

DataDive: Housing Insecurity

Installation

- python>=3.80
- pandas==1.3.0
- numpy==1.20.3
- matplotlib==3.3.4
- plotly==5.3.1
- json==2.0.9
- ipywidgets==7..6.3

Apart from these dependencies, some additional setup might be required to display the plotly graphs depending on your environment. For example this notebook was created using JupyterLab which requires install `jupyterlab` (version 3.0.16 in this case) to display the visuals as discussed here <https://plotly.com/python/getting-started/#jupyterlab-support>.

```
In [1]: # Load Libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import plotly.express as px
import json

# magic commands
%matplotlib inline
%load_ext nb_black
%load_ext lab_black
```

```
In [2]: # !pip install jupyter-dash
```

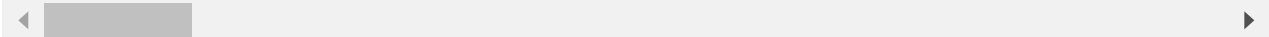
```
In [3]: # Change display options to prevent truncation of rows and columns
pd.set_option("display.max_columns", None)
pd.set_option("display.max_rows", None)
```

```
In [4]: # Load Dataset
df = pd.read_csv("./hillsborough_fl_processed_2017_to_2019_20210916.csv")
```

```
In [5]: df.head()
```

Out[5]:

	census_tract_GEOID	total-households	total-renter-occupied-households	total-owner-occupied-households	total-owner-occupied-households-mortgage	median-gross-rent	median-household-income	median-property-value
0	12057000401	926	338	588	432	1055	48426	148200
1	12057010105	1496	381	1115	653	879	53860	232000
2	12057010203	766	395	371	197	846	39018	96500
3	12057010600	1108	354	754	481	1095	80600	234500
4	12057002300	1419	599	820	592	1138	62636	212000



In [6]:

```
df.columns
```

Out[6]:

```
Index(['census_tract_GEOID', 'total-households',  
      'total-renter-occupied-households', 'total-owner-occupied-households',  
      'total-owner-occupied-households-mortgage', 'median-gross-rent',  
      'median-household-income', 'median-property-value',  
      'median-monthly-housing-cost', 'pct-white', 'pct-af-am', 'pct-hispanic',  
      'pct-am-indian', 'pct-asian', 'pct-nh-pi', 'pct-multiple', 'pct-other',  
      'pct-below-poverty-level', 'households-children',  
      'single-parent-household', 'older-adult-alone', 'level-of-education',  
      'immigrant-status', 'english-fluency', 'drive-to-work',  
      'public-transport-to-work', 'vacant-properties', 'live-in-mobile-home',  
      'pct-renter-occupied', 'pct-owner-occupied',  
      'pct-owner-occupied-mortgage', 'pct-owner-occupied-without-mortgage',  
      'median-house-age', 'pct-non-white', 'pct-without-health-insurance',  
      'total-evictions', 'avg-evictions', 'total-foreclosure-sales',  
      'avg-foreclosure-sales', 'total-lien-foreclosures',  
      'avg-lien-foreclosures', 'total-evictions-2017',  
      'eviction-filings-2017', 'eviction-rate-2017', 'total-evictions-2018',  
      'eviction-filings-2018', 'eviction-rate-2018', 'total-evictions-2019',  
      'eviction-filings-2019', 'eviction-rate-2019', 'foreclosure-sales-2017',  
      'foreclosure-sales-2018', 'foreclosure-sales-2019',  
      'lien-foreclosures-2017', 'lien-foreclosures-2018',  
      'lien-foreclosures-2019', 'avg-foreclosure-rate',  
      'foreclosure-rate-2017', 'foreclosure-rate-2018',  
      'foreclosure-rate-2019', 'avg-lien-foreclosure-rate',  
      'lien-foreclosure-rate-2017', 'lien-foreclosure-rate-2018',  
      'lien-foreclosure-rate-2019', 'avg-eviction-rate',  
      'ratio-to-mean-foreclosure-rate', 'ratio-to-mean-eviction-rate',  
      'avg-housing-loss-rate', 'evictions-pct-total-housing-loss',  
      'housing-loss-index', 'county_GEOID', 'county', 'state'],  
      dtype='object')
```

We can see above that some columns have year wise values, whereas some columns are aggregations / don't have year wise values.

We will create 2 csv files with Year and without Year wise features which can be connected using 'census_tract_GEOID'

Creating Non-Year CSV

```
In [7]: df_non_year = df[[x for x in df.columns if "2" not in x]]
```

```
In [8]: # Exporting CSV
df_non_year.to_csv("./Hillsborough Aggregate Stats.csv", index=False)
```

Creating Year wise CSV

This csv contains columns which have year wise data in a cleaner format to use for visualizations

```
In [9]: df_year = df[["census_tract_GEOID"] + [x for x in df.columns if "2" in x]]
```

```
In [10]: # We melt this down to get year wise rates for each columns and make these easier to work with
df_year.head()
```

```
Out[10]:
```

	census_tract_GEOID	total- evictions- 2017	eviction- filings- 2017	eviction- rate- 2017	total- evictions- 2018	eviction- filings- 2018	eviction- rate- 2018	total- evictions- 2019	eviction filing 2019
0	12057000401	19.893939	39.0	0.510101	12.752525	25.0	0.510101	16.833333	33.0
1	12057010105	9.428571	22.0	0.428571	3.000000	7.0	0.428571	6.000000	14.0
2	12057010203	22.316456	43.0	0.518987	10.898734	21.0	0.518987	26.987342	52.0
3	12057010600	37.626667	68.0	0.553333	34.306667	62.0	0.553333	34.306667	62.0
4	12057002300	3.243243	6.0	0.540541	4.324324	8.0	0.540541	9.729730	18.0

```
In [11]: # Collating columns for melting

id_vars = ["census_tract_GEOID"]

eviction_rate_cols = [x for x in df_year.columns if "eviction-rate" in x]

total_eviction_cols = [x for x in df_year.columns if "total-evictions" in x]

eviction_filings_cols = [x for x in df_year.columns if "eviction-filings" in x]

foreclosure_sales_cols = [x for x in df_year.columns if "foreclosure-sales" in x]

foreclosure_rate_cols = [
    x for x in df_year.columns if "foreclosure-rate" in x and "lien" not in x
]
```

```

lien_foreclosure_cols = [
    x for x in df_year.columns if "lien-foreclosure" in x and "rate" not in x
]

lien_foreclosure_rate_cols = [
    x for x in df_year.columns if "lien-foreclosure-rate" in x
]

```

In [12]: *# We melt and combine each of these based on the loop below*

```

ls = [
    eviction_rate_cols,
    total_eviction_cols,
    eviction_filings_cols,
    foreclosure_sales_cols,
    foreclosure_rate_cols,
    lien_foreclosure_cols,
    lien_foreclosure_rate_cols,
]

```

In [13]: *# We have to melt this way, because sequential melts cause duplication of values and ca*

```

list_dfs = []
col_gen_names = []
values = []

for i in ls:
    value = "_".join(i[0].split("-")[:-1])
    col_title = value + "_col"

    values.append(value)
    col_gen_names.append(col_title)

    list_dfs.append(
        pd.melt(
            df_year[id_vars + i],
            id_vars=id_vars,
            value_vars=i,
            var_name=col_title,
            value_name=value,
        )
    )

```

In [14]:

```

df_temp_year = pd.concat(
    [list_dfs[0]] + [x.drop(["census_tract_GEOID"], axis=1) for x in list_dfs[1:]],
    axis=1,
)

```

In [15]:

```

df_temp_year.head()

```

Out[15]:

	census_tract_GEOID	eviction_rate_col	eviction_rate	total_evictions_col	total_evictions	eviction_filings
0	12057000401	eviction-rate-2017	0.510101	total-evictions-2017	19.893939	eviction-filings-2017
1	12057010105	eviction-rate-2017	0.428571	total-evictions-2017	9.428571	eviction-filings-2017
2	12057010203	eviction-rate-2017	0.518987	total-evictions-2017	22.316456	eviction-filings-2017
3	12057010600	eviction-rate-2017	0.553333	total-evictions-2017	37.626667	eviction-filings-2017
4	12057002300	eviction-rate-2017	0.540541	total-evictions-2017	3.243243	eviction-filings-2017

In [16]:

```
# Getting years, this a bit of a Long approach. Although in theory we could just pick 0
# Just for a sanity check we make sure that years are consistent for all these generate
for col in col_gen_names:
    df_temp_year[col] = df_temp_year[col].str.split("-").str.get(-1)

df_temp_year["year"] = df_temp_year[
    df_temp_year[col_gen_names].eq(df_temp_year[col_gen_names[0]], axis=0).sum(axis=1)
    == 7
][col_gen_names[0]].astype(int)
```

In [17]:

```
df_temp_year.head()
```

Out[17]:

	census_tract_GEOID	eviction_rate_col	eviction_rate	total_evictions_col	total_evictions	eviction_filings
0	12057000401	2017	0.510101	2017	19.893939	2
1	12057010105	2017	0.428571	2017	9.428571	2
2	12057010203	2017	0.518987	2017	22.316456	2
3	12057010600	2017	0.553333	2017	37.626667	2
4	12057002300	2017	0.540541	2017	3.243243	2

In [18]:

```
# Keep only relevant columns
df_year_final = df_temp_year[id_vars + values + ["year"]]
```

In [19]:

```
df_year_final.head()
```

Out[19]:

	census_tract_GEOID	eviction_rate	total_evictions	eviction_filings	foreclosure_sales	foreclosure_rate
0	12057000401	0.510101	19.893939	39.0	4.0	0.925926

	census_tract_GEOID	eviction_rate	total_evictions	eviction_filings	foreclosure_sales	foreclosure_rate
1	12057010105	0.428571	9.428571	22.0	5.0	0.765697
2	12057010203	0.518987	22.316456	43.0	2.0	1.015228
3	12057010600	0.553333	37.626667	68.0	2.0	0.415800
4	12057002300	0.540541	3.243243	6.0	8.0	1.351351



In [20]:

```
# Exporting
df_year_final.to_csv(r"./Hillsborough Year Wise.csv", index=False)
```

Data Visualization

We use two approaches:

- The above exported CSVs are imported to Tableau and visualized there
- The Python code below uses Plotly for visualization

Plotly

In [21]:

```
# importing the geojson file for counties
# https://stackoverflow.com/a/47792385

with open(r"./hillsborough_fl_2010_tracts_formatted.geojson") as f:
    geoj = json.load(f)

# gj["features"][1]
```

In [22]:

```
# Plotly choropleth
fig = px.choropleth(
    df_year_final,
    geojson=geoj,
    locations="census_tract_GEOID",
    color="eviction_rate",
    featureidkey="properties.census_tract_GEOID",
    labels={"avg-foreclosure-rate": "Eviction Rate"},
)
fig.update_layout(margin={"r": 0, "t": 0, "l": 0, "b": 0})
fig.show()
```



Plotly Choropleth GeoJSON problem

This does not work because of an interesting problem as highlighted in <https://stackoverflow.com/questions/61966708/plotly-express-choropleth-only-showing-some-information-from-geojson>

The standard for GeoJSON defines a right hand rule which can break certain programs such as Plotly above. The choropleth in Plotly expects the GeoJSON to follow the right hand rule, which is why the choropleth breaks or gives weird colors if the GeoJSON is not in the required format. We use the [geojson_rewind](#) library which is a Python port of Mapbox JS library to solve this as suggested in the StackOverFlow and GitHub Links

```
In [23]: # !pip install geojson-rewind
```

```
In [24]: from geojson_rewind import rewind

geoj = rewind(geoj, rfc7946=False)
```

WARNING:root:Co-ordinates in the input data are assumed to be WGS84 with (lon, lat) ordering, as per RFC 7946. Input with co-ordinates using any other CRS may lead to unexpected results.

```
In [25]: fig = px.choropleth(
    df_year_final[df_year_final.year == 2017],
    geojson=geoj,
    color="eviction_rate",
    color_continuous_scale="reds",
    locations="census_tract_GEOID",
    featureidkey="properties.census_tract_GEOID",
    hover_data=["eviction_filings", "year"],
)
fig.update_geos(fitbounds="locations", visible=False)
fig.update_layout(
    margin={"r": 0, "t": 40, "l": 0, "b": 0}, title_text="Eviction Rate [2017]",
)
fig.show()
```

Eviction Rate [2017]



In [26]:

```
year_taken = 2017

fig = px.choropleth(
    df_year_final[df_year_final.year == year_taken],
    geojson=geoj,
    color="total_evictions",
    color_continuous_scale="cividis",
    locations="census_tract_GEOID",
    featureidkey="properties.census_tract_GEOID",
    hover_data=["eviction_filings", "year"],
)
fig.update_geos(fitbounds="locations", visible=False)
fig.update_layout(
    margin={"r": 0, "t": 40, "l": 0, "b": 0},
    title_text=f"Total Evictions [{year_taken}]",
)
fig.show()
```

Total Evictions [2017]



Using Widgets to make them more dynamic

In [27]:

```
import ipywidgets as widgets
from IPython.display import display
```

In [28]:

```
def choro_interactive(year, column):
    fig = px.choropleth(
        df_year_final[df_year_final.year == year],
        geojson=geoj,
        color=column,
        locations="census_tract_GEOID",
        featureidkey="properties.census_tract_GEOID",
        hover_data=["eviction_filings", "year"],
    )
```



```

)
fig.update_geos(fitbounds="locations", visible=False)
fig.update_layout(
    margin={"r": 0, "t": 40, "l": 0, "b": 0}, title_text=f"{column} [{year}]",
)
fig.show()

```

```

In [29]: display(widgets.interact(choro_interactive, year=[2017, 2018, 2019], column=values))

```

```

<function __main__.choro_interactive(year, column)>

```

Mapbox based

These are more responsive and better performant

```

In [42]: # A default argument changes the default value of the widget
def choro_interactive_mapbox(year, column="eviction_filings"):
    fig = px.choropleth_mapbox(
        df_year_final[df_year_final.year == year],
        geojson=geoj,
        color=column,
        color_continuous_scale="viridis",
        locations="census_tract_GEOID",
        featureidkey="properties.census_tract_GEOID",
        mapbox_style="carto-positron",
        hover_data=["eviction_filings", "eviction_rate"],
    )

    fig.update_layout(
        margin={"r": 0, "t": 0, "l": 0, "b": 0},
        mapbox_zoom=8,
        mapbox_center={"lat": 27.924894, "lon": -82.569520},
    )
    display(fig)

display(
    widgets.interact(choro_interactive_mapbox, year=[2017, 2018, 2019], column=values)
)

```

```

<function __main__.choro_interactive_mapbox(year, column='eviction_filings')>

```

```

In [46]: # For PDF, since vizes do not get export when used with widgets

```

```

fig = px.choropleth_mapbox(
    df_year_final[df_year_final.year == 2019],
    geojson=geoj,
    color="total_evictions",
    color_continuous_scale="blues",
    locations="census_tract_GEOID",
    featureidkey="properties.census_tract_GEOID",
    mapbox_style="open-street-map",
    hover_data=["eviction_filings", "eviction_rate"],
)

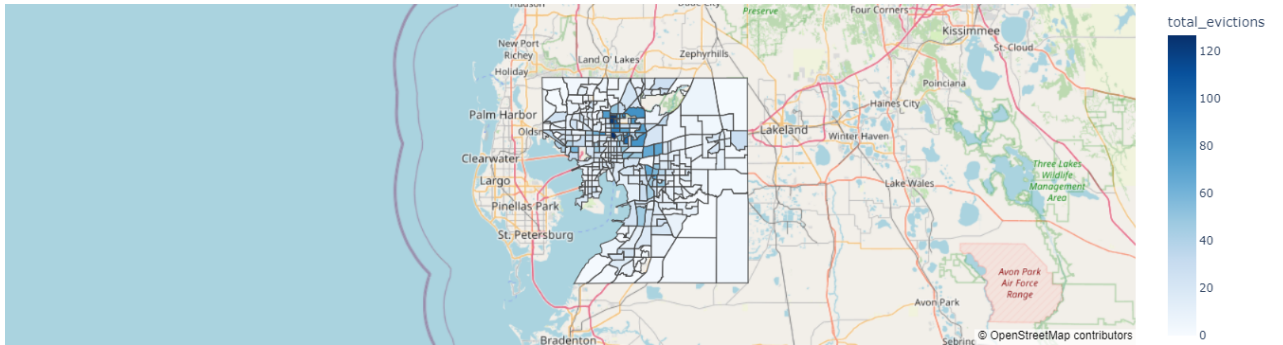
```

```

)

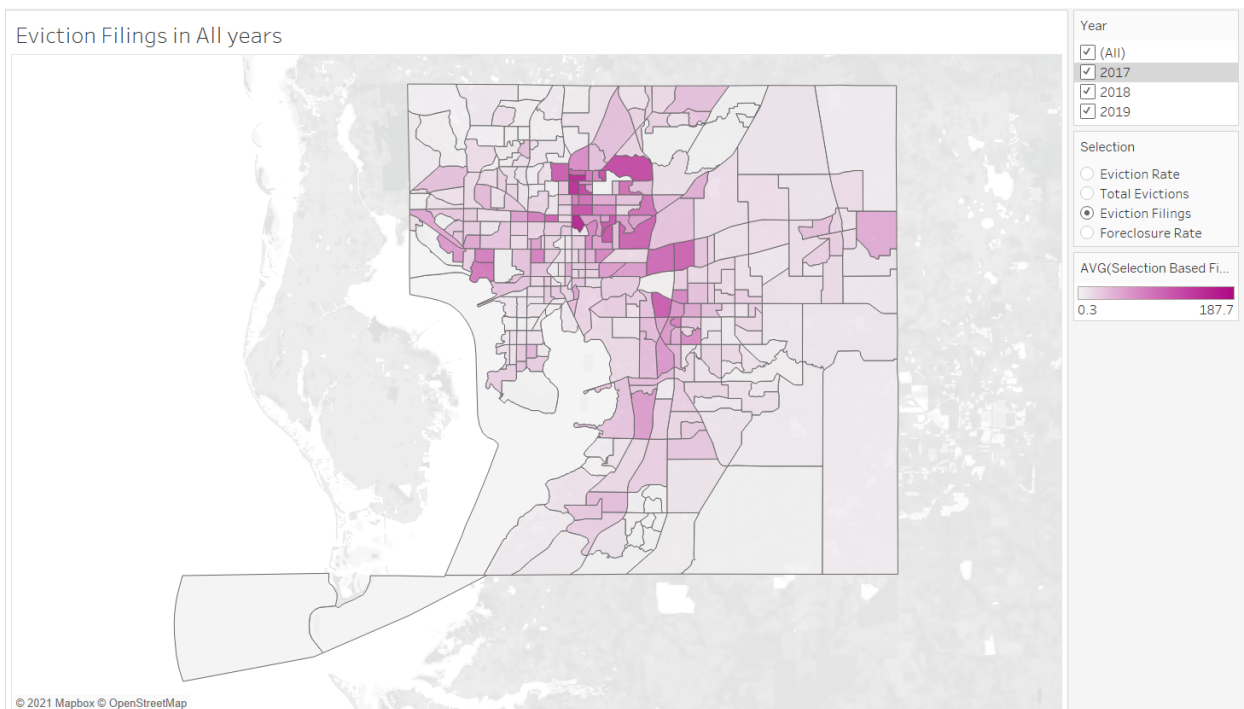
fig.update_layout(
    margin={"r": 0, "t": 0, "l": 0, "b": 0},
    mapbox_zoom=8,
    mapbox_center={"lat": 27.924894, "lon": -82.569520},
)
display(fig)

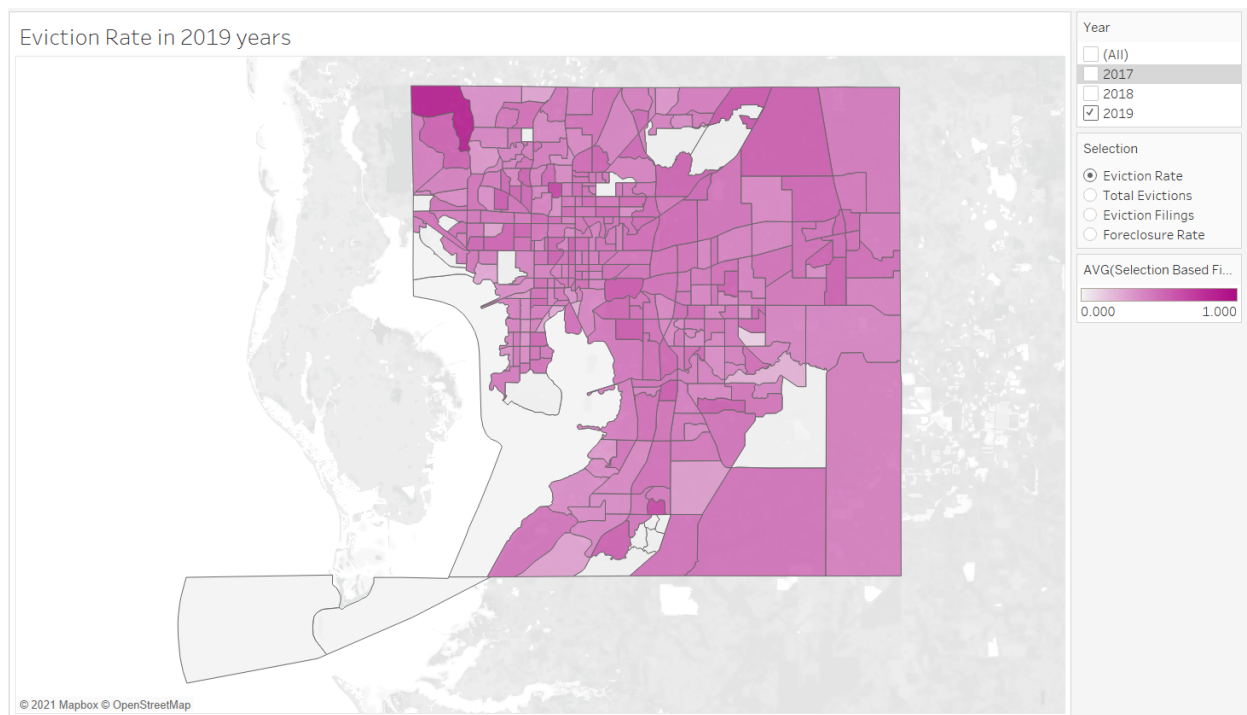
```



Tableau

Similar Visualizations were explored using Tableau as shown:





Get Versions

```
In [ ]: # import geojson_rewind
# import pandas as pd
# import numpy as np
# import matplotlib
# import plotly
# import json
# import ipywidgets

# ls_ver = [pd, np, matplotlib, plotly, json, ipywidgets]
```

```
In [ ]: # for i in ls_ver:
#     print(i, i.__version__)
```

```
In [ ]: from importlib.metadata import version

version("geojson_rewind")
```

```
In [ ]: import sys

sys.version
```

```
In [ ]: import jupyterlab

jupyterlab.__version__
```

Learnings

- nbconvert to pdf -> ensure that images in markdown have a URL like path as shown above for Tableau. [Ref](#)