Introduction

Compare different states in terms of how they are doing against each other, with COVID cases and deaths,and comparing specific state counties. Below we begin to extrpolate all the data we can, and develop a coherent understanding of what is actually happening. Generate our data for new cases involving confirmed and death for a specfic state. This specific state displayed below is Colorado (CO). We are using the .csv we created earlier that compiled all data concerning the new data.

In [ ]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

covid_population = pd.read_csv("data/covid_county_population_usafacts.csv")
covid_data = pd.read_csv("data/covid_comprehensive.csv")

df_CO = covid_data.loc[covid_data["StateFIPS"] == 8]
df_CO_deaths = df_CO[df_CO.columns.drop(list(df_CO.filter(regex=r'(confirmed|deaths
df_CO_confirmed = df_CO[df_CO.columns.drop(list(df_CO.filter(regex=r'(confirmed|dea

def get_median_data(df):
    return df[df.columns.drop(list(df.filter(regex=r'( Sum | Mean | Mode )')))]
def get_sum_data(df):
    return df[df.columns.drop(list(df.filter(regex=r'( Mean | Mode | Median )')))]
def get_mode_data(df):
    return df[df.columns.drop(list(df.filter(regex=r'( Mean | Median | Sum )')))]
def get_mean_data(df):
    return df[df.columns.drop(list(df.filter(regex=r'( Mode | Sum | Median )')))]

df_CO_deaths_state = df_CO_deaths.groupby('State').sum(numeric_only=True).drop(['co
df_CO_confirmed_state = df_CO_confirmed.groupby('State').sum(numeric_only=True).dro
```

Below are the statistics statewide per week concerning new deaths and new confirmed cases:

In [ ]:

```
display(df_CO_confirmed_state)
display(df_CO_deaths_state)
```

	State	2022-06-01 - 2022-06-08 Sum (Confirmed)	2022-06-01 - 2022-06-08 Mean (Confirmed)	2022-06-01 - 2022-06-08 Median (Confirmed)	2022-06-01 - 2022-06-08 Mode (Confirmed)	2022-06-08 - 2022-06-15 Sum (Confirmed)	2022-06-08 - 2022-06-15 Mean (Confirmed)	2022-06 2022-06 Mec (Confirm
0	CO	0	0.0	0.0	0.0	0	0.0	

1 rows × 126 columns

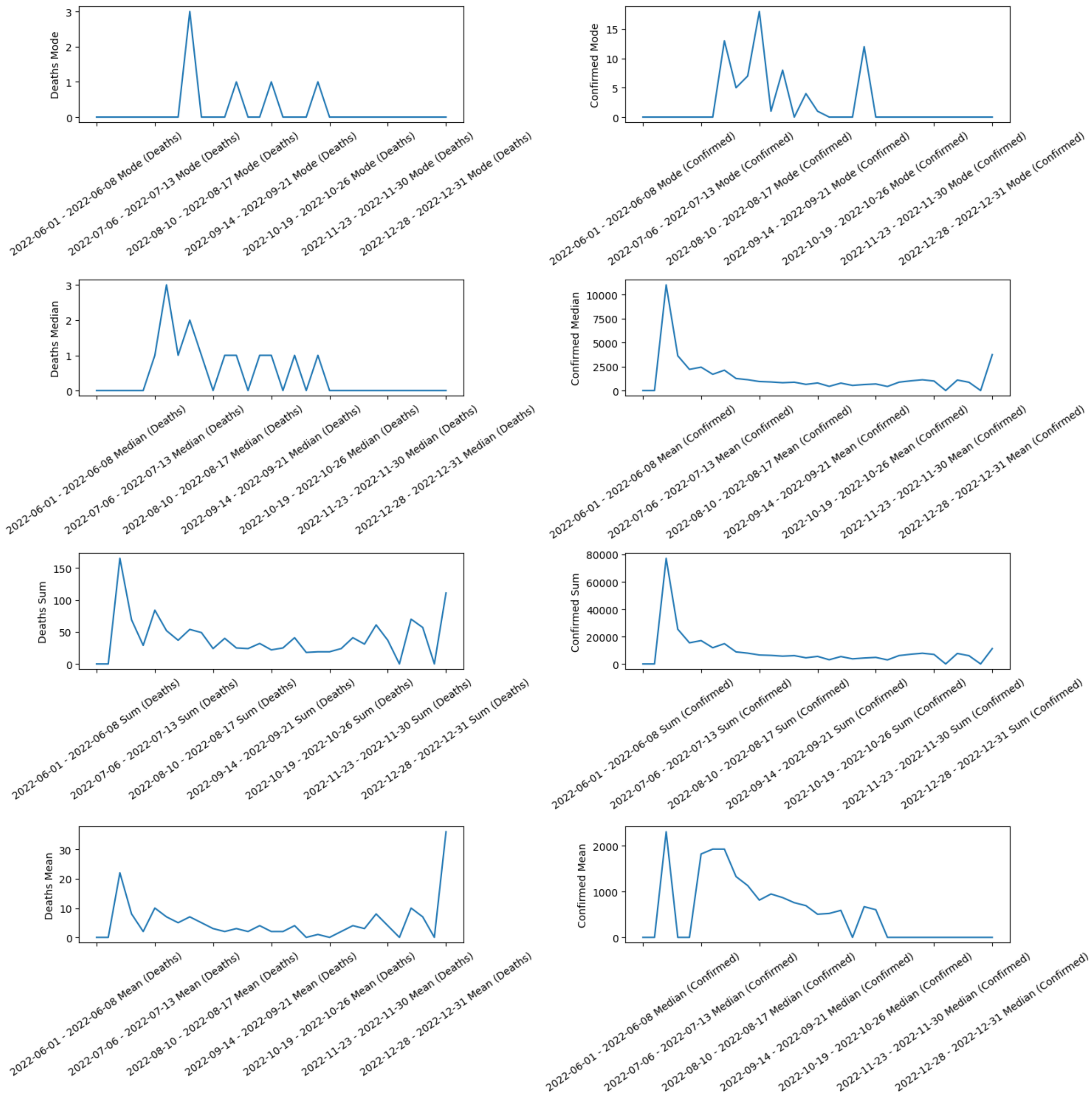
	State	2022-06-01 - 2022-06-08 Sum (Deaths)	2022-06-01 - 2022-06-08 Mean (Deaths)	2022-06-01 - 2022-06-08 Median (Deaths)	2022-06-01 - 2022-06-08 Mode (Deaths)	2022-06-08 - 2022-06-15 Sum (Deaths)	2022-06-08 - 2022-06-15 Mean (Deaths)	2022-06-08 - 2022-06-15 Median (Deaths)
0	CO	0	0.0	0.0	0.0	0	0.0	0.0

1 rows × 126 columns

Plotting the results of our data:

In [ ]:

```
### Confirmed Modes, Sums, Means, and Medians to use ###

df_CO_deaths_mode = get_mode_data(df_CO_deaths_state.drop(['State', 'population'],
df_CO_deaths_mean = get_mean_data(df_CO_deaths_state.drop(['State', 'population'],
df_CO_deaths_sum = get_sum_data(df_CO_deaths_state.drop(['State', 'population'], ax
df_CO_deaths_median = get_median_data(df_CO_deaths_state.drop(['State', 'population

### Confirmed Modes, Sums, Means, and Medians to use ###

df_CO_confirmed_mode = get_mode_data(df_CO_confirmed_state.drop(['State', 'populati
df_CO_confirmed_mean = get_mean_data(df_CO_confirmed_state.drop(['State', 'populati
df_CO_confirmed_sum = get_sum_data(df_CO_confirmed_state.drop(['State', 'population
df_CO_confirmed_median = get_median_data(df_CO_confirmed_state.drop(['State', 'popu

fig, ax = plt.subplots(4, 2, figsize=(15, 15))
ax[0,0].set_ylabel('Deaths Mode')
ax[1,0].set_ylabel('Deaths Median')
ax[2,0].set_ylabel('Deaths Sum')
ax[3,0].set_ylabel('Deaths Mean')

ax[0,1].set_ylabel('Confirmed Mode')
ax[1,1].set_ylabel('Confirmed Median')
ax[2,1].set_ylabel('Confirmed Sum')
ax[3,1].set_ylabel('Confirmed Mean')


df_CO_deaths_mode.iloc[0].plot(kind="line", ax = ax[0,0])
df_CO_deaths_mean.iloc[0].plot(kind="line", ax = ax[3,0])
df_CO_deaths_sum.iloc[0].plot(kind="line", ax = ax[2,0])
df_CO_deaths_median.iloc[0].plot(kind="line", ax = ax[1,0])


df_CO_confirmed_mode.iloc[0].plot(kind="line", ax = ax[0,1])
df_CO_confirmed_mean.iloc[0].plot(kind="line", ax = ax[1,1])
df_CO_confirmed_sum.iloc[0].plot(kind="line", ax = ax[2,1])
df_CO_confirmed_median.iloc[0].plot(kind="line", ax = ax[3,1])

for x in ax .flatten():
    plt.sca(x)
    plt.xticks(rotation = 35)

plt.tight_layout()

plt.show()
```



It is interesting to note that there are more spikes during holidays, for example summer vacations or the start of Christmas. This is based on one state though, but I believe that same can be said for others. Furthermore, there may be dips in the data due to reporting delays or human error. Either way the data showcases a good estimation of what an average year with a highly transmissable disease can do.

Below are the statistics per county each week.

```
In [ ]: display(df_CO_confirmed.drop(['countyFIPS', 'StateFIPS'], axis=1))
        display(df_CO_deaths.drop(['countyFIPS', 'StateFIPS'], axis=1))
```

	County Name	State	2022-06-01 - 2022-06-08 Sum (Confirmed)	2022-06-01 - 2022-06-08 Mean (Confirmed)	2022-06-01 - 2022-06-08 Median (Confirmed)	2022-06-01 - 2022-06-08 Mode (Confirmed)	2022-06-08 - 2022-06-15 Sum (Confirmed)	2022-0 - 2022-0 M (Confir
244	Adams County	CO	0	0.0	0.0	0.0	0	
245	Alamosa County	CO	0	0.0	0.0	0.0	0	
246	Arapahoe County	CO	0	0.0	0.0	0.0	0	
247	Archuleta County	CO	0	0.0	0.0	0.0	0	
248	Baca County	CO	0	0.0	0.0	0.0	0	
...	...	...	...	...	...	...	...	
303	Summit County	CO	0	0.0	0.0	0.0	0	
304	Teller County	CO	0	0.0	0.0	0.0	0	
305	Washington County	CO	0	0.0	0.0	0.0	0	
306	Weld County	CO	0	0.0	0.0	0.0	0	
307	Yuma County	CO	0	0.0	0.0	0.0	0	

64 rows × 127 columns

	County Name	State	2022-06-01 - 2022-06-08 Sum (Deaths)	2022-06-01 - 2022-06-08 Mean (Deaths)	2022-06-01 - 2022-06-08 Median (Deaths)	2022-06-01 - 2022-06-08 Mode (Deaths)	2022-06-08 - 2022-06-15 Sum (Deaths)	2022-06-0 - 2022-06-1 Mea (Deaths
244	Adams County	CO	0	0.0	0.0	0.0	0	0.
245	Alamosa County	CO	0	0.0	0.0	0.0	0	0.
246	Arapahoe County	CO	0	0.0	0.0	0.0	0	0.
247	Archuleta County	CO	0	0.0	0.0	0.0	0	0.
248	Baca County	CO	0	0.0	0.0	0.0	0	0.
...	...	...	...	...	...	...	...	.
303	Summit County	CO	0	0.0	0.0	0.0	0	0.
304	Teller County	CO	0	0.0	0.0	0.0	0	0.
305	Washington County	CO	0	0.0	0.0	0.0	0	0.
306	Weld County	CO	0	0.0	0.0	0.0	0	0.
307	Yuma County	CO	0	0.0	0.0	0.0	0	0.

64 rows × 127 columns

Comparing States

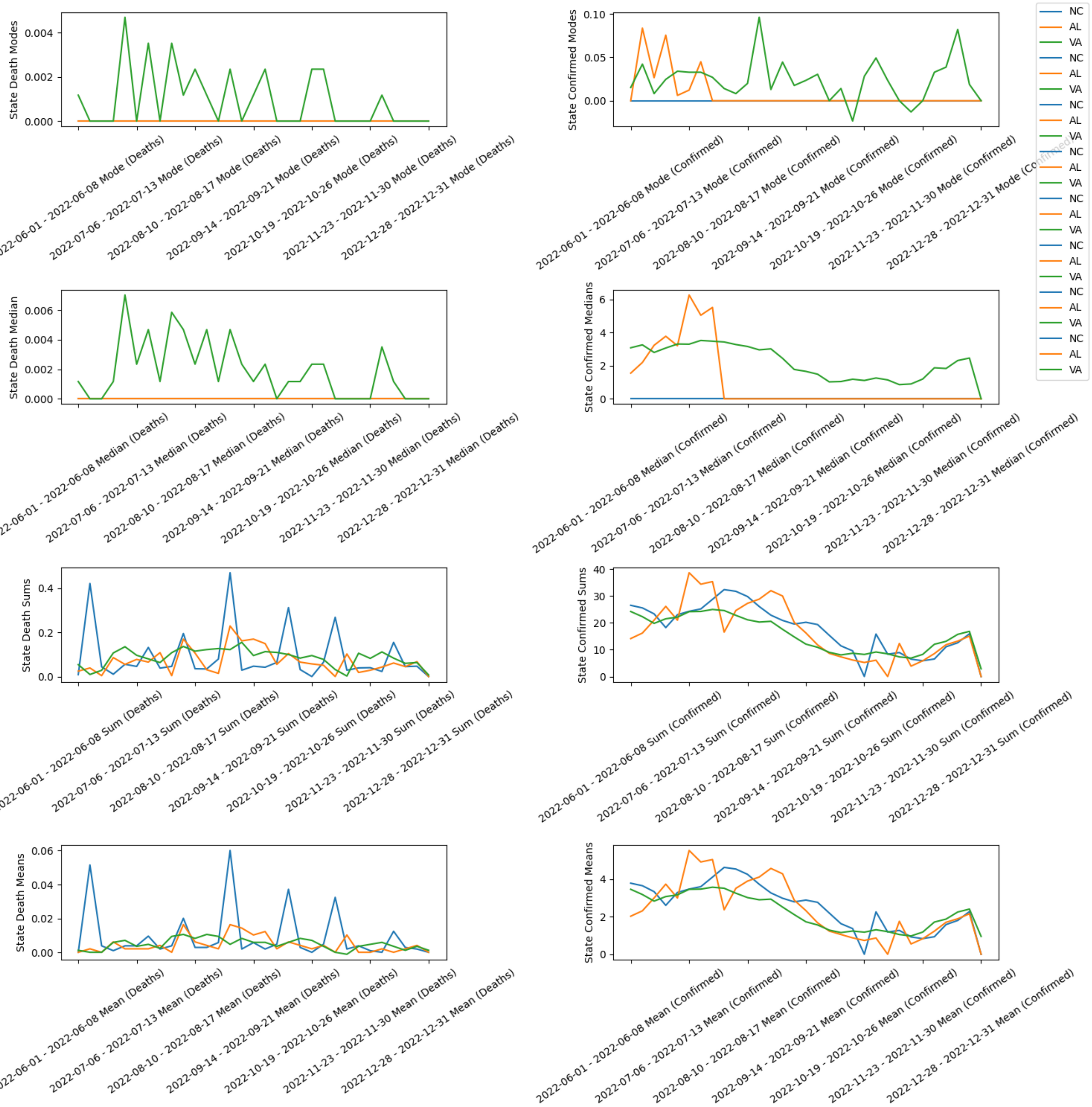
In the code below we compare our data against three other states. These states are NC, VA, and AL. It is important to 'clean' our data, below I strip out all strings and any columns that are not of us for this analysis. The main focus is to determine how each state stacks against the other in terms of new deaths and confirmed cases.

In [ ]:

```
#Helper functions

FACTOR = 10000
STATES = ["NC", "AL", "VA"]

covid_population.drop(covid_population[covid_population["County Name"].str.contains
population_state = covid_population.drop(['countyFIPS', 'County Name'], axis=1).gro

def get_new_deaths(df):
    return df[df.columns.drop(list(df.filter(regex=r'(confirmed|deaths|(Confirmed))

def get_new_confirmed(df):
    return df[df.columns.drop(list(df.filter(regex=r'(confirmed|deaths|(Deaths))'))

def normalize(df, population):
    return (df/population) * FACTOR
#Get our three states

df_NC = covid_data.loc[covid_data["StateFIPS"] == 37]
df_AL = covid_data.loc[covid_data["StateFIPS"] == 1]
df_VA = covid_data.loc[covid_data["StateFIPS"] == 51]

df_NC = df_NC.groupby('State').sum(numeric_only=True).drop(['countyFIPS', 'StateFIP
df_AL = df_AL.groupby('State').sum(numeric_only=True).drop(['countyFIPS', 'StateFIP
df_VA = df_VA.groupby('State').sum(numeric_only=True).drop(['countyFIPS', 'StateFIP


#Get our new data and normalize it
df_NC_deaths = normalize(get_new_deaths(df_NC.drop(['State'], axis=1)), population_
df_AL_deaths = normalize(get_new_deaths(df_AL.drop(['State'], axis=1)), population_
df_VA_deaths = normalize(get_new_deaths(df_VA.drop(['State'], axis=1)), population_

df_NC_confirmed = normalize(get_new_confirmed(df_NC.drop(['State'], axis=1)), popul
df_AL_confirmed = normalize(get_new_confirmed(df_AL.drop(['State'], axis=1)), popul
df_VA_confirmed = normalize(get_new_confirmed(df_VA.drop(['State'], axis=1)), popul

### Deaths Modes, Sums, Means, and Medians to use ###

df_NC_deaths_mode = get_mode_data(df_NC_deaths)
df_NC_deaths_mean = get_mean_data(df_NC_deaths)
df_NC_deaths_sum = get_sum_data(df_NC_deaths)
df_NC_deaths_median = get_median_data(df_NC_deaths)

df_AL_deaths_mode = get_mode_data(df_AL_deaths)
df_AL_deaths_mean = get_mean_data(df_AL_deaths)
df_AL_deaths_sum = get_sum_data(df_AL_deaths)
df_AL_deaths_median = get_median_data(df_AL_deaths)

df_VA_deaths_mode = get_mode_data(df_VA_deaths)
df_VA_deaths_mean = get_mean_data(df_VA_deaths)
df_VA_deaths_sum = get_sum_data(df_VA_deaths)
df_VA_deaths_median = get_median_data(df_VA_deaths)

### Confirmed Modes, Sums, Means, and Medians to use ###

df_NC_confirmed_mode = get_mode_data(df_NC_confirmed)
```

```
df_NC_confirmed_mean = get_mean_data(df_NC_confirmed)
df_NC_confirmed_sum = get_sum_data(df_NC_confirmed)
df_NC_confirmed_median = get_median_data(df_NC_confirmed)

df_AL_confirmed_mode = get_mode_data(df_AL_confirmed)
df_AL_confirmed_mean = get_mean_data(df_AL_confirmed)
df_AL_confirmed_sum = get_sum_data(df_AL_confirmed)
df_AL_confirmed_median = get_median_data(df_AL_confirmed)

df_VA_confirmed_mode = get_mode_data(df_VA_confirmed)
df_VA_confirmed_mean = get_mean_data(df_VA_confirmed)
df_VA_confirmed_sum = get_sum_data(df_VA_confirmed)
df_VA_confirmed_median = get_median_data(df_VA_confirmed)


#Plot our data

fig, ax = plt.subplots(4, 2, figsize=(15, 15))
ax[0,0].set_ylabel('State Death Modes')
ax[1,0].set_ylabel('State Death Median')
ax[2,0].set_ylabel('State Death Sums')
ax[3,0].set_ylabel('State Death Means')

ax[0,1].set_ylabel('State Confirmed Modes')
ax[1,1].set_ylabel('State Confirmed Medians')
ax[2,1].set_ylabel('State Confirmed Sums')
ax[3,1].set_ylabel('State Confirmed Means')


df_NC_deaths_mode.iloc[0].plot(kind="line", ax = ax[0,0], label='NC')
df_AL_deaths_mode.iloc[0].plot(kind="line", ax = ax[0,0], label='AL')
df_VA_deaths_mode.iloc[0].plot(kind="line", ax = ax[0,0], label='VA')

df_NC_deaths_median.iloc[0].plot(kind="line", ax = ax[1,0], label='NC')
df_AL_deaths_median.iloc[0].plot(kind="line", ax = ax[1,0], label='AL')
df_VA_deaths_median.iloc[0].plot(kind="line", ax = ax[1,0], label='VA')

df_NC_deaths_sum.iloc[0].plot(kind="line", ax = ax[2,0], label='NC')
df_AL_deaths_sum.iloc[0].plot(kind="line", ax = ax[2,0], label='AL')
df_VA_deaths_sum.iloc[0].plot(kind="line", ax = ax[2,0], label='VA')

df_NC_deaths_mean.iloc[0].plot(kind="line", ax = ax[3,0], label='NC')
df_AL_deaths_mean.iloc[0].plot(kind="line", ax = ax[3,0], label='AL')
df_VA_deaths_mean.iloc[0].plot(kind="line", ax = ax[3,0], label='VA')

#################


df_NC_confirmed_mode.iloc[0].plot(kind="line", ax = ax[0,1], label='NC')
df_AL_confirmed_mode.iloc[0].plot(kind="line", ax = ax[0,1], label='AL')
df_VA_confirmed_mode.iloc[0].plot(kind="line", ax = ax[0,1], label='VA')

df_NC_confirmed_median.iloc[0].plot(kind="line", ax = ax[1,1], label='NC')
df_AL_confirmed_median.iloc[0].plot(kind="line", ax = ax[1,1], label='AL')
df_VA_confirmed_median.iloc[0].plot(kind="line", ax = ax[1,1], label='VA')
```

```
df_NC_confirmed_sum.iloc[0].plot(kind="line", ax = ax[2,1], label='NC')
df_AL_confirmed_sum.iloc[0].plot(kind="line", ax = ax[2,1], label='AL')
df_VA_confirmed_sum.iloc[0].plot(kind="line", ax = ax[2,1], label='VA')

df_NC_confirmed_mean.iloc[0].plot(kind="line", ax = ax[3,1], label='NC')
df_AL_confirmed_mean.iloc[0].plot(kind="line", ax = ax[3,1], label='AL')
df_VA_confirmed_mean.iloc[0].plot(kind="line", ax = ax[3,1], label='VA')


for x in ax .flatten():
    plt.sca(x)
    plt.xticks(rotation = 35)

fig.legend(loc="upper right")
plt.tight_layout()
plt.show()
```



Sifting throught the data, there are noticable peaks and differences between the three states (NC, AL, VA).

To start, there is noticeable 0 references in the data, that is because of either human error from the online websites, however the data has plenty to go off on. The peaks between the different states are different, but sometimes originate near the same areas. If you notice on the "State Death Means" graph, All three states, has a considerable peak at the same time. I belive this may have originated because of southern schools letting out for the summer and families go on vacations, spreading the virus and causing deaths to occur later in the summer.

The peaks were somewhat close the US pattern, but of course there are differences based on locations and places.

I belive the rates differ between each state due to human reporting based on a case by case basis. If you notice, the first two graphs have zero data to report, either people are healthier in these states...or there is erroneous reporting, which is what I believe. Further, each state has different events/social activities, so people could've contracted it earlier or later in the time. Lastly, some states could've had more strict rules on having masks/quarantine. A lot to factor in.

It is interesting to notice that NC has such a high rate of deaths... that I am not sure why. One thing could be NC's citizens' stance on COVID during this time, which was lax for the most part.

Counties

Below we find the three highest counties within North Carolina with high cases and death rates.

```
In [ ]:
```

In [ ]:

```
pop_data = pd.read_csv('data/covid_county_population_usafacts.csv')
pop_data.drop(pop_data[(pop_data["countyFIPS"] == 0)].index, inplace=True)

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)

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)

covid_confirmed_data = pd.merge(confirmed, pop_data, on='countyFIPS')
covid_death_data = pd.merge(deaths, pop_data, on='countyFIPS')

covid_confirmed_data.drop(covid_confirmed_data[(covid_confirmed_data['countyFIPS']
covid_death_data.drop(covid_death_data[(covid_death_data['countyFIPS'] == 0)].index

county_NC_confirmed = covid_confirmed_data.loc[covid_confirmed_data["StateFIPS"] ==
county_NC_deaths = covid_death_data.loc[covid_death_data["StateFIPS"] == 37]

find_sum_confirmed = county_NC_confirmed.groupby('County Name_x').sum(numeric_only=
find_sum_deaths = county_NC_deaths.groupby('County Name_x').sum(numeric_only=True).

top_three_confirmed = find_sum_confirmed.sort_values(by="2022-12-31", ascending=Fal
top_three_deaths = find_sum_deaths.sort_values(by="2022-12-31", ascending=False).he

display(top_three_confirmed)
display(top_three_deaths)
```

	County Name_x	countyFIPS	2022-05-31	2022-06-01	2022-06-02	2022-06-03	2022-06-04	2022
91	Wake County	37183	311960	317226	317226	317226	317226	
59	Mecklenburg County	37119	290858	293852	293852	293852	293852	
40	Guilford County	37081	124604	126137	126137	126137	126137	

3 rows × 218 columns

	County Name_x	countyFIPS	2022-05-31	2022-06-01	2022-06-02	2022-06-03	2022-06-04	2022
59	Mecklenburg County	37119	1622	1622	1622	1622	1622	
40	Guilford County	37081	1212	1213	1213	1213	1213	
91	Wake County	37183	1122	1122	1122	1122	1122	

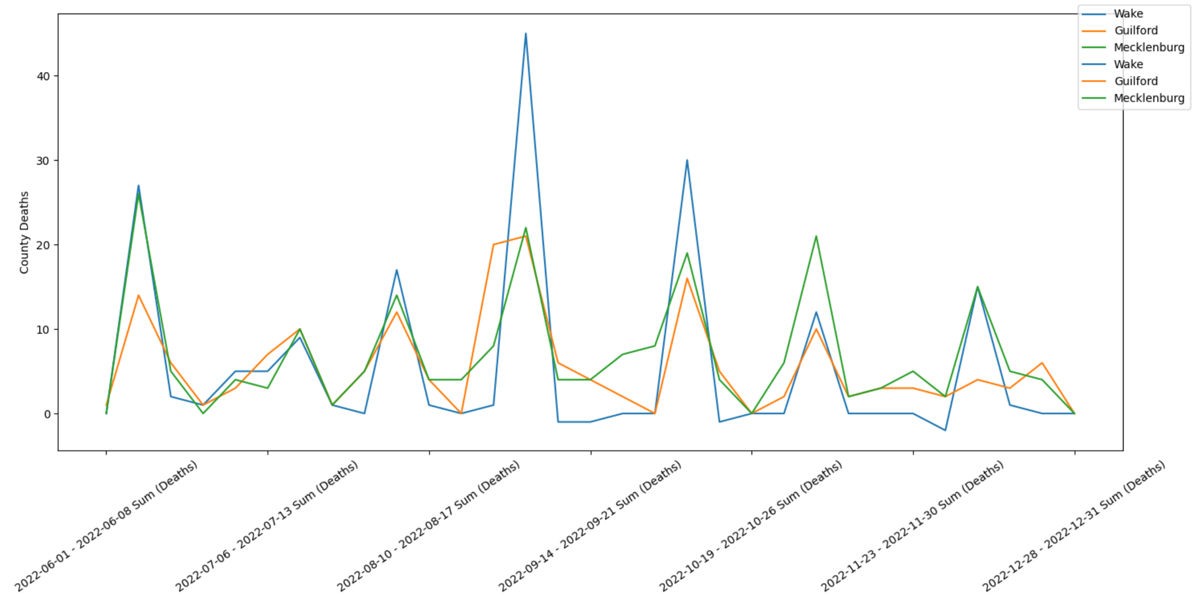
3 rows × 218 columns

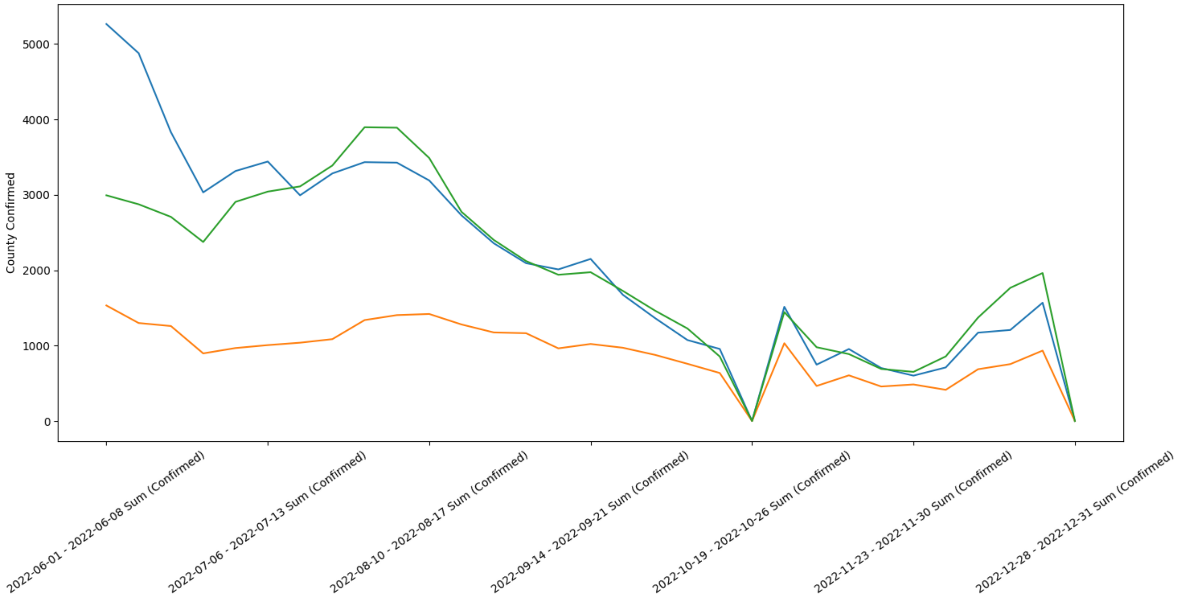
I decided to find the top three counties in our state that had the most deaths and confirmed cases. Guildord County is ranked number three out of the entire state during this 6 month period, a bit scary...

Weekly Trends of the Three Counties

Below I plot the weekly trends of new cases to find anything noteworthy, the results were surprising to find.

```
In [ ]: df_NC = covid_data.loc[covid_data["StateFIPS"] == 37]

        df_NC_wake = df_NC.loc[df_NC["countyFIPS"] == 37183]
        df_NC_guilford = df_NC.loc[df_NC["countyFIPS"] == 37081]
        df_NC_meck = df_NC.loc[df_NC["countyFIPS"] == 37119]

        df_NC_wake = df_NC_wake.reset_index()
        df_NC_guilford = df_NC_guilford.reset_index()
        df_NC_meck = df_NC_meck.reset_index()

        #clean data
        df_NC_wake = df_NC_wake.drop(['index','countyFIPS', 'State', 'County Name', 'StateF
        df_NC_guilford = df_NC_guilford.drop(['index','countyFIPS', 'State', 'County Name',
        df_NC_meck = df_NC_meck.drop(['index','countyFIPS', 'State', 'County Name', 'StateF

        df_wake_deaths = get_sum_data(get_new_deaths(df_NC_wake))
        df_wake_confirmed = get_sum_data(get_new_confirmed(df_NC_wake))

        df_guilford_deaths = get_sum_data(get_new_deaths(df_NC_guilford))
        df_guilford_confirmed = get_sum_data(get_new_confirmed(df_NC_guilford))

        df_meck_deaths = get_sum_data(get_new_deaths(df_NC_meck))
        df_meck_confirmed = get_sum_data(get_new_confirmed(df_NC_meck))

        fig, ax = plt.subplots(2, 1, figsize=(15, 15))
        ax[0].set_ylabel('County Deaths')
        ax[1].set_ylabel('County Confirmed')

        df_wake_deaths.iloc[0].plot(kind="line", ax = ax[0], label='Wake')
        df_guilford_deaths.iloc[0].plot(kind="line", ax = ax[0], label='Guilford')
        df_meck_deaths.iloc[0].plot(kind="line", ax = ax[0], label='Mecklenburg')

        df_wake_confirmed.iloc[0].plot(kind="line", ax = ax[1], label='Wake')
        df_guilford_confirmed.iloc[0].plot(kind="line", ax = ax[1], label='Guilford')
        df_meck_confirmed.iloc[0].plot(kind="line", ax = ax[1], label='Mecklenburg')


        for x in ax .flatten():
            plt.sca(x)
            plt.xticks(rotation = 35)

        fig.legend(loc="upper right")
        plt.tight_layout()
        plt.show()
```





The three different counties follow a similar trend. In each county, Wake county ended up having the largest spikes, with Mecklenburg in close second. I believe that there was a larger spike, due to schools back in session around the August time frame.

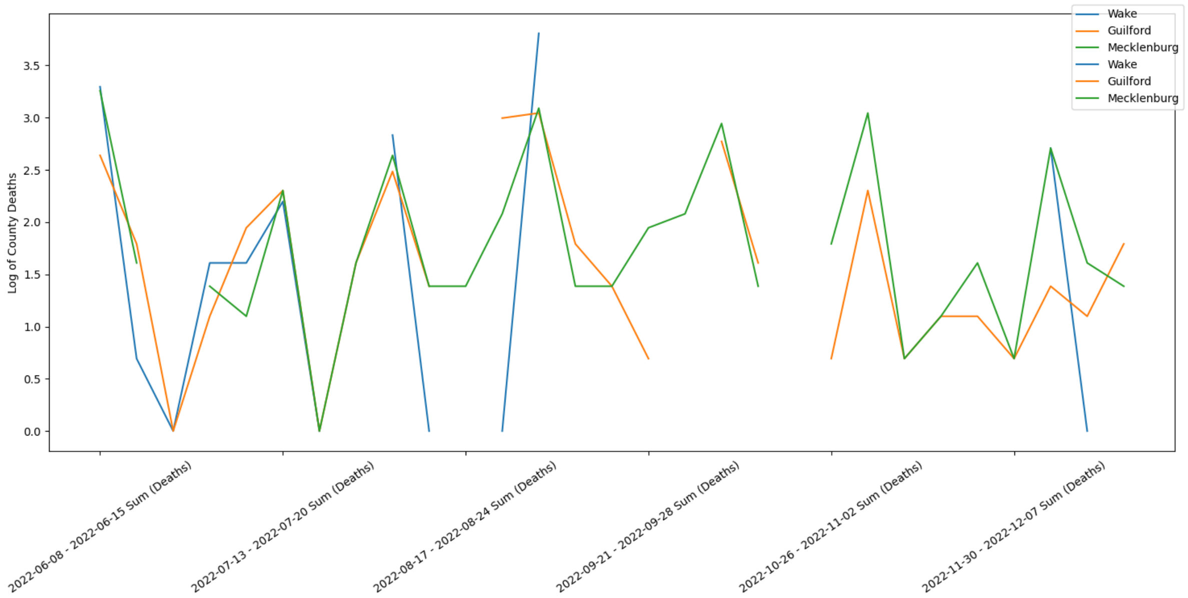
In terms of confirmed cases, there was a decrease over the summer, but as soon as schools opened up and people began traveling again. Also, started to uptick around the holidays too. There is a uptick of confirmed cases. So it goes to show that quarantining or 'separating' does work.

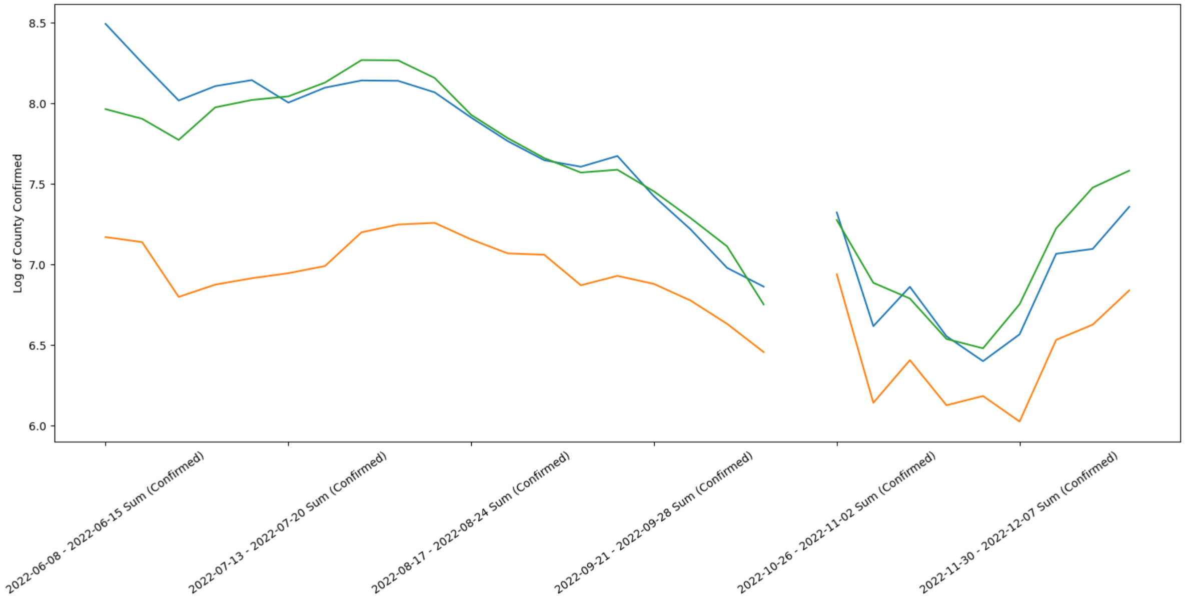
Below I utilized the log function to find any differences between the normal and non-normal of my plots.

In [ ]:

```
df_wake_deaths_log = np.log(df_wake_deaths.iloc[:, 1:])
df_guilford_deaths_log = np.log(df_guilford_deaths.iloc[:, 1:])
df_meck_deaths_log = np.log(df_meck_deaths.iloc[:, 1:])

df_wake_confirmed_log = np.log(df_wake_confirmed.iloc[:, 1:])
df_guilford_confirmed_log = np.log(df_guilford_confirmed.iloc[:, 1:])
df_meck_confirmed_log = np.log(df_meck_confirmed.iloc[:, 1:])

fig, ax = plt.subplots(2, 1, figsize=(15, 15))
ax[0].set_ylabel('Log of County Deaths')
ax[1].set_ylabel('Log of County Confirmed')


df_wake_deaths_log.iloc[0].plot(kind="line", ax = ax[0], label='Wake')
df_guilford_deaths_log.iloc[0].plot(kind="line", ax = ax[0], label='Guilford')
df_meck_deaths_log.iloc[0].plot(kind="line", ax = ax[0], label='Mecklenburg')

df_wake_confirmed_log.iloc[0].plot(kind="line", ax = ax[1], label='Wake')
df_guilford_confirmed_log.iloc[0].plot(kind="line", ax = ax[1], label='Guilford')
df_meck_confirmed_log.iloc[0].plot(kind="line", ax = ax[1], label='Mecklenburg')

for x in ax .flatten():
    plt.sca(x)
    plt.xticks(rotation = 35)

fig.legend(loc="upper right")
plt.tight_layout()
plt.show()
```

```
c:\Users\warso\AppData\Local\Programs\Python\Python310\lib\site-packages\pandas\cor
e\internals\blocks.py:351: RuntimeWarning: divide by zero encountered in log
  result = func(self.values, **kwargs)
c:\Users\warso\AppData\Local\Programs\Python\Python310\lib\site-packages\pandas\cor
e\internals\blocks.py:351: RuntimeWarning: invalid value encountered in log
  result = func(self.values, **kwargs)
```





Based on the graphs above, the data is still very similar and showcases that are raw values and data are true. There was an instance of negative or zero values from the log function, however the data still proves to be valuable nonetheless. As I said before, I believe that what is causing the peaks are the holidays, back to school events and anything in between (socials, baseball games, etc.) Also, it is interesting to notice but all of the NC counties follow the NC State pattern. So I really believe that our school systems could be spreading this virus more effectively than work.

Conclusion

The data the was found while this report can be proven invaluable in case another pandemic of the likes of COVID-19 happens again. Of course we are still going though COVID, I believe that looking at the trends in different counties and states, we can be better prepared next time (hopefully it doesn't happen), if this were to happen.

I believe I learned a lot from scanning and reviewing the most confirmed/death cases in North Carolina. I had no idea that our schools could be the main culprit in spreading COVID-19. I feel as if that having the opporutunity to work from home is a big part of our society, but going to school in-person is becoming the norm. This follows suit to what is occuring in this graphs.