Nishant_Sharma_stage2

March 13, 2023

[1]:
```
import pandas as pd

# Getting the population for each county to merge to the main dataset used for␣
 ↪this project

population = pd.read_csv('data/covid_county_population_usafacts.csv', usecols=␣
 ↪['countyFIPS', 'population'])

population = population[population.countyFIPS != 0]

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

[1]:
```
            population
countyFIPS
1001             55869
1003            223234
1005             24686
1007             22394
1009             57826
…                    …
56037            42343
56039            23464
56041            20226
56043             7805
56045             6927

[3144 rows x 1 columns]
```

[74]:
```
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)

# New cases: taking difference
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
```

```python
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 + 6]} Sum'] = confirmed[confirmed.columns[i:i + 7]].sum(axis=1)
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + 6]} Mean'] = confirmed[confirmed.columns[i:i + 7]].mean(axis=1).round()
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + 6]} Median'] = confirmed[confirmed.columns[i:i + 7]].median(axis=1).round()
        confirmed[f'{confirmed.columns[i]} - {confirmed.columns[i + 6]} Mode'] = confirmed[confirmed.columns[i:i + 7]].mode(axis=1)[0]

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

confirmed
```

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```

[74]:

```
      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 - 2022-12-20 Median  2022-12-14 - 2022-12-20 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 - 2022-12-27 Sum  2022-12-21 - 2022-12-27 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 - 2022-12-27 Median  2022-12-21 - 2022-12-27 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]
```

[75]:

```
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 + 6]} Sum'] =␣
  ↪deaths[deaths.columns[i:i + 7]].sum(axis=1)
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + 6]} Mean'] =␣
  ↪deaths[deaths.columns[i:i + 7]].mean(axis=1).round()
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + 6]} Median'] =␣
  ↪deaths[deaths.columns[i:i + 7]].median(axis=1).round()
        deaths[f'{deaths.columns[i]} - {deaths.columns[i + 6]} Mode'] =␣
  ↪deaths[deaths.columns[i:i + 7]].mode(axis=1)[0]


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

```
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```

```
[75]:       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 - 2022-12-20 Median  2022-12-14 - 2022-12-20 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 - 2022-12-27 Sum  2022-12-21 - 2022-12-27 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 - 2022-12-27 Median  2022-12-21 - 2022-12-27 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]
```

[77]:

```
# Merging population to both confirmed and death dataframe

confirmed = confirmed.merge(population, how='left', on='countyFIPS')
deaths = deaths.merge(population, how='left', on='countyFIPS')
confirmed = confirmed.fillna(0)
deaths = deaths.fillna(0)
```

[81]:

```
confirmed = confirmed.set_index('countyFIPS')
deaths = deaths.set_index('countyFIPS')
confirmed
```

[81]:

```
                      County Name State  StateFIPS  2022-06-01  2022-06-02  \
countyFIPS
0           Statewide Unallocated    AL          1           0           0
1001                  Autauga County    AL          1           6           9
1003                  Baldwin County    AL          1          68          68
1005                  Barbour County    AL          1           3           4
1007                     Bibb County    AL          1           8           4
…                           …   …        …         …         …
56037              Sweetwater County    AL         56           0           0
56039                   Teton County    WY         56           0           0
56041                   Uinta County    WY         56           0           0
56043                Washakie County    WY         56           0           0
56045                  Weston County    WY         56           0           0
```

```
            2022-06-03  2022-06-04  2022-06-05  2022-06-06  2022-06-07  …  \
countyFIPS                                                              …
0                    0           0           0           0           0  …
1001                 0           0           0          54          20  …
1003                 0           0           0         247          60  …
1005                 0           0           0           5          14  …
1007                 0           0           0          22           1  …
…                …         …         …         …         …  …
56037                0           0           0           0           0  …
56039                0           0           0           0           0  …
56041                0           0           0           0           0  …
56043                0           0           0           0           0  …
56045                0           0           0           0           0  …

            2022-12-14 - 2022-12-20 Mode  2022-12-21 - 2022-12-27 Sum  \
countyFIPS
0                                    0.0                            0
1001                                 0.0                          114
1003                                 0.0                          275
1005                                 0.0                           20
1007                                 0.0                           24
…                                  …                          …
56037                                0.0                           20
56039                                0.0                           29
56041                                0.0                           16
56043                                0.0                            0
56045                                0.0                            5

            2022-12-21 - 2022-12-27 Mean  2022-12-21 - 2022-12-27 Median  \
countyFIPS
0                                    0.0                             0.0
1001                                16.0                             0.0
1003                                39.0                             0.0
1005                                 3.0                             0.0
1007                                 3.0                             0.0
…                                  …                             …
56037                                3.0                             0.0
56039                                4.0                             0.0
56041                                2.0                             0.0
56043                                0.0                             0.0
56045                                1.0                             0.0

            2022-12-21 - 2022-12-27 Mode  2022-12-28 - 2022-12-31 Sum  \
countyFIPS
0                                    0.0                            0
1001                                 0.0                            0
1003                                 0.0                            0
```

```
1005                                 0.0                            0
1007                                 0.0                            0
…                                  …                          …
56037                                0.0                            0
56039                                0.0                            0
56041                                0.0                            0
56043                                0.0                            0
56045                                0.0                            0

            2022-12-28 - 2022-12-31 Mean  2022-12-28 - 2022-12-31 Median  \
countyFIPS
0                                    0.0                             0.0
1001                                 0.0                             0.0
1003                                 0.0                             0.0
1005                                 0.0                             0.0
1007                                 0.0                             0.0
…                                  …                             …
56037                                0.0                             0.0
56039                                0.0                             0.0
56041                                0.0                             0.0
56043                                0.0                             0.0
56045                                0.0                             0.0

            2022-12-28 - 2022-12-31 Mode  population
countyFIPS
0                                    0.0         0.0
1001                                 0.0     55869.0
1003                                 0.0    223234.0
1005                                 0.0     24686.0
1007                                 0.0     22394.0
…                                  …         …
56037                                0.0     42343.0
56039                                0.0     23464.0
56041                                0.0     20226.0
56043                                0.0      7805.0
56045                                0.0      6927.0

[3193 rows x 342 columns]
```

[82]:

```
deaths
```

[82]:

```
                      County Name State  StateFIPS  2022-06-01  2022-06-02  \
countyFIPS
0           Statewide Unallocated    AL          1           0           0
1001              Autauga County     AL          1           0           0
1003              Baldwin County     AL          1           0           0
1005              Barbour County     AL          1           0           0
```

```
1007                 Bibb County     AL           1           0           0
…                           …   …        …         …         …
56037          Sweetwater County     WY          56           0           0
56039               Teton County     WY          56           0           0
56041               Uinta County     WY          56           0           0
56043            Washakie County     WY          56           0           0
56045              Weston County     WY          56           0           0

            2022-06-03  2022-06-04  2022-06-05  2022-06-06  2022-06-07  …  \
countyFIPS                                                              …
0                    0           0           0           0           0  …
1001                 0           0           0           0           0  …
1003                 0           0           0           0           0  …
1005                 0           0           0           0           0  …
1007                 0           0           0           0           0  …
…                …         …         …         …         …  …
56037                0           0           0           0           0  …
56039                0           0           0           0           0  …
56041                0           0           0           0           0  …
56043                0           0           0           0           0  …
56045                0           0           0           0           0  …

            2022-12-14 - 2022-12-20 Mode  2022-12-21 - 2022-12-27 Sum  \
countyFIPS
0                                      0                            0
1001                                   0                            0
1003                                   0                            2
1005                                   0                            0
1007                                   0                            0
…                                  …                          …
56037                                  0                            1
56039                                  0                            0
56041                                  0                            0
56043                                  0                            0
56045                                  0                            0

            2022-12-21 - 2022-12-27 Mean  2022-12-21 - 2022-12-27 Median  \
countyFIPS
0                                    0.0                             0.0
1001                                 0.0                             0.0
1003                                 0.0                             0.0
1005                                 0.0                             0.0
1007                                 0.0                             0.0
…                                  …                             …
56037                                0.0                             0.0
56039                                0.0                             0.0
56041                                0.0                             0.0
```

```
56043                                0.0                             0.0
56045                                0.0                             0.0

            2022-12-21 - 2022-12-27 Mode  2022-12-28 - 2022-12-31 Sum  \
countyFIPS
0                                      0                            0
1001                                   0                            0
1003                                   0                            0
1005                                   0                            0
1007                                   0                            0
…                                  …                          …
56037                                  0                            0
56039                                  0                            0
56041                                  0                            0
56043                                  0                            0
56045                                  0                            0

            2022-12-28 - 2022-12-31 Mean  2022-12-28 - 2022-12-31 Median  \
countyFIPS
0                                    0.0                             0.0
1001                                 0.0                             0.0
1003                                 0.0                             0.0
1005                                 0.0                             0.0
1007                                 0.0                             0.0
…                                  …                             …
56037                                0.0                             0.0
56039                                0.0                             0.0
56041                                0.0                             0.0
56043                                0.0                             0.0
56045                                0.0                             0.0

            2022-12-28 - 2022-12-31 Mode  population
countyFIPS
0                                    0.0         0.0
1001                                 0.0     55869.0
1003                                 0.0    223234.0
1005                                 0.0     24686.0
1007                                 0.0     22394.0
…                                  …         …
56037                                0.0     42343.0
56039                                0.0     23464.0
56041                                0.0     20226.0
56043                                0.0      7805.0
56045                                0.0      6927.0

[3193 rows x 342 columns]
```

[83]:
```python
# Only selecting new cases for Virginia
confirmed_VA = confirmed[confirmed['State'].str.contains('VA')]

# Generate weekly statistics (mean, median, mode) for number of new cases␣
 ↪across a specific state.

confirmed_VA.filter(regex=r'County Name|State|StateFIPS|Mean|Median|Mode')
```

[83]:
```
                        County Name State  StateFIPS  \
countyFIPS
0            Statewide Unallocated    VA         51
51001              Accomack County    VA         51
51003             Albemarle County    VA         51
51005             Alleghany County    VA         51
51007                Amelia County    VA         51
…                              …   …        …
51800               City of Suffolk    VA         51
51810        City of Virginia Beach    VA         51
51820            City of Waynesboro    VA         51
51830          City of Williamsburg    VA         51
51840            City of Winchester    VA         51

            2022-06-01 - 2022-06-07 Mean  2022-06-01 - 2022-06-07 Median  \
countyFIPS
0                                    0.0                             0.0
51001                                8.0                             5.0
51003                               42.0                            51.0
51005                                0.0                             0.0
51007                                3.0                             0.0
…                                     …                              …
51800                               32.0                            38.0
51810                              135.0                           148.0
51820                                4.0                             1.0
51830                                2.0                             1.0
51840                                6.0                             7.0

            2022-06-01 - 2022-06-07 Mode  2022-06-08 - 2022-06-14 Mean  \
countyFIPS
0                                    0.0                           0.0
51001                                0.0                           8.0
51003                                0.0                          35.0
51005                                0.0                           6.0
51007                                0.0                           4.0
…                                     …                            …
51800                                0.0                          22.0
51810                                0.0                         133.0
51820                                0.0                           5.0
```

```
51830                                0.0                           1.0
51840                                0.0                           8.0

            2022-06-08 - 2022-06-14 Median  2022-06-08 - 2022-06-14 Mode  \
countyFIPS
0                                      0.0                           0.0
51001                                  4.0                           0.0
51003                                 34.0                           0.0
51005                                  4.0                           0.0
51007                                  5.0                           0.0
…                                    …                           …
51800                                 25.0                           0.0
51810                                131.0                           0.0
51820                                  3.0                           0.0
51830                                  1.0                           0.0
51840                                  4.0                           0.0

            2022-06-15 - 2022-06-21 Mean  …  2022-12-07 - 2022-12-13 Mode  \
countyFIPS                                …
0                                    0.0  …                           0.0
51001                                9.0  …                           0.0
51003                               28.0  …                           0.0
51005                                4.0  …                           0.0
51007                                2.0  …                           0.0
…                                  …  …                           …
51800                               21.0  …                           0.0
51810                              114.0  …                           0.0
51820                                3.0  …                           0.0
51830                                2.0  …                           0.0
51840                                6.0  …                           0.0

            2022-12-14 - 2022-12-20 Mean  2022-12-14 - 2022-12-20 Median  \
countyFIPS
0                                    0.0                             0.0
51001                               11.0                             6.0
51003                               25.0                            27.0
51005                                3.0                             2.0
51007                                3.0                             1.0
…                                  …                             …
51800                               18.0                            18.0
51810                               84.0                            88.0
51820                                7.0                             3.0
51830                                1.0                             0.0
51840                                6.0                             6.0

            2022-12-14 - 2022-12-20 Mode  2022-12-21 - 2022-12-27 Mean  \
countyFIPS
```

```
0                                    0.0                           0.0
51001                                0.0                          11.0
51003                                0.0                          18.0
51005                                0.0                           5.0
51007                                0.0                           3.0
…                                  …                           …
51800                                0.0                          22.0
51810                                0.0                          99.0
51820                                0.0                           5.0
51830                                0.0                           1.0
51840                                0.0                           6.0

            2022-12-21 - 2022-12-27 Median  2022-12-21 - 2022-12-27 Mode  \
countyFIPS
0                                      0.0                           0.0
51001                                 13.0                           0.0
51003                                 13.0                           0.0
51005                                  4.0                           0.0
51007                                  4.0                           0.0
…                                    …                           …
51800                                 20.0                           0.0
51810                                109.0                           0.0
51820                                  2.0                           0.0
51830                                  0.0                           0.0
51840                                  6.0                           0.0

            2022-12-28 - 2022-12-31 Mean  2022-12-28 - 2022-12-31 Median  \
countyFIPS
0                                    0.0                             0.0
51001                                2.0                             0.0
51003                                9.0                             0.0
51005                                4.0                             0.0
51007                                1.0                             0.0
…                                  …                             …
51800                                7.0                             0.0
51810                               28.0                             0.0
51820                                0.0                             0.0
51830                                1.0                             0.0
51840                                4.0                             0.0

            2022-12-28 - 2022-12-31 Mode
countyFIPS
0                                    0.0
51001                                0.0
51003                                0.0
51005                                0.0
51007                                0.0
```

```
…                                  …
51800                                0.0
51810                                0.0
51820                                0.0
51830                                0.0
51840                                0.0

[134 rows x 96 columns]
```

[84]:

```
# Only selecting new death cases for Virginia
deaths_VA = deaths[deaths['State'].str.contains('VA')]

# Generate weekly statistics (mean, median, mode) for number of new deaths␣
 ↪across a specific state.

deaths_VA.filter(regex=r'County Name|State|StateFIPS|Mean|Median|Mode')
```

[84]:

```
                       County Name State  StateFIPS  \
countyFIPS
0             Statewide Unallocated    VA         51
51001             Accomack County     VA         51
51003            Albemarle County     VA         51
51005            Alleghany County     VA         51
51007               Amelia County     VA         51
…                            …   …        …
51800              City of Suffolk    VA         51
51810       City of Virginia Beach    VA         51
51820           City of Waynesboro    VA         51
51830         City of Williamsburg    VA         51
51840           City of Winchester    VA         51

            2022-06-01 - 2022-06-07 Mean  2022-06-01 - 2022-06-07 Median  \
countyFIPS
0                                    0.0                             0.0
51001                                0.0                             0.0
51003                                0.0                             0.0
51005                               -0.0                             0.0
51007                               -0.0                             0.0
…                                  …                             …
51800                                0.0                             0.0
51810                                0.0                             0.0
51820                                0.0                             0.0
51830                                0.0                             0.0
51840                                0.0                             0.0

            2022-06-01 - 2022-06-07 Mode  2022-06-08 - 2022-06-14 Mean  \
countyFIPS
```

```
0                                    0.0                           0.0
51001                                0.0                           0.0
51003                                0.0                           0.0
51005                                0.0                           0.0
51007                                0.0                           0.0
…                                  …                           …
51800                                0.0                           0.0
51810                                0.0                           0.0
51820                                0.0                           0.0
51830                                0.0                           0.0
51840                                0.0                           0.0

            2022-06-08 - 2022-06-14 Median  2022-06-08 - 2022-06-14 Mode  \
countyFIPS
0                                      0.0                           0.0
51001                                  0.0                           0.0
51003                                  0.0                           0.0
51005                                  0.0                           0.0
51007                                  0.0                           0.0
…                                    …                           …
51800                                  0.0                           0.0
51810                                  0.0                           0.0
51820                                  0.0                           0.0
51830                                  0.0                           0.0
51840                                  0.0                           0.0

            2022-06-15 - 2022-06-21 Mean  …  2022-12-07 - 2022-12-13 Mode  \
countyFIPS                                …
0                                    0.0  …                           0.0
51001                                0.0  …                           0.0
51003                                0.0  …                           0.0
51005                                0.0  …                           0.0
51007                                0.0  …                           0.0
…                                  …  …                           …
51800                                0.0  …                           0.0
51810                                0.0  …                           0.0
51820                                0.0  …                           0.0
51830                                0.0  …                           0.0
51840                                0.0  …                           0.0

            2022-12-14 - 2022-12-20 Mean  2022-12-14 - 2022-12-20 Median  \
countyFIPS
0                                    0.0                             0.0
51001                                0.0                             0.0
51003                                0.0                             0.0
51005                                0.0                             0.0
51007                                0.0                             0.0
```

```
…                                  …                             …
51800                                0.0                             0.0
51810                                0.0                             0.0
51820                                0.0                             0.0
51830                                0.0                             0.0
51840                                0.0                             0.0

            2022-12-14 - 2022-12-20 Mode  2022-12-21 - 2022-12-27 Mean  \
countyFIPS
0                                      0                           0.0
51001                                  0                           0.0
51003                                  0                           0.0
51005                                  0                           0.0
51007                                  0                           0.0
…                                  …                           …
51800                                  0                           0.0
51810                                  0                           0.0
51820                                  0                           0.0
51830                                  0                           0.0
51840                                  0                           0.0

            2022-12-21 - 2022-12-27 Median  2022-12-21 - 2022-12-27 Mode  \
countyFIPS
0                                      0.0                             0
51001                                  0.0                             0
51003                                  0.0                             0
51005                                  0.0                             0
51007                                  0.0                             0
…                                    …                           …
51800                                  0.0                             0
51810                                  0.0                             0
51820                                  0.0                             0
51830                                  0.0                             0
51840                                  0.0                             0

            2022-12-28 - 2022-12-31 Mean  2022-12-28 - 2022-12-31 Median  \
countyFIPS
0                                    0.0                             0.0
51001                                0.0                             0.0
51003                                0.0                             0.0
51005                                0.0                             0.0
51007                                0.0                             0.0
…                                  …                             …
51800                                0.0                             0.0
51810                                0.0                             0.0
51820                                0.0                             0.0
51830                                0.0                             0.0
```

```
51840                           0.0                       0.0

            2022-12-28 - 2022-12-31 Mode
countyFIPS
0                               0.0
51001                           0.0
51003                           0.0
51005                           0.0
51007                           0.0
…                             …
51800                           0.0
51810                           0.0
51820                           0.0
51830                           0.0
51840                           0.0

[134 rows x 96 columns]
```

Compare the data against 3 other states. Normalize by population, use a normalization factor which is able to identify cases and deaths, for example try per 10,000 or 100,000 (this depends on the population). Plot the values across the weeks in a line plot for the 3 states in a single graph. Describe why the rates differ across these states in the notebook. Identify the peaks, are they consistent with the US pattern?

[85]:

```
# VA Normalization data
confirmed_VA_norm = confirmed_VA.filter(regex = r'Sum|population')
confirmed_VA_norm = confirmed_VA_norm.sum()

deaths_VA_norm = deaths_VA.filter(regex = r'Sum|population')
deaths_VA_norm = deaths_VA_norm.sum()

confirmed_VA_norm
```

[85]:

```
2022-06-01 - 2022-06-07 Sum      20652.0
2022-06-08 - 2022-06-14 Sum      19010.0
2022-06-15 - 2022-06-21 Sum      16895.0
2022-06-22 - 2022-06-28 Sum      18346.0
2022-06-29 - 2022-07-05 Sum      18866.0
2022-07-06 - 2022-07-12 Sum      20608.0
2022-07-13 - 2022-07-19 Sum      20676.0
2022-07-20 - 2022-07-26 Sum      21316.0
2022-07-27 - 2022-08-02 Sum      20965.0
2022-08-03 - 2022-08-09 Sum      19438.0
2022-08-10 - 2022-08-16 Sum      18025.0
2022-08-17 - 2022-08-23 Sum      17310.0
2022-08-24 - 2022-08-30 Sum      17543.0
2022-08-31 - 2022-09-06 Sum      14998.0
```

```
2022-09-07 - 2022-09-13 Sum      12588.0
2022-09-14 - 2022-09-20 Sum      10291.0
2022-09-21 - 2022-09-27 Sum       9286.0
2022-09-28 - 2022-10-04 Sum       7686.0
2022-10-05 - 2022-10-11 Sum       6871.0
2022-10-12 - 2022-10-18 Sum       7401.0
2022-10-19 - 2022-10-25 Sum       7025.0
2022-10-26 - 2022-11-01 Sum       7793.0
2022-11-02 - 2022-11-08 Sum       7207.0
2022-11-09 - 2022-11-15 Sum       6238.0
2022-11-16 - 2022-11-22 Sum       5853.0
2022-11-23 - 2022-11-29 Sum       7037.0
2022-11-30 - 2022-12-06 Sum      10250.0
2022-12-07 - 2022-12-13 Sum      11188.0
2022-12-14 - 2022-12-20 Sum      13402.0
2022-12-21 - 2022-12-27 Sum      14347.0
2022-12-28 - 2022-12-31 Sum       2435.0
population                     8535519.0
dtype: float64
```

[86]:

```
deaths_VA_norm
```

[86]:

```
2022-06-01 - 2022-06-07 Sum         46.0
2022-06-08 - 2022-06-14 Sum          8.0
2022-06-15 - 2022-06-21 Sum         24.0
2022-06-22 - 2022-06-28 Sum         91.0
2022-06-29 - 2022-07-05 Sum        115.0
2022-07-06 - 2022-07-12 Sum         82.0
2022-07-13 - 2022-07-19 Sum         68.0
2022-07-20 - 2022-07-26 Sum         54.0
2022-07-27 - 2022-08-02 Sum         92.0
2022-08-03 - 2022-08-09 Sum        116.0
2022-08-10 - 2022-08-16 Sum         98.0
2022-08-17 - 2022-08-23 Sum        104.0
2022-08-24 - 2022-08-30 Sum        108.0
2022-08-31 - 2022-09-06 Sum        104.0
2022-09-07 - 2022-09-13 Sum        132.0
2022-09-14 - 2022-09-20 Sum         81.0
2022-09-21 - 2022-09-27 Sum         96.0
2022-09-28 - 2022-10-04 Sum         93.0
2022-10-05 - 2022-10-11 Sum         85.0
2022-10-12 - 2022-10-18 Sum         71.0
2022-10-19 - 2022-10-25 Sum         81.0
2022-10-26 - 2022-11-01 Sum         66.0
2022-11-02 - 2022-11-08 Sum         27.0
2022-11-09 - 2022-11-15 Sum          2.0
2022-11-16 - 2022-11-22 Sum         90.0
```

```
2022-11-23 - 2022-11-29 Sum         70.0
2022-11-30 - 2022-12-06 Sum         95.0
2022-12-07 - 2022-12-13 Sum         71.0
2022-12-14 - 2022-12-20 Sum         51.0
2022-12-21 - 2022-12-27 Sum         54.0
2022-12-28 - 2022-12-31 Sum          6.0
population                     8535519.0
dtype: float64
```

[87]:

```
# Preparing data for visualization/plotting
VA_norm_10k_cases = {}
VA_norm_100k_cases = {}
VA_norm_10k_deaths = {}
VA_norm_100k_deaths = {}
for x in range(0, len(confirmed_VA_norm) - 1):
    VA_norm_10k_cases[f'{confirmed_VA_norm.index.values[x]} normalized'] =␣
 ↪(confirmed_VA_norm[x]/confirmed_VA_norm['population']) * 10000
    VA_norm_100k_cases[f'{confirmed_VA_norm.index.values[x]} normalized'] =␣
 ↪(confirmed_VA_norm[x]/confirmed_VA_norm['population']) * 100000

for x in range(0, len(deaths_VA_norm) - 1):
    VA_norm_10k_deaths[f'{deaths_VA_norm.index.values[x]} normalized'] =␣
 ↪(deaths_VA_norm[x]/deaths_VA_norm['population']) * 10000
    VA_norm_100k_deaths[f'{deaths_VA_norm.index.values[x]} normalized'] =␣
 ↪(deaths_VA_norm[x]/deaths_VA_norm['population']) * 100000
```

[88]:

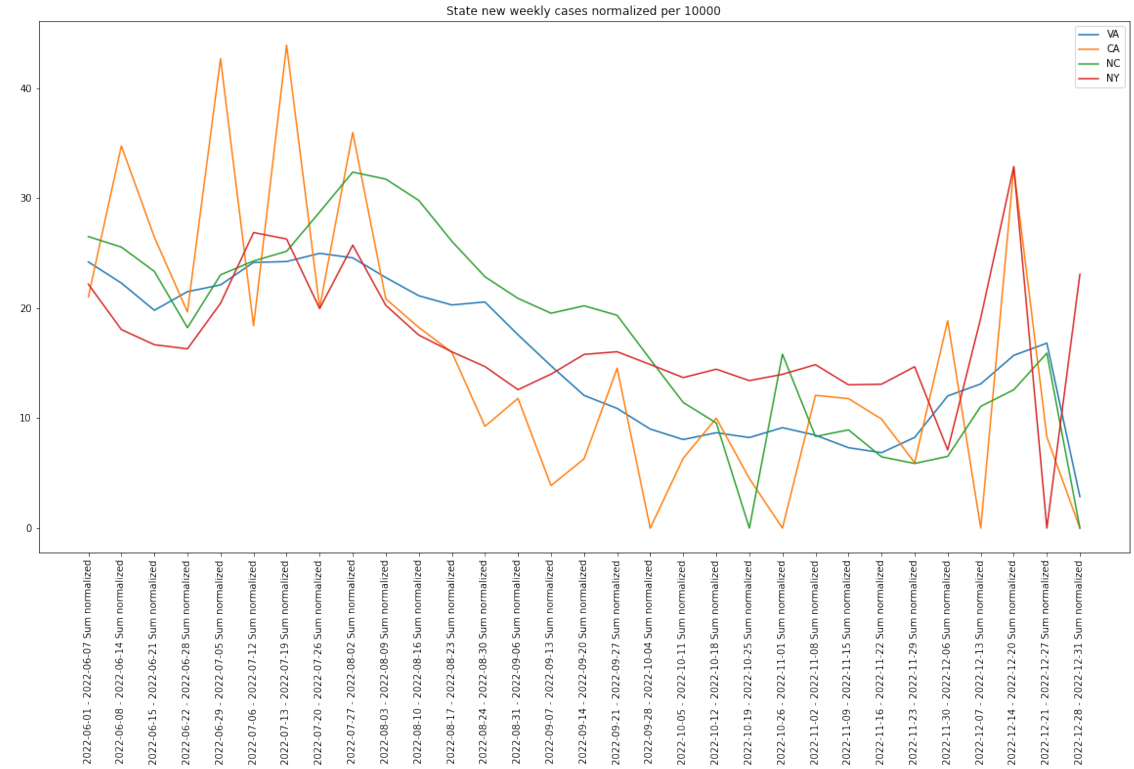
```
def normalization(state, x, case_or_death):
    d = pd.DataFrame
    if(case_or_death == 'case'):
        d = confirmed[confirmed['State'].str.contains(state)]
    else:
        d = deaths[deaths['State'].str.contains(state)]

    d = d.filter(regex = r'Sum|population')
    d = d.sum()

    if(x == 10):
        norm_10k_cases = {}
        for x in range(0, len(d) - 1):
            norm_10k_cases[f'{d.index.values[x]} normalized'] = (d[x]/
 ↪d['population']) * 10000

        return norm_10k_cases
    elif(x == 100):
        norm_100k_cases = {}
        for x in range(0, len(d) - 1):
            norm_100k_cases[f'{d.index.values[x]} normalized'] = (d[x] /␣
 ↪d['population']) * 100000

        return norm_100k_cases
```

[89]:

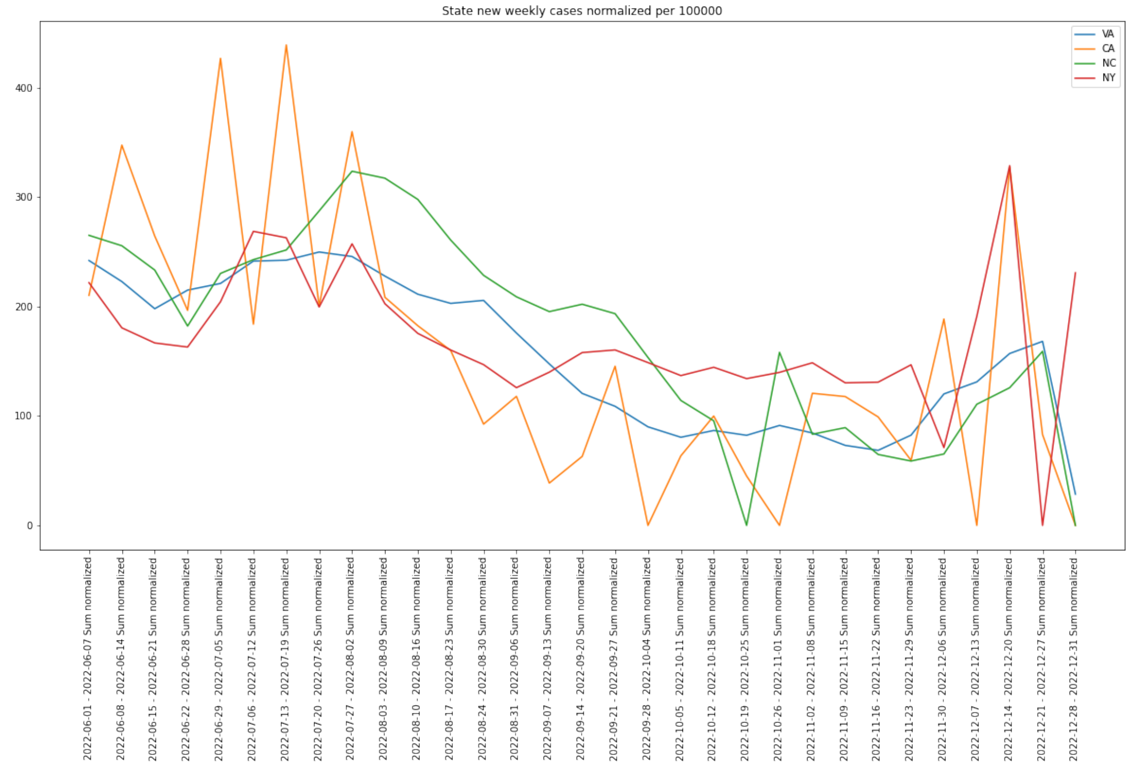
```
# California normalization data
CA_norm_10k_cases = normalization('CA', 10, 'case')
CA_norm_100k_cases = normalization('CA', 100, 'case')
CA_norm_10k_deaths = normalization('CA', 10, 'deaths')
CA_norm_100k_deaths = normalization('CA', 100, 'deaths')

# North Carolina normalization data
NC_norm_10k_cases = normalization('NC', 10, 'case')
NC_norm_100k_cases = normalization('NC', 100, 'case')
NC_norm_10k_deaths = normalization('NC', 10, 'deaths')
NC_norm_100k_deaths = normalization('NC', 100, 'deaths')

# New York normalization data
NY_norm_10k_cases = normalization('NY', 10, 'case')
NY_norm_100k_cases = normalization('NY', 100, 'case')
NY_norm_10k_deaths = normalization('NY', 10, 'deaths')
NY_norm_100k_deaths = normalization('NY', 100, 'deaths')
```

[93]:

```
from matplotlib import pyplot as plt
plt.figure(figsize=(20, 10))
plt.title('State new weekly cases normalized per 10000')
plt.plot(VA_norm_10k_cases.keys(), VA_norm_10k_cases.values(), label = 'VA')
plt.plot(CA_norm_10k_cases.keys(), CA_norm_10k_cases.values(), label = 'CA')
plt.plot(NC_norm_10k_cases.keys(), NC_norm_10k_cases.values(), label = 'NC')
plt.plot(NY_norm_10k_cases.keys(), NY_norm_10k_cases.values(), label = 'NY')
plt.xticks(rotation=90)

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



[94]:
```
plt.figure(figsize=(20, 10))
plt.title('State new weekly cases normalized per 100000')
plt.plot(VA_norm_100k_cases.keys(), VA_norm_100k_cases.values(), label = 'VA')
plt.plot(CA_norm_100k_cases.keys(), CA_norm_100k_cases.values(), label = 'CA')
plt.plot(NC_norm_100k_cases.keys(), NC_norm_100k_cases.values(), label = 'NC')
plt.plot(NY_norm_100k_cases.keys(), NY_norm_100k_cases.values(), label = 'NY')
plt.xticks(rotation=90)

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

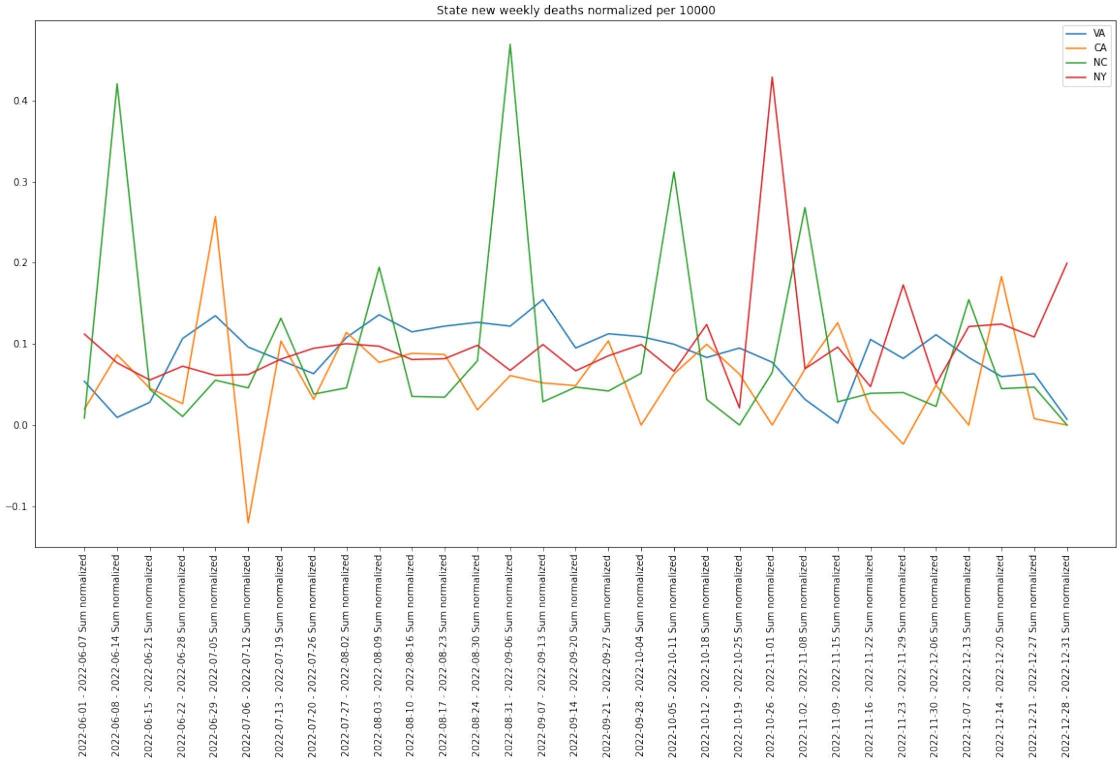


Describe why the rates differ across these states in the notebook. Identify the peaks, are they consistent with the US pattern?

If we look at the rates of cases across the states like Virginia, North Carolina, New York, and California, they rate of Covid cases are different. This is due to couple of reason: One of the main reasons is the difference in population density. California and New York are two of the states that have higher population density than other two states. Although California only ranks 17th and New York slightly higher in the population density table, the earlier state has the highest population in comparison to other states. In addition to that, some of the largest cities in the United States are in California, so this another reason why California has a higher case rate. Another reason is that California is a big state, so they have capacity to allow more Covid-19 testing.

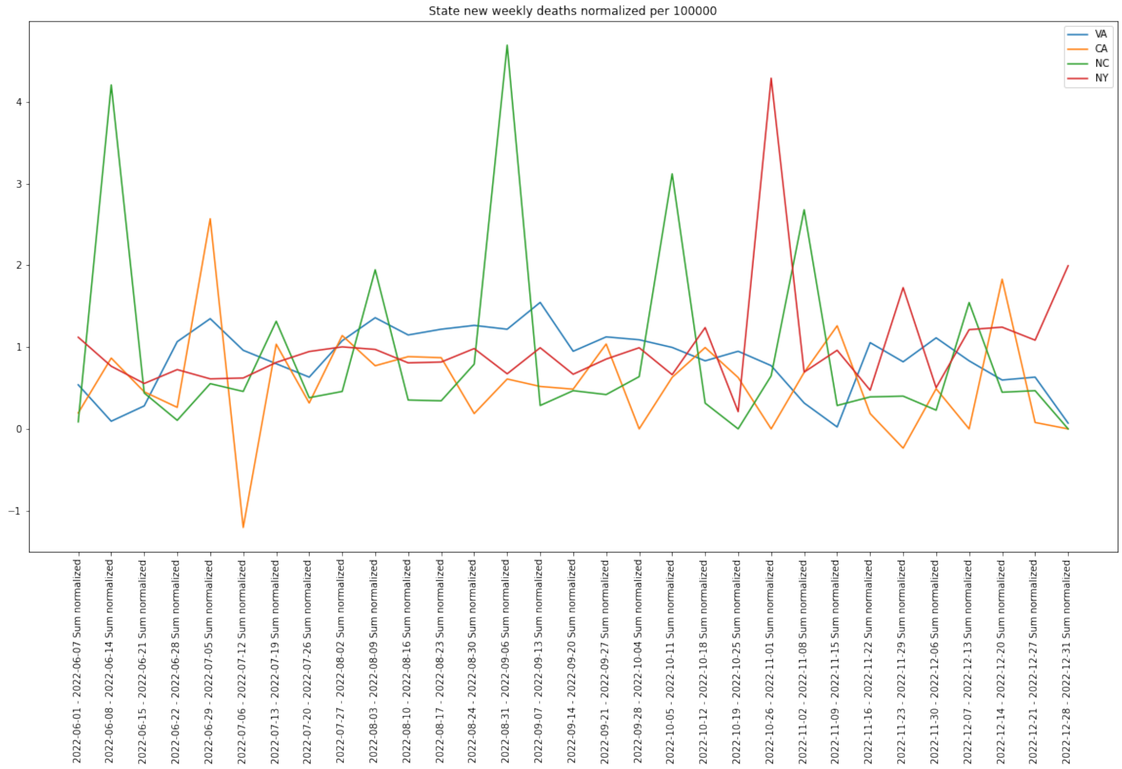
[95]:

```
plt.figure(figsize=(20, 10))
plt.title('State new weekly deaths normalized per 10000')
plt.plot(VA_norm_10k_deaths.keys(), VA_norm_10k_deaths.values(), label = 'VA')
plt.plot(CA_norm_10k_deaths.keys(), CA_norm_10k_deaths.values(), label = 'CA')
plt.plot(NC_norm_10k_deaths.keys(), NC_norm_10k_deaths.values(), label = 'NC')
plt.plot(NY_norm_10k_deaths.keys(), NY_norm_10k_deaths.values(), label = 'NY')
plt.xticks(rotation=90)

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



[96]:

```
plt.figure(figsize=(20, 10))
plt.title('State new weekly deaths normalized per 100000')
plt.plot(VA_norm_100k_deaths.keys(), VA_norm_100k_deaths.values(), label = 'VA')
plt.plot(CA_norm_100k_deaths.keys(), CA_norm_100k_deaths.values(), label = 'CA')
plt.plot(NC_norm_100k_deaths.keys(), NC_norm_100k_deaths.values(), label = 'NC')
plt.plot(NY_norm_100k_deaths.keys(), NY_norm_100k_deaths.values(), label = 'NY')
plt.xticks(rotation=90)

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



If we look at the death rates across the states like Virginia, North Carolina, New York, and California, the death rate is higher in North Carolina in comparison to other states. This might be due to: Age distribution of people living in North Carolina. North Carolina has a greater number of older populations in comparison to other states in the US. Furthermore, North Carolina has higher number of poverty as well as people with chronic health conditions which impact the death rate.

US has the highest peak of Covid cases in the week 2022-07-13 to 2022-07-19. If we look at the rates at the state level, California also has its highest Covid rate in the same period. Also, other states have also their highest Covid rates around this date, for instance New York has it highest peak one week before this period, North Carolina after 2 weeks and Virginia after one week. US has the highest peak of Covid deaths in the week 2022-11-09 to 2022-11-15. If we look at the rates at the state level, they are not consistent with the US pattern, but we can see slight increase in the death rates in comparison to previous week.

Identify 3 counties within a state of your choice with high cases and death rates.

[97]:

```
top_3_cases_counties = confirmed_VA.sum(axis=1).sort_values(ascending=False).
 ↪head(3)

print('Top 3 counties within VA with high cases: ')
for i in top_3_cases_counties.index:
    print(confirmed_VA.loc[i]['County Name'])
```

```
Top 3 counties within VA with high cases:
Fairfax County
Prince William County
City of Virginia Beach
```

```
<ipython-input-97-c5e52ec9d109>:1: FutureWarning: Dropping of nuisance columns
in DataFrame reductions (with 'numeric_only=None') is deprecated; in a future
version this will raise TypeError.  Select only valid columns before calling the
reduction.
  top_3_cases_counties =
confirmed_VA.sum(axis=1).sort_values(ascending=False).head(3)
```

[98]:

```
top_3_deaths_counties = deaths_VA.sum(axis=1).sort_values(ascending=False).
 ↪head(3)

print('\nTop 3 counties within VA with high deaths: ')
for i in top_3_deaths_counties.index:
    print(deaths_VA.loc[i]['County Name'])
```

```

Top 3 counties within VA with high deaths:
Fairfax County
Prince William County
City of Virginia Beach
```

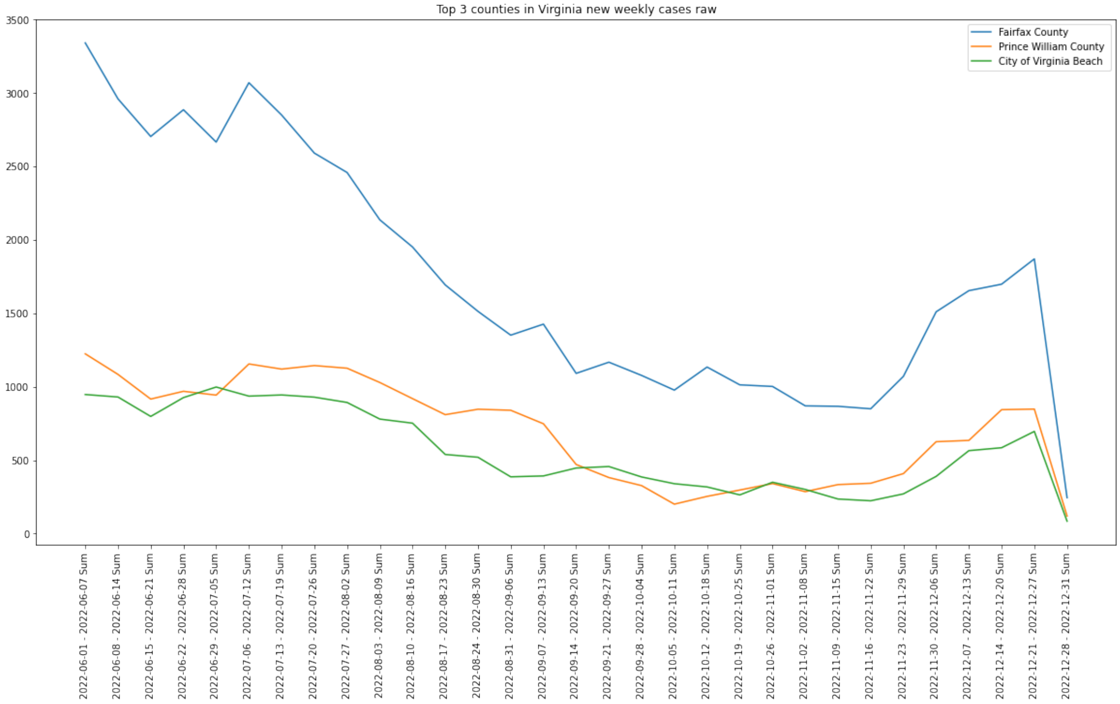
```
<ipython-input-98-a9b325780328>:1: FutureWarning: Dropping of nuisance columns
in DataFrame reductions (with 'numeric_only=None') is deprecated; in a future
version this will raise TypeError.  Select only valid columns before calling the
reduction.
  top_3_deaths_counties =
deaths_VA.sum(axis=1).sort_values(ascending=False).head(3)
```

[99]:

```
import numpy as np
def normalization_log_county(county, case_or_death):
    d = pd.DataFrame
    if (case_or_death == 'case'):
        d = confirmed.loc[county]
    else:
        d = deaths.loc[county]

    d = d.filter(regex=r'Sum|population')

    norm_log_cases = {}
    for x in range(0, len(d) - 1):
        norm_log_cases[f'{d.index.values[x]} log_normal'] = np.log((d[x] +␣
 ↪1e-6)/d['population'])

    return norm_log_cases
```

Show plots by raw values cases:

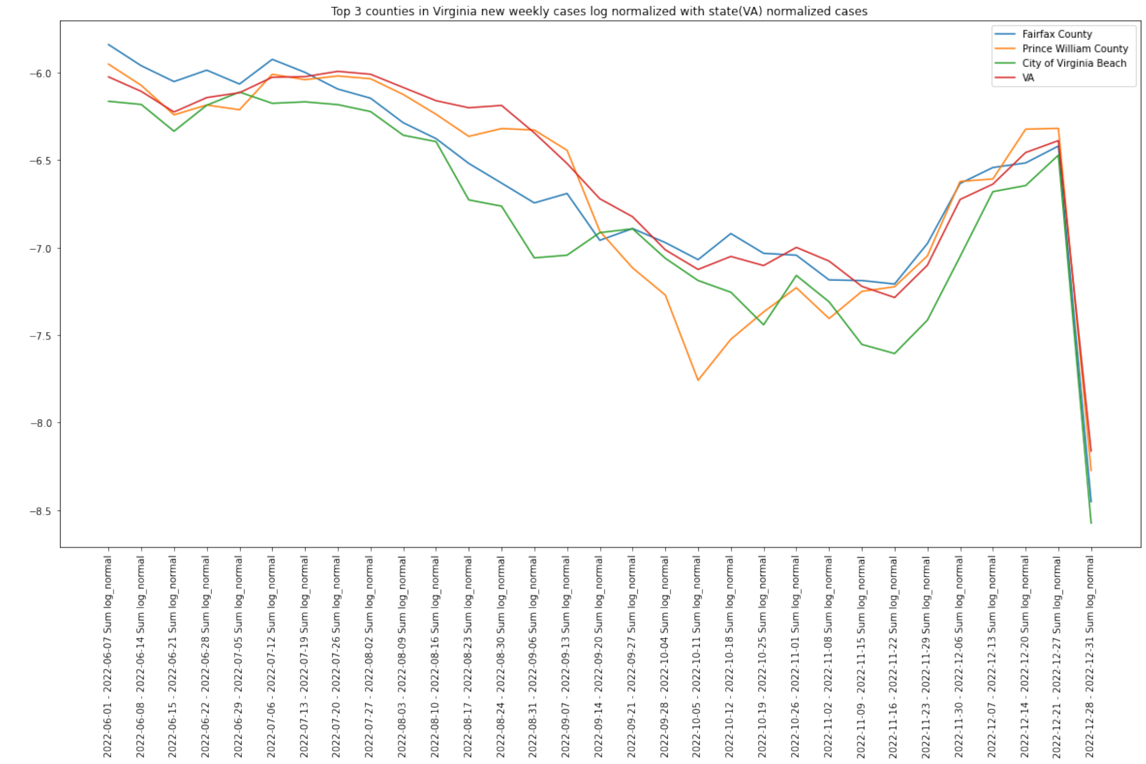
```
[100]: data = {}
       for i in top_3_cases_counties.head(3).index:
           data[confirmed_VA.loc[i]['County Name']] = confirmed_VA.loc[i].filter(regex␣
        ↪= 'Sum')

       ind = []
       val = []

       plt.figure(figsize=(20, 10))
       plt.title('Top 3 counties in Virginia new weekly cases raw')
       for i in data:
           ind = data[i].index
           val = data[i].values
           plt.plot(ind, val, label = i)

       plt.xticks(rotation=90)
       plt.legend()
       plt.show()
```



Show plots by log normalized values:

```
[102]: VA_log_norm = confirmed_VA.filter(regex = 'Sum|population')
```

```
d = VA_log_norm.sum()

VA_norm_log_cases = {}
for x in range(0, len(d) - 1):
    VA_norm_log_cases[f'{d.index[x]} log_normal'] = np.log((d[x] + 1e-6)/
  ↪d['population'])

plt.figure(figsize=(20, 10))
plt.title('Top 3 counties in Virginia new weekly cases log normalized with␣
  ↪state(VA) normalized cases')

for i in range(3):

    data = {}
    data = normalization_log_county(top_3_cases_counties.index[i], 'case')
    plt.plot(list(data), data.values(), label = confirmed_VA.
  ↪loc[top_3_cases_counties.index[i]]['County Name'])
plt.plot(list(VA_norm_log_cases), VA_norm_log_cases.values(), label = 'VA')

plt.xticks(rotation=90)
plt.legend()
plt.show()
```



Describe what is causing them and what were the peaks. Do the counties follow state pattern.

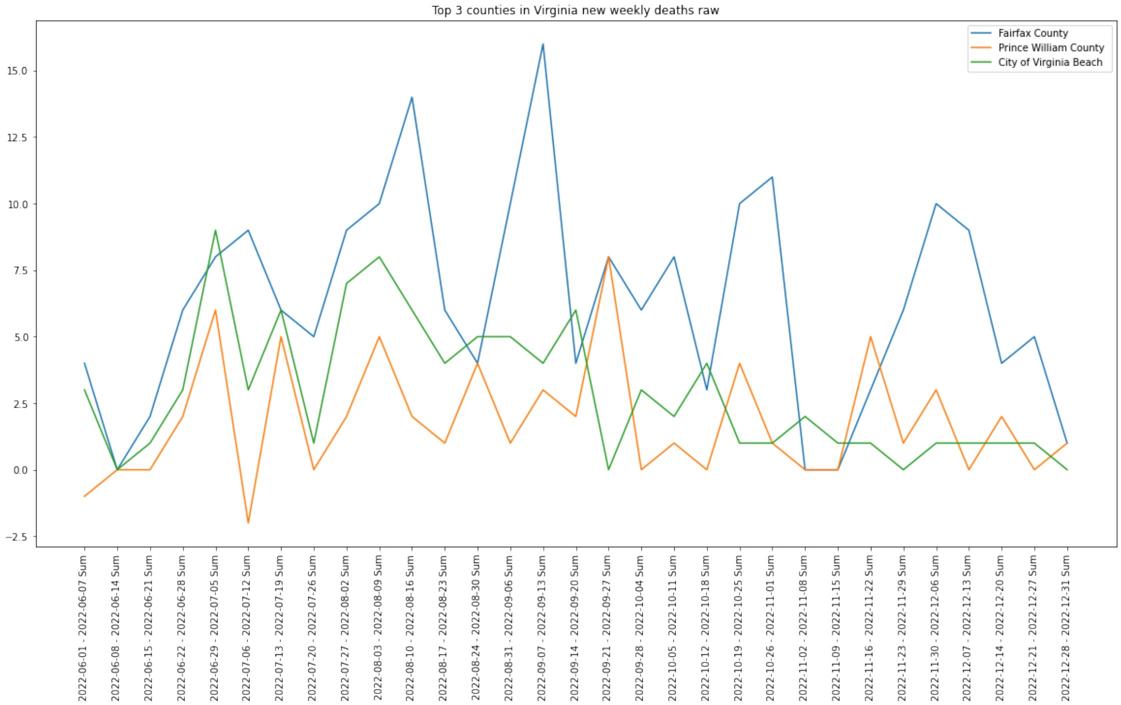
As we can visualize in this plot, the covid cases in the second half of the year is decreasing until the end of November. This might be because the weather is starting to get colder and people do not really want to go out that often and prefer to stay warm inside. However, we do see an increase in cases from end of November and have a peak during the Christmas weekend. During Christmas people tend to spend the times with their families so it makes perfect sense that the Covid cases hits its peak during this time of the year. More people together means more chances of spreading the virus.

If we compare the state pattern with the counties, we see that the patterns are realtively similar which makes sense. It makes sense because Fairfax, Prince William and City of Virginia Beach are larger counties so whenever these counties encounter increase/decrease in cases, the state is affected and follows this pattern too.

Show plots by raw values deaths:

[103]:

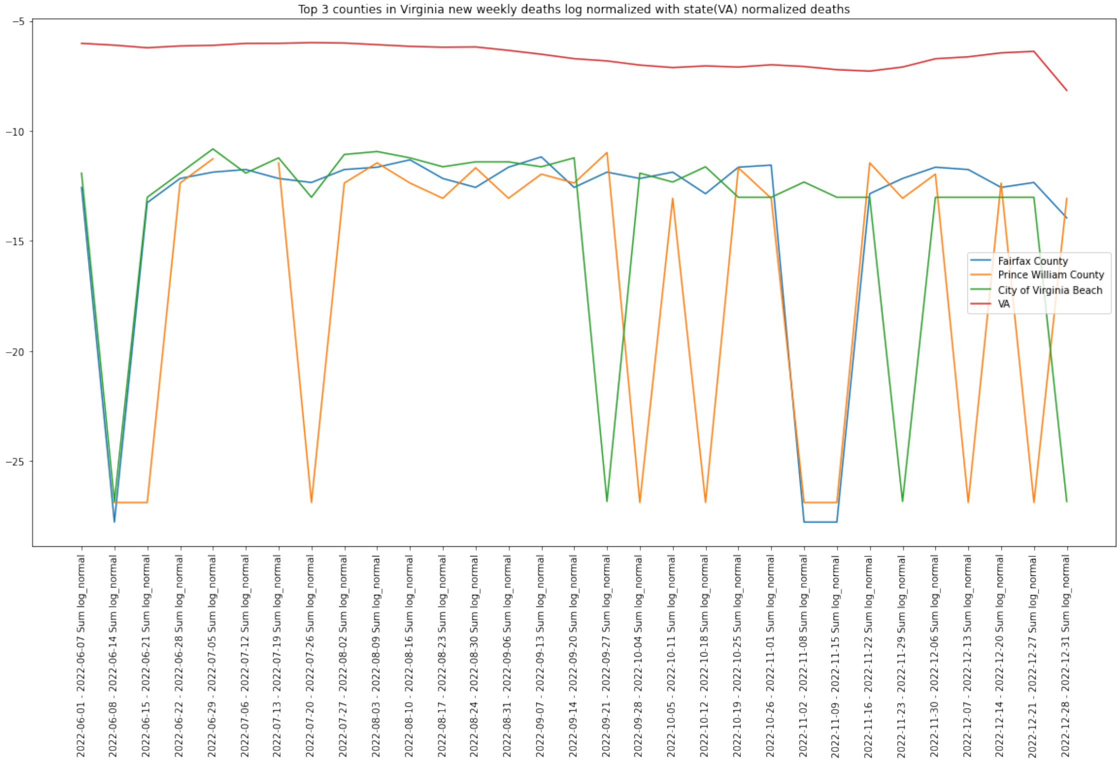
```
data = {}
for i in top_3_deaths_counties.head(3).index:
    data[deaths_VA.loc[i]['County Name']] = deaths_VA.loc[i].filter(regex =␣
 ↪'Sum')

plt.figure(figsize=(20, 10))
plt.title('Top 3 counties in Virginia new weekly deaths raw')

for i in data:
    ind = data[i].index
    val = data[i].values
    plt.plot(ind, val, label = i)

plt.xticks(rotation=90)
plt.legend()
plt.show()
```



Show plots by log normalized values deaths

[104]:
```
VA_log_norm_deaths = deaths_VA.filter(regex = 'Sum|population')

d = VA_log_norm_deaths.sum()

VA_norm_log_deaths = {}
for x in range(0, len(d) - 1):
    VA_norm_log_deaths[f'{d.index[x]} log_normal'] = np.log((d[x] + 1e-6)/
  ↪d['population'])

plt.figure(figsize=(20, 10))
plt.title('Top 3 counties in Virginia new weekly deaths log normalized with␣
  ↪state(VA) normalized deaths')

for i in range(3):

    data = {}
    data = normalization_log_county(top_3_deaths_counties.index[i], 'death')
    plt.plot(list(data), data.values(), label = deaths_VA.
  ↪loc[top_3_cases_counties.index[i]]['County Name'])

plt.plot(list(VA_norm_log_cases), VA_norm_log_cases.values(), label = 'VA')
plt.xticks(rotation=90)
plt.legend()
plt.show()
```

```
<ipython-input-99-ba5ea108e04f>:13: RuntimeWarning: invalid value encountered in
log
  norm_log_cases[f'{d.index.values[x]} log_normal'] = np.log((d[x] +
1e-6)/d['population'])
```



Initially looking at the death cases pattern, we see that the Prince William county and City of Virginia Beach has a lot of weeks where the death rate was zero and sometimes even negative. The later might be due to an error in recording the numbers. When we look at the Fairfax county's plot, the death rate hits the highest peak on the week of 2022-08-31, but the death rate is stable in this county. This might be due to the fact that Fairfax county is one of the largest populated county in Virginia and most of the population is old. If we compare the state pattern to the counties, we see that only Fairfax county tend to follow similar pattern as the state pattern. If we were to ignore zero cases or negative cases, Prince William county and City of Virginia Beach do have similar trend to that of Virginia.