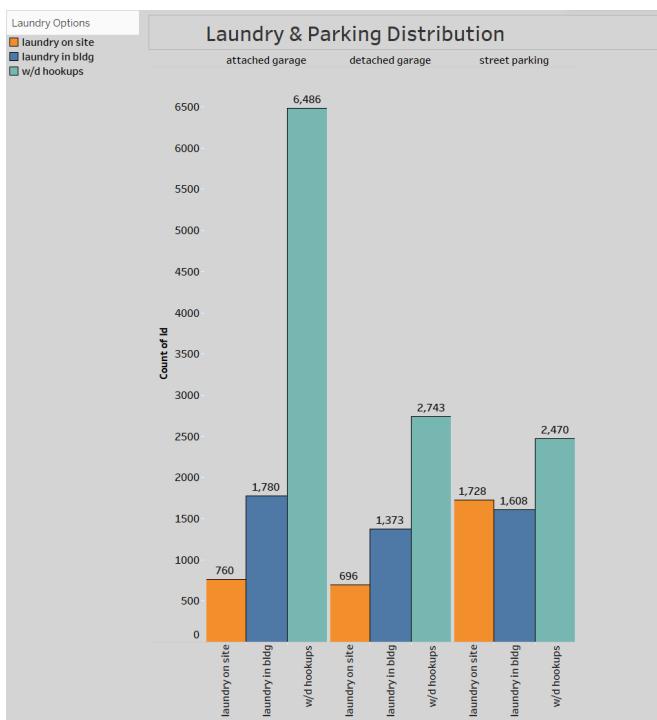
The principle describes how the human brain sees visual information, such as similar elements, recognizes patterns, and simplifies complex images when we see objects. Several such principles were incorporated when creating visualization to have a pleasing interface.

### 6.1. Proximity

The law of proximity is that we perceive objects close to each other as belonging to a group. Figure 22 below shows the laundry and parking distribution of the rental property. The bar represents the count of properties and the number of available options. The bar is grouped based on the parking and colored based on laundry. The spaces separate each group from the others around them. And user will also be able to understand the chart without requiring much effort since the bars are correctly grouped.

**Figure 22**

Laundry and Parking Distribution – Proximity Principle

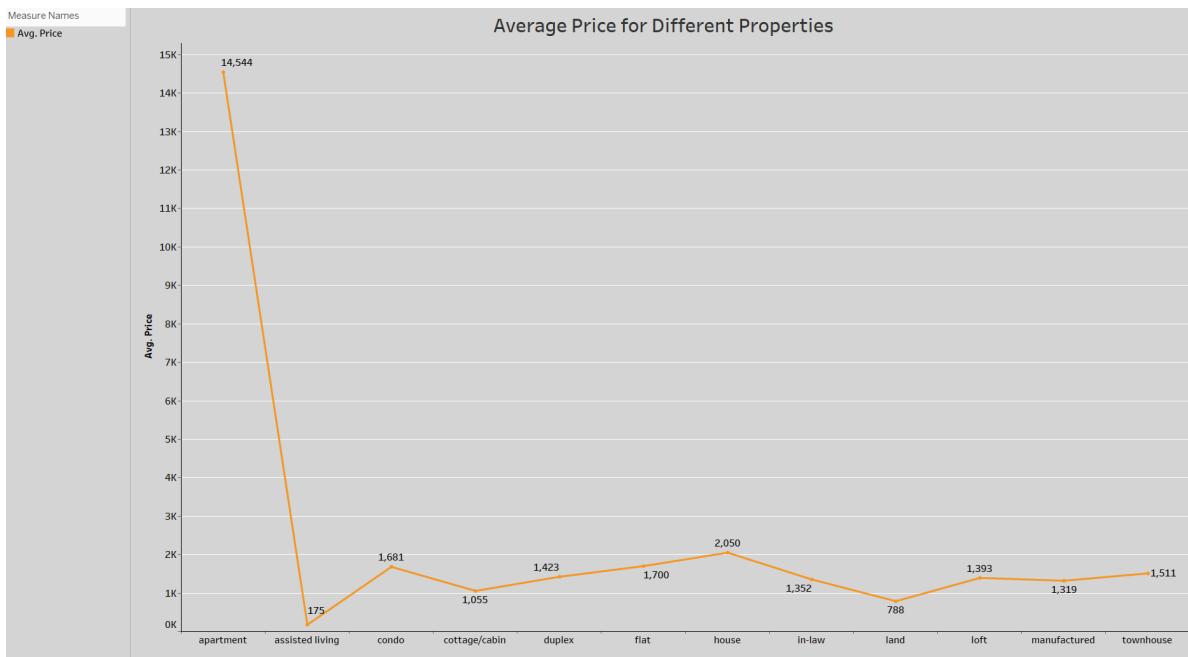


## 6.2. Closure

The Law of closure is that the mind will tend to complete figures or forms even when the picture or chart is incomplete. Figure 19 shows a line chart of the average price of different rental properties. By having a complete chart, we can avoid the issue of ambiguity in the graph being incomplete or when full; the users stop the eye's tendency to complete the missing piece or shapes. We should ensure that the chart is complete when we can reasonably do so to avoid misinterpretation. Figure 23 shows the closure principle implemented.

**Figure 23**

Average Price of Rental Properties – Closure Principle



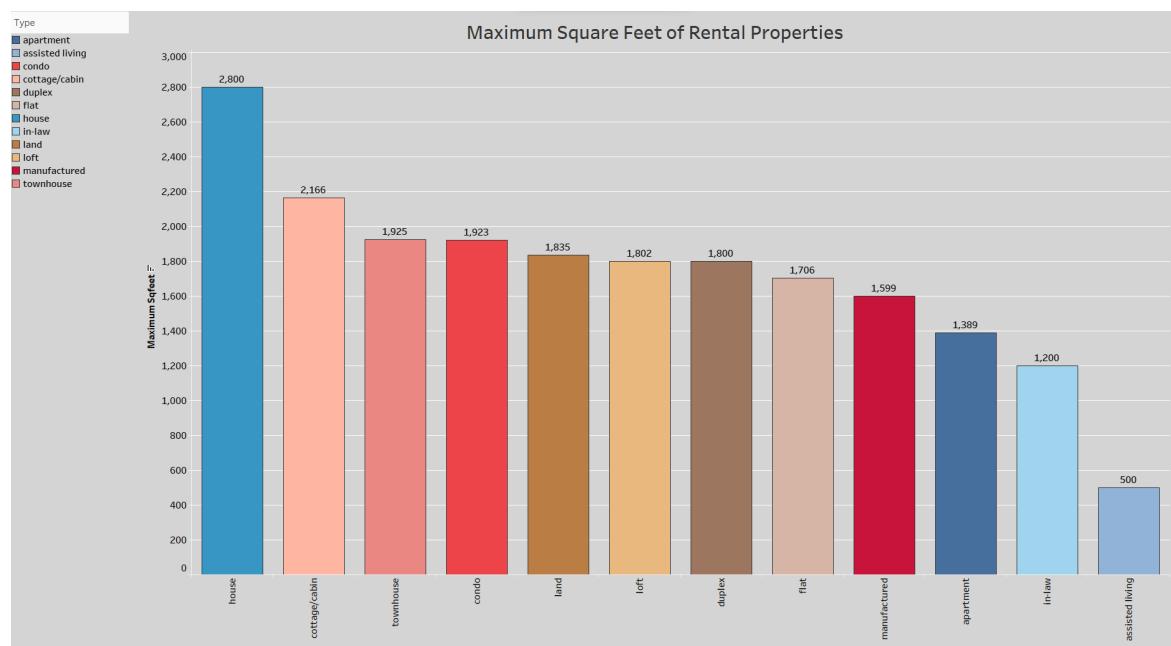
## 6.3. Continuity

The Law of continuity is that we see continuous shapes to the degree possible, and the human eye follows shapes, patterns, curves, or lines in a sequence to create a path. The bar chart in figure 18 represents the data for each type of rental property and their average square feet.

Ordering the data points makes it easier to identify the person who is best and least performing. The visualization follows the principle of continuity since the bars are arranged to align with the corresponding bars. By ordering, we are giving a visual direction to the chart showing it as part of the continuation. Figure 24 shows the principle of continuity.

**Figure 24**

### Maximum Square Feet of Rental Units – Continuity Principle



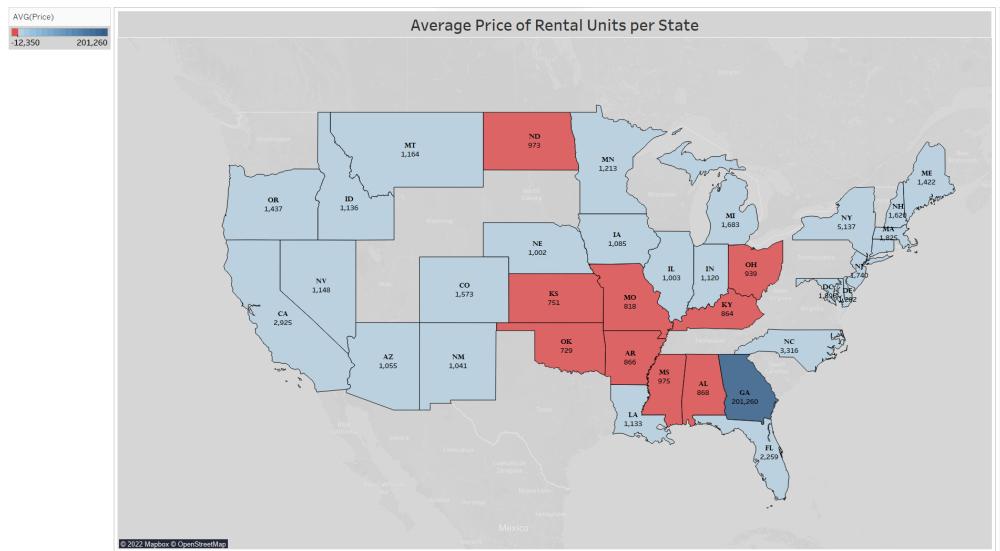
### 6.4. Figure and Ground

The Law of figure and ground segments the visuals into ground and figure. Ground refers to the background, and the figure represents the data we want people to focus on. The geospatial chart below in figure 20 shows the data on the average price for the United States of America. The information in the chart is highlighted such that only those states and values belonging to it are represented. The geospatial graph follows the principle of figure and ground since we can differentiate the data point and the background from each other. The states in the chart are

highlighted with yellow, which stands out from the background color; hence this will ensure the human eye will focus on the states. And we will be able to convey the information. Figure 25 depicts the figure and ground implementation.

**Figure 25**

#### Average Price of Rental Units per State – Continuity Principle



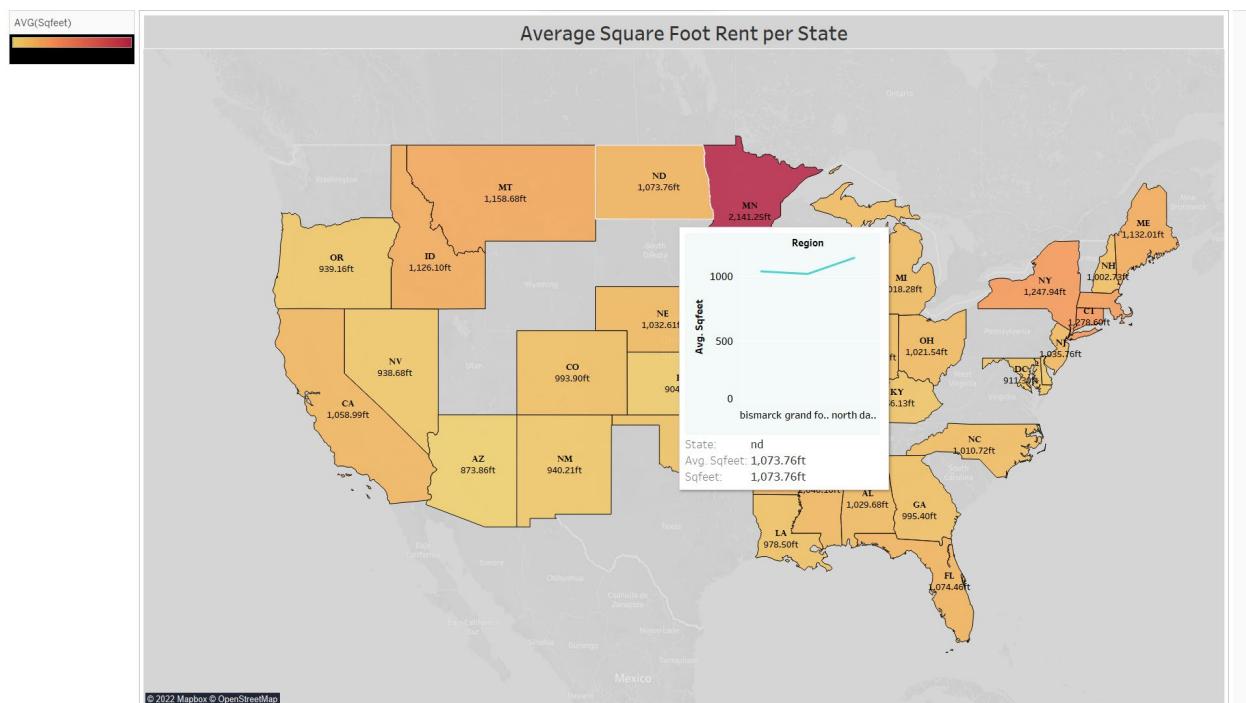
Interactions can help uncover insights that lead to better, data-driven decisions. Some of the interactions applied in this project when creating the graphs and charts are discussed.

## 7.1. Tooltips / Hover Help

Tooltips are additional information that pops up when the mouse or pointer is moved over charts and graphs. This was applied to all the charts in the dashboard. This will help the user gain extra information. Figure 26 shows one of the charts where the tooltip was implemented. The tooltip can be customized to show additional details regarding the project, such as adding charts and text with relevant information.

**Figure 26**

Average Square Foot Rent per State - Tooltip



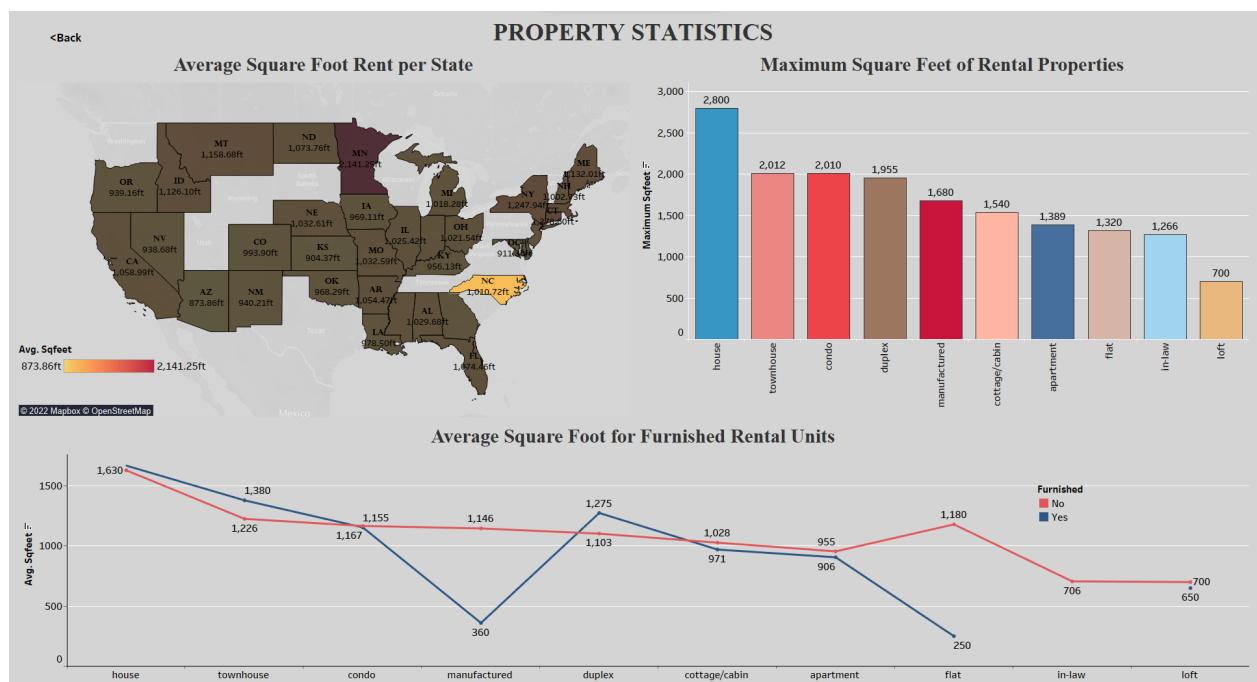
## 7.2. Drill Down

When clicking or tapping, the charts expand or pop up with additional information. This can also change the contents of the existing panel, which was implemented in the dashboard to drill down to detailed information, which will help make data-driven decisions.

Figure 27 shows the drill-down interaction in the dashboard. When one item was selected, the charts in the existing panels changed to data to represent the given state.

**Figure 27**

### Property Statistics – Drill-Down Interactions



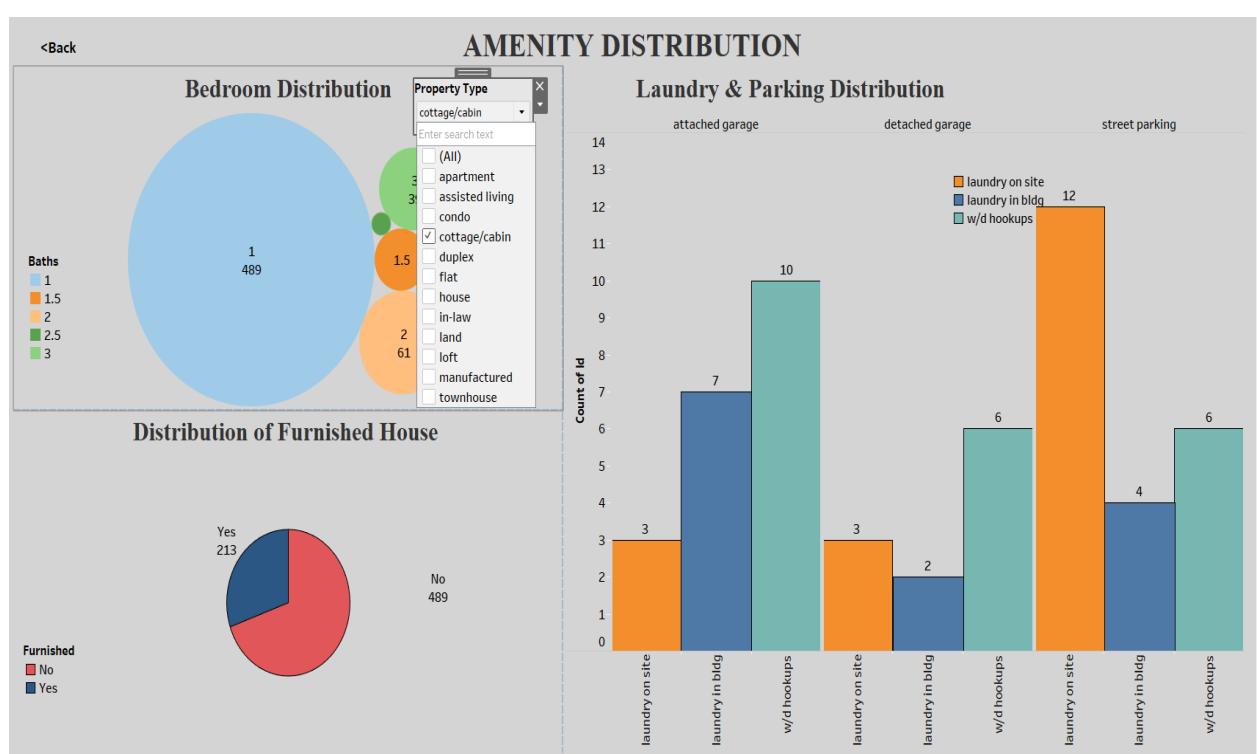
## 7.3. Selection

The selection interactions were implemented on the main page, where the user can choose which type of property one wants to get a detailed understanding of. This interaction will allow the user to select the data they want to display. The main page has three buttons, as

shown in figure 12. The user will be navigated to the corresponding dashboard by clicking each button. These buttons make it easier to keep the user interface more concise and cleaner. This will help drill down the information corresponding to the user's requirements. Figure 28 shows the other selection applied in the amenity dashboard with a drop-down selection. This selection will be applied to the entire dashboard.

**Figure 28**

### Amenity Distribution – Selection Interactions



### 7.4. Zooming and Scaling

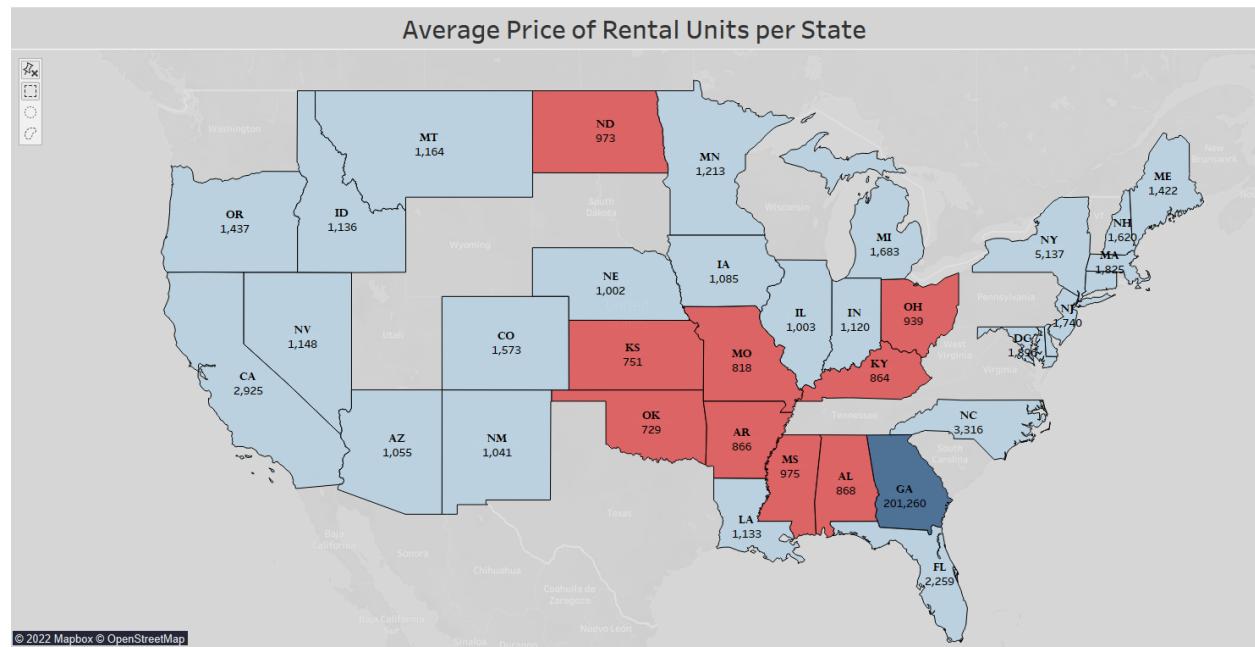
This interaction was implemented with geospatial charts. This will allow the user to zoom in or out to see more details from the chart. By zooming interaction enabled, the user can get a

clear view of how the data is in the geospatial map. Figure 29 shows the toolbar where we can select the option on the map. And using the mouse controls, we can zoom or scale the map.

These interactions were applied to the dashboard to make it more user-friendly and easily customizable to their needs. Using such options makes it easy for the user to attain more information and make a data-driven decision.

**Figure 29**

Average Price Distribution – Zooming/Scaling Interactions

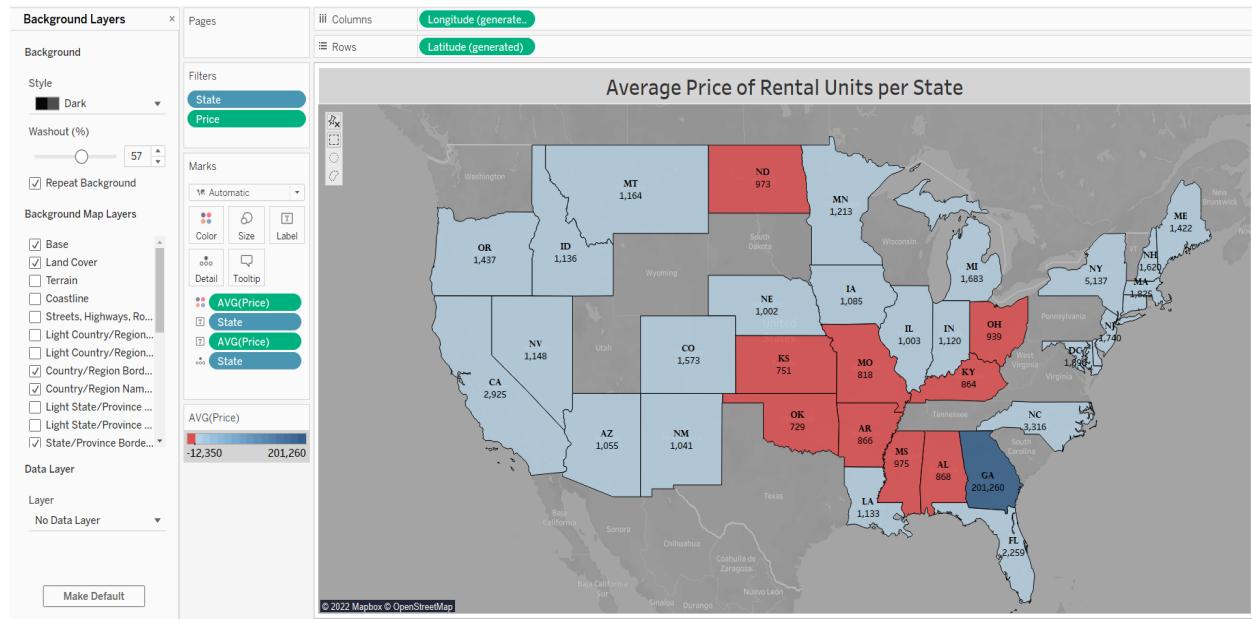


## 7.5 Overlays

The overlays add an additional layer of depth to the geospatial charts. The user can toggle the selections in order to obtain customized setting to visualize the charts. Figure 30 shows the different options that can be selected to add additional informative layers to the chart. The selections will enable borders and name of state and country. Users can choose to add different selection of color to increase the understanding of the map.

**Figure 30**

## Average Price Distribution – Overlays



## 8. User Interface Principles

Visualization can be named good if it adheres to specific rules; most of these were implemented in the visualization. Firstly, the charts and dashboards were set up so that users could control what they wanted to see. Secondly, adding buttons to the dashboard makes it easier to reverse the action made. Thirdly, the visuals were kept simple and cohesive so that it's clear and had a flow to them, making them easier to interpret and gain insights. Fourthly, the cognitive model of the top-down approach was implemented. This helped in giving the essential information, letting the user slowly build an opinion with added information. Lastly, the charts were consistent and placed in a similar order so that users could get used to the interface and rely on recognition, not recall. By applying all these rules, the visualization ensured an excellent user interface and a good user experience.

## 9. Overall Effectiveness

The visualization shows easy understanding of the charts. The main page will act as the user interface which will help the user move between different dashboards containing various information. The dashboards were created by using the principles, including gestalt principles, implementing an interaction, and adhering to graphic design standards. By doing all of these things, the project was able to allow the user to explore easily and make insightful insights. Furthermore, discoveries could be achieved with the least amount of work with the aid of interaction.

## 10. Summary

The project's objective was to help users and stakeholders use this visualization to attain more information on the housing price and other characteristics that are present in the properties. The users can use this to gain more information on the current rent price for the amenities they are looking for. On the other hand, stakeholders can use this information to gain knowledge on where they can invest in getting a great return.

Some of the main insights attained from this visualization are that apartments are high in number and expensive in terms of rent. The square feet of homes in most states are more than other properties. The amenities present in the properties differ from region to region. Overall, many rental properties are pet friendly. The bedroom-to-bathroom ratio in all the properties that were listed was good.

A good user interface was created using all the principle, that shows a main page containing buttons that will help the user navigate around the dashboard to view different

statistics and information. A total of 3 dashboards were created and 13 charts were created to represent the data which help attain information regarding the housing rental.

The principles, such as gestalt principles, were used, an interaction was implemented, and graphic design principles were followed when creating the dashboards. By following all these, the project achieved an overall effectiveness of allowing the user to explore easily and make useful observations. And with the help of interaction, discoveries could be made with minimum effort.

## Reference

Dataset: <https://www.kaggle.com/datasets/rkb0023/houserentpredictiondataset>