smith-stage-2

March 13, 2023

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

[2]:
```
population = pd.read_csv('data/covid_county_population_usafacts.csv', usecols=␣
 ↪['State', 'population'])

population = population[population.State != 0]

population = population.set_index('State')
population
```

[2]:
```
       population
State
AL              0
AL          55869
AL         223234
AL          24686
AL          22394
…               …
WY          42343
WY          23464
WY          20226
WY           7805
WY           6927

[3195 rows x 1 columns]
```

[3]:
```
confirmed = pd.read_csv('data/covid_confirmed_usafacts.csv')
confirmed = confirmed.drop(confirmed.iloc[:, 4 : 864], axis=1)
confirmed = confirmed.drop(confirmed.iloc[:, 219 : 235], axis=1)

# Calculating the difference to get the new cases
for i in range (5, len(confirmed.columns)):
    diff = confirmed[confirmed.columns[i]] - confirmed[confirmed.columns[i - 1]]
    confirmed[f'new_cases {confirmed.columns[i]}'] = diff
```

```
confirmed = confirmed.drop(confirmed.iloc[:, 4:219], axis= 1)
temp = {}
j = ((len(confirmed.columns) - 4) % 7) - 1

length = len(confirmed.columns) - 3
for i in range(4, len(confirmed.columns), 7):
    if (length) < (i + 7) :
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + j]} Sum'] =␣
 ↪confirmed[confirmed.columns[i:i + j]].sum(axis=1)
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + j]} Mean']␣
 ↪= confirmed[confirmed.columns[i:i + j]].mean(axis=1).round()
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + j]}␣
 ↪Median'] = confirmed[confirmed.columns[i:i + j]].median(axis=1).round()
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + j]} Mode']␣
 ↪= confirmed[confirmed.columns[i:i + j]].mode(axis=1)[0]
    else:
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + 7]} Sum'] =␣
 ↪confirmed[confirmed.columns[i:i + 7]].sum(axis=1)
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + 7]} Mean']␣
 ↪= confirmed[confirmed.columns[i:i + 7]].mean(axis=1).round()
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + 7]}␣
 ↪Median'] = confirmed[confirmed.columns[i:i + 7]].median(axis=1).round()
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + 7]} Mode']␣
 ↪= confirmed[confirmed.columns[i:i + 7]].mode(axis=1)[0]

confirmed.columns = confirmed.columns.str.replace('new_cases ', '')

confirmed
```

[3]:

	countyFIPS	County Name	State	StateFIPS	2022-06-01	\
0	0	Statewide Unallocated	AL	1	0	
1	1001	Autauga County	AL	1	6	
2	1003	Baldwin County	AL	1	68	
3	1005	Barbour County	AL	1	3	
4	1007	Bibb County	AL	1	8	
…	…	…	…	…	…	
3188	56037	Sweetwater County	WY	56	0	
3189	56039	Teton County	WY	56	0	
3190	56041	Uinta County	WY	56	0	
3191	56043	Washakie County	WY	56	0	
3192	56045	Weston County	WY	56	0	

	2022-06-02	2022-06-03	2022-06-04	2022-06-05	2022-06-06	…	\
0	0	0	0	0	0	…	
1	9	0	0	0	54	…	
2	68	0	0	0	247	…	

```
3              4           0           0           0           5  …
4              4           0           0           0          22  …
…          …          …          …          …          …  …
3188           0           0           0           0           0  …
3189           0           0           0           0           0  …
3190           0           0           0           0           0  …
3191           0           0           0           0           0  …
3192           0           0           0           0           0  …

      2022-12-14 - 2022-12-21 Median  2022-12-14 - 2022-12-21 Mode  \
0                                 0.0                           0.0
1                                 0.0                           0.0
2                                 0.0                           0.0
3                                 0.0                           0.0
4                                 0.0                           0.0
…                                 …                             …
3188                              0.0                           0.0
3189                              0.0                           0.0
3190                              0.0                           0.0
3191                              0.0                           0.0
3192                              0.0                           0.0

      2022-12-21 - 2022-12-28 Sum  2022-12-21 - 2022-12-28 Mean  \
0                               0                           0.0
1                             114                          16.0
2                             275                          39.0
3                              20                           3.0
4                              24                           3.0
…                              …                             …
3188                           20                           3.0
3189                           29                           4.0
3190                           16                           2.0
3191                            0                           0.0
3192                            5                           1.0

      2022-12-21 - 2022-12-28 Median  2022-12-21 - 2022-12-28 Mode  \
0                                 0.0                           0.0
1                                 0.0                           0.0
2                                 0.0                           0.0
3                                 0.0                           0.0
4                                 0.0                           0.0
…                                 …                             …
3188                              0.0                           0.0
3189                              0.0                           0.0
3190                              0.0                           0.0
3191                              0.0                           0.0
3192                              0.0                           0.0
```

```
      2022-12-28 - 2022-12-31 Sum  2022-12-28 - 2022-12-31 Mean  \
0                                0                           0.0
1                                0                           0.0
2                                0                           0.0
3                                0                           0.0
4                                0                           0.0
…                              …                             …
3188                             0                           0.0
3189                             0                           0.0
3190                             0                           0.0
3191                             0                           0.0
3192                             0                           0.0

      2022-12-28 - 2022-12-31 Median  2022-12-28 - 2022-12-31 Mode
0                                0.0                          0.0
1                                0.0                          0.0
2                                0.0                          0.0
3                                0.0                          0.0
4                                0.0                          0.0
…                              …                            …
3188                             0.0                          0.0
3189                             0.0                          0.0
3190                             0.0                          0.0
3191                             0.0                          0.0
3192                             0.0                          0.0

[3193 rows x 342 columns]
```

[4]:
```
deaths = pd.read_csv("data/covid_deaths_usafacts.csv")

deaths = deaths.drop(deaths.iloc[:, 4 : 864], axis=1)
deaths = deaths.drop(deaths.iloc[:, 219 : 235], axis=1)

for i in range (5, len(deaths.columns)):
    diff = deaths[deaths.columns[i]] - deaths[deaths.columns[i - 1]]
    deaths[f'new_deaths {deaths.columns[i]}'] = diff

deaths = deaths.drop(deaths.iloc[:, 4:219], axis= 1)
temp = {}
j = ((len(deaths.columns) - 4) % 7) - 1

length = len(deaths.columns) - 3
for i in range(4, len(deaths.columns), 7):
    if (length) < (i + 7) :
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + j]} Sum'] =␣
 ↪deaths[deaths.columns[i:i + j]].sum(axis=1)
```

```
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + j]} Mean'] =␣
 ↪deaths[deaths.columns[i:i + j]].mean(axis=1).round()
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + j]} Median'] =␣
 ↪deaths[deaths.columns[i:i + j]].median(axis=1).round()
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + j]} Mode'] =␣
 ↪deaths[deaths.columns[i:i + j]].mode(axis=1)[0]
    else:
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + 7]} Sum'] =␣
 ↪deaths[deaths.columns[i:i + 7]].sum(axis=1)
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + 7]} Mean'] =␣
 ↪deaths[deaths.columns[i:i + 7]].mean(axis=1).round()
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + 7]} Median'] =␣
 ↪deaths[deaths.columns[i:i + 7]].median(axis=1).round()
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + 7]} Mode'] =␣
 ↪deaths[deaths.columns[i:i + 7]].mode(axis=1)[0]


deaths.columns = deaths.columns.str.replace('new_deaths ', '')
deaths
```

[4]:

	countyFIPS	County Name	State	StateFIPS	2022-06-01	\
0	0	Statewide Unallocated	AL	1	0	
1	1001	Autauga County	AL	1	0	
2	1003	Baldwin County	AL	1	0	
3	1005	Barbour County	AL	1	0	
4	1007	Bibb County	AL	1	0	
…	…	…	…	…	…	
3188	56037	Sweetwater County	WY	56	0	
3189	56039	Teton County	WY	56	0	
3190	56041	Uinta County	WY	56	0	
3191	56043	Washakie County	WY	56	0	
3192	56045	Weston County	WY	56	0	

	2022-06-02	2022-06-03	2022-06-04	2022-06-05	2022-06-06	…	\
0	0	0	0	0	0	…	
1	0	0	0	0	0	…	
2	0	0	0	0	0	…	
3	0	0	0	0	0	…	
4	0	0	0	0	0	…	
…	…	…	…	…	…	…	
3188	0	0	0	0	0	…	
3189	0	0	0	0	0	…	
3190	0	0	0	0	0	…	
3191	0	0	0	0	0	…	
3192	0	0	0	0	0	…	

```
      2022-12-14 - 2022-12-21 Median  2022-12-14 - 2022-12-21 Mode  \
0                                0.0                              0
1                                0.0                              0
2                                0.0                              0
3                                0.0                              0
4                                0.0                              0
…                                …                              …
3188                             0.0                              0
3189                             0.0                              0
3190                             0.0                              0
3191                             0.0                              0
3192                             0.0                              0

      2022-12-21 - 2022-12-28 Sum  2022-12-21 - 2022-12-28 Mean  \
0                               0                            0.0
1                               0                            0.0
2                               2                            0.0
3                               0                            0.0
4                               0                            0.0
…                             …                            …
3188                            1                            0.0
3189                            0                            0.0
3190                            0                            0.0
3191                            0                            0.0
3192                            0                            0.0

      2022-12-21 - 2022-12-28 Median  2022-12-21 - 2022-12-28 Mode  \
0                                0.0                              0
1                                0.0                              0
2                                0.0                              0
3                                0.0                              0
4                                0.0                              0
…                                …                              …
3188                             0.0                              0
3189                             0.0                              0
3190                             0.0                              0
3191                             0.0                              0
3192                             0.0                              0

      2022-12-28 - 2022-12-31 Sum  2022-12-28 - 2022-12-31 Mean  \
0                               0                            0.0
1                               0                            0.0
2                               0                            0.0
3                               0                            0.0
4                               0                            0.0
…                             …                            …
3188                            0                            0.0
```

```
3189                              0                              0.0
3190                              0                              0.0
3191                              0                              0.0
3192                              0                              0.0

      2022-12-28 - 2022-12-31 Median  2022-12-28 - 2022-12-31 Mode
0                                 0.0                            0.0
1                                 0.0                            0.0
2                                 0.0                            0.0
3                                 0.0                            0.0
4                                 0.0                            0.0
…                                 …                              …
3188                              0.0                            0.0
3189                              0.0                            0.0
3190                              0.0                            0.0
3191                              0.0                            0.0
3192                              0.0                            0.0

[3193 rows x 342 columns]
```

[5]:
```
confirmed = confirmed.merge(population, how='left', on='State')
deaths = deaths.merge(population, how='left', on='State')
```

[6]:
```
ny_confirmed = confirmed[confirmed['StateFIPS'] == 36]
ny_confirmed = ny_confirmed.drop(ny_confirmed.iloc[:, 4 : 218], axis=1)

ny_confirmed
```

[6]:
```
        countyFIPS            County Name State  StateFIPS  \
161549           0  Statewide Unallocated    NY         36
161550           0  Statewide Unallocated    NY         36
161551           0  Statewide Unallocated    NY         36
161552           0  Statewide Unallocated    NY         36
161553           0  Statewide Unallocated    NY         36
…              …                      …   …         …
165576       36123          Yates County     NY         36
165577       36123          Yates County     NY         36
165578       36123          Yates County     NY         36
165579       36123          Yates County     NY         36
165580       36123          Yates County     NY         36

        2022-06-01 - 2022-06-08 Sum  2022-06-01 - 2022-06-08 Mean  \
161549                            0                            0.0
161550                            0                            0.0
161551                            0                            0.0
161552                            0                            0.0
161553                            0                            0.0
```

```
…                                …                                …
165576                             7                              1.0
165577                             7                              1.0
165578                             7                              1.0
165579                             7                              1.0
165580                             7                              1.0

        2022-06-01 - 2022-06-08 Median  2022-06-01 - 2022-06-08 Mode  \
161549                             0.0                            0.0
161550                             0.0                            0.0
161551                             0.0                            0.0
161552                             0.0                            0.0
161553                             0.0                            0.0
…                                  …                              …
165576                             1.0                            1.0
165577                             1.0                            1.0
165578                             1.0                            1.0
165579                             1.0                            1.0
165580                             1.0                            1.0

        2022-06-08 - 2022-06-15 Sum  2022-06-08 - 2022-06-15 Mean  …  \
161549                            0                            0.0  …
161550                            0                            0.0  …
161551                            0                            0.0  …
161552                            0                            0.0  …
161553                            0                            0.0  …
…                                 …                            …  …
165576                           16                            2.0  …
165577                           16                            2.0  …
165578                           16                            2.0  …
165579                           16                            2.0  …
165580                           16                            2.0  …

        2022-12-14 - 2022-12-21 Mode  2022-12-21 - 2022-12-28 Sum  \
161549                             0.0                            0
161550                             0.0                            0
161551                             0.0                            0
161552                             0.0                            0
161553                             0.0                            0
…                                  …                              …
165576                             0.0                            0
165577                             0.0                            0
165578                             0.0                            0
165579                             0.0                            0
165580                             0.0                            0

        2022-12-21 - 2022-12-28 Mean  2022-12-21 - 2022-12-28 Median  \
```

```
161549                          0.0                          0.0
161550                          0.0                          0.0
161551                          0.0                          0.0
161552                          0.0                          0.0
161553                          0.0                          0.0
…                               …                            …
165576                          0.0                          0.0
165577                          0.0                          0.0
165578                          0.0                          0.0
165579                          0.0                          0.0
165580                          0.0                          0.0

        2022-12-21 - 2022-12-28 Mode  2022-12-28 - 2022-12-31 Sum  \
161549                          0.0                            0
161550                          0.0                            0
161551                          0.0                            0
161552                          0.0                            0
161553                          0.0                            0
…                               …                              …
165576                          0.0                           18
165577                          0.0                           18
165578                          0.0                           18
165579                          0.0                           18
165580                          0.0                           18

        2022-12-28 - 2022-12-31 Mean  2022-12-28 - 2022-12-31 Median  \
161549                          0.0                            0.0
161550                          0.0                            0.0
161551                          0.0                            0.0
161552                          0.0                            0.0
161553                          0.0                            0.0
…                               …                              …
165576                          6.0                            0.0
165577                          6.0                            0.0
165578                          6.0                            0.0
165579                          6.0                            0.0
165580                          6.0                            0.0

        2022-12-28 - 2022-12-31 Mode  population
161549                          0.0           0
161550                          0.0           0
161551                          0.0      305506
161552                          0.0       46091
161553                          0.0     1418207
…                               …           …
165576                          0.0       61204
165577                          0.0       89918
```

```
165578                          0.0      967506
165579                          0.0       39859
165580                          0.0       24913

[4032 rows x 129 columns]
```

[7]:
```
ny_deaths = deaths[deaths['StateFIPS'] == 36]
ny_deaths = ny_deaths.drop(ny_deaths.iloc[:, 4 : 218], axis=1)

ny_deaths
```

[7]:
```
        countyFIPS            County Name State  StateFIPS  \
161549           0  Statewide Unallocated    NY         36
161550           0  Statewide Unallocated    NY         36
161551           0  Statewide Unallocated    NY         36
161552           0  Statewide Unallocated    NY         36
161553           0  Statewide Unallocated    NY         36
…              …                     …   …         …
165576       36123          Yates County     NY         36
165577       36123          Yates County     NY         36
165578       36123          Yates County     NY         36
165579       36123          Yates County     NY         36
165580       36123          Yates County     NY         36

        2022-06-01 - 2022-06-08 Sum  2022-06-01 - 2022-06-08 Mean  \
161549                            1                           0.0
161550                            1                           0.0
161551                            1                           0.0
161552                            1                           0.0
161553                            1                           0.0
…                               …                           …
165576                            0                           0.0
165577                            0                           0.0
165578                            0                           0.0
165579                            0                           0.0
165580                            0                           0.0

        2022-06-01 - 2022-06-08 Median  2022-06-01 - 2022-06-08 Mode  \
161549                             0.0                           0.0
161550                             0.0                           0.0
161551                             0.0                           0.0
161552                             0.0                           0.0
161553                             0.0                           0.0
…                                …                           …
165576                             0.0                           0.0
165577                             0.0                           0.0
165578                             0.0                           0.0
```

```
165579                            0.0                            0.0
165580                            0.0                            0.0

        2022-06-08 - 2022-06-15 Sum  2022-06-08 - 2022-06-15 Mean  …  \
161549                            2                            0.0  …
161550                            2                            0.0  …
161551                            2                            0.0  …
161552                            2                            0.0  …
161553                            2                            0.0  …
…                               …                              …  …
165576                            0                            0.0  …
165577                            0                            0.0  …
165578                            0                            0.0  …
165579                            0                            0.0  …
165580                            0                            0.0  …

        2022-12-14 - 2022-12-21 Mode  2022-12-21 - 2022-12-28 Sum  \
161549                             0                             1
161550                             0                             1
161551                             0                             1
161552                             0                             1
161553                             0                             1
…                                …                             …
165576                             0                             0
165577                             0                             0
165578                             0                             0
165579                             0                             0
165580                             0                             0

        2022-12-21 - 2022-12-28 Mean  2022-12-21 - 2022-12-28 Median  \
161549                           0.0                              0.0
161550                           0.0                              0.0
161551                           0.0                              0.0
161552                           0.0                              0.0
161553                           0.0                              0.0
…                                …                              …
165576                           0.0                              0.0
165577                           0.0                              0.0
165578                           0.0                              0.0
165579                           0.0                              0.0
165580                           0.0                              0.0

        2022-12-21 - 2022-12-28 Mode  2022-12-28 - 2022-12-31 Sum  \
161549                             0                             3
161550                             0                             3
161551                             0                             3
161552                             0                             3
```

```
161553                              0                              3
…                                 …                              …
165576                              0                              0
165577                              0                              0
165578                              0                              0
165579                              0                              0
165580                              0                              0

        2022-12-28 - 2022-12-31 Mean  2022-12-28 - 2022-12-31 Median  \
161549                           1.0                              0.0
161550                           1.0                              0.0
161551                           1.0                              0.0
161552                           1.0                              0.0
161553                           1.0                              0.0
…                                …                                …
165576                           0.0                              0.0
165577                           0.0                              0.0
165578                           0.0                              0.0
165579                           0.0                              0.0
165580                           0.0                              0.0

        2022-12-28 - 2022-12-31 Mode  population
161549                           0.0           0
161550                           0.0           0
161551                           0.0      305506
161552                           0.0       46091
161553                           0.0     1418207
…                                …           …
165576                           0.0       61204
165577                           0.0       89918
165578                           0.0      967506
165579                           0.0       39859
165580                           0.0       24913

[4032 rows x 129 columns]
```

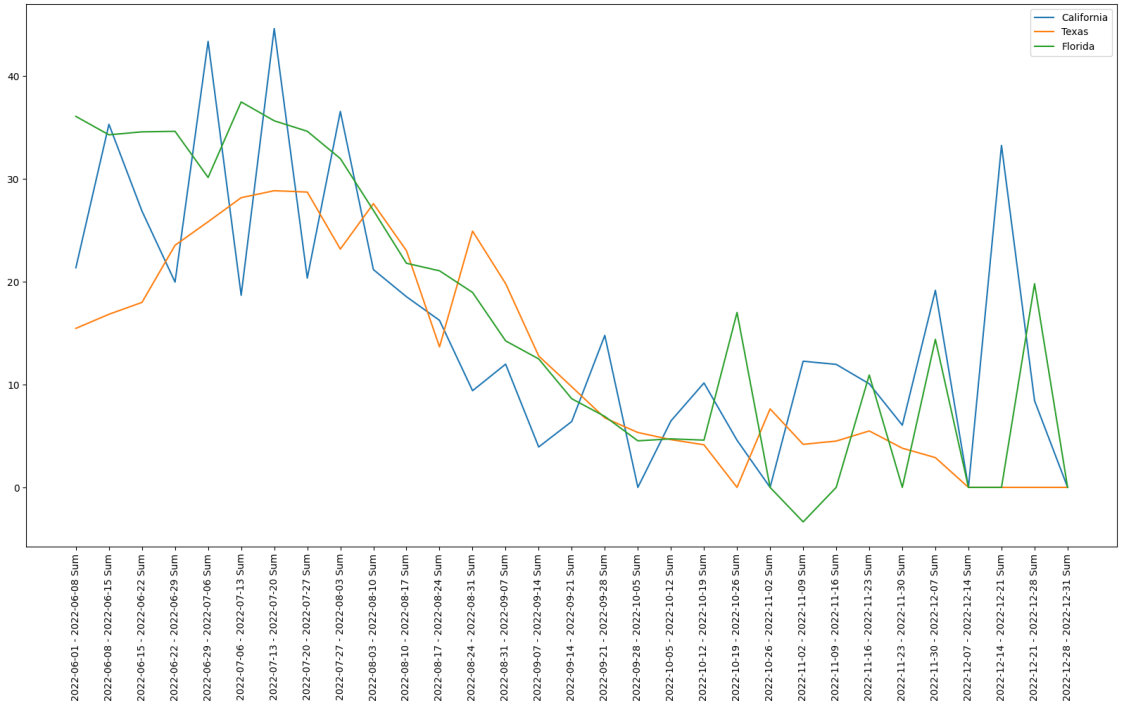
[8]:
```python
#get same statistics for three other states, choosing TX, CA, FL
ca_confirmed = confirmed[confirmed['StateFIPS'] == 6]
ca_confirmed = ca_confirmed.drop(ca_confirmed.iloc[:, 4 : 218], axis=1)
tx_confirmed = confirmed[confirmed['StateFIPS'] == 48]
tx_confirmed = tx_confirmed.drop(tx_confirmed.iloc[:, 4 : 218], axis=1)
fl_confirmed = confirmed[confirmed['StateFIPS'] == 12]
fl_confirmed = fl_confirmed.drop(fl_confirmed.iloc[:, 4 : 218], axis=1)

ca_deaths = deaths[deaths['StateFIPS'] == 6]
ca_deaths = ca_deaths.drop(ca_deaths.iloc[:, 4 : 218], axis=1)
tx_deaths = deaths[deaths['StateFIPS'] == 48]
```

```
tx_deaths = tx_deaths.drop(tx_deaths.iloc[:, 4 : 218], axis=1)
fl_deaths = deaths[deaths['StateFIPS'] == 12]
fl_deaths = fl_deaths.drop(fl_deaths.iloc[:, 4 : 218], axis=1)
```

[9]:
```
#function for normalizing the data between the four states
def normalization(data):
    d = data
    d = d.filter(regex=r'Sum|population')
    d = d.sum()

    norm_cases = {}
    for x in range(0, len(d) - 1):
        denominator = d['population']
        norm_cases[f'{d.index.values[x]}'] = ((d[x] / denominator) * 10000)

    return norm_cases
```

[10]:
```
ca_normalized_cases = normalization(ca_confirmed)
ca_normalized_deaths = normalization(ca_deaths)

tx_normalized_cases = normalization(tx_confirmed)
tx_normalized_deaths = normalization(tx_deaths)

fl_normalized_cases = normalization(fl_confirmed)
fl_normalized_deaths = normalization(fl_deaths)
```

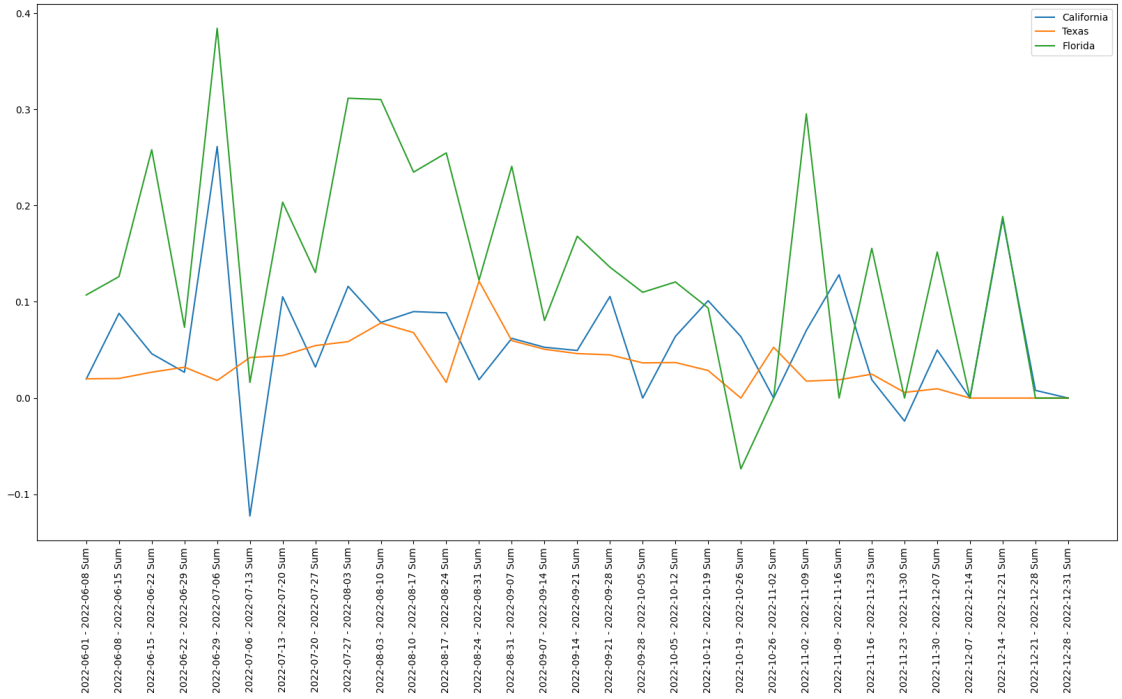
[11]:
```
from matplotlib import pyplot as plt
plt.figure(figsize=(20, 10))

#plt.plot(ny_normalized_cases.keys(), ny_normalized_cases.values(), label =␣
 ↪'New York')
plt.plot(ca_normalized_cases.keys(), ca_normalized_cases.values(), label =␣
 ↪'California')
plt.plot(tx_normalized_cases.keys(), tx_normalized_cases.values(), label =␣
 ↪'Texas')
plt.plot(fl_normalized_cases.keys(), fl_normalized_cases.values(), label =␣
 ↪'Florida')
plt.xticks(rotation=90)

plt.legend()
plt.show()
```



Here we see the confirmed cases between three states: Texas, California and Florida. We want to discuss why we see a difference in the rates between these three states. From the lines we can tell that the most prone to massive shifts in recorded cases is California, but they also have consistently the most cases out of the three states. The reason for these jumps in confirmed cases is that the state of California reports covid 19 cases every week and a half. Because of this staggered reporting basis, it could lead to more jumps in the data. However, California sees the most volatility not because it has a higher population than the other two states, but because out of the three shown it has the highest population density. It is going to be the most prone to higher rates of confirmed cases because of cities like Los Angeles, San Diego and San Jose.

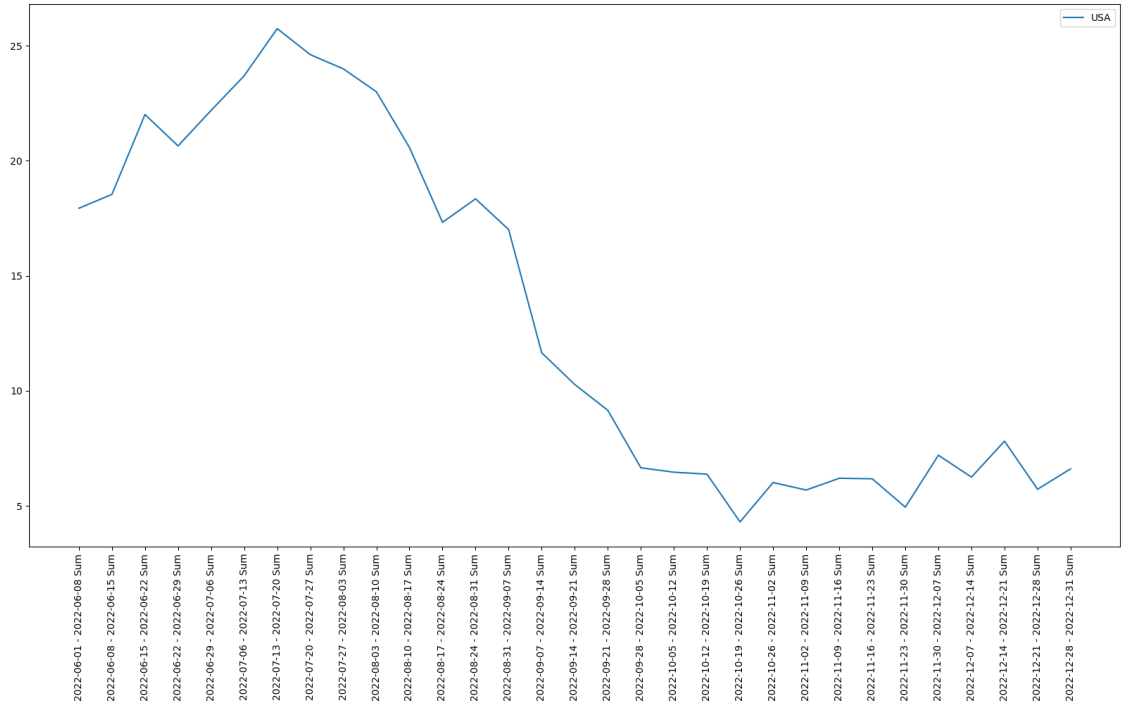
[12]:
```
from matplotlib import pyplot as plt
plt.figure(figsize=(20, 10))

#plt.plot(ny_normalized_deaths.keys(), ny_normalized_deaths.values(), label =␣
 ↪'New York')
plt.plot(ca_normalized_deaths.keys(), ca_normalized_deaths.values(), label =␣
 ↪'California')
plt.plot(tx_normalized_deaths.keys(), tx_normalized_deaths.values(), label =␣
 ↪'Texas')
plt.plot(fl_normalized_deaths.keys(), fl_normalized_deaths.values(), label =␣
 ↪'Florida')
plt.xticks(rotation=90)

plt.legend()
```

```
plt.show()
```

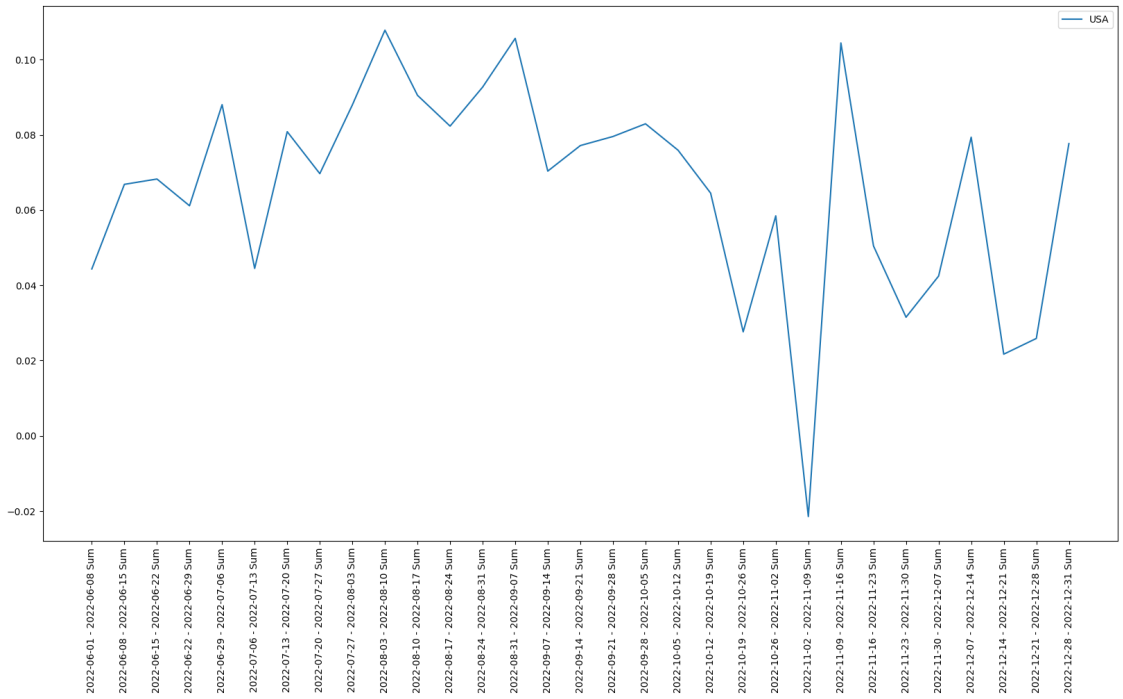


When it comes to deaths, interestingly, we see fairly volatile information. However, what we do notice is that Florida and California consistently have more reported deaths than Texas. One big reason why we might see more people dying in Florida and California is that more elderly men and women retire to those places. Elderly men and women are among those more susceptible and likely to have fatal interactions with the virus versus Texas which may have a lower population of elderly and immunocompromised individuals. This would also, in some part, explain some of the volatility we see in the data. This idea, combined with the fact of those two states having a higher population density, can lend itself well to Covid 19 being more fatal to Florida and California than Texas.

[13]:
```
us_cases_normalized = normalization(confirmed)

plt.figure(figsize=(20, 10))
plt.plot(us_cases_normalized.keys(), us_cases_normalized.values(), label =␣
  ↪'USA')
plt.xticks(rotation=90)

plt.legend()
plt.show()
```



[14]:
```
us_deaths_normalized = normalization(deaths)

plt.figure(figsize=(20, 10))
plt.plot(us_deaths_normalized.keys(), us_deaths_normalized.values(), label =␣
↪'USA')
plt.xticks(rotation=90)

plt.legend()
plt.show()
```



When we analyze this data and compare it to the US rates of cases and deaths, we see that generally the cases and deaths match in terms of their trends. Cases start high and then reduce approaching the end of the year with spikes approaching the holidays.

[15]:
```
#Identifying the top 3 counties in New York with high case and death rates␣
 ↪based on population
county_sum_cases = ny_confirmed.groupby('County Name').sum()
county_sum_cases = county_sum_cases[county_sum_cases.columns.
 ↪drop(list(county_sum_cases.filter(regex='Mean|Median|Mode')))]
county_sum_cases['county_sums'] = county_sum_cases.iloc[:, 0 : 33].sum(axis=1)
county_sum_cases
```

[15]:

County Name	countyFIPS	StateFIPS	2022-06-01 - 2022-06-08 Sum	\
Albany County	2304064	2304	35136	
Allegany County	2304192	2304	1920	
Bronx County	2304320	2304	192000	
Broome County	2304448	2304	13632	
Cattaraugus County	2304576	2304	5632	
…	…	…	…	
Washington County	2311360	2304	5568	
Wayne County	2311488	2304	4096	
Westchester County	2311616	2304	155008	
Wyoming County	2311744	2304	1536	
Yates County	2311872	2304	448	

County Name	2022-06-08 - 2022-06-15 Sum	2022-06-15 - 2022-06-22 Sum	\
Albany County	21248	18176	
Allegany County	2048	1408	
Bronx County	164800	163904	
Broome County	9408	7168	
Cattaraugus County	4352	3392	
…	…	…	
Washington County	4160	2560	
Wayne County	3520	3264	
Westchester County	129792	117376	
Wyoming County	896	1920	
Yates County	1024	1216	

County Name	2022-06-22 - 2022-06-29 Sum	2022-06-29 - 2022-07-06 Sum	\
Albany County	18688	19520	
Allegany County	2368	1472	
Bronx County	159872	217920	
Broome County	6720	8640	
Cattaraugus County	2880	3776	
…	…	…	
Washington County	2176	2496	
Wayne County	3008	3456	
Westchester County	111552	148672	
Wyoming County	960	512	
Yates County	768	320	

County Name	2022-07-06 - 2022-07-13 Sum	2022-07-13 - 2022-07-20 Sum	\
Albany County	28224	29184	
Allegany County	2176	1728	
Bronx County	305728	308992	
Broome County	13376	12160	
Cattaraugus County	3776	3840	
…	…	…	
Washington County	4096	4160	
Wayne County	6720	5248	
Westchester County	177152	160320	
Wyoming County	1280	768	
Yates County	1408	896	

County Name	2022-07-20 - 2022-07-27 Sum	…	\
Albany County	26496	…	
Allegany County	1728	…	

Bronx County	231936	…
Broome County	13376	…
Cattaraugus County	3584	…
…	…	…
Washington County	2624	…
Wayne County	4352	…
Westchester County	120704	…
Wyoming County	2240	…
Yates County	576	…

County Name	2022-11-09 - 2022-11-16 Sum	2022-11-16 - 2022-11-23 Sum	\
Albany County	14912	10048	
Allegany County	1664	1024	
Bronx County	150016	151296	
Broome County	10496	8576	
Cattaraugus County	2752	2176	
…	…	…	
Washington County	2432	2112	
Wayne County	3648	2816	
Westchester County	77440	86272	
Wyoming County	832	1856	
Yates County	960	832	

County Name	2022-11-23 - 2022-11-30 Sum	2022-11-30 - 2022-12-07 Sum	\
Albany County	13440	7104	
Allegany County	2048	384	
Bronx County	159744	91968	
Broome County	9344	7552	
Cattaraugus County	1856	960	
…	…	…	
Washington County	3648	1600	
Wayne County	4224	1792	
Westchester County	102272	49216	
Wyoming County	1024	320	
Yates County	576	384	

County Name	2022-12-07 - 2022-12-14 Sum	2022-12-14 - 2022-12-21 Sum	\
Albany County	16128	26624	
Allegany County	1792	2368	
Bronx County	214784	365760	
Broome County	13376	19648	
Cattaraugus County	1600	5632	
…	…	…	
Washington County	4480	7552	

```
Wayne County                              5376                          7872
Westchester County                      131008                        230848
Wyoming County                            1536                          2368
Yates County                               448                          1536

                     2022-12-21 - 2022-12-28 Sum  2022-12-28 - 2022-12-31 Sum  \
County Name
Albany County                                  0                         23360
Allegany County                                0                          3392
Bronx County                                   0                        246784
Broome County                                  0                         18496
Cattaraugus County                             0                          4672
…                                            …                             …
Washington County                              0                          4800
Wayne County                                   0                          6592
Westchester County                             0                        167168
Wyoming County                                 0                          1152
Yates County                                   0                          1152

                     population  county_sums
County Name
Albany County          19453561      2999936
Allegany County        19453561      2374208
Bronx County           19453561      7677568
Broome County          19453561      2749760
Cattaraugus County     19453561      2453248
…                           …            …
Washington County      19453561      2444288
Wayne County           19453561      2476032
Westchester County     19453561      5669120
Wyoming County         19453561      2369216
Yates County           19453561      2349760

[63 rows x 35 columns]
```

[16]:
```
county_sum_cases_partial = county_sum_cases.drop(county_sum_cases.columns[0 :␣
↪33], axis=1)
county_sum_cases_partial
```

[16]:
```
                     population  county_sums
County Name
Albany County          19453561      2999936
Allegany County        19453561      2374208
Bronx County           19453561      7677568
Broome County          19453561      2749760
Cattaraugus County     19453561      2453248
…                           …            …
```

```
Washington County      19453561      2444288
Wayne County           19453561      2476032
Westchester County     19453561      5669120
Wyoming County         19453561      2369216
Yates County           19453561      2349760

[63 rows x 2 columns]
```

[17]:
```
# Calculate the ratio of confirmed cases to population
county_sum_cases_partial['cases_per_population'] =␣
 ↪county_sum_cases_partial['county_sums'] /␣
 ↪county_sum_cases_partial['population']

# Find the row(s) with the highest value(s) of the ratio
sorted_cases = county_sum_cases_partial.sort_values(by='cases_per_population',␣
 ↪ascending=False)

# Select the first three rows of the sorted DataFrame
top_three_cases = sorted_cases.head(3)

# Print the top three rows
top_three_cases
```

[17]:
```
                 population  county_sums  cases_per_population
County Name
Queens County       19453561     12194560              0.626855
Kings County        19453561     11667200              0.599746
New York County     19453561      9378496              0.482097
```

[18]:
```
county_sum_deaths = ny_deaths.groupby('County Name').sum()
county_sum_deaths = county_sum_deaths[county_sum_deaths.columns.
 ↪drop(list(county_sum_deaths.filter(regex='Mean|Median|Mode')))]
county_sum_deaths['county_sums'] = county_sum_deaths.iloc[:, 0 : 33].sum(axis=1)
county_sum_deaths
```

[18]:
```
                    countyFIPS  StateFIPS  2022-06-01 - 2022-06-08 Sum  \
County Name
Albany County          2304064       2304                            0
Allegany County        2304192       2304                            0
Bronx County           2304320       2304                          768
Broome County          2304448       2304                           64
Cattaraugus County     2304576       2304                            0
…                          …          …                            …
Washington County      2311360       2304                           64
Wayne County           2311488       2304                          128
Westchester County     2311616       2304                          256
Wyoming County         2311744       2304                            0
```

```
Yates County            2311872       2304                          0

                  2022-06-08 - 2022-06-15 Sum  2022-06-15 - 2022-06-22 Sum  \
County Name
Albany County                              192                           64
Allegany County                              0                            0
Bronx County                              1024                          704
Broome County                               64                            0
Cattaraugus County                           0                           64
…                                            …                           …
Washington County                           64                           64
Wayne County                               128                            0
Westchester County                         256                          128
Wyoming County                               0                            0
Yates County                                 0                            0

                  2022-06-22 - 2022-06-29 Sum  2022-06-29 - 2022-07-06 Sum  \
County Name
Albany County                              128                            0
Allegany County                              0                            0
Bronx County                               704                          512
Broome County                                0                            0
Cattaraugus County                         128                            0
…                                            …                           …
Washington County                           64                            0
Wayne County                                64                           64
Westchester County                         576                          128
Wyoming County                               0                            0
Yates County                                 0                            0

                  2022-07-06 - 2022-07-13 Sum  2022-07-13 - 2022-07-20 Sum  \
County Name
Albany County                                0                          128
Allegany County                             64                          128
Bronx County                               384                          896
Broome County                              128                            0
Cattaraugus County                           0                            0
…                                            …                           …
Washington County                           64                            0
Wayne County                                 0                            0
Westchester County                         192                          512
Wyoming County                               0                            0
Yates County                                 0                            0

                  2022-07-20 - 2022-07-27 Sum  …  \
County Name                                    …
Albany County                               64  …
```

```
Allegany County                          0  …
Bronx County                          1024  …
Broome County                          128  …
Cattaraugus County                       0  …
…                                      …  …
Washington County                      128  …
Wayne County                           128  …
Westchester County                     640  …
Wyoming County                           0  …
Yates County                             0  …

                 2022-11-09 - 2022-11-16 Sum  2022-11-16 - 2022-11-23 Sum  \
County Name
Albany County                            384                          128
Allegany County                            0                            0
Bronx County                             192                          448
Broome County                            256                          320
Cattaraugus County                         0                           64
…                                        …                            …
Washington County                          0                           64
Wayne County                              64                            0
Westchester County                       640                          320
Wyoming County                             0                            0
Yates County                              64                            0

                 2022-11-23 - 2022-11-30 Sum  2022-11-30 - 2022-12-07 Sum  \
County Name
Albany County                            192                            0
Allegany County                            0                            0
Bronx County                            1088                          832
Broome County                              0                            0
Cattaraugus County                        64                            0
…                                        …                            …
Washington County                         64                            0
Wayne County                               0                            0
Westchester County                       448                          128
Wyoming County                             0                            0
Yates County                               0                            0

                 2022-12-07 - 2022-12-14 Sum  2022-12-14 - 2022-12-21 Sum  \
County Name
Albany County                             64                          128
Allegany County                            0                            0
Bronx County                            1472                         1600
Broome County                              0                          192
Cattaraugus County                         0                            0
…                                        …                            …
```

```
Washington County                              0                              128
Wayne County                                   0                                0
Westchester County                           896                              576
Wyoming County                                 0                                0
Yates County                                  64                                0

                    2022-12-21 - 2022-12-28 Sum  2022-12-28 - 2022-12-31 Sum  \
County Name
Albany County                                320                              128
Allegany County                               64                                0
Bronx County                                1088                             2816
Broome County                                 64                              192
Cattaraugus County                             0                               64
…                                            …                                …
Washington County                             64                              192
Wayne County                                   0                                0
Westchester County                           320                             1088
Wyoming County                                 0                                0
Yates County                                   0                                0

                    population  county_sums
County Name
Albany County         19453561      2310016
Allegany County       19453561      2307008
Bronx County          19453561      2343680
Broome County         19453561      2310208
Cattaraugus County    19453561      2308224
…                        …          …
Washington County     19453561      2314944
Wayne County          19453561      2315200
Westchester County    19453561      2326720
Wyoming County        19453561      2314368
Yates County          19453561      2314304

[63 rows x 35 columns]
```

[19]:
```
county_sum_deaths_partial = county_sum_deaths.drop(county_sum_deaths.columns[0 :
 ↪ 33], axis=1)
county_sum_deaths_partial
```

[19]:
```
                    population  county_sums
County Name
Albany County         19453561      2310016
Allegany County       19453561      2307008
Bronx County          19453561      2343680
Broome County         19453561      2310208
Cattaraugus County    19453561      2308224
```

```
…                          …          …
Washington County      19453561      2314944
Wayne County           19453561      2315200
Westchester County     19453561      2326720
Wyoming County         19453561      2314368
Yates County           19453561      2314304

[63 rows x 2 columns]
```

[20]:
```
# Calculate the ratio of confirmed deaths to population
county_sum_deaths_partial['deaths_per_population'] =␣
 ↪county_sum_deaths_partial['county_sums'] /␣
 ↪county_sum_deaths_partial['population']

# Find the rows with the highest value(s) of the ratio
sorted_deaths = county_sum_deaths_partial.
 ↪sort_values(by='deaths_per_population', ascending=False)
top_three_deaths = sorted_deaths.head(3)

# Print the top three rows
top_three_deaths
```

[20]:
```
                population  county_sums  deaths_per_population
County Name
Queens County     19453561      2385408               0.122621
Kings County      19453561      2371456               0.121903
Bronx County      19453561      2343680               0.120476
```

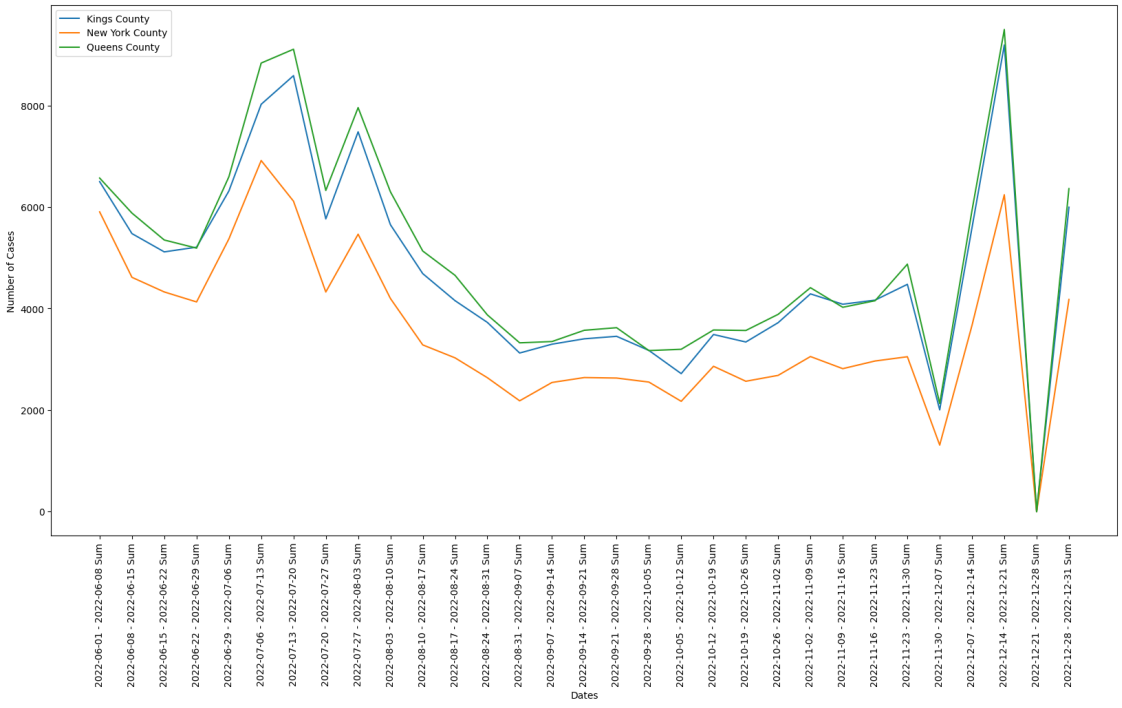
[21]:
```
top_three_counties_cases = ['Queens County', 'Kings County', 'New York County']

top_three_cases_df = ny_confirmed[ny_confirmed['County Name'].str.contains('|'.
 ↪join(top_three_counties_cases))]
top_three_cases_df = top_three_cases_df[top_three_cases_df.columns.
 ↪drop(list(top_three_cases_df.filter(regex='Mean|Median|Mode|population')))]
top_three_cases_df = top_three_cases_df.drop(columns=['countyFIPS', 'State',␣
 ↪'StateFIPS'])
top_three_cases_df = top_three_cases_df.groupby('County Name').mean().
 ↪reset_index()
top_three_cases_df
```

[21]:
```
         County Name  2022-06-01 - 2022-06-08 Sum  2022-06-08 - 2022-06-15 Sum  \
0     Kings County                          6500                         5476
1  New York County                          5904                         4615
2    Queens County                          6570                         5880

   2022-06-15 - 2022-06-22 Sum  2022-06-22 - 2022-06-29 Sum  \
0                         5116                         5209
```

```
1                          4327                          4130
2                          5350                          5190

   2022-06-29 - 2022-07-06 Sum  2022-07-06 - 2022-07-13 Sum  \
0                          6315                          8023
1                          5371                          6915
2                          6595                          8835

   2022-07-13 - 2022-07-20 Sum  2022-07-20 - 2022-07-27 Sum  \
0                          8587                          5766
1                          6114                          4326
2                          9107                          6326

   2022-07-27 - 2022-08-03 Sum  …  2022-10-26 - 2022-11-02 Sum  \
0                          7480  …                          3722
1                          5464  …                          2684
2                          7957  …                          3886

   2022-11-02 - 2022-11-09 Sum  2022-11-09 - 2022-11-16 Sum  \
0                          4289                          4085
1                          3055                          2816
2                          4411                          4025

   2022-11-16 - 2022-11-23 Sum  2022-11-23 - 2022-11-30 Sum  \
0                          4166                          4477
1                          2967                          3051
2                          4154                          4874

   2022-11-30 - 2022-12-07 Sum  2022-12-07 - 2022-12-14 Sum  \
0                          2005                          5592
1                          1311                          3669
2                          2129                          5931

   2022-12-14 - 2022-12-21 Sum  2022-12-21 - 2022-12-28 Sum  \
0                          9191                             0
1                          6241                             0
2                          9495                             0

   2022-12-28 - 2022-12-31 Sum
0                          5995
1                          4178
2                          6361

[3 rows x 32 columns]
```

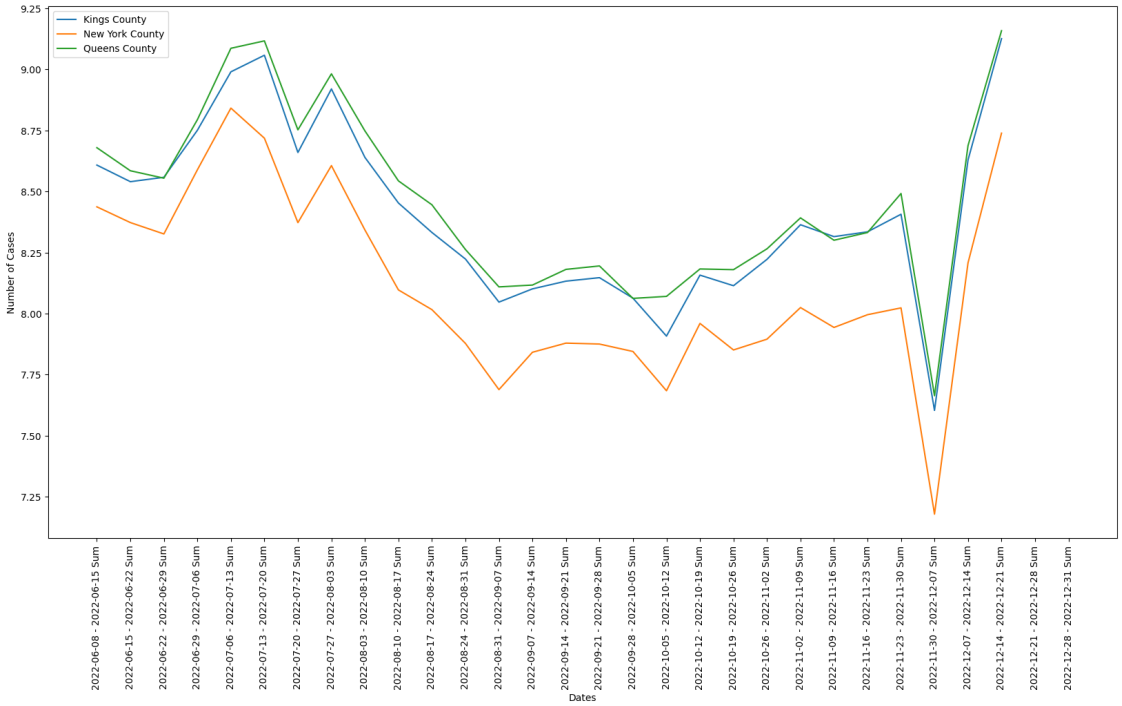
[22]:
```
county_names = ['Kings County', 'New York County', 'Queens County']
dates = list(top_three_cases_df.columns[1:])
```

```
data = top_three_cases_df.values[:,1:]

plt.figure(figsize=(20, 10))
for i in range(3):
    plt.plot(dates, data[i,:], label=county_names[i])

plt.xlabel('Dates')
plt.ylabel('Number of Cases')
plt.legend()
plt.xticks(rotation=90)


plt.show()
```



[23]:
```
#Now taking the log normalized cases
top_three_cases_df_log = np.log(top_three_cases_df.iloc[:, 1:])

county_names = ['Kings County', 'New York County', 'Queens County']
dates = list(top_three_cases_df_log.columns[1:])
data = top_three_cases_df_log.values[:,1:]

plt.figure(figsize=(20, 10))
for i in range(3):
    plt.plot(dates, data[i,:], label=county_names[i])
```

```
plt.xlabel('Dates')
plt.ylabel('Number of Cases')
plt.legend()
plt.xticks(rotation=90)


plt.show()
```



Taking a look at the number of cases between the top three counties in New York, we can see that all of them are in the downtown area. There's no mystery as to why this could be, seeing as how they have the highest population density out of anywhere in New York. Analyzing the overall trends however, we want to see why there may be more cases in some of the higher case months of the year. In terms of this dataset, those times would be the last week of June to the last week of July. One possible explanation of this trend is that many people are getting out of the house to go on vacation or enjoy the summer weather. New York being quite cold in the winter, it makes for a perfect breeding ground for spread of the Coronavirus. More people being out of the house can lead to more people hanging out in groups, which can lead to spread of the virus.

We also see a massive uptick of infections towards the end of November into December. I feel a good explanation for this is simply reflected by the fact that more people are spending time with family for Thanksgiving and Christmas. More concentrated groups of families can lead to spreading events between people in the family, who then spread it to their immediate group of friends or extended family.

[24]:
```
top_three_counties_deaths = ['Queens County', 'Kings County', 'Bronx County']

top_three_deaths_df = ny_confirmed[ny_confirmed['County Name'].str.contains('|'.
 ↪join(top_three_counties_deaths))]
top_three_deaths_df = top_three_deaths_df[top_three_deaths_df.columns.
 ↪drop(list(top_three_deaths_df.filter(regex='Mean|Median|Mode|population')))]
top_three_deaths_df = top_three_deaths_df.drop(columns=['countyFIPS', 'State',␣
 ↪'StateFIPS'])
top_three_deaths_df = top_three_deaths_df.groupby('County Name').mean().
 ↪reset_index()
top_three_deaths_df
```

[24]:

	County Name	2022-06-01 - 2022-06-08 Sum	2022-06-08 - 2022-06-15 Sum	\
0	Bronx County	3000	2575	
1	Kings County	6500	5476	
2	Queens County	6570	5880	

	2022-06-15 - 2022-06-22 Sum	2022-06-22 - 2022-06-29 Sum	\
0	2561	2498	
1	5116	5209	
2	5350	5190	

	2022-06-29 - 2022-07-06 Sum	2022-07-06 - 2022-07-13 Sum	\
0	3405	4777	
1	6315	8023	
2	6595	8835	

	2022-07-13 - 2022-07-20 Sum	2022-07-20 - 2022-07-27 Sum	\
0	4828	3624	
1	8587	5766	
2	9107	6326	

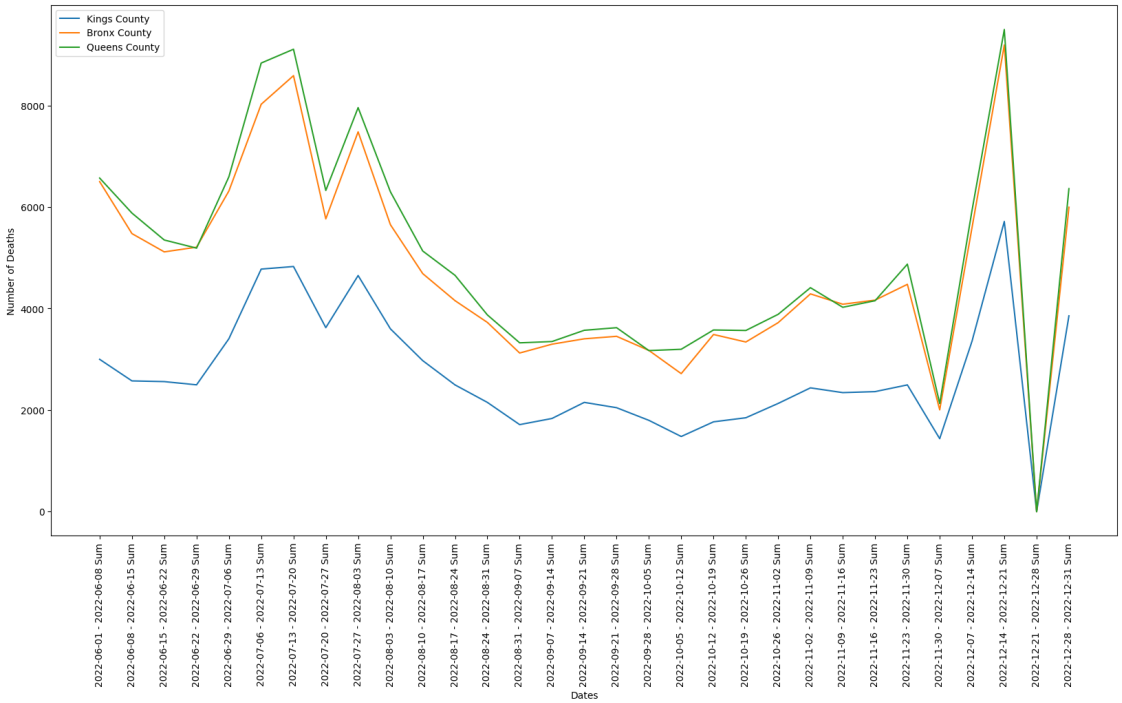
	2022-07-27 - 2022-08-03 Sum	…	2022-10-26 - 2022-11-02 Sum	\
0	4650	…	2131	
1	7480	…	3722	
2	7957	…	3886	

	2022-11-02 - 2022-11-09 Sum	2022-11-09 - 2022-11-16 Sum	\
0	2438	2344	
1	4289	4085	
2	4411	4025	

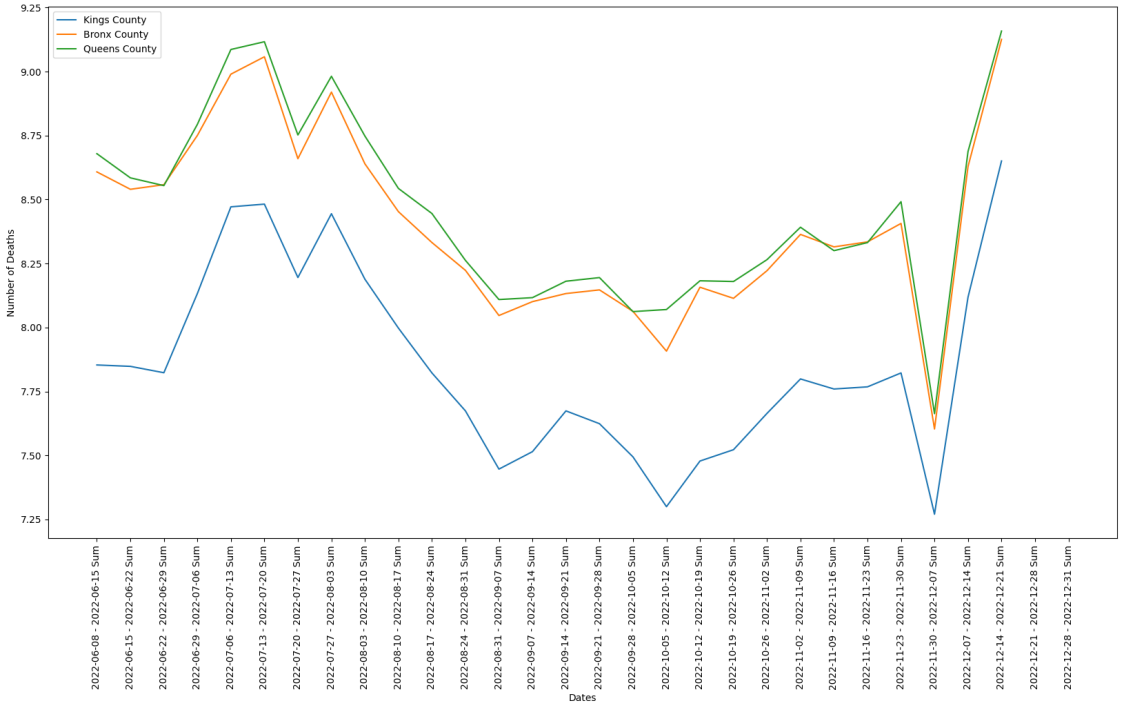
	2022-11-16 - 2022-11-23 Sum	2022-11-23 - 2022-11-30 Sum	\
0	2364	2496	
1	4166	4477	
2	4154	4874	

```
   2022-11-30 - 2022-12-07 Sum  2022-12-07 - 2022-12-14 Sum  \
0                         1437                         3356
1                         2005                         5592
2                         2129                         5931

   2022-12-14 - 2022-12-21 Sum  2022-12-21 - 2022-12-28 Sum  \
0                         5715                            0
1                         9191                            0
2                         9495                            0

   2022-12-28 - 2022-12-31 Sum
0                         3856
1                         5995
2                         6361

[3 rows x 32 columns]
```

[25]:
```
county_names = ['Kings County', 'Bronx County', 'Queens County']
dates = list(top_three_deaths_df.columns[1:])
data = top_three_deaths_df.values[:,1:]

plt.figure(figsize=(20, 10))
for i in range(3):
    plt.plot(dates, data[i,:], label=county_names[i])

plt.xlabel('Dates')
plt.ylabel('Number of Deaths')
plt.legend()
plt.xticks(rotation=90)


plt.show()
```



[26]:
```
#Now taking the log normalized deaths
top_three_deaths_df_log = np.log(top_three_deaths_df.iloc[:, 1:])
county_names = ['Kings County', 'Bronx County', 'Queens County']
dates = list(top_three_deaths_df_log.columns[1:])
data = top_three_deaths_df_log.values[:,1:]

plt.figure(figsize=(20, 10))
for i in range(3):
    plt.plot(dates, data[i,:], label=county_names[i])

plt.xlabel('Dates')
plt.ylabel('Number of Deaths')
plt.legend()
plt.xticks(rotation=90)


plt.show()
```



Analyzing the deaths in the three given counties, we see similar trends as the infections. The peaks lie pretty solidly in the beginning of the summer months and into the holiday season as well. The reasons for this uptick in death is likely very similar as the analysis for the confirmed cases, there are more people going on vacation in the summer and more people spending time with family in the holiday season.

This is even further reinforced by the fact that more elderly men and women are taking part in these celebrations. They are the people who are more susceptible to the virus and for whom the virus can be more fatal.

Comparing the rate of cases and deaths in New York, we do see that the two datasets match up quite well. Although, it is worth noting that the rates of cases and deaths will be slightly different inside and outside of New York City. The population density in New York City lends itself well to the spread of the virus. Higher population density shows us higher rates of confirmed cases and deaths. I do feel, however, that most of these trends will likely be the same anywhere in the United States, and that these trends are not simply unique to New York.

Created in Deepnote