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Exploring the Geospatial Relationship between COVID-19 Positivity and Income in Mixed Urban-Rural Population

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Agenda

- Introduction & Background
- Research Methods
- Study Results
- Discussion
- Study Limitations
- Conclusion
- Future Work

Introduction & Background

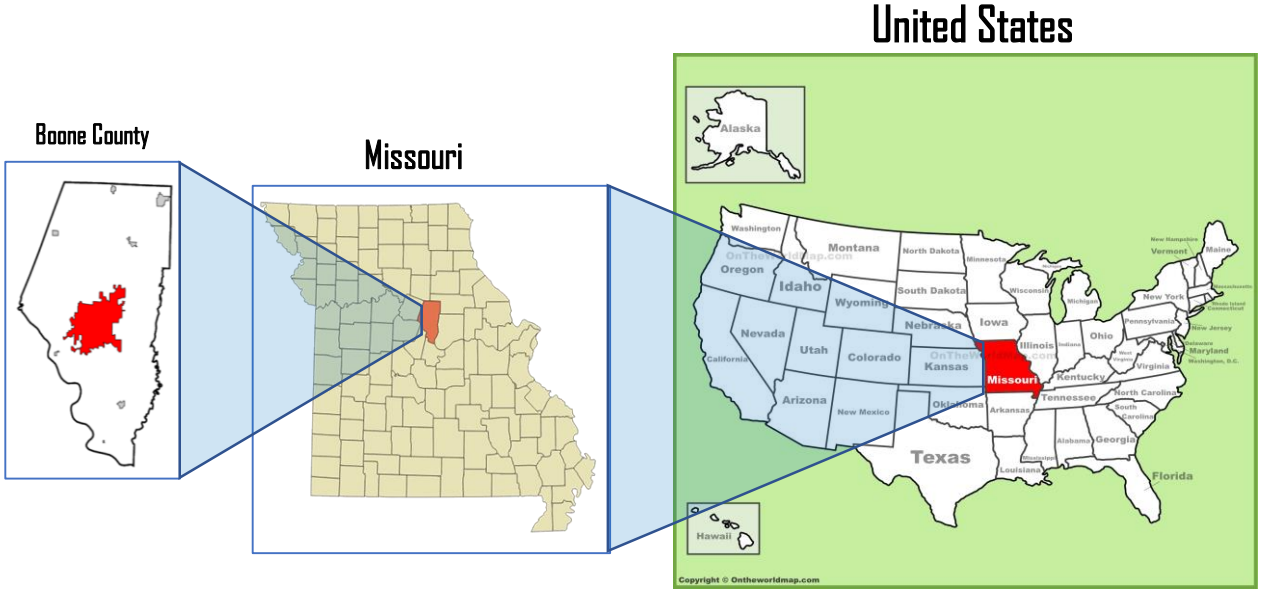
- Pandemic **worsens** the existing **average income** inequalities in American society
- Wealthier areas significantly **decreased mobility** compared to the **poorer** areas
- Lower-income communities have **lower access** to healthcare and **higher levels** of preexisting health conditions

Introduction & Background

- Previous research studies have shown that there are large **spatial inequities** in COVID-19 testing, confirmed cases, mortality, and positivity rates among U.S. cities
- Showed a **strong relation** between COVID-19 testing, confirmed cases, mortality, and positivity rates with **higher** neighborhood **social vulnerability**
- Reinforced and generated due to the **residential discrimination** that is linked to structural racism & **income inequality**

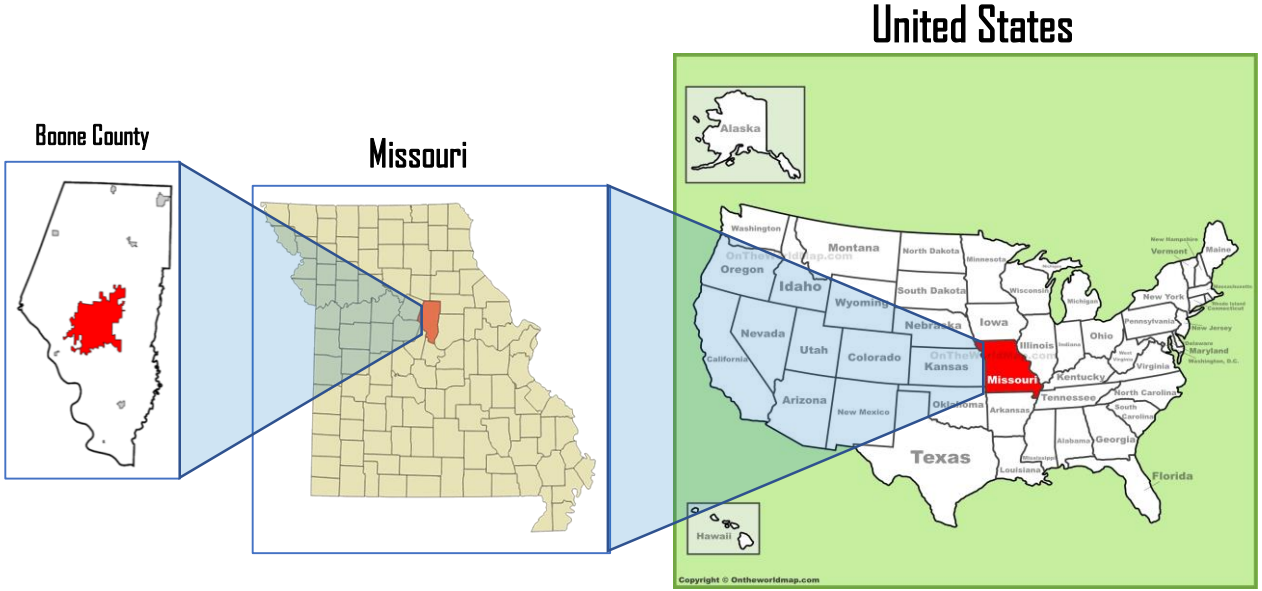
Research Methods

- Boone County is part of the Mid-Missouri geographic region within the Midwestern U.S.
- Home to 180,463 residents
- Boone County, Missouri consists of 11 primary cities and towns: Columbia, Ashland, Centralia, Hallsville, Harrisburg, Sturgeon, Hartsburg, Rocheport, McBaine, Huntsdale, and Pierpont; including 40 Census tracts

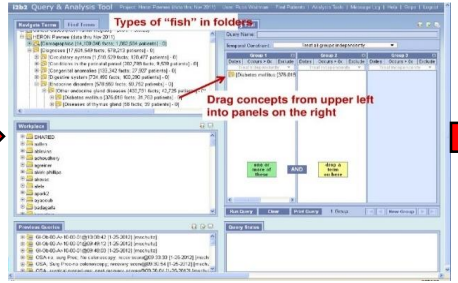


Research Methods

- Columbia is the **largest** city with a population of **126,853** residents
- Only **Urban area** in Boone County
- **Hypothesis:** individuals with **lower median income** will have **lower testing rates** and **higher positivity rates** in a mixed urban-rural population in Boone County, Missouri



Research Methods



REDCap
Research Electronic Data Capture

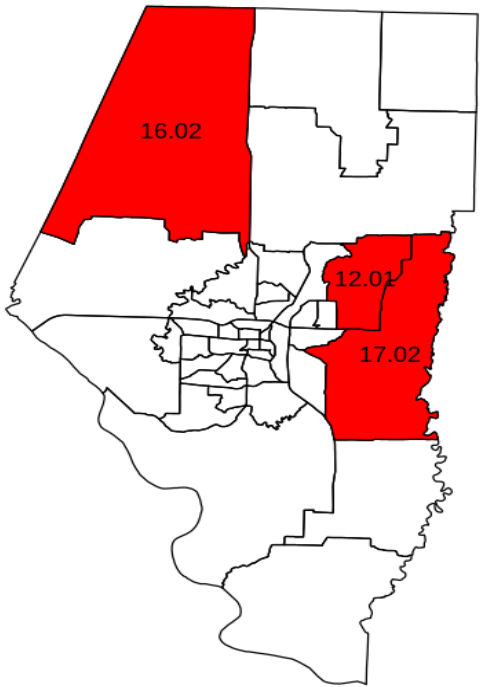
- Data from the **Cerner Electronic Health Record (EHR)** from the University of Missouri Hospital and Clinics
  - Individuals who were **tested for COVID-19**
  - Time Period: **March 2020 and December 2021**
- More than **60 primary and specialty-care clinics** (including the Mizzou Quick Care Clinics) and the University Physicians medical group

Research Methods

- Data includes the **demographic** information for **126,900** distinct patients
- **236,809** COVID tests, **15,903** which were **positive**, and **81,809 unique addresses**
- Includes the patients' **detailed addresses**, the testing dates along with the testing locations
- Boone County, Missouri has a **median** household **income** of **$58,740 (USD)** and income **per capita** (individual income) of **$30,340 (USD)**

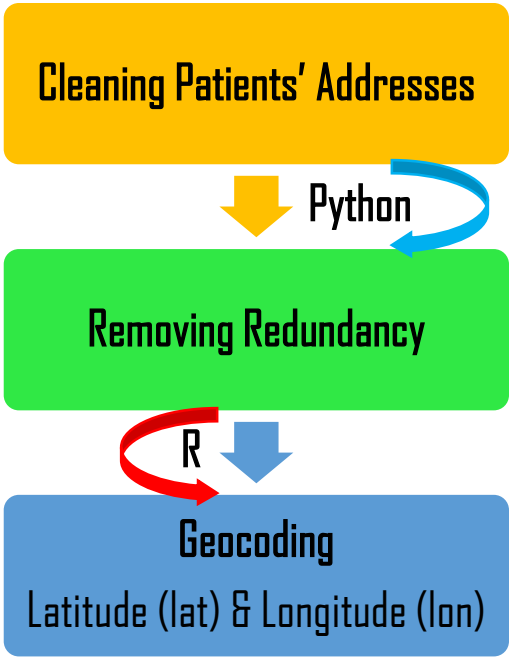
Research Methods

- In 2020, Census Tract 16.02 had the highest median household income of $104,632 (USD) followed by Census Tract 12.01, $101,529 (USD) and Census Tract 17.02, $95,389 (USD)
- Geocoding can be defined as the process of transforming a description of a location such as an address or a name of a place to a location on the Earth's surface, e.g., a pair of coordinates (latitude and longitude)
- Geocoding allows us to take patients' information and create a map of their locations



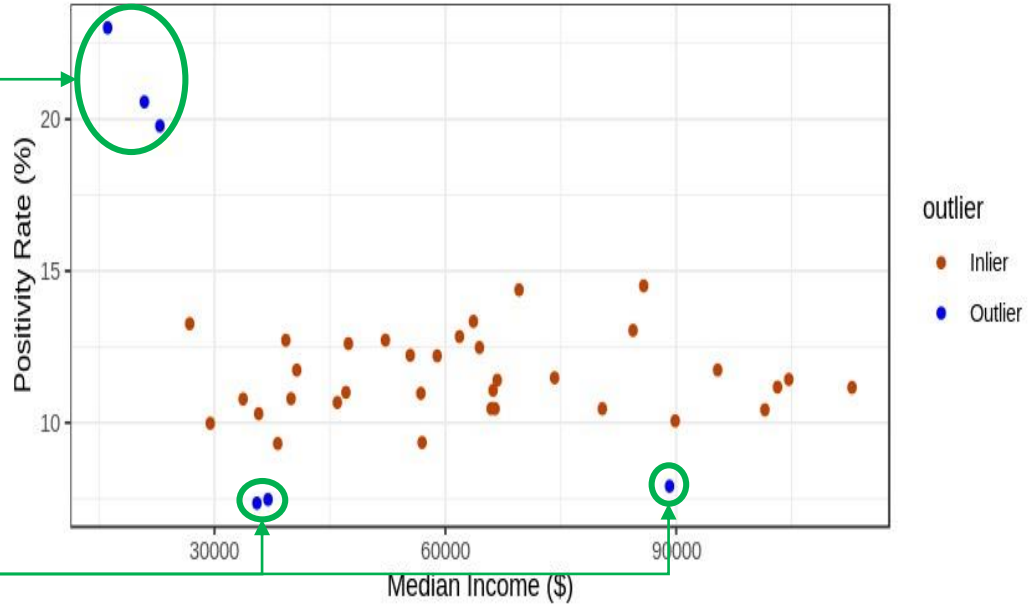
Research Methods

- Data Cleansing:
  - First step focused on cleaning the patients' addresses
  - Second step focused on removing the redundancy
- Finally, we geocoded the data to get the latitude (lat) and longitude (lon)



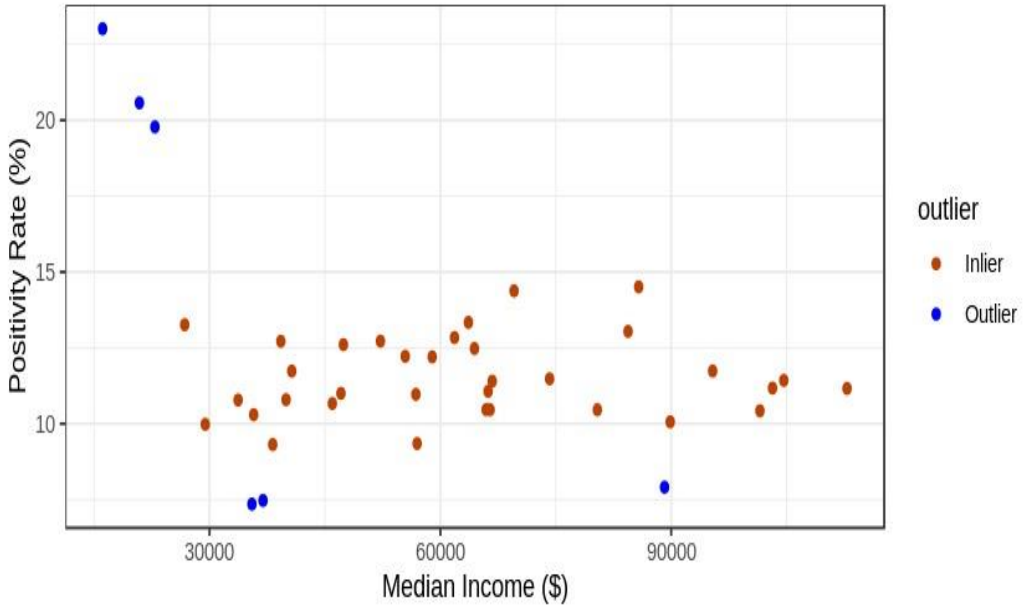
Study Results

- Scatter plot of the **median income** and **positivity rate** for Boone County, Missouri tracks
  - **Six outlier** tracks **(blue dots)**
- **Three outlier** tracks shown on the **top** of the plot
  - Exceptionally **high positivity rates** (higher than **19.5%**) associated with **lower median income**
- **Three outlier** tracks shown at the **bottom** of the plot
  - Exceptionally **low positivity rates** (lower than **8%**)



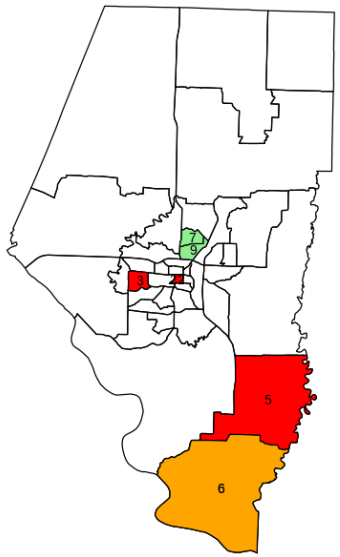
Study Results

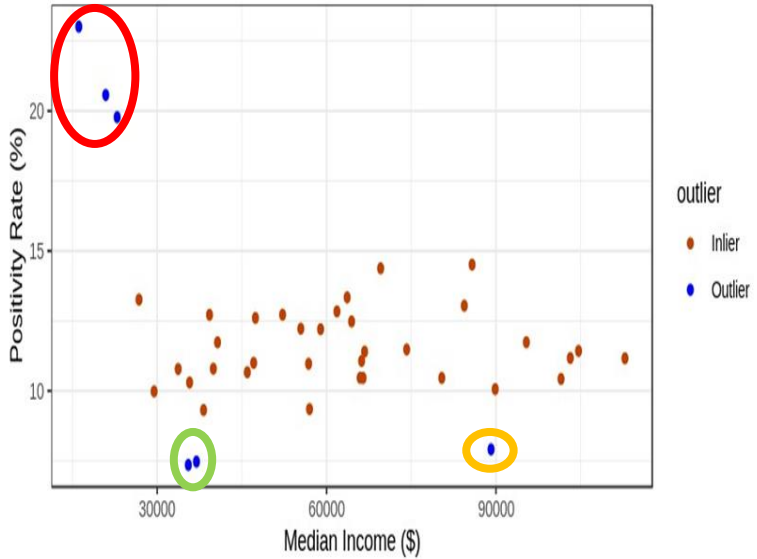
- **Two tracks** within the **$37K/yr** areas
- **One track** within the **$90K/yr** area
- **Pearson Correlation Coefficient** between the **positivity rate** and **median income** is **-0.324**
  - Indicates an **inverse relationship** between the **positivity rate** and the **median income**



Study Results

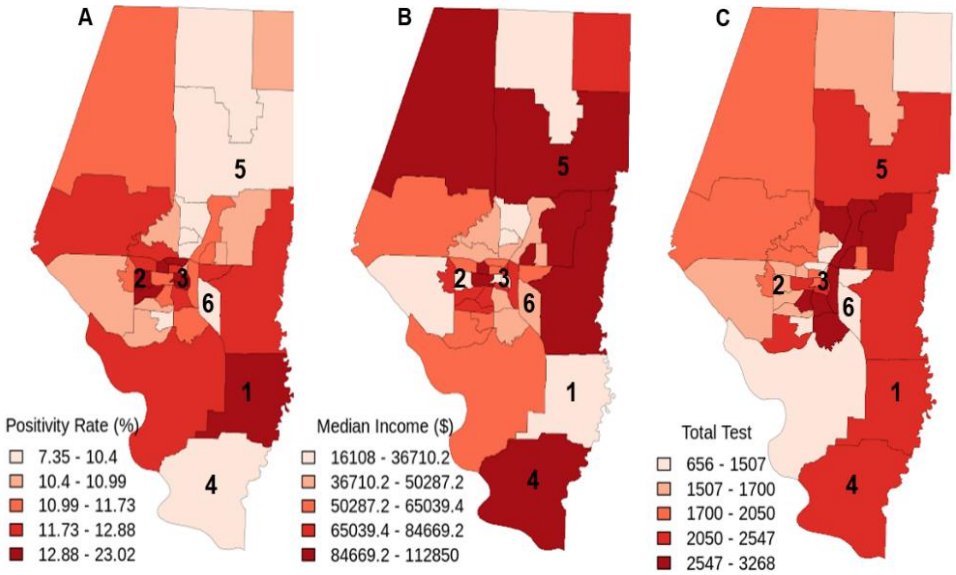
Tract Number	Positivity Rate	Median Income
3.00	19.78	22,907
5.00	23.01	16,108
6.00	7.90	89,138
7.00	7.35	35,512
9.00	7.47	36,953
22.00	20.57	20,885





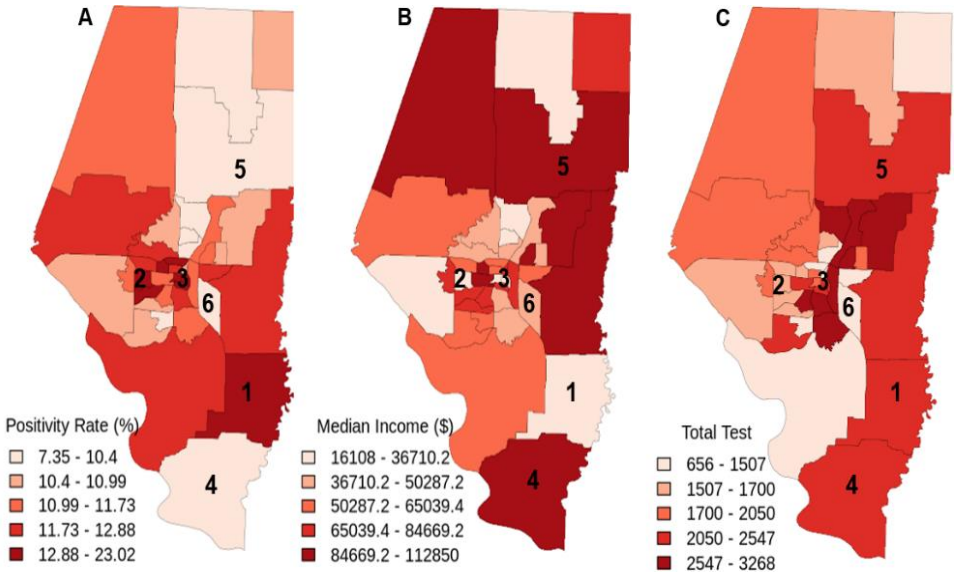
Study Results

- Three **maps** of Boone County Missouri, USA
- **Fig. A** shows the Census tract-wise COVID-19 **positivity rate**
- **Fig. B** shows the Census tract-wise **median income**
- **Fig. C** shows the Census tract-wise **total number** of COVID-19 **tests** in 2020



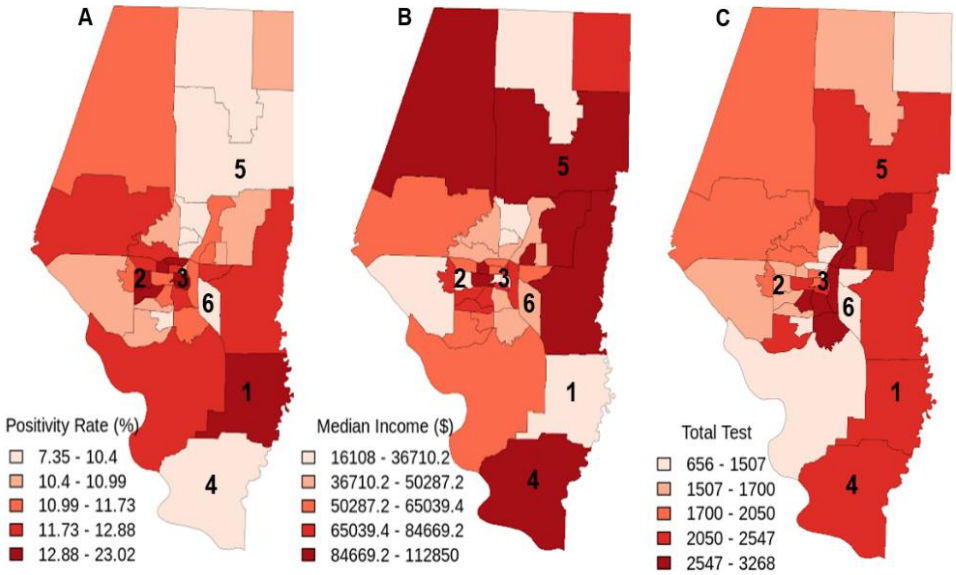
Study Results

- Tracks labeled 1–3 represent the highest positivity rates Fig. A
- Those three tracks are associated with lower median income Fig. B
- Lower total number of COVID-19 tests Fig. C



Study Results

- Tracks labeled 4–6 represent the lowest positivity rates Fig. A
- Those three tracks are associated with higher median income Fig. B
- Higher total number of COVID-19 tests Fig. C



Discussion

- Upper **three outlier** tracks have an exceptionally **high positivity rates** (higher than **19.5%**) associated with **lower median income**
- The **bottom three outlier** tracks have exceptionally **low positivity rates** (lower than **8%**) with **two tracks** in the **$37K/yr** and **one track** within the **$90K/yr**
- From the analysis, we can conclude that tracks **1, 2,** and **3** have **higher** positivity rates, **lower** median income, and a **lower** total number of tests
- On the other hand, tracks **4, 5,** and **6** have **lower** positivity rates, **higher** median income, and a **higher** number of total tests

Study Limitations

- Despite the interesting findings, there are **several limitations** in our study
  - First, the **tests** have been known to have the possibility of **false positives** and **false negatives**
  - Second, we do not have **information** about the **individuals** who did not test in Boone County or tested at **some other** clinics and facilities other than the University of Missouri hospital and clinics
    - Taking into consideration that University of Missouri hospital is the **main healthcare provider** for Boone County along with **13 other surrounding counties**

Conclusion

- COVID-19 is an **ongoing** source of **threat**
- A continuous **need** for **research** studies and analyses to understand:
  - Its **behavior** and to **monitor**:
    - **Social determinants-of-health**, demographic, and **equitable distribution** of life-saving resources for fighting the virus
- From a **social-determinants-of-health** and **geospatial perspective**, our study findings
  - **Support** the **hypotheses** that **low-income** individuals have **lower** testing rates and **higher** positivity rates than **high-income** individuals in Boone County, Missouri

Future Work

- More **resources** should be allocated to the most vulnerable **income** to address the COVID pandemic in an **equitable** manner
- As such, our team is conducting **additional studies** that will include:
  - More **geospatial analysis** and **remote sensing** based on the zip code addresses and **census blocks/tracts** of the tested individuals in Boone County to:
    - Study and define the **associations** and **other features** that could be related to the testing, positivity, and death rates for COVID-19

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Thank You!

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