Group Assignment 4

March 12, 2021

1 Assignment # 5

In this notebook I conduct a spatial Autocorrelation on my data set of industries. Here I want to look at the Acommadation industry that has experience the most job loss during the COVID-19 Pandemic. When I first ran this code the areas were a bit scattered, so I'm hoping to narrow down area that held these positions in 2019.

1.1 Bringing in the libraries

[1]:
```
import geopandas as gpd
import matplotlib.pyplot as plt
import pandas as pd
import contextily as ctx
from sodapy import Socrata
import seaborn as sns
from pointpats import centrography
from matplotlib.patches import Ellipse
import numpy
import urllib.request, json
import plotly.express as px
import esda
from esda.moran import Moran, Moran_Local
import splot
from splot.esda import moran_scatterplot, plot_moran,␣
↪lisa_cluster,plot_moran_simulation
import libpysal as lps
import matplotlib.pyplot as plt
import plotly.express as px
```

```
/opt/conda/lib/python3.8/site-packages/geopandas/_compat.py:106: UserWarning:
The Shapely GEOS version (3.8.1-CAPI-1.13.3) is incompatible with the GEOS
version PyGEOS was compiled with (3.9.0-CAPI-1.16.2). Conversions between both
will be slow.
  warnings.warn(
```

1.2 Uploading the Data set and cleaning it up.

The previous industry dataset that I investigated was an overall industry employment during 2020 and the income in each industry based within each census tract. Unfortunaley that data is not yet avaibale during for 2020, so I will be looking at the 2019 dataset from CensusExplorer to get idea of the industries by census tract. Previously, I also look at occupations in the areas, but in order to make comparisons I opted to look at the indusities moving forward. I was having a hard time looking up occupation data for 2020.

[2]:
```
industry = gpd.read_file('acs2019_5yr_B24031_14000US06037432102.geojson')
```

1.2.1 In the following cells, I'll clean the data

First I look at what's in this data frame. I drop the first row, and unnecessay columns. I think relabel the columns and check the data by looking at the top rows.

[3]:
```
industry.head ()
```

[3]:
```
                 geoid                                  name  B24031001  \
0         05000US06037                 Los Angeles County, CA    36039.0
1  14000US06037101110  Census Tract 1011.10, Los Angeles, CA    39444.0
2  14000US06037101122  Census Tract 1011.22, Los Angeles, CA    43300.0
3  14000US06037101210  Census Tract 1012.10, Los Angeles, CA    24579.0
4  14000US06037101220  Census Tract 1012.20, Los Angeles, CA    31139.0

   B24031001, Error  B24031002  B24031002, Error  B24031003  B24031003, Error  \
0             148.0    24925.0            1218.0    22153.0             724.0
1           10750.0        NaN               NaN        NaN               NaN
2            7628.0        NaN               NaN        NaN               NaN
3            4419.0   155000.0          238813.0   155000.0          238813.0
4            3738.0        NaN               NaN        NaN               NaN

   B24031004  B24031004, Error  …  B24031023, Error  B24031024  \
0    65732.0            9358.0  …             233.0    31705.0
1        NaN               NaN  …           10705.0    25714.0
2        NaN               NaN  …           14945.0    47273.0
3        NaN               NaN  …            8991.0        NaN
4        NaN               NaN  …            1835.0        NaN

   B24031024, Error  B24031025  B24031025, Error  B24031026  B24031026, Error  \
0             379.0    20905.0             182.0    24115.0             381.0
1           44930.0    19952.0           11180.0    32379.0           14273.0
2           14945.0        NaN               NaN    22708.0           31090.0
3               NaN    25739.0            3717.0    19071.0            5736.0
4               NaN     9356.0            1809.0    24000.0            8491.0

   B24031027  B24031027, Error  \
```

```
0    61372.0            971.0
1    62938.0          26179.0
2    33750.0          39781.0
3    10881.0           2462.0
4    86154.0          62406.0

                                        geometry
0  MULTIPOLYGON (((-118.70339 34.16859, -118.7033…
1  MULTIPOLYGON (((-118.30229 34.25870, -118.3009…
2  MULTIPOLYGON (((-118.30334 34.27371, -118.3033…
3  MULTIPOLYGON (((-118.29945 34.25598, -118.2979…
4  MULTIPOLYGON (((-118.28593 34.25227, -118.2859…

[5 rows x 57 columns]
```

[4]:
```
industry = industry.drop ([0])
```

[5]:
```
columns_to_keep = ['geoid',
                   'name',
                   'B24031001',
                   'B24031003',
                   'B24031004',
                   'B24031005',
                   'B24031006',
                   'B24031007',
                   'B24031008',
                   'B24031010',
                   'B24031011',
                   'B24031012',
                   'B24031014',
                   'B24031015',
                   'B24031017',
                   'B24031018',
                   'B24031019',
                   'B24031021',
                   'B24031022',
                   'B24031024',
                   'B24031025',
                   'B24031026',
                   'B24031027',
                   'geometry']
```

[6]:
```
industry = industry[columns_to_keep]
```

[7]:
```
industry.columns = ['geoid',
                    'name',
                    'total',
```

```
                    'Agriculture, forestry, fishing and hunting',
                     'Mining, quarrying, and oil and gas extraction',
                     'Construction',
                     'Manufacturing',
                     'Wholesale trade',
                     'Retail trade',
                     'Transportation and warehousing',
                     'Utilities',
                     'Information',
                     'Finance and insurance',
                     'Real estate and rental and leasing',
                     'Professional, scientific, and technical services',
                     'Management of companies and enterprises',
                     'Administrative and support and waste management services',
                     'Educational services',
                     'Health care and social assistance',
                     'Arts, entertainment, and recreation',
                     'Accommodation and food services',
                     'Other services',
                     'Public administration',
                     'geometry']
```

[8]:
```
industry.head ()
```

[8]:
```
                 geoid                                     name    total  \
1  14000US06037101110  Census Tract 1011.10, Los Angeles, CA  39444.0
2  14000US06037101122  Census Tract 1011.22, Los Angeles, CA  43300.0
3  14000US06037101210  Census Tract 1012.10, Los Angeles, CA  24579.0
4  14000US06037101220  Census Tract 1012.20, Los Angeles, CA  31139.0
5  14000US06037101300     Census Tract 1013, Los Angeles, CA  50993.0

  Agriculture, forestry, fishing and hunting  \
1                                        NaN
2                                        NaN
3                                   155000.0
4                                        NaN
5                                        NaN

  Mining, quarrying, and oil and gas extraction  Construction  Manufacturing  \
1                                           NaN       72813.0        24901.0
2                                           NaN       44375.0        68646.0
3                                           NaN       17697.0        29301.0
4                                           NaN       22000.0        32292.0
5                                           NaN       44167.0        71202.0

  Wholesale trade  Retail trade  Transportation and warehousing  …  \
1         43304.0       19038.0                         61607.0  …
```

```
2         50938.0       29531.0                              19009.0  …
3         45223.0       16818.0                              50903.0  …
4         66250.0       27625.0                              60125.0  …
5         36776.0       23646.0                              63281.0  …

   Professional, scientific, and technical services  \
1                                           94167.0
2                                           96818.0
3                                           75106.0
4                                          100156.0
5                                           67548.0

   Management of companies and enterprises  \
1                                      NaN
2                                      NaN
3                                      NaN
4                                      NaN
5                                      NaN

   Administrative and support and waste management services  \
1                                            14853.0
2                                            22083.0
3                                            12320.0
4                                            32386.0
5                                            19659.0

   Educational services  Health care and social assistance  \
1               31314.0                            43750.0
2               34583.0                            41288.0
3               15675.0                            31452.0
4               28162.0                            35156.0
5               47083.0                            61632.0

   Arts, entertainment, and recreation  Accommodation and food services  \
1                              25714.0                          19952.0
2                              47273.0                              NaN
3                                  NaN                          25739.0
4                                  NaN                           9356.0
5                              43750.0                          40833.0

   Other services  Public administration  \
1         32379.0                62938.0
2         22708.0                33750.0
3         19071.0                10881.0
4         24000.0                86154.0
5         70694.0                16700.0
```

```
                                            geometry
1  MULTIPOLYGON (((-118.30229 34.25870, -118.3009…
2  MULTIPOLYGON (((-118.30334 34.27371, -118.3033…
3  MULTIPOLYGON (((-118.29945 34.25598, -118.2979…
4  MULTIPOLYGON (((-118.28593 34.25227, -118.2859…
5  MULTIPOLYGON (((-118.27822 34.25068, -118.2782…

[5 rows x 24 columns]
```

[9]:

```python
industry['geoid'] = industry['geoid'].str.replace('14000US','')
industry.tail()
```

[9]:

```
            geoid                                  name    total  \
2342  06037980031  Census Tract 9800.31, Los Angeles, CA  64500.0
2343  06037980033  Census Tract 9800.33, Los Angeles, CA      NaN
2344  06037990100     Census Tract 9901, Los Angeles, CA      NaN
2345  06037990200     Census Tract 9902, Los Angeles, CA      NaN
2346  06037990300     Census Tract 9903, Los Angeles, CA      NaN

      Agriculture, forestry, fishing and hunting  \
2342                                         NaN
2343                                         NaN
2344                                         NaN
2345                                         NaN
2346                                         NaN

      Mining, quarrying, and oil and gas extraction  Construction  \
2342                                            NaN           NaN
2343                                            NaN           NaN
2344                                            NaN           NaN
2345                                            NaN           NaN
2346                                            NaN           NaN

      Manufacturing  Wholesale trade  Retail trade  \
2342            NaN              NaN           NaN
2343            NaN              NaN           NaN
2344            NaN              NaN           NaN
2345            NaN              NaN           NaN
2346            NaN              NaN           NaN

      Transportation and warehousing  …  \
2342                             NaN  …
2343                             NaN  …
2344                             NaN  …
2345                             NaN  …
2346                             NaN  …
```

```
     Professional, scientific, and technical services  \
2342                                               NaN
2343                                               NaN
2344                                               NaN
2345                                               NaN
2346                                               NaN

     Management of companies and enterprises  \
2342                                      NaN
2343                                      NaN
2344                                      NaN
2345                                      NaN
2346                                      NaN

     Administrative and support and waste management services  \
2342                                                NaN
2343                                                NaN
2344                                                NaN
2345                                                NaN
2346                                                NaN

     Educational services  Health care and social assistance  \
2342                  NaN                                NaN
2343                  NaN                                NaN
2344                  NaN                                NaN
2345                  NaN                                NaN
2346                  NaN                                NaN

     Arts, entertainment, and recreation  Accommodation and food services  \
2342                                 NaN                              NaN
2343                                 NaN                              NaN
2344                                 NaN                              NaN
2345                                 NaN                              NaN
2346                                 NaN                              NaN

     Other services  Public administration  \
2342            NaN                    NaN
2343            NaN                    NaN
2344            NaN                    NaN
2345            NaN                    NaN
2346            NaN                    NaN

                                              geometry
2342  MULTIPOLYGON (((-118.29105 33.75378, -118.2905…
2343  MULTIPOLYGON (((-118.24897 33.75590, -118.2470…
2344  MULTIPOLYGON (((-118.95114 33.99643, -118.9505…
2345  MULTIPOLYGON (((-118.63598 34.03255, -118.6325…
```

```
2346  MULTIPOLYGON (((-118.47656 33.75038, -118.4661…

[5 rows x 24 columns]
```

I start narrowing down on which data I plan on running stat by sorting the values by Accomodation and food services

[10]:
```
industry.sort_values(by='Accommodation and food services', ascending = True).
↪tail(50)
```

[10]:
```
            geoid                                   name     total  \
2120  06037701201  Census Tract 7012.01, Los Angeles, CA   91500.0
2149  06037703002  Census Tract 7030.02, Los Angeles, CA   63896.0
2154  06037800202  Census Tract 8002.02, Los Angeles, CA   79925.0
2156  06037800204  Census Tract 8002.04, Los Angeles, CA   68375.0
2170  06037800506  Census Tract 8005.06, Los Angeles, CA  107619.0
2174  06037900201  Census Tract 9002.01, Los Angeles, CA   36471.0
2184  06037900606  Census Tract 9006.06, Los Angeles, CA   33623.0
2197  06037901003  Census Tract 9010.03, Los Angeles, CA       NaN
2208  06037901210  Census Tract 9012.10, Los Angeles, CA   43585.0
2209  06037901213  Census Tract 9012.13, Los Angeles, CA   59549.0
2220  06037910210  Census Tract 9102.10, Los Angeles, CA   55556.0
2252  06037910811  Census Tract 9108.11, Los Angeles, CA   30750.0
2253  06037910812  Census Tract 9108.12, Los Angeles, CA   54338.0
2256  06037920011  Census Tract 9200.11, Los Angeles, CA   51000.0
2257  06037920012  Census Tract 9200.12, Los Angeles, CA   47661.0
2265  06037920026  Census Tract 9200.26, Los Angeles, CA   32375.0
2271  06037920033  Census Tract 9200.33, Los Angeles, CA   32375.0
2298  06037920200     Census Tract 9202, Los Angeles, CA       NaN
2315  06037930101  Census Tract 9301.01, Los Angeles, CA   51136.0
2316  06037930200     Census Tract 9302, Los Angeles, CA   52218.0
2317  06037930301  Census Tract 9303.01, Los Angeles, CA   50893.0
2318  06037980001  Census Tract 9800.01, Los Angeles, CA       NaN
2319  06037980002  Census Tract 9800.02, Los Angeles, CA       NaN
2320  06037980003  Census Tract 9800.03, Los Angeles, CA       NaN
2321  06037980004  Census Tract 9800.04, Los Angeles, CA       NaN
2322  06037980005  Census Tract 9800.05, Los Angeles, CA       NaN
2323  06037980006  Census Tract 9800.06, Los Angeles, CA       NaN
2324  06037980007  Census Tract 9800.07, Los Angeles, CA       NaN
2325  06037980008  Census Tract 9800.08, Los Angeles, CA       NaN
2326  06037980009  Census Tract 9800.09, Los Angeles, CA    5833.0
2327  06037980010  Census Tract 9800.10, Los Angeles, CA   50000.0
2328  06037980013  Census Tract 9800.13, Los Angeles, CA       NaN
2329  06037980014  Census Tract 9800.14, Los Angeles, CA       NaN
2330  06037980015  Census Tract 9800.15, Los Angeles, CA   53843.0
2331  06037980018  Census Tract 9800.18, Los Angeles, CA       NaN
2332  06037980019  Census Tract 9800.19, Los Angeles, CA  105750.0
```

```
2333  06037980020  Census Tract 9800.20, Los Angeles, CA       NaN
2334  06037980021  Census Tract 9800.21, Los Angeles, CA   70417.0
2335  06037980022  Census Tract 9800.22, Los Angeles, CA       NaN
2336  06037980023  Census Tract 9800.23, Los Angeles, CA       NaN
2337  06037980024  Census Tract 9800.24, Los Angeles, CA   51250.0
2338  06037980025  Census Tract 9800.25, Los Angeles, CA       NaN
2339  06037980026  Census Tract 9800.26, Los Angeles, CA       NaN
2340  06037980028  Census Tract 9800.28, Los Angeles, CA       NaN
2341  06037980030  Census Tract 9800.30, Los Angeles, CA       NaN
2342  06037980031  Census Tract 9800.31, Los Angeles, CA   64500.0
2343  06037980033  Census Tract 9800.33, Los Angeles, CA       NaN
2344  06037990100     Census Tract 9901, Los Angeles, CA       NaN
2345  06037990200     Census Tract 9902, Los Angeles, CA       NaN
2346  06037990300     Census Tract 9903, Los Angeles, CA       NaN

      Agriculture, forestry, fishing and hunting  \
2120                                         NaN
2149                                         NaN
2154                                         NaN
2156                                         NaN
2170                                         NaN
2174                                     33977.0
2184                                         NaN
2197                                         NaN
2208                                         NaN
2209                                     14808.0
2220                                         NaN
2252                                         NaN
2253                                         NaN
2256                                         NaN
2257                                     29000.0
2265                                         NaN
2271                                         NaN
2298                                         NaN
2315                                         NaN
2316                                         NaN
2317                                         NaN
2318                                         NaN
2319                                         NaN
2320                                         NaN
2321                                         NaN
2322                                         NaN
2323                                         NaN
2324                                         NaN
2325                                         NaN
2326                                         NaN
2327                                         NaN
```

2328	NaN
2329	NaN
2330	NaN
2331	NaN
2332	NaN
2333	NaN
2334	NaN
2335	NaN
2336	NaN
2337	NaN
2338	NaN
2339	NaN
2340	NaN
2341	NaN
2342	NaN
2343	NaN
2344	NaN
2345	NaN
2346	NaN

	Mining, quarrying, and oil and gas extraction	Construction	\
2120	NaN	NaN	
2149	NaN	101635.0	
2154	NaN	NaN	
2156	NaN	18036.0	
2170	NaN	241250.0	
2174	NaN	40833.0	
2184	NaN	41845.0	
2197	NaN	NaN	
2208	NaN	52083.0	
2209	NaN	47727.0	
2220	NaN	76546.0	
2252	NaN	NaN	
2253	NaN	76818.0	
2256	NaN	NaN	
2257	NaN	50000.0	
2265	NaN	NaN	
2271	NaN	26750.0	
2298	NaN	NaN	
2315	NaN	NaN	
2316	NaN	NaN	
2317	NaN	NaN	
2318	NaN	NaN	
2319	NaN	NaN	
2320	NaN	NaN	
2321	NaN	NaN	
2322	NaN	NaN	

2323	NaN	NaN
2324	NaN	NaN
2325	NaN	NaN
2326	NaN	NaN
2327	NaN	NaN
2328	NaN	NaN
2329	NaN	NaN
2330	NaN	32969.0
2331	NaN	NaN
2332	NaN	NaN
2333	NaN	NaN
2334	NaN	NaN
2335	NaN	NaN
2336	NaN	NaN
2337	NaN	NaN
2338	NaN	NaN
2339	NaN	NaN
2340	NaN	NaN
2341	NaN	NaN
2342	NaN	NaN
2343	NaN	NaN
2344	NaN	NaN
2345	NaN	NaN
2346	NaN	NaN

	Manufacturing	Wholesale trade	Retail trade	\
2120	131750.0	33000.0	32500.0	
2149	141417.0	85333.0	21250.0	
2154	104826.0	250001.0	52642.0	
2156	158108.0	128482.0	44939.0	
2170	141913.0	NaN	NaN	
2174	26250.0	NaN	NaN	
2184	37750.0	NaN	21250.0	
2197	NaN	NaN	NaN	
2208	43654.0	NaN	43839.0	
2209	136375.0	NaN	48958.0	
2220	86775.0	NaN	60682.0	
2252	NaN	NaN	9423.0	
2253	226563.0	NaN	NaN	
2256	NaN	NaN	NaN	
2257	71932.0	NaN	16250.0	
2265	NaN	NaN	NaN	
2271	29063.0	NaN	21563.0	
2298	NaN	NaN	NaN	
2315	NaN	NaN	43750.0	
2316	52019.0	NaN	NaN	
2317	188750.0	6467.0	31328.0	

```
2318           NaN               NaN           NaN
2319           NaN               NaN           NaN
2320           NaN               NaN           NaN
2321           NaN               NaN           NaN
2322           NaN               NaN           NaN
2323           NaN               NaN           NaN
2324           NaN               NaN           NaN
2325           NaN               NaN           NaN
2326           NaN               NaN           NaN
2327           NaN               NaN           NaN
2328           NaN               NaN           NaN
2329           NaN               NaN           NaN
2330       67031.0               NaN       30688.0
2331           NaN               NaN           NaN
2332           NaN               NaN           NaN
2333           NaN               NaN           NaN
2334           NaN               NaN           NaN
2335           NaN               NaN           NaN
2336           NaN               NaN           NaN
2337           NaN               NaN       47708.0
2338           NaN               NaN           NaN
2339           NaN               NaN           NaN
2340           NaN               NaN           NaN
2341           NaN               NaN           NaN
2342           NaN               NaN           NaN
2343           NaN               NaN           NaN
2344           NaN               NaN           NaN
2345           NaN               NaN           NaN
2346           NaN               NaN           NaN

      Transportation and warehousing  …  \
2120                             NaN  …
2149                         28681.0  …
2154                             NaN  …
2156                             NaN  …
2170                             NaN  …
2174                             NaN  …
2184                             NaN  …
2197                             NaN  …
2208                         18542.0  …
2209                        170278.0  …
2220                         67000.0  …
2252                             NaN  …
2253                             NaN  …
2256                             NaN  …
2257                             NaN  …
2265                             NaN  …
```

```
2271                                   NaN  …
2298                                   NaN  …
2315                                   NaN  …
2316                                   NaN  …
2317                                   NaN  …
2318                                   NaN  …
2319                                   NaN  …
2320                                   NaN  …
2321                                   NaN  …
2322                                   NaN  …
2323                                   NaN  …
2324                                   NaN  …
2325                                   NaN  …
2326                                   NaN  …
2327                                   NaN  …
2328                                   NaN  …
2329                                   NaN  …
2330                                   NaN  …
2331                                   NaN  …
2332                                   NaN  …
2333                                   NaN  …
2334                                   NaN  …
2335                                   NaN  …
2336                                   NaN  …
2337                                   NaN  …
2338                                   NaN  …
2339                                   NaN  …
2340                                   NaN  …
2341                                   NaN  …
2342                                   NaN  …
2343                                   NaN  …
2344                                   NaN  …
2345                                   NaN  …
2346                                   NaN  …

      Professional, scientific, and technical services  \
2120                                          100625.0
2149                                           70871.0
2154                                           75978.0
2156                                          176518.0
2170                                          132946.0
2174                                           68026.0
2184                                               NaN
2197                                               NaN
2208                                           81667.0
2209                                           48938.0
2220                                           41563.0
```

```
2252                                             NaN
2253                                         53750.0
2256                                             NaN
2257                                         83631.0
2265                                             NaN
2271                                         25208.0
2298                                             NaN
2315                                        190313.0
2316                                         52778.0
2317                                             NaN
2318                                             NaN
2319                                             NaN
2320                                             NaN
2321                                             NaN
2322                                             NaN
2323                                             NaN
2324                                             NaN
2325                                             NaN
2326                                             NaN
2327                                             NaN
2328                                             NaN
2329                                             NaN
2330                                        100125.0
2331                                             NaN
2332                                         77250.0
2333                                             NaN
2334                                             NaN
2335                                             NaN
2336                                             NaN
2337                                             NaN
2338                                             NaN
2339                                             NaN
2340                                             NaN
2341                                             NaN
2342                                             NaN
2343                                             NaN
2344                                             NaN
2345                                             NaN
2346                                             NaN

      Management of companies and enterprises  \
2120                                      NaN
2149                                      NaN
2154                                      NaN
2156                                      NaN
2170                                      NaN
2174                                      NaN
```

```
2184                                                NaN
2197                                                NaN
2208                                                NaN
2209                                                NaN
2220                                                NaN
2252                                                NaN
2253                                                NaN
2256                                                NaN
2257                                                NaN
2265                                                NaN
2271                                                NaN
2298                                                NaN
2315                                                NaN
2316                                                NaN
2317                                                NaN
2318                                                NaN
2319                                                NaN
2320                                                NaN
2321                                                NaN
2322                                                NaN
2323                                                NaN
2324                                                NaN
2325                                                NaN
2326                                                NaN
2327                                                NaN
2328                                                NaN
2329                                                NaN
2330                                                NaN
2331                                                NaN
2332                                                NaN
2333                                                NaN
2334                                                NaN
2335                                                NaN
2336                                                NaN
2337                                                NaN
2338                                                NaN
2339                                                NaN
2340                                                NaN
2341                                                NaN
2342                                                NaN
2343                                                NaN
2344                                                NaN
2345                                                NaN
2346                                                NaN

      Administrative and support and waste management services  \
2120                                            41667.0
```

2149	53421.0
2154	53409.0
2156	250001.0
2170	NaN
2174	NaN
2184	30538.0
2197	NaN
2208	42000.0
2209	38250.0
2220	42196.0
2252	NaN
2253	NaN
2256	51250.0
2257	NaN
2265	NaN
2271	NaN
2298	NaN
2315	NaN
2316	NaN
2317	NaN
2318	NaN
2319	NaN
2320	NaN
2321	NaN
2322	NaN
2323	NaN
2324	NaN
2325	NaN
2326	NaN
2327	NaN
2328	NaN
2329	NaN
2330	NaN
2331	NaN
2332	NaN
2333	NaN
2334	NaN
2335	NaN
2336	NaN
2337	NaN
2338	NaN
2339	NaN
2340	NaN
2341	NaN
2342	NaN
2343	NaN
2344	NaN

```
2345                                                    NaN
2346                                                    NaN

      Educational services  Health care and social assistance  \
2120               69844.0                            44219.0
2149               72569.0                            80208.0
2154               26574.0                            51944.0
2156               71902.0                            44953.0
2170               51860.0                            92115.0
2174               33281.0                            32938.0
2184               33973.0                            34893.0
2197                   NaN                                NaN
2208               27083.0                            41625.0
2209               53250.0                            54519.0
2220               48824.0                            44507.0
2252                   NaN                                NaN
2253                   NaN                            50250.0
2256                   NaN                                NaN
2257               61442.0                            48417.0
2265              123750.0                            18365.0
2271               12917.0                            73750.0
2298                   NaN                                NaN
2315                   NaN                                NaN
2316                   NaN                                NaN
2317               45781.0                            29861.0
2318                   NaN                                NaN
2319                   NaN                                NaN
2320                   NaN                                NaN
2321                   NaN                                NaN
2322                   NaN                                NaN
2323                   NaN                                NaN
2324                   NaN                                NaN
2325                   NaN                                NaN
2326                5625.0                                NaN
2327                   NaN                                NaN
2328                   NaN                                NaN
2329                   NaN                                NaN
2330                   NaN                            53603.0
2331                   NaN                                NaN
2332              103750.0                           126250.0
2333                   NaN                                NaN
2334                   NaN                                NaN
2335                   NaN                                NaN
2336                   NaN                                NaN
2337               80313.0                                NaN
2338                   NaN                                NaN
2339                   NaN                                NaN
```

2340	NaN	NaN
2341	NaN	NaN
2342	NaN	NaN
2343	NaN	NaN
2344	NaN	NaN
2345	NaN	NaN
2346	NaN	NaN

	Arts, entertainment, and recreation	Accommodation and food services \
2120	37143.0	NaN
2149	14975.0	NaN
2154	88488.0	NaN
2156	153125.0	NaN
2170	250001.0	NaN
2174	NaN	NaN
2184	NaN	NaN
2197	NaN	NaN
2208	NaN	NaN
2209	10729.0	NaN
2220	11395.0	NaN
2252	NaN	NaN
2253	NaN	NaN
2256	NaN	NaN
2257	NaN	NaN
2265	NaN	NaN
2271	NaN	NaN
2298	NaN	NaN
2315	NaN	NaN
2316	NaN	NaN
2317	NaN	NaN
2318	NaN	NaN
2319	NaN	NaN
2320	NaN	NaN
2321	NaN	NaN
2322	NaN	NaN
2323	NaN	NaN
2324	NaN	NaN
2325	NaN	NaN
2326	NaN	NaN
2327	NaN	NaN
2328	NaN	NaN
2329	NaN	NaN
2330	NaN	NaN
2331	NaN	NaN
2332	NaN	NaN
2333	NaN	NaN
2334	NaN	NaN

2335	NaN	NaN
2336	NaN	NaN
2337	NaN	NaN
2338	NaN	NaN
2339	NaN	NaN
2340	NaN	NaN
2341	NaN	NaN
2342	NaN	NaN
2343	NaN	NaN
2344	NaN	NaN
2345	NaN	NaN
2346	NaN	NaN

	Other services	Public administration	\
2120	43125.0	NaN	
2149	11184.0	61680.0	
2154	NaN	NaN	
2156	NaN	NaN	
2170	45833.0	104038.0	
2174	36000.0	97321.0	
2184	15625.0	53375.0	
2197	NaN	NaN	
2208	25868.0	112656.0	
2209	54196.0	103472.0	
2220	17440.0	90238.0	
2252	NaN	NaN	
2253	NaN	NaN	
2256	NaN	NaN	
2257	11875.0	118750.0	
2265	23750.0	NaN	
2271	NaN	NaN	
2298	NaN	NaN	
2315	NaN	NaN	
2316	NaN	NaN	
2317	NaN	NaN	
2318	NaN	NaN	
2319	NaN	NaN	
2320	NaN	NaN	
2321	NaN	NaN	
2322	NaN	NaN	
2323	NaN	NaN	
2324	NaN	NaN	
2325	NaN	NaN	
2326	NaN	NaN	
2327	NaN	NaN	
2328	NaN	NaN	
2329	NaN	NaN	

2330	NaN	82813.0
2331	NaN	NaN
2332	NaN	NaN
2333	NaN	NaN
2334	NaN	NaN
2335	NaN	NaN
2336	NaN	NaN
2337	NaN	NaN
2338	NaN	NaN
2339	NaN	NaN
2340	NaN	NaN
2341	NaN	NaN
2342	NaN	NaN
2343	NaN	NaN
2344	NaN	NaN
2345	NaN	NaN
2346	NaN	NaN

	geometry
2120	MULTIPOLYGON (((-118.50440 34.04017, -118.5040…
2149	MULTIPOLYGON (((-118.38655 33.97716, -118.3862…
2154	MULTIPOLYGON (((-118.71177 34.10542, -118.7117…
2156	MULTIPOLYGON (((-118.69824 34.14388, -118.6981…
2170	MULTIPOLYGON (((-118.65342 34.07002, -118.6531…
2174	MULTIPOLYGON (((-118.05924 34.68994, -118.0584…
2184	MULTIPOLYGON (((-118.13709 34.70395, -118.1369…
2197	MULTIPOLYGON (((-118.23669 34.70207, -118.2366…
2208	MULTIPOLYGON (((-118.43776 34.69477, -118.4377…
2209	MULTIPOLYGON (((-118.37804 34.64508, -118.3778…
2220	MULTIPOLYGON (((-118.21032 34.61809, -118.2098…
2252	MULTIPOLYGON (((-118.40529 34.38096, -118.3972…
2253	MULTIPOLYGON (((-118.11829 34.47830, -118.1182…
2256	MULTIPOLYGON (((-118.54254 34.48617, -118.5424…
2257	MULTIPOLYGON (((-118.45431 34.59261, -118.4541…
2265	MULTIPOLYGON (((-118.46752 34.47406, -118.4675…
2271	MULTIPOLYGON (((-118.44536 34.45159, -118.4430…
2298	MULTIPOLYGON (((-118.61830 34.48921, -118.6182…
2315	MULTIPOLYGON (((-118.28661 34.28156, -118.2865…
2316	MULTIPOLYGON (((-118.51028 34.34504, -118.5102…
2317	MULTIPOLYGON (((-118.18075 34.28729, -118.1806…
2318	MULTIPOLYGON (((-118.37031 34.20120, -118.3658…
2319	MULTIPOLYGON (((-118.25753 33.80197, -118.2571…
2320	MULTIPOLYGON (((-118.14019 34.78468, -118.1401…
2321	MULTIPOLYGON (((-118.12795 34.64591, -118.1274…
2322	MULTIPOLYGON (((-118.35210 33.85818, -118.3517…
2323	MULTIPOLYGON (((-118.09420 33.78670, -118.0941…
2324	MULTIPOLYGON (((-118.11512 33.76305, -118.1135…

```
2325   MULTIPOLYGON (((-118.50267 34.22121, -118.5015…
2326   MULTIPOLYGON (((-118.33707 34.14160, -118.3361…
2327   MULTIPOLYGON (((-118.25165 34.08038, -118.2515…
2328   MULTIPOLYGON (((-118.39627 33.92804, -118.3962…
2329   MULTIPOLYGON (((-118.26088 33.76850, -118.2602…
2330   MULTIPOLYGON (((-118.31048 33.76685, -118.3102…
2331   MULTIPOLYGON (((-118.18066 33.80597, -118.1806…
2332   MULTIPOLYGON (((-118.59919 34.07436, -118.5991…
2333   MULTIPOLYGON (((-118.34412 34.21700, -118.3438…
2334   MULTIPOLYGON (((-118.40183 34.26509, -118.4017…
2335   MULTIPOLYGON (((-118.50266 34.30809, -118.5026…
2336   MULTIPOLYGON (((-118.64870 34.23120, -118.6480…
2337   MULTIPOLYGON (((-118.51849 34.18389, -118.5184…
2338   MULTIPOLYGON (((-118.25712 33.83927, -118.2571…
2339   MULTIPOLYGON (((-118.35173 34.28034, -118.3517…
2340   MULTIPOLYGON (((-118.45246 33.94315, -118.4464…
2341   MULTIPOLYGON (((-118.43712 33.91639, -118.4299…
2342   MULTIPOLYGON (((-118.29105 33.75378, -118.2905…
2343   MULTIPOLYGON (((-118.24897 33.75590, -118.2470…
2344   MULTIPOLYGON (((-118.95114 33.99643, -118.9505…
2345   MULTIPOLYGON (((-118.63598 34.03255, -118.6325…
2346   MULTIPOLYGON (((-118.47656 33.75038, -118.4661…

[50 rows x 24 columns]
```

[11]:
```python
industry = industry[industry['Accommodation and food services'] >= 1]
```

[12]:
```python
industry.shape
```

[12]:
```
(2208, 24)
```

[13]:
```python
industry.sort_values(by='Accommodation and food services').tail(20)
```

[13]:
```
            geoid                                   name     total  \
924   06037275603  Census Tract 2756.03, Los Angeles, CA   60598.0
998   06037300901  Census Tract 3009.01, Los Angeles, CA   86203.0
2038  06037620602  Census Tract 6206.02, Los Angeles, CA   75128.0
1375  06037462900     Census Tract 4629, Los Angeles, CA   54575.0
1076  06037401002  Census Tract 4010.02, Los Angeles, CA   58197.0
837   06037262704  Census Tract 2627.04, Los Angeles, CA   77159.0
1802  06037554519  Census Tract 5545.19, Los Angeles, CA   66923.0
875   06037269500     Census Tract 2695, Los Angeles, CA  101830.0
1061  06037400205  Census Tract 4002.05, Los Angeles, CA   90560.0
1988  06037602302  Census Tract 6023.02, Los Angeles, CA   78164.0
828   06037262100     Census Tract 2621, Los Angeles, CA  100408.0
2161  06037800328  Census Tract 8003.28, Los Angeles, CA   49184.0
2117  06037700902  Census Tract 7009.02, Los Angeles, CA   69914.0
```

```
1935  06037577501  Census Tract 5775.01, Los Angeles, CA   66250.0
330   06037139802  Census Tract 1398.02, Los Angeles, CA   82670.0
2169  06037800504  Census Tract 8005.04, Los Angeles, CA   77679.0
1385  06037463700     Census Tract 4637, Los Angeles, CA   85360.0
2113  06037700700     Census Tract 7007, Los Angeles, CA  149205.0
1006  06037301300     Census Tract 3013, Los Angeles, CA   79875.0
2030  06037620301  Census Tract 6203.01, Los Angeles, CA  109152.0

      Agriculture, forestry, fishing and hunting  \
924                                          NaN
998                                          NaN
2038                                         NaN
1375                                         NaN
1076                                         NaN
837                                          NaN
1802                                         NaN
875                                          NaN
1061                                         NaN
1988                                         NaN
828                                          NaN
2161                                         NaN
2117                                         NaN
1935                                         NaN
330                                          NaN
2169                                         NaN
1385                                         NaN
2113                                         NaN
1006                                         NaN
2030                                         NaN

      Mining, quarrying, and oil and gas extraction  Construction  \
924                                             NaN       59063.0
998                                             NaN           NaN
2038                                            NaN       63171.0
1375                                            NaN       44615.0
1076                                            NaN       63182.0
837                                             NaN           NaN
1802                                            NaN           NaN
875                                             NaN           NaN
1061                                            NaN      128906.0
1988                                            NaN       73269.0
828                                             NaN           NaN
2161                                            NaN       46705.0
2117                                            NaN       40446.0
1935                                            NaN      105474.0
330                                             NaN       81000.0
2169                                            NaN      250001.0
```

```
1385                                                    NaN       103245.0
2113                                                    NaN            NaN
1006                                                    NaN            NaN
2030                                                    NaN        53571.0

      Manufacturing  Wholesale trade  Retail trade  \
924        102391.0          64688.0       61083.0
998        119333.0          30114.0       40855.0
2038        92414.0          52188.0       34917.0
1375        54837.0              NaN       33750.0
1076        73750.0          57813.0       34375.0
837         72232.0          91250.0       26023.0
1802        74792.0          71827.0       24135.0
875        106474.0          25988.0       76250.0
1061        66705.0         119318.0       36500.0
1988       122232.0          63523.0       22614.0
828             NaN         100272.0       44432.0
2161       149722.0          83393.0       14786.0
2117        63277.0          77609.0       71628.0
1935       101667.0         128750.0       38450.0
330        114853.0              NaN       23155.0
2169            NaN              NaN       44816.0
1385       131953.0              NaN       40250.0
2113            NaN         107308.0       25208.0
1006        17222.0          69464.0       26563.0
2030       250001.0         125313.0       38750.0

      Transportation and warehousing  …  \
924                          72059.0  …
998                              NaN  …
2038                         50284.0  …
1375                         48333.0  …
1076                             NaN  …
837                              NaN  …
1802                         32019.0  …
875                              NaN  …
1061                             NaN  …
1988                         56283.0  …
828                         161042.0  …
2161                         15357.0  …
2117                         62600.0  …
1935                         51128.0  …
330                              NaN  …
2169                             NaN  …
1385                             NaN  …
2113                             NaN  …
1006                         68750.0  …
```

```
2030                       26058.0  …

      Professional, scientific, and technical services  \
924                                            62216.0
998                                           140254.0
2038                                          140568.0
1375                                          103875.0
1076                                          115139.0
837                                           142273.0
1802                                           59712.0
875                                           191250.0
1061                                          129167.0
1988                                          102065.0
828                                           125357.0
2161                                           86364.0
2117                                           86429.0
1935                                           93929.0
330                                            91250.0
2169                                          118750.0
1385                                          131845.0
2113                                          213712.0
1006                                           86000.0
2030                                          162188.0

      Management of companies and enterprises  \
924                                       NaN
998                                       NaN
2038                                      NaN
1375                                      NaN
1076                                      NaN
837                                       NaN
1802                                      NaN
875                                       NaN
1061                                      NaN
1988                                      NaN
828                                       NaN
2161                                      NaN
2117                                      NaN
1935                                      NaN
330                                       NaN
2169                                      NaN
1385                                      NaN
2113                                      NaN
1006                                      NaN
2030                                      NaN

      Administrative and support and waste management services  \
```

```
924                                           24205.0
998                                          103776.0
2038                                          40988.0
1375                                           4234.0
1076                                          26406.0
837                                               NaN
1802                                          38125.0
875                                               NaN
1061                                              NaN
1988                                              NaN
828                                               NaN
2161                                              NaN
2117                                              NaN
1935                                          26216.0
330                                           70909.0
2169                                          24615.0
1385                                          49688.0
2113                                              NaN
1006                                          48750.0
2030                                          49500.0

      Educational services  Health care and social assistance  \
924                42571.0                            62639.0
998                75950.0                            81066.0
2038               46159.0                            46796.0
1375               42857.0                            46351.0
1076               59539.0                            57647.0
837                91023.0                            14375.0
1802               63594.0                            79286.0
875                58269.0                            62708.0
1061               78750.0                           126786.0
1988               77045.0                            75500.0
828                35208.0                           250001.0
2161               46944.0                            64625.0
2117               61475.0                            62891.0
1935               76172.0                            93594.0
330                43365.0                            86979.0
2169               84345.0                            92738.0
1385               61433.0                            80455.0
2113               18000.0                           250001.0
1006               43500.0                            82292.0
2030               22321.0                           128966.0

      Arts, entertainment, and recreation  Accommodation and food services  \
924                              101618.0                          72880.0
998                               51602.0                          73895.0
2038                             160972.0                          75125.0
```

```
1375                          90560.0                           75192.0
1076                          27500.0                           81295.0
837                           21944.0                           81591.0
1802                              NaN                           82159.0
875                          250001.0                           85298.0
1061                              NaN                           85563.0
1988                          40536.0                           97206.0
828                           42273.0                           98958.0
2161                          13625.0                          100239.0
2117                          42714.0                          105813.0
1935                              NaN                          106250.0
330                               NaN                          107667.0
2169                           7344.0                          109063.0
1385                          60000.0                          112904.0
2113                              NaN                          125705.0
1006                         250001.0                          135104.0
2030                          15694.0                          250001.0

      Other services  Public administration  \
924          24091.0               141250.0
998          11250.0                44657.0
2038         21667.0               101293.0
1375         17917.0                89125.0
1076         20515.0               148056.0
837          20909.0                    NaN
1802         52813.0               104375.0
875         103393.0               175139.0
1061         47045.0                76667.0
1988         16765.0                70469.0
828          30875.0                    NaN
2161         32946.0                88889.0
2117         11875.0                    NaN
1935        148594.0                 3629.0
330          23482.0                72500.0
2169          7442.0                    NaN
1385             NaN                72772.0
2113         21853.0                70500.0
1006             NaN                61250.0
2030          5893.0                    NaN

                                               geometry
924   MULTIPOLYGON (((-118.41555 33.98671, -118.4148…
998   MULTIPOLYGON (((-118.22547 34.16131, -118.2254…
2038  MULTIPOLYGON (((-118.37280 33.85916, -118.3728…
1375  MULTIPOLYGON (((-118.09867 34.14625, -118.0986…
1076  MULTIPOLYGON (((-117.87252 34.13665, -117.8725…
837   MULTIPOLYGON (((-118.55638 34.03798, -118.5561…
```

```
1802  MULTIPOLYGON (((-118.06361 33.85858, -118.0622…
875   MULTIPOLYGON (((-118.40065 34.04654, -118.4005…
1061  MULTIPOLYGON (((-117.75680 34.14402, -117.7567…
1988  MULTIPOLYGON (((-118.37874 33.89872, -118.3787…
828   MULTIPOLYGON (((-118.46823 34.12921, -118.4681…
2161  MULTIPOLYGON (((-118.73706 34.15444, -118.7367…
2117  MULTIPOLYGON (((-118.39914 34.06029, -118.3990…
1935  MULTIPOLYGON (((-118.13066 33.75524, -118.1294…
330   MULTIPOLYGON (((-118.56889 34.13847, -118.5687…
2169  MULTIPOLYGON (((-118.71425 34.03070, -118.7141…
1385  MULTIPOLYGON (((-118.16776 34.14147, -118.1676…
2113  MULTIPOLYGON (((-118.42704 34.09063, -118.4263…
1006  MULTIPOLYGON (((-118.27918 34.17249, -118.2790…
2030  MULTIPOLYGON (((-118.41250 33.90190, -118.4096…

[20 rows x 24 columns]
```

[14]:
```python
minx, miny, maxx, maxy = industry.geometry.total_bounds
print(minx)
print(maxx)
print(miny)
print(maxy)
```

```
-118.94518
-117.655235
32.75004
34.823301
```

Once I sort the values and get an ideal of what the visual might look like. Next steps I take are to normalize the data, specifically just the Accomodation and food service.

[15]:
```python
industry_web = industry.to_crs('EPSG:4326')
```

[16]:
```python
industry['Accommodation_and_food_services_per_1000'] = industry['Accommodation␣
↪and food services']/industry['total']*1000
```

[17]:
```python
industry.sort_values(by="Accommodation_and_food_services_per_1000").head()
```

[17]:
```
            geoid                                  name     total  \
825   06037261101  Census Tract 2611.01, Los Angeles, CA  103651.0
2096  06037670406  Census Tract 6704.06, Los Angeles, CA  115625.0
2121  06037701202  Census Tract 7012.02, Los Angeles, CA   81904.0
2027  06037620101  Census Tract 6201.01, Los Angeles, CA   76725.0
1387  06037463900     Census Tract 4639, Los Angeles, CA   74063.0

      Agriculture, forestry, fishing and hunting  \
825                                          NaN
2096                                         NaN
```

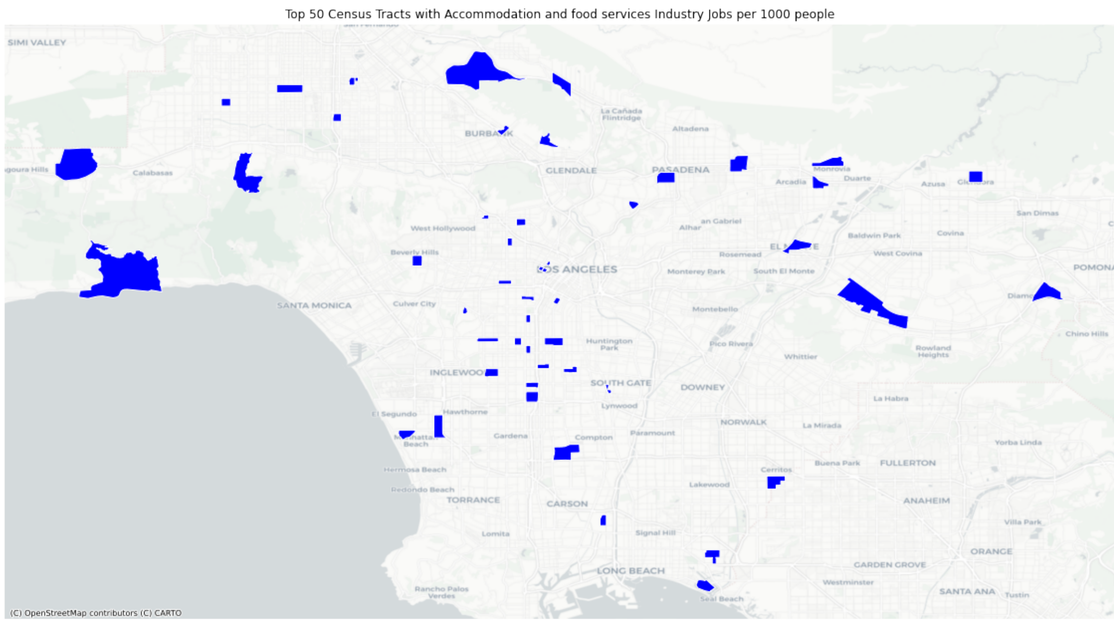
```
2121                                           NaN
2027                                           NaN
1387                                           NaN

      Mining, quarrying, and oil and gas extraction  Construction  \
825                                             NaN       64500.0
2096                                            NaN           NaN
2121                                            NaN       57813.0
2027                                            NaN       70885.0
1387                                            NaN       90150.0

      Manufacturing  Wholesale trade  Retail trade  \
825        123750.0              NaN       41161.0
2096       160795.0         119250.0       99500.0
2121        31250.0              NaN       78417.0
2027       121096.0         200533.0       44271.0
1387       100086.0          31607.0       50208.0

      Transportation and warehousing  …  \
825                          28490.0  …
2096                        231250.0  …
2121                         57000.0  …
2027                         38750.0  …
1387                        127000.0  …

      Management of companies and enterprises  \
825                                        NaN
2096                                       NaN
2121                                       NaN
2027                                       NaN
1387                                       NaN

      Administrative and support and waste management services  \
825                                             68106.0
2096                                                NaN
2121                                            76250.0
2027                                            21667.0
1387                                            15809.0

      Educational services  Health care and social assistance  \
825                78681.0                            64449.0
2096               78250.0                           117981.0
2121               82763.0                            71875.0
2027               60313.0                            77575.0
1387               72250.0                            80117.0

      Arts, entertainment, and recreation  Accommodation and food services  \
```

```
825                                 87159.0                            2499.0
2096                                 8636.0                            3000.0
2121                                41389.0                            2499.0
2027                                20795.0                            2499.0
1387                                36354.0                            2499.0

      Other services  Public administration  \
825          35781.0                    NaN
2096         63000.0                    NaN
2121         53571.0                79531.0
2027         36607.0               130804.0
1387         71750.0                53750.0

                                               geometry  \
825   MULTIPOLYGON (((-118.41760 34.10724, -118.4175…
2096  MULTIPOLYGON (((-118.39328 33.76111, -118.3928…
2121  MULTIPOLYGON (((-118.49502 34.03232, -118.4946…
2027  MULTIPOLYGON (((-118.42878 33.93097, -118.4272…
1387  MULTIPOLYGON (((-118.16805 34.12392, -118.1677…

      Accommodation_and_food_services_per_1000
825                                  24.109753
2096                                 25.945946
2121                                 30.511330
2027                                 32.570870
1387                                 33.741544

[5 rows x 25 columns]
```

I map out what the top 50 census tracts. I choose 50 to show because I am curious to refine this to specific areas. From the comments I received from my midterm, I found that the historical comparisons from 2008 recession and 2020 would be interested to see what improvements occurred and where to help determine long term strategies to economic recovery.

[48]:
```
fig,ax = plt.subplots(figsize=(20,20))
industry.
 ↪sort_values(by='Accommodation_and_food_services_per_1000',ascending=False)[:
 ↪50].plot(ax=ax,
                                                                     color='blue',
                                                                    ␣
 ↪edgecolor='white')

ax.set_title('Top 50 Census Tracts with Accommodation and food services␣
 ↪Industry Jobs per 1000 people')

ax.axis('off')
```

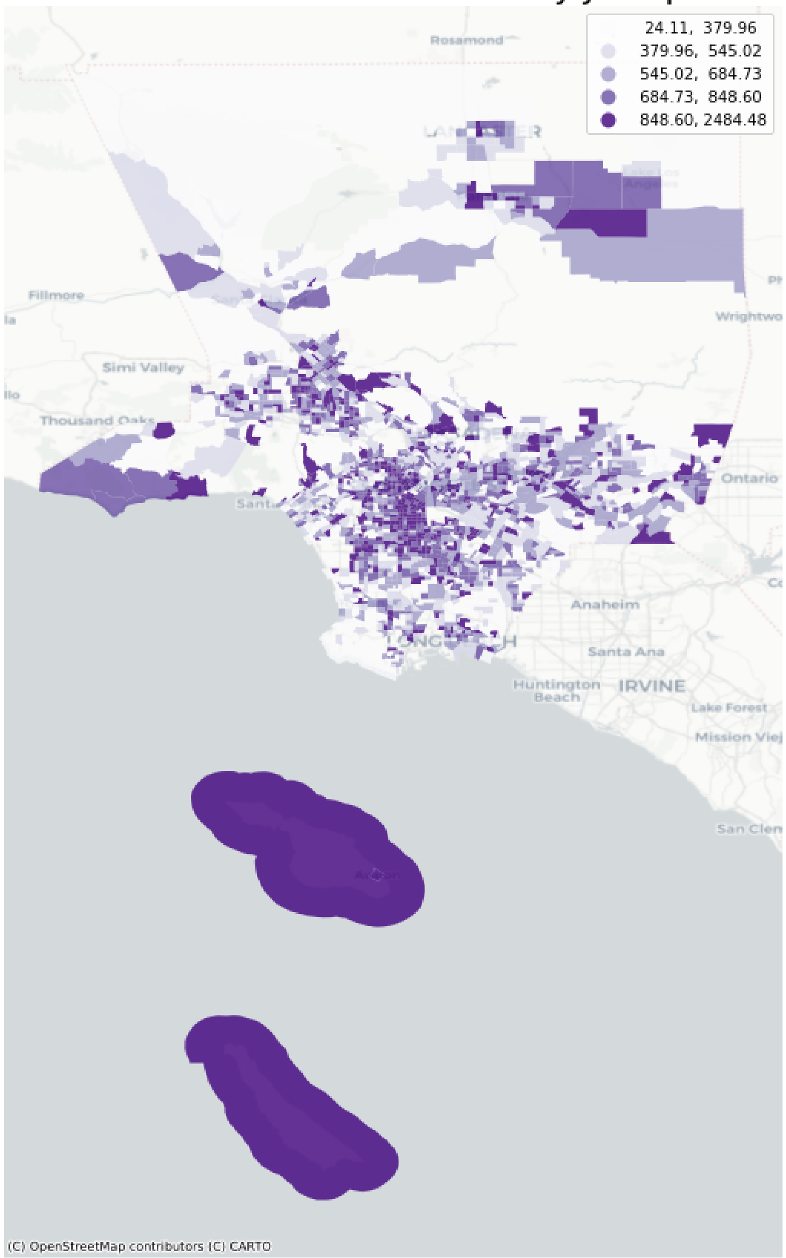
```
ctx.add_basemap(ax,
                crs='epsg:4326',
                source=ctx.providers.CartoDB.Positron)
```



in the following map, I produce a choropleth map in quartiles of people per the 1000 that held a job in the Accomodation and food services industry. This map looks a bit scattered, but South LA looks like the area with a concentration of census tracts

[19]:
```
fig,ax = plt.subplots(figsize=(15,15))

industry.plot(ax=ax,
        column='Accommodation_and_food_services_per_1000',
        legend=True,
        alpha=0.8,
        cmap='Purples',
        scheme='quantiles')

ax.axis('off')
ax.set_title('Accommodation and food services Industry Jobs per 1000␣
 ↪people',fontsize=22)
ctx.add_basemap(ax,
                crs='epsg:4326', # surprise! You can change the crs here!
                source=ctx.providers.CartoDB.Positron)
```

Accommodation and food services Industry Jobs per 1000 people



In the next cells I start the spatial autocorrelation to refine the data so that the areas are narrowed.
I calculate the spatial weight to create a lag.

[20]:
```
wq =  lps.weights.KNN.from_dataframe(industry,k=8)

wq.transform = 'r'
```

[21]:
```
industry['Accommodation_and_food_services_per_1000_lag'] = lps.weights.
↪lag_spatial(wq, industry['Accommodation_and_food_services_per_1000'])
```

[22]:
```
industry.sample(10)[['total','Accommodation and food␣
↪services','Accommodation_and_food_services_per_1000','Accommodation_and_food_services_per_1
↪'geometry']]
```

[22]:
```
        total  Accommodation and food services  \
76    40198.0                          20673.0
1932  62453.0                          29407.0
1960  24881.0                          16875.0
476   56991.0                          45781.0
525   23304.0                          14083.0
1893  49667.0                           6333.0
1844  50352.0                          19018.0
1922  46521.0                          26553.0
770   28846.0                          18596.0
2221  67188.0                          16923.0

      Accommodation_and_food_services_per_1000  \
76                                  514.279317
1932                                470.866091
1960                                678.228367
476                                 803.302276
525                                 604.316855
1893                                127.509211
1844                                377.700985
1922                                570.774489
770                                 644.664772
2221                                251.875335

      Accommodation_and_food_services_per_1000_lag  \
76                                      647.231799
1932                                    515.895598
1960                                    648.345676
476                                     650.650469
525                                     699.049741
1893                                    573.548081
1844                                    259.082011
1922                                    683.178128
770                                     735.205568
2221                                    333.195746

                                               geometry
76    MULTIPOLYGON (((-118.49151 34.25024, -118.4915…
1932  MULTIPOLYGON (((-118.16264 33.73965, -118.1625…
1960  MULTIPOLYGON (((-118.34784 33.97174, -118.3472…
```

```
476   MULTIPOLYGON (((-118.28355 34.08389, -118.2815…
525   MULTIPOLYGON (((-118.20956 34.02717, -118.2095…
1893  MULTIPOLYGON (((-118.13405 33.78446, -118.1340…
1844  MULTIPOLYGON (((-118.14247 33.83481, -118.1424…
1922  MULTIPOLYGON (((-118.18443 33.76261, -118.1837…
770   MULTIPOLYGON (((-118.31775 33.97502, -118.3177…
2221  MULTIPOLYGON (((-118.23629 34.63307, -118.2362…
```

[23]:
```
industry['Accommodation_and_food_services_per_1000_lag_diff'] =␣
↪industry['Accommodation_and_food_services_per_1000'] -␣
↪industry['Accommodation_and_food_services_per_1000_lag']
```

After I create the Spatial Lag, I look for the donut and diamond.

[24]:
```
industry_donut = industry.
↪sort_values(by='Accommodation_and_food_services_per_1000_lag_diff').head(1)
industry_donut
```

[24]:
```
            geoid                                    name    total  \
2213  06037910201  Census Tract 9102.01, Los Angeles, CA  48054.0

      Agriculture, forestry, fishing and hunting  \
2213                                         NaN

      Mining, quarrying, and oil and gas extraction  Construction  \
2213                                            NaN       48902.0

      Manufacturing  Wholesale trade  Retail trade  \
2213        71523.0          37305.0       38021.0

      Transportation and warehousing  …  Educational services  \
2213                         49750.0  …               51125.0

      Health care and social assistance  Arts, entertainment, and recreation  \
2213                            85556.0                                  NaN

      Accommodation and food services  Other services  Public administration  \
2213                           2499.0          9500.0                66207.0

                                               geometry  \
2213  MULTIPOLYGON (((-118.14777 34.61262, -118.1477…

      Accommodation_and_food_services_per_1000  \
2213                                 52.003996

      Accommodation_and_food_services_per_1000_lag  \
2213                                    758.333805
```

```
   Accommodation_and_food_services_per_1000_lag_diff
2213                                         -706.32981

[1 rows x 27 columns]
```

The donut is in palmdale, people are making less in the Accomodation and food services industry.

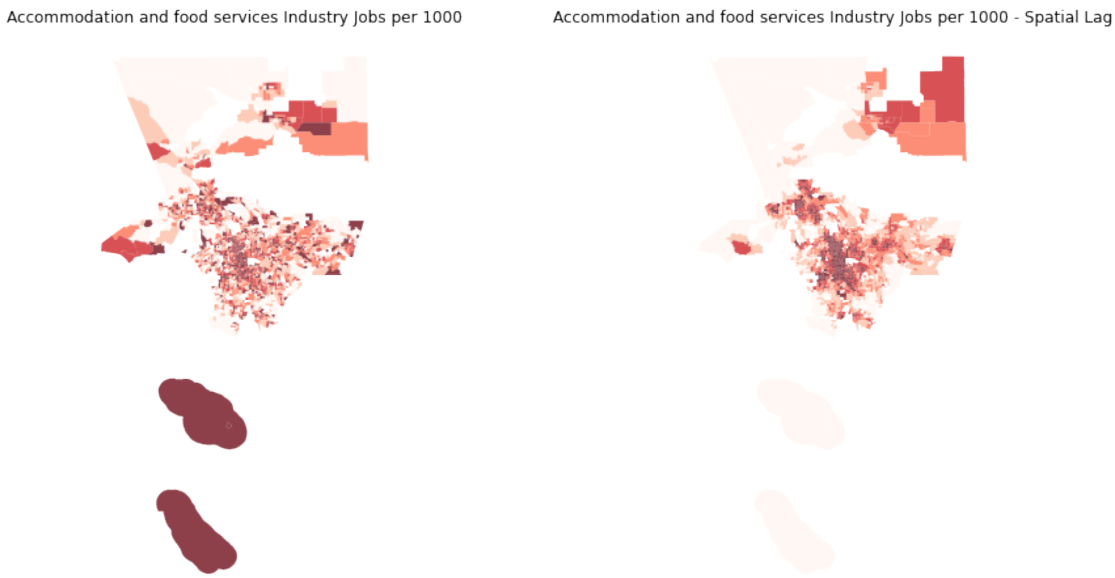
[25]:
```python
industry_diamond = industry.
 ↪sort_values(by='Accommodation_and_food_services_per_1000_lag_diff').tail(1)
industry_diamond
```

[25]:
```
            geoid                                name    total  \
1699  06037543100  Census Tract 5431, Los Angeles, CA  26261.0

      Agriculture, forestry, fishing and hunting  \
1699                                     19514.0

      Mining, quarrying, and oil and gas extraction  Construction  \
1699                                            NaN       35938.0

      Manufacturing  Wholesale trade  Retail trade  \
1699        27040.0          53224.0       23077.0

      Transportation and warehousing  …  Educational services  \
1699                         31696.0  …               54375.0

      Health care and social assistance  Arts, entertainment, and recreation  \
1699                            15735.0                              23897.0

      Accommodation and food services  Other services  Public administration  \
1699                          65245.0         22679.0                65372.0

                                               geometry  \
1699  MULTIPOLYGON (((-118.26600 33.87342, -118.2659…

      Accommodation_and_food_services_per_1000  \
1699                               2484.482693

      Accommodation_and_food_services_per_1000_lag  \
1699                                    426.426381

      Accommodation_and_food_services_per_1000_lag_diff
1699                                        2058.056312

[1 rows x 27 columns]
```

The diamond is in downtown LA, the Arts District. THis tells me that the area has high income for people who are in the accomodation and food services industry. GIven the gentrification of teh area, this might be due to the different types of businesses that cater to specific clientle and different level of servics.

In the following map I look at the difference between the Accomodation and food services per 1000 and the spatial lag

[39]:
```
fig, ax = plt.subplots(1, 2, figsize=(15, 8))
industry.plot(ax=ax[0],
         column='Accommodation_and_food_services_per_1000',
         cmap='Reds',
         scheme='quantiles',
         k=5,
         edgecolor='grey',
         linewidth=0,
         alpha=0.75,
           )



ax[0].axis("off")
ax[0].set_title("Accommodation and food services Industry Jobs per 1000")



industry.plot(ax=ax[1],
         column='Accommodation_and_food_services_per_1000_lag',
         cmap='Reds',
         scheme='quantiles',
         k=5,
         edgecolor='grey',
         linewidth=0,
         alpha=0.75
           )

ax[1].axis("off")
ax[1].set_title("Accommodation and food services Industry Jobs per 1000 -␣
 ↪Spatial Lag")

plt.show()
```

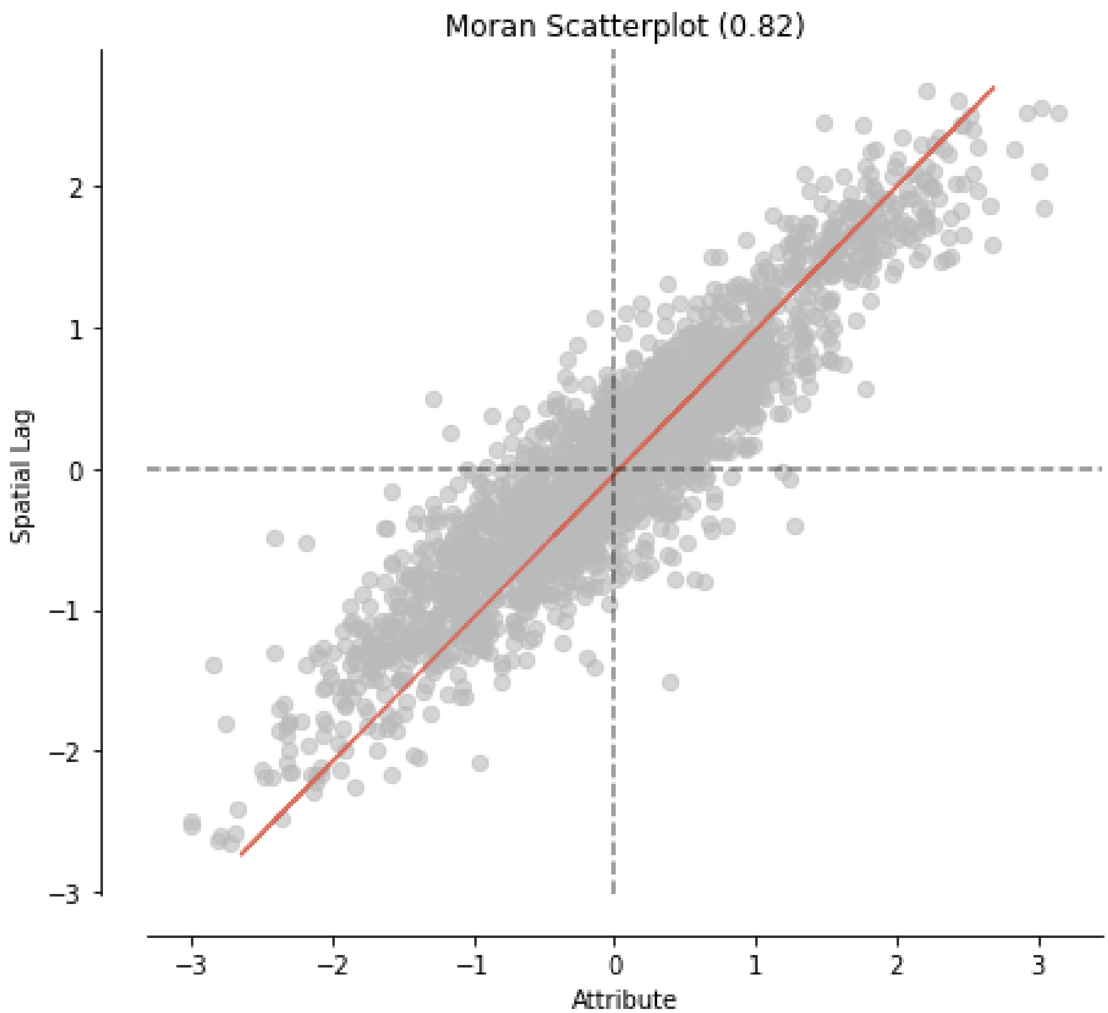


the Spatial Lag really makes a difference, its clearer to see where the concentration lies in the spatial lag map. This map helps isolate specific regions that hold individuals with incomes in the the accomodation industry. People in the darkest red areas rely more on an income and have lower incomes in the accomodation industry.

1.3 Below I map out the Moran Local ScatterPlot

I'll calcualte the moran values and then plot them to see if there is autocorrelation

[68]:
```
fig, ax = moran_scatterplot(moran, aspect_equal=True)
plt.show()
```



[27]:
```
industry_web = industry.to_crs('EPSG:4326')
```

[28]:
```
minx, miny, maxx, maxy = industry_web.geometry.total_bounds
center_lat_gdf_web = (maxy-miny)/2+miny
center_lon_gdf_web = (maxx-minx)/2+minx
```

[29]:
```
industry_web.Accommodation_and_food_services_per_1000_lag.describe()
```

[29]:
```
count    2208.000000
mean      633.203414
std       160.159239
min       153.012219
25%       529.589370
50%       630.862927
75%       738.860074
```

```
max      1137.532668
Name: Accommodation_and_food_services_per_1000_lag, dtype: float64
```

[30]:
```
median = industry_web.Accommodation_and_food_services_per_1000_lag.median()
```

[31]:
```
y = industry.Accommodation_and_food_services_per_1000_lag
moran = Moran(y, wq)
moran.I
```

[31]:
```
0.8246451518525661
```

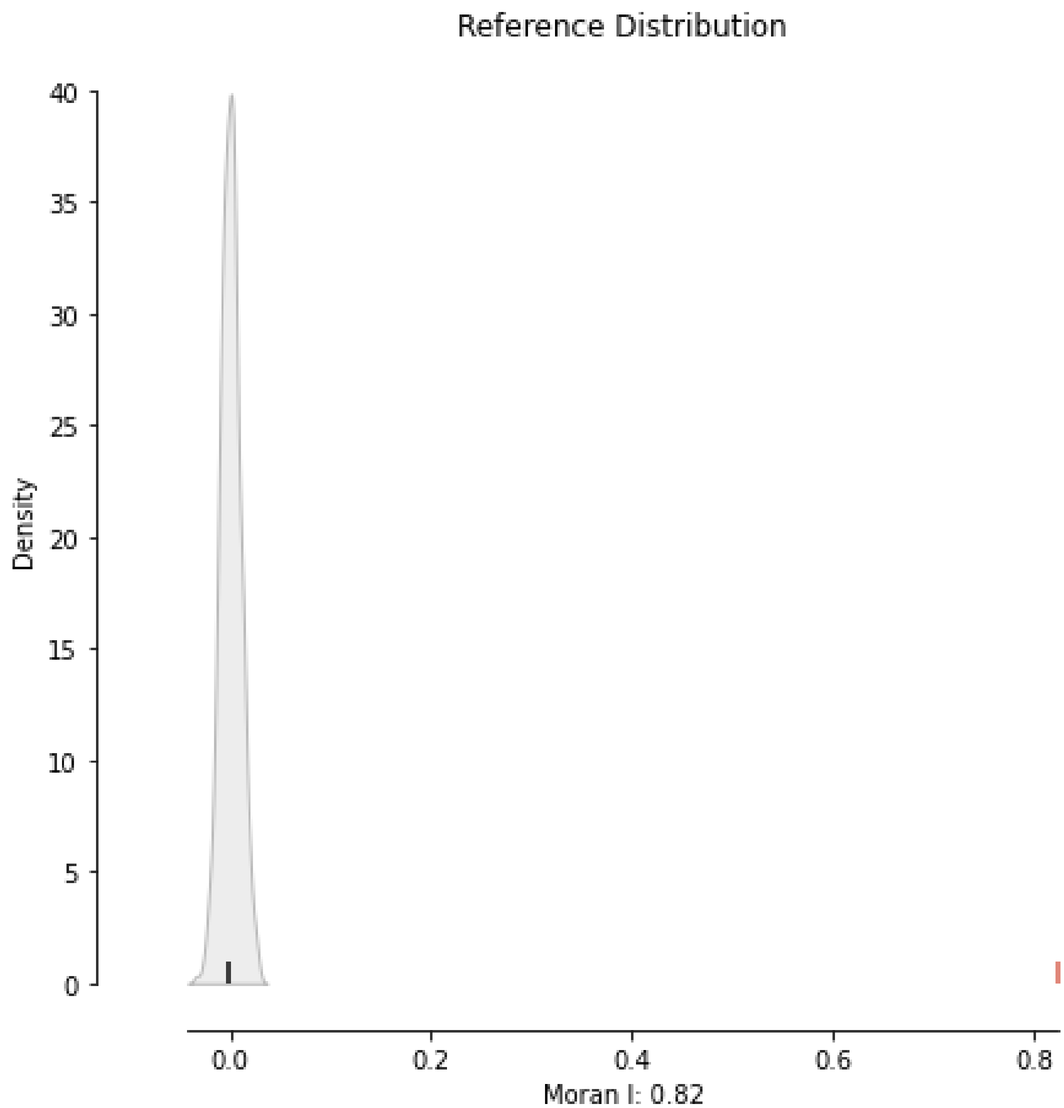
[32]:
```
moran.p_sim
```

[32]:
```
0.001
```

[69]:
```
plot_moran_simulation(moran,aspect_equal=False)
```

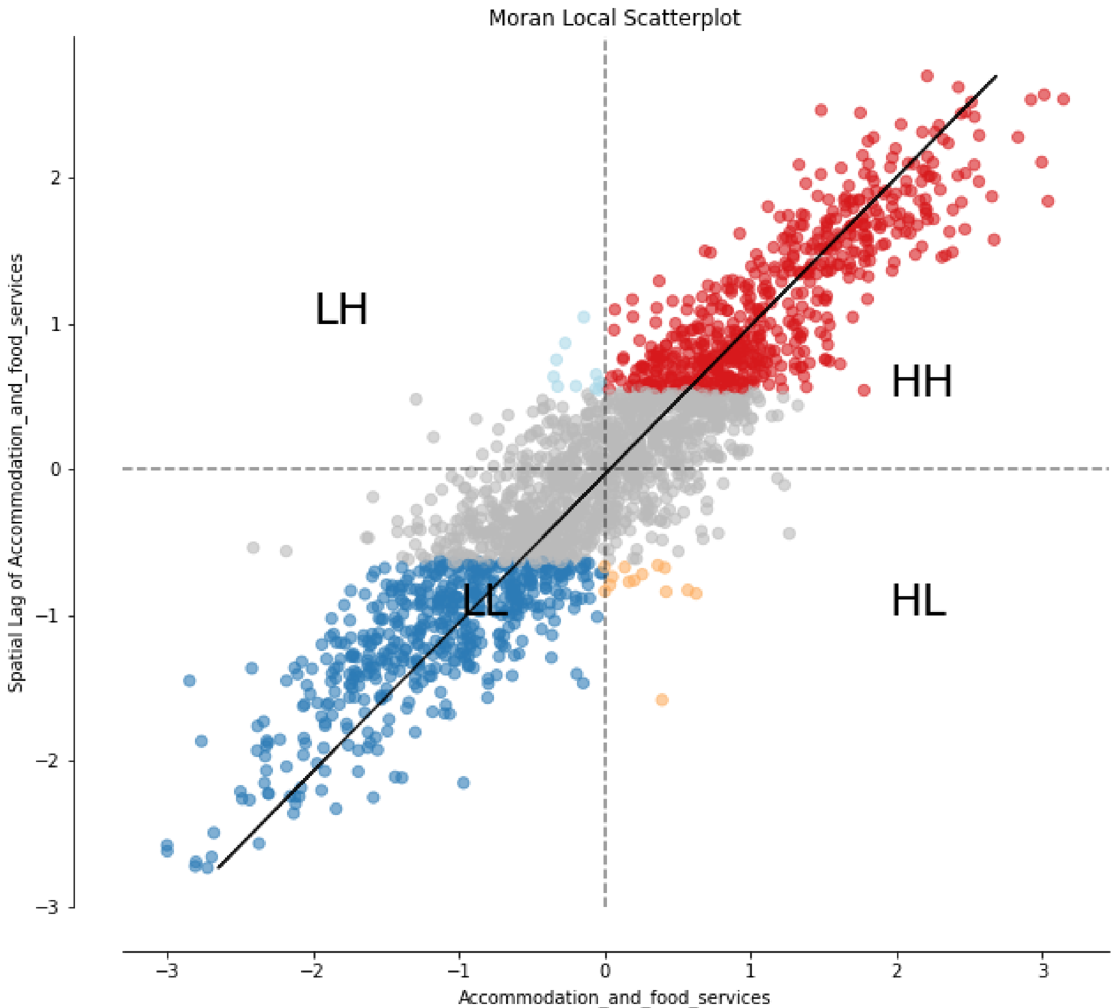
```
/opt/conda/lib/python3.8/site-packages/splot/_viz_esda_mpl.py:47:
MatplotlibDeprecationWarning:
The set_smart_bounds function was deprecated in Matplotlib 3.2 and will be
removed two minor releases later.
  ax.spines['left'].set_smart_bounds(True)
/opt/conda/lib/python3.8/site-packages/splot/_viz_esda_mpl.py:48:
MatplotlibDeprecationWarning:
The set_smart_bounds function was deprecated in Matplotlib 3.2 and will be
removed two minor releases later.
  ax.spines['bottom'].set_smart_bounds(True)
```

[69]:
```
(<Figure size 504x504 with 1 Axes>,
 <matplotlib.axes._subplots.AxesSubplot at 0x7fbcf3b100a0>)
```



[33]:
```
lisa = esda.moran.Moran_Local(y, wq)
```

[34]:
```
fig,ax = plt.subplots(figsize=(10,15))

moran_scatterplot(lisa, ax=ax, p=0.05)
ax.set_xlabel("Accommodation_and_food_services")
ax.set_ylabel('Spatial Lag of Accommodation_and_food_services')

plt.text(1.95, 0.5, "HH", fontsize=25)
plt.text(1.95, -1, "HL", fontsize=25)
plt.text(-2, 1, "LH", fontsize=25)
plt.text(-1, -1, "LL", fontsize=25)
plt.show()
```



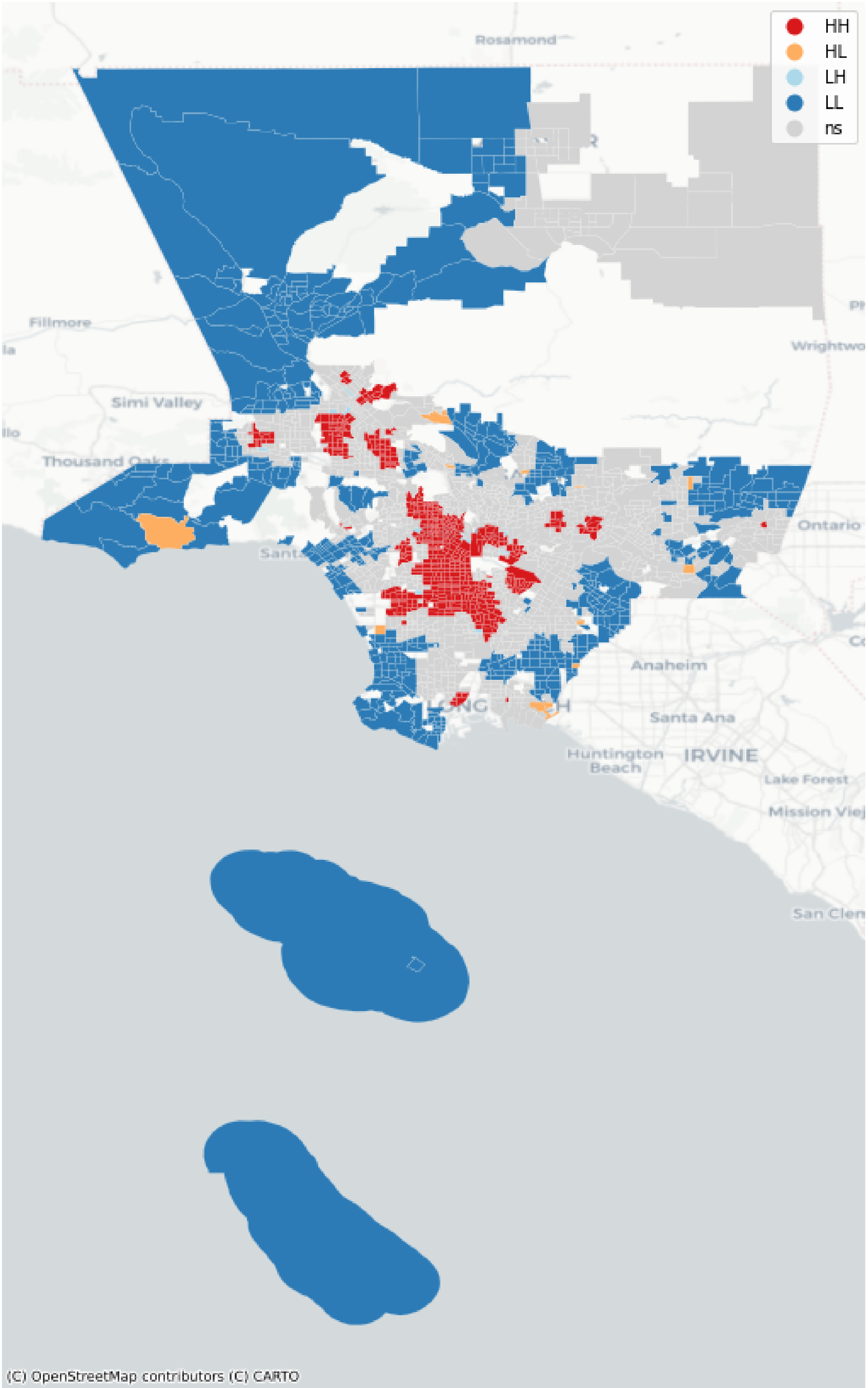
I added: HH areas with individuals high working in the Accomodation industry with low incomes. HL areas with individuals high working in the Accomodation industry with mid low incomes. LH areas with individuals high working in the Accomodation industry with mid high incomes. LL areas with individuals high working in the Accomodation industry with high incomes.

The distribution looks like there is even distribution, but I would argue that there are more areas that might fall under the HH category or more people who work in the Accomodation and food services that also have low incomes.

Below I map the moran scatter plot data, so we can visually see these statistically significant clusters.

[35]:
```
fig, ax = plt.subplots(figsize=(15,15))
lisa_cluster(lisa, industry, p=0.05, ax=ax)

ctx.add_basemap(ax,
```

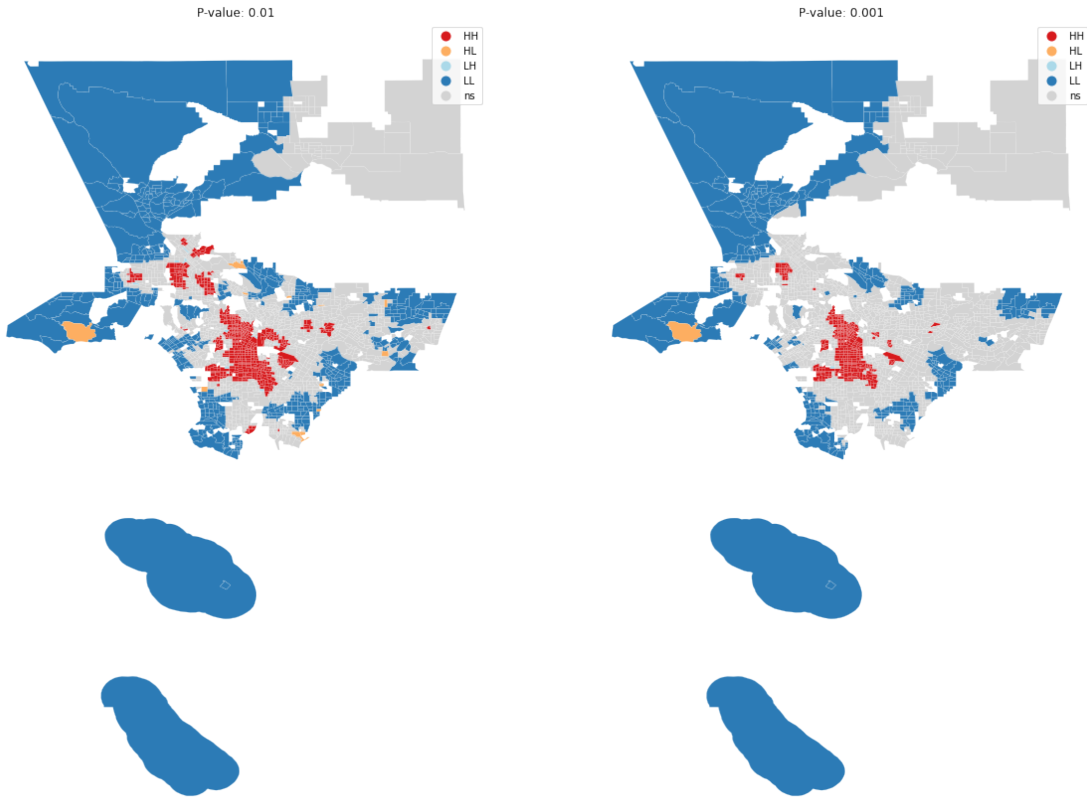
```
                crs='epsg:4326', # surprise! You can change the crs here!
                source=ctx.providers.CartoDB.Positron)

plt.show()
```


HH
HL
LH
LL
ns
Rosamond
Fillmore
Simi Valley
Thousand Oaks
Wrightwo
Ontario
Anaheim
Santa Ana
Huntington Beach
IRVINE
Lake Forest
Mission Viej
San Clem
(C) OpenStreetMap contributors (C) CARTO

Similar map that I mapped earlier, but this map shows the stat significant areas. So this is more evidence to show that there are areas that can staticially see high unemployment because of the pandemic.

Below I compare the P-values at .01 and .001. Because I did want to zoom in on specific areas, I when with a higher accomodation and food service jobs and low incomes, so I want to look at the areas most concentrated with most likly low incomes.

[36]:
```
# create the 1x2 subplots
fig, ax = plt.subplots(1, 2, figsize=(20, 20))

# regular count map on the left
lisa_cluster(lisa, industry, p=0.05, ax=ax[0])

ax[0].axis("off")
ax[0].set_title("P-value: 0.01")


# spatial lag map on the right
lisa_cluster(lisa, industry, p=0.01, ax=ax[1])
ax[1].axis("off")
ax[1].set_title("P-value: 0.001")


plt.show()
```



The p-value of .001, shows a narrow area in South LA, district 9, that has a high concentration of individuals with low incomes in the accomodation and food service industry. I will want to take a close look at what's happening in this area.

Below I wanted to see if I could look at the make up of Accomodation and food services jobs by district. Still needs somework, but I'm curious at how can all indicators be represented on on map. Is this possible? I would want to see the distribution of industry incomes by council district, especial the ones that overlap with areas impacted.

[49]:
```
gdf_cd = gpd.read_file('http://boundaries.latimes.com/1.0/boundary-set/
↪la-city-council-districts-2012/?format=geojson')
```

[50]:
```
indicators = ['Agriculture, forestry, fishing and hunting',
              'Mining, quarrying, and oil and gas extraction',
              'Construction',
              'Manufacturing',
              'Wholesale trade',
              'Retail trade',
              'Transportation and warehousing',
              'Utilities',
              'Information',
```

```
                         'Finance and insurance',
                         'Real estate and rental and leasing',
                         'Professional, scientific, and technical services',
                         'Management of companies and enterprises',
                         'Administrative and support and waste management services',
                         'Educational services',
                         'Health care and social assistance',
                         'Arts, entertainment, and recreation',
                         'Accommodation and food services',
                         'Other services',
                         'Public administration']
```

[52]:
```
for indicator in indicators:
    print ('mean for ' + indicator + ' is ' + str(industry[indicator].mean()))
```

```
mean for Agriculture, forestry, fishing and hunting is 25922.434343434343
mean for Mining, quarrying, and oil and gas extraction is 59982.25
mean for Construction is 42366.87367357251
mean for Manufacturing is 49788.20947515095
mean for Wholesale trade is 47544.251041047
mean for Retail trade is 29009.10409090909
mean for Transportation and warehousing is 40218.94689378757
mean for Utilities is 91461.61373390559
mean for Information is 68037.93617021276
mean for Finance and insurance is 66210.66373239437
mean for Real estate and rental and leasing is 52722.36931380108
mean for Professional, scientific, and technical services is 60021.23940149626
mean for Management of companies and enterprises is 100663.0
mean for Administrative and support and waste management services is
33040.53336653386
mean for Educational services is 41798.39722222222
mean for Health care and social assistance is 43141.15660463005
mean for Arts, entertainment, and recreation is 36429.68241965974
mean for Accommodation and food services is 22524.48822463768
mean for Other services is 27975.448130841123
mean for Public administration is 62534.72802850356
```

[66]:
```
for indicator in indicators:
    print(indicator)
    print (industry.sort_values(by = indicator, ascending=False)[indicator].
 ↪head(10))
```

```
Agriculture, forestry, fishing and hunting
3       155000.0
38      117661.0
1081    100132.0
74       55694.0
```

```
1086     55000.0
1621     51528.0
16       49886.0
1110     46250.0
1246     42563.0
19       41544.0
Name: Agriculture, forestry, fishing and hunting, dtype: float64
Mining, quarrying, and oil and gas extraction
2200    83500.0
2177    67143.0
1070    52619.0
1685    36667.0
1           NaN
3           NaN
4           NaN
5           NaN
6           NaN
7           NaN
Name: Mining, quarrying, and oil and gas extraction, dtype: float64
Construction
1072    250001.0
841     250001.0
2157    250001.0
2169    250001.0
247     243719.0
2155    215536.0
1402    192031.0
1396    177833.0
2163    177708.0
826     170529.0
Name: Construction, dtype: float64
Manufacturing
2030    250001.0
2168    250001.0
827     250001.0
458     216094.0
546     194306.0
456     194091.0
1397    180750.0
2098    175313.0
911     174375.0
2051    172431.0
Name: Manufacturing, dtype: float64
Wholesale trade
67      250001.0
1738    250001.0
2166    250001.0
2159    250001.0
```

```
874     250001.0
1456    250001.0
624     240417.0
2158    225375.0
915     216065.0
368     215446.0
Name: Wholesale trade, dtype: float64
Retail trade
872     250001.0
830     188676.0
847     177500.0
2124    161574.0
1348    161389.0
2046    135027.0
921     127955.0
2125    125769.0
1079    116184.0
2099    114338.0
Name: Retail trade, dtype: float64
Transportation and warehousing
1357    250001.0
2163    250001.0
2042    250001.0
2096    231250.0
308     176250.0
302     172650.0
828     161042.0
2050    160238.0
2094    139028.0
62      137500.0
Name: Transportation and warehousing, dtype: float64
Utilities
1798    250001.0
1069    215500.0
2313    161429.0
1749    153324.0
2076    151071.0
1386    149167.0
1396    146563.0
1044    146222.0
1842    145250.0
1011    143125.0
Name: Utilities, dtype: float64
Information
2180    250001.0
1349    250001.0
845     250001.0
875     250001.0
```

```
1891    250001.0
2032    250001.0
1456    250001.0
1402    250001.0
2090    250001.0
2091    250001.0
Name: Information, dtype: float64
Finance and insurance
2125    250001.0
2087    250001.0
317     250001.0
874     250001.0
872     250001.0
2030    250001.0
999     250001.0
828     250001.0
2113    250001.0
2046    250001.0
Name: Finance and insurance, dtype: float64
Real estate and rental and leasing
2030    250001.0
831     250001.0
830     250001.0
1367    250001.0
1288    250001.0
458     250001.0
828     215208.0
1341    215111.0
340     215000.0
1349    205588.0
Name: Real estate and rental and leasing, dtype: float64
Professional, scientific, and technical services
2113    213712.0
875     191250.0
2042    189688.0
1380    174063.0
2101    170000.0
2030    162188.0
2168    162159.0
825     161667.0
249     161563.0
344     160117.0
Name: Professional, scientific, and technical services, dtype: float64
Management of companies and enterprises
923     250001.0
1383     96429.0
2107     78988.0
2157     66786.0
```

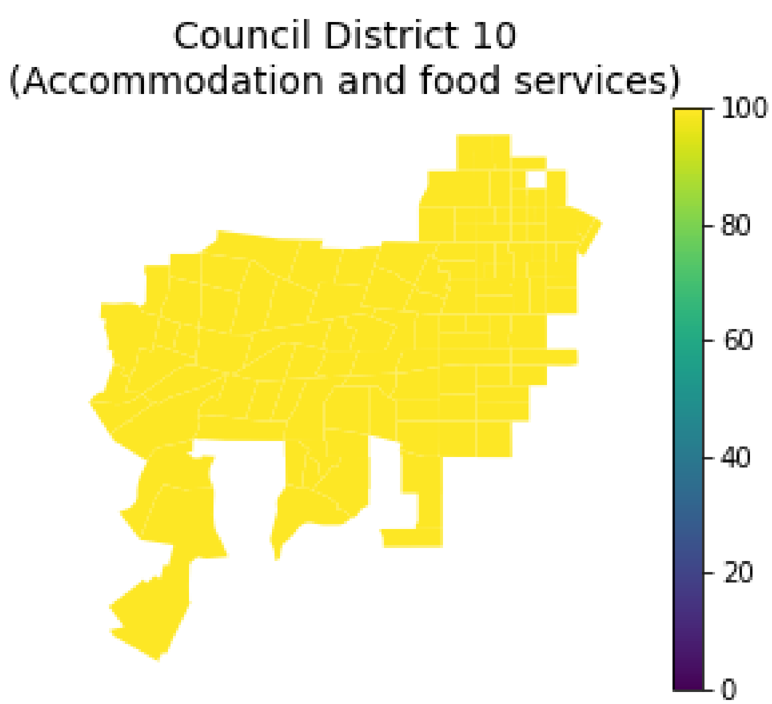
```
830      11111.0
1            NaN
3            NaN
4            NaN
5            NaN
6            NaN
Name: Management of companies and enterprises, dtype: float64
Administrative and support and waste management services
846     250001.0
1277    202594.0
977     182813.0
201     171655.0
643     170781.0
461     162865.0
1346    156250.0
2314    151471.0
1843    150938.0
1884    150568.0
Name: Administrative and support and waste management services, dtype: float64
Educational services
311     171576.0
593     137830.0
2123    135640.0
2127    126528.0
1390    125563.0
827     121250.0
402     108125.0
1956    106250.0
1704    104453.0
1848    103229.0
Name: Educational services, dtype: float64
Health care and social assistance
2091    250001.0
2113    250001.0
828     250001.0
404     250001.0
2101    201250.0
642     180833.0
996     161000.0
2163    161000.0
919     160333.0
831     155169.0
Name: Health care and social assistance, dtype: float64
Arts, entertainment, and recreation
1006    250001.0
875     250001.0
321     250001.0
2155    250001.0
```

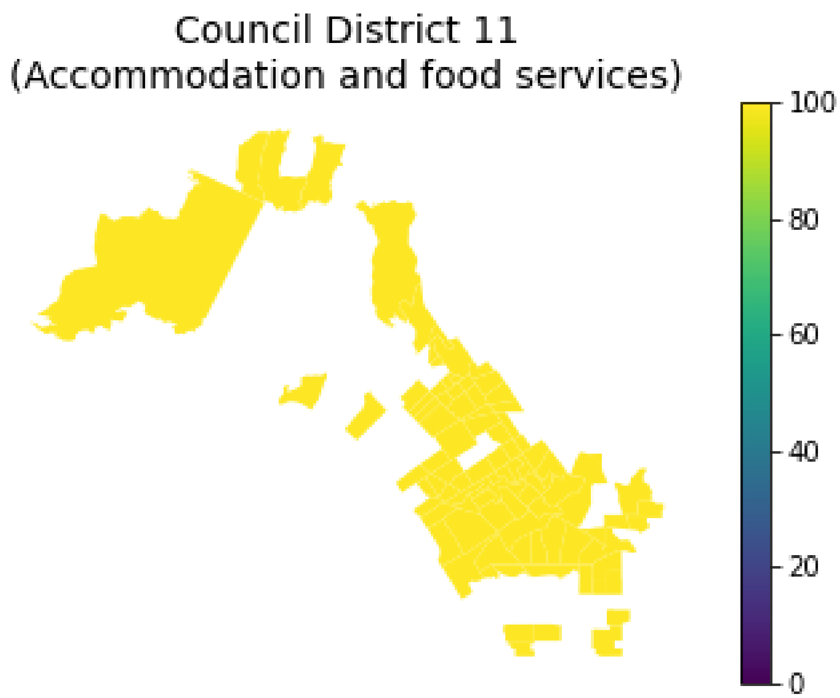
```
1346    250001.0
2033    220688.0
313     205833.0
1676    205104.0
301     186607.0
307     174091.0
Name: Arts, entertainment, and recreation, dtype: float64
Accommodation and food services
2030    250001.0
1006    135104.0
2113    125705.0
1385    112904.0
2169    109063.0
330     107667.0
1935    106250.0
2117    105813.0
2161    100239.0
828      98958.0
Name: Accommodation and food services, dtype: float64
Other services
2101    193125.0
2094    170781.0
869     160250.0
1935    148594.0
2246    148221.0
1939    140197.0
1140    111250.0
1999    108235.0
2114    106042.0
875     103393.0
Name: Other services, dtype: float64
Public administration
1120    248200.0
406     202768.0
2146    200625.0
1462    199167.0
2163    177969.0
910     177734.0
874     175227.0
875     175139.0
2215    169167.0
347     168250.0
Name: Public administration, dtype: float64
```

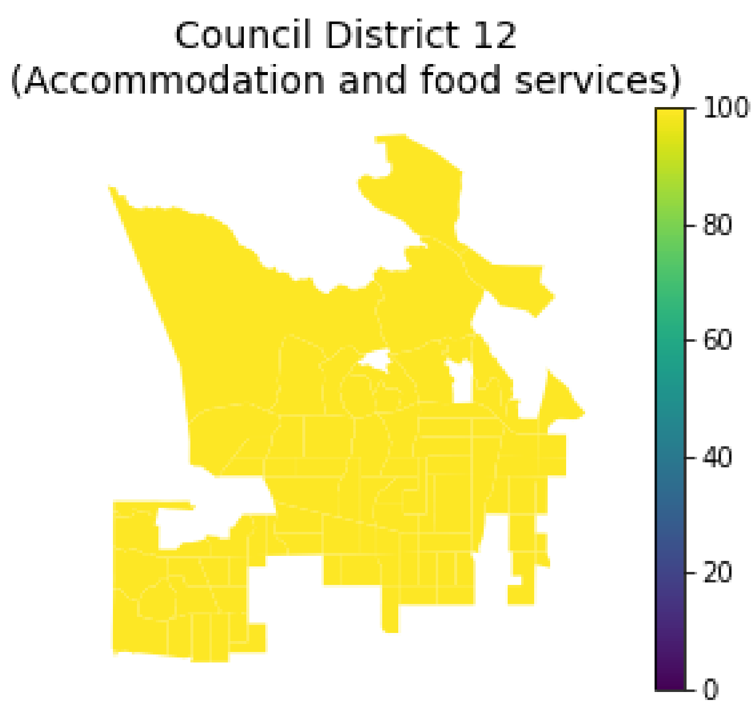
[63]:
```python
# function to create a council district map
def cd_map(name = '1', column = 'Accommodation and food services'):
    # this cd
```

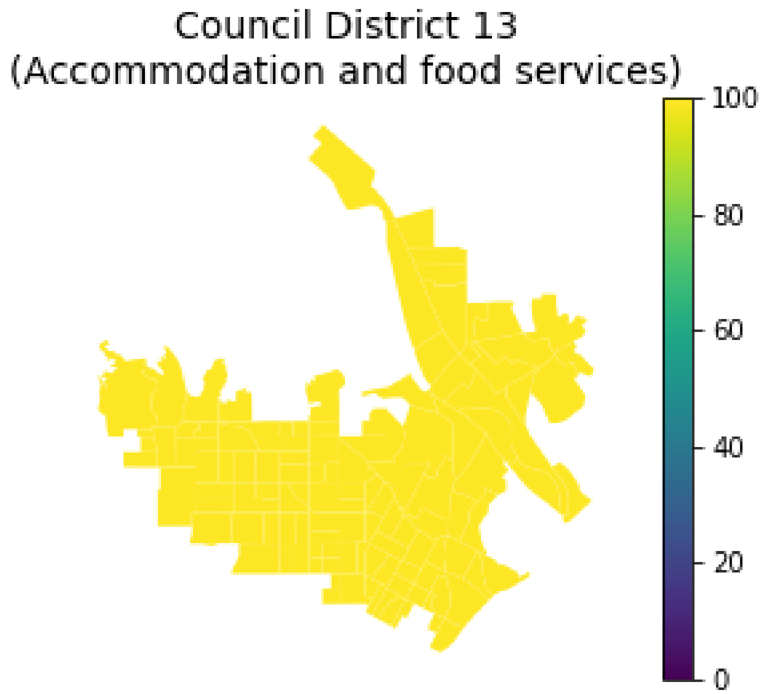
```
    this_cd = gdf_cd[gdf_cd['name']==name]

    # spatial join to get tracts
    tracts = gpd.sjoin(industry,this_cd)

    # plot it
    fig,ax = plt.subplots()

    # map
    tracts.plot(ax=ax,
                column=column,
                vmin=0,
                vmax=100,
                legend=True)

    ax.axis('off')
    ax.set_title('Council District ' + name + '\n(' + column + ')', fontsize=14)
```

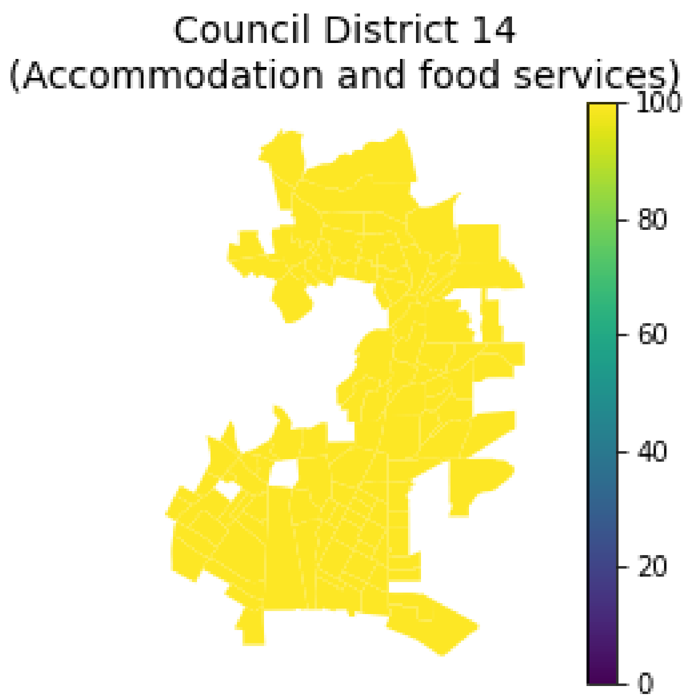
[64]:
```
for index, row in gdf_cd.iterrows():
    cd_map(name = row['name'])
```

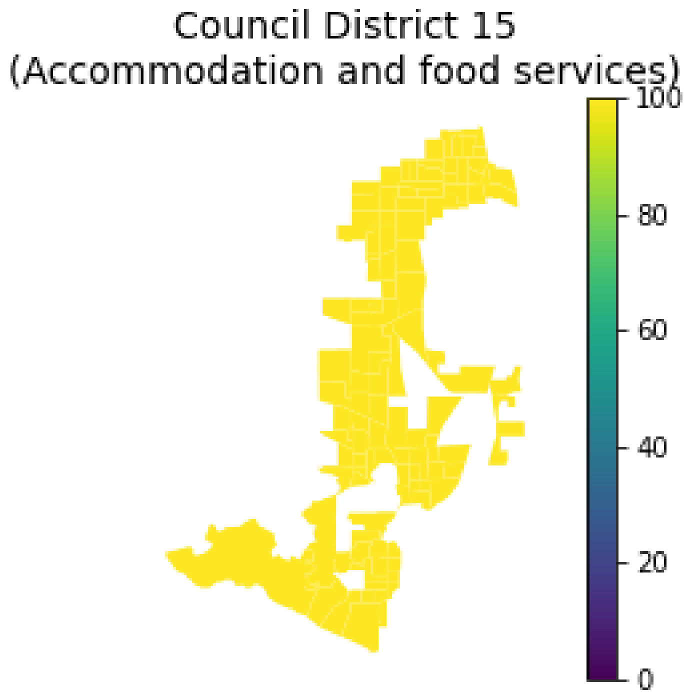


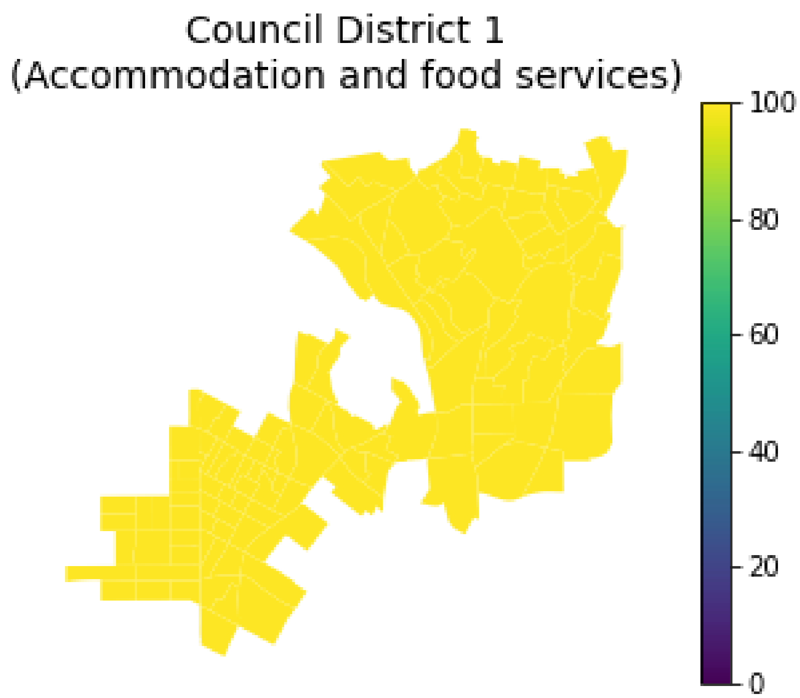

Council District 11
(Accommodation and food services)
100
80
60
40
20
0

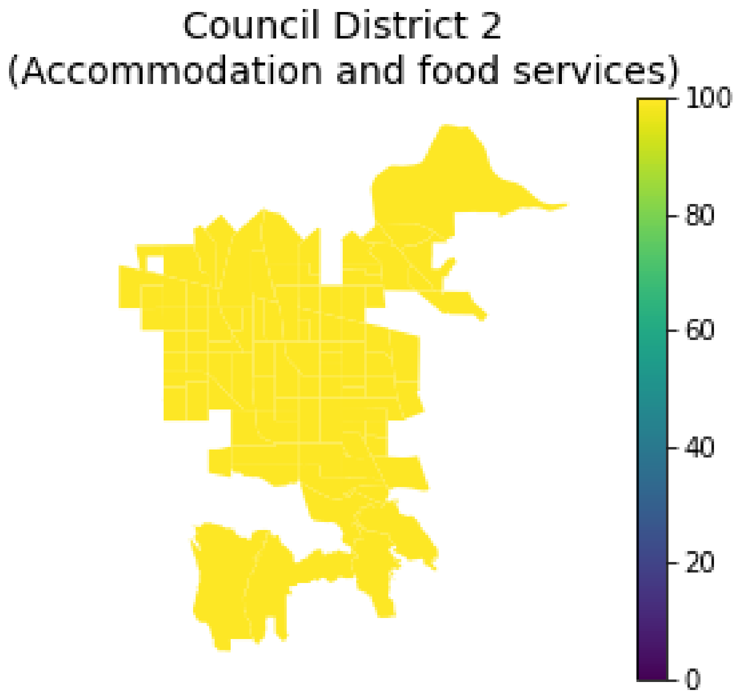

Council District 12
(Accommodation and food services)
100
80
60
40
20
0

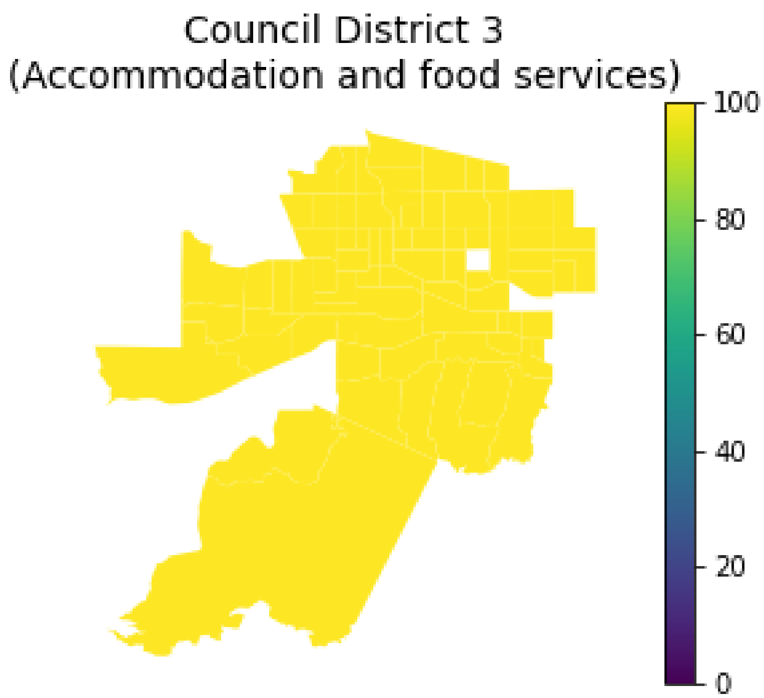

Council District 13
(Accommodation and food services)
100
80
60
40
20
0

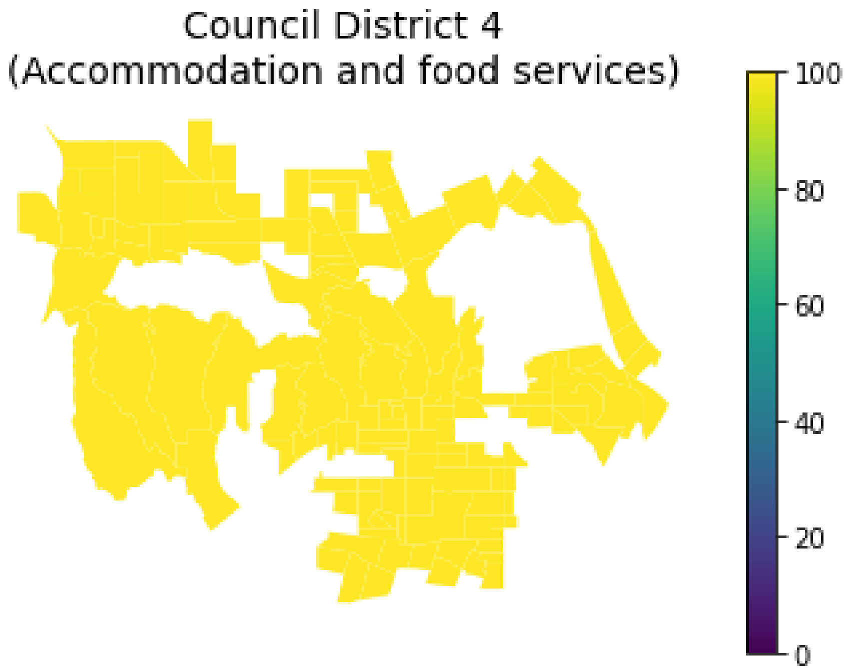

Council District 14
(Accommodation and food services)
100
80
60
40
20
0

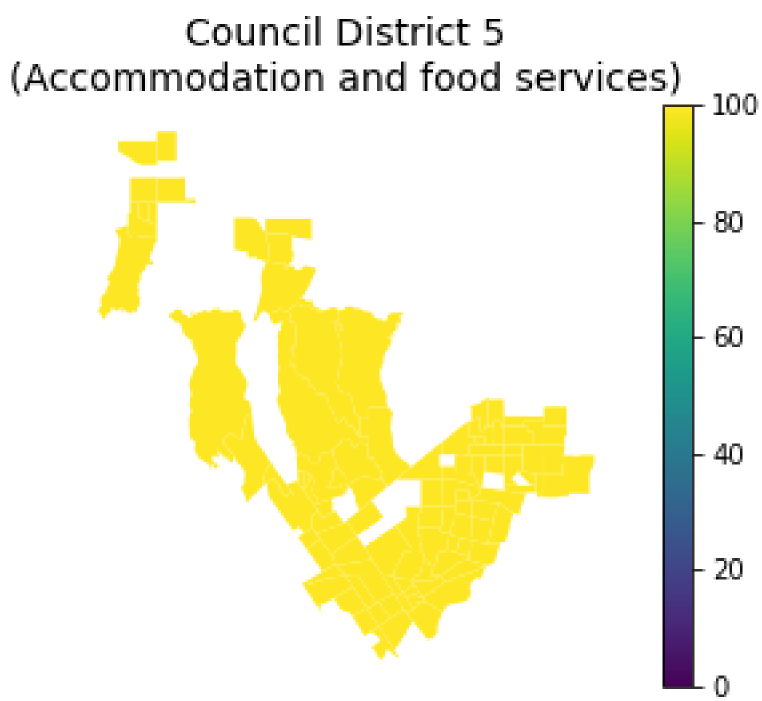

Council District 15
(Accommodation and food services)
100
80
60
40
20
0

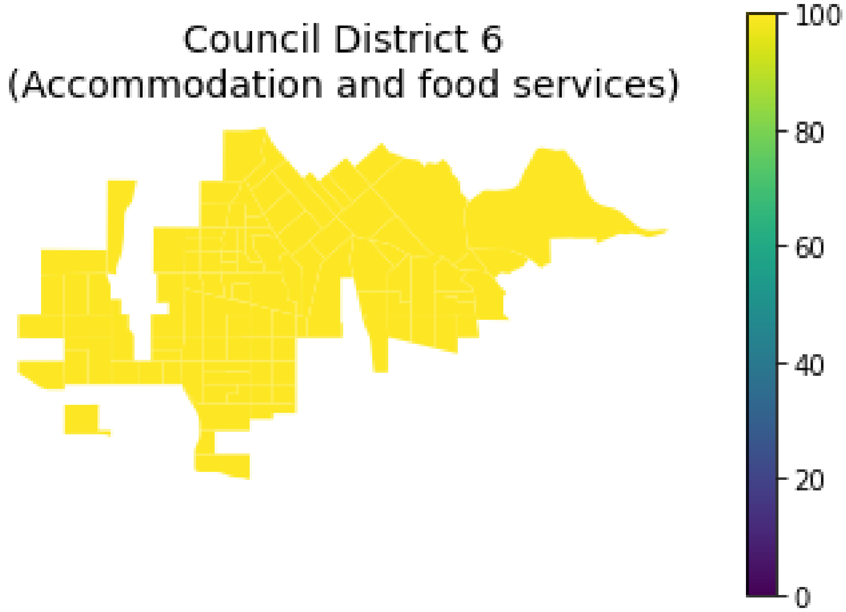

Council District 1
(Accommodation and food services)
100
80
60
40
20
0

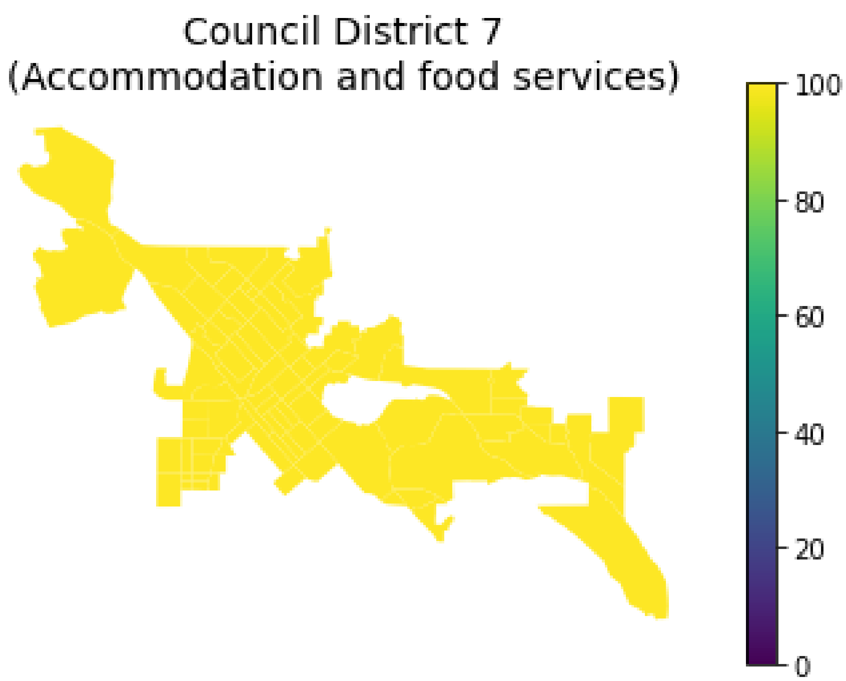

Council District 2
(Accommodation and food services)
100
80
60
40
20
0

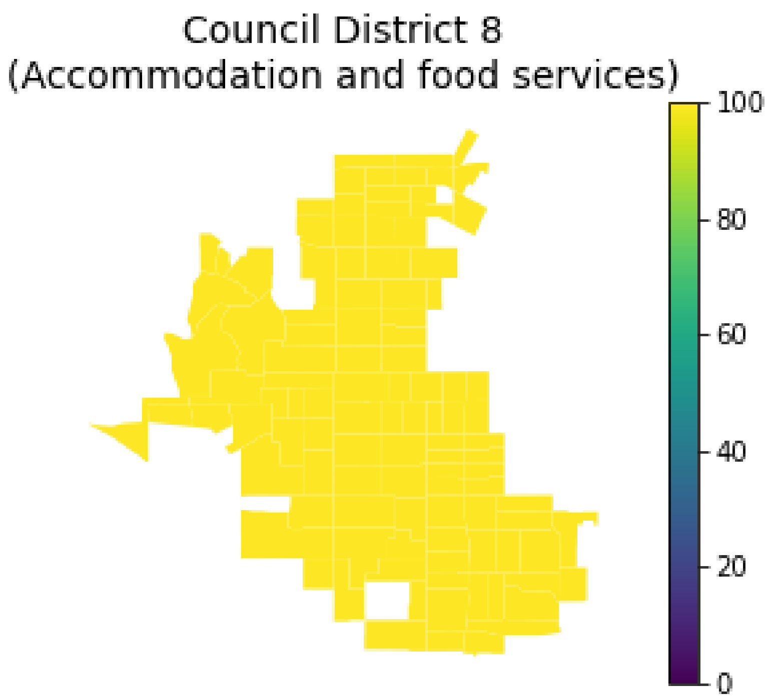

Council District 3
(Accommodation and food services)
100
80
60
40
20
0

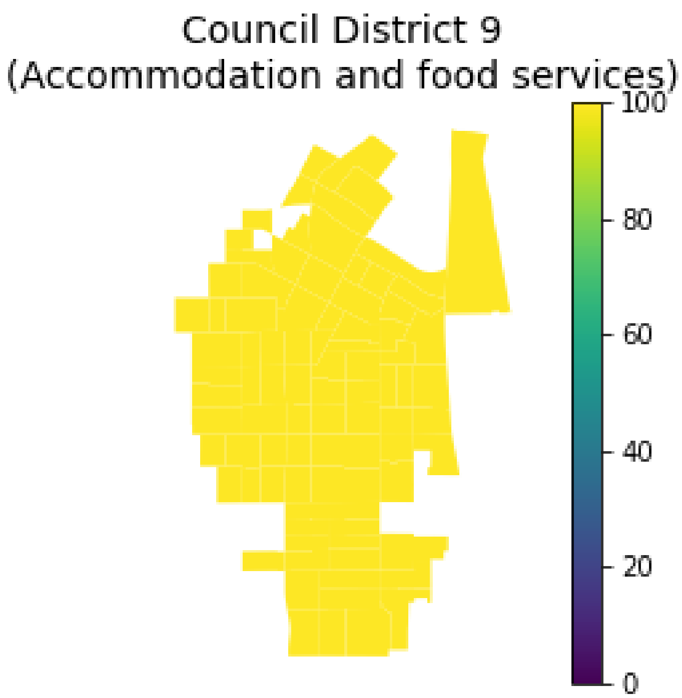

Council District 4
(Accommodation and food services)
100
80
60
40
20
0


Council District 5
(Accommodation and food services)
100
80
60
40
20
0

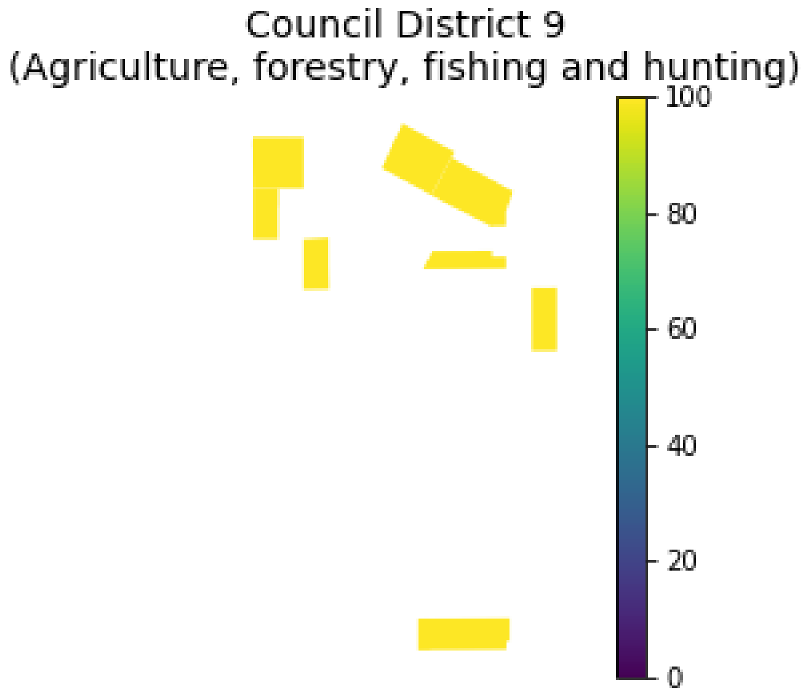

Council District 6
(Accommodation and food services)
100
80
60
40
20
0

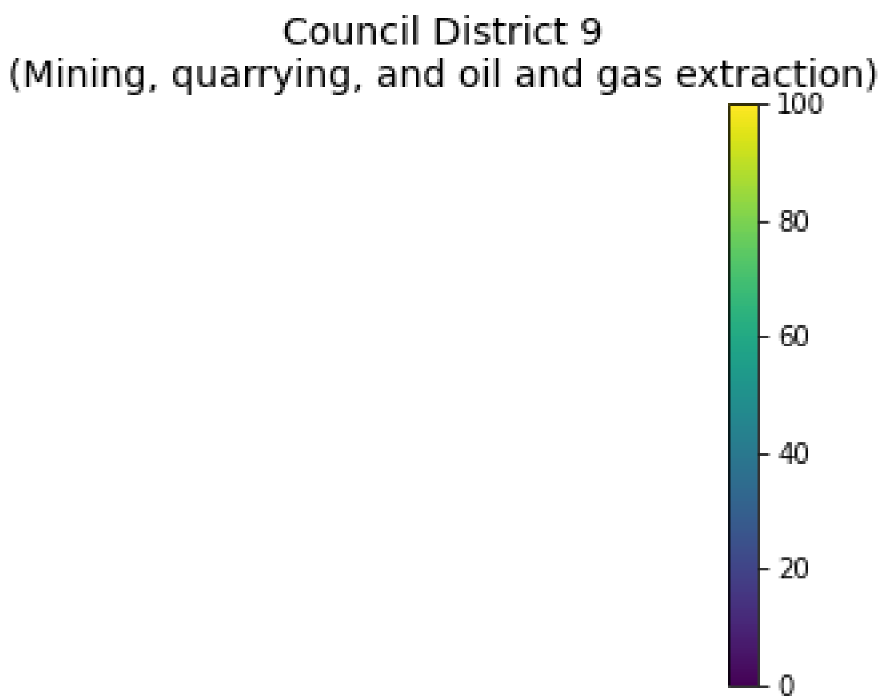

Council District 7
(Accommodation and food services)
100
80
60
40
20
0

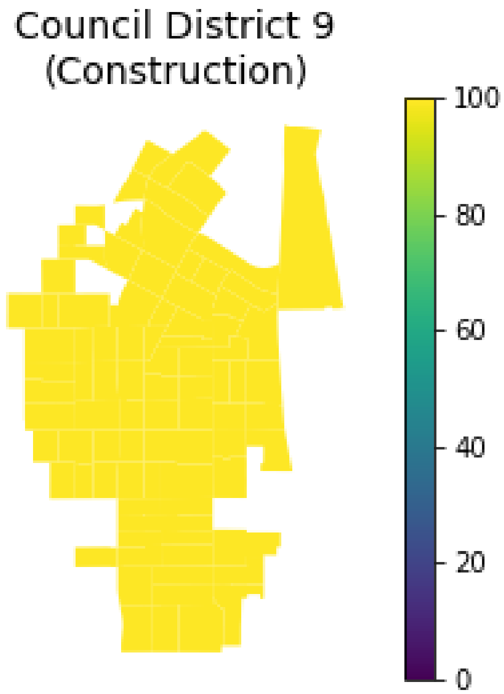

Council District 8
(Accommodation and food services)
100
80
60
40
20
0

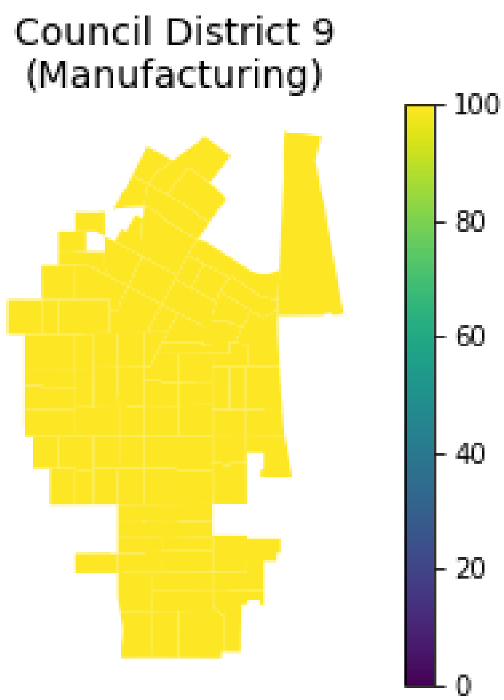

Council District 9
(Accommodation and food services)
100
80
60
40
20
0

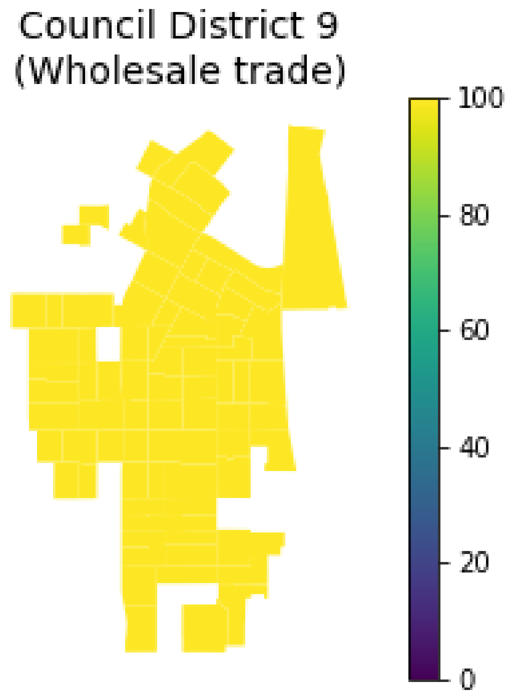
```
[67]: for indicator in indicators:
          cd_map(name='9',column=indicator)
```

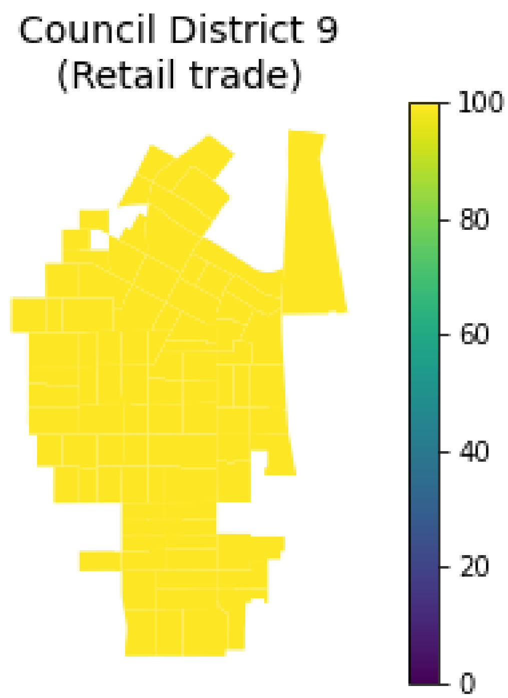


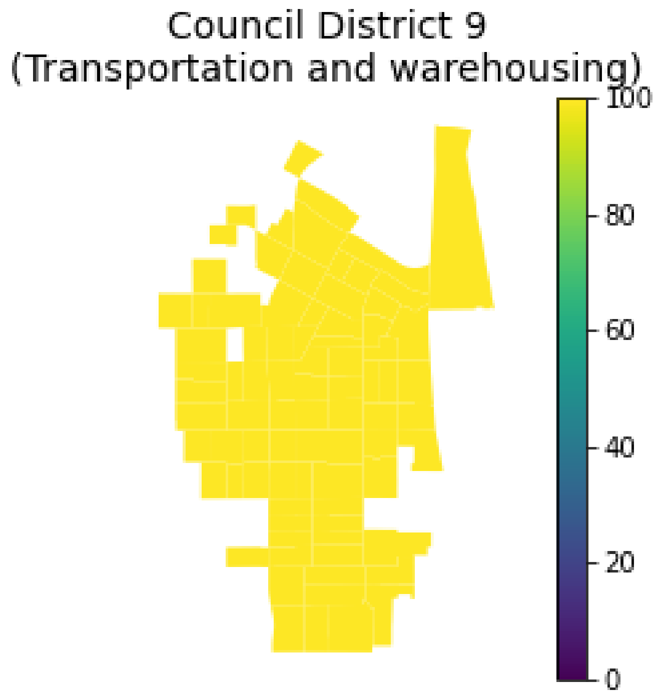


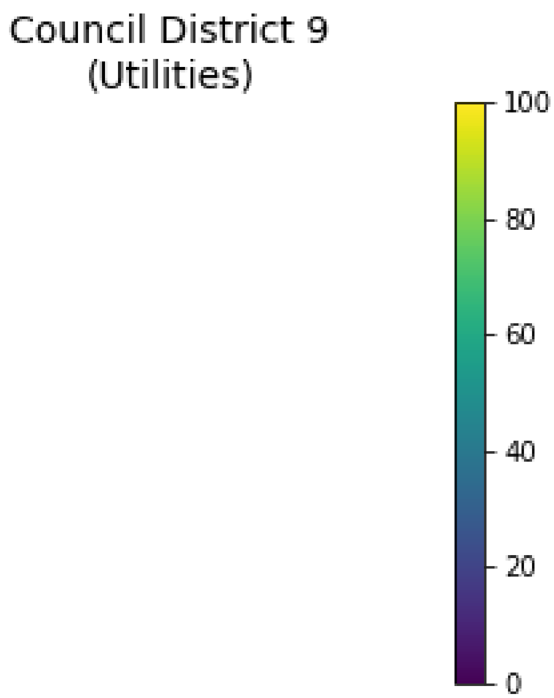

Council District 9
(Construction)
100
80
60
40
20
0

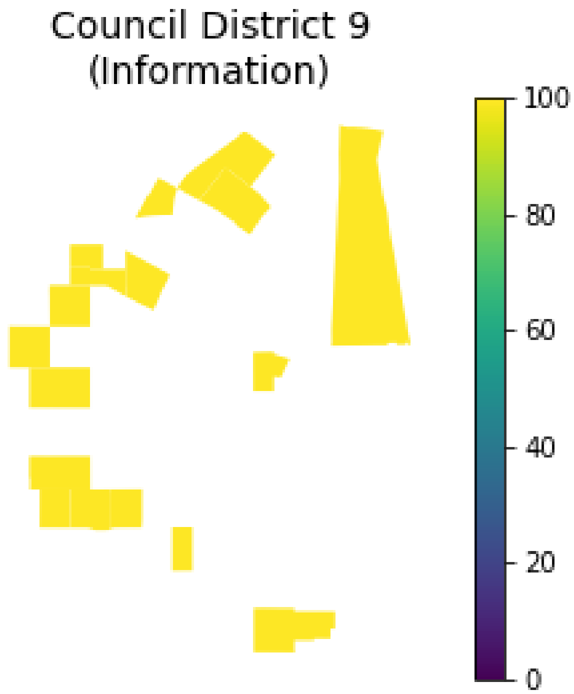

Council District 9
(Manufacturing)
100
80
60
40
20
0

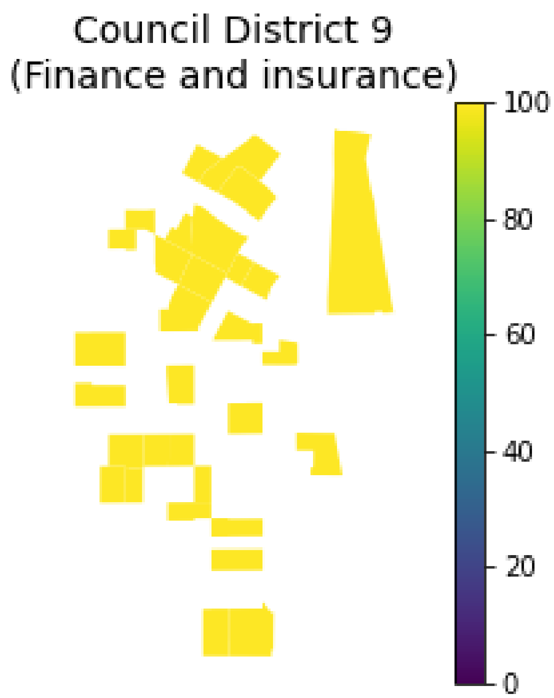

Council District 9
(Wholesale trade)
100
80
60
40
20
0

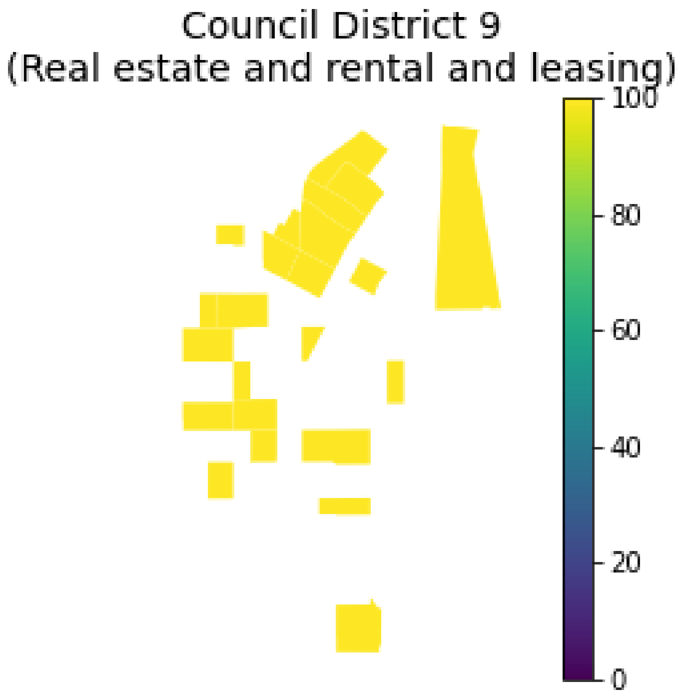

Council District 9
(Retail trade)
100
80
60
40
20
0

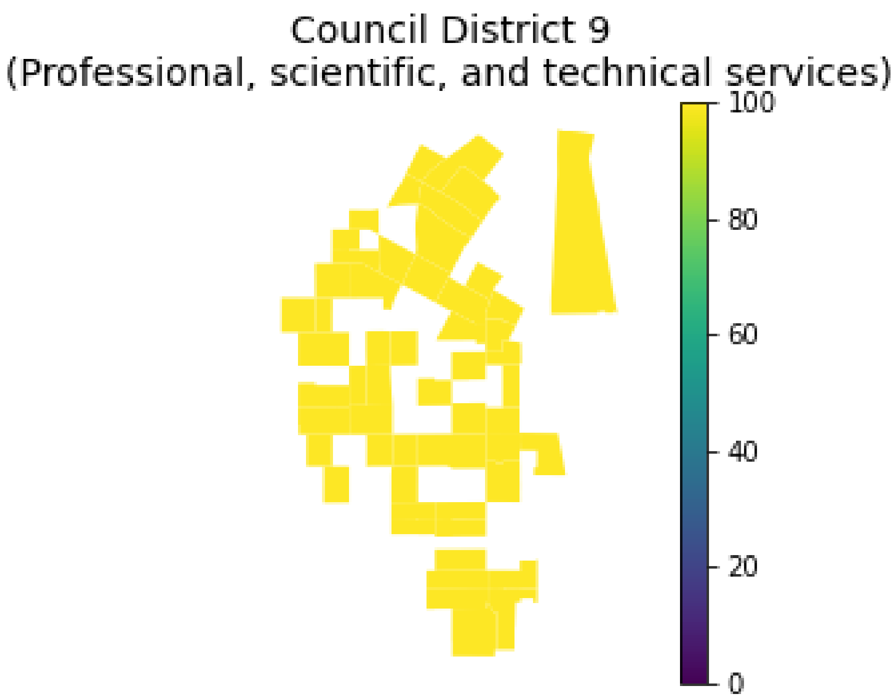

Council District 9
(Transportation and warehousing)
100
80
60
40
20
0


Council District 9
(Utilities)
100
80
60
40
20
0

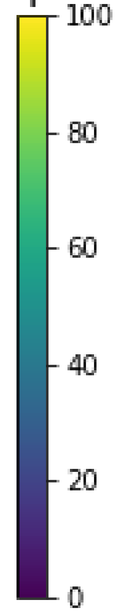

Council District 9
(Information)
100
80
60
40
20
0


Council District 9
(Finance and insurance)
100
80
60
40
20
0

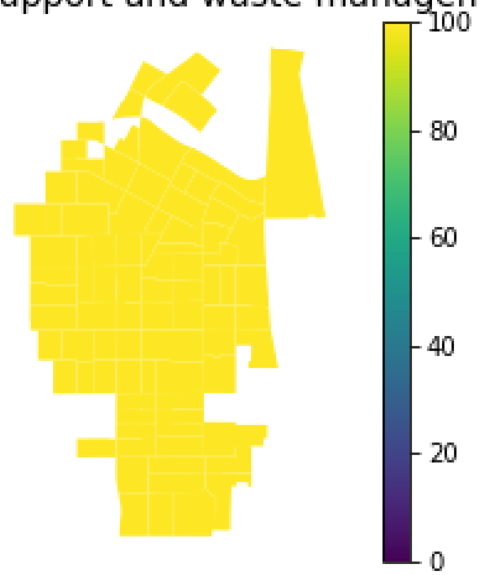

Council District 9
(Real estate and rental and leasing)
100
80
60
40
20
0

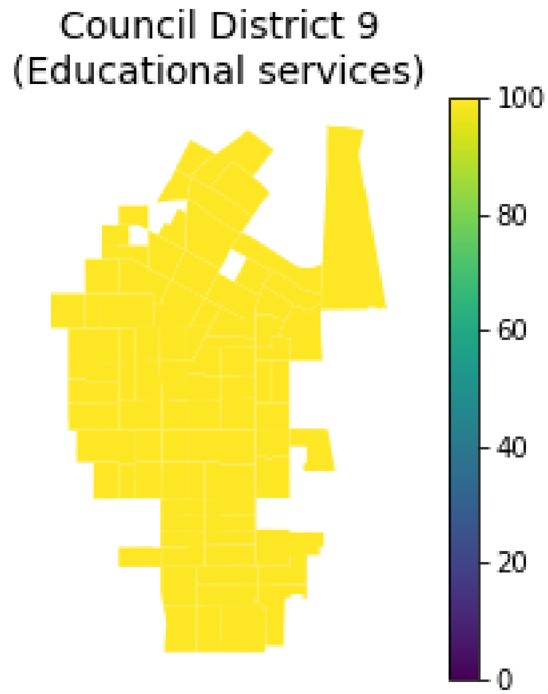

Council District 9
(Professional, scientific, and technical services)
100
80
60
40
20
0

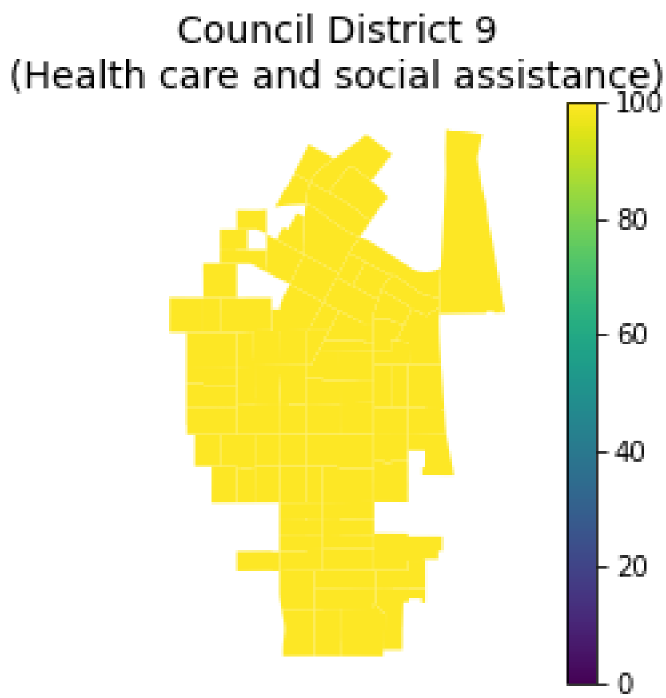
Council District 9
(Management of companies and enterprises)

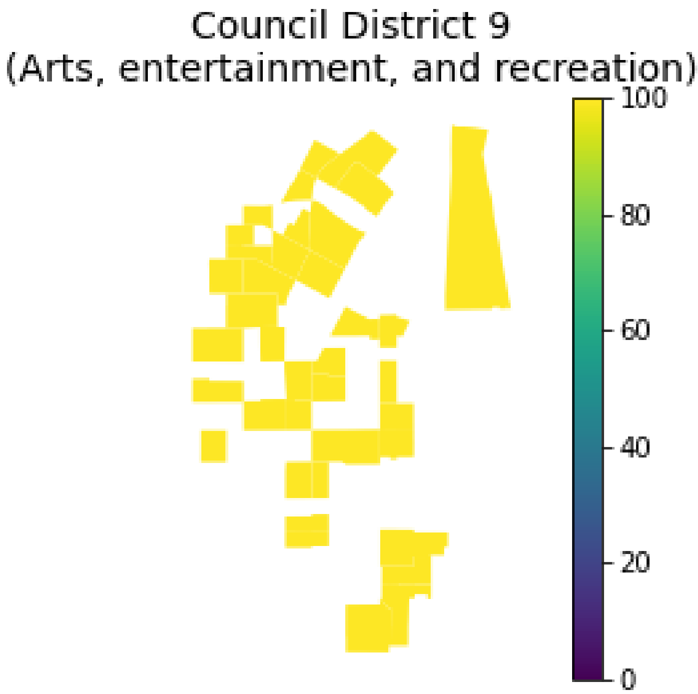


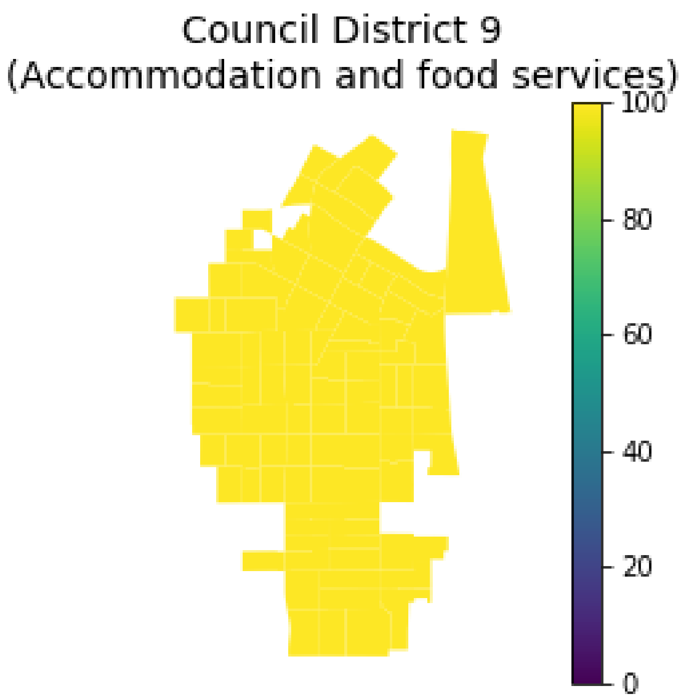
Council District 9
(Administrative and support and waste management services)

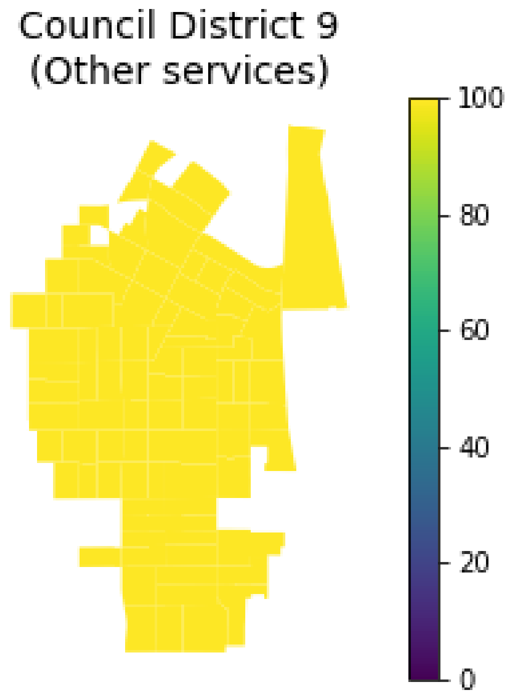


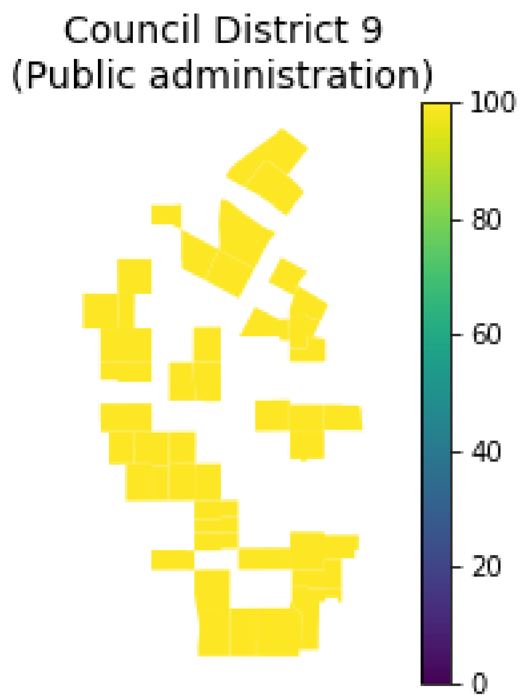

Council District 9
(Educational services)
100
80
60
40
20
0


Council District 9
(Health care and social assistance)
100
80
60
40
20
0


Council District 9
(Arts, entertainment, and recreation)
100
80
60
40
20
0


Council District 9
(Accommodation and food services)
100
80
60
40
20
0





I choose to only look at council district 9 because this is the area that overlaps. I will look at historial data from the 2008 recession to see what the changes have occured, if any.