THE GEORGE WASHINGTON UNIVERSITY

WASHINGTON, DC

GEOSPATIAL ANALYSIS OF DISEASE OUTBREAK

Covid Outbreak in New York

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INTRODUCTION

- COVID-19 overwhelmed healthcare systems globally.
- Traditional analysis methods struggled to capture real-time transmission patterns.
- GIS helped governments track outbreaks, allocate resources, and implement containment strategies.
- This project explores how GIS can provide insights into disease outbreaks in NYC

PROBLEM STATEMENT

How have the spatial patterns of COVID-19 evolved across NYC with the incorporation of comprehensive data analyses and ArcGIS hotspot studies?

Are health outcomes affected by demographics such as income, race, and healthcare access?

How do the updated hotspot analyses reveal current high-risk areas across NYC?

LITERATURE REVIEW

01 COVID-19 and Inequity: a Comparative Spatial Analysis of New York City and Chicago Hot Spots : NATIONAL LIBRARY OF MEDICINE

https://pmc.ncbi.nlm.nih.gov/articles/PMC7371785/

02 TRACKING CORONAVIRUS IN NEW YORK STATE: NYC TIMES

https://www.nytimes.com/interactive/2021/us/new-york-city-new-york-covid-cases.html#

03 HARNESSING GEOSPATIAL DATA FOR INFORMED HEALTH CARE PLANNING : esri

https://www.esri.com/en-us/industries/blog/articles/harnessing-geospatial-data-for-informed-healthcare-planning/

METHODOLOGY

Data Sources:

- COVID-19 Case Data: Updated figures from the NYC Health Department.
- Demographics: U.S. Census 2020 data (supplemented with community surveys where available).
- Healthcare Access Data: Facility locations and capacities from NYC Open Data.

Data Preprocessing:

- Correction of anomalies and removal of duplicate records.
- Interpolation of missing values and standardization to the WGS 84 coordinate system.
- Merging COVID-19 data with census and environmental datasets.

GIS Analysis on ArcGIS:

- Creation of updated Heatmaps to visualize case density.
- Development of Choropleth Maps to relate mortality and case rates to socio-demographic factors.
- Hotspot Analysis:
    - Execution of ArcGIS Getis-Ord Gi* analysis to identify statistically significant clusters.
    - Comparison of hotspots across different NYC regions.

DATA PREPROCESSING

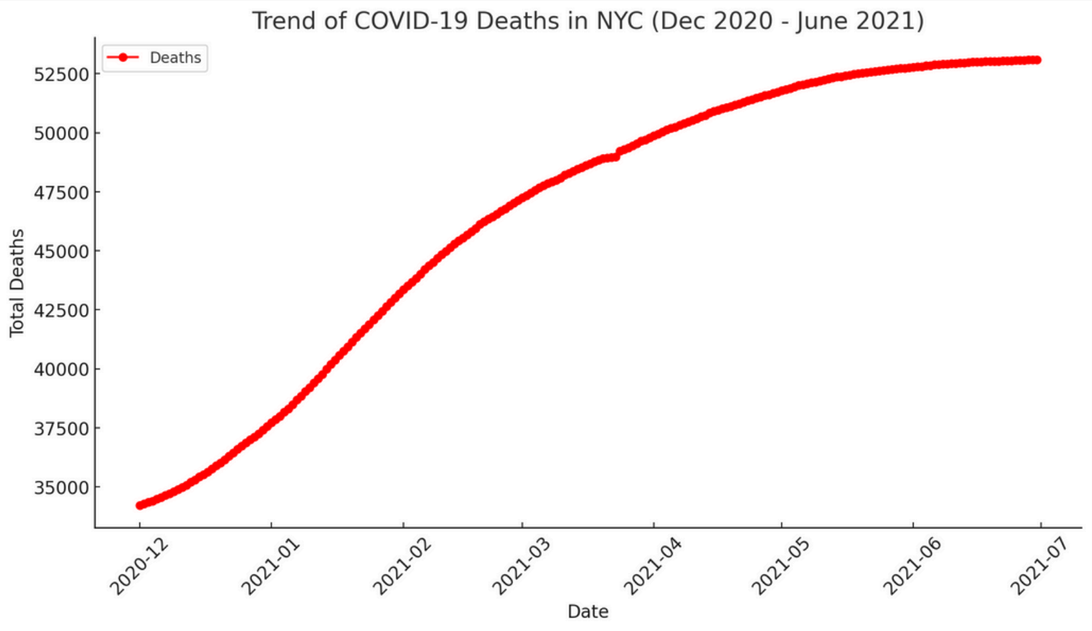
Borough-Level Breakdown:
- Detailed trends in case and mortality rates across NYC boroughs.

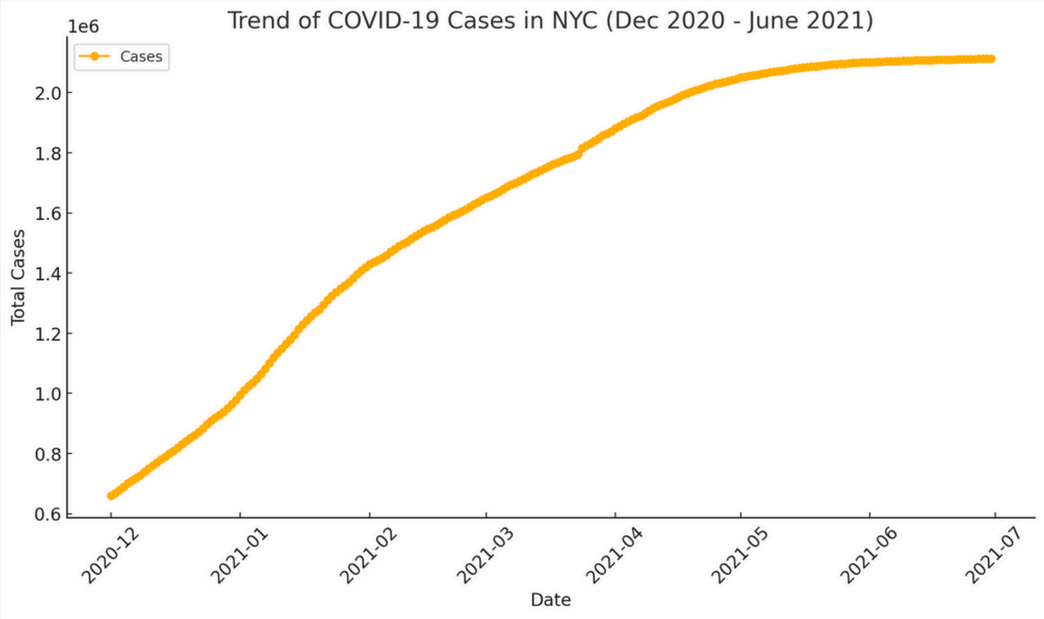
Demographic Impact:
- Analysis of case rates in relation to income, race, and healthcare access.
- Visualization insights indicating that lower-income and minority-dominated neighborhoods face higher case densities.

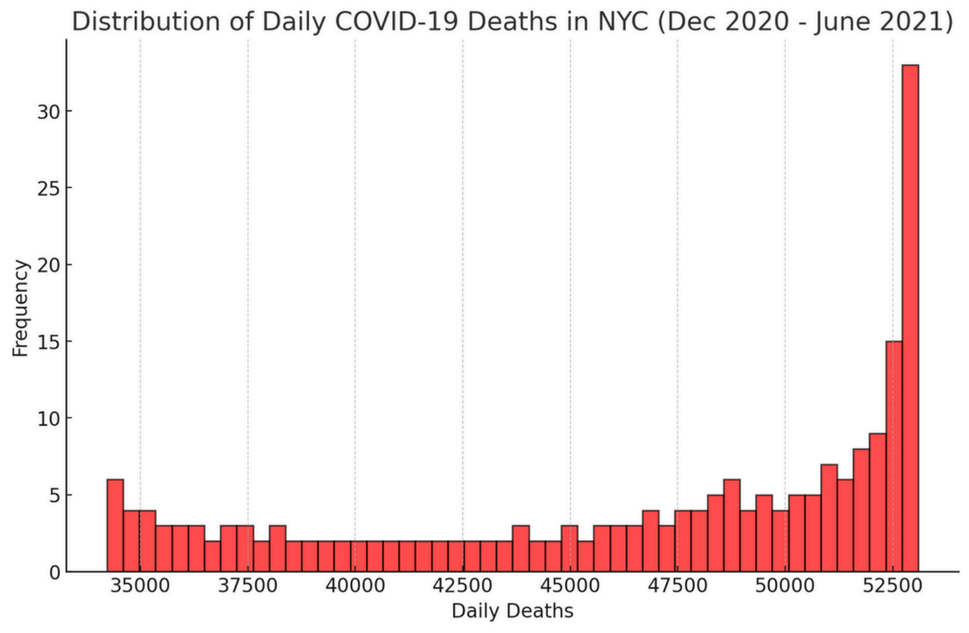
Temporal Trends:
- Time series analysis showing the progression and peaks of outbreaks.

Visuals:
- Updated bar charts, line graphs, and scatter plots with annotations to highlight key trends.

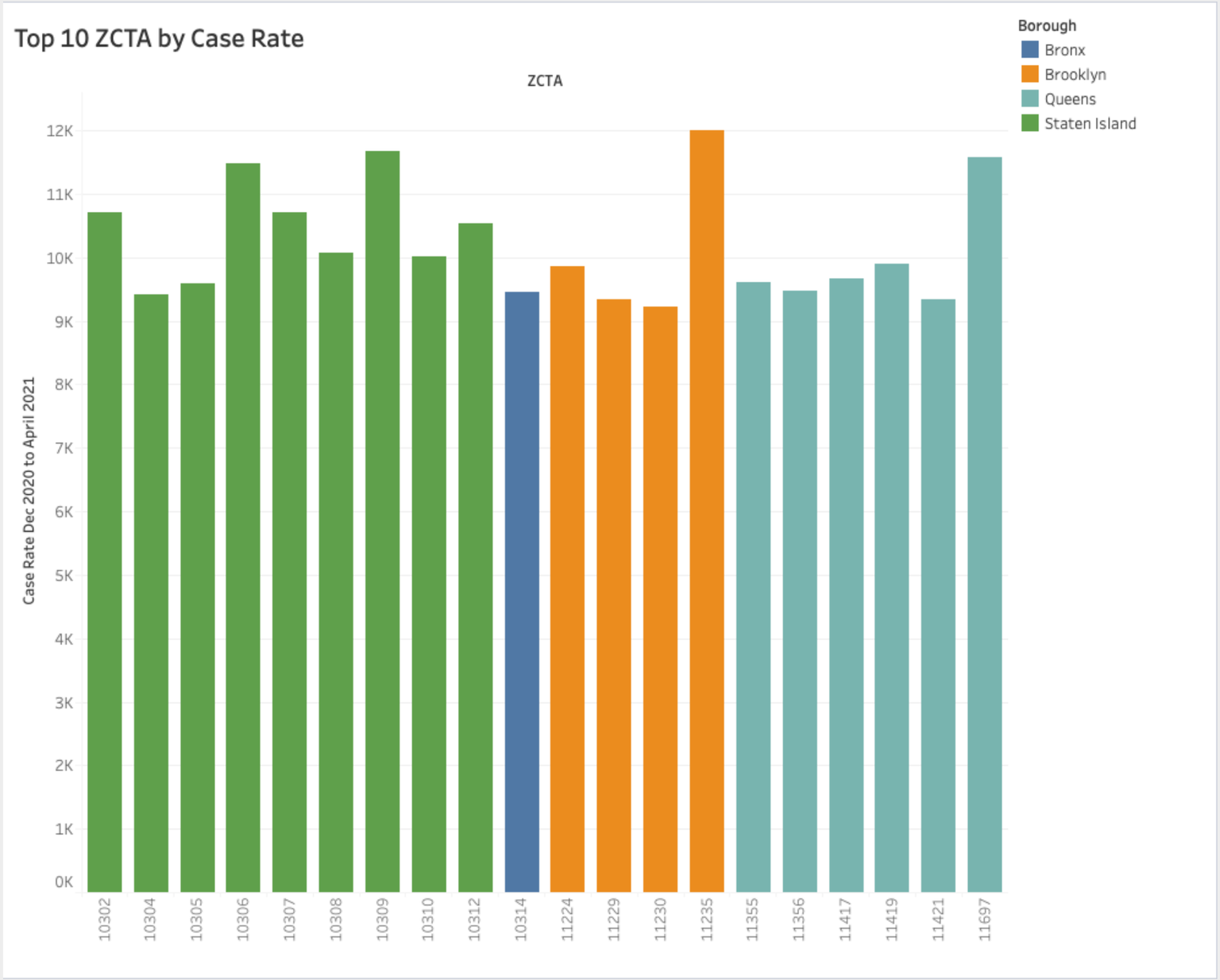
EDA – Results


Trend of COVID-19 Deaths in NYC (Dec 2020 - June 2021)
Deaths
Total Deaths
52500
50000
47500
45000
42500
40000
37500
35000
2020-12
2021-01
2021-02
2021-03
2021-04
2021-05
2021-06
2021-07
Date

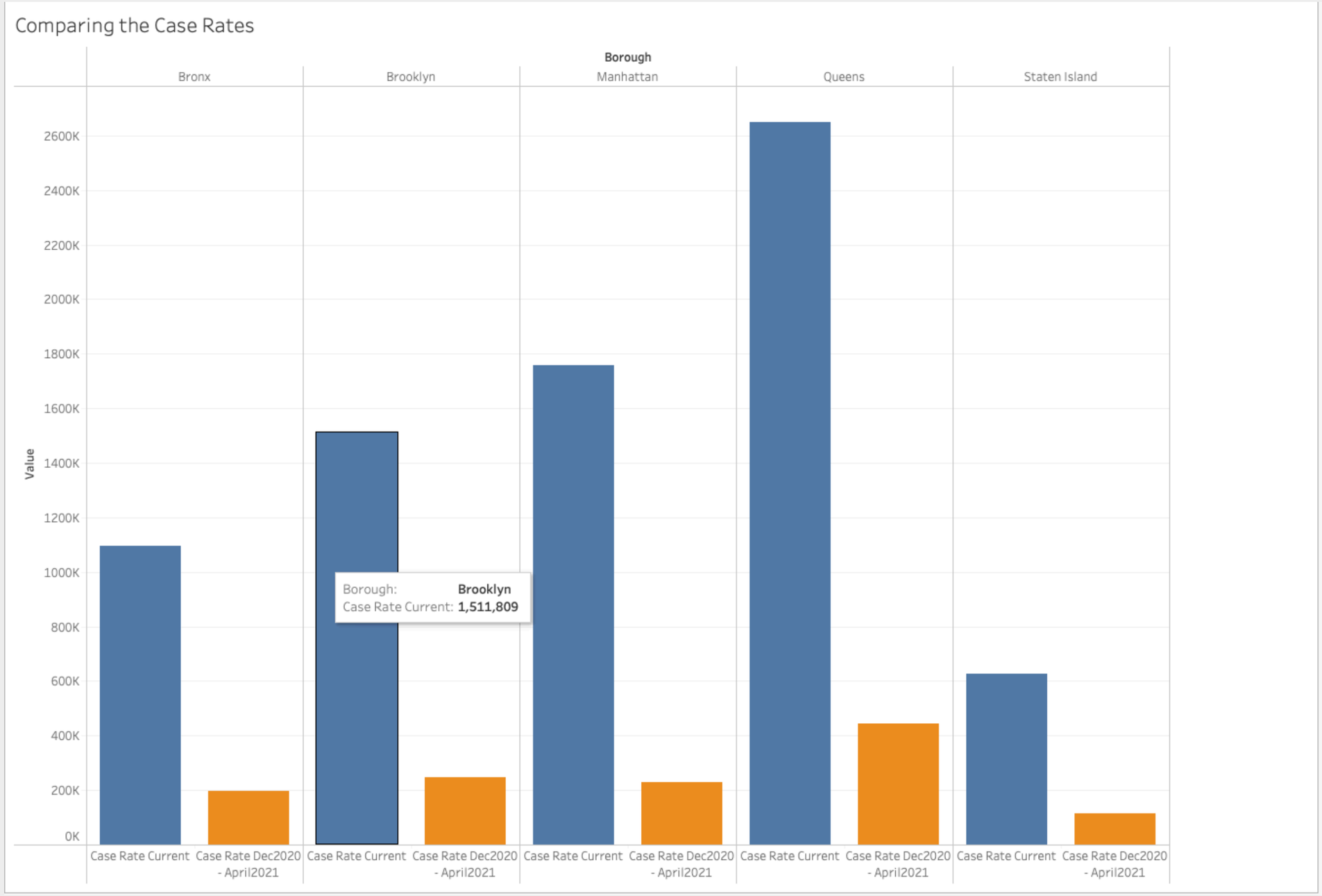

Trend of COVID-19 Cases in NYC (Dec 2020 - June 2021)
1e6
Cases
Total Cases
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
2020-12
2021-01
2021-02
2021-03
2021-04
2021-05
2021-06
2021-07
Date


Distribution of Daily COVID-19 Deaths in NYC (Dec 2020 - June 2021)
Frequency
30
25
20
15
10
5
0
35000
37500
40000
42500
45000
47500
50000
52500
Daily Deaths

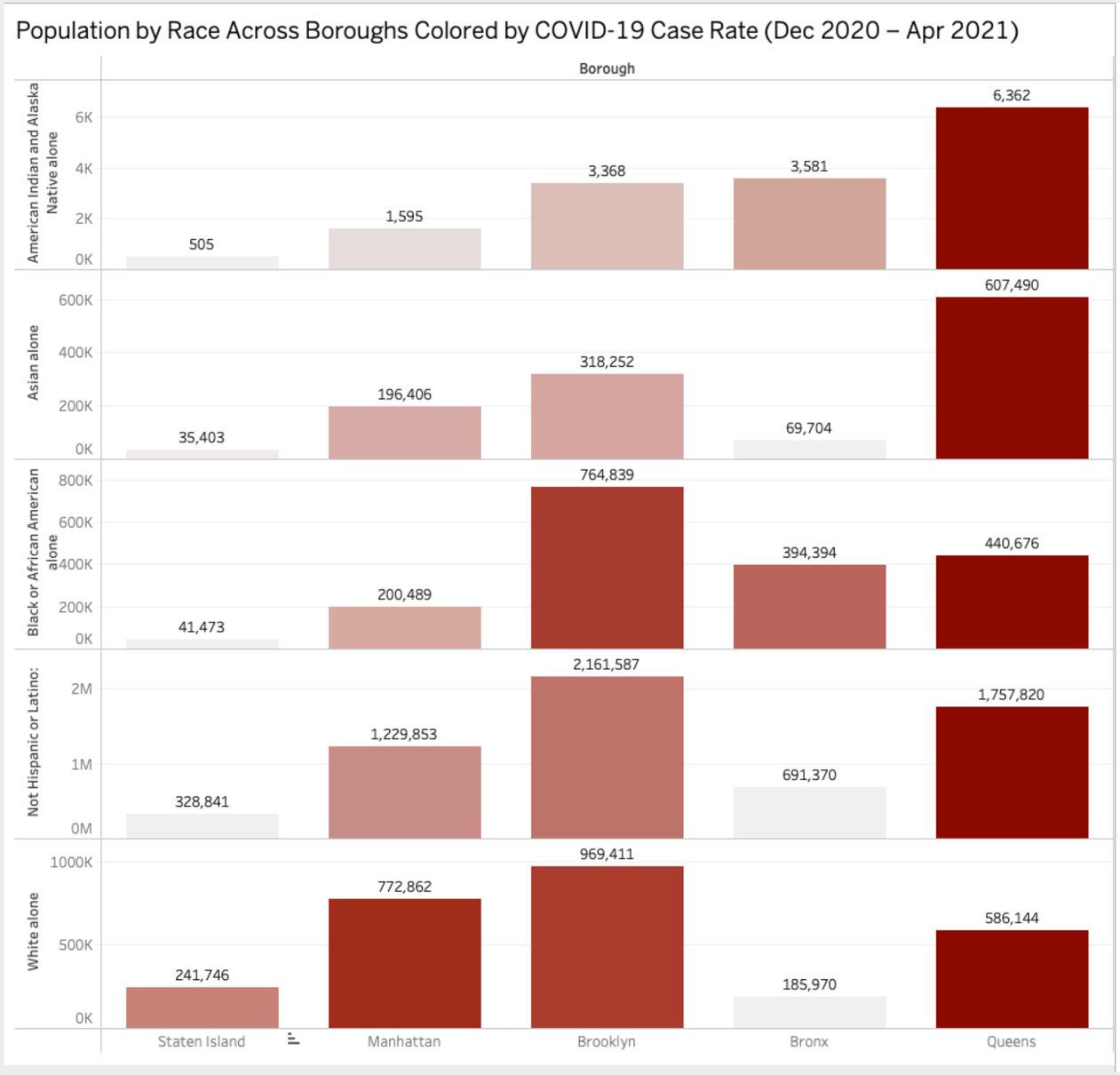
EDA – Results

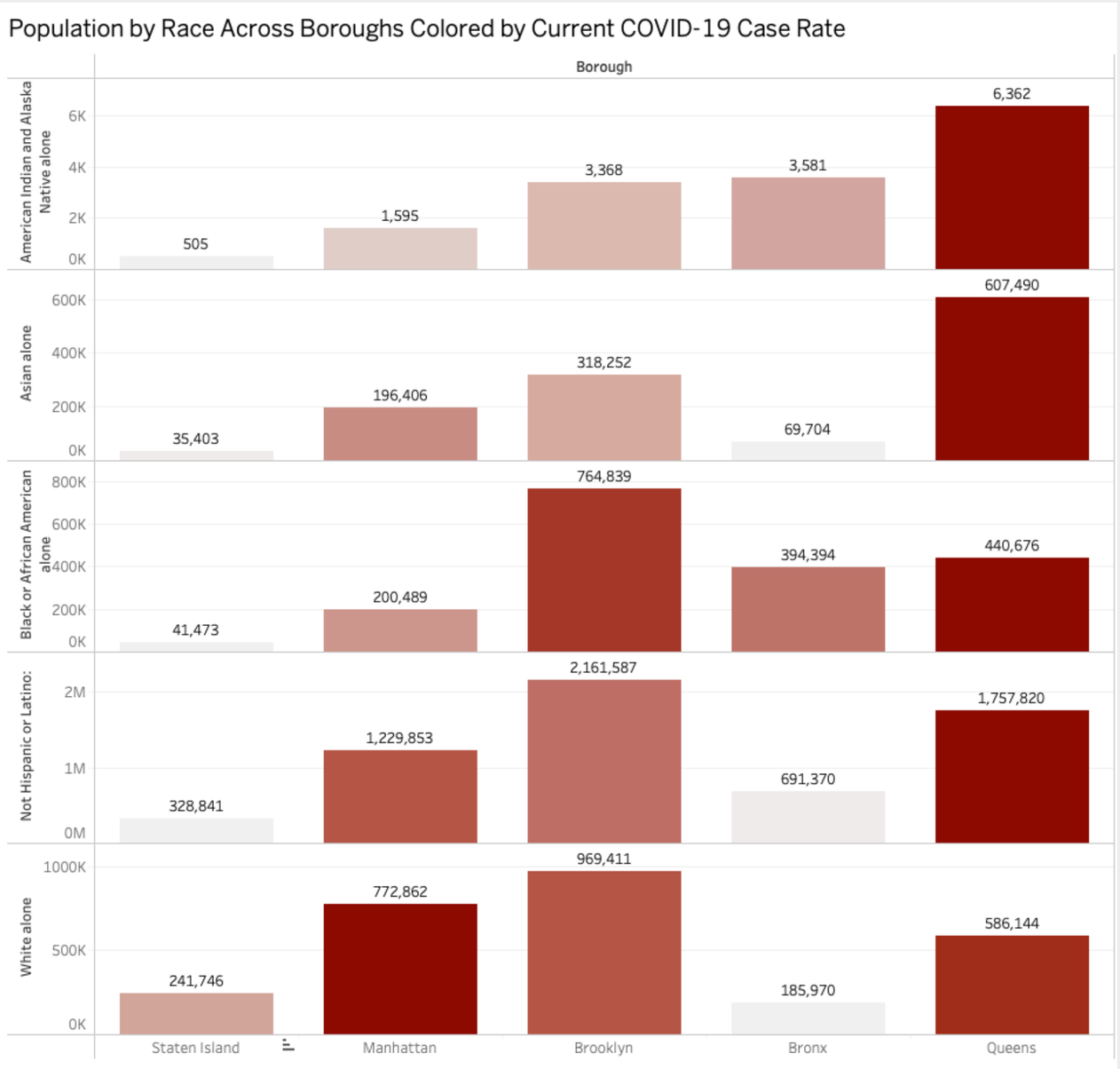

Top 10 ZCTA by Case Rate
ZCTA
Case Rate Dec 2020 to April 2021
0K
1K
2K
3K
4K
5K
6K
7K
8K
9K
10K
11K
12K
10302
10304
10305
10306
10307
10308
10309
10310
10312
10314
11224
11229
11230
11235
11355
11356
11417
11419
11421
11697
Borough
Bronx
Brooklyn
Queens
Staten Island

EDA – Results


Comparing the Case Rates
Borough
Bronx
Brooklyn
Manhattan
Queens
Staten Island
Value
2600K
2400K
2200K
2000K
1800K
1600K
1400K
1200K
1000K
800K
600K
400K
200K
0K
Borough: Brooklyn
Case Rate Current: 1,511,809
Case Rate Current
Case Rate Dec2020 - April2021
Measure Names
Case Rate Current
Case Rate Dec2020 - ..

EDA –Results


Population by Race Across Boroughs Colored by COVID-19 Case Rate (Dec 2020 – Apr 2021)
Borough
American Indian and Alaska Native alone
505
1,595
3,368
3,581
6,362
Asian alone
35,403
196,406
318,252
69,704
607,490
Black or African American alone
41,473
200,489
764,839
394,394
440,676
Not Hispanic or Latino:
328,841
1,229,853
2,161,587
691,370
1,757,820
White alone
241,746
772,862
969,411
185,970
586,144
Staten Island
Manhattan
Brooklyn
Bronx
Queens


Population by Race Across Boroughs Colored by Current COVID-19 Case Rate
Borough
American Indian and Alaska Native alone
505
1,595
3,368
3,581
6,362
Asian alone
35,403
196,406
318,252
69,704
607,490
Black or African American alone
41,473
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440,676
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Bronx
Queens

GEOSPATIAL ANALYSIS

Final Mapping Outcomes:

- Enhanced Heatmaps
- Choropleth Maps

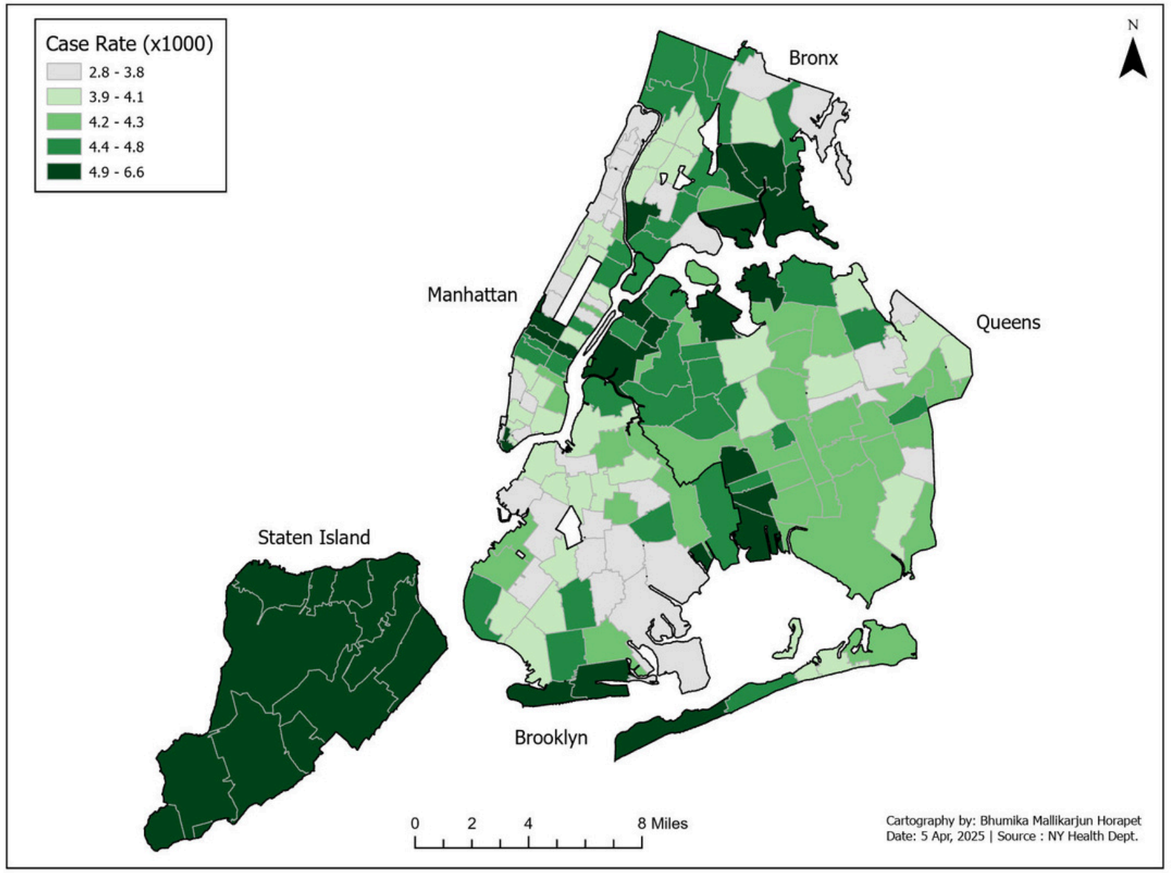
Hotspot Analysis:

- ArcGIS Getis-Ord Gi* maps reveal areas with statistically significant clusters.
- Side-by-side comparison with midterm maps to illustrate the progression in spatial patterns.

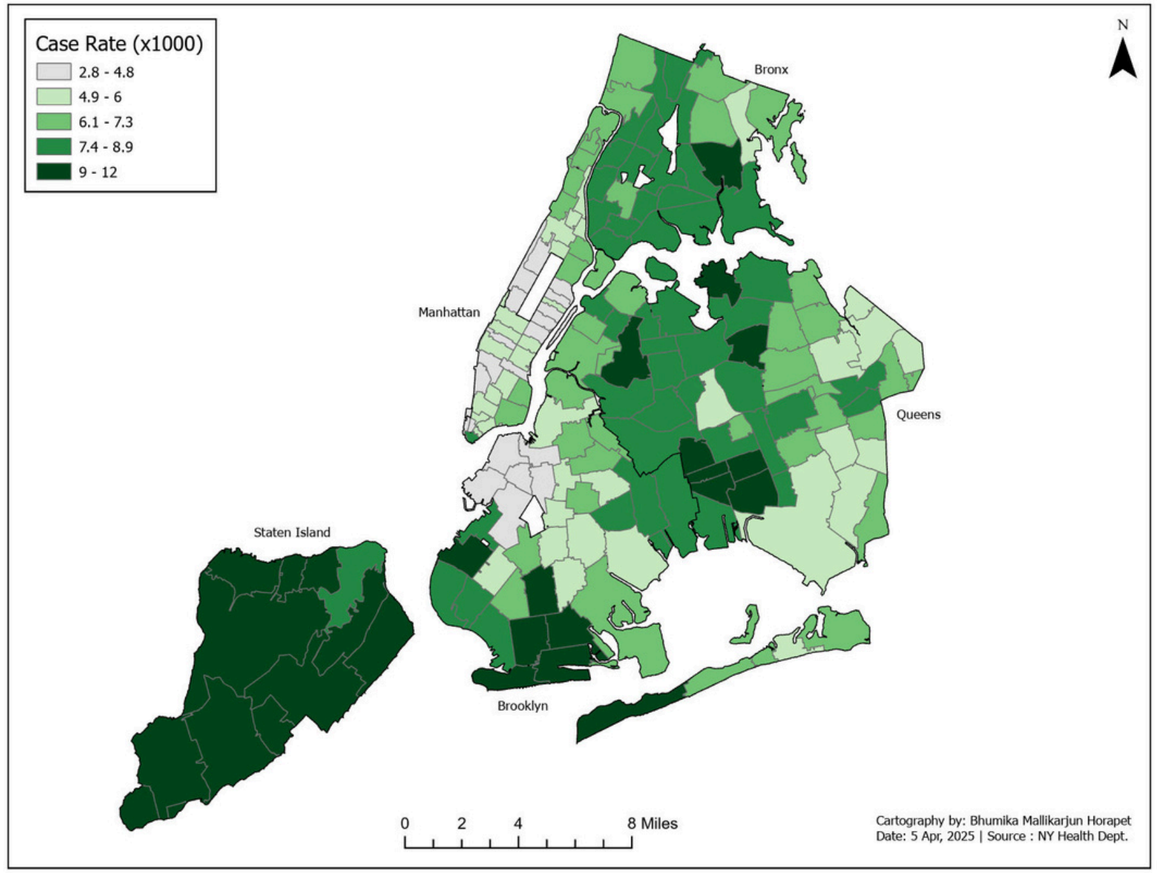
Visual Comparison:

- Highlight persistent high-risk zones (e.g., specific neighborhoods in the Bronx, Queens, or Brooklyn).
- Clearly marked legends and color keys for easy interpretation.

GEOSPATIAL ANALYSIS

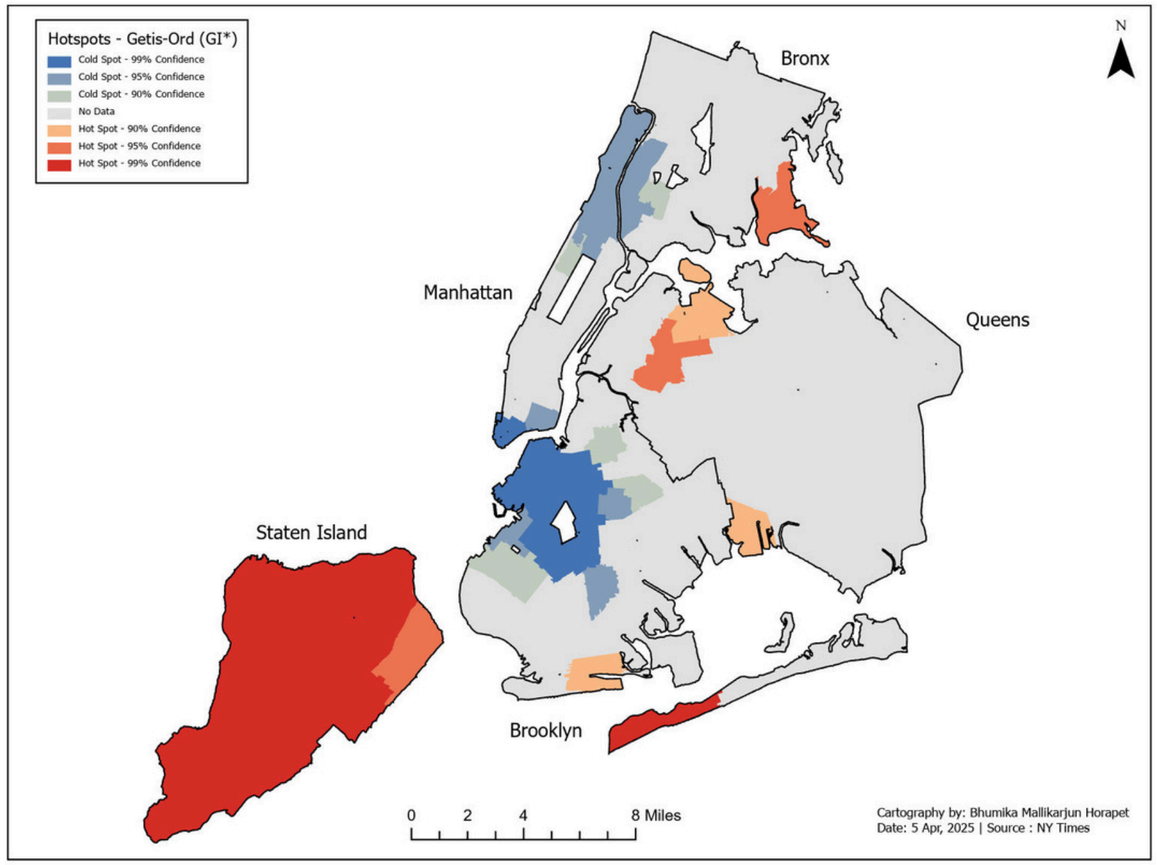


Case Rate
Current

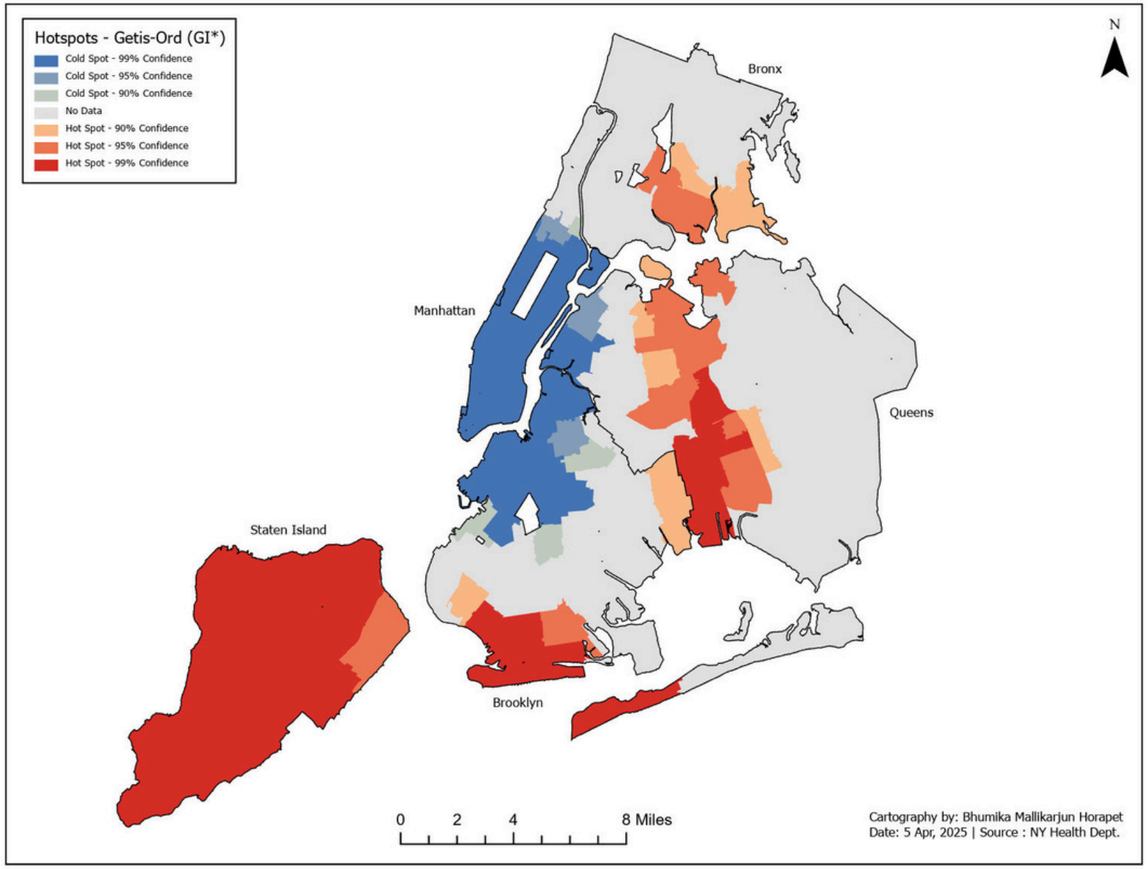


Case Rate
Dec 2020 - Apr 2021

GEOSPATIAL ANALYSIS



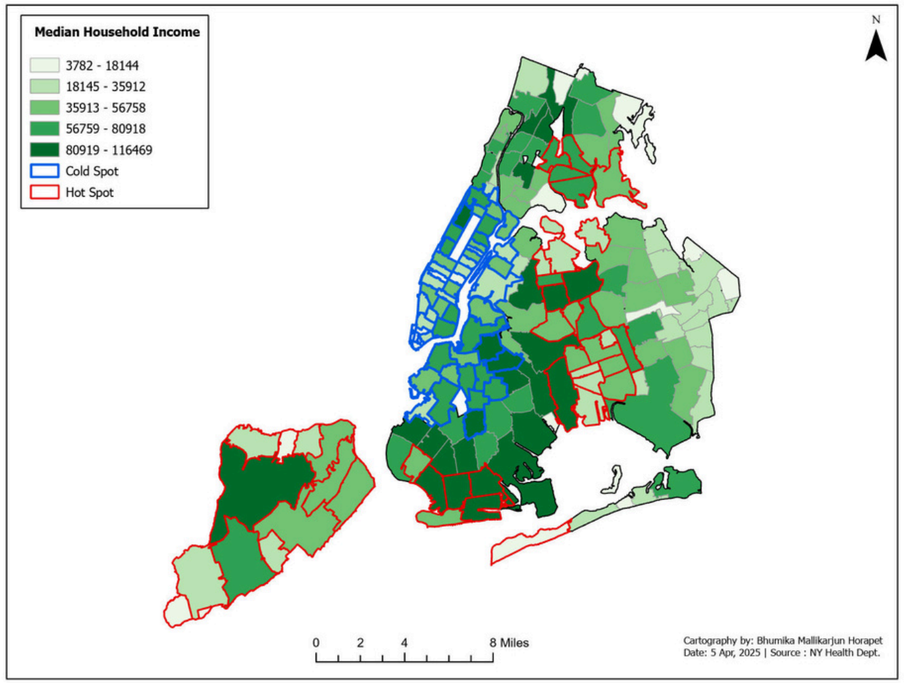
Hotspot Analysis
Current

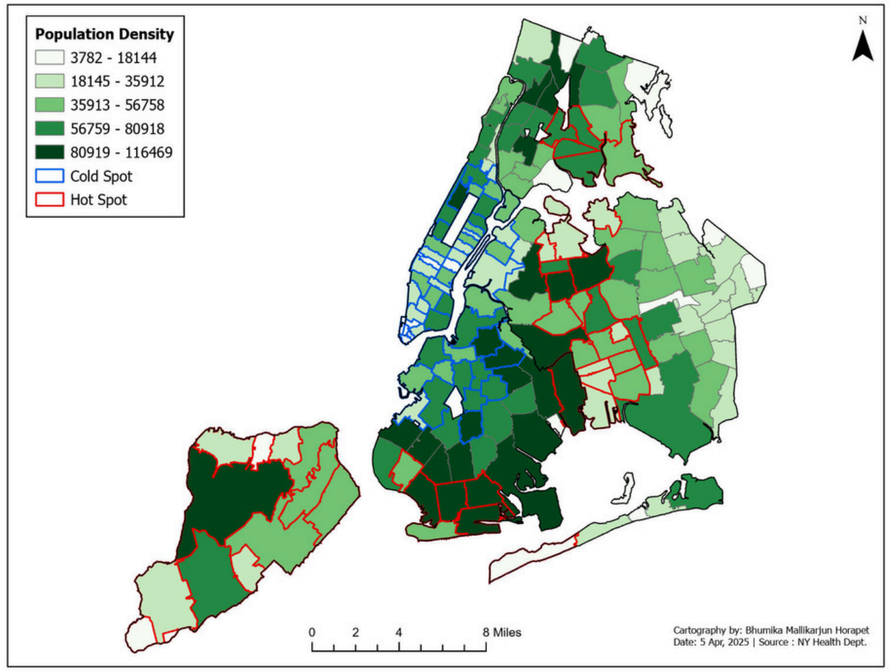


Hotspot Analysis
Dec 2020 - Apr 2021

Median Household Income

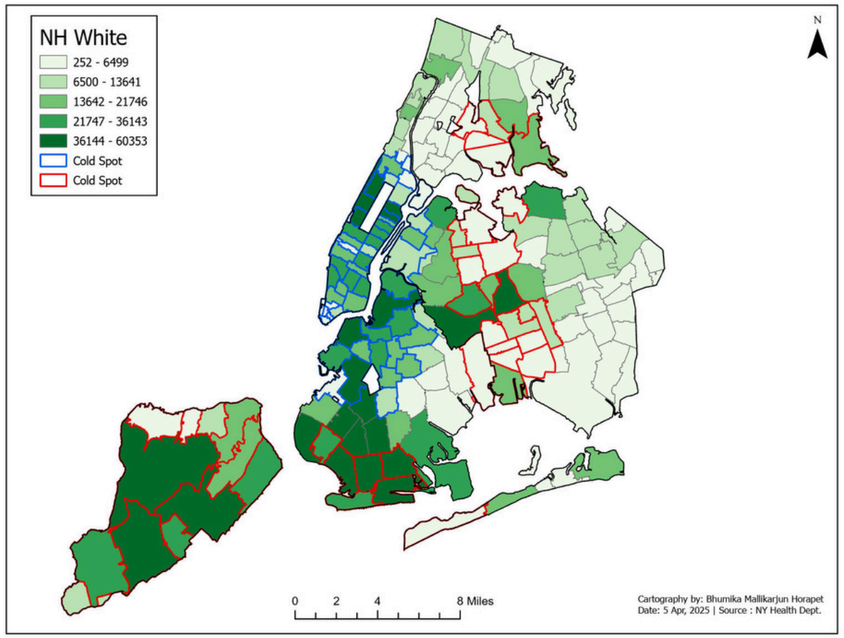
Dec 202 - Apr 2021





Population Density

Dec 202 - Apr 2021



%NH White

Dec 202 - Apr 2021

CONCLUSION AND POLICY IMPLICATIONS

Summary of Final Insights:

- The refined geospatial analysis confirms that COVID-19's spread is intricately linked to socio-economic factors.
- The integration of real-time data and advanced spatial models enhances the reliability of our predictions.

Policy Implications:

- Emphasis on targeted testing and vaccination drives in high-risk areas.
- Resource allocation should consider both current hotspot intensity and predictive risk zones.
- Need for ongoing investment in GIS capabilities for public health monitoring.

Call to Action:

- Encourage collaboration between city planners, health officials, and GIS specialists to refine intervention strategies.

REFERENCES

Data Sources:

- NYC Health Department, U.S. Census Bureau, NYC Open Data

Key Literature & Reports:

- National Library of Medicine, NYTimes Interactive Maps, Esri Geospatial Health Resources

Thank you