

# Analysis of the COVID-19 Pandemic

Contributing Factors, Responses,  
and Effects

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## **Global Analysis: Katie**

- Examine contributing factors to the COVID-19 pandemic globally
- Determine how COVID-19 vaccine distribution affected case rates in individual nations

## **United States Analysis: Greyson**

- Examine effectiveness of Vaccine rollout in the United States and its impact on COVID-19 cases per capita.

## **Mississippi Analysis: Thomas**

- Look specifically at the state of Mississippi and focus on how overall economic activity reacted to the increase in COVID-19 cases, the relationship between poverty rates and per capita case numbers, and schooling modalities throughout the 2020-2021 school year.

# Analysis of the COVID-19 Pandemic on a Global Scale

## **Question 1:**

Did nations with higher health expenditure allocations in 2019 reduce daily new COVID-19 cases in June 2020?

## **Question 2:**

Which socioeconomic factor most closely indicated increased COVID-19 mortality metrics?

## **Question 3:**

How did the COVID-19 vaccination dispersal affect daily COVID-19 case metrics? Was the vaccine effective in minimizing COVID-19 cases?

# Q1: Effect of 2019 Health Expenditures on COVID-19 Cases in June 2020

Country	Avg New Cases (Per Million People) Per Day June 2020	Health Expenditure (as percentage of GDP)
Tuvalu	0.0	24.0
United States	80.9	16.8
Marshall Islands	0.0	16.3
Palau	0.0	15.2
Afghanistan	13.6	13.2

Fig 1: 5 nations with highest 2019 health expenditure allocations as a percentage of GDP

- Avg. new cases per day globally in June 2020 = 21.1 per million people
- Oceanic nations depicted in map below
  - Geographically isolated



# Q1: Effect of 2019 Health Expenditures on COVID-19 Cases in June 2020

Country	Avg New Cases (Per Million People) Per Day June 2020	Health Expenditure (as percentage of GDP)
Brunei	0	2.2
Cambodia	0	7.0
China	0	5.4
Cook Islands	0	3.1
Fiji	0	3.8

- Cook Islands and Fiji are island nations located in the South Pacific ocean and Oceania, respectively
  - Geographic isolation
- Brunei and Cambodia border South Pacific ocean
- Brunei, Cambodia, and China all enforced strict shut downs

Fig 2: 5 nations with lowest average new daily COVID-19 case rates, June 2020

# Q1: Effect of 2019 Health Expenditures on COVID-19 Cases in June 2020

- Of the 5 nations with lowest allocations of GDP towards health expenditures in 2019, all had 0 new cases in June 2020
- Results indicate that increased health expenditures did not result in reduced initial COVID-19 spread
- Possible Reasoning:
  - Lack of proper testing/reporting
  - Geographic isolation of island nations
  - Strict shutdowns

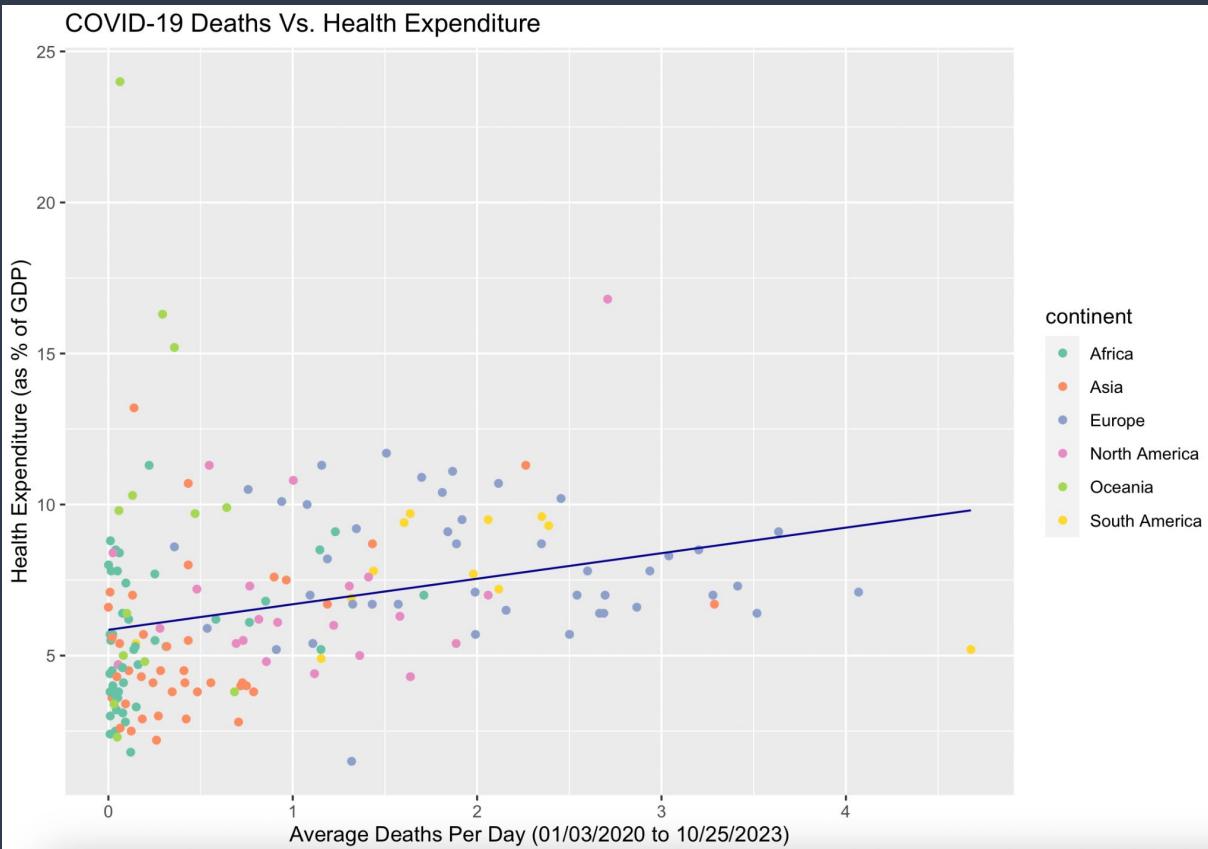


Team preparing to disinfect Wuhan Railway Station, 03/24/2020

# Q2: Which socioeconomic factor most closely indicated increased COVID-19 mortality metrics?

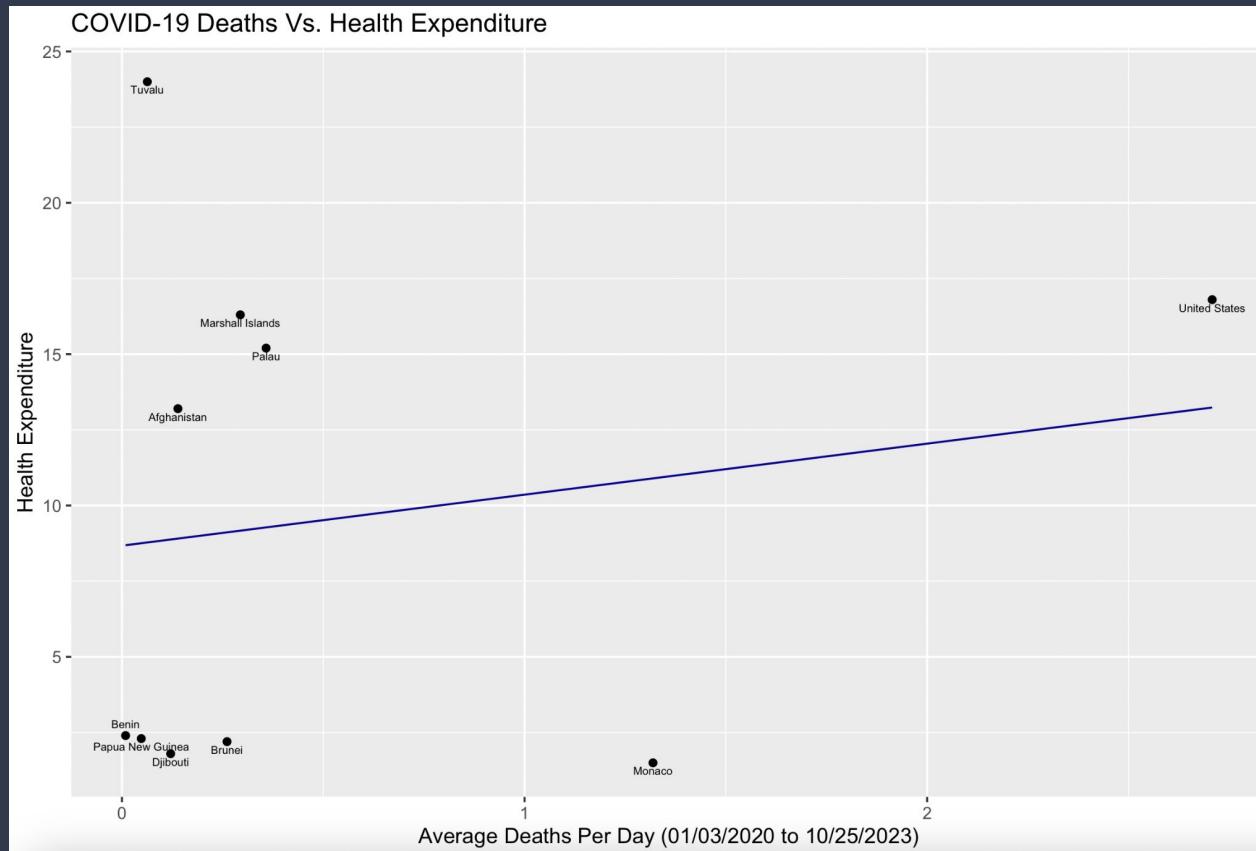
- Analyze trends between the following factors and COVID-19 mortality rates from January 2020 - October 2023:
  - 2019 Health expenditures as a percentage of a nation's GDP
  - GDP per capita
  - Population density
  - Median age

# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors

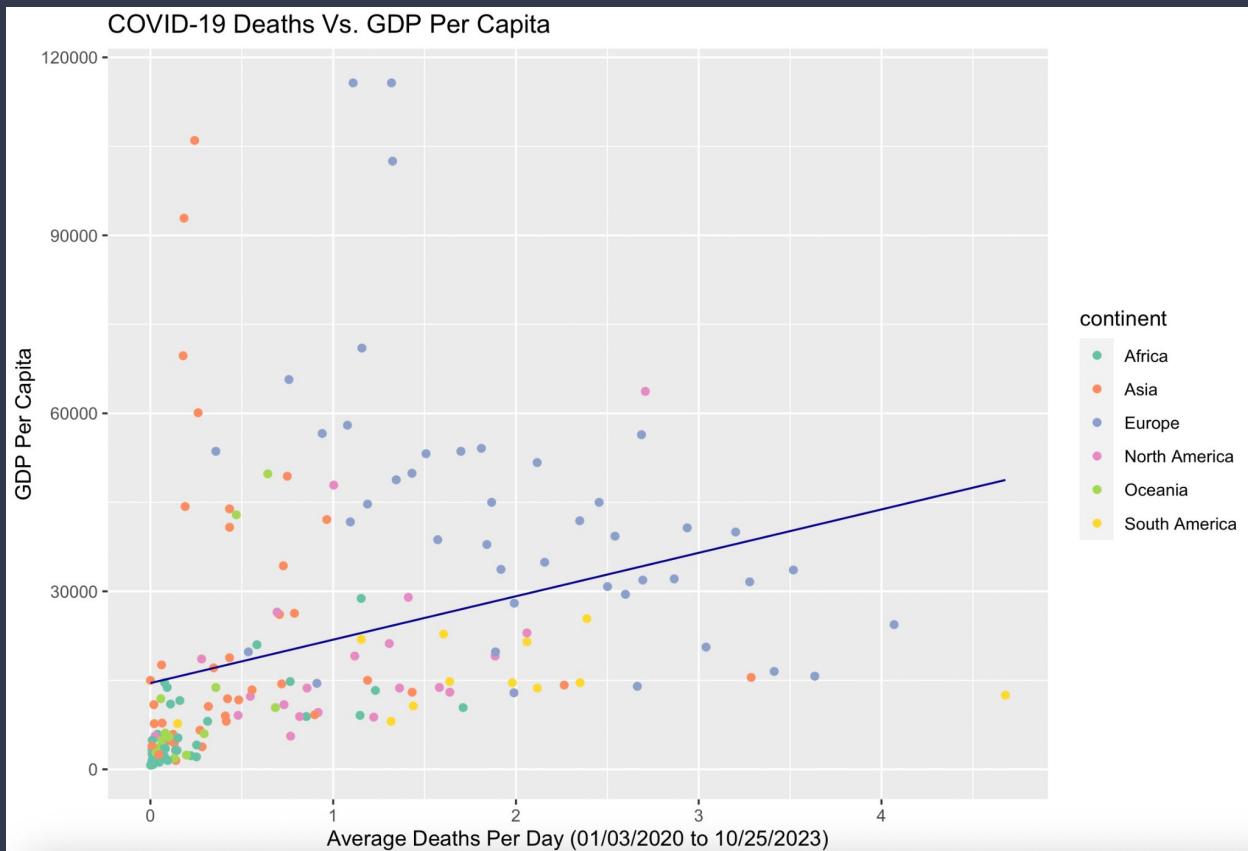


- Correlation coefficient = 0.2821242
  - Weak positive correlation
  - As health expenditure increases, COVID-19 mortality rates increase

# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors

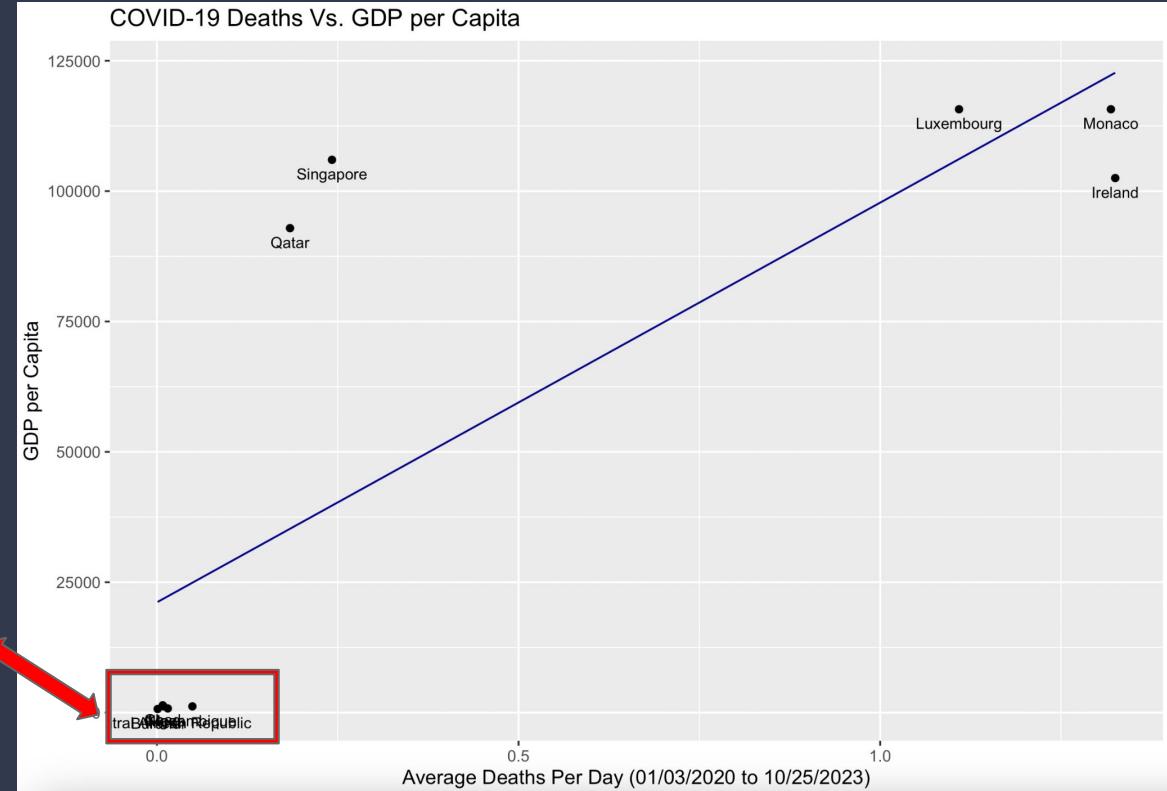
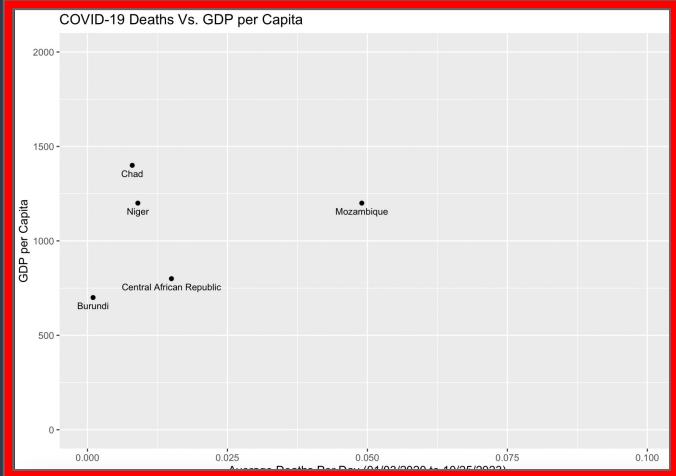


# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors

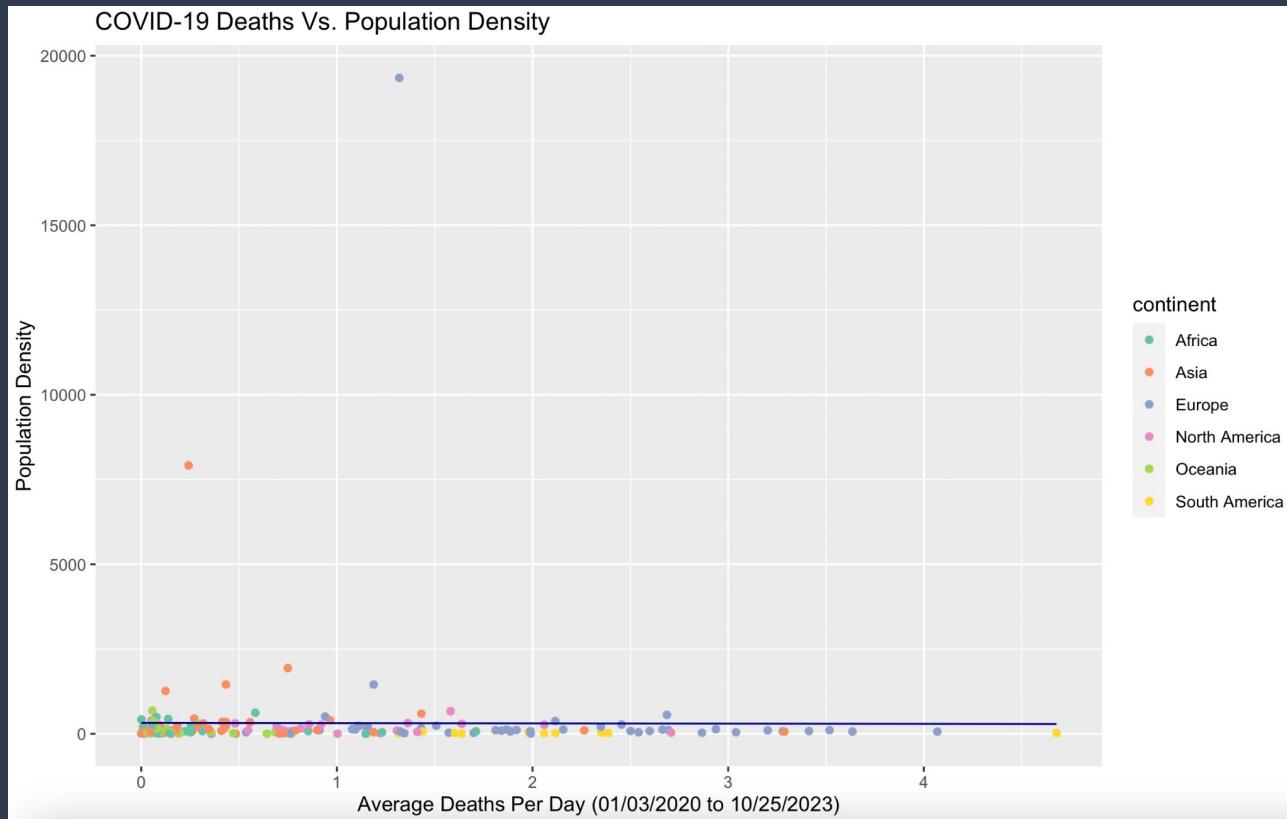


- Correlation Coefficient = 0.3684578
- Slightly stronger positive correlation
- As a nation's GDP per capita increases, COVID-19 mortality rates increase

# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors



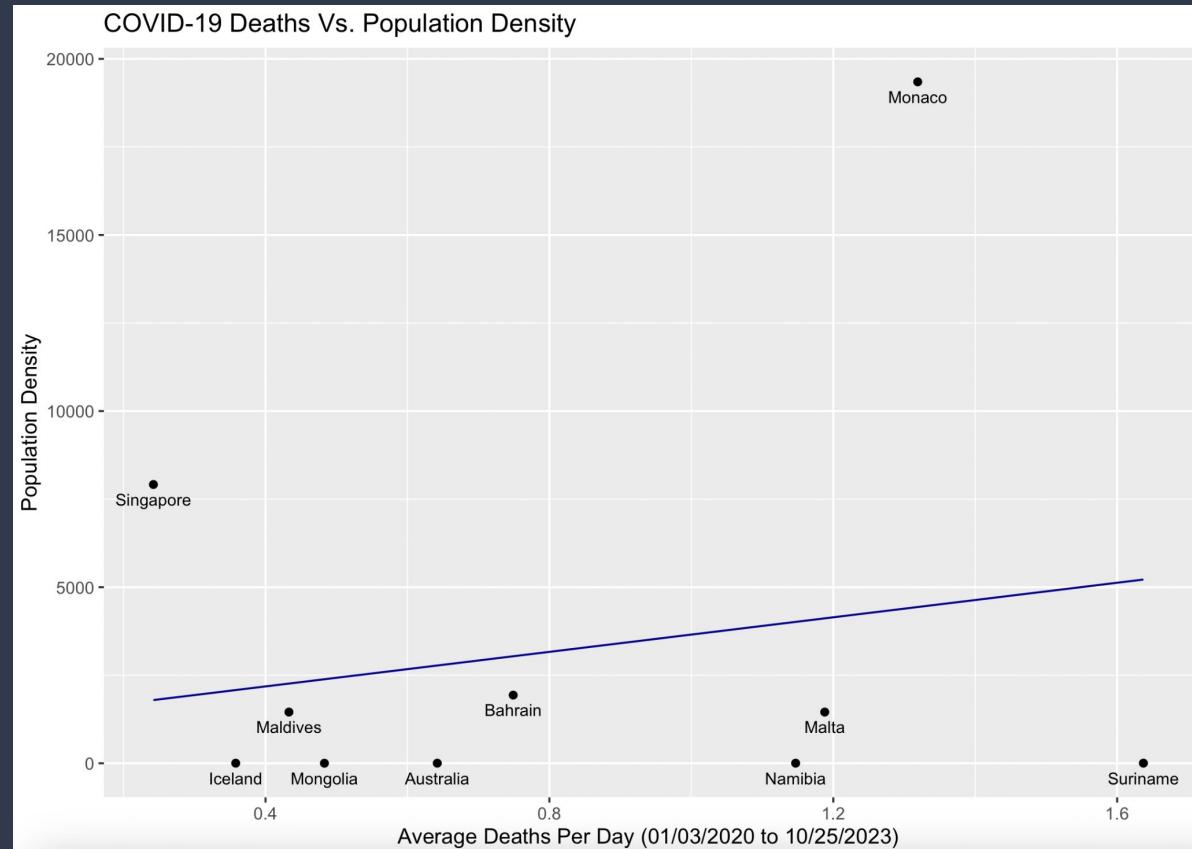
# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors



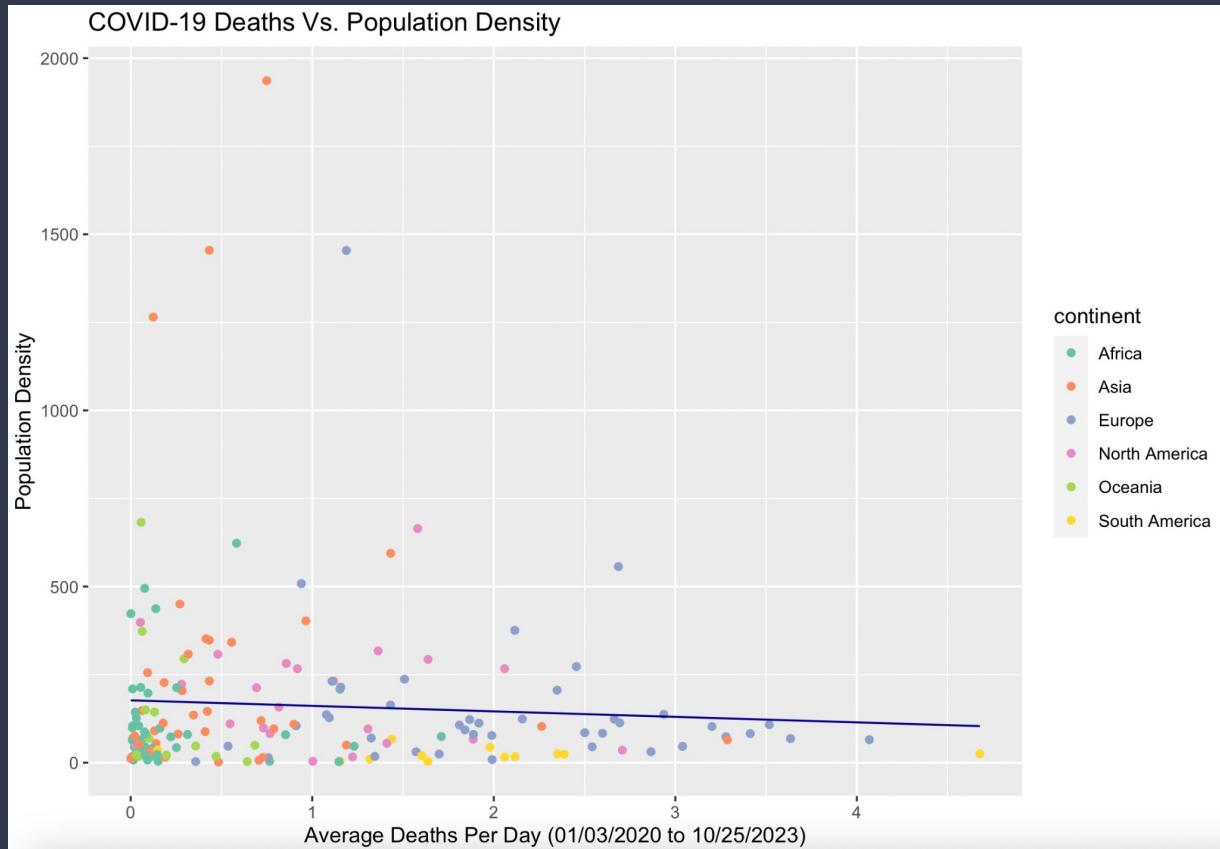
- Correlation Coefficient = -0.004574373
- Very weak negative correlation
- As population density decreases, COVID-19 mortality rates increase

## Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors

- 2 clear outliers: Singapore and Monaco
- In order to better visualize trendline, exclude these outliers

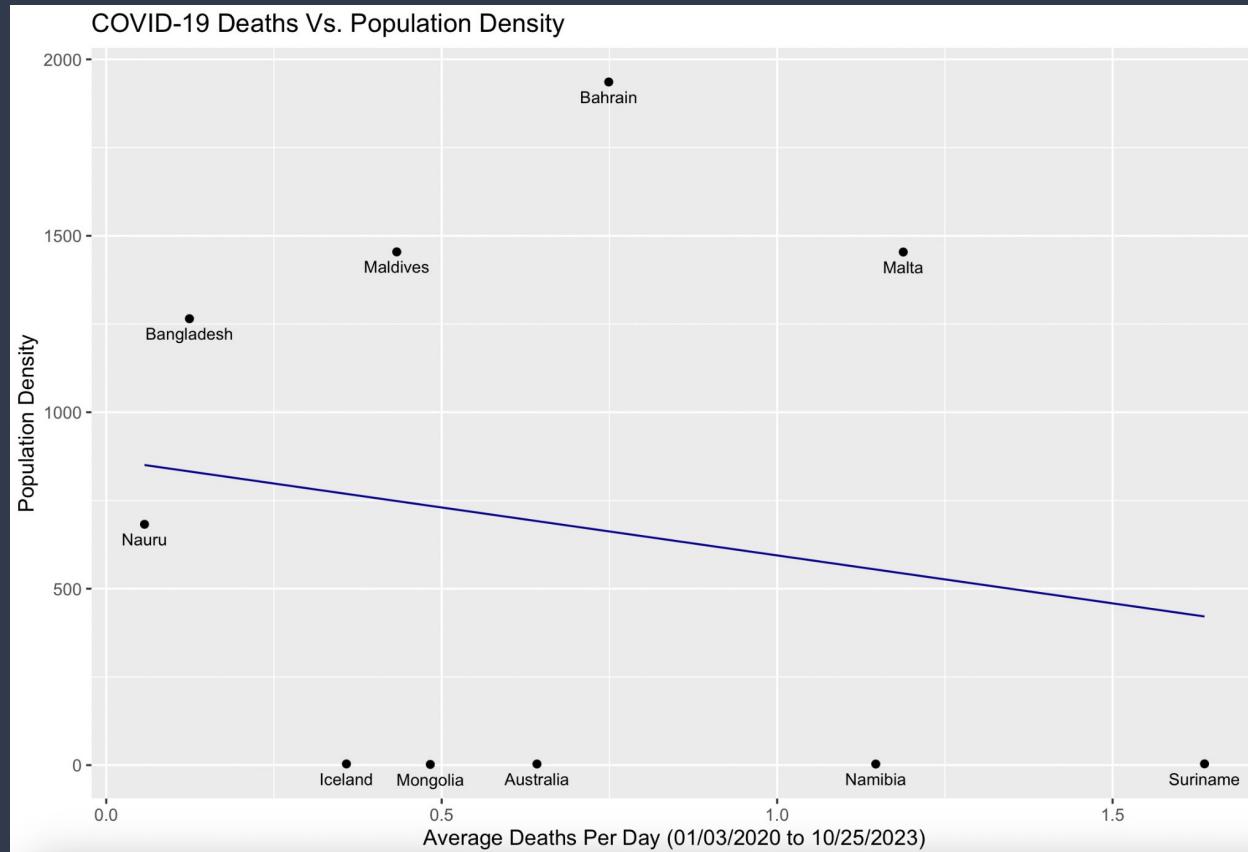


# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors



- Population density visualization without outliers
- Correlation Coefficient = -0.06217191
  - Slightly stronger negative correlation
  - As population density decreases, COVID-19 mortality rates increase

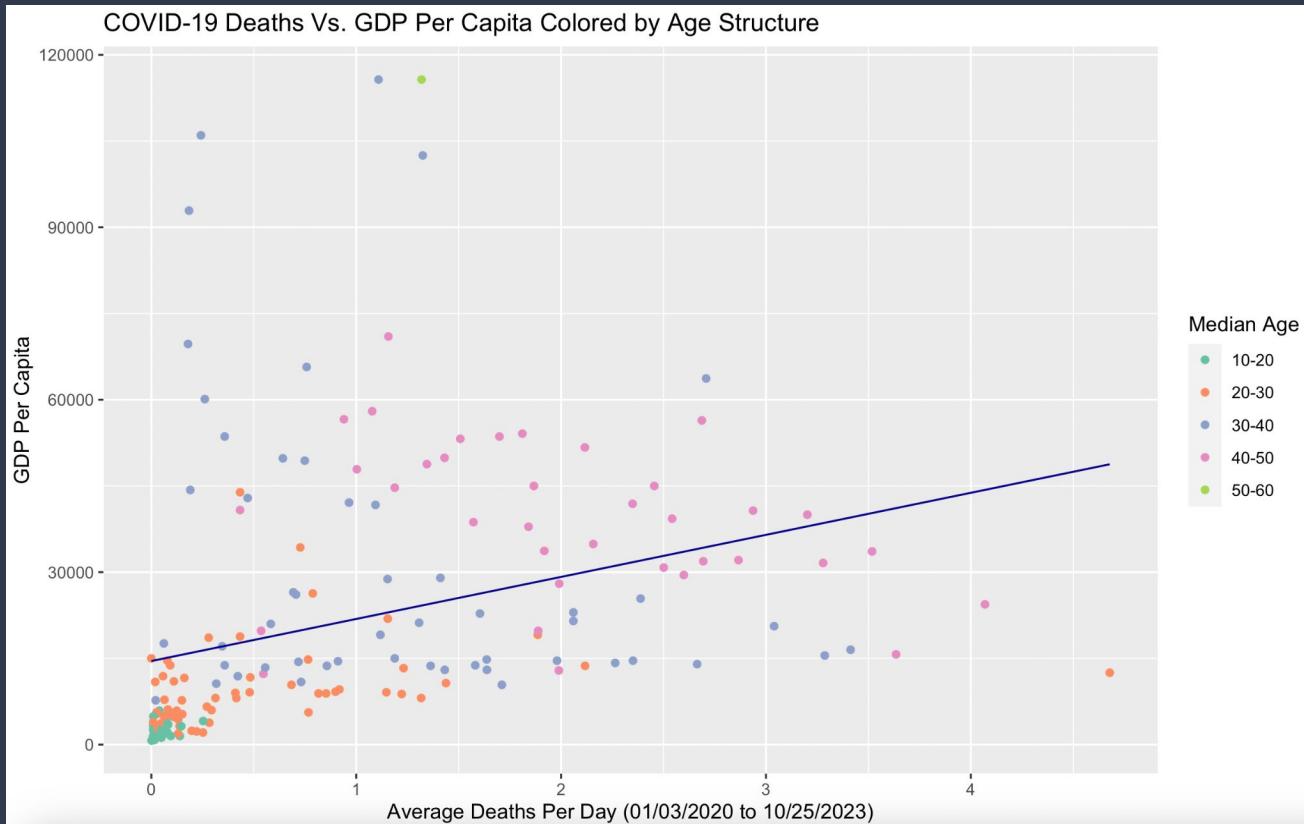
# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors



## Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors

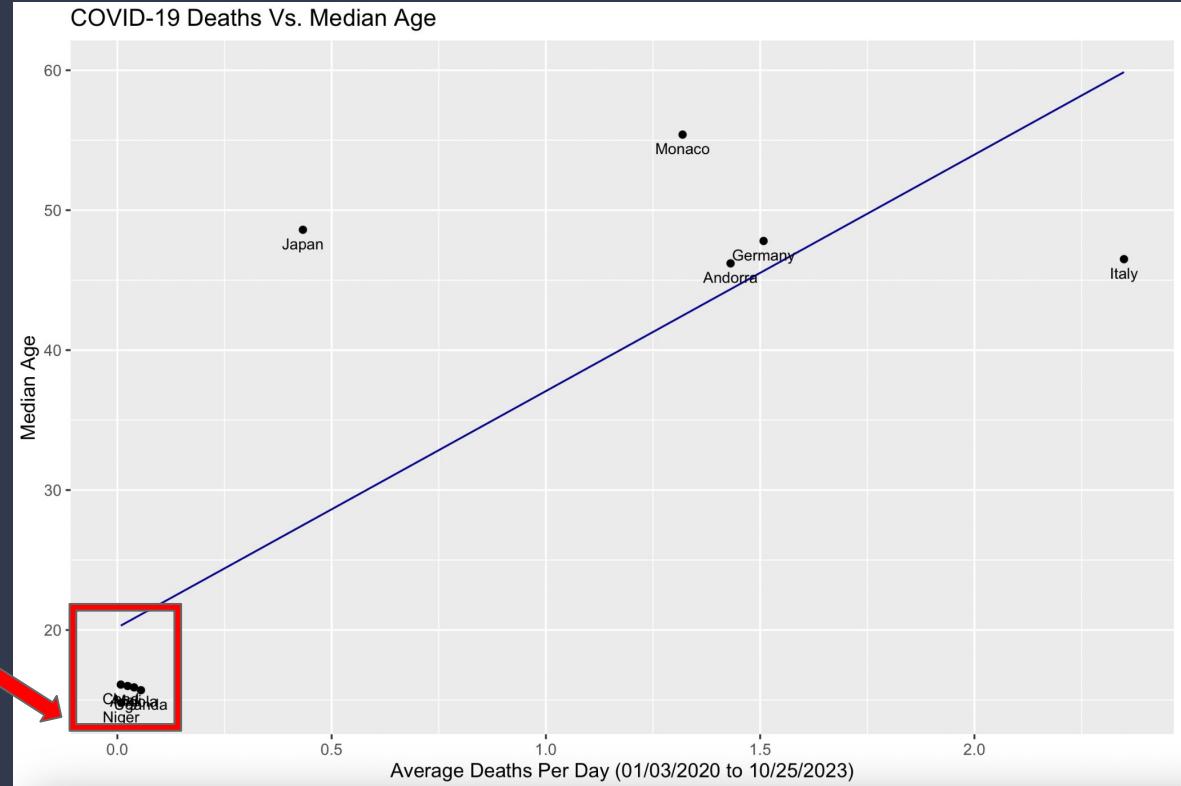
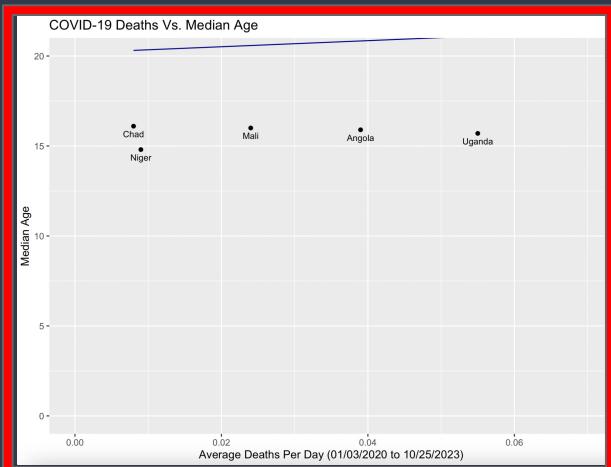
- All trends proved my initial hypotheses incorrect:
  - COVID-19 mortality rates increased as a nation's **health expenditure increased**
  - COVID-19 mortality rates increased as a nation's **GDP per capita increased**
  - COVID-19 mortality rates increased as a nation's **population density decreased**
- Possible reasoning:
  - Inconsistent testing results
  - Differing levels of shutdowns
    - Nation's with higher population densities may have implemented more rigid shutdown policies
  - Nation's with higher GDP's per capita may have higher median ages

# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors



- Correlation Coefficient = 0.6785565
- Moderately strong positive correlation
- As median age increases, COVID-19 mortality rates increase

# Q2: COVID-19 Mortality Rates and Associated Socioeconomic Factors



# Q3: How did the COVID-19 vaccination dispersal affect daily COVID-19 case metrics?

- Determine the day in which each nation distributed the most COVID-19 vaccinations
  - Did COVID-19 case rates increase or decrease after this date?
  - What do these COVID-19 case growth rates say about the effectiveness of vaccines and the global response to the COVID-19 pandemic?



COVID-19 vaccine clinic in Dodger Stadium parking lot,  
March 2021

### Q3: Analyze how COVID-19 case rates were affected by vaccine distribution

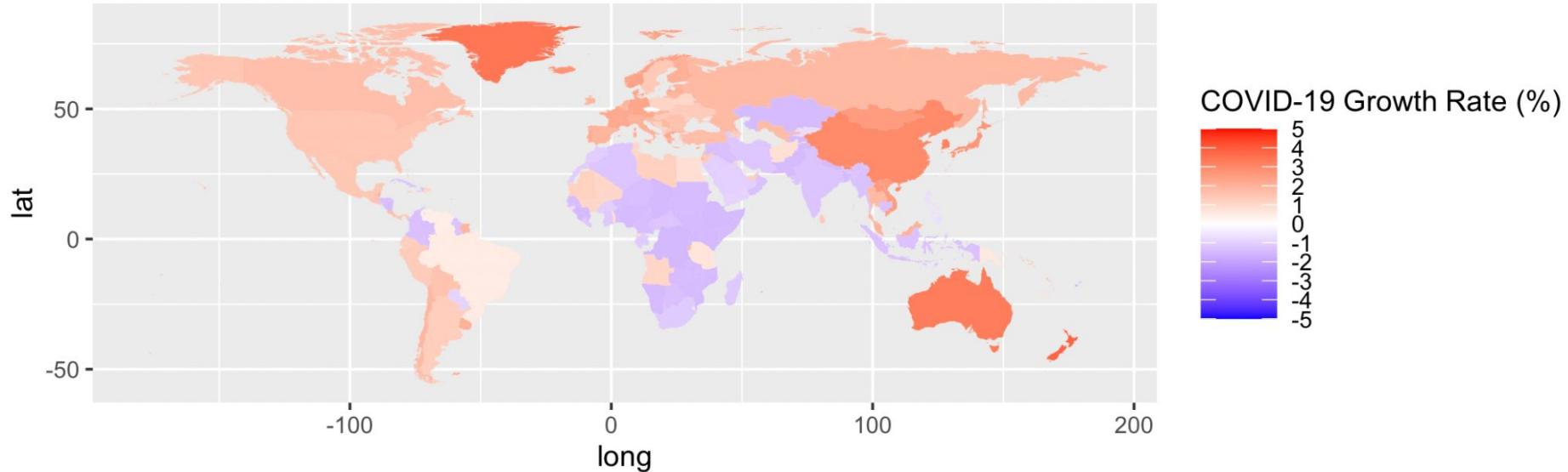
location	Date of Maximum Vaccinations
United States	2021-04-11
China	2021-06-28
Japan	2021-07-11
Brazil	2021-08-19
Norway	2021-08-30
Australia	2021-09-23
Egypt	2021-11-13
Germany	2021-12-20
Zimbabwe	2022-04-03

- Dates in which the maximum number of vaccinations were administered
  - This date represents the peak of vaccine distribution
  - Following this date, are COVID-19 case rates reduced?

### Q3: Analyze how COVID-19 case rates were affected by vaccine distribution

Covid Growth Rates

Comparison of New COVID-19 Cases Before and After Maximum Vaccination Day



# Global COVID-19 Analysis Takeaways:

1. Increased allocation of funds towards health expenditure in the year prior to the COVID-19 pandemic did not reduce effects of the pandemic
2. COVID-19 mortality rates increased as a nation's GDP per capita decreased and population density decreased.
3. The age structure is the best indicator of its COVID-19 mortality rate. Nation's with high median ages were afflicted with more COVID-19 deaths.
4. In many nations, documented COVID-19 cases increased following the peak of vaccine distribution.

# The Effects of the Vaccine rollout

## **Question 1:**

What is the correlation between how many vaccines were distributed to a state and how many cases that state has?

## **Question 2:**

How are the number of deaths affected by the proximity of vaccine distribution sites?

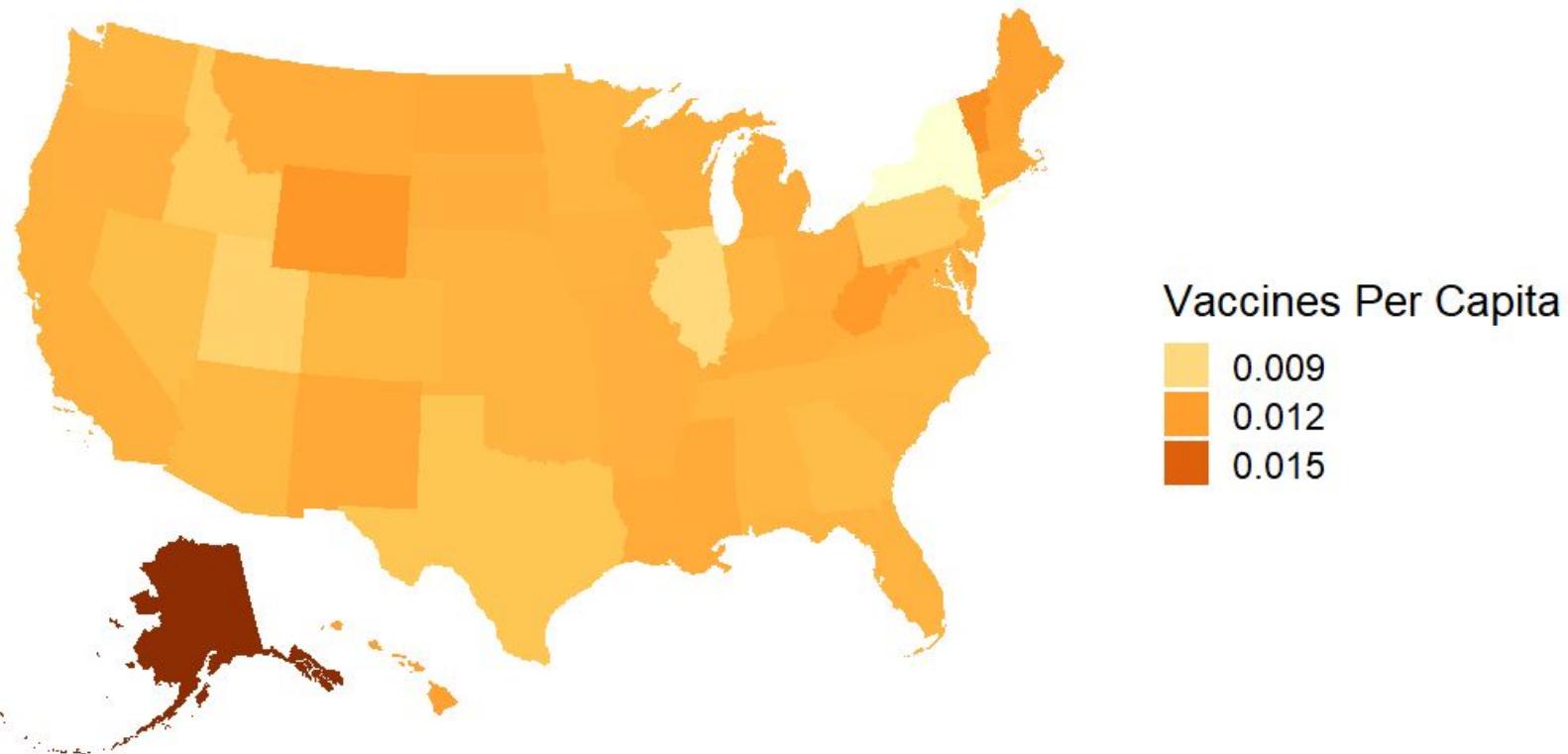
## **Question 3:**

Does vaccine hesitation play a role in mortality from COVID?

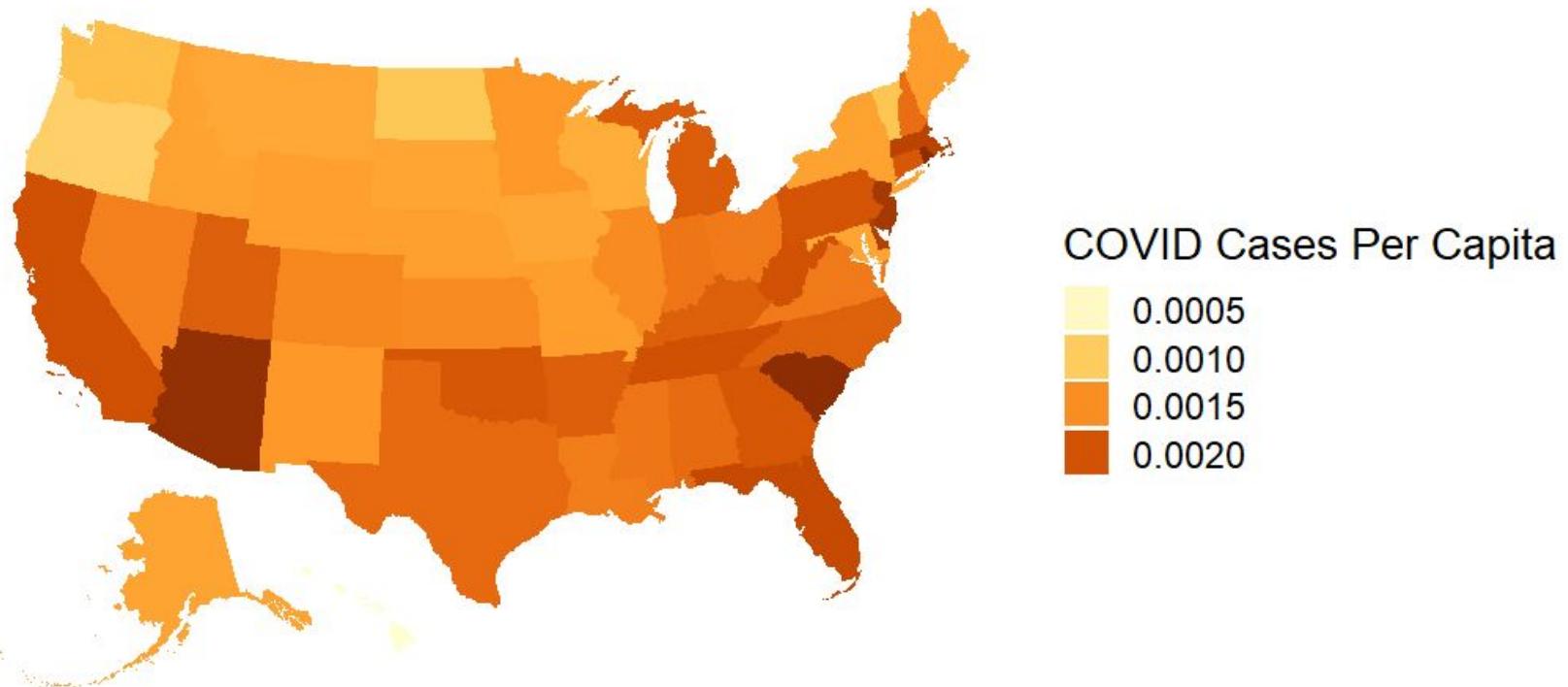
What is the correlation between how many vaccines were distributed to a state and how many cases that state has?

- What states received the most vaccines?
- Did this affect the number of cases present?

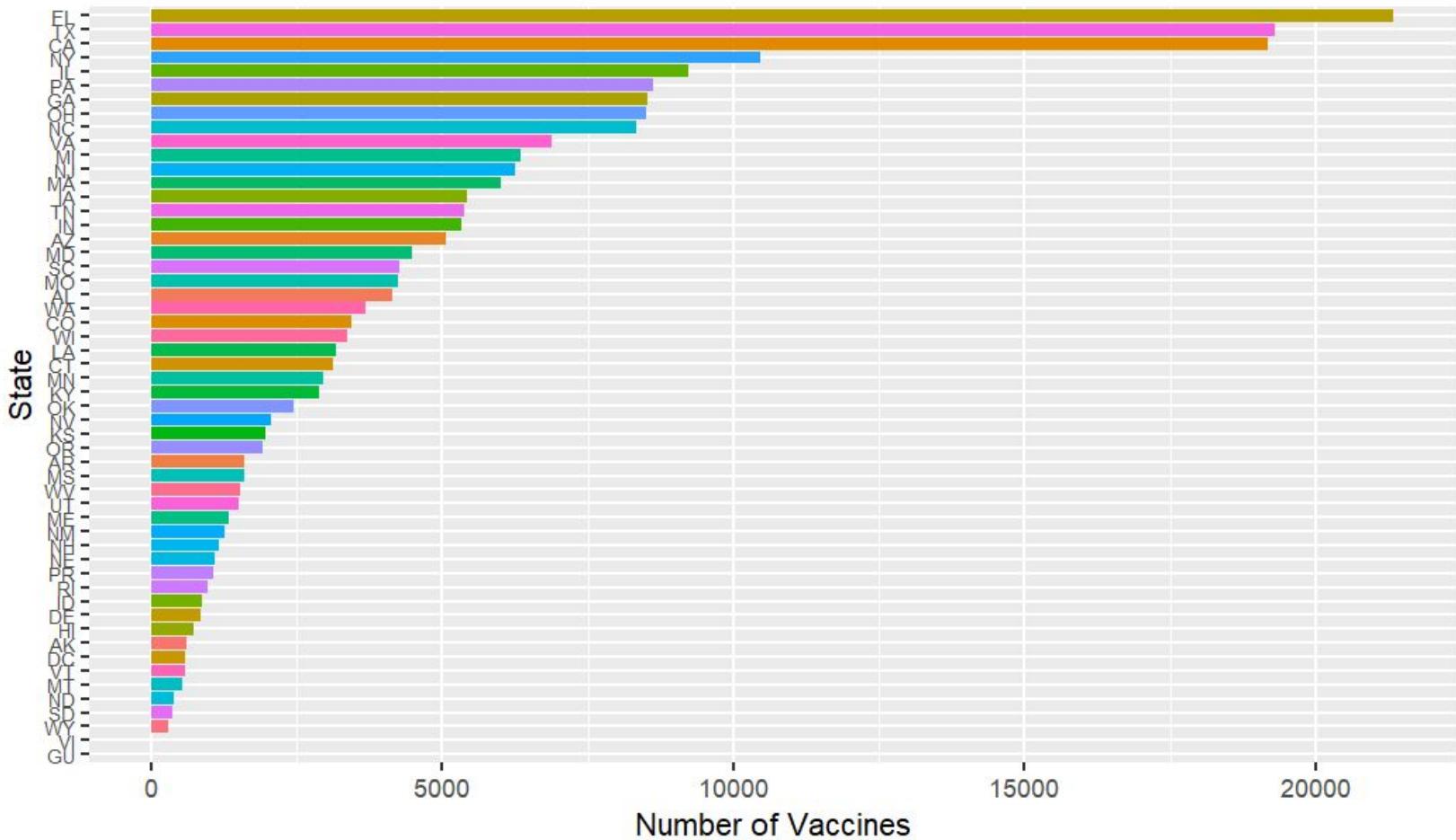
## Average Number of Vaccines Distributed Per Capita in 2021



## Average Number of COVID Cases Per Capita in 2021



## Number of Vaccines Distributed Per State

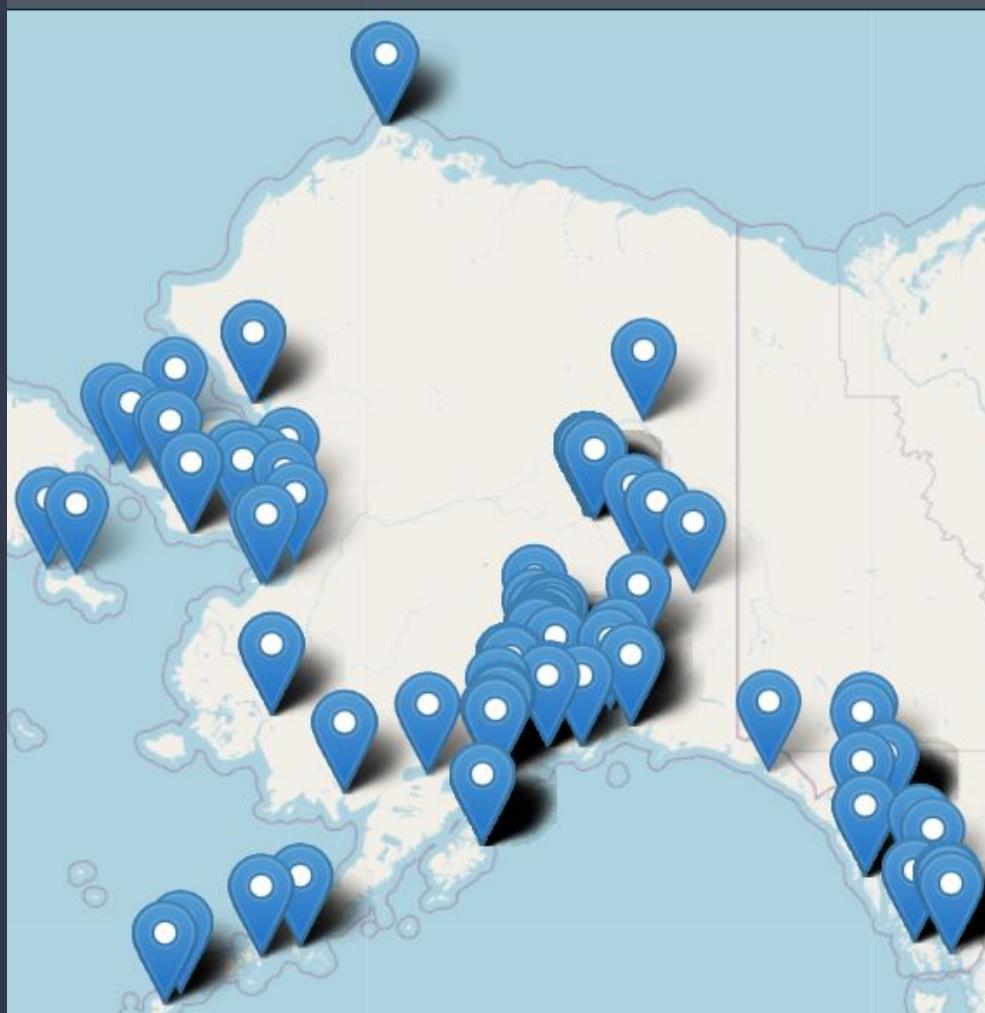


# So what does this mean?

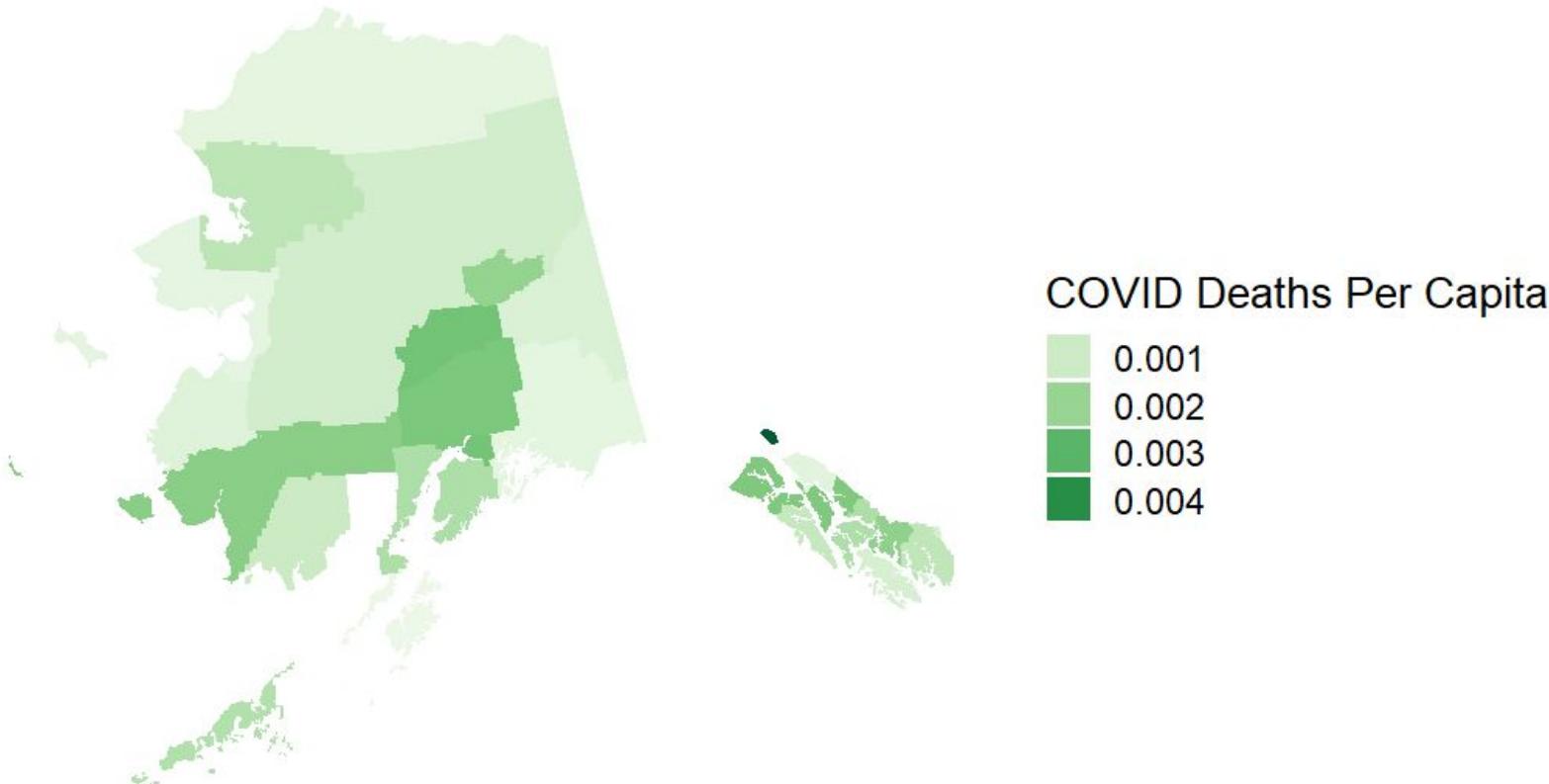
- Correlation between vaccines and cases
  - P-value = 2.2e-16
- Vaccines distributed based on population
- Alaska is a great representative

How are the number  
of deaths affected by  
the proximity of  
vaccine distribution  
sites?

- Does it matter?



## Deaths involving Covid 19 Per Capita in Alaska's County's



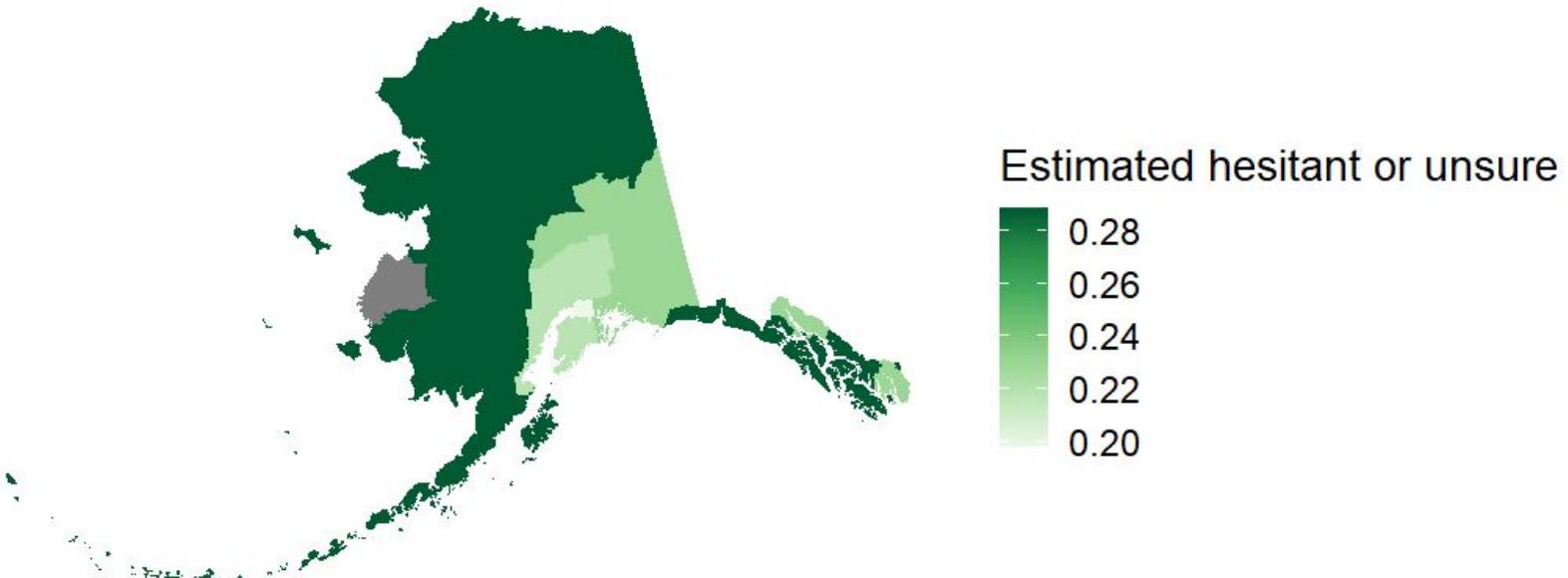
# Why does this seem off?

- Higher death rates close to distributors?
- Maybe hesitance?

# Does vaccine hesitation play a role in mortality from COVID?

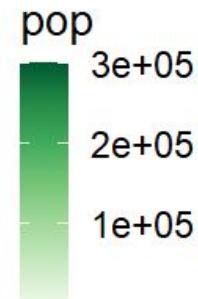
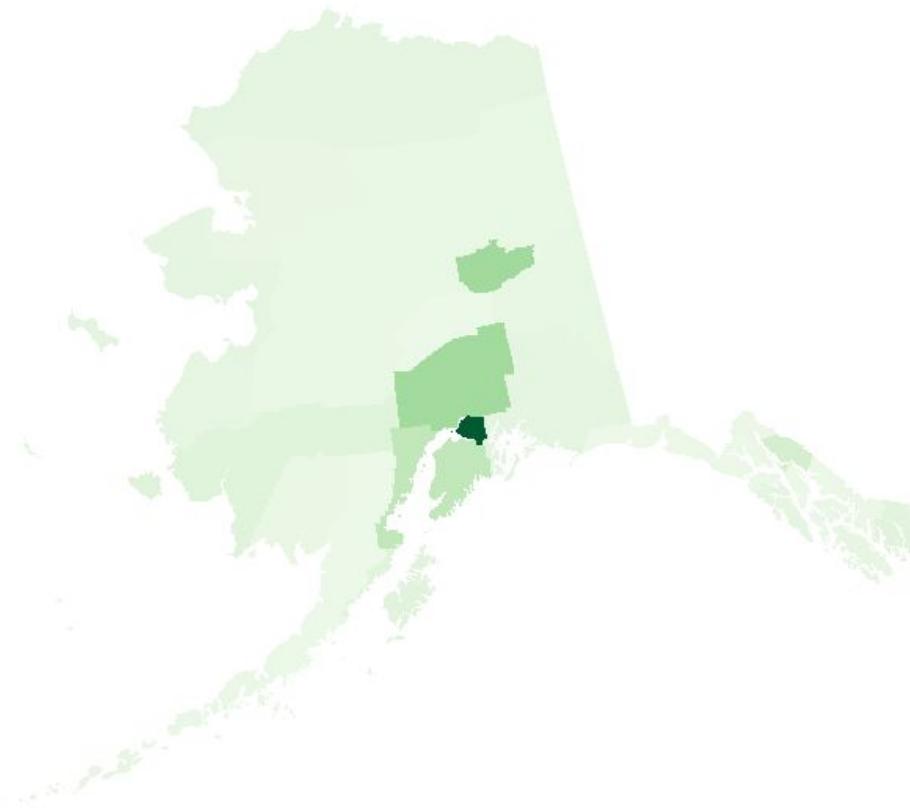
- Fear of the unknown
- Religious reasons
- Etc.

## Estimated Vaccine Hesitancy by County in Alaska



# WHY?

# Population Density of Alaska



# Conclusion

- Major decider is population density
- Vaccines reduce cases

# Analysis of the COVID-19 Pandemic in the State of Mississippi

## **Question 1:**

Analyze the relationship between a steady increase in COVID-19 cases in the state of Mississippi and overall economic activity in the state, measured by total gross sales.

## **Question 2:**

Investigate the correlation between the poverty rate and the number of COVID-19 cases per capita in the counties of Mississippi.

## **Question 3:**

Examine the growth rate of COVID-19 cases in relation to the different types of schooling (in-person, remote, and hybrid) in Mississippi school districts in the 2020-2021 school year.

# Q1: Relationship between State Economic Activity and COVID-19



# How Should We Measure Economic Activity?

## Gross Sales

- Better indicator of overall economic performance and state economic health
- Total sales revenue for all businesses within MS
- Gives total collections so far in the Fiscal Year

vs.

## Cash Report

- Gives a breakdown of each type of tax collected by the state that month
- Shows what the Department of Revenue has actually collected.
- Gives total for each month and collected so far.

# MS Department of Revenue Website

## Gross Retail Sales by County Totals

You can download an Acrobat PDF (portable document format) or Excel version of any of the reports listed. If you do not have Acrobat Reader or the Excel viewer, refer to the [Downloads page](#) for help on obtaining the correct viewer, or click on the below icon to download Adobe Acrobat Reader.



▼ 2023	
01 - January	<a href="#">XLSX</a>
02 - February	<a href="#">XLSX</a>
03 - March	<a href="#">XLSX</a>
04 - April	<a href="#">XLSX</a>
05 - May	<a href="#">XLSX</a>
06 - June	<a href="#">XLSX</a>
07 - July	<a href="#">XLSX</a>
08 - August	<a href="#">XLSX</a>
09 - September	<a href="#">XLSX</a>

- Released monthly in Excel formats.
- Combine files in each FY to get per month data

# Mississippi Fiscal Year

	Q1			Q2			Q3			Q4		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Calendar Year	January 2018											December 2018
State of MS Fiscal Year 2019							July 2018					June 2019

# Calculating Total Sales for One Month

Mississippi Department of Revenue Gross Sales by County Fiscal Year 2019 Through July	
County	Net Sales
OUT OF STATE	\$317,054,329
COUNTY NOT AVAILABLE	2,933,851
ADAMS	52,906,773
ALCORN	56,141,719
AMITE	4,538,898
ATTALA	16,991,384
BENTON	4,566,418
WINSTON	17,122,656
YALOBUSHA	5,355,194
YAZOO	21,697,707
STATEWIDE	0
Total for State	<b>\$4,866,664,186</b>

Note: Figures may not add due to computer rounding.

Mississippi Department of Revenue Gross Sales by County Fiscal Year 2019 Through August	
County	Net Sales
OUT OF STATE	\$725,627,724
COUNTY NOT AVAILABLE	5,565,298
ADAMS	103,272,793
ALCORN	110,011,298
AMITE	10,090,284
ATTALA	33,237,764
BENTON	10,877,967
WINSTON	33,538,783
YALOBUSHA	11,569,874
YAZOO	43,531,601
STATEWIDE	0
Total for State	<b>\$11,009,461,066</b>

Note: Figures may not add due to computer rounding.

August Total  
11,009,461,066

July Total  
4,866,664,186

Sales in August  
**\$6,142,796,880**

2018					
July	August	September	October	November	December
\$4,866,664,186	\$6,142,796,880	\$4,966,563,330	\$4,717,170,342	\$3,612,182,151	\$4,753,824,338

2019					
January	February	March	April	May	June
\$5,275,137,289	\$4,364,489,606	\$4,383,329,429	\$5,324,775,321	\$4,922,535,424	\$5,149,128,349

July	August	September	October	November	December
\$5,015,094,142	\$5,105,024,456	\$5,154,941,323	\$4,952,637,887	\$5,153,788,381	\$4,973,690,252

2020					
January	February	March	April	May	June
\$5,436,475,957	\$4,757,933,913	\$4,333,678,824	\$4,852,213,502	\$4,311,933,876	\$5,225,986,238

July	August	September	October	November	December
\$5,447,086,941	\$5,475,680,212	\$5,213,454,076	\$5,339,018,658	\$89,445,033	\$10,415,874,749

2021					
January	February	March	April	May	June
\$5,875,633,206	\$4,968,375,569	\$4,536,187,996	\$6,347,272,594	\$6,168,551,379	\$5,943,690,217

July	August	September	October	November	December
\$5,961,493,041	\$6,183,764,489	\$4,675,654,712	\$6,530,657,984	\$5,939,080,772	\$5,763,145,051

2022					
January	February	March	April	May	June
\$6,561,056,140	\$5,308,697,992	\$5,432,940,860	\$6,489,386,095	\$5,923,459,947	\$6,203,984,927

# Even When Lockdowns First Occurred, Economic Activity Shows No Noticeable Hit.

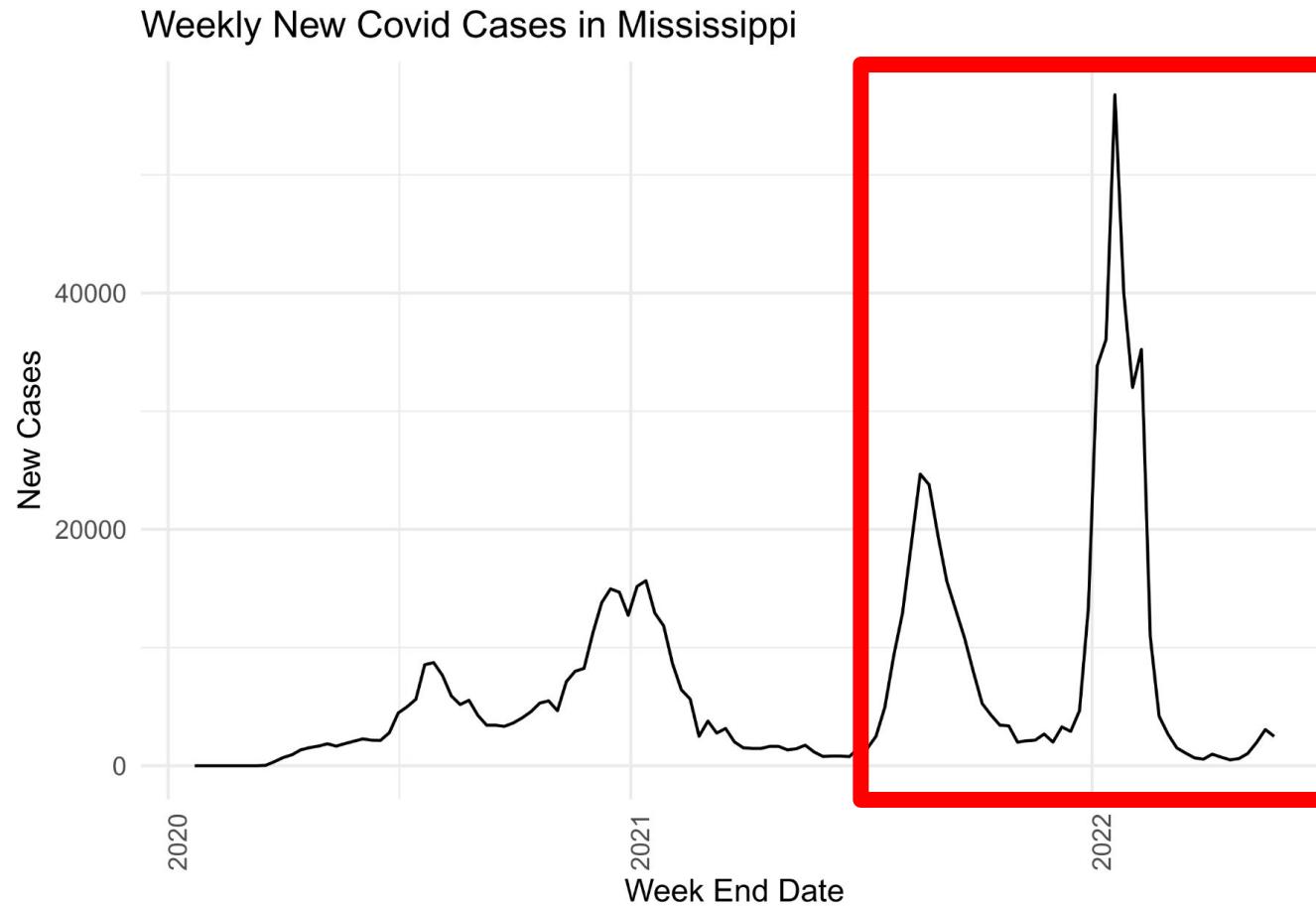
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\$5,447,086,941	\$5,475,680,212	\$5,213,454,076	\$5,339,018,658	\$89,445,033	\$10,415,874,749

Even though it may look like a dip, March is normally a slow month for the state.

March 2019 - \$ 4,383,329,429  
March 2021 - \$ 4,536,187,996

Plot COVID-19 Growth in MS to examine a possible relationship.

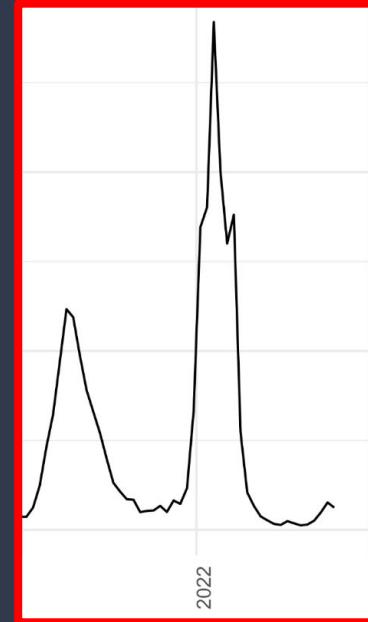


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2022

January	February	March	April	May	June
\$6,561,056,140	\$5,308,697,992	\$5,432,940,860	\$6,489,386,095	\$5,923,459,947	\$6,203,984,927

Despite Record COVID-19 Cases, Economic Activity Remained Roughly the Same.



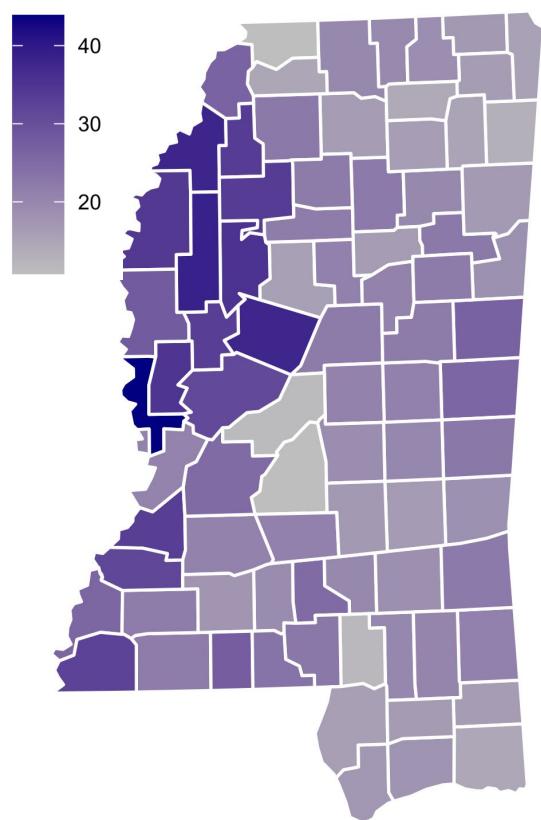
Q2: Relationship  
between poverty  
rate and COVID-19  
cases per capita in  
Mississippi.



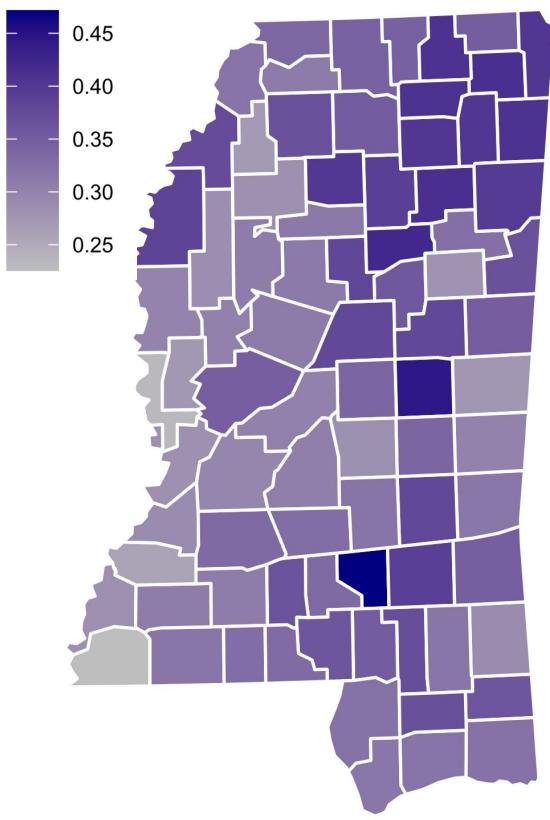
# Does poverty rate and population density have an effect on COVID-19 per capita?

- Asking this question comes with some assumptions.
  - Poverty Rate: Higher poverty rates might correlate with higher COVID-19 rates due to factors such as limited access to healthcare, living conditions, and higher rates of underlying health conditions.
  - Population Density: Areas with higher population density could potentially have a higher rate of COVID-19 transmission due to increased human contact.

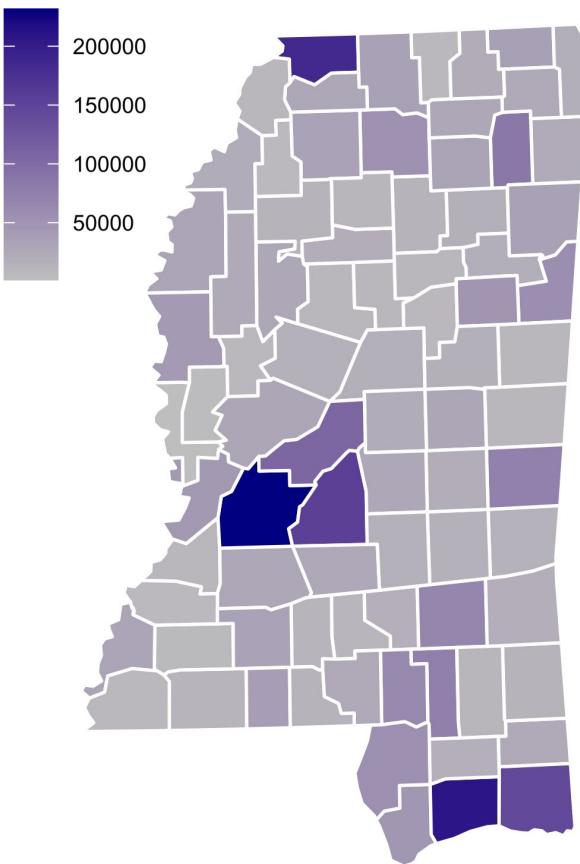
Poverty Rate by County in Mississippi



Total Covid Cases Per Capita in Mississippi



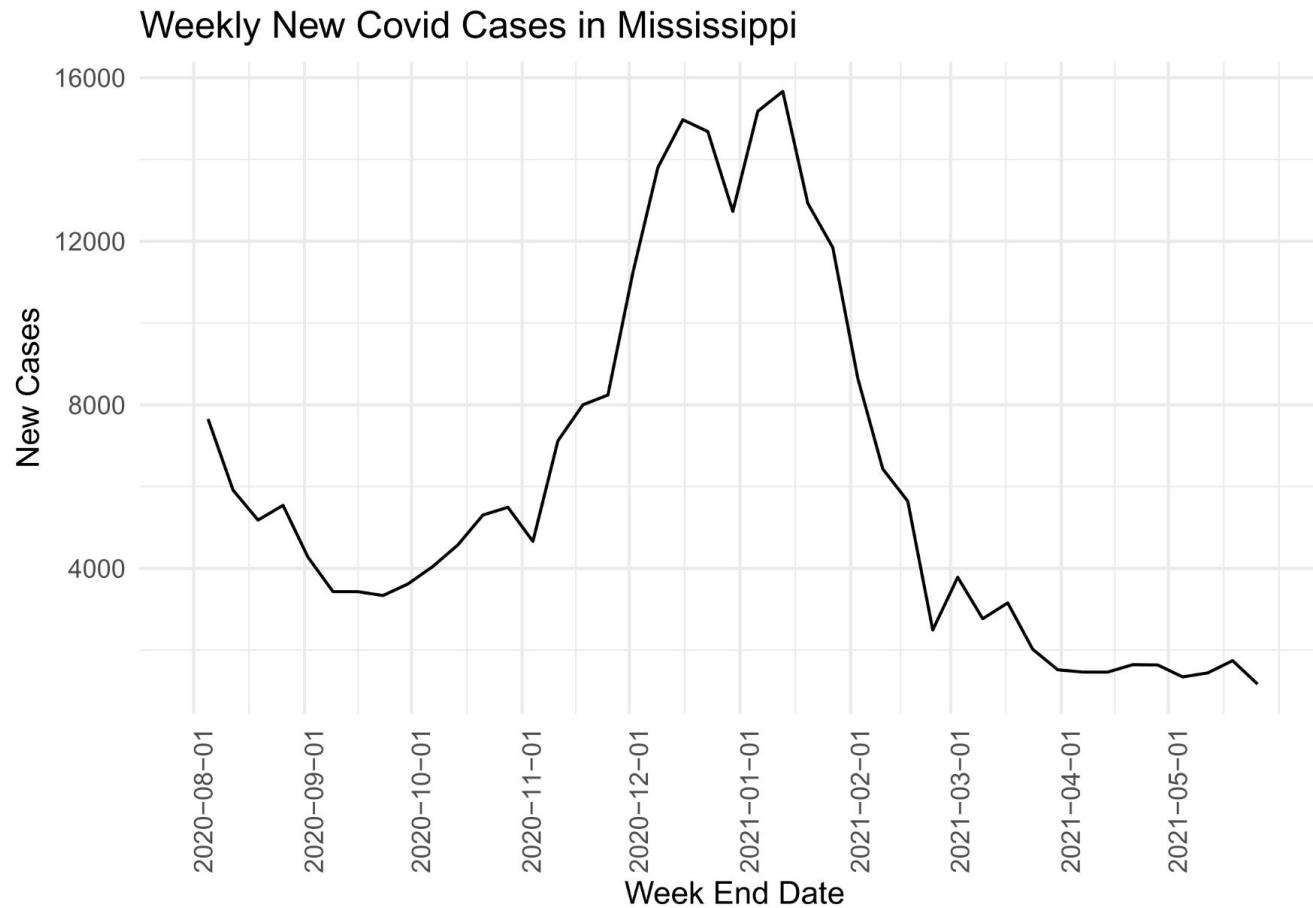
Population of Counties in Mississippi



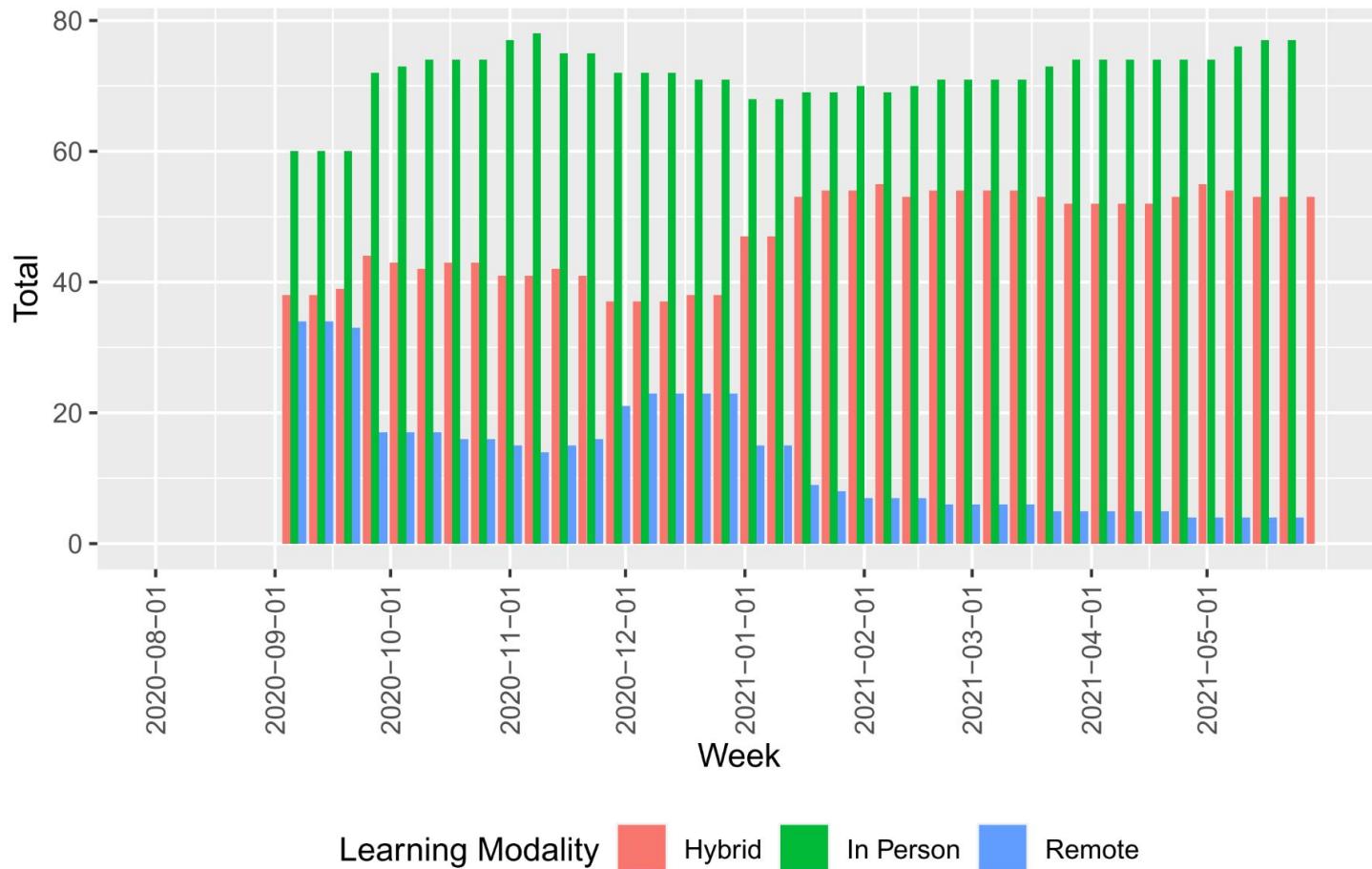
Q3: Examine the growth rate of COVID-19 cases in relation to the different types of schooling modes in Mississippi.



# First, Plotted Weekly Covid Cases (Aug. '20 - May. '21)

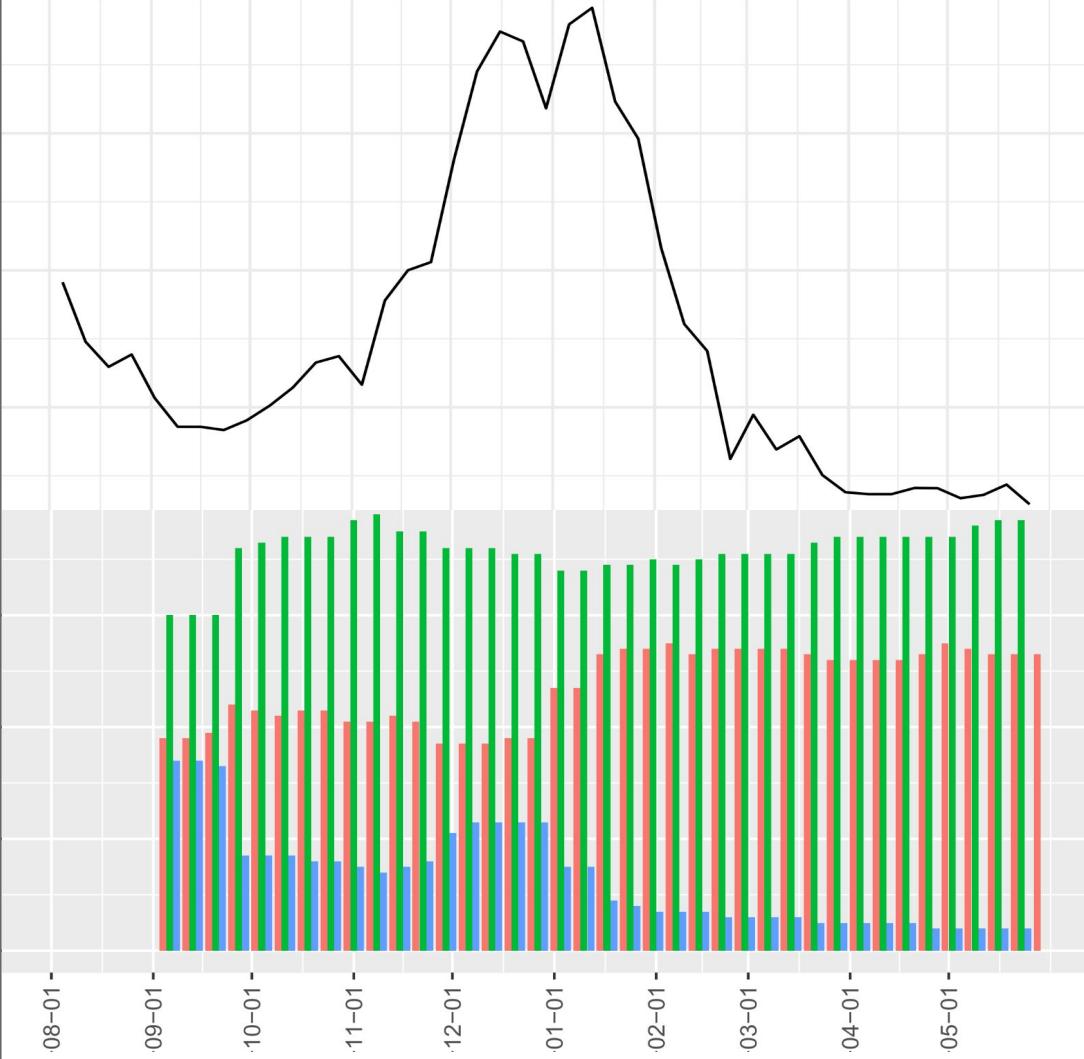


## Number of In Person, Hybrid, and Remote Schools per Week in Mississippi



## Learning Modality

- Hybrid
- In Person
- Remote



# Mississippi COVID-19 Analysis Takeaways:

1. Financially, the State of Mississippi performed fairly in-line when compared to previous year's economic activity. Even during peak periods, gross sales remained well within reason.
2. My initial expectation that COVID-19 cases per capita would be centered around metro areas and impoverished counties, was mostly incorrect.
3. There are interesting conclusions you can draw from analyzing school district learning modality data through the pandemic, specifically the timing of reopening schools to fully in person.

# Analysis of COVID-19 Pandemic Conclusions

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- The COVID-19 pandemic had innumerable effects on a global, national and state level scale
- Global changes to almost every aspect of society:
  - Economic markets
  - Governmental health programs
  - Education systems
  - Structure of workplaces
  - Daily life
- This project analyzed three main aspects of the COVID-19 pandemic:
  - Contributing factors
  - Responses
  - Effects
- Takeaways:
  - Effects of COVID-19 pandemic reached nearly every community in the world
  - The pandemic displayed the resilience of the global community