In [25]:

```
!pip install folium
import pandas as pd
import matplotlib.pyplot as plt
import folium
from folium.plugins import HeatMap
import numpy as np
import reverse_geocoder as rg
import reverse_geocode
from geopy.geocoders import Nominatim
```

```
Collecting folium
  Downloading folium-0.14.0-py2.py3-none-any.whl (102 kB)
     -------------------------------------- 102.3/102.3 kB 1.5 MB/s eta 0:00:00
Requirement already satisfied: requests in c:\users\lucas\anaconda3\lib\site-packages
(from folium) (2.28.1)
Requirement already satisfied: jinja2>=2.9 in c:\users\lucas\anaconda3\lib\site-packa
ges (from folium) (2.11.3)
Collecting branca>=0.6.0
  Downloading branca-0.6.0-py3-none-any.whl (24 kB)
Requirement already satisfied: numpy in c:\users\lucas\anaconda3\lib\site-packages (f
rom folium) (1.21.5)
Requirement already satisfied: MarkupSafe>=0.23 in c:\users\lucas\anaconda3\lib\site-
packages (from jinja2>=2.9->folium) (2.0.1)
Requirement already satisfied: charset-normalizer<3,>=2 in c:\users\lucas\anaconda3\l
ib\site-packages (from requests->folium) (2.0.4)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\lucas\anaconda3\lib
\site-packages (from requests->folium) (1.26.11)
Requirement already satisfied: idna<4,>=2.5 in c:\users\lucas\anaconda3\lib\site-pack
ages (from requests->folium) (3.3)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\lucas\anaconda3\lib\sit
e-packages (from requests->folium) (2022.9.14)
Installing collected packages: branca, folium
Successfully installed branca-0.6.0 folium-0.14.0
```

In [26]:

```
zero_access_data = pd.read_csv("zeroaccess.csv", encoding='utf8')
state_internet_data = pd.read_csv('state-internets.csv')
county_data = pd.read_csv('county-data.csv')
```

In [27]:

```
zero_access_data["lat"] = zero_access_data["lat"].astype(str)
zero_access_data["long"] = zero_access_data["long"].astype(str)
zero_access_data["location"] = zero_access_data["lat"] + ", " + zero_access_data["long
zero_access_data.head(10)
```

Out[27]:

	lat	long	location
0	-10.0	-55.0	-10.0, -55.0
1	38.0888	-78.5592	38.0888, -78.5592
2	38.999	-84.6266	38.999, -84.6266
3	48.621	7.4944	48.621, 7.4944
4	43.2342	-86.2484	43.2342, -86.2484
5	47.0	20.0	47.0, 20.0
6	44.8012	-68.7778	44.8012, -68.7778
7	51.3333	1.4333	51.3333, 1.4333
8	36.058	-88.8253	36.058, -88.8253
9	20.6	-100.3833	20.6, -100.3833

In [29]:

```
def get_country(latitudes, longitudes):
    coordinates = list(zip(latitudes, longitudes))
    locations = rg.search(coordinates)
    return [loc['cc'] for loc in locations]
def get_state(latitudes, longitudes):
    coordinates = list(zip(latitudes, longitudes))
    locations = rg.search(coordinates)
    return [loc['admin1'] for loc in locations]
def get_county(latitudes, longitudes):
    coordinates = list(zip(latitudes, longitudes))
    locations = rg.search(coordinates)
    return [loc['name'] for loc in locations]



latitudes = zero_access_data['lat'].tolist()
longitudes = zero_access_data['long'].tolist()

country_codes = get_country(latitudes, longitudes)


zero_access_data['country'] = country_codes

zero_access_data = zero_access_data[zero_access_data['country'] == 'US']

state = get_state(latitudes, longitudes)
county = get_county(latitudes, longitudes)

zero_access_data['state'] = state
zero_access_data['county'] = county

zero_access_data = zero_access_data.replace('US', 'United States')

zero_access_data.head(10)
```

Out[29]:

	lat	long	location	country	state	county
1	38.0888	-78.5592	38.0888, -78.5592	United States	Virginia	Charlottesville
2	38.999	-84.6266	38.999, -84.6266	United States	Kentucky	Florence
4	43.2342	-86.2484	43.2342, -86.2484	United States	Michigan	Muskegon
6	44.8012	-68.7778	44.8012, -68.7778	United States	Maine	Bangor
8	36.058	-88.8253	36.058, -88.8253	United States	Tennessee	Bradford
20	41.1172	-78.6861	41.1172, -78.6861	United States	Pennsylvania	Treasure Lake
21	43.0796	-89.3758	43.0796, -89.3758	United States	Wisconsin	Madison
23	41.9792	-88.0895	41.9792, -88.0895	United States	Illinois	Roselle
25	42.0643	-87.9921	42.0643, -87.9921	United States	Illinois	Arlington Heights
28	33.596	-96.5454	33.596, -96.5454	United States	Texas	Sherman

In [30]:

```
county_data = county_data.rename(columns={'subregion' : 'county', 'region': 'state'})
county_data['state'] = county_data['state'].str.title()
county_data['county'] = county_data['county'].str.title()
```

In [31]:

```
merged_df = pd.merge(county_data, state_internet_data, on='state')
merged_df = pd.merge(county_data, zero_access_data, on=['county', 'state'])
merged_df.head(10)
```

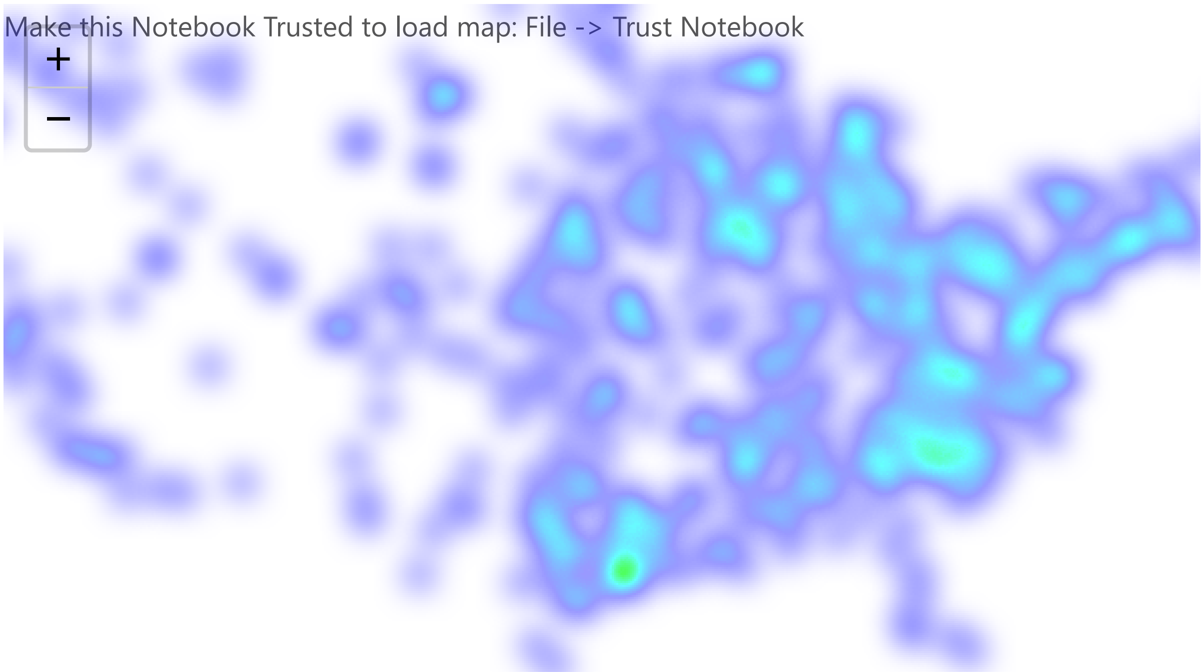
Out[31]:

	county	state	pop	income	ipaddr	ufo2010	lat	long	location	country
0	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
1	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
2	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
3	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
4	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
5	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
6	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
7	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
8	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States
9	Abbeville	South Carolina	25101	34670	30330	2	34.1621	-82.4333	34.1621, -82.4333	United States

In [35]:

```
m = folium.Map(location=[37.0902, -95.7129], zoom_start=4)
HeatMap(data=merged_df[['lat', 'long']], radius=8).add_to(m)
m
```

Out[35]:



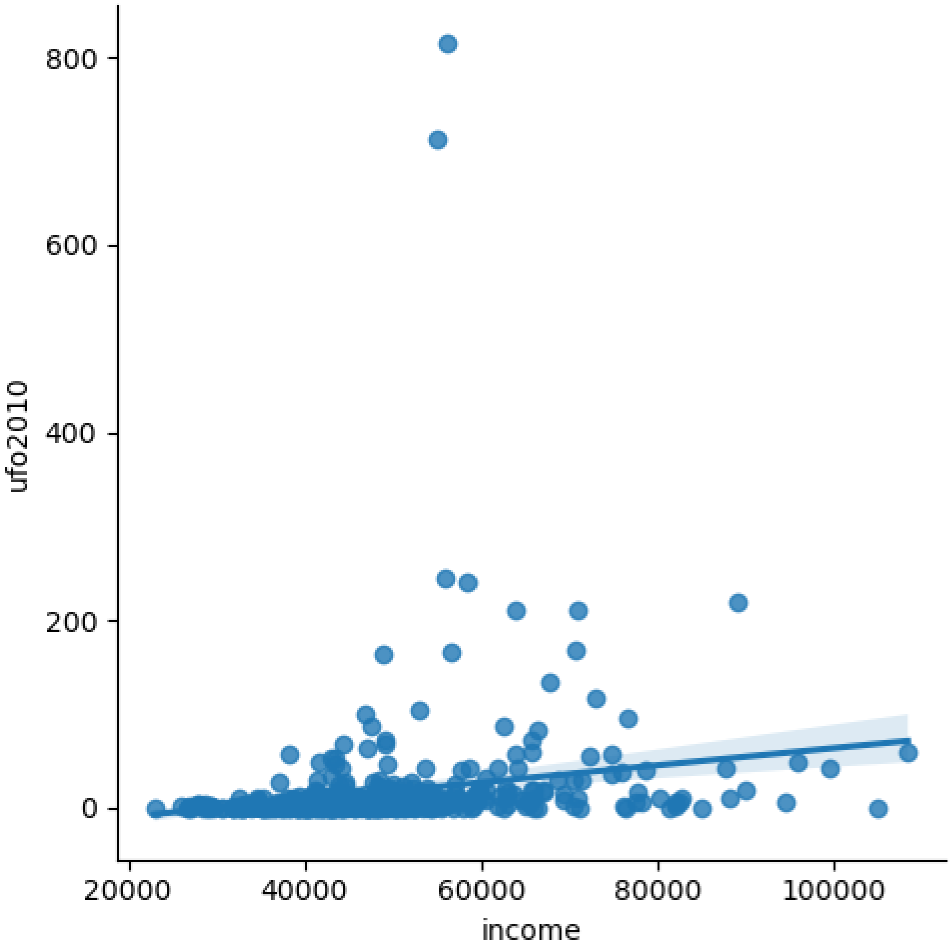
Make this Notebook Trusted to load map: File -> Trust Notebook

Leaflet (https://leafletjs.com) | Data by © OpenStreetMap (http://openstreetmap.org), under ODbL (http://www.openstreetmap.org/copyright).

In [40]:

```
import seaborn as sns
county_data = merged_df.groupby('county').agg({'income': 'mean','ufo2010': 'mean'})
corr_coef = county_data.corr().loc['income', 'ufo2010']
sns.lmplot(x='income', y='ufo2010', data=county_data)
print('Correlation coefficient:', corr_coef)
```

```
Correlation coefficient: 0.20630694435288954
```


800
600
400
200
0
ufo2010
20000
40000
60000
80000
100000
income

```
In [ ]:
```