Impact of COVID-19 on the U.S. Housing Market

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Introduction

The United States has experience the steady growth in the housing market. This steady growth was interrupted by COVID-19 pandemic. This study compares the United States' housing market before and after COVID -19.

This information is important to the local government and real estate developers when planning to develop the next community.

Research Questions

- Has there been a change in house prices since COVID-19?

- Has there been a change in in-demand house location since COVID-19?

- Has there been a change in buyer's house buying criteria since COVID-19?

Data Sources

Data Set	Source	Description
Land Area	US Census Bureau	The file will use county land area information to compute the population densities.
Population	Economic Research Service US Department of Agriculture	This file provides population estimates for all counties in the US. Note: 2016 to 2019 estimates and 2020 actual population will be used.
Real Estate	Realtor.com	This real estate data file contains a historical market trends and monthly statistics on active for-sale listings (including median list price, average list price, luxury list price, median days on market, average days on market, total active listings, new listings, price increases, price reductions)
Rural Area	US Census Bureau	The file will use county rural information to categorize the urban and mostly and all rural areas.

Data Variables

| DATA VARIABLE	DESCRIPTION
Active Listing Count	The count of active listings within the specified geography during the specified month. The active listing count tracks the number of for sale properties on the market, excluding pending listings where a pending status is available. This is a snapshot measure of how many active listings can be expected on any given day of the specified month.
Avg Listing Price	The average listing price within the specified geography during the specified month.
Avg Listing Price M/M	The percentage change in the average listing price from the previous month.
Avg Listing Price Y/Y	The percentage change in the average listing price from the same month in the previous year.
County	The county in the state
Date	The date of the property transaction
Density	The ratio of the population per square mile of the county
FIPS	The five digit code representing the state and the county
Median List Price Per Sqft	The median listing price per square foot within the specified geography during the specified month.
Median Listing Price	The median listing price within the specified geography during the specified month.
Median Listing Sqft	The median listing square feet within the specified geography during the specified month.
Rural Percent	The total percentage of the population that classifies almost or all rural areas and urban area
Rural Cat	The category 1 represents all or mostly rural areas; category 2 represents urban area.
State	The abbrevation of the state
Total Listing Count	The total of both active listings and pending listings within the specified geography during the specified month. This is a snapshot measure of how many total listings can be expected on any given day of the specified month.

Variables and Measurements

- Average listing price and average listing prices changes per year for the state, individual state, and county will be to analyzed during 2019 and 2021.

- The basis of comparison is pre-COVID (2019) and post-COVID (2021)

- The unit for analysis used is FIPS which represents the Federal Information Processing Standard code. FIPS is a five digit code that uniquely identifies counties in the United States.

Initial Exploratory Results
Correlational Matrix
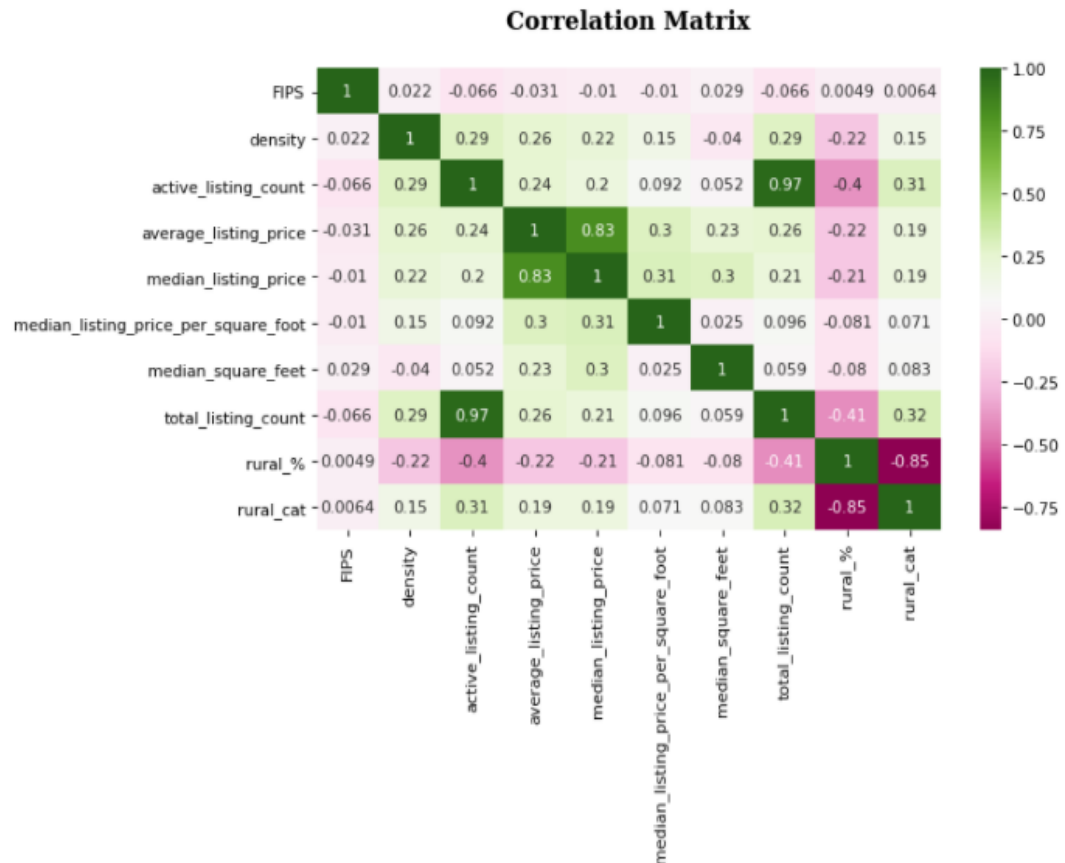
The highest correlation is between active listing count and total listing count which is 97%. The second highest is between average listing price and median listing price which is 83%.

Initial Exploratory Analysis

Price Ratio Increase - Counties 2019 and 2021

```
Price ratios for : 2019
Increase in prices      0.548410
Down from last year     0.231984
Down from last month    0.219606
Name: category, dtype: float64


Price ratios for : 2021
Increase in prices      0.610669
Down from last month    0.224034
Down from last year     0.165296
Name: category, dtype: float64
```

On 2019, 54.84% of the counties in the United States experienced a price increased. 23.20 % of the counties experience down from last year and 21.96% down from last month.
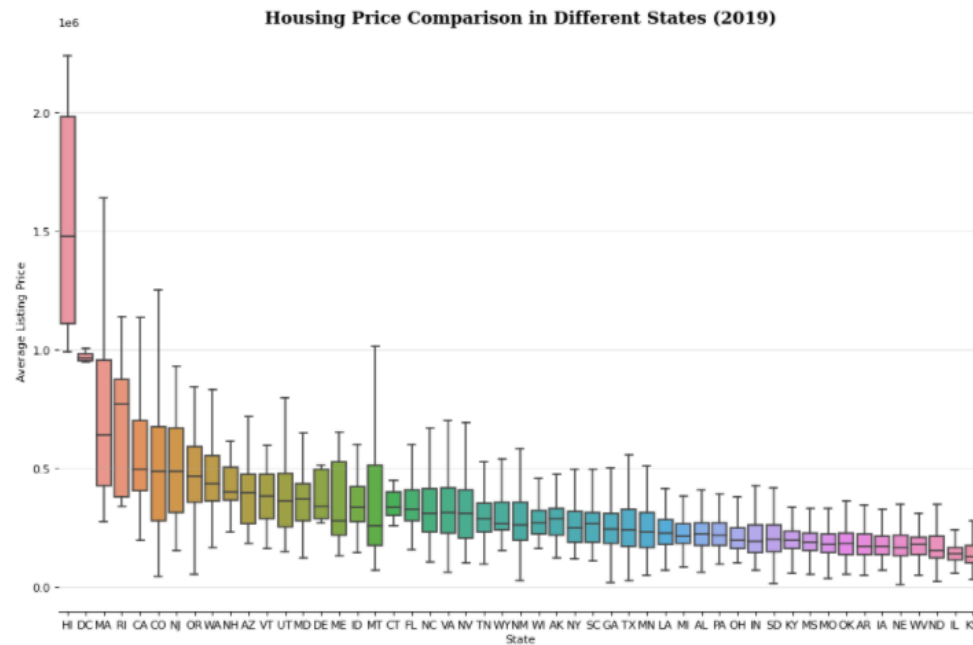
On 2021, 61.07% of the counties in the United States experienced a price increased. 22.40% of the counties experience down from last year and 16.53% down from last month.
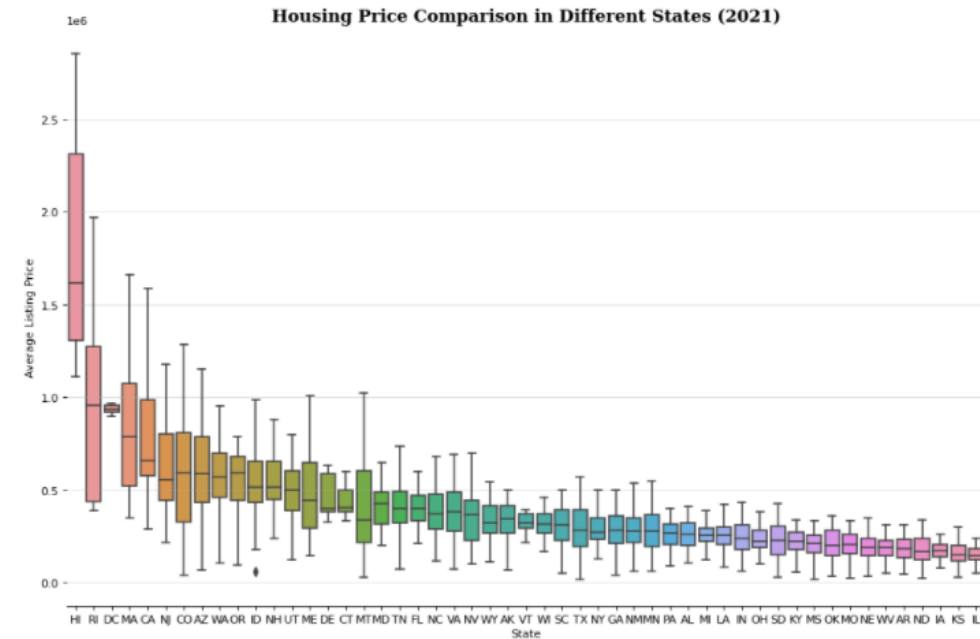
Initial Exploratory Results
Average Listing Price - State

2019

2021

Initial Exploratory Results
Average Listing Price

2019

	state	average_listing_price
0	HI	1.548047e+06
1	DC	9.708098e+05
2	MA	7.026050e+05
3	RI	6.959859e+05
4	CA	5.597055e+05

2021

	state	average_listing_price
0	HI	1.778542e+06
1	RI	9.362832e+05
2	DC	9.340552e+05
3	MA	8.537671e+05
4	CA	7.788309e+05

Hawaii maintained a highest average listing price in 2019 and 2021.

DC was second highest average listing price for 2019 but was displaced by Rhode Island in 2021. Rhode Island used to be the 4th placer in 2019 and even surpassed Massachusetts with a higher average listing price in 2021
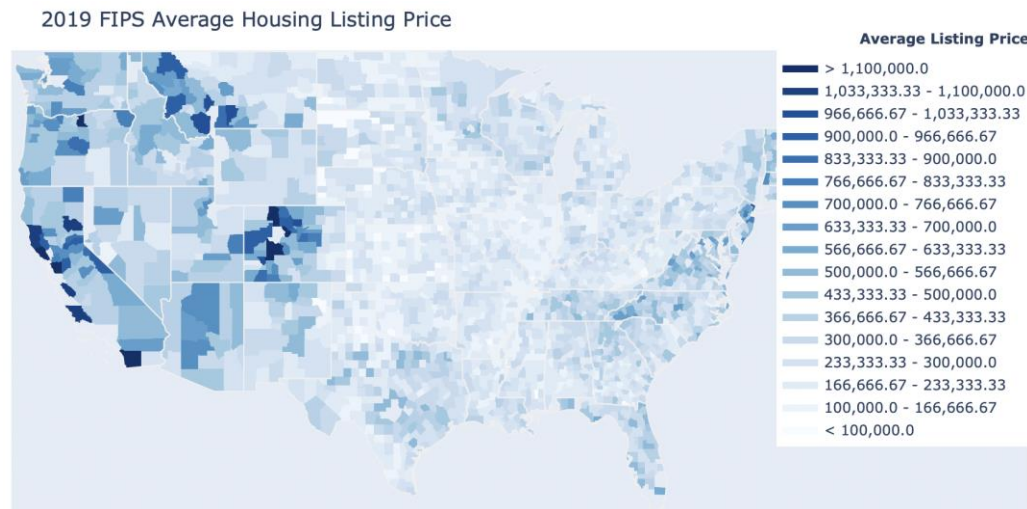
DC has the highest density 11294 density/sq. mile, Massachusetts has 901 density/sq. mile, California of 253 density/sq. mile, Hawaii has 229 density/sq. mile, and Rhode Island of 106 density/sq. mile.
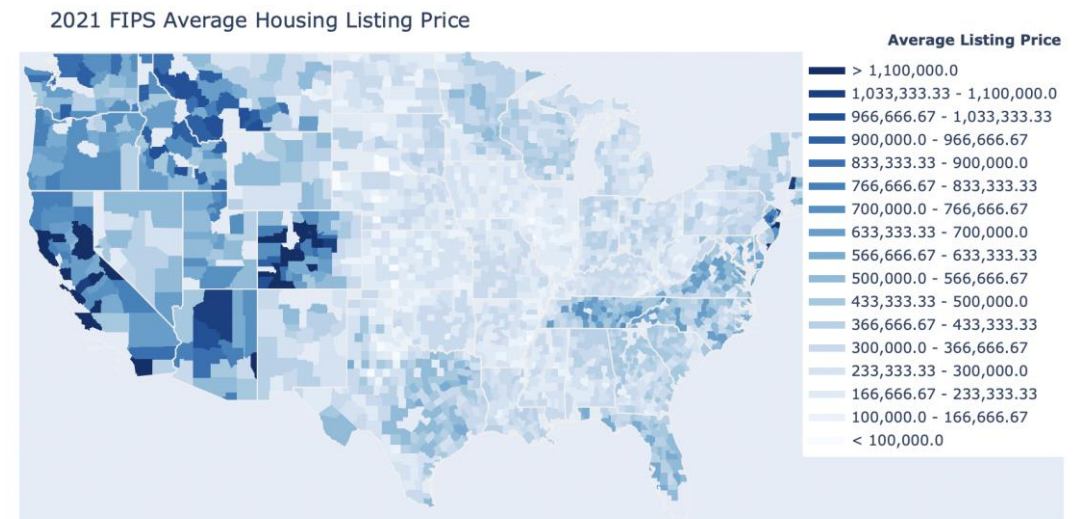
Initial Exploratory Results
Average Listing Price - FIPS

2019

2021

Initial Exploratory Results
Average Listing Price – FIPS

2019

	FIPS	state	county	density	rural_%	rural_cat	average_listing_price
0	15007	HI	Kauai County	118	12.860145	2	2.022722e+06
1	15009	HI	Maui County	141	14.567860	2	2.000211e+06
2	25025	MA	Suffolk County	13722	0.074091	2	1.471328e+06
3	8107	CO	Routt County	10	45.178442	2	1.222046e+06
4	15003	HI	Honolulu County	1692	0.862877	2	1.154390e+06

2021

	FIPS	state	county	density	rural_%	rural_cat	average_listing_price
0	15007	HI	Kauai County	118	12.860145	2	2.273151e+06
1	15009	HI	Maui County	141	14.567860	2	2.261603e+06
2	44005	RI	Newport County	836	12.092221	2	1.641150e+06
3	25025	MA	Suffolk County	13722	0.074091	2	1.555851e+06
4	6073	CA	San Diego County	784	3.297049	2	1.533289e+06

Kauai (HI), Maui (HI), and Suffolk (MA) have been on the top 5 highest average listing price for 2019 and 2021.

Routt (CO, 45.18 rural %) and Honolulu (HI, 0.87 rural %) were eliminated on top 5 list of 2021.

Newport (RI, 12.1 rural %) and San Diego (CA, 3.29 rural %) were added to top 5 list of 2021
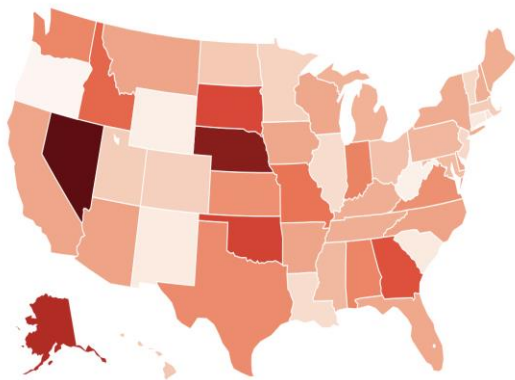
Initial Exploratory Results
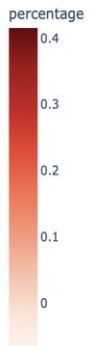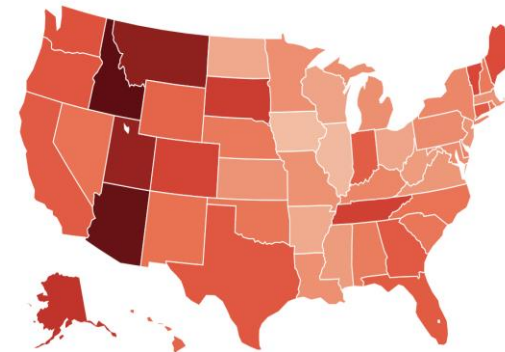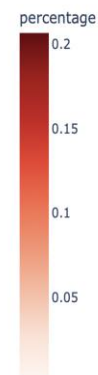## Average Listing Price Change (%) - State

2019

2021

2019 US Average Listing Price Change per State (%)

2021 US Average Listing Price Change per State (%)

Initial Exploratory Results
Average Listing Price Change (%) - FIPS

2019

	state	average_listing_price_yy
0	NV	0.206349
1	NE	0.184821
2	AK	0.161531
3	OK	0.138829
4	SD	0.128995

2021

	state	average_listing_price_yy
0	ID	0.414870
1	AZ	0.405253
2	MT	0.384309
3	UT	0.355432
4	AK	0.284018

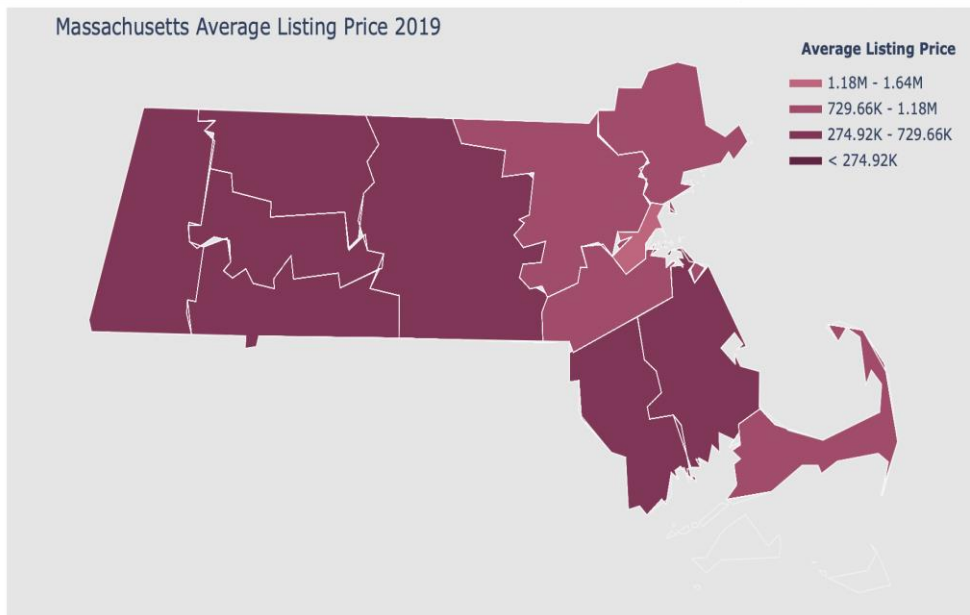The predominant state within the top 5 high average listing price change in 2019 and 2021 was Alaska (AK).

The average listing price percentage change in 2021 is higher than 2019.

Initial Exploratory Results
Average Listing Price – Massachusetts (FIPS)

2019

Massachusetts Average Listing Price 2019

Average Listing Price
- 1.18M - 1.64M
- 729.66K - 1.18M
- 274.92K - 729.66K
- < 274.92K

2021

Massachusetts Average Listing Price 2021

Average Listing Price
- 1.22M - 1.66M
- 784.43K - 1.22M
- 348.40K - 784.43K
- < 348.40K
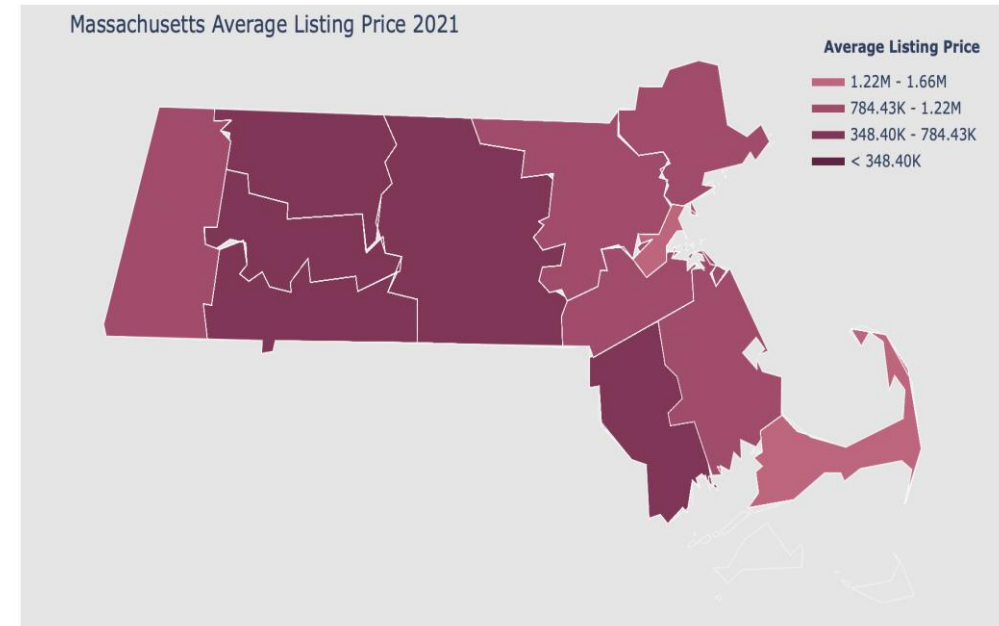
Initial Exploratory Results
Average Listing Price – Massachusetts (FIPS)

2019

	FIPS	county	density	rural_%	rural_cat	average_listing_price
0	25025	Suffolk County	13722	0.074091	2	1.471328e+06
1	25017	Middlesex County	1995	3.027706	2	9.772631e+05
2	25001	Barnstable County	581	7.483047	2	9.664294e+05
3	25021	Norfolk County	1832	1.240489	2	9.615623e+05
4	25009	Essex County	1644	4.244045	2	8.081962e+05

2021

	FIPS	county	density	rural_%	rural_cat	average_listing_price
0	25025	Suffolk County	13722	0.074091	2	1.555851e+06
1	25001	Barnstable County	581	7.483047	2	1.476872e+06
2	25021	Norfolk County	1832	1.240489	2	1.083184e+06
3	25017	Middlesex County	1995	3.027706	2	1.078144e+06
4	25003	Berkshire County	139	31.593748	2	9.752928e+05

Suffolk has the highest average listing price in 2019 and 2021.

Berkshire moved to 5th place in 2021 and has a 31.59% of rural percentage displace Essex that has rural percentage of 4.24%.

Machine Learning Model

The machine learning model to be used for this project is K-means with centroid. K-means works by selecting how many clusters, k, exist in the data. Each cluster will be represented by a centroid (average) of similar points with continuous features.
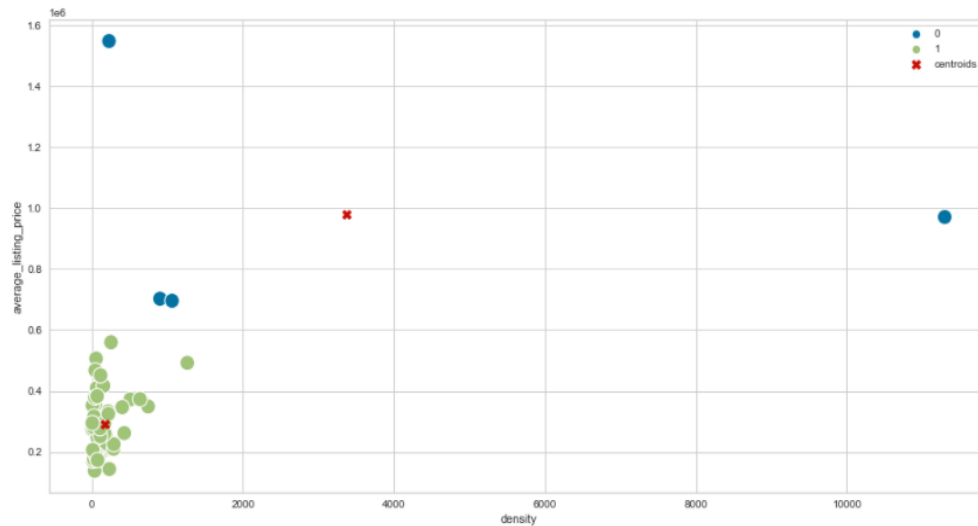
It will be applied to the average listing price, average listing price change, rural percentage, and density on the county, state, and individual state level.
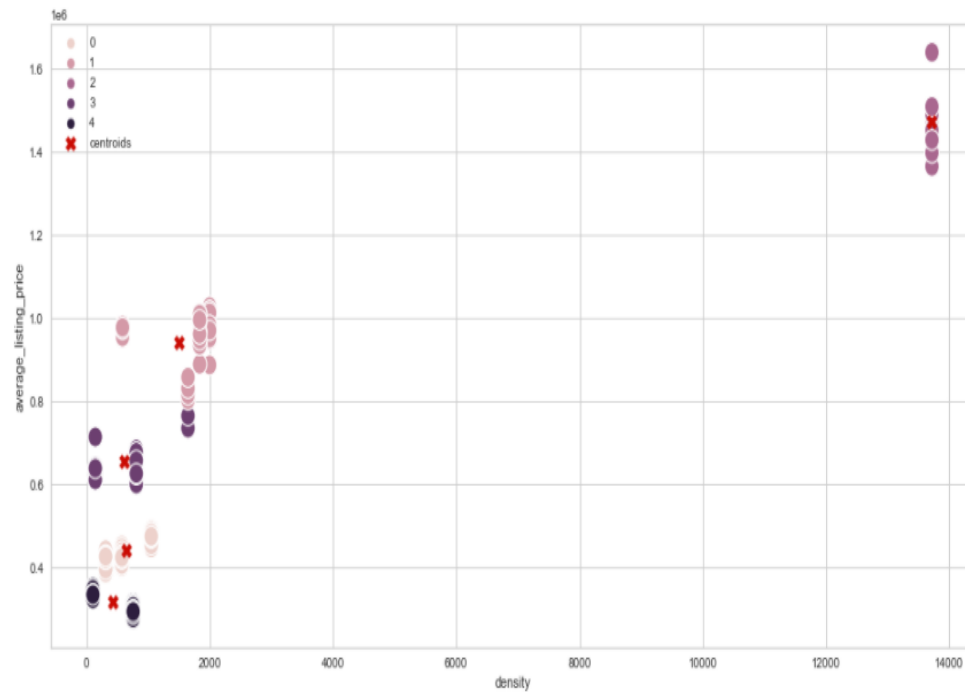
K-means
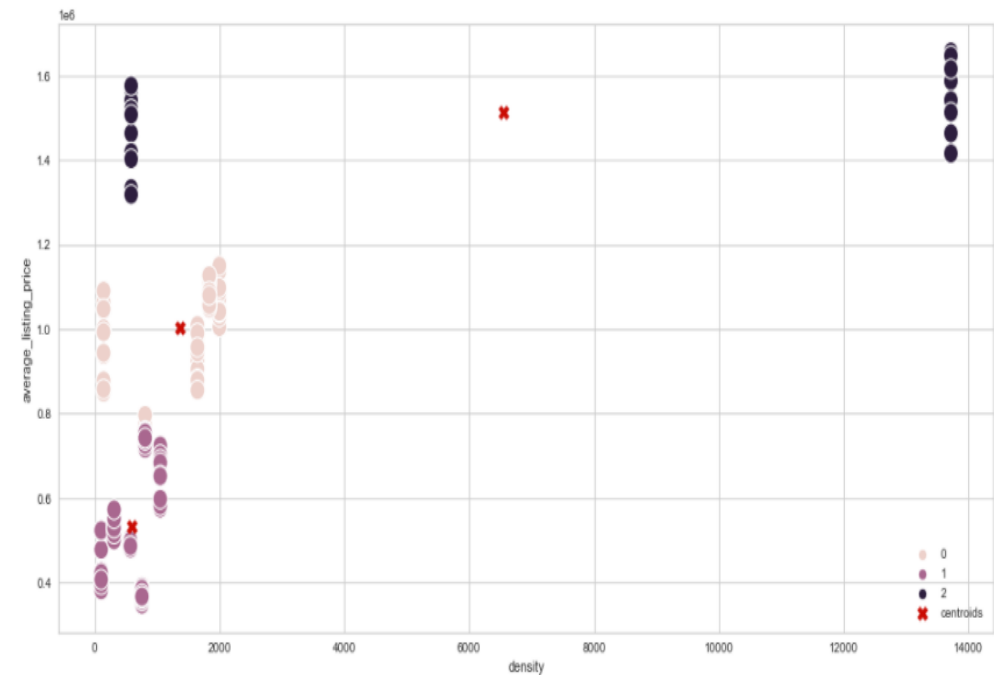## Average Listing Price (State Level)

For 2019

For 2021

K-means
Average Listing Price (Individual State Level)-Massachusetts

2019

2021

Expected Outcome

Has there been a change in house prices since COVID-19?

There has been a change in house prices since COVID-19. According to Airgood-Obrycki, there were construction delays in 2020 because "local business offices were closed or adopted new processes, shutdown of non-essential construction, supply chains have been disrupted, and construction labor force was at risk." Thus, there has been a short of housing inventory. According to Friedman, "a shortage of homes for sale led to bidding wars, pushing price growth to new high."

Expected Outcome

Has there been a change in in-demand house location since COVID-19?

There has been a change in in-demand house location since COVID-19. According to Liu, "homes sales declined more in counties with higher population density and higher pre-COVID home value. The pandemic has spurred more new listings in denser neighborhoods. As a result, home inventory increased more in denser and more expensive counties. The pandemic has shifted housing toward less dense and cheaper locations."

Expected Outcome

Has there been a change in buyer's house buying criteria since COVID-19?

There has been a change in buyer's house buying criteria since COVID-19. According to Dotzour, "Americans will move within 60 minutes of major cities as the historic benefits of dense urban housing and work arrangement are curb by COVID restriction." Previous commuters to work "have broadly embraced work-from-home arrangements, previous home buying considerations like concerns about commutes will fall in importance." (Dotzour)

References

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Friedman, N. (2022, February 23). Home-Price Growth Hit Record in 2021. *Wall Street Journal - Online Edition*, N.PAG.

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Zhai, W., & Peng, Z.-R. (2021). Featured Graphics: Where to Buy a House in the United States amid COVID-19? Environment and Planning A, 53(1), 9–11. Retrieved Feb. 3, 2022. https://doi-org.proxy-bc.researchport.umd.edu/http://epn.sagepub.com/content/by/year