Courtney Zimmer_Final Project

September 6, 2020

1 IST 652 - Final Project

1.1 Does Airbnb have a negative effect on the real estate rental market in NYC?

1.2 Importing the data

[7]:
```
import pandas as pd
import numpy as np
```

[8]:
```
# Importing the AirBnb dataset. Each dataset is from January of each year
ny2015 = pd.read_csv('/Users/ihrtrobot/Desktop/IST652/Final Project/NY_01-2015.
 ↪csv',
                     index_col=0)
ny2016 = pd.read_csv('/Users/ihrtrobot/Desktop/IST652/Final Project/NY_01-2016.
 ↪csv',
                     index_col=0)
ny2017 = pd.read_csv('/Users/ihrtrobot/Desktop/IST652/Final Project/NY_01-2017.
 ↪csv',
                     index_col=0)
ny2018 = pd.read_csv('/Users/ihrtrobot/Desktop/IST652/Final Project/NY_01-2018.
 ↪csv',
                     index_col=0)
ny2019 = pd.read_csv('/Users/ihrtrobot/Desktop/IST652/Final Project/NY_01-2019.
 ↪csv',
                     index_col=0)
ny2020 = pd.read_csv('/Users/ihrtrobot/Desktop/IST652/Final Project/NY_01-2020.
 ↪csv',
                     index_col=0)
```

[9]:
```
#Import the Streeteasy rental inventory dataset
rental_df = pd.read_csv('/Users/ihrtrobot/Desktop/IST652/Final Project/
 ↪rentalInventory_All.csv')
rental_df.head(5)
```

[9]:

	areaName	Borough	areaType	2010-01	2010-02	2010-03	2010-04	\
0	Bronx	Bronx	borough	165	183	186	154	
1	Brooklyn	Brooklyn	borough	1831	1799	1860	1857	
2	Manhattan	Manhattan	borough	12925	13461	13650	13933	

```
3         Queens         Queens  borough      562      587      599      567
4  Staten Island  Staten Island  borough        7        5        6        6

   2010-05  2010-06  2010-07  …  2019-10  2019-11  2019-12  2020-01  \
0      138      119      107  …      885      837      731      719
1     1688     1637     1577  …    10395     9183     8228     9301
2    13191    13602    12919  …    16595    14677    13422    14547
3      538      548      530  …     4710     4151     3697     4146
4        2        3        2  …       65       62       49       49

   2020-02  2020-03  2020-04  2020-05  2020-06  2020-07
0      653      569      427      568      678      772
1     8831     8104     7341    13011    18189    22708
2    13308    12426    12395    20029    28572    37195
3     3887     3304     2593     3855     5304     6637
4       51       46       26       40       38       36

[5 rows x 130 columns]
```

1.3 Data Cleaning

[10]:
```
# Subsetting the streeteasy dataset to only show the 5 NYC boroughs
borough = rental_df[rental_df['areaType']=='borough']
# Removing the borough and areaType columns
borough = borough.drop(columns = ['Borough','areaType'])
# setting the index to the borough name column
borough = borough.set_index('areaName')
borough.head(3)
```

[10]:
```
           2010-01  2010-02  2010-03  2010-04  2010-05  2010-06  2010-07  \
areaName
Bronx          165      183      186      154      138      119      107
Brooklyn      1831     1799     1860     1857     1688     1637     1577
Manhattan    12925    13461    13650    13933    13191    13602    12919

           2010-08  2010-09  2010-10  …  2019-10  2019-11  2019-12  2020-01  \
areaName                              …
Bronx          109       81       97  …      885      837      731      719
Brooklyn      1581     1384     1429  …    10395     9183     8228     9301
Manhattan    12190    10718    10531  …    16595    14677    13422    14547

           2020-02  2020-03  2020-04  2020-05  2020-06  2020-07
areaName
Bronx          653      569      427      568      678      772
Brooklyn      8831     8104     7341    13011    18189    22708
Manhattan    13308    12426    12395    20029    28572    37195
```

```
[3 rows x 127 columns]
```

[11]:
```
# Transposing the rows and columns of the original dataframe
# Adding an index column and renaming the YearMonth column
boro_df = borough.T
boro_df = boro_df.reset_index()
boro_df = boro_df.rename(columns = {'index':'YearMonth'})
boro_df.head(3)
```

[11]:

areaName	YearMonth	Bronx	Brooklyn	Manhattan	Queens	Staten Island
0	2010-01	165	1831	12925	562	7
1	2010-02	183	1799	13461	587	5
2	2010-03	186	1860	13650	599	6

[12]:
```
# Adding a Year and Month column for analysis purposes
boro_df['Year'] = boro_df['YearMonth'].str.split('-').str[0]
boro_df['Month'] = boro_df['YearMonth'].str.split('-').str[-1]
boro_df.head(3)
```

[12]:

areaName	YearMonth	Bronx	Brooklyn	Manhattan	Queens	Staten Island	Year	\
0	2010-01	165	1831	12925	562	7	2010	
1	2010-02	183	1799	13461	587	5	2010	
2	2010-03	186	1860	13650	599	6	2010	

areaName	Month
0	01
1	02
2	03

[13]:
```
# Creating a neighborhood only dataframe and removing redundant name columns
neigh = rental_df[rental_df['areaType']=='neighborhood']
neighborhood = ['Bedford-Stuyvesant', 'Williamsburg', 'Bushwick', 'Midtown␣
↪West', 'Upper West Side'
                , 'East Village', 'Upper East Side', 'Crown Heights',␣
↪'Midtown', 'Central Harlem']
neigh = neigh[neigh.areaName.isin(neighborhood)]
neigh = neigh.drop(columns = ['Borough','areaType'])
neigh = neigh.set_index('areaName')
neigh.head()
```

[13]:

areaName	2010-01	2010-02	2010-03	2010-04	2010-05	2010-06	\
Bedford-Stuyvesant	132	122	118	121	105	110	
Bushwick	13	12	20	52	41	18	
Central Harlem	430	402	345	316	288	325	
Crown Heights	87	78	78	84	83	67	
East Village	457	486	537	539	562	566	

```
                    2010-07  2010-08  2010-09  2010-10  …  2019-10  2019-11  \
areaName                                                 …
Bedford-Stuyvesant      101      113      107      129  …     1405     1261
Bushwick                 22       16       21       19  …     1142      930
Central Harlem          302      301      262      281  …      721      643
Crown Heights            67       79       73       61  …      908      851
East Village            499      422      343      321  …      857      674

                    2019-12  2020-01  2020-02  2020-03  2020-04  2020-05  \
areaName
Bedford-Stuyvesant     1136     1344     1258     1162     1013     1959
Bushwick                793      895      901      863      816     1636
Central Harlem          575      671      620      576      462      792
Crown Heights           853      969      842      761      686     1184
East Village            622      659      628      631      786     1548

                    2020-06  2020-07
areaName
Bedford-Stuyvesant     2607     3304
Bushwick               2316     2922
Central Harlem         1159     1479
Crown Heights          1734     1983
East Village           2290     3022

[5 rows x 127 columns]
```

[14]:
```
# Transposing the rows and columns of the original dataframe
# Adding an index column and renaming the YearMonth column
neigh_df = neigh.T
neigh_df = neigh_df.reset_index()
neigh_df = neigh_df.rename(columns = {'index':'YearMonth'})
neigh_df['Year'] = neigh_df['YearMonth'].str.split('-').str[0]
neigh_df['Month'] = neigh_df['YearMonth'].str.split('-').str[-1]
neigh_df.head(20)
```

[14]:
```
areaName YearMonth  Bedford-Stuyvesant  Bushwick  Central Harlem  \
0          2010-01                 132        13             430
1          2010-02                 122        12             402
2          2010-03                 118        20             345
3          2010-04                 121        52             316
4          2010-05                 105        41             288
5          2010-06                 110        18             325
6          2010-07                 101        22             302
7          2010-08                 113        16             301
8          2010-09                 107        21             262
9          2010-10                 129        19             281
```

10	2010-11	123	20	263
11	2010-12	139	51	241
12	2011-01	166	72	248
13	2011-02	169	96	249
14	2011-03	147	124	290
15	2011-04	150	77	310
16	2011-05	143	78	304
17	2011-06	134	33	292
18	2011-07	154	38	294
19	2011-08	171	40	288

areaName	Crown Heights	East Village	Midtown	Midtown West	Upper East Side	\
0	87	457	489	774	2550	
1	78	486	454	826	2652	
2	78	537	414	817	2641	
3	84	539	440	896	2589	
4	83	562	400	826	2500	
5	67	566	365	895	2670	
6	67	499	353	911	2579	
7	79	422	384	715	2556	
8	73	343	374	640	2339	
9	61	321	381	682	2378	
10	92	332	360	668	2302	
11	97	312	382	618	2404	
12	129	329	370	626	2417	
13	135	310	350	648	2283	
14	117	341	366	660	2527	
15	105	402	342	688	2333	
16	110	444	373	752	2326	
17	117	501	385	773	2394	
18	137	498	353	740	2367	
19	112	496	352	805	2345	

areaName	Upper West Side	Williamsburg	Year	Month
0	2164	317	2010	01
1	2188	315	2010	02
2	2309	342	2010	03
3	2455	316	2010	04
4	2327	282	2010	05
5	2414	303	2010	06
6	2220	308	2010	07
7	1924	305	2010	08
8	1699	236	2010	09
9	1669	220	2010	10
10	1614	218	2010	11
11	1560	171	2010	12
12	1563	175	2011	01

13	1576	229	2011	02
14	1673	253	2011	03
15	1608	233	2011	04
16	1746	275	2011	05
17	1955	288	2011	06
18	2053	275	2011	07
19	2080	260	2011	08

1.4 Exploratory Analysis

1.4.1 Airbnb Data

[15]:
```
# Calculating the Average Price by Borough for each of the years
df15 = ny2015.groupby('neighbourhood_group')['price'].mean()
df16 = ny2016.groupby('neighbourhood_group')['price'].mean()
df17 = ny2017.groupby('neighbourhood_group')['price'].mean()
df18 = ny2018.groupby('neighbourhood_group')['price'].mean()
df19 = ny2019.groupby('neighbourhood_group')['price'].mean()
df20 = ny2020.groupby('neighbourhood_group')['price'].mean()

# Merging all of the Average Prices by Boroughs into on dataframe
df = pd.merge(df15, df16, on='neighbourhood_group')
df = pd.merge(df, df17, on='neighbourhood_group')
df = pd.merge(df, df18, on='neighbourhood_group')
df = pd.merge(df, df19, on='neighbourhood_group')
df = pd.merge(df, df20, on='neighbourhood_group')
df.columns = ['2015', '2016', '2017', '2018', '2019', '2020']
df
```

[15]:

neighbourhood_group	2015	2016	2017	2018	2019	2020
Bronx	83.066406	82.159645	80.247295	87.113450	86.289825	89.158576
Brooklyn	129.712820	122.364759	120.069892	118.199901	121.196501	125.055593
Manhattan	206.289978	183.182927	180.846515	183.309904	192.046676	217.641681
Queens	103.336830	95.306306	94.412698	98.099921	100.514431	98.688015
Staten Island	185.215385	135.418478	103.939394	128.153355	110.292169	103.127937

[16]:
```
df = df.T
df
```

[16]:
neighbourhood_group	Bronx	Brooklyn	Manhattan	Queens	Staten Island
2015	83.066406	129.712820	206.289978	103.336830	185.215385
2016	82.159645	122.364759	183.182927	95.306306	135.418478
2017	80.247295	120.069892	180.846515	94.412698	103.939394
2018	87.113450	118.199901	183.309904	98.099921	128.153355
2019	86.289825	121.196501	192.046676	100.514431	110.292169
2020	89.158576	125.055593	217.641681	98.688015	103.127937

[17]:
```
# Calculating the Average Price by Borough by room type for each of the years
df15 = ny2015.groupby(['neighbourhood_group', 'room_type'])['price'].mean()
df16 = ny2016.groupby(['neighbourhood_group', 'room_type'])['price'].mean()
df17 = ny2017.groupby(['neighbourhood_group', 'room_type'])['price'].mean()
df18 = ny2018.groupby(['neighbourhood_group', 'room_type'])['price'].mean()
df19 = ny2019.groupby(['neighbourhood_group', 'room_type'])['price'].mean()
df20 = ny2020.groupby(['neighbourhood_group', 'room_type'])['price'].mean()

# Merging all of the Average Prices by Boroughs & room type into on dataframe
df1 = pd.merge(df15, df16, on = ['neighbourhood_group', 'room_type'])
df1 = pd.merge(df1, df17, on = ['neighbourhood_group', 'room_type'])
df1 = pd.merge(df1, df18, on = ['neighbourhood_group', 'room_type'])
df1 = pd.merge(df1, df19, on = ['neighbourhood_group', 'room_type'])
df1 = pd.merge(df1, df20, on = ['neighbourhood_group', 'room_type'])
df1.columns = ['2015', '2016', '2017', '2018', '2019', '2020']
df1
```

[17]:
neighbourhood_group	room_type	2015	2016	2017
Bronx	Entire home/apt	126.350649	129.807692	118.473404
	Private room	65.329193	64.938849	65.961995
	Shared room	56.555556	49.441860	49.394737
Brooklyn	Entire home/apt	179.257726	175.243116	172.871493
	Private room	81.006488	75.703212	77.824555
	Shared room	59.640000	55.687351	66.046196
Manhattan	Entire home/apt	254.762031	230.669392	237.402078
	Private room	115.525441	105.107148	107.711729
	Shared room	92.097561	82.796992	105.128623
Queens	Entire home/apt	141.001289	140.535679	140.784431
	Private room	73.027083	68.292279	68.660413
	Shared room	101.600000	77.116667	56.516129

```
Staten Island       Entire home/apt  299.179104  244.514286  168.310345
                    Private room      64.483871   69.018018   65.521127
                    Shared room       35.000000   46.666667   31.500000
```

neighbourhood_group	room_type	2018	2019	2020
Bronx	Entire home/apt	129.200787	120.084548	130.185022
	Private room	69.853832	67.905172	64.394993
	Shared room	61.925000	67.720000	76.126984
Brooklyn	Entire home/apt	171.402973	173.691955	178.176500
	Private room	75.888051	74.579226	75.922995
	Shared room	53.857513	51.893424	72.736961
Manhattan	Entire home/apt	239.713567	241.025170	243.447586
	Private room	106.042473	111.829581	178.675257
	Shared room	86.425000	85.489224	86.327935
Queens	Entire home/apt	144.769950	144.446798	145.627375
	Private room	73.760396	75.477941	70.350402
	Shared room	51.472574	65.800000	77.800000
Staten Island	Entire home/apt	202.423611	167.894040	143.580311
	Private room	65.415663	61.983240	62.924324
	Shared room	34.666667	85.000000	29.200000

[18]:
```
# Calculating the number of Airbnb listings for each of the years by boroughs & room type
df15 = ny2015.groupby(['neighbourhood_group', 'room_type'])['neighbourhood'].count()
df16 = ny2016.groupby(['neighbourhood_group', 'room_type'])['neighbourhood'].count()
df17 = ny2017.groupby(['neighbourhood_group', 'room_type'])['neighbourhood'].count()
df18 = ny2018.groupby(['neighbourhood_group', 'room_type'])['neighbourhood'].count()
df19 = ny2019.groupby(['neighbourhood_group', 'room_type'])['neighbourhood'].count()
df20 = ny2020.groupby(['neighbourhood_group', 'room_type'])['neighbourhood'].count()

# Merging all of the borough listings into one dataframe
df3 = pd.merge(df15, df16, on = ['neighbourhood_group', 'room_type'])
df3 = pd.merge(df3, df17, on = ['neighbourhood_group', 'room_type'])
df3 = pd.merge(df3, df18, on = ['neighbourhood_group', 'room_type'])
df3 = pd.merge(df3, df19, on = ['neighbourhood_group', 'room_type'])
df3 = pd.merge(df3, df20, on = ['neighbourhood_group', 'room_type'])
df3.columns = ['2015', '2016', '2017', '2018', '2019', '2020']
df3
```

[18]:

neighbourhood_group	room_type	2015	2016	2017	2018	2019	2020
Bronx	Entire home/apt	77	130	188	254	343	454
	Private room	161	278	421	561	580	719
	Shared room	18	43	38	40	50	63
Brooklyn	Entire home/apt	4854	6573	7486	9013	9807	10000
	Private room	4470	6850	8886	10746	10388	10376
	Shared room	325	419	368	386	441	441
Manhattan	Entire home/apt	10203	11866	11070	12928	14541	13689
	Private room	4933	6533	7989	8735	8262	8071
	Shared room	410	532	552	560	464	494
Queens	Entire home/apt	776	1023	1336	1817	2030	2316
	Private room	960	1632	2132	3030	3264	3730
	Shared room	75	120	186	237	215	225
Staten Island	Entire home/apt	67	70	87	144	151	193
	Private room	62	111	142	166	179	185
	Shared room	1	3	2	3	2	5

[89]:
```
# Calculating the number of Airbnb listings for each of the years by boroughs
df15 = ny2015.groupby(['neighbourhood_group'])['neighbourhood'].count()
df16 = ny2016.groupby(['neighbourhood_group'])['neighbourhood'].count()
df17 = ny2017.groupby(['neighbourhood_group'])['neighbourhood'].count()
df18 = ny2018.groupby(['neighbourhood_group'])['neighbourhood'].count()
df19 = ny2019.groupby(['neighbourhood_group'])['neighbourhood'].count()
df20 = ny2020.groupby(['neighbourhood_group'])['neighbourhood'].count()

# Merging all of the borough listings into one dataframe
df2 = pd.merge(df15, df16, on='neighbourhood_group')
df2 = pd.merge(df2, df17, on='neighbourhood_group')
df2 = pd.merge(df2, df18, on='neighbourhood_group')
df2 = pd.merge(df2, df19, on='neighbourhood_group')
df2 = pd.merge(df2, df20, on='neighbourhood_group')
df2.columns = ['2015', '2016', '2017', '2018', '2019', '2020']
cols = ['2015', '2016', '2017', '2018', '2019', '2020']
df2
```

[89]:

neighbourhood_group	2015	2016	2017	2018	2019	2020
Bronx	256	451	647	855	973	1236
Brooklyn	9649	13842	16740	20145	20636	20848
Manhattan	15546	18931	19611	22223	23267	22586
Queens	1811	2775	3654	5084	5509	6308
Staten Island	130	184	231	313	332	383

[92]:
```
df2['2015 %'] = round((df2['2015']/df2['2015'].sum())*100,2)
df2['2016 %'] = round((df2['2016']/df2['2016'].sum())*100,2)
df2['2017 %'] = round((df2['2017']/df2['2017'].sum())*100,2)
```

```
df2['2018 %'] = round((df2['2018']/df2['2018'].sum())*100,2)
df2['2019 %'] = round((df2['2019']/df2['2019'].sum())*100,2)
df2['2020 %'] = round((df2['2020']/df2['2020'].sum())*100,2)
df2
```

[92]:

neighbourhood_group	2015	2016	2017	2018	2019	2020	2015 %	2016 %	\
Bronx	256	451	647	855	973	1236	0.93	1.25	
Brooklyn	9649	13842	16740	20145	20636	20848	35.23	38.26	
Manhattan	15546	18931	19611	22223	23267	22586	56.75	52.32	
Queens	1811	2775	3654	5084	5509	6308	6.61	7.67	
Staten Island	130	184	231	313	332	383	0.47	0.51	

neighbourhood_group	2017 %	2018 %	2019 %	2020 %
Bronx	1.58	1.76	1.92	2.41
Brooklyn	40.95	41.43	40.69	40.59
Manhattan	47.97	45.71	45.88	43.98
Queens	8.94	10.46	10.86	12.28
Staten Island	0.57	0.64	0.65	0.75

[282]:
```
# Calculating the number of Airbnb listings for each of the years by room type
df15 = ny2015.groupby(['room_type'])['neighbourhood'].count()
df16 = ny2016.groupby(['room_type'])['neighbourhood'].count()
df17 = ny2017.groupby(['room_type'])['neighbourhood'].count()
df18 = ny2018.groupby(['room_type'])['neighbourhood'].count()
df19 = ny2019.groupby(['room_type'])['neighbourhood'].count()
df20 = ny2020.groupby(['room_type'])['neighbourhood'].count()

# Merging all of the room type listings into one dataframe
df4 = pd.merge(df15, df16, on='room_type')
df4 = pd.merge(df4, df17, on='room_type')
df4 = pd.merge(df4, df18, on='room_type')
df4 = pd.merge(df4, df19, on='room_type')
df4 = pd.merge(df4, df20, on='room_type')
df4.columns = ['2015', '2016', '2017', '2018', '2019', '2020']
df4
```

[282]:

room_type	2015	2016	2017	2018	2019	2020
Entire home/apt	15977	19662	20167	24156	26872	26652
Private room	10586	15404	19570	23238	22673	23081
Shared room	829	1117	1146	1226	1172	1228

[283]:
```
# Calculating the number of Airbnb listings for each of the years by room type
df15 = ny2015.groupby(['neighbourhood'])['room_type'].count()
df16 = ny2016.groupby(['neighbourhood'])['room_type'].count()
```

```
df17 = ny2017.groupby(['neighbourhood'])['room_type'].count()
df18 = ny2018.groupby(['neighbourhood'])['room_type'].count()
df19 = ny2019.groupby(['neighbourhood'])['room_type'].count()
df20 = ny2020.groupby(['neighbourhood'])['room_type'].count()

# Merging all of the room type listings into one dataframe
df5 = pd.merge(df15, df16, on='neighbourhood')
df5 = pd.merge(df5, df17, on='neighbourhood')
df5 = pd.merge(df5, df18, on='neighbourhood')
df5 = pd.merge(df5, df19, on='neighbourhood')
df5 = pd.merge(df5, df20, on='neighbourhood')
df5.columns = ['2015', '2016', '2017', '2018', '2019', '2020']
df5_sort = df5.sort_values(by=['2020'], ascending=False)
df5_sort.head(10)
```

[283]:

neighbourhood	2015	2016	2017	2018	2019	2020
Bedford-Stuyvesant	1224	1985	2757	3480	3709	4012
Williamsburg	2021	3203	3796	4324	4212	3977
Harlem	934	2005	2519	2870	2812	2793
Bushwick	1098	1597	1939	2470	2512	2503
Hell's Kitchen	1299	1508	1584	1898	2214	2129
Upper West Side	1410	1822	1789	2033	2095	2016
East Village	897	2080	1962	2157	2025	1919
Upper East Side	1319	1582	1541	1779	1927	1800
Crown Heights	810	1137	1299	1646	1633	1640
Midtown	293	963	970	1261	1708	1609

1.4.2 Streeteasy Data

[290]:
```
# Creating a pivot table to show the average inventory by Borough by Year
pivot1 = boro_df.pivot_table(values=['Bronx', 'Brooklyn', 'Manhattan',␣
 ↪'Queens', 'Staten Island'],
                             index=['Year'], aggfunc=np.mean)
round(pivot1,2)
```

[290]:

Year	Bronx	Brooklyn	Manhattan	Queens	Staten Island
2010	128.67	1641.50	12288.50	544.33	4.58
2011	153.08	1826.83	11021.92	510.25	4.75
2012	225.92	2318.58	12709.42	854.50	11.58
2013	227.58	3807.17	16056.42	1116.42	27.58
2014	451.08	7650.42	19418.00	2476.00	43.50
2015	730.83	10942.08	20933.58	3385.50	77.08
2016	797.42	11696.67	22447.58	3895.92	86.75
2017	829.17	14528.25	22406.42	5431.17	82.33
2018	868.50	15101.33	19622.42	5142.83	85.42

```
2019      991.00  13330.17   18451.67  4850.08          67.33
2020      626.57  12497.86   19781.71  4246.57          40.86
```

[291]:
```
# Creating a pivot table to show the average inventory by Borough by Month
pivot2 = boro_df.pivot_table(values=['Bronx', 'Brooklyn', 'Manhattan',␣
 ↪'Queens', 'Staten Island'],
                             index=['Month'], aggfunc=np.mean)
round(pivot2,2)
```

[291]:
```
areaName    Bronx  Brooklyn  Manhattan   Queens  Staten Island
Month
01         526.82   7546.73   15767.09  2580.91          48.27
02         517.45   7327.73   15540.82  2657.91          49.36
03         527.55   7730.91   16631.64  2850.09          50.36
04         496.27   7803.00   17400.27  2868.55          46.64
05         528.09   9096.82   19159.00  3170.45          51.64
06         548.45  10056.64   20612.82  3387.64          44.00
07         588.73  10927.27   21771.73  3431.00          44.18
08         569.00   9460.00   19425.20  2789.10          41.80
09         551.70   8431.80   17330.00  2693.50          46.00
10         581.10   8400.20   17140.70  2912.10          54.30
11         576.50   7917.10   15857.60  2803.40          57.00
12         537.50   7413.00   14949.10  2581.70          50.70
```

[347]:
```
# Creating a pivot table to show the average inventory by Borough by Year for␣
 ↪the top 10 neighbourhoods of Airbnb
pivot3 = neigh_df.pivot_table(values=['Bedford-Stuyvesant', 'Williamsburg',␣
 ↪'Bushwick', 'Midtown West'
                                      , 'Upper West Side', 'East Village',␣
 ↪'Upper East Side', 'Crown Heights'
                                      , 'Midtown', 'Central Harlem'],
                             index=['Year'], aggfunc=np.mean)
round(pivot3,2)
```

[347]:
```
areaName  Bedford-Stuyvesant  Bushwick  Central Harlem  Crown Heights  \
Year
2010                  118.33     25.42          313.00          78.83
2011                  156.50     55.67          286.00         116.67
2012                  212.17     71.92          430.33         127.92
2013                  378.33    161.42          585.92         206.67
2014                  902.58    471.42          768.42         564.42
2015                 1425.92    915.58          898.58         920.83
2016                 1554.92   1055.58         1033.67         928.50
2017                 1882.75   1358.17          955.08        1304.50
2018                 1866.50   1903.50          864.58        1316.67
2019                 1805.92   1619.00          852.17        1273.25
2020                 1806.71   1478.43          822.71        1165.57
```

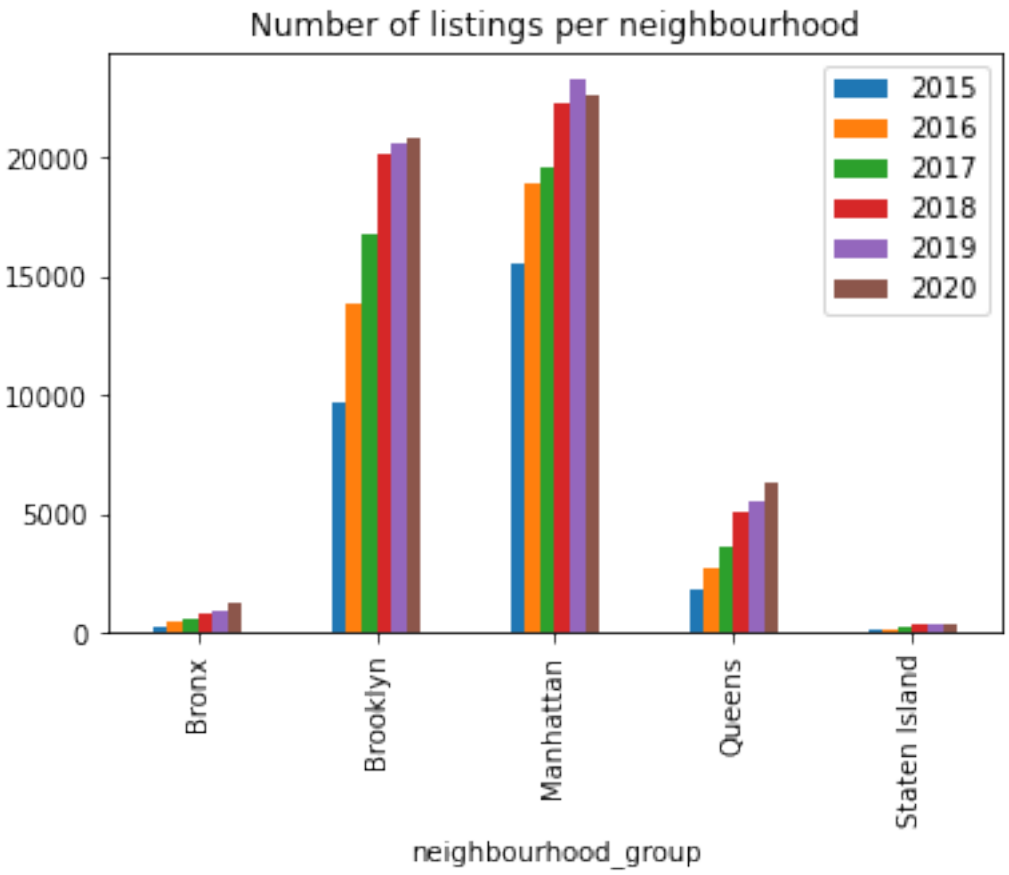
```
areaName  East Village  Midtown  Midtown West  Upper East Side  \
Year
2010            448.00   399.67        772.33          2513.33
2011            398.75   344.50        714.25          2225.25
2012            585.00   396.08        865.92          2279.00
2013            810.33   435.25       1091.58          2734.00
2014           1088.67   511.50       1330.67          3160.67
2015           1262.17   575.33       1538.83          3307.50
2016           1249.33   634.25       1685.92          3658.08
2017           1357.25   546.17       1697.83          3356.00
2018           1206.50   481.75       1552.75          3039.67
2019           1175.67   476.17       1481.17          2769.42
2020           1366.29   482.71       1610.00          2719.29

areaName  Upper West Side  Williamsburg
Year
2010              2045.25        277.75
2011              1791.75        271.25
2012              1988.00        493.75
2013              2353.00        771.25
2014              2861.75       1278.83
2015              3026.92       1709.83
2016              3126.42       1835.33
2017              3059.58       2007.42
2018              2708.25       2588.67
2019              2352.00       1666.08
2020              2725.43       1951.86
```

1.4.3 Visualizations

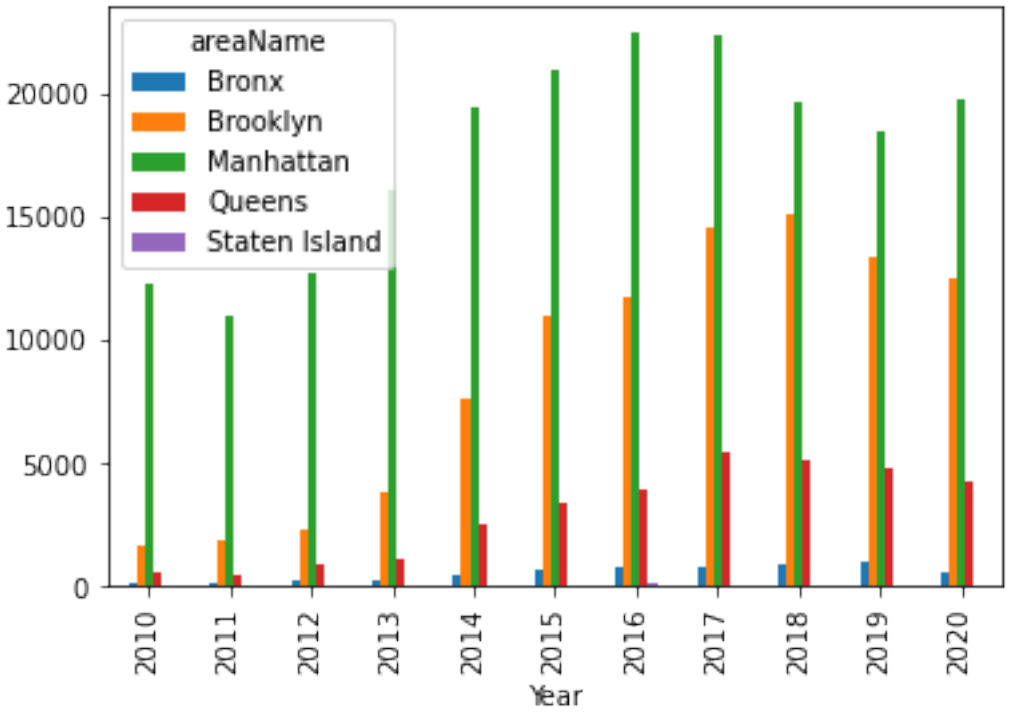
[231]:
```
# Creating a bar graph showing the number of listings per neighbourhood for␣
↪Airbnb
df2.plot.bar(title = 'Number of listings per neighbourhood')
```

[231]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7ff7f880edd0>
```



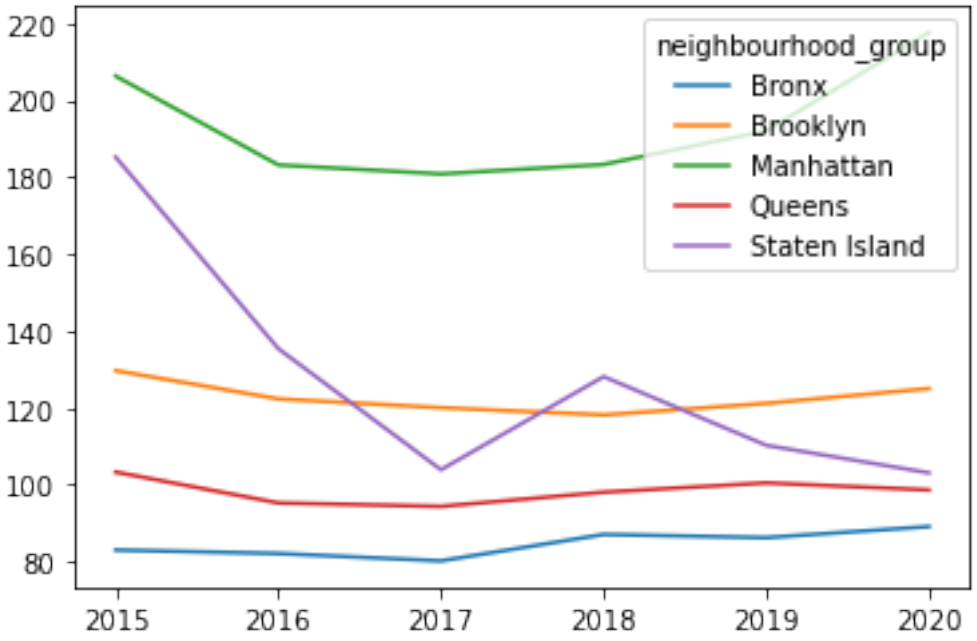
[352]:
```
# bar plot that shows average number of streeteasy inventory by borough by year
pivot1.plot.bar()
```

[352]: <matplotlib.axes._subplots.AxesSubplot at 0x7ff7fb906b50>



[245]:
```
# Creating a line graph of the average price of airbnb rentals per borough per␣
↪year
df.plot.line()
```

[245]: <matplotlib.axes._subplots.AxesSubplot at 0x7ff7f8c94c90>



[351]:
```
pivot3.plot.line(marker='o')
```

[351]: <matplotlib.axes._subplots.AxesSubplot at 0x7ff7f8ac9290>