

Alper Yılmaz - Final Report - CSSM 502

January 19, 2023

- State Capacity as a territorial reach
- Because of the existence of territorial challengers during the state formation process, the state could develop uneven state capacity over the territory.
- Measurement of territorial reach based on public good provision in the literature.
- The case is the Republic of Turkey.
- I examine three fields; health, education, and justice.
- I collected data from TÜİK
- Variables that I used are the following:

- 1) the number of hospital beds per 100.000 people,
- 2) the number of public hospitals per 100.000 people,
- 3) the number of doctors per 100.000 people,
- 4) the number of schools per 100.000 5-9 aged people,
- 5) the number of classes per 100.000 5-9 aged people,
- 6) the number of crimes per 100.000 people.

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

```
[24]: import geopandas as gpd

shapefile = gpd.read_file("/Users/alperylimaz/Downloads/
↳turkey_administrativelevels0_1_2/tur_polbnda_adm1.shp")
print(shapefile)
```

	adm1_tr	adm1_en	adm1	Shape_Leng	Shape_Area	adm0_en	\
0	ADANA	ADANA	TUR001	8.271786	1.407083	TURKEY	
1	ADİYAMAN	ADİYAMAN	TUR002	5.494422	0.750561	TURKEY	
2	AFYONKARAHİSAR	AFYONKARAHISAR	TUR003	7.149996	1.450064	TURKEY	
3	AĞRI	AGRI	TUR004	6.588304	1.163170	TURKEY	
4	AKSARAY	AKSARAY	TUR068	4.432509	0.790388	TURKEY	

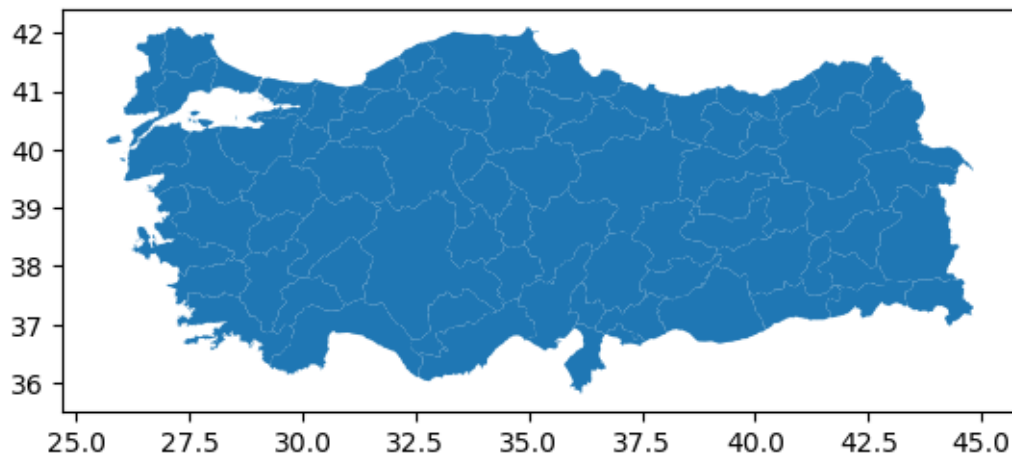
..
76	UŞAK	USAK	TUR064	3.864988	0.574221	TURKEY
77	VAN	VAN	TUR065	8.362708	2.159743	TURKEY
78	YALOVA	YALOVA	TUR077	2.051652	0.087016	TURKEY
79	YOZGAT	YOZGAT	TUR066	6.386410	1.436743	TURKEY
80	ZONGULDAK	ZONGULDAK	TUR067	3.270366	0.360484	TURKEY

	adm0_tr	adm0	geometry
0	TÜRKİYE	TUR	POLYGON ((36.31587 38.36376, 36.31769 38.36367...
1	TÜRKİYE	TUR	POLYGON ((39.25297 38.18188, 39.25334 38.18159...
2	TÜRKİYE	TUR	POLYGON ((31.14797 39.26246, 31.15825 39.25753...
3	TÜRKİYE	TUR	POLYGON ((43.28706 40.01281, 43.29129 40.00884...
4	TÜRKİYE	TUR	POLYGON ((33.96446 39.03804, 33.96453 39.03723...
..
76	TÜRKİYE	TUR	POLYGON ((29.74957 38.92497, 29.75259 38.92385...
77	TÜRKİYE	TUR	POLYGON ((43.86293 39.35519, 43.86625 39.35450...
78	TÜRKİYE	TUR	POLYGON ((29.53290 40.74757, 29.53292 40.73702...
79	TÜRKİYE	TUR	POLYGON ((35.38648 40.24666, 35.38896 40.24665...
80	TÜRKİYE	TUR	POLYGON ((32.12947 41.56021, 32.13194 41.55960...

[81 rows x 9 columns]

```
[25]: shapefile.plot()
```

```
[25]: <AxesSubplot:>
```



```
[26]: data2020 = pd.read_excel('/Users/alperylimaz/Downloads/tuikstat2020extended.
↳xlsx')
```

```
data2020.columns
```

```
[26]: Index(['Year', 'adm1', 'adm1_en', 'Primary School ', 'Crime',
'Specialist doctor', 'Population', 'Hospital', 'Hospital_bed',
'Primary school branch', 'Killing', 'Public hospital', 'Teacher',
'Public hospital bed', 'Doctor', 'population 5-9', 'Primary School_2',
'population 10-14', 'bed per 100thou', 'population 15-19',
'Primary school Class', 'public hospital_100thoupop',
'doctor_100thoupop', 'primary_5-9_100thou_pop', 'class_100thou_pop',
'crime_100thou_pop', 'revolts'],
dtype='object')
```

```
[27]: merged_data = shapefile.merge(data2020, on='adm1')
```

```
merged_data.columns
print(merged_data.head())
merged_data
```

	adm1_tr	adm1_en_x	adm1	Shape_Leng	Shape_Area	adm0_en	\
0	ADANA	ADANA	TUR001	8.271786	1.407083	TURKEY	
1	ADIYAMAN	ADIYAMAN	TUR002	5.494422	0.750561	TURKEY	
2	AFYONKARAHİSAR	AFYONKARAHISAR	TUR003	7.149996	1.450064	TURKEY	
3	AĞRI	AGRI	TUR004	6.588304	1.163170	TURKEY	
4	AKSARAY	AKSARAY	TUR068	4.432509	0.790388	TURKEY	

	adm0_tr	adm0	geometry	Year	...	\
0	TÜRKİYE	TUR	POLYGON ((36.31587 38.36376, 36.31769 38.36367...	2020	...	
1	TÜRKİYE	TUR	POLYGON ((39.25297 38.18188, 39.25334 38.18159...	2020	...	
2	TÜRKİYE	TUR	POLYGON ((31.14797 39.26246, 31.15825 39.25753...	2020	...	
3	TÜRKİYE	TUR	POLYGON ((43.28706 40.01281, 43.29129 40.00884...	2020	...	
4	TÜRKİYE	TUR	POLYGON ((33.96446 39.03804, 33.96453 39.03723...	2020	...	

	population 10-14	bed per 100thou	population 15-19	Primary school Class	\
0	188746	328	176530	6817	
1	59705	222	57100	2312	
2	55001	314	55200	3136	
3	59065	167	58706	3482	
4	35951	199	33719	1737	

	public hospital_100thoupop	doctor_100thoupop	primary_5-9_100thou_pop	\
0	0.619821	207.639909	173.643702	
1	1.581130	157.322451	197.587187	
2	2.442625	171.526587	215.214576	
3	1.494112	105.708443	134.380978	
4	1.654803	139.712679	389.094007	

	class_100thou_pop	crime_100thou_pop	revolts
0	3554.742090	363.524796	0
1	3713.996562	145.463975	1
2	5719.600941	360.965760	0

3	5504.877239	229.346233	1
4	4933.257597	350.109099	0

[5 rows x 35 columns]

[27]:

	adm1_tr	adm1_en_x	adm1	Shape_Leng	Shape_Area	adm0_en	\
0	ADANA	ADANA	TUR001	8.271786	1.407083	TURKEY	
1	ADIYAMAN	ADIYAMAN	TUR002	5.494422	0.750561	TURKEY	
2	AFYONKARAHİSAR	AFYONKARAHISAR	TUR003	7.149996	1.450064	TURKEY	
3	AĞRI	AGRI	TUR004	6.588304	1.163170	TURKEY	
4	AKSARAY	AKSARAY	TUR068	4.432509	0.790388	TURKEY	
..	
76	UŞAK	USAK	TUR064	3.864988	0.574221	TURKEY	
77	VAN	VAN	TUR065	8.362708	2.159743	TURKEY	
78	YALOVA	YALOVA	TUR077	2.051652	0.087016	TURKEY	
79	YOZGAT	YOZGAT	TUR066	6.386410	1.436743	TURKEY	
80	ZONGULDAK	ZONGULDAK	TUR067	3.270366	0.360484	TURKEY	

	adm0_tr	adm0	geometry	Year	\
0	TÜRKİYE	TUR	POLYGON ((36.31587 38.36376, 36.31769 38.36367...	2020	
1	TÜRKİYE	TUR	POLYGON ((39.25297 38.18188, 39.25334 38.18159...	2020	
2	TÜRKİYE	TUR	POLYGON ((31.14797 39.26246, 31.15825 39.25753...	2020	
3	TÜRKİYE	TUR	POLYGON ((43.28706 40.01281, 43.29129 40.00884...	2020	
4	TÜRKİYE	TUR	POLYGON ((33.96446 39.03804, 33.96453 39.03723...	2020	
..	
76	TÜRKİYE	TUR	POLYGON ((29.74957 38.92497, 29.75259 38.92385...	2020	
77	TÜRKİYE	TUR	POLYGON ((43.86293 39.35519, 43.86625 39.35450...	2020	
78	TÜRKİYE	TUR	POLYGON ((29.53290 40.74757, 29.53292 40.73702...	2020	
79	TÜRKİYE	TUR	POLYGON ((35.38648 40.24666, 35.38896 40.24665...	2020	
80	TÜRKİYE	TUR	POLYGON ((32.12947 41.56021, 32.13194 41.55960...	2020	

	... population 10-14	bed per 100thou	population 15-19	\
0	...	188746	328	176530
1	...	59705	222	57100
2	...	55001	314	55200
3	...	59065	167	58706
4	...	35951	199	33719
..
76	...	24012	334	24474
77	...	124786	263	122384
78	...	18690	277	18507
79	...	31370	301	32340
80	...	38707	388	39009

	Primary school Class	public hospital_100thoupop	doctor_100thoupop	\
0	6817	0.619821	207.639909	
1	2312	1.581130	157.322451	

2	3136	2.442625	171.526587
3	3482	1.494112	105.708443
4	1737	1.654803	139.712679
..
76	1142	1.624110	148.064737
77	5592	0.870063	140.863207
78	877	1.449013	159.029161
79	2137	3.340531	167.503788
80	1633	1.353171	188.090744

	primary_5-9_100thou_pop	class_100thou_pop	crime_100thou_pop	revolts
0	173.643702	3554.742090	363.524796	0
1	197.587187	3713.996562	145.463975	1
2	215.214576	5719.600941	360.965760	0
3	134.380978	5504.877239	229.346233	1
4	389.094007	4933.257597	350.109099	0
..
76	650.877635	4795.498446	429.306532	0
77	88.548725	4305.777997	201.332589	1
78	1266.905436	4688.084674	290.527078	0
79	425.215265	7572.375182	255.312041	0
80	402.680703	4696.982771	327.467338	0

[81 rows x 35 columns]

```
[12]: from matplotlib import pyplot as plt

merged_data.plot(column='bed per 100thou', legend=True,
                  legend_kwds={'label': "The Number of Hospital Bed per 100.000_
↪people", 'orientation': "horizontal"},
                  figsize=(15, 15))

plt.savefig('The Number of Hospital Bed per 100.000 people.pdf')

merged_data.plot(column='public hospital_100thoupop', legend=True,
                  legend_kwds={'label': "The Number of Public Hospital per 100.000_
↪people", 'orientation': "horizontal"},
                  figsize=(15, 15))

plt.savefig('The Number of Public Hospital per 100.000 people.pdf')

merged_data.plot(column='doctor_100thoupop', legend=True,
                  legend_kwds={'label': "The Number of Doctor per 100.000 people",
↪'orientation': "horizontal"},
                  figsize=(15, 15))
```

```

plt.savefig('The Number of Doctor per 100.000 people.pdf')

merged_data.plot(column='primary_5-9_100thou_pop', legend=True,
                  legend_kwds={'label': "The Number of School per 100.000 5-9 ages_
→people", 'orientation': "horizontal"},
                  figsize=(15, 15))

plt.savefig('The Number of School per 100.000 5-9 ages people.pdf')

merged_data.plot(column='class_100thou_pop', legend=True,
                  legend_kwds={'label': "The Number of Class per 100.000 5-9 ages_
→people", 'orientation': "horizontal"},
                  figsize=(15, 15))

plt.savefig('The Number of Class per 100.000 5-9 ages people.pdf')

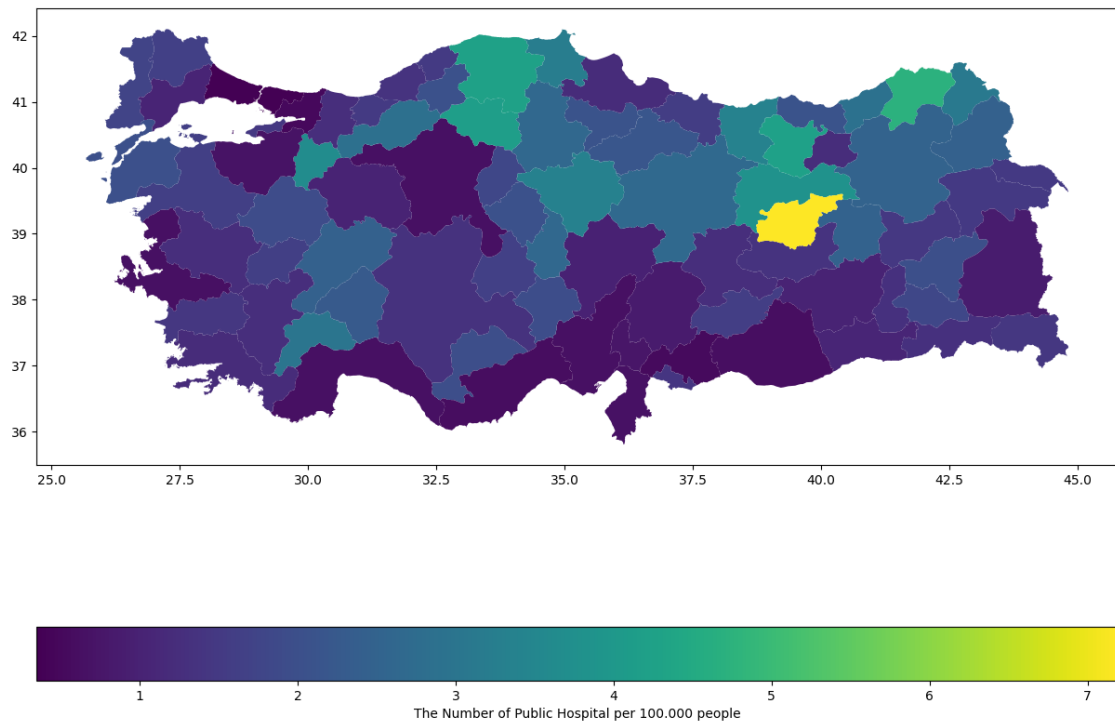
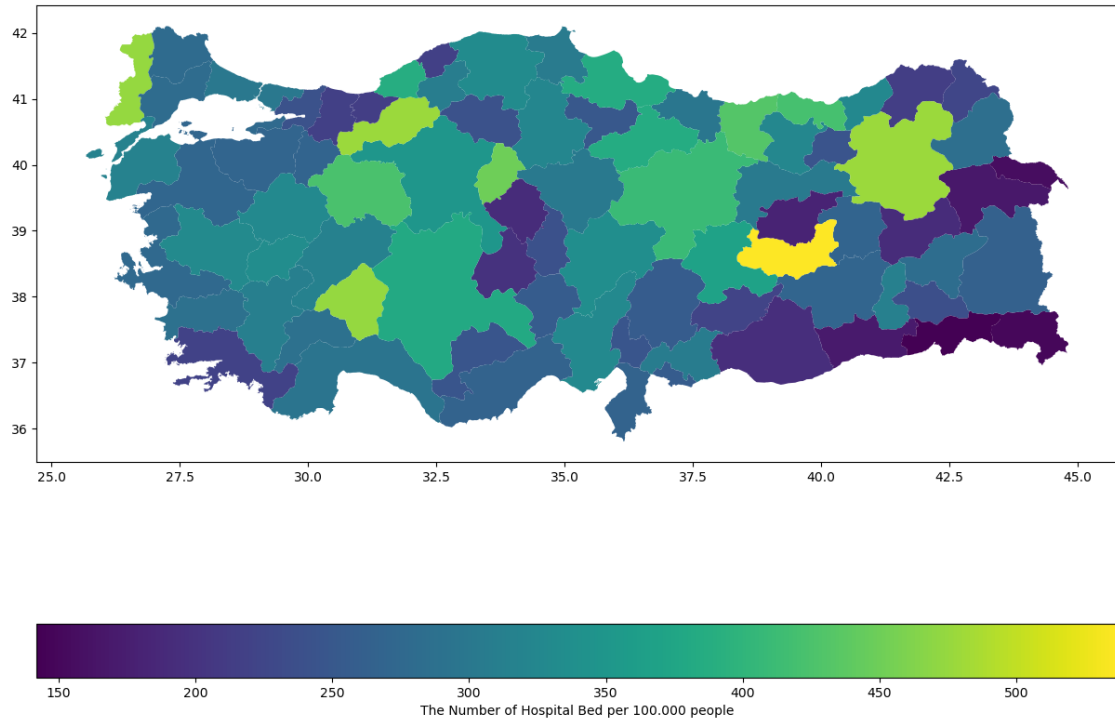
merged_data.plot(column='crime_100thou_pop', legend=True,
                  legend_kwds={'label': "The Number of Crime per 100.000 people",
→'orientation': "horizontal"},
                  figsize=(15, 15))

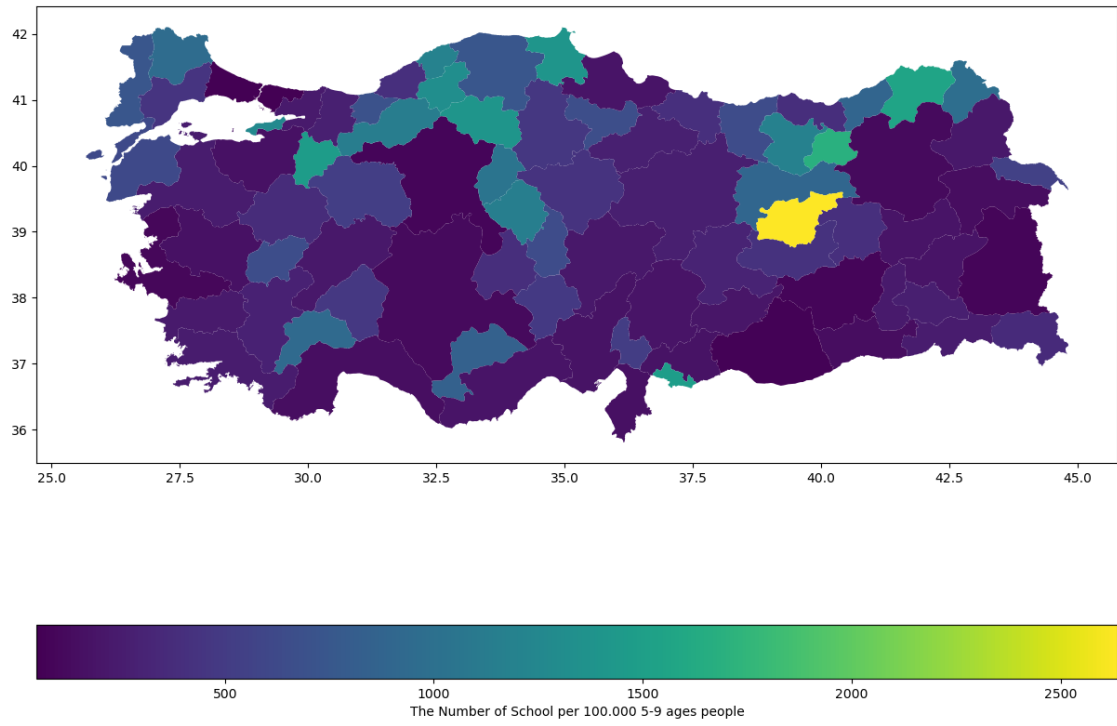
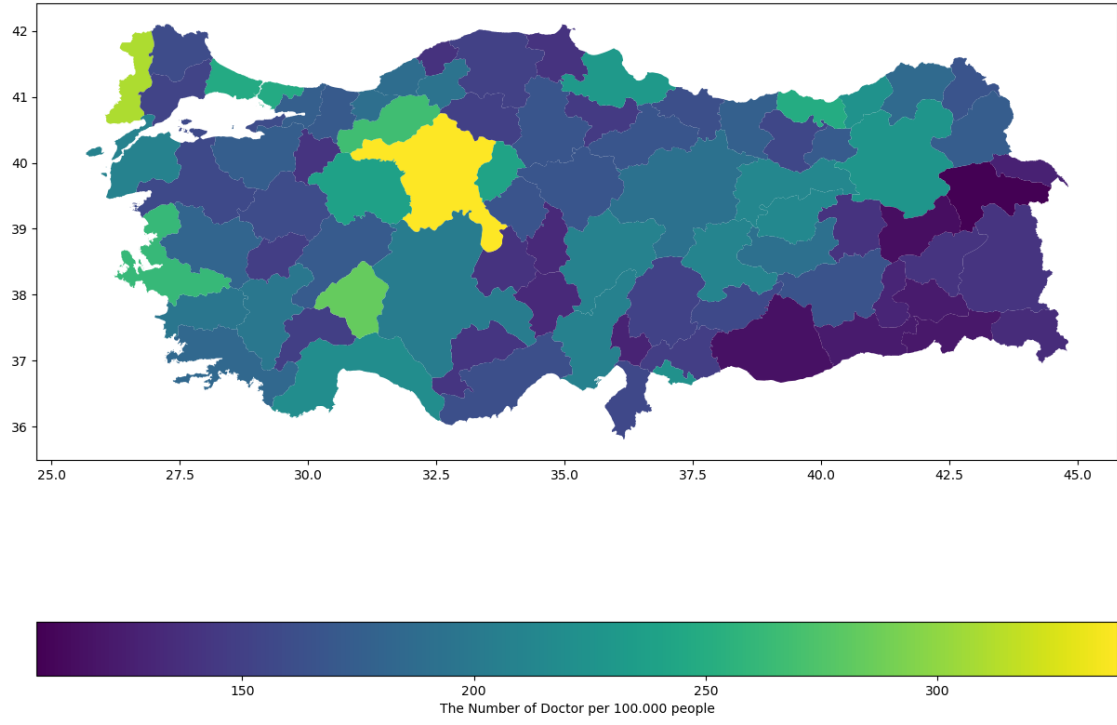
plt.savefig('The Number of Crime per 100.000 people.pdf')

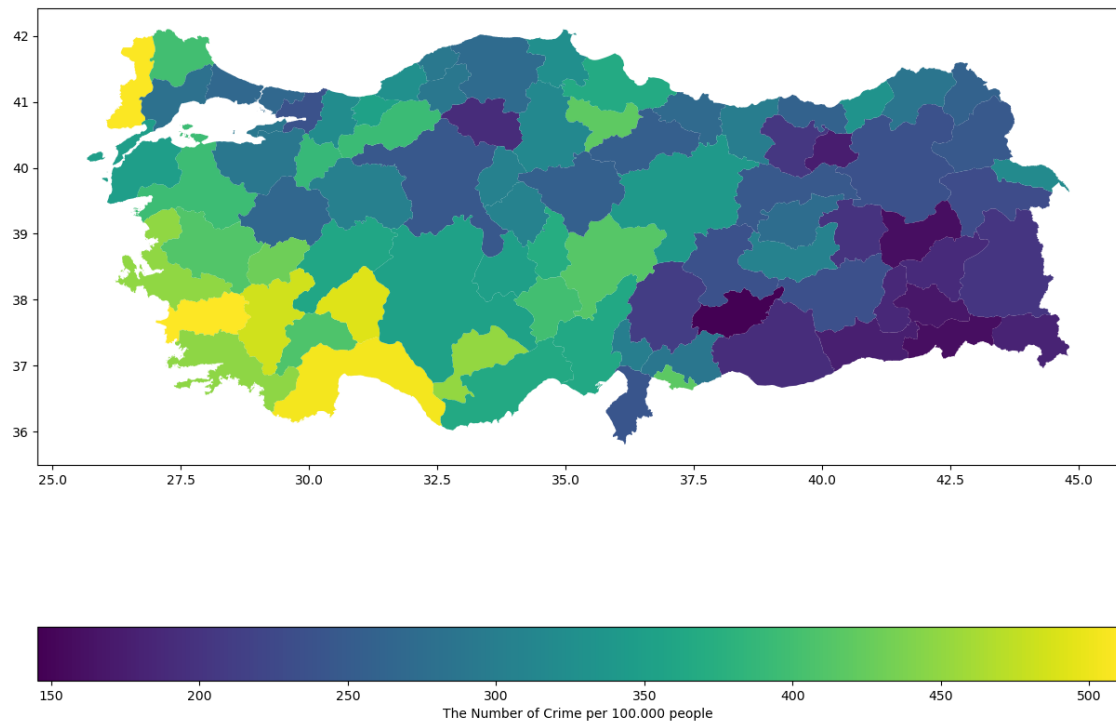
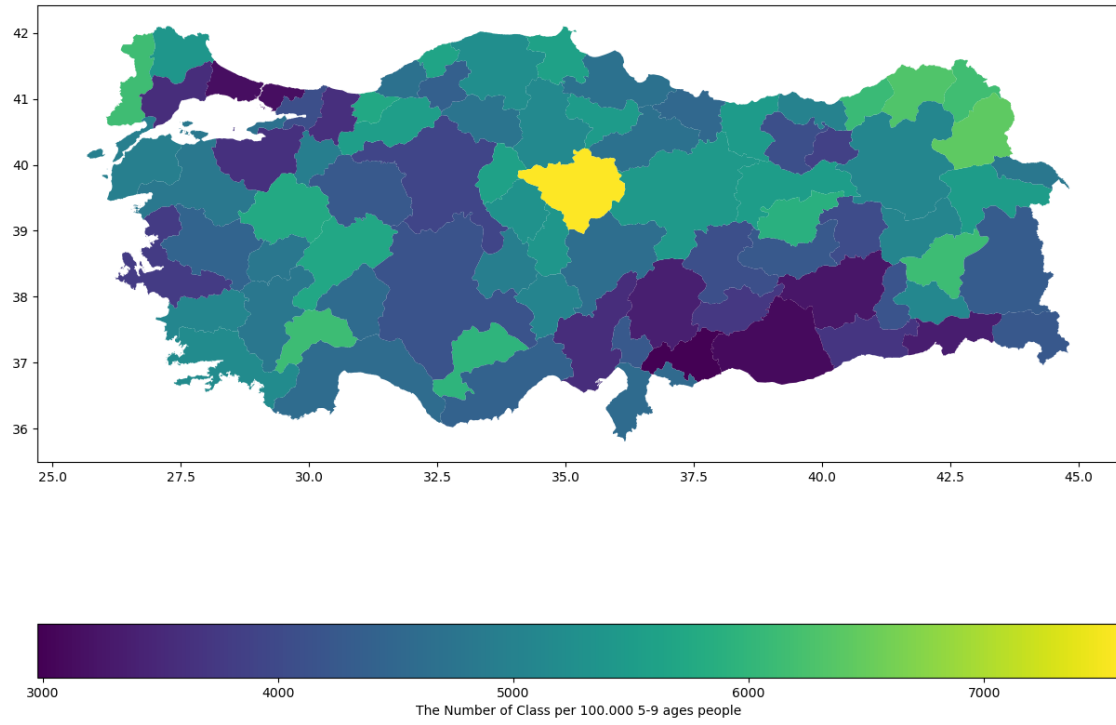
merged_data.plot(column='revolts', legend=True,
                  legend_kwds={'label': "The provinces where revolts occurred in_
→years between 1923-1938", 'orientation': "horizontal"},
                  figsize=(15, 15))

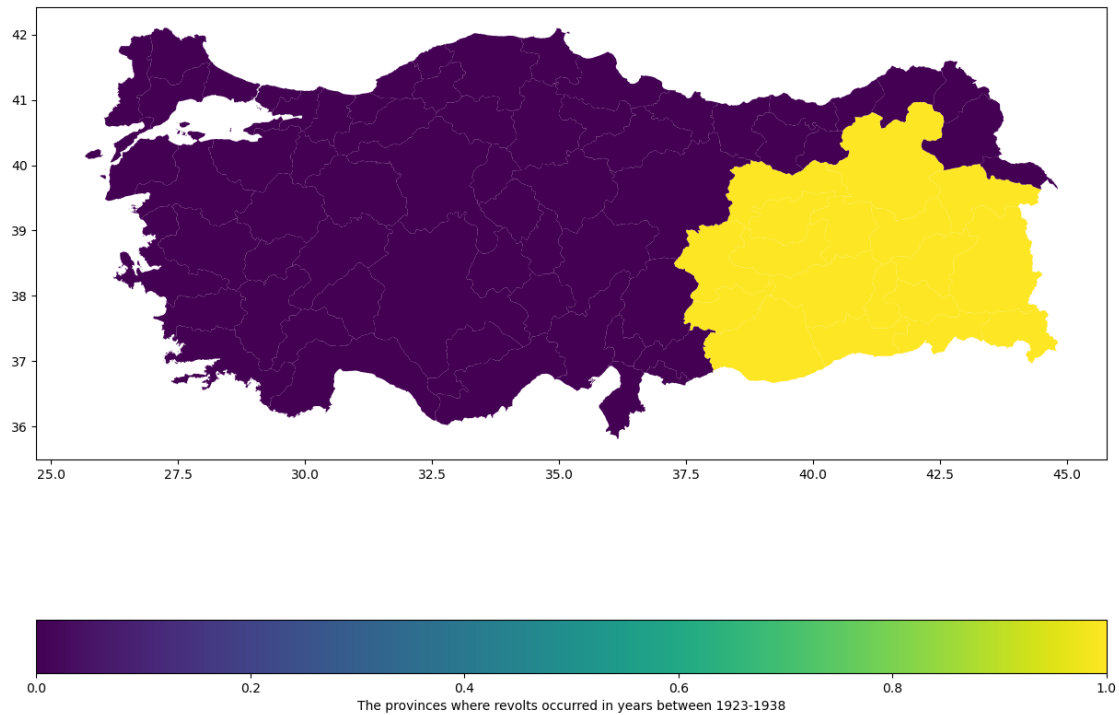
plt.savefig('The provinces where revolts occurred in years between 1923-1938.
→pdf')

```









```
[1]: pip install pysal
```

```
Collecting pysal
  Downloading pysal-2.7.0-py3-none-any.whl (17 kB)
Collecting giddy>=2.3.3
  Downloading giddy-2.3.3-py3-none-any.whl (60 kB)
    60.9/60.9 kB
476.3 kB/s eta 0:00:00a 0:00:01
Collecting momepy>=0.5.3
  Downloading momepy-0.5.4-py3-none-any.whl (243 kB)
    243.7/243.7
kB 1.1 MB/s eta 0:00:00a 0:00:01
Collecting libpysal>=4.6.2
  Downloading libpysal-4.7.0-py3-none-any.whl (2.4 MB)
    2.4/2.4 MB
1.0 MB/s eta 0:00:0000:0100:01
Collecting mgwr>=2.1.2
  Downloading mgwr-2.1.2.tar.gz (41 kB)
    41.8/41.8 kB
1.4 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
Collecting tobler>=0.8.2
  Downloading tobler-0.9.0-py3-none-any.whl (22 kB)
Collecting mapclassify>=2.4.3
```

```

    Downloading mapclassify-2.5.0-py3-none-any.whl (39 kB)
Collecting access>=1.1.8
    Downloading access-1.1.8-py3-none-any.whl (21 kB)
Collecting spopt>=0.4.1
    Downloading spopt-0.5.0-py3-none-any.whl (112 kB)
    112.9/112.9

kB 1.3 MB/s eta 0:00:0000:0100:01
Collecting spaghetti>=1.6.6
    Downloading spaghetti-1.7.2-py3-none-any.whl (50 kB)
    50.3/50.3 kB
1.5 MB/s eta 0:00:00
Collecting spint>=1.0.7
    Downloading spint-1.0.7.tar.gz (28 kB)
    Preparing metadata (setup.py) ... done
Collecting splot>=1.1.5.post1
    Downloading splot-1.1.5.post1-py3-none-any.whl (39 kB)
Collecting pointpats>=2.2.0
    Downloading pointpats-2.2.0.tar.gz (55 kB)
    55.4/55.4 kB
1.6 MB/s eta 0:00:00
    Preparing metadata (setup.py) ... done
Collecting esda>=2.4.1
    Downloading esda-2.4.3.tar.gz (116 kB)
    116.6/116.6

kB 2.1 MB/s eta 0:00:00a 0:00:01
    Preparing metadata (setup.py) ... done
Collecting spreg>=1.2.4
    Downloading spreg-1.3.0-py3-none-any.whl (220 kB)
    220.1/220.1

kB 2.5 MB/s eta 0:00:0000:0100:01
Collecting spvcm>=0.3.0
    Downloading spvcm-0.3.0.tar.gz (5.7 MB)
    5.7/5.7 MB
2.5 MB/s eta 0:00:0000:0100:01
    Preparing metadata (setup.py) ... done
Collecting segregation>=2.3.1
    Downloading segregation-2.3.1-py3-none-any.whl (147 kB)
    147.5/147.5

kB 2.7 MB/s eta 0:00:00a 0:00:01
Collecting inequality>=1.0.0
    Downloading inequality-1.0.0.tar.gz (11 kB)
    Preparing metadata (setup.py) ... done
Collecting spglm>=1.0.8
    Downloading spglm-1.0.8.tar.gz (37 kB)
    Preparing metadata (setup.py) ... done

```

```

Requirement already satisfied: numpy>=1.3 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
access>=1.1.8->pysal) (1.21.5)
Requirement already satisfied: requests>=2 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
access>=1.1.8->pysal) (2.28.1)
Requirement already satisfied: geopandas in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
access>=1.1.8->pysal) (0.12.2)
Requirement already satisfied: pandas>=0.23.4 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
access>=1.1.8->pysal) (1.4.4)
Requirement already satisfied: scipy>=0.11 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
esda>=2.4.1->pysal) (1.9.1)
Requirement already satisfied: scikit-learn in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
esda>=2.4.1->pysal) (1.0.2)
Collecting quantecon>=0.4.7
  Downloading quantecon-0.6.0-py3-none-any.whl (206 kB)
    206.9/206.9

kB 2.3 MB/s eta 0:00:0000:0100:01
Requirement already satisfied: jinja2 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
libpysal>=4.6.2->pysal) (2.11.3)
Requirement already satisfied: platformdirs in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
libpysal>=4.6.2->pysal) (2.5.2)
Requirement already satisfied: packaging in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
libpysal>=4.6.2->pysal) (21.3)
Requirement already satisfied: beautifulsoup4 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
libpysal>=4.6.2->pysal) (4.11.1)
Requirement already satisfied: networkx in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
mapclassify>=2.4.3->pysal) (2.8.4)
Requirement already satisfied: tqdm>=4.27.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
momepy>=0.5.3->pysal) (4.64.1)
Collecting pygeos
  Downloading pygeos-0.14-cp39-cp39-macosx_10_9_x86_64.whl (1.2 MB)
    1.2/1.2 MB
3.2 MB/s eta 0:00:0000:0100:01
Requirement already satisfied: matplotlib in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
pointpats>=2.2.0->pysal) (3.5.2)

```

```

Collecting opencv-contrib-python>=4.2.0
  Downloading opencv_contrib_python-4.7.0.68-cp37-abi3-macosx_10_13_x86_64.whl
(61.3 MB)
    61.3/61.3 MB
4.4 MB/s eta 0:00:0000:0100:01
Requirement already satisfied: pip in
/Users/alperylimaz/opt/anaconda3/lib/python3.9/site-packages (from
segregation>=2.3.1->pysal) (22.2.2)
Requirement already satisfied: seaborn in
/Users/alperylimaz/opt/anaconda3/lib/python3.9/site-packages (from
segregation>=2.3.1->pysal) (0.11.2)
Requirement already satisfied: pyproj>=3 in
/Users/alperylimaz/opt/anaconda3/lib/python3.9/site-packages (from
segregation>=2.3.1->pysal) (3.4.1)
Collecting deprecation
  Downloading deprecation-2.1.0-py2.py3-none-any.whl (11 kB)
Collecting rvlib>=0.0.5
  Downloading rvlib-0.0.6.tar.gz (183 kB)
    183.2/183.2
kB 1.6 MB/s eta 0:00:00a 0:00:01
  Preparing metadata (setup.py) ... done
Requirement already satisfied: numba in
/Users/alperylimaz/opt/anaconda3/lib/python3.9/site-packages (from
segregation>=2.3.1->pysal) (0.55.1)
Collecting quilt3
  Downloading quilt3-5.1.0-py3-none-any.whl (79 kB)
    79.0/79.0 kB
2.1 MB/s eta 0:00:00
Requirement already satisfied: joblib in
/Users/alperylimaz/opt/anaconda3/lib/python3.9/site-packages (from
segregation>=2.3.1->pysal) (1.1.0)
Requirement already satisfied: rtree in
/Users/alperylimaz/opt/anaconda3/lib/python3.9/site-packages (from
spaghetti>=1.6.6->pysal) (0.9.7)
Collecting pulp
  Downloading PuLP-2.7.0-py3-none-any.whl (14.3 MB)
    14.3/14.3 MB
5.2 MB/s eta 0:00:0000:0100:01
Requirement already satisfied: statsmodels in
/Users/alperylimaz/opt/anaconda3/lib/python3.9/site-packages (from
tobler>=0.8.2->pysal) (0.13.2)
Collecting rasterstats
  Downloading rasterstats-0.17.0-py3-none-any.whl (16 kB)
Collecting rasterio
  Downloading rasterio-1.3.4-cp39-cp39-macosx_10_15_x86_64.whl (30.9 MB)
    30.9/30.9 MB
3.1 MB/s eta 0:00:0000:0100:01

```

Requirement already satisfied: shapely>=1.7 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
geopandas->access>=1.1.8->pysal) (2.0.0)

Requirement already satisfied: fiona>=1.8 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
geopandas->access>=1.1.8->pysal) (1.8.22)

Requirement already satisfied: python-dateutil>=2.8.1 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
pandas>=0.23.4->access>=1.1.8->pysal) (2.8.2)

Requirement already satisfied: pytz>=2020.1 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
pandas>=0.23.4->access>=1.1.8->pysal) (2022.1)

Requirement already satisfied: certifi in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
pyproj>=3->segregation>=2.3.1->pysal) (2022.9.24)

Requirement already satisfied: sympy in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
quantecon>=0.4.7->giddy>=2.3.3->pysal) (1.10.1)

Requirement already satisfied: idna<4,>=2.5 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
requests>=2->access>=1.1.8->pysal) (3.3)

Requirement already satisfied: charset-normalizer<3,>=2 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
requests>=2->access>=1.1.8->pysal) (2.0.4)

Requirement already satisfied: urllib3<1.27,>=1.21.1 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
requests>=2->access>=1.1.8->pysal) (1.26.11)

Requirement already satisfied: cffi>=1.0.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
rvlib>=0.0.5->segregation>=2.3.1->pysal) (1.15.1)

Requirement already satisfied: PyYAML in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
rvlib>=0.0.5->segregation>=2.3.1->pysal) (6.0)

Requirement already satisfied: setuptools in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
numba->segregation>=2.3.1->pysal) (63.4.1)

Requirement already satisfied: llvmlite<0.39,>=0.38.0rc1 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
numba->segregation>=2.3.1->pysal) (0.38.0)

Requirement already satisfied: threadpoolctl>=2.0.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from scikit-
learn->esda>=2.4.1->pysal) (2.2.0)

Requirement already satisfied: soupsieve>1.2 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
beautifulsoup4->libpysal>=4.6.2->pysal) (2.3.1)

Requirement already satisfied: MarkupSafe>=0.23 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
jinja2->libpysal>=4.6.2->pysal) (2.0.1)

Requirement already satisfied: kiwisolver>=1.0.1 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
matplotlib->pointpats>=2.2.0->pysal) (1.4.2)

Requirement already satisfied: cycler>=0.10 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
matplotlib->pointpats>=2.2.0->pysal) (0.11.0)

Requirement already satisfied: fonttools>=4.22.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
matplotlib->pointpats>=2.2.0->pysal) (4.25.0)

Requirement already satisfied: pyparsing>=2.2.1 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
matplotlib->pointpats>=2.2.0->pysal) (3.0.9)

Requirement already satisfied: pillow>=6.2.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
matplotlib->pointpats>=2.2.0->pysal) (9.2.0)

Collecting aws-requests-auth>=0.4.2
 Downloading aws_requests_auth-0.4.3-py2.py3-none-any.whl (6.8 kB)

Collecting requests-futures==1.0.0
 Downloading requests_futures-1.0.0-py2.py3-none-any.whl (7.4 kB)

Requirement already satisfied: boto3>=1.10.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
quilt3->segregation>=2.3.1->pysal) (1.24.28)

Collecting jsonlines==1.2.0
 Downloading jsonlines-1.2.0-py2.py3-none-any.whl (7.6 kB)

Requirement already satisfied: jsonschema<5,>=3 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
quilt3->segregation>=2.3.1->pysal) (4.16.0)

Requirement already satisfied: tenacity>=5.1.1 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
quilt3->segregation>=2.3.1->pysal) (8.0.1)

Requirement already satisfied: six in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
jsonlines==1.2.0->quilt3->segregation>=2.3.1->pysal) (1.16.0)

Collecting affine
 Downloading affine-2.3.1-py2.py3-none-any.whl (16 kB)

Requirement already satisfied: click-plugins in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
rasterio->tobler>=0.8.2->pysal) (1.1.1)

Collecting snuggs>=1.4.1
 Downloading snuggs-1.4.7-py3-none-any.whl (5.4 kB)

Requirement already satisfied: cligj>=0.5 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
rasterio->tobler>=0.8.2->pysal) (0.7.2)

Requirement already satisfied: attrs in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
rasterio->tobler>=0.8.2->pysal) (21.4.0)

Requirement already satisfied: click>=4.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from

```

rasterio->tobler>=0.8.2->pysal) (8.0.4)
Collecting simplejson
  Downloading simplejson-3.18.1-cp39-cp39-macosx_10_9_x86_64.whl (75 kB)
    75.9/75.9 kB
2.2 MB/s eta 0:00:00
Requirement already satisfied: patsy>=0.5.2 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
statsmodels->tobler>=0.8.2->pysal) (0.5.2)
Requirement already satisfied: botocore<1.28.0,>=1.27.28 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
boto3>=1.10.0->quilt3->segregation>=2.3.1->pysal) (1.27.28)
Requirement already satisfied: s3transfer<0.7.0,>=0.6.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
boto3>=1.10.0->quilt3->segregation>=2.3.1->pysal) (0.6.0)
Requirement already satisfied: jmespath<2.0.0,>=0.7.1 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
boto3>=1.10.0->quilt3->segregation>=2.3.1->pysal) (0.10.0)
Requirement already satisfied: pycparser in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
cffi>=1.0.0->rvlib>=0.0.5->segregation>=2.3.1->pysal) (2.21)
Requirement already satisfied: munch in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
fiona>=1.8->geopandas->access>=1.1.8->pysal) (2.5.0)
Requirement already satisfied: pypersistent!=0.17.0,!0.17.1,!0.17.2,>=0.14.0 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
jsonschema<5,>=3->quilt3->segregation>=2.3.1->pysal) (0.18.0)
Requirement already satisfied: mpmath>=0.19 in
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-packages (from
sympy->quantecon>=0.4.7->giddy>=2.3.3->pysal) (1.2.1)
Building wheels for collected packages: esda, inequality, mgwr, pointpats,
spgml, spint, spvcm, rvlib
  Building wheel for esda (setup.py) ... done
  Created wheel for esda: filename=esda-2.4.3-py3-none-any.whl size=122765
sha256=561813cd336be357f46f275a5c359103c0ab7d252644536b4894f80939da856c
  Stored in directory: /Users/alperiyilmaz/Library/Caches/pip/wheels/92/4b/14/df6
9615cd54ad1ce64b70d141dee8b269ebc7ace679cef9f3f
  Building wheel for inequality (setup.py) ... done
  Created wheel for inequality: filename=inequality-1.0.0-py3-none-any.whl
size=11782
sha256=7674830449c6ae9daa5bfdd3d2ac122d8cf6f2f666c11b578f838c9f78526323
  Stored in directory: /Users/alperiyilmaz/Library/Caches/pip/wheels/80/71/07/4d4
c8ecaba710bd79e91014602e70fc4d008328c99d524db40
  Building wheel for mgwr (setup.py) ... done
  Created wheel for mgwr: filename=mgwr-2.1.2-py3-none-any.whl size=46366
sha256=b9421a267bdd94901ca64f71922cc9548ab786ee05f457323787ad6d81ddca6e
  Stored in directory: /Users/alperiyilmaz/Library/Caches/pip/wheels/7f/03/f3/6d9
5ff5d1911ba9e13f98d96dab2afb10969270ee75ab82bc8
  Building wheel for pointpats (setup.py) ... done

```



```

Created wheel for pointpats: filename=pointpats-2.2.0-py3-none-any.whl
size=60815
sha256=9d065ad8262e46fec186779fa4ce001c7b393e5ba24ca784ac0d9726b8125b0a
Stored in directory: /Users/alperilymaz/Library/Caches/pip/wheels/7b/0e/54/93d
2d4ff41e11a26caf8429453066f194eb9a66f0962b43d11
Building wheel for spglm (setup.py) ... done
Created wheel for spglm: filename=spglm-1.0.8-py3-none-any.whl
size=38786
sha256=bccfd9c5de7941e09892f36f498d62eb7a1393ba7818fdb86b0f55474d40974
Stored in directory: /Users/alperilymaz/Library/Caches/pip/wheels/c2/b8/7e/709
d2af4286d94d611711d81727d40149e7467ca9a43c5e30c
Building wheel for spint (setup.py) ... done
Created wheel for spint: filename=spint-1.0.7-py3-none-any.whl
size=31364
sha256=1cca0b2a719c41f956325daa462df1b2b526319fc815fabd2200eacd15f081ca
Stored in directory: /Users/alperilymaz/Library/Caches/pip/wheels/93/a7/ea/0e6
5be5d06cd2860a4c2ea99656ead582f96aa3954652b6ad7
Building wheel for spvcm (setup.py) ... done
Created wheel for spvcm: filename=spvcm-0.3.0-py3-none-any.whl
size=5777185
sha256=2a2b6f7edd501e494b1a9c7b8c4a32619e44423507a7df2fa3b09096bfe01896
Stored in directory: /Users/alperilymaz/Library/Caches/pip/wheels/73/d0/2c/ef6
50f39e25225566643b2839ebfe7a2d4adc5d777dc8d7d73
Building wheel for rvlib (setup.py) ... done
Created wheel for rvlib:
filename=rvlib-0.0.6-cp39-cp39-macosx_10_9_x86_64.whl size=128667
sha256=3fff975c5f1f3ef6c5d3a1e72951e19ba4e12bb3eca44f3efb0b2efd51811ae7
Stored in directory: /Users/alperilymaz/Library/Caches/pip/wheels/29/f3/69/6ce
5aa63741790d5de2a371141f5939150fb1f231d05028b10
Successfully built esda inequality mgwr pointpats spglm spint spvcm rvlib
Installing collected packages: pulp, affine, snuggs, simplejson, pygeos, opencv-
contrib-python, jsonlines, rvlib, requests-futures, rasterio, quantecon,
inequality, deprecation, aws-requests-auth, rasterstats, mapclassify, libpysal,
tobler, spreg, pointpats, momepy, esda, access, spvcm, spglm, spaghetti, quilt3,
giddy, spopt, splot, spint, segregation, mgwr, pysal
Successfully installed access-1.1.8 affine-2.3.1 aws-requests-auth-0.4.3
deprecation-2.1.0 esda-2.4.3 giddy-2.3.3 inequality-1.0.0 jsonlines-1.2.0
libpysal-4.7.0 mapclassify-2.5.0 mgwr-2.1.2 momepy-0.5.4 opencv-contrib-
python-4.7.0.68 pointpats-2.2.0 pulp-2.7.0 pygeos-0.14 pysal-2.7.0
quantecon-0.6.0 quilt3-5.1.0 rasterio-1.3.4 rasterstats-0.17.0 requests-
futures-1.0.0 rvlib-0.0.6 segregation-2.3.1 simplejson-3.18.1 snuggs-1.4.7
spaghetti-1.7.2 spglm-1.0.8 spint-1.0.7 splot-1.1.5.post1 spopt-0.5.0
spreg-1.3.0 spvcm-0.3.0 tobler-0.9.0
Note: you may need to restart the kernel to use updated packages.

```

```
[7]: import libpysal
```

```
[8]: from libpysal.weights import Queen, Rook, KNN
```

```
[9]: w_knn1 = KNN.from_shapefile("/Users/alperiyilmaz/Downloads/  
    ↪turkey_administrativelevels0_1_2/tur_polbnda_adm1.shp")
```

```
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-  
packages/libpysal/cg/shapes.py:1492: FutureWarning: Objects based on the  
`Geometry` class will deprecated and removed in a future version of libpysal.  
    warnings.warn(dep_msg, FutureWarning)  
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-  
packages/libpysal/cg/shapes.py:1208: FutureWarning: Objects based on the  
`Geometry` class will deprecated and removed in a future version of libpysal.  
    warnings.warn(dep_msg, FutureWarning)  
/Users/alperiyilmaz/opt/anaconda3/lib/python3.9/site-  
packages/libpysal/cg/shapes.py:103: FutureWarning: Objects based on the  
`Geometry` class will deprecated and removed in a future version of libpysal.  
    warnings.warn(dep_msg, FutureWarning)
```

```
[10]: len(w_knn1.neighbors)
```

```
[10]: 81
```

```
[11]: w_knn1.neighbors
```

```
[11]: {0: [63, 61],  
      1: [54, 67],  
      2: [38, 31],  
      3: [37, 44],  
      4: [50, 60],  
      5: [66, 73],  
      6: [48, 22],  
      7: [19, 38],  
      8: [44, 9],  
      9: [8, 64],  
      10: [58, 55],  
      11: [55, 21],  
      12: [42, 80],  
      13: [68, 56],  
      14: [74, 34],  
      15: [65, 51],  
      16: [25, 75],  
      17: [68, 59],  
      18: [26, 80],  
      19: [24, 38],  
      20: [78, 53],  
      21: [11, 27],  
      22: [45, 48],  
      23: [5, 69],
```

24: [76, 19],
25: [56, 16],
26: [18, 65],
27: [72, 49],
28: [75, 29],
29: [75, 34],
30: [9, 59],
31: [2, 15],
32: [47, 41],
33: [34, 62],
34: [74, 29],
35: [77, 70],
36: [63, 47],
37: [3, 44],
38: [2, 19],
39: [78, 20],
40: [55, 10],
41: [32, 63],
42: [12, 80],
43: [57, 52],
44: [8, 3],
45: [22, 42],
46: [60, 79],
47: [32, 36],
48: [50, 22],
49: [72, 27],
50: [48, 60],
51: [65, 78],
52: [43, 4],
53: [76, 15],
54: [1, 28],
55: [40, 11],
56: [13, 25],
57: [43, 61],
58: [10, 24],
59: [17, 30],
60: [50, 61],
61: [60, 4],
62: [73, 33],
63: [0, 36],
64: [14, 9],
65: [51, 26],
66: [5, 73],
67: [1, 28],
68: [70, 17],
69: [23, 45],
70: [68, 17],

```

71: [73, 62],
72: [49, 27],
73: [5, 62],
74: [34, 14],
75: [29, 28],
76: [53, 24],
77: [35, 3],
78: [20, 39],
79: [60, 23],
80: [18, 26]}

```

```

[12]: w_knn3 = KNN.from_shapefile("/Users/alperylimaz/Downloads/
      ↪turkey_administrativelevels0_1_2/tur_polbnda_adm1.shp", 3)

```

```

[13]: w_knn3.neighbors

```

```

[13]: {0: [63, 61, 36],
      1: [54, 67, 32],
      2: [38, 31, 53],
      3: [37, 44, 77],
      4: [50, 60, 61],
      5: [66, 73, 23],
      6: [48, 22, 18],
      7: [19, 38, 2],
      8: [44, 9, 3],
      9: [8, 64, 30],
      10: [58, 55, 40],
      11: [55, 21, 20],
      12: [42, 80, 45],
      13: [68, 56, 25],
      14: [74, 34, 64],
      15: [65, 51, 53],
      16: [25, 75, 59],
      17: [68, 59, 70],
      18: [26, 80, 65],
      19: [24, 38, 7],
      20: [78, 53, 15],
      21: [11, 27, 72],
      22: [45, 48, 42],
      23: [5, 69, 79],
      24: [76, 19, 58],
      25: [56, 16, 13],
      26: [18, 65, 80],
      27: [72, 49, 21],
      28: [75, 29, 25],
      29: [75, 34, 28],
      30: [9, 59, 64],

```

31: [2, 15, 18],
32: [47, 41, 63],
33: [34, 62, 29],
34: [74, 29, 14],
35: [77, 70, 68],
36: [63, 47, 0],
37: [3, 44, 77],
38: [2, 19, 7],
39: [78, 20, 51],
40: [55, 10, 11],
41: [32, 63, 47],
42: [12, 80, 22],
43: [57, 52, 4],
44: [8, 3, 37],
45: [22, 42, 69],
46: [60, 79, 0],
47: [32, 36, 63],
48: [50, 22, 6],
49: [72, 27, 39],
50: [48, 60, 4],
51: [65, 78, 15],
52: [43, 4, 38],
53: [76, 15, 20],
54: [1, 28, 71],
55: [40, 11, 10],
56: [13, 25, 68],
57: [43, 61, 4],
58: [10, 24, 19],
59: [17, 30, 68],
60: [50, 61, 4],
61: [60, 4, 0],
62: [73, 33, 71],
63: [0, 36, 41],
64: [14, 9, 74],
65: [51, 26, 15],
66: [5, 73, 69],
67: [1, 28, 25],
68: [70, 17, 13],
69: [23, 45, 66],
70: [68, 17, 13],
71: [73, 62, 54],
72: [49, 27, 21],
73: [5, 62, 66],
74: [34, 14, 64],
75: [29, 28, 34],
76: [53, 24, 55],
77: [35, 3, 17],

```
78: [20, 39, 51],
79: [60, 23, 5],
80: [18, 26, 12]}
```

```
[14]: w_queen = Queen.from_shapefile("/Users/alperylimaz/Downloads/
↳turkey_administrativelevels0_1_2/tur_polbnda_adm1.shp")
```

```
[15]: len(w_queen.neighbors)
```

```
[15]: 81
```

```
[16]: w_queen.neighbors
```

```
[16]: {0: [36, 41, 57, 61, 46, 63],
1: [32, 67, 54, 25, 41],
2: [19, 52, 53, 38, 24, 76, 31],
3: [17, 37, 59, 44, 77, 30],
4: [50, 52, 6, 60, 61],
5: [73, 66, 79, 23],
6: [48, 50, 18, 4, 52, 22, 31],
7: [19, 52, 38, 57, 58, 43],
8: [9, 44, 30],
9: [64, 8, 30],
10: [40, 24, 58, 55],
11: [20, 53, 21, 55, 40],
12: [80, 42, 45],
13: [17, 68, 56, 25, 59],
14: [64, 34, 74, 29, 30],
15: [65, 18, 51, 20, 53, 31],
16: [30, 25, 75, 28, 29, 59],
17: [13, 3, 68, 59, 77],
18: [65, 6, 42, 15, 80, 22, 26, 31],
19: [2, 38, 7, 24, 58],
20: [51, 53, 11, 78, 15],
21: [72, 11, 27],
22: [48, 18, 6, 23, 42, 45],
23: [48, 66, 5, 69, 22, 45, 79],
24: [2, 19, 10, 55, 58, 76],
25: [1, 67, 13, 16, 54, 56, 59, 28],
26: [80, 65, 18],
27: [72, 49, 21],
28: [16, 54, 25, 75, 29],
29: [33, 34, 71, 75, 14, 16, 54, 28, 30],
30: [64, 3, 8, 9, 44, 14, 16, 59, 29],
31: [2, 18, 52, 53, 6, 15],
32: [1, 67, 36, 41, 47, 63],
33: [34, 71, 74, 29, 62],
```

34: [33, 74, 29, 14],
 35: [77, 70],
 36: [0, 32, 63],
 37: [3, 44],
 38: [2, 19, 52, 7],
 39: [72, 49, 51],
 40: [10, 11, 55],
 41: [0, 32, 1, 54, 71, 46, 63],
 42: [80, 18, 22, 12, 45],
 43: [57, 52, 7],
 44: [8, 3, 37, 30],
 45: [69, 22, 23, 42, 12],
 46: [0, 71, 41, 60, 61, 79],
 47: [32],
 48: [50, 6, 23, 22, 79],
 49: [72, 27, 39],
 50: [48, 4, 6, 60, 79],
 51: [65, 20, 39, 78, 15],
 52: [2, 4, 38, 7, 6, 43, 57, 61, 31],
 53: [2, 20, 55, 11, 76, 31, 15],
 54: [1, 71, 41, 28, 29, 25],
 55: [53, 40, 24, 10, 11, 76],
 56: [67, 68, 70, 25, 13],
 57: [0, 52, 7, 43, 61],
 58: [24, 10, 19, 7],
 59: [16, 17, 3, 25, 13, 30],
 60: [50, 4, 61, 46, 79],
 61: [0, 4, 52, 57, 60, 46],
 62: [73, 33, 66, 71],
 63: [0, 41, 32, 36],
 64: [9, 74, 14, 30],
 65: [26, 18, 51, 15],
 66: [69, 5, 23, 73, 62],
 67: [32, 1, 56, 25],
 68: [17, 77, 70, 56, 13],
 69: [66, 45, 23],
 70: [56, 35, 68, 77],
 71: [33, 41, 73, 46, 79, 54, 29, 62],
 72: [49, 27, 21, 39],
 73: [66, 5, 71, 62, 79],
 74: [64, 33, 34, 14],
 75: [16, 28, 29],
 76: [24, 2, 53, 55],
 77: [17, 3, 68, 35, 70],
 78: [51, 20],
 79: [5, 71, 73, 46, 48, 50, 23, 60],
 80: [18, 26, 42, 12]}

```
[18]: w_rook = Rook.from_shapefile("/Users/alperylimaz/Downloads/  
↳turkey_administrativelevels0_1_2/tur_polbnda_adm1.shp")
```

```
[19]: len(w_rook.neighbors)
```

```
[19]: 81
```

```
[20]: w_rook.neighbors
```

```
[20]: {0: [63, 36, 41, 61, 46, 57],  
      1: [32, 67, 54, 25, 41],  
      2: [19, 52, 53, 38, 24, 76, 31],  
      3: [17, 37, 59, 44, 77, 30],  
      4: [50, 52, 6, 60, 61],  
      5: [73, 66, 79, 23],  
      6: [48, 50, 18, 4, 52, 22, 31],  
      7: [19, 52, 38, 57, 58, 43],  
      8: [9, 44, 30],  
      9: [64, 8, 30],  
      10: [40, 24, 58, 55],  
      11: [20, 53, 21, 55, 40],  
      12: [80, 42, 45],  
      13: [17, 68, 56, 25, 59],  
      14: [64, 34, 74, 29, 30],  
      15: [65, 18, 51, 20, 53, 31],  
      16: [25, 75, 59, 28, 29, 30],  
      17: [13, 3, 68, 59, 77],  
      18: [65, 6, 42, 15, 80, 22, 26, 31],  
      19: [2, 38, 7, 24, 58],  
      20: [51, 53, 11, 78, 15],  
      21: [72, 11, 27],  
      22: [48, 18, 6, 23, 42, 45],  
      23: [48, 66, 69, 5, 22, 45, 79],  
      24: [2, 19, 58, 55, 10, 76],  
      25: [1, 67, 13, 16, 54, 56, 59, 28],  
      26: [80, 65, 18],  
      27: [72, 49, 21],  
      28: [16, 54, 25, 75, 29],  
      29: [33, 34, 71, 75, 14, 16, 54, 28, 30],  
      30: [64, 3, 8, 9, 44, 14, 16, 59, 29],  
      31: [2, 18, 52, 53, 6, 15],  
      32: [1, 67, 36, 41, 47, 63],  
      33: [34, 71, 74, 29, 62],  
      34: [33, 74, 29, 14],  
      35: [77, 70],  
      36: [0, 32, 63],  
      37: [3, 44],
```



```

38: [2, 19, 52, 7],
39: [72, 49, 51],
40: [10, 11, 55],
41: [0, 1, 32, 54, 71, 46, 63],
42: [80, 18, 22, 12, 45],
43: [57, 52, 7],
44: [8, 3, 37, 30],
45: [69, 22, 23, 42, 12],
46: [0, 71, 41, 60, 61, 79],
47: [32],
48: [50, 22, 23, 6, 79],
49: [72, 27, 39],
50: [48, 4, 6, 60, 79],
51: [65, 20, 39, 78, 15],
52: [2, 4, 6, 7, 38, 43, 57, 61, 31],
53: [2, 20, 55, 11, 76, 31, 15],
54: [1, 71, 25, 28, 29, 41],
55: [53, 40, 24, 10, 11, 76],
56: [67, 68, 70, 25, 13],
57: [0, 52, 7, 43, 61],
58: [24, 10, 19, 7],
59: [16, 17, 3, 25, 13, 30],
60: [50, 4, 61, 46, 79],
61: [0, 4, 52, 57, 60, 46],
62: [73, 33, 66, 71],
63: [0, 41, 32, 36],
64: [9, 74, 30, 14],
65: [26, 18, 51, 15],
66: [5, 69, 23, 73, 62],
67: [32, 1, 56, 25],
68: [17, 13, 70, 56, 77],
69: [66, 45, 23],
70: [56, 35, 68, 77],
71: [33, 41, 73, 46, 79, 54, 29, 62],
72: [49, 27, 21, 39],
73: [66, 5, 71, 62, 79],
74: [64, 33, 34, 14],
75: [16, 28, 29],
76: [24, 2, 53, 55],
77: [17, 3, 68, 35, 70],
78: [51, 20],
79: [5, 71, 73, 46, 48, 50, 23, 60],
80: [18, 26, 42, 12]}

```

```

[28]: wq = libpysal.weights.Queen.from_dataframe(merged_data)
      wq

```

```
[28]: <libpysal.weights.contiguity.Queen at 0x7fb8edcd6970>
```

```
[37]: merged_data['bed per 100thou_splag'] = libpysal.weights.lag_spatial(wq,merged_data['bed per 100thou'])

merged_data['public_hospital_100thoupop_splag'] = libpysal.weights.lag_spatial(wq, merged_data['public_hospital_100thoupop'])

merged_data['doctor_100thoupop_splag'] = libpysal.weights.lag_spatial(wq,merged_data['doctor_100thoupop'])

merged_data['primary_5-9_100thou_pop_splag'] = libpysal.weights.lag_spatial(wq,merged_data['primary_5-9_100thou_pop'])

merged_data['class_100thou_pop_splag'] = libpysal.weights.lag_spatial(wq,merged_data['class_100thou_pop'])

merged_data['crime_100thou_pop_splag'] = libpysal.weights.lag_spatial(wq,merged_data['crime_100thou_pop'])
```

```
[38]: merged_data['bed per 100thou_splag'],merged_data['bed per 100thou']

merged_data['public_hospital_100thoupop_splag'],merged_data['public_hospital_100thoupop']

merged_data['doctor_100thoupop_splag'],merged_data['doctor_100thoupop']

merged_data['primary_5-9_100thou_pop_splag'],merged_data['primary_5-9_100thou_pop']

merged_data['class_100thou_pop_splag'],merged_data['class_100thou_pop']

merged_data['crime_100thou_pop_splag'],merged_data['crime_100thou_pop']
```

```
[38]: (0      1931.878065
      1      1160.233886
      2      2736.003910
      3      1349.043072
      4      1674.348325
      ...
      76     1521.363059
      77      925.031788
      78      525.919386
      79     2724.985222
      80     1327.527877
      Name: crime_100thou_pop_splag, Length: 81, dtype: float64,
      0      363.524796
      1      145.463975
```

```

2      360.965760
3      229.346233
4      350.109099
...
76     429.306532
77     201.332589
78     290.527078
79     255.312041
80     327.467338
Name: crime_100thou_pop, Length: 81, dtype: float64)

```

```
[45]: merged_data['bed per 100thou'].corr(merged_data['bed per 100thou_splag'])
```

```
[45]: 0.3339017910730658
```

```
[47]: merged_data['public_hospital_100thoupop'].corr(merged_data['public_
↪hospital_100thoupop_splag'])
```

```
[47]: 0.3570000091041012
```

```
[48]: merged_data['doctor_100thoupop'].corr(merged_data['doctor_100thoupop_splag'])
```

```
[48]: 0.21062758310547658
```

```
[49]: merged_data['primary_5-9_100thou_pop'].
↪corr(merged_data['primary_5-9_100thou_pop_splag'])
```

```
[49]: 0.8255851535444946
```

```
[50]: merged_data['class_100thou_pop'].corr(merged_data['class_100thou_pop_splag'])
```

```
[50]: 0.12373496725872773
```

```
[51]: merged_data['crime_100thou_pop'].corr(merged_data['crime_100thou_pop_splag'])
```

```
[51]: 0.3339017910730658
```