



alpaca

Brandeis International Business School
MARKET RESEARCH FIELD PROJECT

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Background & Objectives

Background

Alpaca is looking to expand their apartment rental services beyond their current presence in Boston and New York City, and wants to find out which city or cities to best focus on next for expansion efforts

Objectives

Assess prospective cities for subsequent expansion of the chatbot product that aids users in their apartment rental search

Rank the top five cities based on metric analysis for market expansion purposes

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Method

For comparison purposes, we utilize two approaches to the data in conjunction with one another



Two Approaches to Data

– Success Cities & Ideal City

We use two types of benchmarks for our analysis:

Success Cities: Using New York and Boston as benchmarks to perform distance-based data analysis and assess the similarities with the potential cities

Ideal City: Using client recommendations, we built an “ideal” case to use as the benchmark for data analysis

Two Approaches to Data - All Metrics & Key Metrics

Using our benchmarks, we analyzed the data using two methods:



All Metrics: Analysis accounts for all metrics in the dataset as discussed, each given equal weights

Key Metrics: Analysis specifically selects metrics that are deemed most influential to the expansion efforts via discussions between the client and the team

Data Analysis: Normalization

- We normalize the data to adjust values measured on different scales to a notionally common scale
- This is done via min-max feature scaling to bring all the values within the range [0, 1]
- Through this process, we can eliminate possible errors caused by imbalanced measurement unit of our different variables

Data Analysis: Euclidean Distance

- We use the Euclidean distance to measure the distance between benchmark cities and potential cities
- The lower the distance value, the higher the similarities between the potential city and the benchmark cities

$$\begin{aligned}d(\mathbf{p}, \mathbf{q}) = d(\mathbf{q}, \mathbf{p}) &= \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2} \\&= \sqrt{\sum_{i=1}^n (q_i - p_i)^2}.\end{aligned}$$

	Population	Population Change (%)	Population Change	Population Density (per sq. Miles)	Age 25-34	Age 25-34(%)	Median Age	Immigrant Population (%) (2018 Census)
Mean	5298227.27	0.01	37395.66	852.27	876754.55	0.15	37.59	0.19
Range	16484000.00	0.04	148999.51	2092.60	2610450.00	0.04	7.70	0.31
Stdev	3878110.74	0.01	40607.34	542.17	605038.13	0.01	2.00	0.08

Metric Statistics

	Average Studio Rent Price	Average 1br Rent Price	Average 2br Rent Price	Total Apartment Stock	Vacancy Rates (%)	Homeownership Rate	Median Household Income (2018 Census)	Number of Colleges (by State)
Mean	1074.19	1263.74	1570.28	515475.27	0.06	0.61	73574.55	483.50
Range	1294.00	1589.00	1995.00	2221060.00	0.09	0.22	52986.00	1213.00
Stdev	358.03	415.89	527.31	494635.97	0.02	0.06	14177.55	402.96

Metric Statistics

Data Analysis: Accounting for Range Disparities

Due to the varied dimensions of each variables, we ran the model excluding some of the metrics that may be statistically insignificant in the analysis:

	Population Change (%)	Age 25-34(%)	Immigrant Population (%) (2018 Census)	Vacancy Rates (%)	Homeownership Rate(%)
Range	0.04	0.04	0.31	0.09	0.22
Stdev	0.01	0.01	0.08	0.02	0.06

We found that while the results from ranks 3 and below differ, the top ranked cities remained the same.

With all metrics

Rank	Metro_area	Distance from Ideal Metro_area
1	San Francisco-Oakland-Berkeley, CA	3.1888
2	Los Angeles-Long Beach-Anaheim, CA	4.3485
3	Washington-Arlington-Alexandria, DC-VA-MD-WV	5.2812
4	San Diego-Chula Vista-Carlsbad, CA	5.7214
5	Houston-The Woodlands-Sugar Land, TX	6.2371
6	Seattle-Tacoma-Bellevue, WA	6.3841
7	Miami-Fort Lauderdale-Pompano Beach, FL	6.5108
8	Atlanta-Sandy Springs-Alpharetta, GA	7.0549
9	Chicago-Naperville-Elgin, IL-IN-WI	7.1280
10	Dallas-Fort Worth-Arlington, TX	7.1906
11	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	7.3133
12	Tampa-St. Petersburg-Clearwater, FL	7.3145
13	Denver-Aurora-Lakewood, CO	7.4260
14	Riverside-San Bernardino-Ontario, CA	7.4261
15	Baltimore-Columbia-Towson, MD	7.7215

Without small-range metrics

Rank	Metro_area	Distance from Ideal Metro_area
1	San Francisco-Oakland-Berkeley, CA	2.3990
2	Los Angeles-Long Beach-Anaheim, CA	3.1715
3	San Diego-Chula Vista-Carlsbad, CA	4.9013
4	Washington-Arlington-Alexandria, DC-VA-MD-WV	5.0140
5	Seattle-Tacoma-Bellevue, WA	5.9470
6	Miami-Fort Lauderdale-Pompano Beach, FL	6.1056
7	Chicago-Naperville-Elgin, IL-IN-WI	6.2402
8	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	6.3710
9	Atlanta-Sandy Springs-Alpharetta, GA	6.5621
10	Baltimore-Columbia-Towson, MD	6.6121
11	Houston-The Woodlands-Sugar Land, TX	6.6320
12	Dallas-Fort Worth-Arlington, TX	6.6534
13	Tampa-St. Petersburg-Clearwater, FL	6.7256
14	Riverside-San Bernardino-Ontario, CA	7.0017
15	Denver-Aurora-Lakewood, CO	7.1638



Results

All Metrics Approach

Rank	Metro-area	Distance from Boston
1	Washington-Arlington-Alexandria, DC-VA-MD-WV	0.0734
2	San Diego-Chula Vista-Carlsbad, CA	0.3668
3	Houston-The Woodlands-Sugar Land, TX	0.8825
4	Los Angeles-Long Beach-Anaheim, CA	1.0062
5	Seattle-Tacoma-Bellevue, WA	1.0294
6	Miami-Fort Lauderdale-Pompano Beach, FL	1.1562
7	Atlanta-Sandy Springs-Alpharetta, GA	1.7003
8	Chicago-Naperville-Elgin, IL-IN-WI	1.7733
9	Dallas-Fort Worth-Arlington, TX	1.8360
10	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1.9587
11	Tampa-St. Petersburg-Clearwater, FL	1.9599
12	Denver-Aurora-Lakewood, CO	2.0714
13	Riverside-San Bernardino-Ontario, CA	2.0714
14	San Francisco-Oakland-Berkeley, CA	2.1659
15	Baltimore-Columbia-Towson, MD	2.3668

Result Tables- All Metrics

Rank	Metro-area	Distance from Boston	Rank	Metro-area	Distance from NYC
1	Washington-Arlington-Alexandria, DC-VA-MD-WV	0.0734	1	San Francisco-Oakland-Berkeley, CA	0.2185
2	San Diego-Chula Vista-Carlsbad, CA	0.3668	2	Los Angeles-Long Beach-Anaheim, CA	1.3782
3	Houston-The Woodlands-Sugar Land, TX	0.8825	3	Washington-Arlington-Alexandria, DC-VA-MD-WV	2.3109
4	Los Angeles-Long Beach-Anaheim, CA	1.0062	4	San Diego-Chula Vista-Carlsbad, CA	2.7511
5	Seattle-Tacoma-Bellevue, WA	1.0294	5	Houston-The Woodlands-Sugar Land, TX	3.2668
6	Miami-Fort Lauderdale-Pompano Beach, FL	1.1562	6	Seattle-Tacoma-Bellevue, WA	3.4138
7	Atlanta-Sandy Springs-Alpharetta, GA	1.7003	7	Miami-Fort Lauderdale-Pompano Beach, FL	3.5405
8	Chicago-Naperville-Elgin, IL-IN-WI	1.7733	8	Atlanta-Sandy Springs-Alpharetta, GA	4.0846
9	Dallas-Fort Worth-Arlington, TX	1.8360	9	Chicago-Naperville-Elgin, IL-IN-WI	4.1577
10	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1.9587	10	Dallas-Fort Worth-Arlington, TX	4.2203
11	Tampa-St. Petersburg-Clearwater, FL	1.9599	11	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	4.3430
12	Denver-Aurora-Lakewood, CO	2.0714	12	Tampa-St. Petersburg-Clearwater, FL	4.3442
13	Riverside-San Bernardino-Ontario, CA	2.0714	13	Denver-Aurora-Lakewood, CO	4.4557
14	San Francisco-Oakland-Berkeley, CA	2.1659	14	Riverside-San Bernardino-Ontario, CA	4.4558
15	Baltimore-Columbia-Towson, MD	2.3668	15	Baltimore-Columbia-Towson, MD	4.7512

Result Tables- All Metrics

Rank	Metro-area	Distance from Boston	Rank	Metro-area	Distance from NYC	Rank	Metro-area	Distance from Ideal Metro-area
1	Washington-Arlington-Alexandria, DC-VA-MD-WV	0.0734	1	San Francisco-Oakland-Berkeley, CA	0.2185	1	San Francisco-Oakland-Berkeley, CA	3.1888
2	San Diego-Chula Vista-Carlsbad, CA	0.3668	2	Los Angeles-Long Beach-Anaheim, CA	1.3782	2	Los Angeles-Long Beach-Anaheim, CA	4.3485
3	Houston-The Woodlands-Sugar Land, TX	0.8825	3	Washington-Arlington-Alexandria, DC-VA-MD-WV	2.3109	3	Washington-Arlington-Alexandria, DC-VA-MD-WV	5.2812
4	Los Angeles-Long Beach-Anaheim, CA	1.0062	4	San Diego-Chula Vista-Carlsbad, CA	2.7511	4	San Diego-Chula Vista-Carlsbad, CA	5.7214
5	Seattle-Tacoma-Bellevue, WA	1.0294	5	Houston-The Woodlands-Sugar Land, TX	3.2668	5	Houston-The Woodlands-Sugar Land, TX	6.2371
6	Miami-Fort Lauderdale-Pompano Beach, FL	1.1562	6	Seattle-Tacoma-Bellevue, WA	3.4138	6	Seattle-Tacoma-Bellevue, WA	6.3841
7	Atlanta-Sandy Springs-Alpharetta, GA	1.7003	7	Miami-Fort Lauderdale-Pompano Beach, FL	3.5405	7	Miami-Fort Lauderdale-Pompano Beach, FL	6.5108
8	Chicago-Naperville-Elgin, IL-IN-WI	1.7733	8	Atlanta-Sandy Springs-Alpharetta, GA	4.0846	8	Atlanta-Sandy Springs-Alpharetta, GA	7.0549
9	Dallas-Fort Worth-Arlington, TX	1.8360	9	Chicago-Naperville-Elgin, IL-IN-WI	4.1577	9	Chicago-Naperville-Elgin, IL-IN-WI	7.1280
10	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1.9587	10	Dallas-Fort Worth-Arlington, TX	4.2203	10	Dallas-Fort Worth-Arlington, TX	7.1906
11	Tampa-St. Petersburg-Clearwater, FL	1.9599	11	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	4.3430	11	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	7.3133
12	Denver-Aurora-Lakewood, CO	2.0714	12	Tampa-St. Petersburg-Clearwater, FL	4.3442	12	Tampa-St. Petersburg-Clearwater, FL	7.3145
13	Riverside-San Bernardino-Ontario, CA	2.0714	13	Denver-Aurora-Lakewood, CO	4.4557	13	Denver-Aurora-Lakewood, CO	7.4260
14	San Francisco-Oakland-Berkeley, CA	2.1659	14	Riverside-San Bernardino-Ontario, CA	4.4558	14	Riverside-San Bernardino-Ontario, CA	7.4261
15	Baltimore-Columbia-Towson, MD	2.3668	15	Baltimore-Columbia-Towson, MD	4.7512	15	Baltimore-Columbia-Towson, MD	7.7215

Result Tables- All Metrics

Common Patterns

Using this approach, the top three ranked cities are interchangeably the same:

1. San Francisco

Ranks 1st in analyses using NYC and Ideal as benchmarks, 15th when using Boston

2. Washington DC

Ranks 1st in analyses using Boston, 3rd when using NYC and Ideal

3. Los Angeles

Ranks 4th for Boston, 2nd for NYC and Ideal



Key Metrics Approach

Rank	Metro-area	Distance from Boston
1	San Francisco-Oakland-Berkeley, CA	0.3055
2	Washington-Arlington-Alexandria, DC-VA-MD-WV	0.3346
3	Los Angeles-Long Beach-Anaheim, CA	0.4333
4	Houston-The Woodlands-Sugar Land, TX	1.1630
5	San Diego-Chula Vista-Carlsbad, CA	1.2900
6	Atlanta-Sandy Springs-Alpharetta, GA	1.4066
7	Chicago-Naperville-Elgin, IL-IN-WI	1.4165
8	Seattle-Tacoma-Bellevue, WA	1.4271
9	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1.5114
10	Tampa-St. Petersburg-Clearwater, FL	1.5424
11	Baltimore-Columbia-Towson, MD	1.5606
12	Miami-Fort Lauderdale-Pompano Beach, FL	1.5845
13	Detroit-Warren-Dearborn, MI	1.8966
14	Dallas-Fort Worth-Arlington, TX	1.9227
15	Minneapolis-St. Paul-Bloomington, MN-WI	2.0415

Result Tables- Key Metrics

Rank	Metro-area	Distance from Boston
1	San Francisco-Oakland-Berkeley, CA	0.3055
2	Washington-Arlington-Alexandria, DC-VA-MD-WV	0.3346
3	Los Angeles-Long Beach-Anaheim, CA	0.4333
4	Houston-The Woodlands-Sugar Land, TX	1.1630
5	San Diego-Chula Vista-Carlsbad, CA	1.2900
6	Atlanta-Sandy Springs-Alpharetta, GA	1.4066
7	Chicago-Naperville-Elgin, IL-IN-WI	1.4165
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Rank	Metro-area	Distance from NYC
1	San Francisco-Oakland-Berkeley, CA	0.9143
2	Washington-Arlington-Alexandria, DC-VA-MD-WV	1.5544
3	Los Angeles-Long Beach-Anaheim, CA	1.6531
4	Houston-The Woodlands-Sugar Land, TX	2.3828
5	San Diego-Chula Vista-Carlsbad, CA	2.5099
6	Atlanta-Sandy Springs-Alpharetta, GA	2.6264
7	Chicago-Naperville-Elgin, IL-IN-WI	2.6363
8	Seattle-Tacoma-Bellevue, WA	2.6469
9	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	2.7312
10	Tampa-St. Petersburg-Clearwater, FL	2.7622
11	Baltimore-Columbia-Towson, MD	2.7804
12	Miami-Fort Lauderdale-Pompano Beach, FL	2.8043
13	Detroit-Warren-Dearborn, MI	3.1165
14	Dallas-Fort Worth-Arlington, TX	3.1425
15	Minneapolis-St. Paul-Bloomington, MN-WI	3.2613

Result Tables- Key Metrics

Rank	Metro-area	Distance from Boston
1	San Francisco-Oakland-Berkeley, CA	0.3055
2	Washington-Arlington-Alexandria, DC-VA-MD-WV	0.3346
3	Los Angeles-Long Beach-Anaheim, CA	0.4333
4	Houston-The Woodlands-Sugar Land, TX	1.1630
5	San Diego-Chula Vista-Carlsbad, CA	1.2900
6	Atlanta-Sandy Springs-Alpharetta, GA	1.4066
7	Chicago-Naperville-Elgin, IL-IN-WI	1.4165
8	Seattle-Tacoma-Bellevue, WA	1.4271
9	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1.5114
10	Tampa-St. Petersburg-Clearwater, FL	1.5424
11	Baltimore-Columbia-Towson, MD	1.5606
12	Miami-Fort Lauderdale-Pompano Beach, FL	1.5845
13	Detroit-Warren-Dearborn, MI	1.8966
14	Dallas-Fort Worth-Arlington, TX	1.9227
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2	Washington-Arlington-Alexandria, DC-VA-MD-WV	1.5544
3	Los Angeles-Long Beach-Anaheim, CA	1.6531
4	Houston-The Woodlands-Sugar Land, TX	2.3828
5	San Diego-Chula Vista-Carlsbad, CA	2.5099
6	Atlanta-Sandy Springs-Alpharetta, GA	2.6264
7	Chicago-Naperville-Elgin, IL-IN-WI	2.6363
8	Seattle-Tacoma-Bellevue, WA	2.6469
9	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	2.7312
10	Tampa-St. Petersburg-Clearwater, FL	2.7622
11	Baltimore-Columbia-Towson, MD	2.7804
12	Miami-Fort Lauderdale-Pompano Beach, FL	2.8043
13	Detroit-Warren-Dearborn, MI	3.1165
14	Dallas-Fort Worth-Arlington, TX	3.1425
15	Minneapolis-St. Paul-Bloomington, MN-WI	3.2613

Rank	Metro-area	Distance from Ideal Metro-area
1	San Francisco-Oakland-Berkeley, CA	1.4276
2	Washington-Arlington-Alexandria, DC-VA-MD-WV	2.0677
3	Los Angeles-Long Beach-Anaheim, CA	2.1664
4	Houston-The Woodlands-Sugar Land, TX	2.8961
5	San Diego-Chula Vista-Carlsbad, CA	3.0231
6	Atlanta-Sandy Springs-Alpharetta, GA	3.1397
7	Chicago-Naperville-Elgin, IL-IN-WI	3.1496
8	Seattle-Tacoma-Bellevue, WA	3.1602
9	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	3.2445
10	Tampa-St. Petersburg-Clearwater, FL	3.2755
11	Baltimore-Columbia-Towson, MD	3.2937
12	Miami-Fort Lauderdale-Pompano Beach, FL	3.3176
13	Detroit-Warren-Dearborn, MI	3.6297
14	Dallas-Fort Worth-Arlington, TX	3.6558
15	Minneapolis-St. Paul-Bloomington, MN-WI	3.7746

Result Tables- Key Metrics

Metro Area	Average Ranks
Washington DC	2.17
San Francisco	2.33
Los Angeles	2.67
Houston	3.67
San Diego	4.83
Atlanta	7.33
Seattle	7.33
Chicago	8.50
Miami	8.83

- Includes:
- Boston, All Metrics
 - Boston, Key Metrics
 - NYC, All Metrics
 - NYC, Key Metrics
 - Ideal, All Metrics
 - Ideal, Key Metrics

Average Ranks (in order)

*More in Appendix

Recommendations

Preliminary & Post-Qualitative Analysis

PRELIMINARY RECOMMENDATIONS

TOP 3

1. Washington DC
2. San Francisco
3. Los Angeles

Los Angeles-Long Beach-Anaheim, CA

Rank 3 → 1



Covid Commentary:

- Rent freeze, eviction ban
- 160th in daily new cases

Key takeaways:

- 2nd most populous metro area (+)
- Highest population density (+)
- Lowest vacancy rate (2.3%) (+)
- Lowest homeownership rate (+)
- Highest apartment stock among all metros (+)
- Lowest average real estate commission among top 5 - 4.96% (-)

San Francisco-Oakland-Berkeley, CA

Rank 2



Avg rent



Population



Covid Commentary:

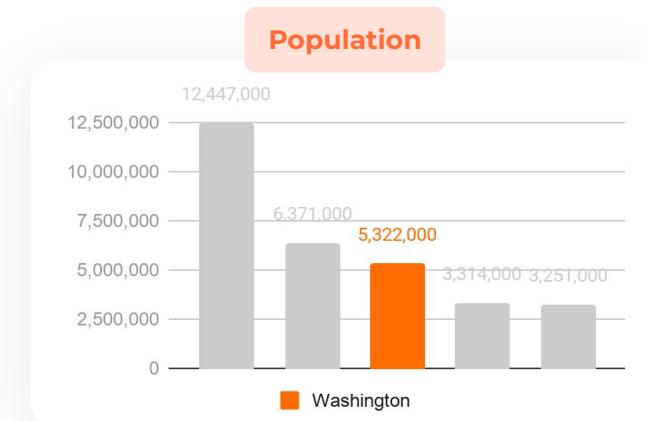
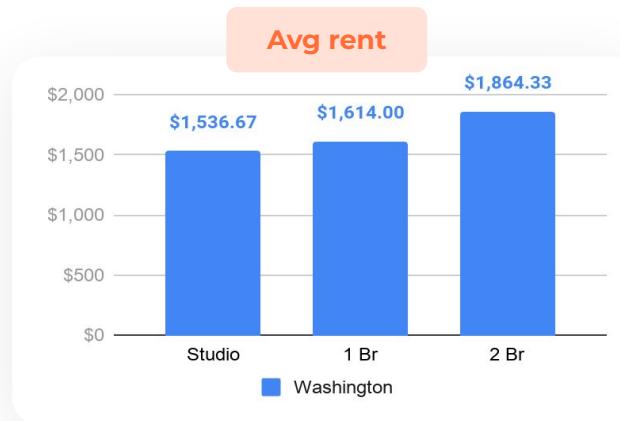
- Until August 31st, ban on eviction and rent increase
- 287th in daily new cases

Key takeaways:

- Highest average rent among all metro areas (+)
- Highest median household income (+)
- 3rd most densely populated metro (+)
- 4th highest population for ages 25-34 in terms of % (+)

Washington-Arlington-Alexandria, DC-VA-MD-WV

Rank 1 → 3



Covid Commentary:

- Rent freeze
- Rent assistance policies
- 385th (last) in daily new cases confirmed across all metros

Key takeaways:

- 2nd highest median household income (+)
- 4th highest average rent for studio apartments (+)
- Highest average broker's fee among top 5 at 5.7% (+)
- Highest homeownership rate among top 3 (-)

Final Recommendations

Through this analysis, we found there can be some changes to the rankings:

1. Los Angeles (↑)
2. San Francisco (~)
3. Washington DC (↓)



Questions & Comments?

Thank You!

Appendix

Links

- [Excel sheet](#)
- [Qualitative Data Document](#)
- [Working code](#)
- [Covid Data](#)

Population	Population Change (%)	Population Change	Population Density (per sq. Miles)	Age 25-34	Age 25-34(%)	Median Age	Immigrant Population (%) (2018 Census)
14,000,000	2.98%	405,127	2,251.10	2942,971.00	17.04%	35	34.00%

Average Studio Rent Price	Average 1br Rent Price	Average 2br Rent Price	Total Apartment Stock	Vacancy Rates (%)	Homeownership Rate	Median Household Income (2018 Census)	Number of Colleges (by State)
1,989.00	2,445.00	3,071.00	2,000,000.00	2.30%	48.20%	83,594.50	1000

Ideal Metro-area Metric Values

Metrics List

- Population
- Population Change (%)
- Population Change
- Population Density (per sq. Miles)
- Age 25-34
- Age 25-34(%)
- Average Studio Rent Price
- Average 1Br Rent Price
- Average 2Br Rent Price
- Total Apartment Stock
- Vacancy Rate (%)
- Homeownership Rate(%)
- Median Household Income (2018 Census)
- Median Age
- Immigrant Population (%) (2018 Census)
- Number of Colleges (by State)

Metro Area	Rank – Ideal All Variables	Rank – Ideal Key Variables	Average Rank
San Francisco	1	1	1
Washington DC	3	2	2.5
Los Angeles	2	3	2.5
Houston	4	4	4
San Diego	5	5	5
Atlanta	9	6	7.5
Seattle	7	8	7.5
Chicago	10	7	8.5
Miami	6	12	9

Rank Summary - Ideal

Metro Area	Rank – Boston All Variables	Rank – NYC All Variables	Rank – Ideal All Variables	Rank – Boston Key Variables	Rank – NYC Key Variables	Rank – Ideal Key Variables	Average Rank
Washington DC	1	3	3	2	2	2	2.17
San Francisco	9	1	1	1	1	1	2.33
Los Angeles	3	2	2	3	3	3	2.67
Houston	2	4	4	4	4	4	3.67
San Diego	4	5	5	5	5	5	4.83
Atlanta	8	9	9	6	6	6	7.33
Seattle	6	7	7	8	8	8	7.33
Chicago	10	10	10	7	7	7	8.50
Miami	5	6	6	12	12	12	8.83

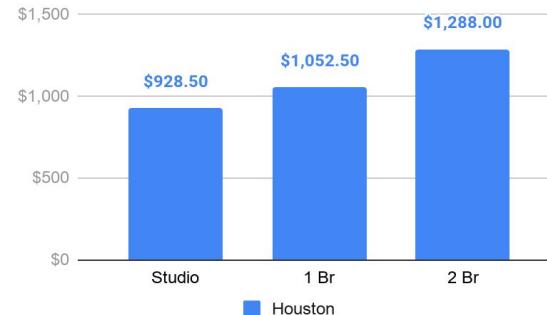
Rank Summary

Houston-The Woodlands-Sugar Land, TX

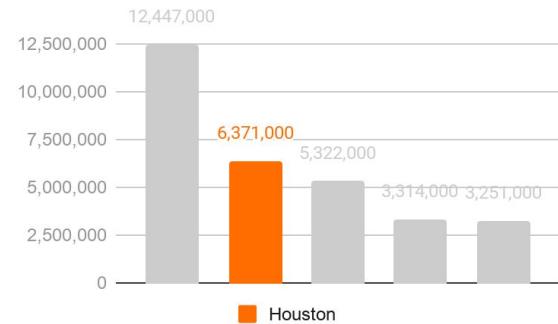
Rank 4



Avg rent



Population



Covid Commentary:

- Rent relief not provided by government, but by independent organizations
- 98th in daily new cases
- 94th in deaths due to Covid

Key takeaways:

- 4th most populous metro area, median age below 35 (+)
- Highest vacancy rate at 11% (-)
- 8th least densely populated metro area (-)
- Relatively high homeownership rate - 60% (-)

San Diego-Chula Vista-Carlsbad, CA

Rank 5



Avg rent



Population



Covid Commentary:

- Temporary ban on evictions, rent increases
- 334th in daily new cases
- 343th for daily new deaths

Key takeaways:

- Low vacancy rate - 2.9% (+)
- 3rd lowest homeownership rate (+)
- 3rd highest population of ages 25-34 in terms of % (+)

Metro Area	Average Broker Commission Rate in 2018(%)
<u>Washington DC</u>	5.71
<u>San Francisco</u>	5.04
<u>Los Angeles</u>	4.96
<u>Houston</u>	5.45
<u>San Diego</u>	4.92

Broker Fee Statistics

*[Source](#)