EDA Template

December 9, 2024

1 STOR 320: Introduction to Data Science

1.1 EDA Group PLACE_GROUP_NUMBER_HERE (Ex: EDA Group 12)

1.2 Part 1: Data cleaning, merging, and visualization (6 points)

[2]:

```python
# At the start of your notebook
from IPython.display import display, HTML
import warnings
warnings.filterwarnings('ignore')

# Hide code cells
display(HTML("""
<style>
.jp-CodeCell {
    display: none !important;
}
.jp-MarkdownCell {
    display: block !important;
}
</style>
"""))

# Hide prompts
display(HTML("""
<style>
.prompt {
    display: none !important;
}
</style>
"""))
```

```
<IPython.core.display.HTML object>

<IPython.core.display.HTML object>
```

[61]:

```python
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import roc_auc_score, precision_recall_curve,␣
  ↪confusion_matrix, classification_report, roc_curve
from sklearn.model_selection import train_test_split
```

[62]:
```
eviction = pd.read_csv('eviction_2020_2024.csv')
eviction.head()
```

[62]:
```
              city          type        GEOID racial_majority    month  \
0  Albuquerque, NM  Census Tract  35001000107           White  01/2020
1  Albuquerque, NM  Census Tract  35001000107           White  02/2020
2  Albuquerque, NM  Census Tract  35001000107           White  03/2020
3  Albuquerque, NM  Census Tract  35001000107           White  04/2020
4  Albuquerque, NM  Census Tract  35001000107           White  05/2020

   filings_2020  filings_avg last_updated  xcourtcofips
0             8     5.333333   2024-08-10           NaN
1            14     9.000000   2024-08-10           NaN
2            10     5.666667   2024-08-10           NaN
3             5     8.333333   2024-08-10           NaN
4             0     6.666667   2024-08-10           NaN
```

[63]:
```
PIT_2023 = pd.read_excel('PITCOC.xlsb', engine='pyxlsb', sheet_name="2023")
PIT_2023.head()
```

[63]:
```
  CoC Number                                           CoC Name  \
0     AK-500                                      Anchorage CoC
1     AK-501                        Alaska Balance of State CoC
2     AL-500  Birmingham/Jefferson, St. Clair, Shelby Counti…
3     AL-501            Mobile City & County/Baldwin County CoC
4     AL-502                     Florence/Northwest Alabama CoC

              CoC Category                      Count Types  Overall Homeless  \
0  Other Largely Urban CoC  Sheltered and Unsheltered Count            1760.0
1        Largely Rural CoC  Sheltered and Unsheltered Count             854.0
2     Largely Suburban CoC  Sheltered and Unsheltered Count             847.0
3  Other Largely Urban CoC  Sheltered and Unsheltered Count             670.0
4        Largely Rural CoC  Sheltered and Unsheltered Count             195.0

   Overall Homeless - Under 18  Overall Homeless - Age 18 to 24  \
0                        185.0                            161.0
1                        176.0                             66.0
2                         67.0                             42.0
3                        110.0                             19.0
4                         63.0                              9.0
```

```
   Overall Homeless - Age 25 to 34  Overall Homeless - Age 35 to 44  \
0                            377.0                            419.0   
1                            124.0                            190.0   
2                            127.0                            182.0   
3                             78.0                            156.0   
4                             42.0                             36.0   

   Overall Homeless - Age 45 to 54  …  \
0                            315.0  …   
1                            144.0  …   
2                            180.0  …   
3                            120.0  …   
4                             23.0  …   

   Overall Homeless Parenting Youth Age 18-24  \
0                                        10.0   
1                                         8.0   
2                                         2.0   
3                                         2.0   
4                                         4.0   

   Sheltered ES Homeless Parenting Youth Age 18-24  \
0                                              5.0   
1                                              8.0   
2                                              1.0   
3                                              2.0   
4                                              2.0   

   Sheltered TH Homeless Parenting Youth Age 18-24  \
0                                              5.0   
1                                              0.0   
2                                              1.0   
3                                              0.0   
4                                              0.0   

   Sheltered Total Homeless Parenting Youth Age 18-24  \
0                                               10.0   
1                                                8.0   
2                                                2.0   
3                                                2.0   
4                                                2.0   

   Unsheltered Homeless Parenting Youth Age 18-24  \
0                                             0.0   
1                                             0.0   
2                                             0.0   
```

```
3                                             0.0
4                                             2.0

   Overall Homeless Children of Parenting Youth  \
0                                          10.0
1                                           7.0
2                                           2.0
3                                           2.0
4                                           4.0

   Sheltered ES Homeless Children of Parenting Youth  \
0                                                5.0
1                                                7.0
2                                                1.0
3                                                2.0
4                                                2.0

   Sheltered TH Homeless Children of Parenting Youth  \
0                                                5.0
1                                                0.0
2                                                1.0
3                                                0.0
4                                                0.0

   Sheltered Total Homeless Children of Parenting Youth  \
0                                               10.0
1                                                7.0
2                                                2.0
3                                                2.0
4                                                2.0

   Unsheltered Homeless Children of Parenting Youth
0                                               0.0
1                                               0.0
2                                               0.0
3                                               0.0
4                                               2.0

[5 rows x 645 columns]
```

```
[64]: eviction.head()
```

```
[64]:
                city          type        GEOID racial_majority    month  \
0  Albuquerque, NM  Census Tract  35001000107           White  01/2020
1  Albuquerque, NM  Census Tract  35001000107           White  02/2020
2  Albuquerque, NM  Census Tract  35001000107           White  03/2020
3  Albuquerque, NM  Census Tract  35001000107           White  04/2020
```

```
4  Albuquerque, NM  Census Tract  35001000107          White  05/2020

   filings_2020  filings_avg last_updated  xcourtcofips
0             8     5.333333   2024-08-10           NaN
1            14     9.000000   2024-08-10           NaN
2            10     5.666667   2024-08-10           NaN
3             5     8.333333   2024-08-10           NaN
4             0     6.666667   2024-08-10           NaN
```

```
[65]: ## column names check (1 point)
```

```
[66]: eviction.columns
```

```
[66]: Index(['city', 'type', 'GEOID', 'racial_majority', 'month', 'filings_2020',
             'filings_avg', 'last_updated', 'xcourtcofips'],
            dtype='object')
```

```
[67]: # remove GEOID, last_updated, and xcourtcofips because they're not useful for␣
        ↪merging or relevant
      eviction = eviction.drop(["GEOID", "last_updated", "xcourtcofips"], axis=1)
      eviction.columns
```

```
[67]: Index(['city', 'type', 'racial_majority', 'month', 'filings_2020',
             'filings_avg'],
            dtype='object')
```

```
[68]: len(PIT_2023.columns) # len because there's a lot
```

```
[68]: 645
```

```
[69]: new_cols = PIT_2023.columns[0:25] # columns after 25 talk about sheltered and␣
        ↪unsheltered
      PIT_sliced = PIT_2023[new_cols][0:386] # truncating rows
      PIT_sliced = PIT_sliced.drop("Count Types", axis=1)
      PIT_sliced.head()
```

```
[69]:   CoC Number                                           CoC Name  \
      0     AK-500                                      Anchorage CoC
      1     AK-501                            Alaska Balance of State CoC
      2     AL-500  Birmingham/Jefferson, St. Clair, Shelby Counti…
      3     AL-501              Mobile City & County/Baldwin County CoC
      4     AL-502                         Florence/Northwest Alabama CoC

                  CoC Category  Overall Homeless  Overall Homeless - Under 18  \
      0  Other Largely Urban CoC            1760.0                        185.0
      1        Largely Rural CoC             854.0                        176.0
      2     Largely Suburban CoC             847.0                         67.0
      3  Other Largely Urban CoC             670.0                        110.0
```

```
4       Largely Rural CoC            195.0                        63.0

   Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
0                            161.0                            377.0
1                             66.0                            124.0
2                             42.0                            127.0
3                             19.0                             78.0
4                              9.0                             42.0

   Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
0                            419.0                            315.0
1                            190.0                            144.0
2                            182.0                            180.0
3                            156.0                            120.0
4                             36.0                             23.0

   Overall Homeless - Age 55 to 64  …  \
0                            223.0  …
1                            123.0  …
2                            187.0  …
3                            140.0  …
4                             16.0  …

   Overall Homeless - Gender that is not Singularly Female or Male  \
0                                                3.0
1                                                2.0
2                                                1.0
3                                                2.0
4                                                0.0

   Overall Homeless - Gender Questioning  \
0                                    2.0
1                                    0.0
2                                    0.0
3                                    0.0
4                                    0.0

   Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
0                                             1638.0
1                                              717.0
2                                              822.0
3                                              655.0
4                                              186.0

   Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
0                                       122.0                     480.0
1                                       137.0                     316.0
```

```
2                                        25.0                     295.0
3                                        15.0                     281.0
4                                         9.0                     130.0

   Overall Homeless - Black, African American, or African  \
0                                              156.0
1                                               25.0
2                                              518.0
3                                              351.0
4                                               48.0

   Overall Homeless - Asian or Asian American  \
0                                        28.0
1                                        10.0
2                                         1.0
3                                         2.0
4                                         0.0

   Overall Homeless - American Indian, Alaska Native, or Indigenous  \
0                                              755.0
1                                              396.0
2                                               14.0
3                                               11.0
4                                                2.0

   Overall Homeless - Native Hawaiian or Other Pacific Islander  \
0                                               83.0
1                                               16.0
2                                                2.0
3                                                6.0
4                                                0.0

   Overall Homeless - Multiple Races
0                              258.0
1                               91.0
2                               17.0
3                               19.0
4                               15.0

[5 rows x 24 columns]
```

[70]:

```
## missing data check (1 point)
```

[71]:

```
eviction_cols = eviction.columns
for col in eviction_cols:
    slice = eviction[str(col)]
    if slice.hasnans:
        print(f"{str(col)} " + f"({len(slice.unique())})" + ": " + str(slice.
  ↪unique()))
```

```
racial_majority (5): ['White' 'Other' 'Latinx' nan 'Black']
filings_avg (2775): [ 5.33333333  9.          5.66666667 … 79.25       59.75
 69.25      ]
```

[72]:
```
# we can drop filings_avg since we are calculating the average for the year␣
  ↪later
# we can drop racial_majority since we can supplement it with census data if␣
  ↪need be
eviction = eviction.drop(["filings_avg", "racial_majority"], axis=1)
eviction
```

[72]:
```
                     city          type    month  filings_2020
0        Albuquerque, NM  Census Tract  01/2020             8
1        Albuquerque, NM  Census Tract  02/2020            14
2        Albuquerque, NM  Census Tract  03/2020            10
3        Albuquerque, NM  Census Tract  04/2020             5
4        Albuquerque, NM  Census Tract  05/2020             0
…                     …             …      …            …
598451    Wilmington, DE  Census Tract  04/2024             1
598452    Wilmington, DE  Census Tract  05/2024             9
598453    Wilmington, DE  Census Tract  06/2024             3
598454    Wilmington, DE  Census Tract  07/2024             5
598455    Wilmington, DE  Census Tract  08/2024             1

[598456 rows x 4 columns]
```

[73]:
```
# replacing NaN with zero because values are not categorical
PIT_sliced = PIT_sliced.fillna(0)
PIT_sliced.head()
```

[73]:
```
  CoC Number                                           CoC Name  \
0     AK-500                                      Anchorage CoC
1     AK-501                         Alaska Balance of State CoC
2     AL-500  Birmingham/Jefferson, St. Clair, Shelby Counti…
3     AL-501            Mobile City & County/Baldwin County CoC
4     AL-502                        Florence/Northwest Alabama CoC

              CoC Category  Overall Homeless  Overall Homeless - Under 18  \
0  Other Largely Urban CoC            1760.0                        185.0
1        Largely Rural CoC             854.0                        176.0
2     Largely Suburban CoC             847.0                         67.0
3  Other Largely Urban CoC             670.0                        110.0
4        Largely Rural CoC             195.0                         63.0

   Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
0                            161.0                            377.0
1                             66.0                            124.0
2                             42.0                            127.0
3                             19.0                             78.0
4                              9.0                             42.0

   Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
0                            419.0                            315.0
1                            190.0                            144.0
2                            182.0                            180.0
3                            156.0                            120.0
4                             36.0                             23.0

   Overall Homeless - Age 55 to 64  …  \
0                            223.0  …
1                            123.0  …
2                            187.0  …
3                            140.0  …
4                             16.0  …

   Overall Homeless - Gender that is not Singularly Female or Male  \
0                                                3.0
1                                                2.0
2                                                1.0
3                                                2.0
4                                                0.0

   Overall Homeless - Gender Questioning  \
0                                    2.0
1                                    0.0
2                                    0.0
3                                    0.0
4                                    0.0

   Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
0                                             1638.0
1                                              717.0
2                                              822.0
3                                              655.0
4                                              186.0

   Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
0                                       122.0                     480.0
1                                       137.0                     316.0
2                                        25.0                     295.0
3                                        15.0                     281.0
4                                         9.0                     130.0
```

```
   Overall Homeless - Black, African American, or African  \
0                                              156.0
1                                               25.0
2                                              518.0
3                                              351.0
4                                               48.0

   Overall Homeless - Asian or Asian American  \
0                                        28.0
1                                        10.0
2                                         1.0
3                                         2.0
4                                         0.0

   Overall Homeless - American Indian, Alaska Native, or Indigenous  \
0                                              755.0
1                                              396.0
2                                               14.0
3                                               11.0
4                                                2.0

   Overall Homeless - Native Hawaiian or Other Pacific Islander  \
0                                               83.0
1                                               16.0
2                                                2.0
3                                                6.0
4                                                0.0

   Overall Homeless - Multiple Races
0                              258.0
1                               91.0
2                               17.0
3                               19.0
4                               15.0

[5 rows x 24 columns]
```

```
[74]: ## Outlier check (1 point)
```

```
[75]: PIT_sliced.describe()
```

```
[75]:        Overall Homeless  Overall Homeless - Under 18  \
      count         386.000000                   386.000000
      mean         3383.958549                   578.341969
      std         33685.071349                  5823.125602
      min            55.000000                     1.000000
```

```
25%          337.000000                    53.000000
50%          656.500000                   109.500000
75%         1549.250000                   226.750000
max       653104.000000                111620.000000

       Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
count                       386.000000                       386.000000
mean                        245.782383                       575.139896
std                        2462.595873                      5768.223300
min                           2.000000                         5.000000
25%                          21.000000                        52.250000
50%                          44.000000                       107.000000
75%                         102.000000                       244.500000
max                       47436.000000                    111002.000000

       Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
count                       386.000000                       386.000000
mean                        618.119171                       504.088083
std                        6160.189569                      5011.779805
min                           0.000000                         0.000000
25%                          60.000000                        48.000000
50%                         120.500000                        99.500000
75%                         285.500000                       233.000000
max                      119297.000000                     97289.000000

       Overall Homeless - Age 55 to 64  Overall Homeless - Over 64  \
count                       386.000000                  386.000000
mean                        469.958549                  191.735751
std                        4672.930049                 1905.210525
min                           0.000000                    0.000000
25%                          41.250000                   16.000000
50%                          89.500000                   36.000000
75%                         216.750000                   88.500000
max                       90702.000000                37005.000000

       Overall Homeless - Female  Overall Homeless - Male  …  \
count                 386.000000               386.000000  …
mean                 1295.383420              2047.461140  …
std                 12896.424039             20384.594635  …
min                    20.000000                23.000000  …
25%                   134.250000               190.500000  …
50%                   255.000000               389.000000  …
75%                   569.500000               890.500000  …
max                250009.000000            395160.000000  …

       Overall Homeless - Gender that is not Singularly Female or Male  \
count                                         386.000000
```

```
mean                                             16.005181
std                                             160.203799
min                                               0.000000
25%                                               0.000000
50%                                               2.000000
75%                                               6.000000
max                                            3089.000000

       Overall Homeless - Gender Questioning  \
count                             386.000000
mean                                3.932642
std                                39.295757
min                                 0.000000
25%                                 0.000000
50%                                 0.000000
75%                                 1.000000
max                               759.000000

       Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
count                                         386.000000
mean                                         2454.756477
std                                         24261.167747
min                                            17.000000
25%                                           292.000000
50%                                           565.500000
75%                                          1197.000000
max                                        473768.000000

       Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
count                                  386.000000                386.000000
mean                                   929.202073               1683.181347
std                                   9548.451413              16621.001323
min                                      0.000000                  9.000000
25%                                     23.250000                156.750000
50%                                     68.000000                344.000000
75%                                    221.750000                821.000000
max                                 179336.000000             324854.000000

       Overall Homeless - Black, African American, or African  \
count                                         386.000000
mean                                         1262.300518
std                                         12835.350265
min                                             0.000000
25%                                            70.000000
50%                                           177.500000
75%                                           436.000000
max                                        243624.000000
```

```
       Overall Homeless - Asian or Asian American  \
count                                  386.000000
mean                                    59.968912
std                                    622.043861
min                                      0.000000
25%                                      1.000000
50%                                      4.000000
75%                                     11.000000
max                                  11574.000000

       Overall Homeless - American Indian, Alaska Native, or Indigenous  \
count                                         386.000000
mean                                          119.772021
std                                          1188.048176
min                                             0.000000
25%                                             2.000000
50%                                            10.000000
75%                                            35.750000
max                                          23116.000000

       Overall Homeless - Native Hawaiian or Other Pacific Islander  \
count                                         386.000000
mean                                           55.502591
std                                           561.061296
min                                             0.000000
25%                                             0.000000
50%                                             2.000000
75%                                             9.000000
max                                         10712.000000

       Overall Homeless - Multiple Races
count                         386.000000
mean                          203.233161
std                          2022.758577
min                             0.000000
25%                            13.000000
50%                            28.000000
75%                            75.750000
max                         39224.000000

[8 rows x 21 columns]
```

[76]:

```
# the max seems quite high for overall homeless
max = PIT_sliced["Overall Homeless"].idxmax()
PIT_sliced.loc[[max]]
```

[76]:

```
    CoC Number CoC Name CoC Category  Overall Homeless  \
385          0    Total            0          653104.0   

     Overall Homeless - Under 18  Overall Homeless - Age 18 to 24  \
385                     111620.0                          47436.0   

     Overall Homeless - Age 25 to 34  Overall Homeless - Age 35 to 44  \
385                         111002.0                         119297.0   

     Overall Homeless - Age 45 to 54  Overall Homeless - Age 55 to 64  …  \
385                          97289.0                          90702.0  …   

     Overall Homeless - Gender that is not Singularly Female or Male  \
385                                             3089.0                   

     Overall Homeless - Gender Questioning  \
385                                  759.0   

     Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
385                                            473768.0   

     Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
385                                    179336.0                  324854.0   

     Overall Homeless - Black, African American, or African  \
385                                            243624.0        

     Overall Homeless - Asian or Asian American  \
385                                     11574.0   

     Overall Homeless - American Indian, Alaska Native, or Indigenous  \
385                                            23116.0                    

     Overall Homeless - Native Hawaiian or Other Pacific Islander  \
385                                            10712.0                

     Overall Homeless - Multiple Races  
385                            39224.0  

[1 rows x 24 columns]
```

[77]:

```python
# these are totals, so it's okay to remove
PIT_sliced = PIT_sliced.drop(max)
PIT_sliced.describe()
```

[77]:

```
       Overall Homeless  Overall Homeless - Under 18  \
count        385.000000                   385.000000   
```

```
mean        1696.374026                   289.922078
std         5955.731326                  1343.006959
min           55.000000                     1.000000
25%          337.000000                    53.000000
50%          653.000000                   109.000000
75%         1532.000000                   226.000000
max        88025.000000                 25200.000000

       Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
count                        385.00000                       385.000000
mean                         123.21039                       288.316883
std                          515.60255                      1233.336451
min                            2.00000                         5.000000
25%                           21.00000                        52.000000
50%                           44.00000                       107.000000
75%                          102.00000                       240.000000
max                         9130.00000                     19577.000000

       Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
count                       385.000000                       385.000000
mean                        309.862338                       252.698701
std                        1128.114723                       852.013239
min                           0.000000                         0.000000
25%                          60.000000                        48.000000
50%                         120.000000                        99.000000
75%                         284.000000                       230.000000
max                       16597.000000                     13475.000000

       Overall Homeless - Age 55 to 64  Overall Homeless - Over 64  \
count                       385.000000                  385.000000
mean                        235.589610                   96.116883
std                         797.125492                  317.653276
min                           0.000000                    0.000000
25%                          41.000000                   16.000000
50%                          89.000000                   36.000000
75%                         216.000000                   87.000000
max                       12841.000000                 4721.000000

       Overall Homeless - Female  Overall Homeless - Male  …  \
count                 385.000000               385.000000  …
mean                  649.374026              1026.389610  …
std                  2289.696403              3623.145956  …
min                    20.000000                23.000000  …
25%                   134.000000               190.000000  …
50%                   254.000000               389.000000  …
75%                   568.000000               880.000000  …
max                 37788.000000             49650.000000  …
```

```
       Overall Homeless - Gender that is not Singularly Female or Male  \
count                                         385.000000
mean                                            8.023377
std                                            32.806995
min                                             0.000000
25%                                             0.000000
50%                                             2.000000
75%                                             6.000000
max                                           570.000000

       Overall Homeless - Gender Questioning  \
count                              385.000000
mean                                 1.971429
std                                  7.721164
min                                  0.000000
25%                                  0.000000
50%                                  0.000000
75%                                  1.000000
max                                110.000000

       Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
count                                         385.000000
mean                                         1230.566234
std                                          3186.678681
min                                            17.000000
25%                                           292.000000
50%                                           565.000000
75%                                          1194.000000
max                                         41029.000000

       Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
count                                  385.000000                385.000000
mean                                   465.807792                843.776623
std                                   2882.200067               2071.985499
min                                      0.000000                  9.000000
25%                                     23.000000                156.000000
50%                                     68.000000                342.000000
75%                                    221.000000                809.000000
max                                  46996.000000              28624.000000

       Overall Homeless - Black, African American, or African  \
count                                         385.000000
mean                                          632.789610
std                                          3436.753939
min                                             0.000000
25%                                            70.000000
```

```
50%                                           174.000000
75%                                           436.000000
max                                         59292.000000

       Overall Homeless - Asian or Asian American  \
count                                  385.000000
mean                                    30.062338
std                                    204.468891
min                                      0.000000
25%                                      1.000000
50%                                      4.000000
75%                                     11.000000
max                                   3773.000000

       Overall Homeless - American Indian, Alaska Native, or Indigenous  \
count                                         385.000000
mean                                           60.041558
std                                           185.485240
min                                             0.000000
25%                                             2.000000
50%                                            10.000000
75%                                            35.000000
max                                          2700.000000

       Overall Homeless - Native Hawaiian or Other Pacific Islander  \
count                                         385.000000
mean                                           27.823377
std                                           138.238208
min                                             0.000000
25%                                             0.000000
50%                                             2.000000
75%                                             9.000000
max                                          1683.000000

       Overall Homeless - Multiple Races
count                         385.000000
mean                          101.880519
std                           356.021559
min                             0.000000
25%                            13.000000
50%                            28.000000
75%                            75.000000
max                          4888.000000

[8 rows x 21 columns]
```

```
[78]: eviction.describe()
```

```
[78]:         filings_2020
       count  598456.000000
       mean        4.744833
       std        86.956711
       min         0.000000
       25%         0.000000
       50%         1.000000
       75%         3.000000
       max     14556.000000
```

```
[79]: max = eviction["filings_2020"].idxmax()
      eviction.loc[[max]] # this makes sense, no need to remove
```

```
[79]:                  city      type    month  filings_2020
      460830  New York, NY  Zip Code  01/2020         14556
```

```
[80]: ## data merging (1 point)
```

```
[81]: # remove data from eviction that is not from 2023
      eviction_2023 = eviction[eviction['month'].str.contains('2023')]
      eviction_2023["month"].unique()
```

```
[81]: array(['01/2023', '02/2023', '03/2023', '04/2023', '05/2023', '06/2023',
             '07/2023', '08/2023', '09/2023', '10/2023', '11/2023', '12/2023'],
            dtype=object)
```

```
[82]: eviction_city = eviction_2023.groupby("city").mean(numeric_only=True)
      eviction_city = eviction_city.reset_index()
      eviction_city['state'] = eviction_city['city'].str[-2:]
      eviction_city["state"][10] = "FL" # ft. lauderdale was mislabeled
      eviction_city["state"][20] = "FL" # miami was mislabeled
      eviction_city["state"][26] = "FL" # palm beach was mislabeled
      eviction_city
```

```
/var/folders/nw/5zcrqdxs7c57b12ptv8284p80000gn/T/ipykernel_1500/372597069.py:4:
SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy

/var/folders/nw/5zcrqdxs7c57b12ptv8284p80000gn/T/ipykernel_1500/372597069.py:5:
SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame
```

```
See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy

/var/folders/nw/5zcrqdxs7c57b12ptv8284p80000gn/T/ipykernel_1500/372597069.py:6:
SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

[82]:

```
                           city  filings_2020 state
0             Albuquerque, NM      4.560734    NM
1                  Austin, TX      8.560688    TX
2                  Boston, MA      2.673019    MA
3              Bridgeport, CT      1.642178    CT
4              Charleston, SC      8.527500    SC
5              Cincinnati, OH      4.695301    OH
6               Cleveland, OH      3.372671    OH
7                Columbus, OH      6.018744    OH
8                  Dallas, TX      4.892802    TX
9              Fort Worth, TX      5.956454    TX
10            Ft. Lauderdale      3.701754    FL
11            Gainesville, FL      3.346045    FL
12             Greenville, SC     10.136425    SC
13               Hartford, CT      2.340749    CT
14                Houston, TX      5.739814    TX
15           Indianapolis, IN      8.988517    IN
16           Jacksonville, FL      5.681818    FL
17            Kansas City, MO      3.308114    MO
18              Las Vegas, NV      8.877954    NV
19                Memphis, TX     10.232667    TN
20                      Miami      2.313795    FL
21              Milwaukee, WI      3.814631    WI
22   Minneapolis-Saint Paul, MN      2.767266    MN
23              Nashville, TN     19.700893    TN
24            New Orleans, LA      2.615489    LA
25               New York, NY     36.728682    NY
26                 Palm Beach      2.003788    FL
27           Philadelphia, PA      2.681133    PA
28                Phoenix, AZ     35.612973    AZ
29             Pittsburgh, PA      7.492009    PA
30             Providence, RI      3.785959    RI
31               Richmond, VA     42.004167    VA
```

```
32            South Bend, IN     2.735944   IN
33              St Louis, MO     3.816227   MO
34                 Tampa, FL     2.764184   FL
35            Wilmington, DE     4.833904   DE
```

[83]:

```
PIT_sliced_state = PIT_sliced[PIT_sliced['CoC Name'].str.contains('State')]
PIT_sliced_state['state'] = PIT_sliced_state['CoC Number'].str[0:2]
PIT_sliced_state.head()
```

```
/var/folders/nw/5zcrqdxs7c57b12ptv8284p80000gn/T/ipykernel_1500/2207987685.py:2:
SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

[83]:

```
   CoC Number                        CoC Name       CoC Category  \
1      AK-501      Alaska Balance of State CoC  Largely Rural CoC
9      AL-507     Alabama Balance of State CoC  Largely Rural CoC
12     AR-503  Arkansas  Balance of State  CoC  Largely Rural CoC
15     AZ-500     Arizona Balance of State CoC  Largely Rural CoC
62     CO-500    Colorado Balance of State CoC  Largely Rural CoC

    Overall Homeless  Overall Homeless - Under 18  \
1              854.0                        176.0
9              283.0                         77.0
12             871.0                         91.0
15            2386.0                        295.0
62            2201.0                        203.0

    Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
1                              66.0                            124.0
9                              25.0                             53.0
12                             66.0                            161.0
15                            117.0                            317.0
62                            120.0                            394.0

    Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
1                             190.0                            144.0
9                              60.0                             38.0
12                            196.0                            190.0
15                            447.0                            473.0
62                            495.0                            460.0
```

```
    Overall Homeless - Age 55 to 64  …  \
1                             123.0  …
9                              13.0  …
12                            133.0  …
15                            457.0  …
62                            380.0  …

    Overall Homeless - Gender Questioning  \
1                                     0.0
9                                     4.0
12                                    3.0
15                                    5.0
62                                    2.0

    Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
1                                               717.0
9                                               258.0
12                                              832.0
15                                             1798.0
62                                             1577.0

    Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
1                                        137.0                     316.0
9                                         25.0                      91.0
12                                        39.0                     619.0
15                                       588.0                    1662.0
62                                       624.0                    1660.0

    Overall Homeless - Black, African American, or African  \
1                                                25.0
9                                               170.0
12                                              233.0
15                                              142.0
62                                               90.0

    Overall Homeless - Asian or Asian American  \
1                                         10.0
9                                          0.0
12                                         2.0
15                                        14.0
62                                         8.0

    Overall Homeless - American Indian, Alaska Native, or Indigenous  \
1                                               396.0
9                                                 1.0
12                                                3.0
15                                              266.0
```

```
62                                              217.0

    Overall Homeless - Native Hawaiian or Other Pacific Islander  \
1                                                16.0
9                                                 0.0
12                                                5.0
15                                               16.0
62                                               10.0

    Overall Homeless - Multiple Races  state
1                               91.0     AK
9                               21.0     AL
12                               9.0     AR
15                             286.0     AZ
62                             216.0     CO

[5 rows x 25 columns]
```

```
[84]: merge = pd.merge(PIT_sliced_state, eviction_city, on = "state")
      merge.head()
```

```
[84]:   CoC Number                          CoC Name          CoC Category  \
      0     AZ-500      Arizona Balance of State CoC     Largely Rural CoC
      1     CT-505  Connecticut Balance of State CoC  Largely Suburban CoC
      2     CT-505  Connecticut Balance of State CoC  Largely Suburban CoC
      3     DE-500            Delaware Statewide CoC  Largely Suburban CoC
      4     IN-502      Indiana Balance of State CoC     Largely Rural CoC

         Overall Homeless  Overall Homeless - Under 18  \
      0            2386.0                        295.0
      1            2418.0                        454.0
      2            2418.0                        454.0
      3            1245.0                        335.0
      4            4398.0                        923.0

         Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
      0                            117.0                            317.0
      1                            190.0                            378.0
      2                            190.0                            378.0
      3                             66.0                            195.0
      4                            238.0                            709.0

         Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
      0                            447.0                            473.0
      1                            430.0                            393.0
      2                            430.0                            393.0
      3                            189.0                            193.0
```

```
4                            848.0                            789.0

   Overall Homeless - Age 55 to 64  …  \
0                            457.0  …
1                            431.0  …
2                            431.0  …
3                            211.0  …
4                            704.0  …

   Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
0                                       588.0                    1662.0
1                                       730.0                    1381.0
2                                       730.0                    1381.0
3                                       107.0                     385.0
4                                       221.0                    3018.0

   Overall Homeless - Black, African American, or African  \
0                                                   142.0
1                                                   832.0
2                                                   832.0
3                                                   773.0
4                                                  1113.0

   Overall Homeless - Asian or Asian American  \
0                                        14.0
1                                        12.0
2                                        12.0
3                                         4.0
4                                        19.0

   Overall Homeless - American Indian, Alaska Native, or Indigenous  \
0                                              266.0
1                                               33.0
2                                               33.0
3                                                3.0
4                                               20.0

   Overall Homeless - Native Hawaiian or Other Pacific Islander  \
0                                               16.0
1                                                6.0
2                                                6.0
3                                                2.0
4                                               30.0

   Overall Homeless - Multiple Races  state              city  filings_2020
0                              286.0     AZ       Phoenix, AZ     35.612973
1                              154.0     CT    Bridgeport, CT      1.642178
```

```
2                             154.0     CT      Hartford, CT      2.340749
3                              78.0     DE    Wilmington, DE      4.833904
4                             198.0     IN  Indianapolis, IN      8.988517

[5 rows x 27 columns]
```

[85]:

```
PIT_sliced
```

[85]:

```
    CoC Number                                          CoC Name  \
0       AK-500                                     Anchorage CoC
1       AK-501                     Alaska Balance of State CoC
2       AL-500  Birmingham/Jefferson, St. Clair, Shelby Counti…
3       AL-501             Mobile City & County/Baldwin County CoC
4       AL-502                   Florence/Northwest Alabama CoC
..         …                                                 …
380     WV-500                      Wheeling, Weirton Area CoC
381     WV-501             Huntington/Cabell, Wayne Counties CoC
382     WV-503  Charleston/Kanawha, Putnam, Boone, Clay Counti…
383     WV-508                West Virginia Balance of State CoC
384     WY-500                          Wyoming Statewide CoC

               CoC Category  Overall Homeless  Overall Homeless - Under 18  \
0    Other Largely Urban CoC            1760.0                        185.0
1          Largely Rural CoC             854.0                        176.0
2       Largely Suburban CoC             847.0                         67.0
3    Other Largely Urban CoC             670.0                        110.0
4          Largely Rural CoC             195.0                         63.0
..                        …                 …                            …
380        Largely Rural CoC             113.0                         37.0
381        Largely Rural CoC             244.0                         18.0
382     Largely Suburban CoC             293.0                         20.0
383        Largely Rural CoC             766.0                         50.0
384        Largely Rural CoC             532.0                         37.0

     Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
0                              161.0                            377.0
1                               66.0                            124.0
2                               42.0                            127.0
3                               19.0                             78.0
4                                9.0                             42.0
..                                 …                                …
380                              3.0                             23.0
381                             19.0                             51.0
382                             40.0                             53.0
383                             74.0                            168.0
384                             62.0                             73.0
```

```
     Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
0                              419.0                            315.0
1                              190.0                            144.0
2                              182.0                            180.0
3                              156.0                            120.0
4                               36.0                             23.0
..                               …                              …
380                             24.0                             16.0
381                             72.0                             53.0
382                             66.0                             72.0
383                            209.0                            148.0
384                            116.0                            126.0

     Overall Homeless - Age 55 to 64  …  \
0                              223.0  …
1                              123.0  …
2                              187.0  …
3                              140.0  …
4                               16.0  …
..                               …  …
380                              9.0  …
381                             25.0  …
382                             28.0  …
383                             78.0  …
384                             75.0  …

     Overall Homeless - Gender that is not Singularly Female or Male  \
0                                                  3.0
1                                                  2.0
2                                                  1.0
3                                                  2.0
4                                                  0.0
..                                                 …
380                                                0.0
381                                                0.0
382                                                0.0
383                                                5.0
384                                                1.0

     Overall Homeless - Gender Questioning  \
0                                      2.0
1                                      0.0
2                                      0.0
3                                      0.0
4                                      0.0
..                                     …
380                                    0.0
```

```
381                                    0.0
382                                    0.0
383                                    4.0
384                                    1.0

     Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
0                                               1638.0
1                                                717.0
2                                                822.0
3                                                655.0
4                                                186.0
..                                                 …
380                                              113.0
381                                              238.0
382                                              292.0
383                                              750.0
384                                              462.0

     Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
0                                         122.0                     480.0
1                                         137.0                     316.0
2                                          25.0                     295.0
3                                          15.0                     281.0
4                                           9.0                     130.0
..                                          …                       …
380                                         0.0                      83.0
381                                         6.0                     206.0
382                                         1.0                     230.0
383                                        16.0                     691.0
384                                        70.0                     419.0

     Overall Homeless - Black, African American, or African  \
0                                                156.0
1                                                 25.0
2                                                518.0
3                                                351.0
4                                                 48.0
..                                                 …
380                                               17.0
381                                               19.0
382                                               42.0
383                                               59.0
384                                               47.0

     Overall Homeless - Asian or Asian American  \
0                                          28.0
1                                          10.0
```

```
2                                            1.0
3                                            2.0
4                                            0.0
..                                          …
380                                          0.0
381                                          2.0
382                                          0.0
383                                          0.0
384                                         14.0

     Overall Homeless - American Indian, Alaska Native, or Indigenous  \
0                                                  755.0
1                                                  396.0
2                                                   14.0
3                                                   11.0
4                                                    2.0
..                                                 …
380                                                  4.0
381                                                  3.0
382                                                  0.0
383                                                  4.0
384                                                 22.0

     Overall Homeless - Native Hawaiian or Other Pacific Islander  \
0                                                   83.0
1                                                   16.0
2                                                    2.0
3                                                    6.0
4                                                    0.0
..                                                 …
380                                                  0.0
381                                                  1.0
382                                                  0.0
383                                                  1.0
384                                                  2.0

     Overall Homeless - Multiple Races
0                                258.0
1                                 91.0
2                                 17.0
3                                 19.0
4                                 15.0
..                                 …
380                                9.0
381                               13.0
382                               21.0
383                               11.0
```

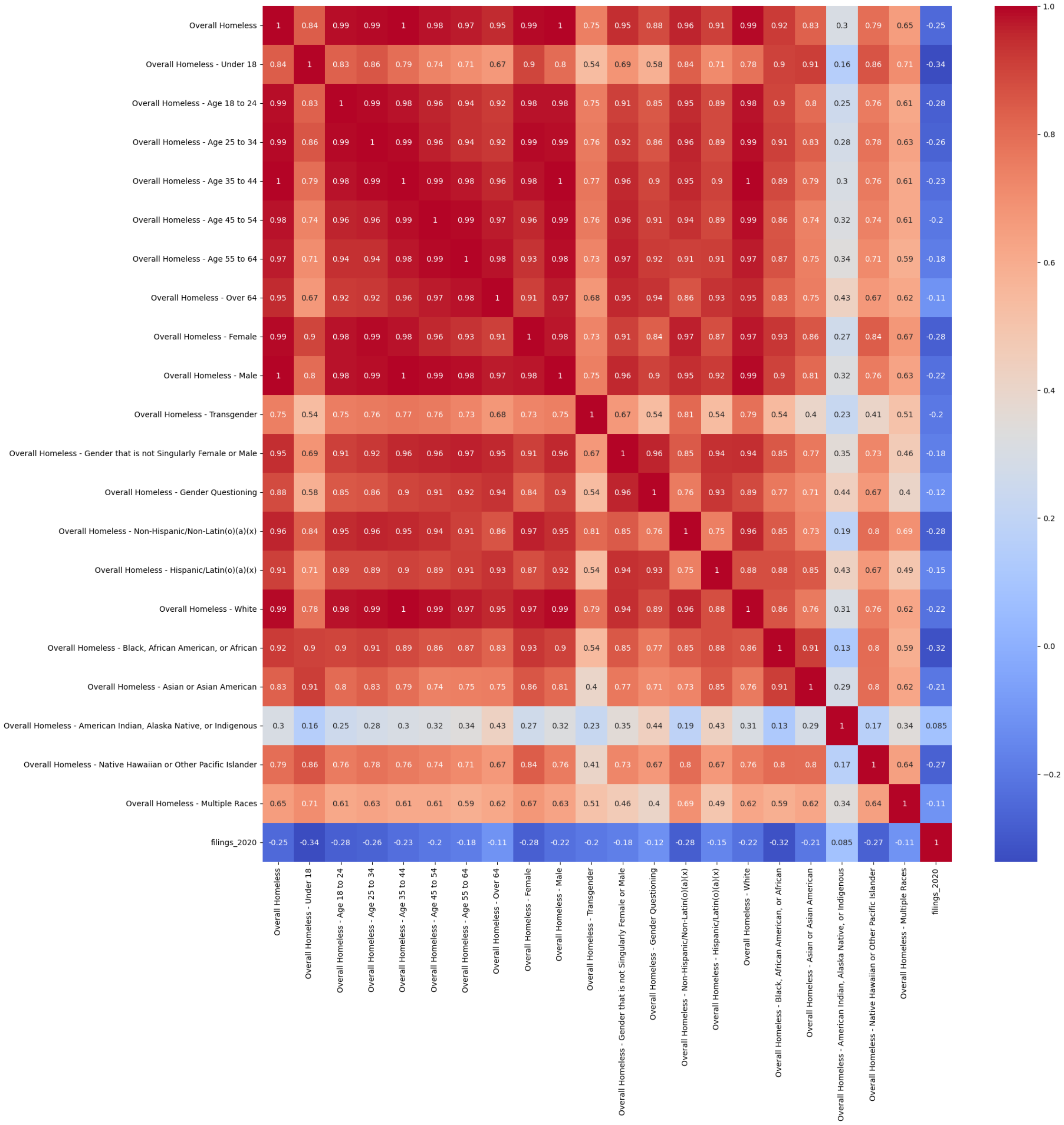
```
384                             28.0

[385 rows x 24 columns]
```

[86]:
```
## data transformation, normalization, and cleaning (1 point)
```

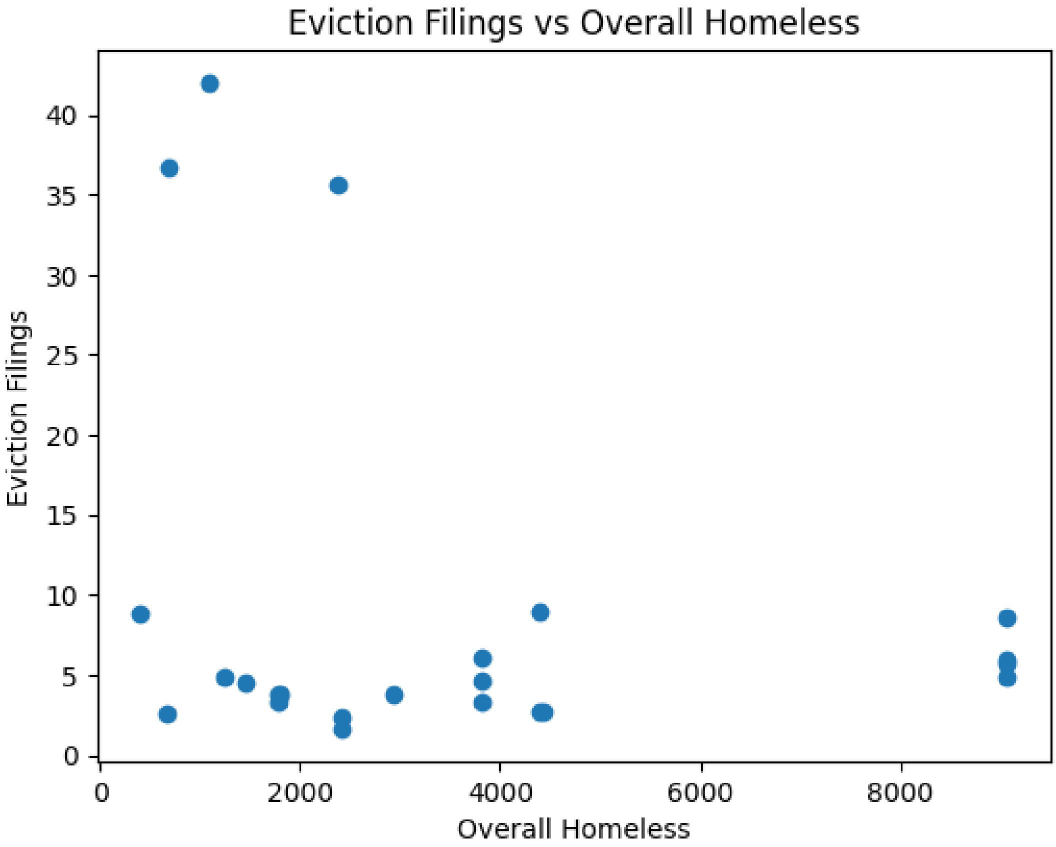
[87]:
```
# sets up data for corrplots and purely quantitative analysis
merge_numeric = merge.select_dtypes(include=[np.number])
```

[88]:
```
## Exploratory data visualization (1 point)
```

[89]:
```
plt.figure(figsize=(20,20))
sns.heatmap(data=merge_numeric.corr(), annot=True, cmap='coolwarm')
plt.show()
```



[90]:
```
import matplotlib.pyplot as plt
plt.scatter(x=merge["Overall Homeless"], y=merge["filings_2020"])
plt.ylabel("Eviction Filings")
plt.xlabel("Overall Homeless")
plt.title("Eviction Filings vs Overall Homeless")
plt.show()
```



High multicollinearity & low n, unfit for regression or advanced models.

1.3 Part 2: Answer questions from the proposals (8 points)

Each plot should be followed by a paragraph of explanation and observation.

1.3.1 Creator: Ivy Nangalia

Question: What demographics of people are more likely to be homeless today?

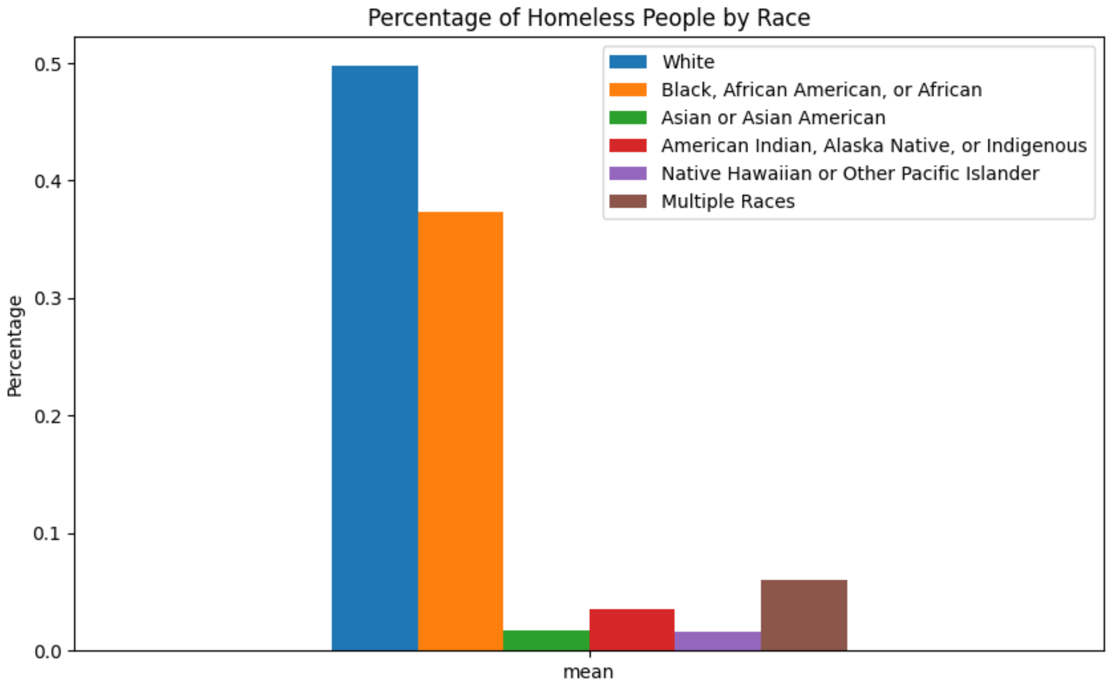
[91]:
```
means = PIT_sliced.describe()[1:2]
race_cols = means.columns[15:22]
```

```
total_sum = means[race_cols].sum(axis=1)
race_percent = means[race_cols].div(total_sum, axis=0)
race_percent.reset_index()
```

```
[91]:   index  Overall Homeless - White  \
      0  mean                    0.4974

         Overall Homeless - Black, African American, or African  \
      0                                           0.373025

         Overall Homeless - Asian or Asian American  \
      0                                    0.017722

         Overall Homeless - American Indian, Alaska Native, or Indigenous  \
      0                                           0.035394

         Overall Homeless - Native Hawaiian or Other Pacific Islander  \
      0                                           0.016402

         Overall Homeless - Multiple Races
      0                            0.060058
```

```
[92]: # renaming columns
      race_percent = race_percent.rename(columns={'Overall Homeless - White': 'White',
                                                  'Overall Homeless - Black, African␣
        ↪American, or African': 'Black, African American, or African',
                                                  'Overall Homeless - Asian or Asian␣
        ↪American': 'Asian or Asian American',
                                                  'Overall Homeless - American␣
        ↪Indian, Alaska Native, or Indigenous': 'American Indian, Alaska Native, or␣
        ↪Indigenous',
                                                  'Overall Homeless - Native Hawaiian␣
        ↪or Other Pacific Islander': 'Native Hawaiian or Other Pacific Islander',
                                                  'Overall Homeless - Multiple Races':
        ↪ 'Multiple Races'})
```

```
[93]: race_percent.plot(kind='bar', figsize=(10, 6))
      plt.ylabel('Percentage')
      plt.title('Percentage of Homeless People by Race')
      plt.xticks(rotation=0)
      plt.show()
```



Answer: It seems that White people have the highest percentage of the homeless population (49.7%) followed closely by Black people (37.3%). White people making up the largest share of the homeless population makes sense since the majority of the American population is White. However, only 13.7% of the population is Black, which implies some disproportionate factors affecting Black people and their housing security. This makes sense considering the long history of racism and racist policies enacted in the United States. Moreover, I'd argue that White people are less likely to be homeless considering that they make up 75.3% of the population but only 49.7% of the homeless population, implying some systemic factors that improve the housing security of White people as compared to others.

Note: the population data is from the US Census.

1.3.2 Interpreter 2: Ximing Sun

Question: What trends do we see in racial segregation?

Answer:

[94]:
```
racial = merge.iloc[:, 16:26]
racial
```

[94]:
```
     Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
0                                               1798.0
1                                               1688.0
2                                               1688.0
3                                               1138.0
```

```
4                                               4177.0
5                                               4177.0
6                                                662.0
7                                               2906.0
8                                               1725.0
9                                               1725.0
10                                               620.0
11                                               349.0
12                                               604.0
13                                              3655.0
14                                              3655.0
15                                              3655.0
16                                              1404.0
17                                              5676.0
18                                              5676.0
19                                              5676.0
20                                              5676.0
21                                              1029.0
22                                              2674.0

    Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
0                                        588.0                    1662.0
1                                        730.0                    1381.0
2                                        730.0                    1381.0
3                                        107.0                     385.0
4                                        221.0                    3018.0
5                                        221.0                    3018.0
6                                         16.0                     273.0
7                                       1526.0                    2153.0
8                                         67.0                    1347.0
9                                         67.0                    1347.0
10                                       828.0                     900.0
11                                        61.0                     361.0
12                                        83.0                     553.0
13                                       168.0                    3027.0
14                                       168.0                    3027.0
15                                       168.0                    3027.0
16                                       406.0                    1140.0
17                                      3389.0                    6533.0
18                                      3389.0                    6533.0
19                                      3389.0                    6533.0
20                                      3389.0                    6533.0
21                                        59.0                     653.0
22                                       266.0                    1933.0

    Overall Homeless - Black, African American, or African  \
0                                                142.0
```

```
1                                               832.0
2                                               832.0
3                                               773.0
4                                              1113.0
5                                              1113.0
6                                               385.0
7                                              1917.0
8                                               328.0
9                                               328.0
10                                              136.0
11                                               16.0
12                                               87.0
13                                              580.0
14                                              580.0
15                                              580.0
16                                              436.0
17                                             2095.0
18                                             2095.0
19                                             2095.0
20                                             2095.0
21                                              366.0
22                                              603.0

    Overall Homeless - Asian or Asian American  \
0                                         14.0   
1                                         12.0   
2                                         12.0   
3                                          4.0   
4                                         19.0   
5                                         19.0   
6                                          1.0   
7                                         78.0   
8                                          5.0   
9                                          5.0   
10                                         4.0   
11                                         3.0   
12                                         1.0   
13                                         7.0   
14                                         7.0   
15                                         7.0   
16                                        12.0   
17                                        59.0   
18                                        59.0   
19                                        59.0   
20                                        59.0   
21                                         6.0   
22                                        35.0   
```

```
    Overall Homeless - American Indian, Alaska Native, or Indigenous  \
0                                               266.0
1                                                33.0
2                                                33.0
3                                                 3.0
4                                                20.0
5                                                20.0
6                                                 4.0
7                                                19.0
8                                                14.0
9                                                14.0
10                                              339.0
11                                               17.0
12                                                3.0
13                                               34.0
14                                               34.0
15                                               34.0
16                                               33.0
17                                              142.0
18                                              142.0
19                                              142.0
20                                              142.0
21                                               13.0
22                                              186.0

    Overall Homeless - Native Hawaiian or Other Pacific Islander  \
0                                                16.0
1                                                 6.0
2                                                 6.0
3                                                 2.0
4                                                30.0
5                                                30.0
6                                                 1.0
7                                                40.0
8                                                23.0
9                                                23.0
10                                                6.0
11                                                0.0
12                                                1.0
13                                               11.0
14                                               11.0
15                                               11.0
16                                                4.0
17                                               33.0
18                                               33.0
19                                               33.0
```

```
20                                               33.0
21                                                0.0
22                                               10.0

    Overall Homeless - Multiple Races state              city
0                               286.0    AZ       Phoenix, AZ
1                               154.0    CT    Bridgeport, CT
2                               154.0    CT      Hartford, CT
3                                78.0    DE    Wilmington, DE
4                               198.0    IN  Indianapolis, IN
5                               198.0    IN    South Bend, IN
6                                14.0    LA   New Orleans, LA
7                               225.0    MA        Boston, MA
8                                75.0    MO   Kansas City, MO
9                                75.0    MO      St Louis, MO
10                               63.0    NM   Albuquerque, NM
11                               13.0    NV     Las Vegas, NV
12                               42.0    NY      New York, NY
13                              164.0    OH    Cincinnati, OH
14                              164.0    OH     Cleveland, OH
15                              164.0    OH      Columbus, OH
16                              185.0    RI    Providence, RI
17                              203.0    TX        Austin, TX
18                              203.0    TX        Dallas, TX
19                              203.0    TX    Fort Worth, TX
20                              203.0    TX       Houston, TX
21                               50.0    VA      Richmond, VA
22                              173.0    WI     Milwaukee, WI
```

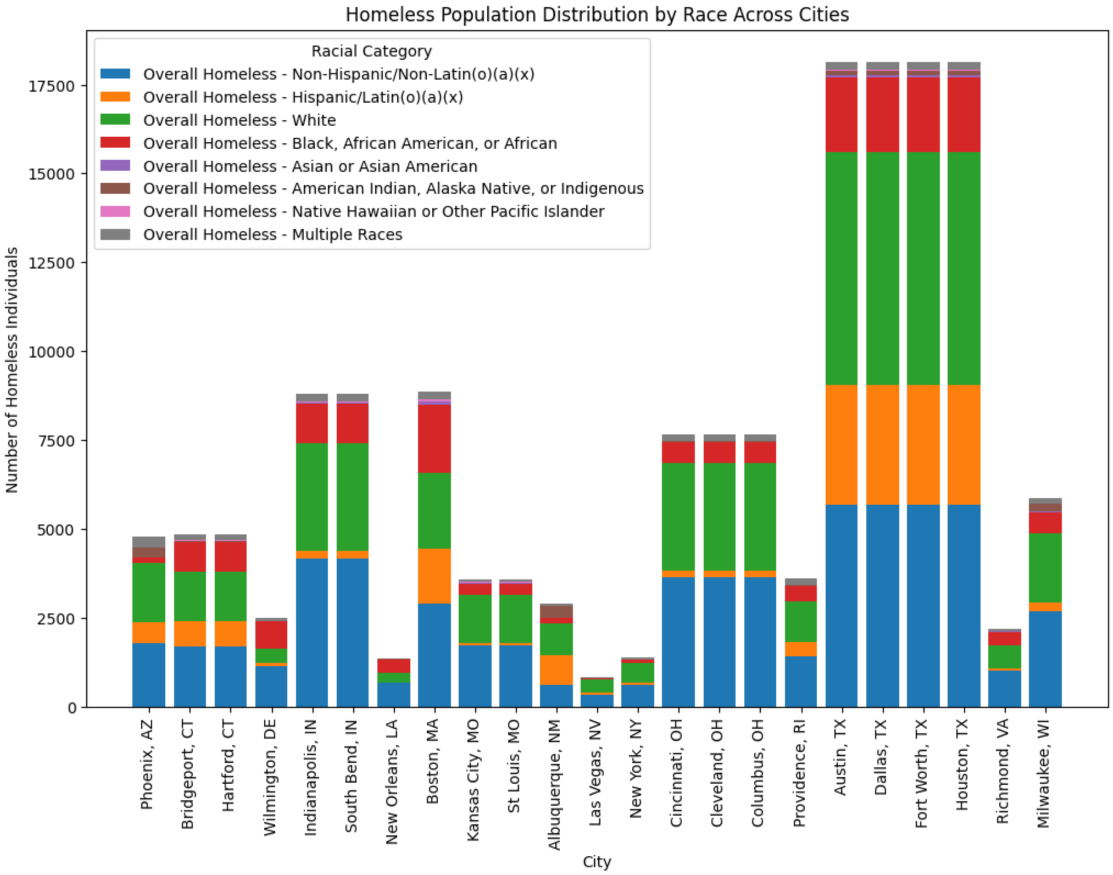
[95]:

```
## Add more cells if your group has more than two interpreters
```

[96]:

```
racial_categories = [
    'Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)',
    'Overall Homeless - Hispanic/Latin(o)(a)(x)',
    'Overall Homeless - White',
    'Overall Homeless - Black, African American, or African',
    'Overall Homeless - Asian or Asian American',
    'Overall Homeless - American Indian, Alaska Native, or Indigenous',
    'Overall Homeless - Native Hawaiian or Other Pacific Islander',
    'Overall Homeless - Multiple Races'
]

fig, ax = plt.subplots(figsize=(12, 8))
for category in racial_categories:
    ax.bar(racial['city'], racial[category], label=category,␣
 ↪bottom=racial[racial_categories].cumsum(axis=1)[category] - racial[category])
```

```
ax.set_xlabel("City")
ax.set_ylabel("Number of Homeless Individuals")
ax.set_title("Homeless Population Distribution by Race Across Cities")
ax.legend(title="Racial Category")
plt.xticks(rotation=90)

plt.show()
```



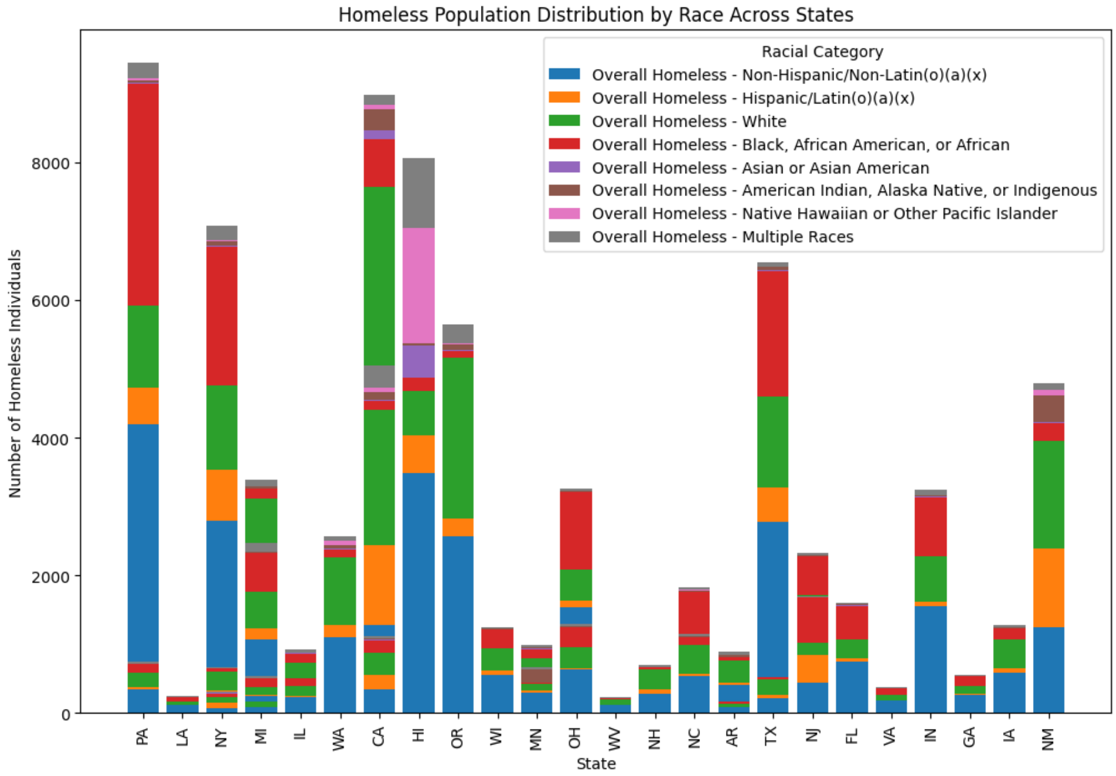
[97]:
```
PIT_sliced["state"] = PIT_sliced["CoC Number"].apply(lambda x: x[:2])

racial_categories = [
    'Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)',
    'Overall Homeless - Hispanic/Latin(o)(a)(x)',
    'Overall Homeless - White',
    'Overall Homeless - Black, African American, or African',
    'Overall Homeless - Asian or Asian American',
    'Overall Homeless - American Indian, Alaska Native, or Indigenous',
    'Overall Homeless - Native Hawaiian or Other Pacific Islander',
    'Overall Homeless - Multiple Races',
    "state"
]


race_country = PIT_sliced.iloc[:, 16:26]
race_country_state = race_country.groupby("state").mean()

#state validation:
states = ["AK", "AL", "AR", "AZ", "CA", "CO", "CT", "DC",
          "DE", "FL", "GA", "HI", "IA", "ID", "IL", "IN", "KS",
          "KY", "LA", "MA", "MD", "ME", "MI", "MN", "MO", "MS", "MT", "NC",
          "ND", "NE", "NH", "NJ", "NM", "NV", "NY", "OH", "OK", "OR", "PA",␣
 ↪"RI",
          "SC", "SD", "TN", "TX", "UT", "VA", "VT", "WA", "WI", "WV", "WY"]
for state in race_country_state.index:
    if state not in states:
        race_country_state.drop(state, inplace=True)

len(race_country_state)
race_country_state["total"] = race_country_state.sum(axis=1)

race_country_state_pct = race_country_state.drop("total", axis=1).
 ↪div(race_country_state["total"], axis=0) * 100

hisp_pct = pd.DataFrame(race_country_state_pct.iloc[:, 1])

import plotly.express as px

state_names = {
    "AK": "Alaska", "AL": "Alabama", "AR": "Arkansas", "AZ": "Arizona",
    "CA": "California", "CO": "Colorado", "CT": "Connecticut", "DC": "District␣
 ↪of Columbia",
    "DE": "Delaware", "FL": "Florida", "GA": "Georgia", "HI": "Hawaii",
    "IA": "Iowa", "ID": "Idaho", "IL": "Illinois", "IN": "Indiana",
    "KS": "Kansas", "KY": "Kentucky", "LA": "Louisiana", "MA": "Massachusetts",
    "MD": "Maryland", "ME": "Maine", "MI": "Michigan", "MN": "Minnesota",
    "MO": "Missouri", "MS": "Mississippi", "MT": "Montana", "NC": "North␣
 ↪Carolina",
    "ND": "North Dakota", "NE": "Nebraska", "NH": "New Hampshire", "NJ": "New␣
 ↪Jersey",
    "NM": "New Mexico", "NV": "Nevada", "NY": "New York", "OH": "Ohio",
    "OK": "Oklahoma", "OR": "Oregon", "PA": "Pennsylvania", "RI": "Rhode␣
 ↪Island",
    "SC": "South Carolina", "SD": "South Dakota", "TN": "Tennessee", "TX":␣
 ↪"Texas",
    "UT": "Utah", "VA": "Virginia", "VT": "Vermont", "WA": "Washington",
    "WI": "Wisconsin", "WV": "West Virginia", "WY": "Wyoming"
}

hisp_data = hisp_pct.reset_index()
hisp_data["state_name"] = hisp_data["state"].map(state_names)

fig = px.choropleth(
    hisp_data,
    locations="state",
    locationmode="USA-states",
    color="Overall Homeless - Hispanic/Latin(o)(a)(x)",
    color_continuous_scale="Viridis",
    range_color=[0, 30],
    title="Percentage of Hispanic/Latin(o)(a)(x) Homeless Population by State",
    labels={"Overall Homeless - Hispanic/Latin(o)(a)(x)": "%"}
    )

fig.update_layout(
    title_x=0.5,
    geo_scope="usa",
    width=1200,
    height=800
    )

fig.show()
```

[142]:

```
```

[98]:

```
# get a random sample of 40 CoC numbers and their corresponding homeless racial␣
 ↪demographics, and plot them

np.random.seed(89)
racial = PIT_sliced.copy().sample(40)

racial_categories = [
    'Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)',
    'Overall Homeless - Hispanic/Latin(o)(a)(x)',
    'Overall Homeless - White',
    'Overall Homeless - Black, African American, or African',
    'Overall Homeless - Asian or Asian American',
    'Overall Homeless - American Indian, Alaska Native, or Indigenous',
    'Overall Homeless - Native Hawaiian or Other Pacific Islander',
    'Overall Homeless - Multiple Races'
]

fig, ax = plt.subplots(figsize=(12, 8))
for category in racial_categories:
    ax.bar(racial["state"], racial[category], label=category,␣
 ↪bottom=racial[racial_categories].cumsum(axis=1)[category] - racial[category])

ax.set_xlabel("State")
ax.set_ylabel("Number of Homeless Individuals")
ax.set_title("Homeless Population Distribution by Race Across States")
ax.legend(title="Racial Category")
plt.xticks(rotation=90)

plt.show()
```



```
[99]: racial.head(15)
```

```
[99]:     CoC Number                                           CoC Name  \
303     PA-500                                   Philadelphia CoC
147     LA-507                   Alexandria/Central Louisiana CoC
269     NY-523  Glens Falls, Saratoga Springs/Saratoga, Washin…
189     MI-518                              Livingston County CoC
129     IL-517                         Aurora, Elgin/Kane County CoC
374     WA-504                          Everett/Snohomish County CoC
58      CA-611        Oxnard, San Buenaventura/Ventura County CoC
108     HI-501                          Honolulu City and County CoC
```

```
295     OR-500                Eugene, Springfield/Lane County CoC
124     IL-512                   Bloomington/Central Illinois CoC
379     WI-503                            Madison/Dane County CoC
194     MN-502                  Rochester/Southeast Minnesota CoC
280     OH-502                      Cleveland/Cuyahoga County CoC
380     WV-500                         Wheeling, Weirton Area CoC
232     NH-502                     Nashua/Hillsborough County CoC

                CoC Category  Overall Homeless  Overall Homeless - Under 18  \
303           Major City CoC            4725.0                        825.0
147        Largely Rural CoC             122.0                         15.0
269     Largely Suburban CoC             332.0                         30.0
189     Largely Suburban CoC              88.0                         36.0
129     Largely Suburban CoC             461.0                         81.0
374     Largely Suburban CoC            1285.0                        202.0
58   Other Largely Urban CoC            2441.0                        141.0
108     Largely Suburban CoC            4028.0                        583.0
295  Other Largely Urban CoC            2824.0                        230.0
124        Largely Rural CoC             256.0                         67.0
379  Other Largely Urban CoC             624.0                        148.0
194        Largely Rural CoC             496.0                        144.0
280     Largely Suburban CoC            1629.0                        281.0
380        Largely Rural CoC             113.0                         37.0
232     Largely Suburban CoC             348.0                         99.0

     Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
303                            409.0                            778.0
147                              3.0                             15.0
269                             27.0                             79.0
189                             12.0                              7.0
129                             32.0                             70.0
374                             70.0                            235.0
58                             100.0                            390.0
108                            328.0                            492.0
295                            199.0                            442.0
124                             32.0                             38.0
379                             33.0                            105.0
194                             39.0                             76.0
280                             95.0                            278.0
380                              3.0                             23.0
232                             15.0                             51.0

     Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
303                            968.0                            753.0
147                             39.0                             24.0
269                             81.0                             48.0
189                             20.0                              8.0
```

```
129                              79.0                                 81.0
374                             297.0                                202.0
58                              513.0                                509.0
108                             681.0                                727.0
295                             564.0                                589.0
124                              32.0                                 30.0
379                             120.0                                 82.0
194                              96.0                                 63.0
280                             309.0                                248.0
380                              24.0                                 16.0
232                              69.0                                 40.0

     Overall Homeless - Age 55 to 64  …  \
303                             768.0  …
147                              22.0  …
269                              44.0  …
189                               4.0  …
129                              77.0  …
374                             211.0  …
58                              498.0  …
108                             895.0  …
295                             552.0  …
124                              24.0  …
379                              83.0  …
194                              51.0  …
280                             310.0  …
380                               9.0  …
232                              43.0  …

     Overall Homeless - Gender Questioning  \
303                                    8.0
147                                    0.0
269                                    0.0
189                                    1.0
129                                    0.0
374                                    2.0
58                                     0.0
108                                    2.0
295                                   17.0
124                                    0.0
379                                    1.0
194                                    0.0
280                                    0.0
380                                    0.0
232                                    0.0

     Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
303                                             4199.0
147                                              119.0
269                                              307.0
189                                               88.0
129                                              269.0
374                                             1106.0
58                                              1275.0
108                                             3479.0
295                                             2563.0
124                                              228.0
379                                              561.0
194                                              446.0
280                                             1532.0
380                                              113.0
232                                              280.0

     Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
303                                       526.0                    1197.0
147                                         3.0                      45.0
269                                        25.0                     267.0
189                                         0.0                      88.0
129                                       192.0                     278.0
374                                       179.0                     981.0
58                                       1166.0                    1969.0
108                                       549.0                     656.0
295                                       261.0                    2338.0
124                                        28.0                     133.0
379                                        63.0                     314.0
194                                        50.0                     293.0
280                                        97.0                     453.0
380                                         0.0                      83.0
232                                        68.0                     285.0

     Overall Homeless - Black, African American, or African  \
303                                             3214.0
147                                               72.0
269                                               51.0
189                                                0.0
129                                              129.0
374                                              112.0
58                                               188.0
108                                              181.0
295                                               96.0
124                                              116.0
379                                              275.0
194                                              141.0
280                                             1133.0
```

```
380                                               17.0
232                                               34.0

     Overall Homeless - Asian or Asian American  \
303                                        26.0
147                                         1.0
269                                         3.0
189                                         0.0
129                                         5.0
374                                        18.0
58                                          9.0
108                                       472.0
295                                         9.0
124                                         0.0
379                                         8.0
194                                         4.0
280                                         5.0
380                                         0.0
232                                         2.0

     Overall Homeless - American Indian, Alaska Native, or Indigenous  \
303                                               32.0
147                                                0.0
269                                                2.0
189                                                0.0
129                                               10.0
374                                               38.0
58                                                57.0
108                                               31.0
295                                               85.0
124                                                0.0
379                                                9.0
194                                               21.0
280                                                2.0
380                                                4.0
232                                                1.0

     Overall Homeless - Native Hawaiian or Other Pacific Islander  \
303                                               20.0
147                                                0.0
269                                                0.0
189                                                0.0
129                                                0.0
374                                               65.0
58                                                57.0
108                                             1683.0
295                                               14.0
```

```
124                                                  1.0
379                                                  1.0
194                                                  1.0
280                                                  4.0
380                                                  0.0
232                                                  4.0

     Overall Homeless - Multiple Races  state
303                              236.0     PA
147                                4.0     LA
269                                9.0     NY
189                                0.0     MI
129                               39.0     IL
374                               71.0     WA
58                               161.0     CA
108                             1005.0     HI
295                              282.0     OR
124                                6.0     IL
379                               17.0     WI
194                               36.0     MN
280                               32.0     OH
380                                9.0     WV
232                               22.0     NH

[15 rows x 25 columns]
```

[100]:

```
totals = race_country_state["total"]
```

[101]:

```
len(race_country_state)
race_country_state["total"] = race_country_state.sum(axis=1)

race_country_state_pct = race_country_state.drop("total", axis=1).
  ↪div(race_country_state["total"], axis=0) * 100

hisp_pct = pd.DataFrame(race_country_state_pct.iloc[:, 1])
hisp_pct
#race_country_state_pct
```

[101]:

```
       Overall Homeless - Hispanic/Latin(o)(a)(x)
state
AK                                       2.477047
AL                                       0.877724
AR                                       1.293599
AZ                                       6.894009
CA                                       9.227035
CO                                       6.523998
CT                                       7.728027
```

```
DC                                       2.453271
DE                                       2.148594
FL                                       4.238197
GA                                       1.386855
HI                                       3.338422
IA                                       2.318130
ID                                       5.265448
IL                                       7.499791
IN                                       1.200765
KS                                       3.060594
KY                                       1.138271
LA                                       0.978227
MA                                       8.752155
MD                                       1.867008
ME                                       1.285815
MI                                       1.803379
MN                                       3.252711
MO                                       1.745447
MS                                       0.712831
MT                                       2.330119
NC                                       1.358417
ND                                       2.136480
NE                                       3.330626
NH                                       2.201966
NJ                                       7.526306
NM                                      12.844872
NV                                       4.208978
NY                                      12.029312
OH                                       1.174688
OK                                       2.570998
OR                                       3.204746
PA                                       3.456515
RI                                       5.607735
SC                                       1.116457
SD                                       1.716069
TN                                       0.784048
TX                                       7.787559
UT                                       5.838080
VA                                       2.558793
VT                                       1.168437
WA                                       3.781745
WI                                       2.288624
WV                                       0.406073
WY                                       3.289474
```

[102]:

```
import plotly.express as px
```

```
state_names = {
    "AK": "Alaska", "AL": "Alabama", "AR": "Arkansas", "AZ": "Arizona",
    "CA": "California", "CO": "Colorado", "CT": "Connecticut", "DC": "District␣
  ↪of Columbia",
    "DE": "Delaware", "FL": "Florida", "GA": "Georgia", "HI": "Hawaii",
    "IA": "Iowa", "ID": "Idaho", "IL": "Illinois", "IN": "Indiana",
    "KS": "Kansas", "KY": "Kentucky", "LA": "Louisiana", "MA": "Massachusetts",
    "MD": "Maryland", "ME": "Maine", "MI": "Michigan", "MN": "Minnesota",
    "MO": "Missouri", "MS": "Mississippi", "MT": "Montana", "NC": "North␣
  ↪Carolina",
    "ND": "North Dakota", "NE": "Nebraska", "NH": "New Hampshire", "NJ": "New␣
  ↪Jersey",
    "NM": "New Mexico", "NV": "Nevada", "NY": "New York", "OH": "Ohio",
    "OK": "Oklahoma", "OR": "Oregon", "PA": "Pennsylvania", "RI": "Rhode␣
  ↪Island",
    "SC": "South Carolina", "SD": "South Dakota", "TN": "Tennessee", "TX":␣
  ↪"Texas",
    "UT": "Utah", "VA": "Virginia", "VT": "Vermont", "WA": "Washington",
    "WI": "Wisconsin", "WV": "West Virginia", "WY": "Wyoming"
}

hisp_data = hisp_pct.reset_index()
hisp_data["state_name"] = hisp_data["state"].map(state_names)

fig = px.choropleth(
    hisp_data,
    locations="state",
    locationmode="USA-states",
    color="Overall Homeless - Hispanic/Latin(o)(a)(x)",
    color_continuous_scale="Viridis",
    range_color=[0, 30],
    title="Percentage of Hispanic/Latin(o)(a)(x) Homeless Population by State",
    labels={"Overall Homeless - Hispanic/Latin(o)(a)(x)": "Percentage"}
    )

fig.update_layout(
    title_x=0.5,
    geo_scope="usa",
    width=1200,
    height=800
    )

fig.show()
```

[103]:

```
totals
```

```
[103]: state
       AK    2614.000000
       AL     826.000000
       AR    1043.600000
       AZ    9491.333333
       CA    8245.409091
       CO    7219.500000
       CT    3015.000000
       DC    9844.000000
       DE    2490.000000
       FL    2278.222222
       GA    2732.000000
       HI    6223.000000
       IA    1768.666667
       ID    2298.000000
       IL    1257.578947
       IN    6017.000000
       KS    1213.000000
       KY    3177.333333
       LA     905.428571
       MA    3190.166667
       MD    1173.000000
       ME    8516.000000
       MI     899.700000
       MN    1678.600000
       MO    1729.500000
       MS     654.666667
       MT    4356.000000
       NC    1625.666667
       ND    1568.000000
       NE    1641.333333
       NH    1627.333333
       NJ    1283.000000
       NM    3842.000000
       NV    5777.333333
       NY    8600.000000
       OH    2530.222222
       OK    1162.000000
       OR    5035.500000
       PA    1569.500000
       RI    3620.000000
       SC    2026.500000
       SD    2564.000000
       TN    1843.000000
       TX    4977.636364
       UT    2458.000000
       VA     845.125000
```

```
VT    3295.000000
WA    9345.333333
WI    2430.500000
WV     708.000000
WY    1064.000000
Name: total, dtype: float64
```

```
[104]: totals["state"] = totals.index
```

```
[105]: race_country_state
```

```
[105]:        Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
state
AK                                            1177.500000
AL                                             398.500000
AR                                             494.800000
AZ                                            3437.000000
CA                                            2601.090909
CO                                            2667.750000
CT                                            1041.500000
DC                                            4439.000000
DE                                            1138.000000
FL                                             946.000000
GA                                            1290.222222
HI                                            2696.000000
IA                                             802.333333
ID                                             907.000000
IL                                             440.157895
IN                                            2864.000000
KS                                             532.250000
KY                                            1516.333333
LA                                             435.000000
MA                                            1036.666667
MD                                             542.700000
ME                                            4039.000000
MI                                             417.400000
MN                                             730.100000
MO                                             804.375000
MS                                             318.000000
MT                                            1975.000000
NC                                             768.666667
ND                                             717.000000
NE                                             711.333333
NH                                             742.000000
NJ                                             448.375000
NM                                             934.000000
NV                                            2402.333333
```

```
NY                                           2230.958333
OH                                           1205.666667
OK                                            521.250000
OR                                           2195.000000
PA                                            676.250000
RI                                           1404.000000
SC                                            968.000000
SD                                           1194.000000
TN                                            892.600000
TX                                           1713.545455
UT                                            942.000000
VA                                            379.312500
VT                                           1570.500000
WA                                           3965.833333
WI                                           1104.000000
WV                                            348.250000
WY                                            462.000000

       Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
state
AK                                     129.500000                398.000000
AL                                      14.500000                168.625000
AR                                      27.000000                339.200000
AZ                                    1308.666667               3003.666667
CA                                    1521.613636               2190.568182
CO                                     942.000000               2413.750000
CT                                     466.000000                826.500000
DC                                     483.000000                587.000000
DE                                     107.000000                385.000000
FL                                     193.111111                614.037037
GA                                      75.777778                511.444444
HI                                     415.500000                647.500000
IA                                      82.000000                562.333333
ID                                     242.000000                951.000000
IL                                     188.631579                291.315789
IN                                     144.500000               1842.000000
KS                                      74.250000                419.500000
KY                                      72.333333               1128.666667
LA                                      17.714286                168.428571
MA                                     558.416667                768.583333
MD                                      43.800000                194.500000
ME                                     219.000000               2044.000000
MI                                      32.450000                213.900000
MN                                     109.200000                299.900000
MO                                      60.375000                491.000000
MS                                       9.333333                143.000000
MT                                     203.000000               1480.000000
```

```
NC                                      44.166667                341.166667
ND                                      67.000000                352.000000
NE                                     109.333333                528.333333
NH                                      71.666667                725.000000
NJ                                     193.125000                244.750000
NM                                     987.000000               1228.000000
NV                                     486.333333               1661.333333
NY                                    2069.041667               1231.333333
OH                                      59.444444                657.444444
OK                                      59.750000                330.250000
OR                                     322.750000               1945.375000
PA                                     108.500000                368.562500
RI                                     406.000000               1140.000000
SC                                      45.250000                495.000000
SD                                      88.000000                372.000000
TN                                      28.900000                571.800000
TX                                     775.272727               1479.727273
UT                                     287.000000                935.000000
VA                                      43.250000                167.562500
VT                                      77.000000               1417.500000
WA                                     706.833333               2841.000000
WI                                     111.250000                684.750000
WV                                       5.750000                302.500000
WY                                      70.000000                419.000000

       Overall Homeless - Black, African American, or African  \
state
AK                                                     90.500000
AL                                                    223.375000
AR                                                    146.600000
AZ                                                   1032.333333
CA                                                   1212.931818
CO                                                    607.750000
CT                                                    558.500000
DC                                                   4091.000000
DE                                                    773.000000
FL                                                    462.777778
GA                                                    796.111111
HI                                                    123.000000
IA                                                    221.333333
ID                                                     25.000000
IL                                                    293.842105
IN                                                    981.000000
KS                                                    116.500000
KY                                                    377.000000
LA                                                    269.285714
MA                                                    721.583333
```

```
MD                                            352.100000
ME                                           2013.000000
MI                                            199.050000
MN                                            315.200000
MO                                            309.125000
MS                                            168.333333
MT                                             63.000000
NC                                            420.416667
ND                                            102.000000
NE                                            176.000000
NH                                             41.333333
NJ                                            363.375000
NM                                            200.000000
NV                                            930.000000
NY                                           2741.291667
OH                                            529.444444
OK                                            123.875000
OR                                            194.875000
PA                                            361.250000
RI                                            436.000000
SC                                            465.750000
SD                                             63.000000
TN                                            310.100000
TX                                            878.909091
UT                                            109.666667
VA                                            214.625000
VT                                            133.000000
WA                                            782.333333
WI                                            398.000000
WV                                             34.250000
WY                                             47.000000

       Overall Homeless - Asian or Asian American  \
state
AK                                       19.000000
AL                                        1.500000
AR                                        1.400000
AZ                                       33.666667
CA                                      159.363636
CO                                       33.750000
CT                                        7.000000
DC                                       40.000000
DE                                        4.000000
FL                                        6.888889
GA                                        4.777778
HI                                      301.500000
IA                                        9.333333
```

```
ID                                       4.000000
IL                                      10.368421
IN                                      13.500000
KS                                       3.000000
KY                                       5.333333
LA                                       2.142857
MA                                      15.083333
MD                                       6.400000
ME                                      17.000000
MI                                       2.550000
MN                                      19.300000
MO                                       5.000000
MS                                       2.333333
MT                                      10.000000
NC                                       5.000000
ND                                       9.000000
NE                                      12.333333
NH                                       4.666667
NJ                                       5.125000
NM                                      12.000000
NV                                      57.333333
NY                                      36.375000
OH                                       4.444444
OK                                       3.000000
OR                                      19.125000
PA                                       4.062500
RI                                      12.000000
SC                                       3.000000
SD                                       7.000000
TN                                       3.000000
TX                                      22.363636
UT                                      13.000000
VA                                       8.312500
VT                                      18.000000
WA                                      57.166667
WI                                      12.750000
WV                                       0.500000
WY                                      14.000000

       Overall Homeless - American Indian, Alaska Native, or Indigenous  \
state
AK                                            575.500000
AL                                              4.625000
AR                                             10.000000
AZ                                            325.000000
CA                                            195.204545
CO                                            207.250000
```

```
CT                                             19.000000
DC                                             73.000000
DE                                              3.000000
FL                                             12.222222
GA                                              6.444444
HI                                             25.000000
IA                                             28.666667
ID                                             80.000000
IL                                              7.526316
IN                                             19.500000
KS                                             18.500000
KY                                             12.000000
LA                                              4.000000
MA                                             10.500000
MD                                              9.600000
ME                                             34.000000
MI                                              5.050000
MN                                             96.100000
MO                                             11.750000
MS                                              2.666667
MT                                            461.000000
NC                                             12.916667
ND                                            276.000000
NE                                             44.666667
NH                                              9.666667
NJ                                              9.312500
NM                                            359.500000
NV                                             79.000000
NY                                             39.416667
OH                                             10.111111
OK                                             77.625000
OR                                            124.500000
PA                                              5.812500
RI                                             33.000000
SC                                              9.500000
SD                                            779.000000
TN                                              8.500000
TX                                             37.818182
UT                                             72.666667
VA                                              3.750000
VT                                             41.500000
WA                                            344.166667
WI                                             52.750000
WV                                              2.750000
WY                                             22.000000

       Overall Homeless - Native Hawaiian or Other Pacific Islander  \
state
AK                                             49.500000
AL                                              1.375000
AR                                              6.000000
AZ                                             35.333333
CA                                             77.568182
CO                                            100.500000
CT                                              3.500000
DC                                             52.000000
DE                                              2.000000
FL                                              4.333333
GA                                              2.222222
HI                                           1168.000000
IA                                              6.000000
ID                                             10.500000
IL                                              3.263158
IN                                             18.000000
KS                                              3.250000
KY                                              3.666667
LA                                              1.857143
MA                                             11.166667
MD                                              2.900000
ME                                              5.000000
MI                                              1.000000
MN                                              4.500000
MO                                              8.500000
MS                                              1.666667
MT                                             18.000000
NC                                              3.000000
ND                                              0.000000
NE                                              3.666667
NH                                              3.333333
NJ                                              2.562500
NM                                             40.500000
NV                                             52.333333
NY                                             12.250000
OH                                              4.222222
OK                                              5.625000
OR                                             46.875000
PA                                              2.812500
RI                                              4.000000
SC                                              2.000000
SD                                              9.000000
TN                                              1.000000
TX                                              8.727273
UT                                             31.666667
VA                                              1.125000
```

```
VT                                              3.000000
WA                                            203.000000
WI                                              3.000000
WV                                              0.500000
WY                                              2.000000

       Overall Homeless - Multiple Races         total
state
AK                             174.500000   5228.000000
AL                              13.500000   1652.000000
AR                              18.600000   2087.200000
AZ                             315.666667  18982.666667
CA                             287.068182  16490.818182
CO                             246.750000  14439.000000
CT                              93.000000   6030.000000
DC                              79.000000  19688.000000
DE                              78.000000   4980.000000
FL                              38.851852   4556.444444
GA                              45.000000   5464.000000
HI                             846.500000  12446.000000
IA                              56.666667   3537.333333
ID                              78.500000   4596.000000
IL                              22.473684   2515.157895
IN                             134.500000  12034.000000
KS                              45.750000   2426.000000
KY                              62.000000   6354.666667
LA                               7.000000   1810.857143
MA                              68.166667   6380.333333
MD                              21.000000   2346.000000
ME                             145.000000  17032.000000
MI                              28.300000   1799.400000
MN                             104.300000   3357.200000
MO                              39.375000   3459.000000
MS                               9.333333   1309.333333
MT                             146.000000   8712.000000
NC                              30.333333   3251.333333
ND                              45.000000   3136.000000
NE                              55.666667   3282.666667
NH                              29.666667   3254.666667
NJ                              16.375000   2566.000000
NM                              81.000000   7684.000000
NV                             108.666667  11554.666667
NY                             239.333333  17200.000000
OH                              59.444444   5060.444444
OK                              40.625000   2324.000000
OR                             187.000000  10071.000000
PA                              42.250000   3139.000000
```

```
RI                                185.000000   7240.000000
SC                                 38.000000   4053.000000
SD                                 52.000000   5128.000000
TN                                 27.100000   3686.000000
TX                                 61.272727   9955.272727
UT                                 67.000000   4916.000000
VA                                 27.187500   1690.250000
VT                                 34.500000   6590.000000
WA                                445.000000  18690.666667
WI                                 64.000000   4861.000000
WV                                 13.500000   1416.000000
WY                                 28.000000   2128.000000
```

[106]:

```python
race_country_state['Overall Homeless - Total'] = race_country_state[
    [
        'Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)',
    'Overall Homeless - Hispanic/Latin(o)(a)(x)',
    'Overall Homeless - White',
    'Overall Homeless - Black, African American, or African',
    'Overall Homeless - Asian or Asian American',
    'Overall Homeless - American Indian, Alaska Native, or Indigenous',
    'Overall Homeless - Native Hawaiian or Other Pacific Islander',
    'Overall Homeless - Multiple Races'
    ]
].sum(axis=1)

state_homeless_totals = race_country_state.groupby('state').
 ↪sum(numeric_only=True)['Overall Homeless - Total']
state_homeless_totals = state_homeless_totals.reset_index()

fig = px.choropleth(
    state_homeless_totals,
    locations='state',
    locationmode="USA-states",
    color='Overall Homeless - Total',
    color_continuous_scale="YlOrRd",

    scope="usa",
    labels={'Overall Homeless - Total': 'Total Homeless Population'},
    title="Total Homeless Population by State in the USA"
)

fig.update_layout(
    title_x=0.5,
    geo_scope="usa",
    width=1200,
    height=800
    )

fig.show()
```

1.3.3 Deliverer: FIRSTNAME LASTNAME

Question:

[ ]:

```

```

Answer:

[ ]:

```

```

[ ]:

```

```

1.4 Part 3: Follow-up Questions (4 points)

1.4.1 New Questions Based Off Initial Investigation

- Q1: WRITE_QUESTION_HERE
- Q2: WRITE_QUESTION_HERE

[ ]:

```

```

1.5 Summary (2 points)

GIVE A 2 PARAGRAPH SUMMARY.

PARAGRAPH 1 SHOULD DESCRIBE WHAT YOU LEARNED ABOUT YOUR DATA FROM INVESTIGATING THE INITIAL QUESTIONS. DID YOU FIND ANYTHING UNUSUAL IN YOUR DATA? DID ANYTHING SURPRISE YOU? WHICH OF THE INITIAL QUESTIONS WERE HELPFUL IN LEADING YOU TO MORE QUESTIONS?

PARAGRAPH 2 SHOULD SUMMARIZE WHAT YOU LEARNED FROM INVESTIGATING THE FOLLOW-UP QUESTIONS. WHY ARE THESE FOLLOW-UP QUESTIONS INTERESTING FOR INVESTIGATION? DESCRIBE THE TABLES/FIGURES YOU USED TO EXPLORE ANSWERS TO THESE FOLLOW-UP QUESTIONS? WHAT DID YOU LEARN FROM THE TABLES/FIGURES REGARDING THE FOLLOW-UP QUESTIONS YOU PROPOSED?

[ ]:

```

```

[107]:

```
# get data from new york
new_york_slice = PIT_sliced_state.loc[269:270]
new_york_slice
```

[107]:

```
    CoC Number                                      CoC Name  \
270     NY-525  New York Balance of State Continuum of Care

          CoC Category  Overall Homeless  Overall Homeless - Under 18  \
270  Largely Rural CoC             687.0                        138.0
```

```
     Overall Homeless - Age 18 to 24  Overall Homeless - Age 25 to 34  \
270                             69.0                            151.0   

     Overall Homeless - Age 35 to 44  Overall Homeless - Age 45 to 54  \
270                            164.0                             94.0   

     Overall Homeless - Age 55 to 64  …  \
270                             53.0  …   

     Overall Homeless - Gender Questioning  \
270                                    0.0   

     Overall Homeless - Non-Hispanic/Non-Latin(o)(a)(x)  \
270                                              604.0    

     Overall Homeless - Hispanic/Latin(o)(a)(x)  Overall Homeless - White  \
270                                        83.0                     553.0   

     Overall Homeless - Black, African American, or African  \
270                                               87.0        

     Overall Homeless - Asian or Asian American  \
270                                         1.0   

     Overall Homeless - American Indian, Alaska Native, or Indigenous  \
270                                                3.0                  

     Overall Homeless - Native Hawaiian or Other Pacific Islander  \
270                                                1.0              

     Overall Homeless - Multiple Races  state  
270                               42.0     NY  

[1 rows x 25 columns]
```

[108]:

```python
nyc_slice = PIT_sliced[PIT_sliced["CoC Number"]=="NY-600"]
total_homeless = nyc_slice["Overall Homeless"].values[0]

# Calculate demographic percentages
race_cols = ["Overall Homeless - White",
            "Overall Homeless - Black, African American, or African",
            "Overall Homeless - Asian or Asian American",
            "Overall Homeless - American Indian, Alaska Native, or Indigenous",
            "Overall Homeless - Native Hawaiian or Other Pacific Islander",
            "Overall Homeless - Multiple Races"]

race_probs = []
```

```
for col in race_cols:
    race_probs.append(nyc_slice[col].values[0] / total_homeless)

# Create simulated population
np.random.seed(42)
n_simulated = 88025

# Simulate race based on observed proportions
simulated_race = np.random.choice(len(race_cols), size=n_simulated,␣
  ↪p=race_probs)

# Create dataframe with simulated data
simulated_df = pd.DataFrame({
    "race": [race_cols[i].replace("Overall Homeless - ", "") for i in␣
  ↪simulated_race]
})

# Add age based on NYC proportions
age_cols = ["Overall Homeless - Under 18",
           "Overall Homeless - Age 18 to 24",
           "Overall Homeless - Age 25 to 34",
           "Overall Homeless - Age 35 to 44",
           "Overall Homeless - Age 45 to 54",
           "Overall Homeless - Age 55 to 64",
           "Overall Homeless - Over 64"]

age_probs = []
for col in age_cols:
    age_probs.append(nyc_slice[col].values[0] / total_homeless)

simulated_df["age"] = np.random.choice(
    [col.replace("Overall Homeless - ", "").replace("Age ", "") for col in␣
  ↪age_cols],
    size=n_simulated,
    p=age_probs
)

# Add gender based on NYC proportions
gender_cols = ["Overall Homeless - Female",
              "Overall Homeless - Male",
              "Overall Homeless - Transgender",
              "Overall Homeless - Gender that is not Singularly Female or Male",
              "Overall Homeless - Gender Questioning"]

gender_probs = []
for col in gender_cols:
    gender_probs.append(nyc_slice[col].values[0] / total_homeless)
```

```
simulated_df["gender"] = np.random.choice(
    [col.replace("Overall Homeless - ", "") for col in gender_cols],
    size=n_simulated,
    p=gender_probs
)


simulated_df["homeless"] = 1
```

[109]:
```
race_probs
```

[109]:
```
[0.2504742970746947,
 0.6735813689292814,
 0.008952002272081795,
 0.008838398182334565,
 0.0026242544731610337,
 0.05552967906844646]
```

[110]:
```
simulated_df
```

[110]:
```
                                      race       age  gender  homeless
0      Black, African American, or African  35 to 44    Male         1
1                           Multiple Races  Under 18  Female         1
2      Black, African American, or African  25 to 34    Male         1
3      Black, African American, or African  35 to 44  Female         1
4                                    White  Under 18    Male         1
…                                        …         …       …         …
88020  Black, African American, or African  25 to 34  Female         1
88021                                White  Under 18    Male         1
88022              Asian or Asian American  18 to 24    Male         1
88023  Black, African American, or African  35 to 44    Male         1
88024  Black, African American, or African  Under 18  Female         1

[88025 rows x 4 columns]
```

[111]:
```
n_non_homeless = 8_800_000 # Approximate NYC population


non_homeless_df = pd.DataFrame()

race_probs = {
    "White": 0.375,
    "Black, African American, or African": 0.231,
    "Asian or Asian American": 0.145,
    "Multiple Races": 0.089,
    "American Indian, Alaska Native, or Indigenous": 0.006,
    "Native Hawaiian or Other Pacific Islander": 0.001,
    "Hispanic or Latino": 0.29 - 0.137
}

non_homeless_df["race"] = np.random.choice(
    list(race_probs.keys()),
    size=n_non_homeless,
    p=list(race_probs.values())
)

# Age distribution based on NYC census
age_dist = {
    "Under 18": 0.21,
    "18 to 24": 0.10,
    "25 to 34": 0.17,
    "35 to 44": 0.14,
    "45 to 54": 0.13,
    "55 to 64": 0.13,
    "Over 64": 0.12
}

non_homeless_df["age"] = np.random.choice(
    list(age_dist.keys()),
    size=n_non_homeless,
    p=list(age_dist.values())
)

# Gender distribution based on NYC census
gender_dist = {
    "Female": 0.52 - (0.0012 +  0.0007 + 0.0001)/2,
    "Male": 0.48 - (0.0012 +  0.0007 + 0.0001)/2,
    "Other": 0.0012 +  0.0007 + 0.0001
}

non_homeless_df["gender"] = np.random.choice(
    list(gender_dist.keys()),
    size=n_non_homeless,
    p=list(gender_dist.values())
)

non_homeless_df["homeless"] = 0

# Combine homeless and non-homeless populations
simulated_df = pd.concat([simulated_df, non_homeless_df], ignore_index=True)
#simulated_df.drop("ethnicity", axis=1, inplace=True)
```

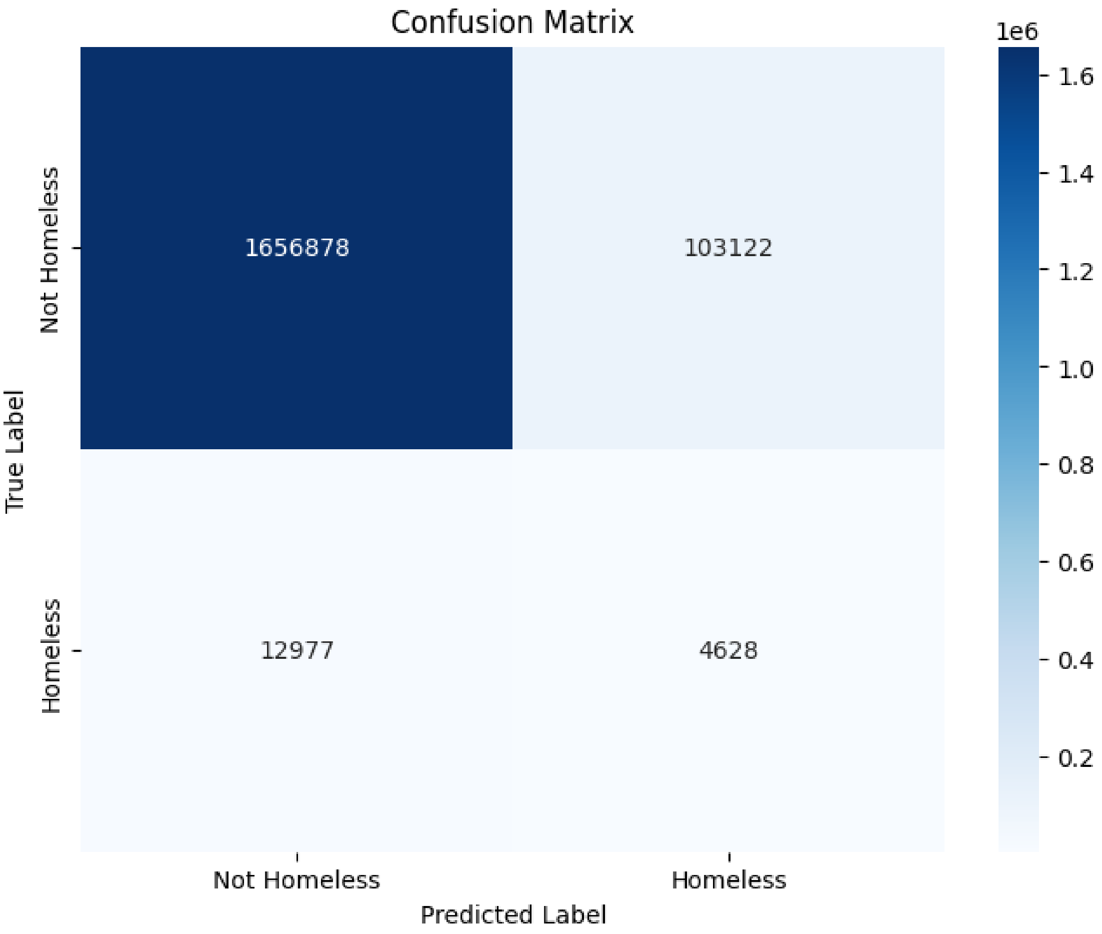
[112]:

```
df = simulated_df.copy()


X = pd.get_dummies(df[["race", "age", "gender"]], drop_first=True)
y = df["homeless"]


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42, stratify=y)


scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)


model = LogisticRegression(
    class_weight="balanced",
    max_iter=1000,
    random_state=42,
    C=0.1
)
model.fit(X_train, y_train)

y_pred_proba = model.predict_proba(X_test_scaled)[:, 1]


precisions, recalls, thresholds = precision_recall_curve(y_test, y_pred_proba)
f1_scores = 2 * (precisions * recalls) / (precisions + recalls)
optimal_threshold = thresholds[np.argmax(f1_scores[:-1])]


y_pred = (y_pred_proba >= optimal_threshold).astype(int)


print(f"Optimal threshold: {optimal_threshold:.3f}")
print("\nClassification Report with Optimal Threshold:")
print(classification_report(y_test, y_pred, zero_division=0))


roc_auc = roc_auc_score(y_test, y_pred_proba)
print(f"\nROC AUC Score: {roc_auc:.3f}")


feature_importance = pd.DataFrame({
    "feature": X.columns,
    "importance": abs(model.coef_[0])
```

```python
})
feature_importance = feature_importance.sort_values("importance",␣
 ↪ascending=False)
print("\nTop 10 Most Important Features:")
print(feature_importance.head(10))


plt.figure(figsize=(8, 6))
sns.heatmap(confusion_matrix(y_test, y_pred),
            annot=True,
            fmt="d",
            cmap="Blues",
            xticklabels=["Not Homeless", "Homeless"],
            yticklabels=["Not Homeless", "Homeless"])
plt.title("Confusion Matrix")
plt.ylabel("True Label")
plt.xlabel("Predicted Label")
plt.show()
```

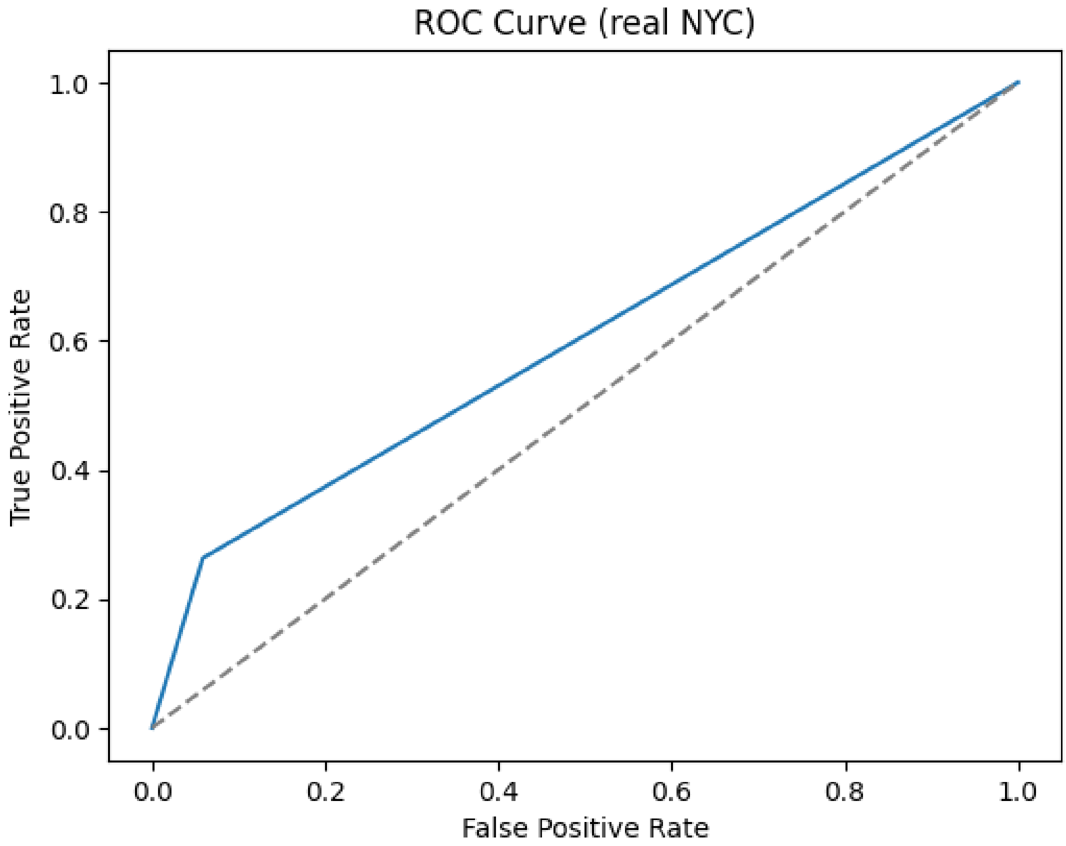
```
/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/site-
packages/sklearn/base.py:493: UserWarning:

X does not have valid feature names, but LogisticRegression was fitted with
feature names


Optimal threshold: 1.000

Classification Report with Optimal Threshold:
              precision    recall  f1-score   support

           0       0.99      0.94      0.97   1760000
           1       0.04      0.26      0.07     17605

    accuracy                           0.93   1777605
   macro avg       0.52      0.60      0.52   1777605
weighted avg       0.98      0.93      0.96   1777605


ROC AUC Score: 0.803

Top 10 Most Important Features:
                                              feature  importance
2                                race_Hispanic or Latino   12.341112
16                                   gender_Transgender    5.998717
15                                         gender_Other    4.039668
0                           race_Asian or Asian American    3.134166
13   gender_Gender that is not Singularly Female or…    2.711221
```

```
10                                   age_Over 64    1.104926
12                    gender_Gender Questioning    0.975387
3                          race_Multiple Races    0.866681
5                                   race_White    0.777499
1       race_Black, African American, or African    0.697871
```



[113]:

```python
fpr, tpr, thresholds = roc_curve(y_test, y_pred)

# use the model to make an roc curve

x = np.linspace(0, 1, 100)
plt.plot(fpr, tpr)
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC Curve (real NYC)')

# random chance line
plt.plot(x,x, color="grey", linestyle="--")
plt.show()
```



[114]:

```
# hypothetical scenario with same number of homeless and non homeless people

n_non_homeless = 88025

nyc_slice = PIT_sliced[PIT_sliced["CoC Number"]=="NY-600"]
total_homeless = nyc_slice["Overall Homeless"].values[0]

# Calculate demographic percentages
race_cols = ["Overall Homeless - White",
            "Overall Homeless - Black, African American, or African",
            "Overall Homeless - Asian or Asian American",
            "Overall Homeless - American Indian, Alaska Native, or Indigenous",
            "Overall Homeless - Native Hawaiian or Other Pacific Islander",
            "Overall Homeless - Multiple Races"]

race_probs = []
```

```
for col in race_cols:
    race_probs.append(nyc_slice[col].values[0] / total_homeless)

# Create simulated population
np.random.seed(42)
n_simulated = 88025

# Simulate race based on observed proportions
simulated_race = np.random.choice(len(race_cols), size=n_simulated,␣
 ↪p=race_probs)

# Create dataframe with simulated data
simulated_df = pd.DataFrame({
    "race": [race_cols[i].replace("Overall Homeless - ", "") for i in␣
 ↪simulated_race]
})

# Add age based on NYC proportions
age_cols = ["Overall Homeless - Under 18",
           "Overall Homeless - Age 18 to 24",
           "Overall Homeless - Age 25 to 34",
           "Overall Homeless - Age 35 to 44",
           "Overall Homeless - Age 45 to 54",
           "Overall Homeless - Age 55 to 64",
           "Overall Homeless - Over 64"]

age_probs = []
for col in age_cols:
    age_probs.append(nyc_slice[col].values[0] / total_homeless)

simulated_df["age"] = np.random.choice(
    [col.replace("Overall Homeless - ", "").replace("Age ", "") for col in␣
 ↪age_cols],
    size=n_simulated,
    p=age_probs
)

# Add gender based on NYC proportions
gender_cols = ["Overall Homeless - Female",
              "Overall Homeless - Male",
              "Overall Homeless - Transgender",
              "Overall Homeless - Gender that is not Singularly Female or Male",
              "Overall Homeless - Gender Questioning"]

gender_probs = []
for col in gender_cols:
    gender_probs.append(nyc_slice[col].values[0] / total_homeless)
```

```python
simulated_df["gender"] = np.random.choice(
    [col.replace("Overall Homeless - ", "") for col in gender_cols],
    size=n_simulated,
    p=gender_probs
)


simulated_df["homeless"] = 1


non_homeless_df = pd.DataFrame()

race_probs = {
    "White": 0.375,
    "Black, African American, or African": 0.231,
    "Asian or Asian American": 0.145,
    "Multiple Races": 0.089,
    "American Indian, Alaska Native, or Indigenous": 0.006,
    "Native Hawaiian or Other Pacific Islander": 0.001,
    "Hispanic or Latino": 0.29 - 0.137
}

non_homeless_df["race"] = np.random.choice(
    list(race_probs.keys()),
    size=n_non_homeless,
    p=list(race_probs.values())
)

# Age distribution based on NYC census
age_dist = {
    "Under 18": 0.21,
    "18 to 24": 0.10,
    "25 to 34": 0.17,
    "35 to 44": 0.14,
    "45 to 54": 0.13,
    "55 to 64": 0.13,
    "Over 64": 0.12
}

non_homeless_df["age"] = np.random.choice(
    list(age_dist.keys()),
    size=n_non_homeless,
    p=list(age_dist.values())
)

# Gender distribution based on NYC census
```

```
gender_dist = {
    "Female": 0.52 - (0.0012 +  0.0007 + 0.0001)/2,
    "Male": 0.48 - (0.0012 +  0.0007 + 0.0001)/2,
    "Other": 0.0012 +  0.0007 + 0.0001
}

non_homeless_df["gender"] = np.random.choice(
    list(gender_dist.keys()),
    size=n_non_homeless,
    p=list(gender_dist.values())
)

non_homeless_df["homeless"] = 0

# Combine homeless and non-homeless populations
simulated_df = pd.concat([simulated_df, non_homeless_df], ignore_index=True)
#simulated_df.drop("ethnicity", axis=1, inplace=True)
```

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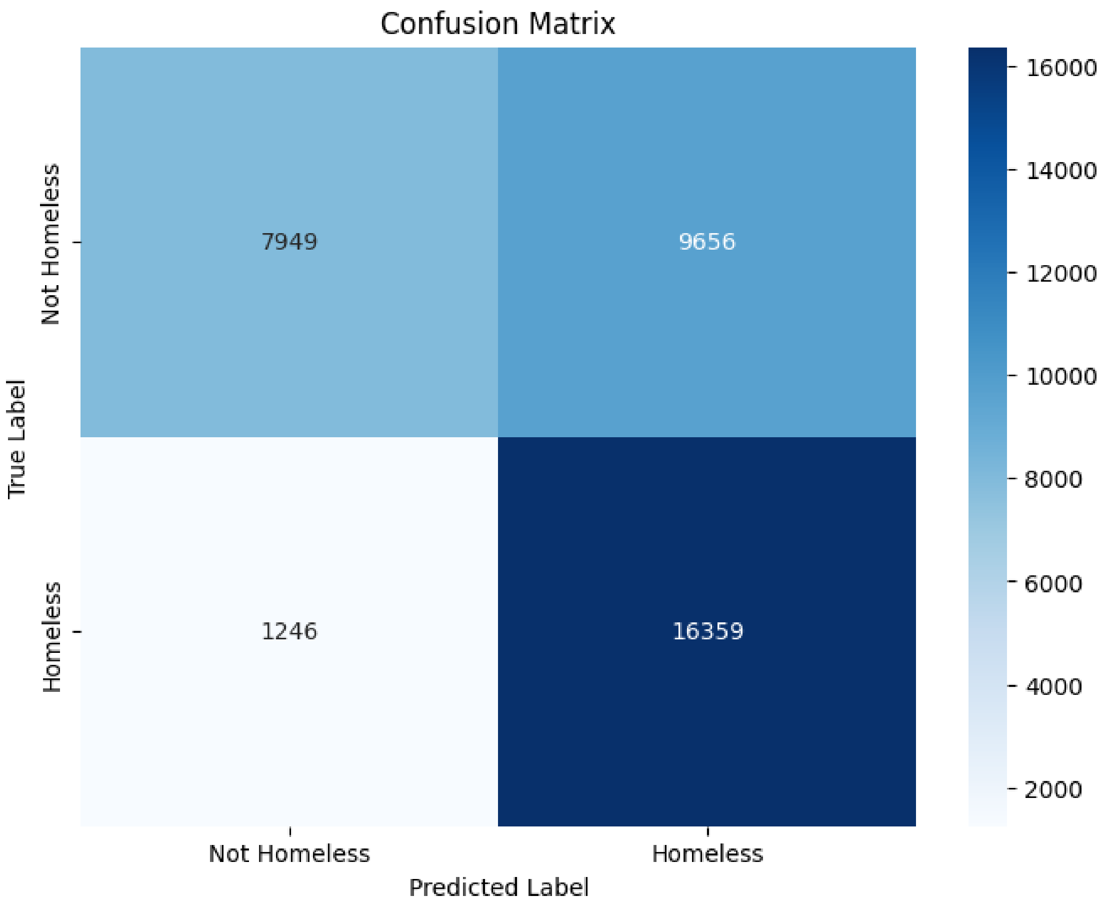
```
df = simulated_df.copy()



X = pd.get_dummies(df[["race", "age", "gender"]], drop_first=True)
y = df["homeless"]



X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42, stratify=y)



scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)



model = LogisticRegression(
    class_weight="balanced",
    max_iter=1000,
    random_state=42,
    C=0.1
)
model.fit(X_train, y_train)

y_pred_proba = model.predict_proba(X_test_scaled)[:, 1]



precisions, recalls, thresholds = precision_recall_curve(y_test, y_pred_proba)
f1_scores = 2 * (precisions * recalls) / (precisions + recalls)
```

```python
optimal_threshold = thresholds[np.argmax(f1_scores[:-1])]


y_pred = (y_pred_proba >= optimal_threshold).astype(int)


print(f"Optimal threshold: {optimal_threshold:.3f}")
print("\nClassification Report with Optimal Threshold:")
print(classification_report(y_test, y_pred, zero_division=0))


roc_auc = roc_auc_score(y_test, y_pred_proba)
print(f"\nROC AUC Score: {roc_auc:.3f}")


feature_importance = pd.DataFrame({
    "feature": X.columns,
    "importance": abs(model.coef_[0])
})
feature_importance = feature_importance.sort_values("importance", ascending=False)
print("\nTop 10 Most Important Features:")
print(feature_importance.head(10))


plt.figure(figsize=(8, 6))
sns.heatmap(confusion_matrix(y_test, y_pred),
            annot=True,
            fmt="d",
            cmap="Blues",
            xticklabels=["Not Homeless", "Homeless"],
            yticklabels=["Not Homeless", "Homeless"])
plt.title("Confusion Matrix")
plt.ylabel("True Label")
plt.xlabel("Predicted Label")
plt.show()
```

```
/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/site-
packages/sklearn/base.py:493: UserWarning:

X does not have valid feature names, but LogisticRegression was fitted with
feature names


Optimal threshold: 0.473

Classification Report with Optimal Threshold:
              precision    recall  f1-score   support
```

```
           0       0.86      0.45      0.59     17605
           1       0.63      0.93      0.75     17605

    accuracy                           0.69     35210
   macro avg       0.75      0.69      0.67     35210
weighted avg       0.75      0.69      0.67     35210


ROC AUC Score: 0.803

Top 10 Most Important Features:
                                              feature  importance
2                             race_Hispanic or Latino    5.321921
0                        race_Asian or Asian American    2.855276
16                                 gender_Transgender    2.612394
15                                       gender_Other    1.689474
10                                        age_Over 64    1.105533
1            race_Black, African American, or African    0.964928
13  gender_Gender that is not Singularly Female or…   0.816621
4      race_Native Hawaiian or Other Pacific Islander    0.703543
3                                 race_Multiple Races    0.624683
5                                          race_White    0.525241
```

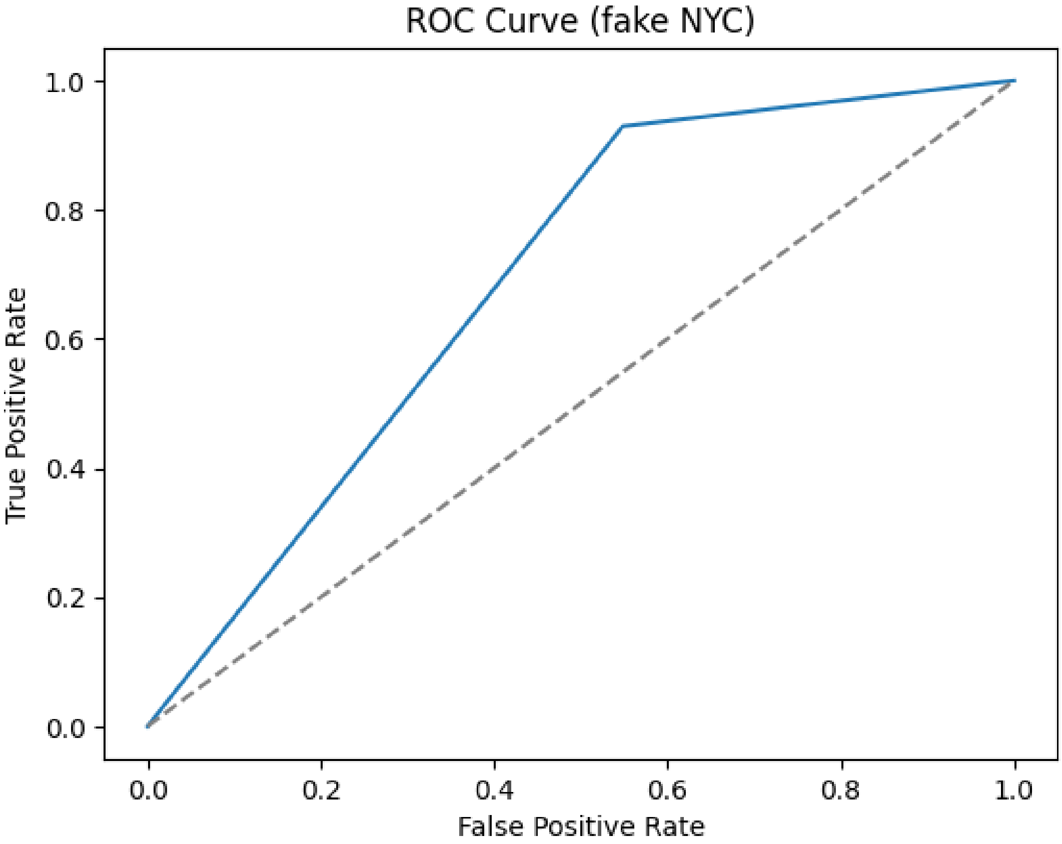


[ ]:

```
```

[116]:

```
fpr, tpr, thresholds = roc_curve(y_test, y_pred)

# use the model to make an roc curve

x = np.linspace(0, 1, 100)
plt.plot(fpr, tpr)
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC Curve (fake NYC)')

# random chance line
plt.plot(x,x, color="grey", linestyle="--")

plt.show()
```


ROC Curve (fake NYC)
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.2
0.4
0.6
0.8
1.0