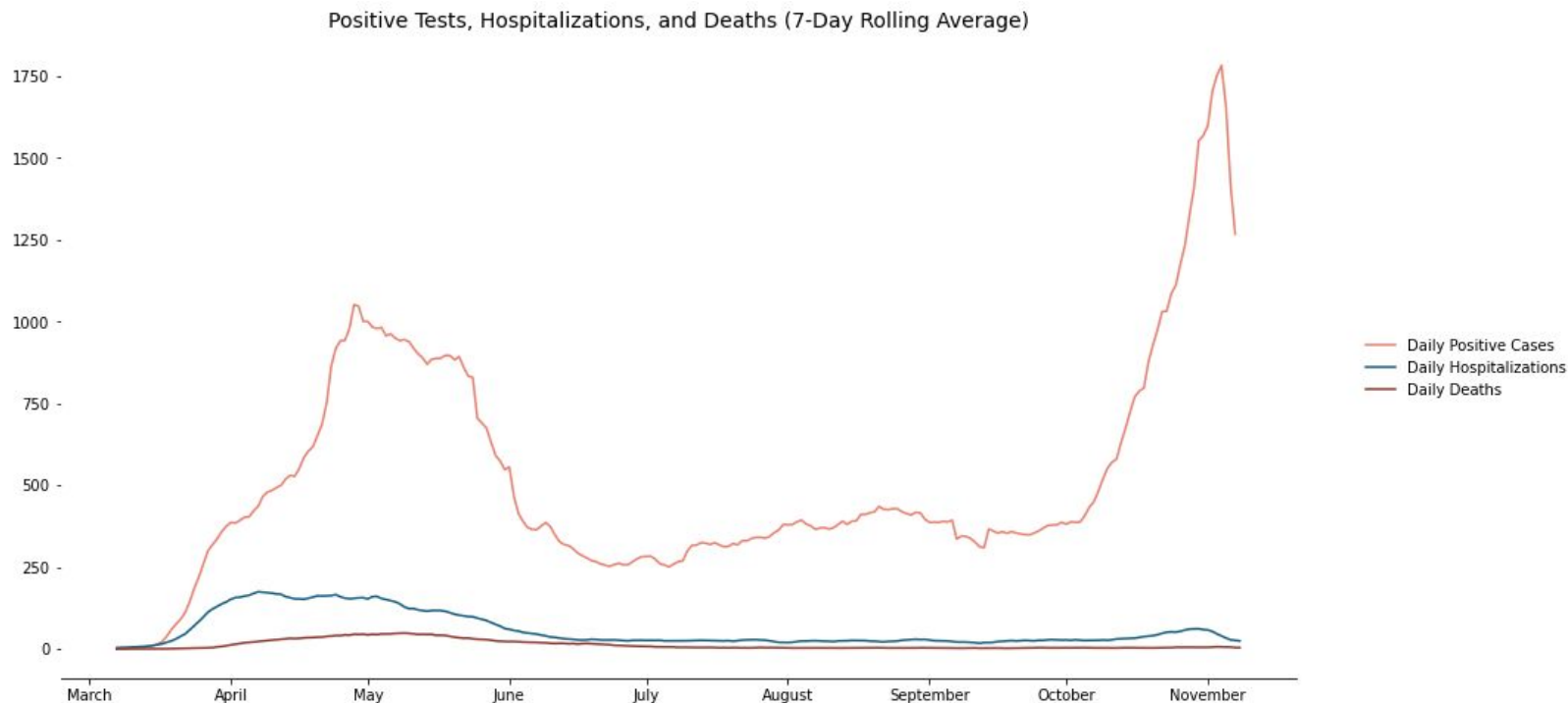


Chicago COVID-19 ZIP Code Analysis

Jamil Mirabito

A dark blue diagonal gradient bar that starts from the bottom left and extends towards the top right, covering the lower half of the slide.

Chicago is in the midst of a second wave of COVID-19 cases, now having surpassed the total number of cases during the initial wave.



Source: Chicago Daily Testing By Test (3/01/2020 - 11/07/2020); Chicago COVID-19 Daily, Cases, Deaths, and Hospitalizations (3/01/2020 - 11/07/2020).

Challenge

With the massive uptick in positive cases, it's important to **understand which communities are most affected by the virus** and how certain mitigation efforts may be working to **reduce the city's overall positivity rate through the coming weeks.**

Analyses

ZIP-Code Analysis:

Using zip-code-level demographic and economic characteristics to understand which variables are most related to positivity rates and testing.

Projecting Chicago's Positivity Rate:

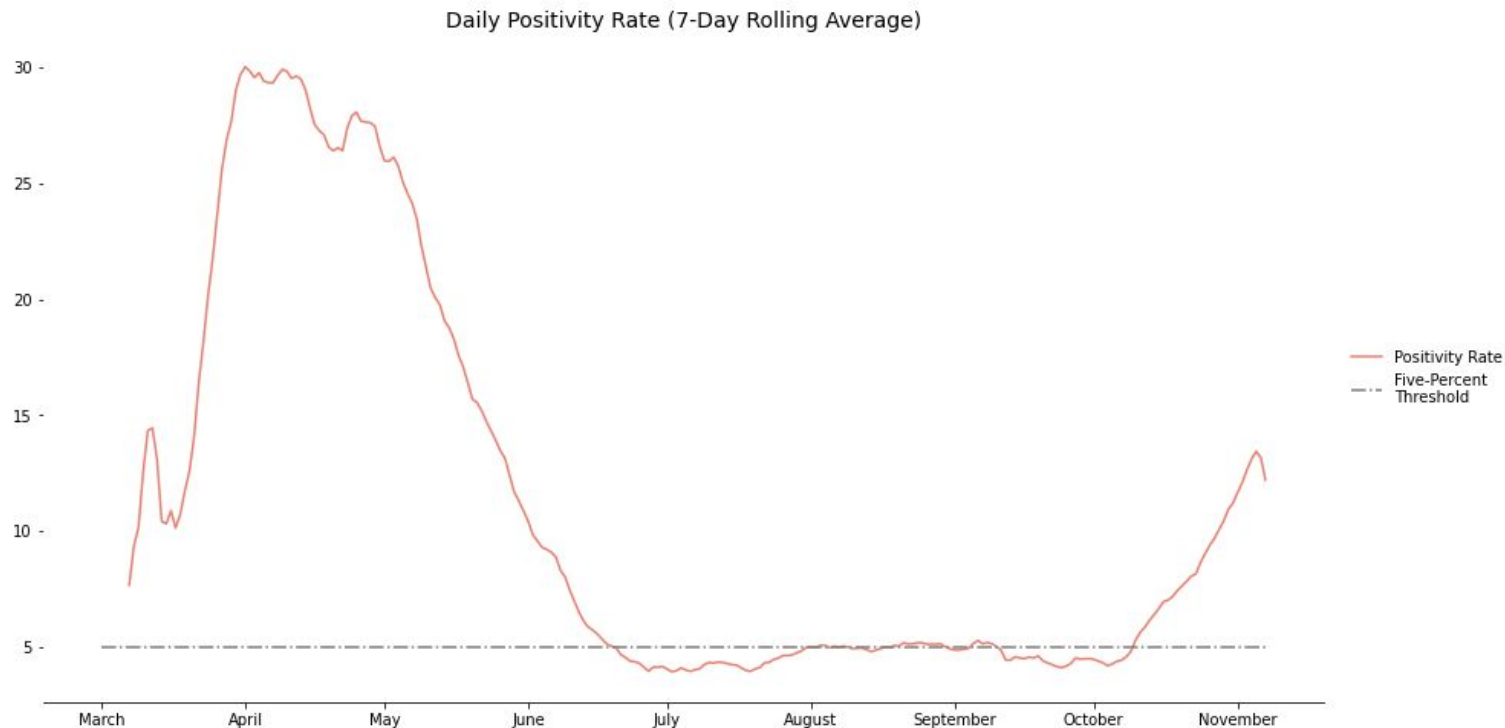
Using time-variant characteristics to model the city's positivity rate for the next two weeks.

Positivity Rates

Positivity rate is the percentage of total tests administered in a given day that come back positive. This does not include rapid tests, or antibody tests.

The World Health Organization (WHO) recommends that the **positivity rate in a particular area remain below 5 percent** for at least 2 weeks before loosening restrictions.

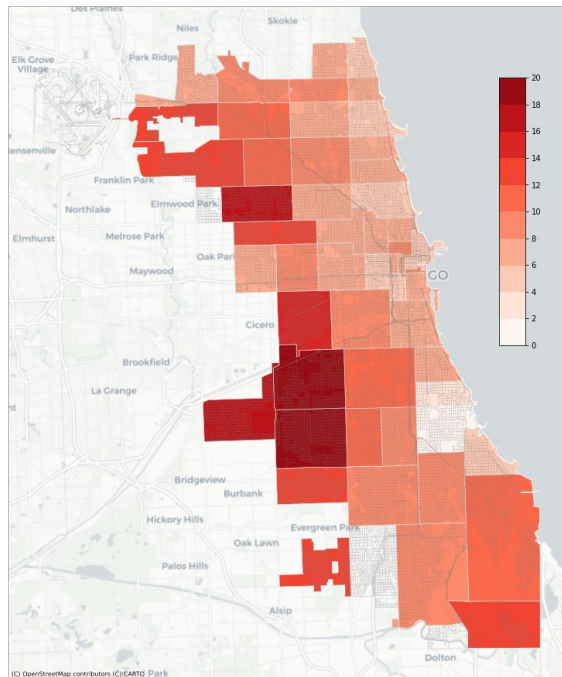
As recently as the start of November, the city-wide positivity rate has approached 15 percent – far exceeding the 5 percent threshold



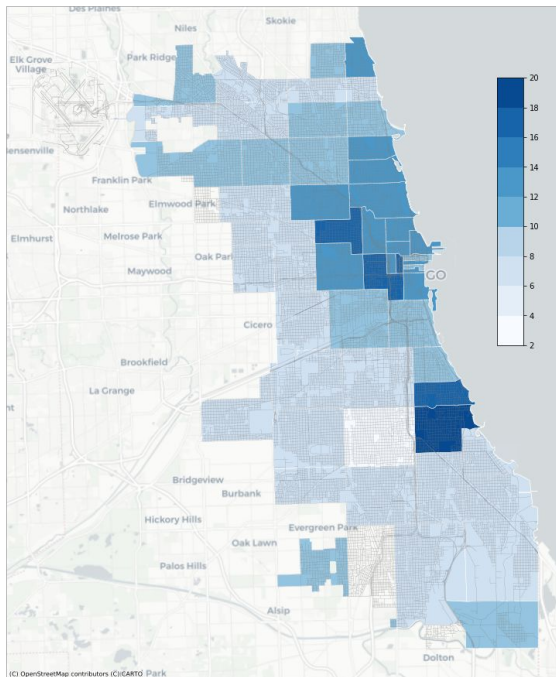
Source: Chicago Daily Testing By Test (3/01/2020 - 11/07/2020). See Appendix section **Cases, Testing & Positivity Rates** for trendlines disaggregated by age group and race.

Primarily Black and Latinx communities have the highest 2-week average positivity rates while testing seems to be focused near universities

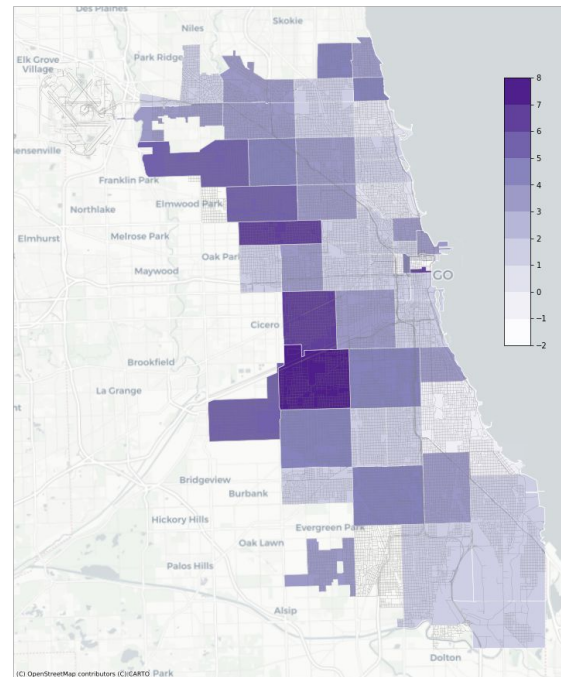
COVID-19 Positivity Rates by ZIP Code
(10/18 - 10/31)



COVID-19 Testing Rates by ZIP Code
(10/18 - 10/31)



COVID-19 Percent Change in Positivity Rates from Prior
2-Week Period (10/4 - 10/17)



Sources: US Census Data, Chicago COVID-19 Cases, Deaths, and Tests (3/01/2020 - 10/31/2020) at the zip-code level. Data sourced from different dataset with ZIP-code-level positivity rates available on a weekly basis. See **Appendix Slide 26** for list of top 5 ZIP codes for positivity rates and testing.

ZIP Code Analysis



ZIP Code Analysis

Data Sources:

- US Census Data
- City of Chicago Cases, Testing and Deaths by ZIP Code
- City of Chicago Testing Sites

Target Variables:

- COVID-19 Positivity Rates
- Testing Per Capita

Variables included in **Ordinary Least Squares (OLS) Model:**

- Median Age
- Median Household Income
- Median Household Size
- Percent of a ZIP Code that is Hispanic/Latinx
- Percent Black
- Percent White
- Percent Undocumented & Percent Undocumented Foreign Born Latin America (FBLA)
- Percent Uninsured
- Percent Unemployed
- Percent Healthcare Workers
- Percent Essential Workers
- Distance from Testing Site

The following features were found to be significantly correlated with COVID-19 positivity rates & testing

Target: COVID-19 Positivity Rates

R-squared: 0.715

- Percent Hispanic (+7.90)
- Percent Health Workers (-80.12)
- Percent Essential Workers (+23.68)

	coef	std err	t	P> t
const	0.0684	0.024	2.824	0.007
pctHispanic	0.0790	0.019	4.191	0.000
pctHealthWorkers	-0.8012	0.241	-3.329	0.002
pctEssential	0.2368	0.071	3.348	0.002

Target: Testing per Capita

R-squared: 0.426

- Median Age (-0.25)
- Percent Uninsured (-27.40)

	coef	std err	t	P> t
const	0.1827	0.024	7.491	0.000
medianAge	-0.0025	0.001	-3.697	0.001
pctUninsured	-0.2740	0.051	-5.397	0.000

Predicting Positivity Rates

Time-Series Modeling

Data Sources:

- Chicago Open Data - Daily Tests by Test
- NOAA Historical Weather Data

Models Tested:

- Naive Untrained Model
- Moving Average Model
- Triple Exponential Smoothing Model
- SARIMA Model
- Various iterations of a SARIMAX model

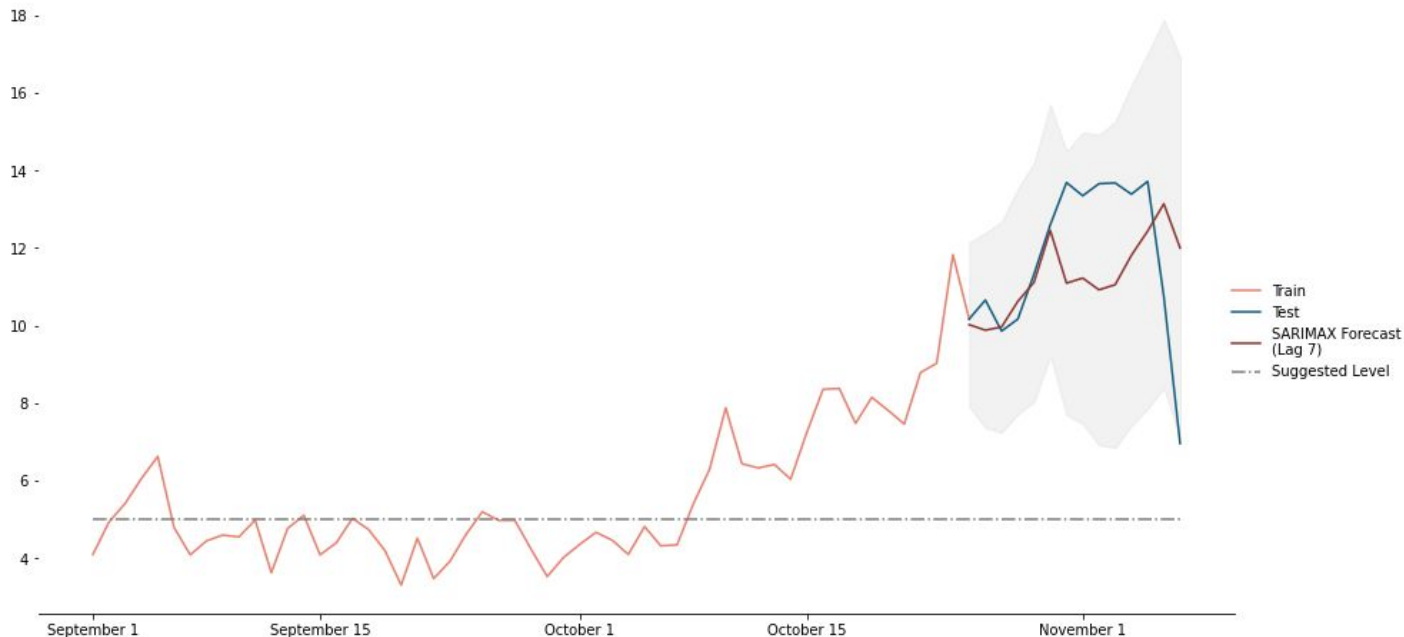
Training Period: 03/01/2020 - 10/25/2020

Testing Period: 10/25/2020 - 11/7/2020

Model Type	RMSE
Naive Untrained Model	2.510
Moving Average Model	3.330
Triple Exponential Smoothing Model	3.153
SARIMA Model	2.503
Final SARIMAX model	2.102

The best-performing model was a SARIMAX Model trained on data from 04/08/2020 - 10/25/2020

Two-Week Covid-19 Positivity Rate Projection for Chicago, IL - Train/Test Comparison

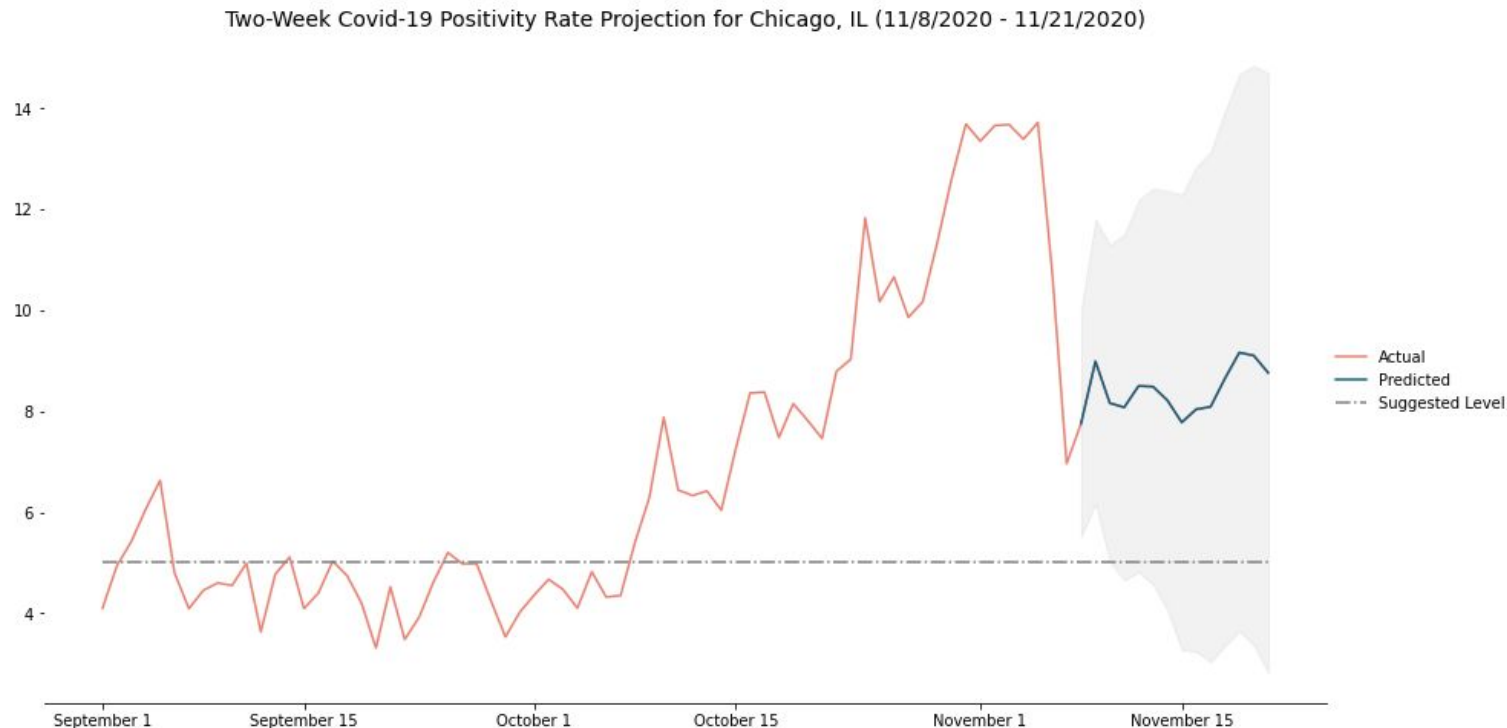


RMSE: 2.102

Exogenous variables
used in model - all 7-day
lag variables:

- Holidays
- Tightening Restrictions
- Loosening Restrictions
- Average Daily Temperature
- Precipitation

Optimal model predicts a steady leveling out in positivity rates over the next 2 weeks – still above 5 percent threshold



Summary & Recommendations

Summary:

Over the past month, COVID-19 positivity rates were highest in **Latinx communities** and areas with a high percentage of **essential workers**.

In the coming weeks, it's projected that the City's overall **positivity rate will decrease by roughly 5 percentage points**, likely driven by increased testing among younger people.

While testing is readily available for **younger students**, communities with a higher percentage of **uninsured individuals are less likely to be tested**.

Recommendations:

Work with community leaders and city stakeholders to **ensure that all community residents are aware of free testing regardless of insurance coverage**.

Consider **mandating regular testing** for all essential and non-essential workers

Continue **stressing the importance of social distancing** in mitigating the spread of the virus particularly in communities with higher positivity rates (i.e., Hispanic communities)

Questions?

Appendix

Data Sources

Census Data (API):

- American Community Survey 2018 Estimates - zip-code level
- ACS Occupation Lookup - Table S2401

Chicago Open Data:

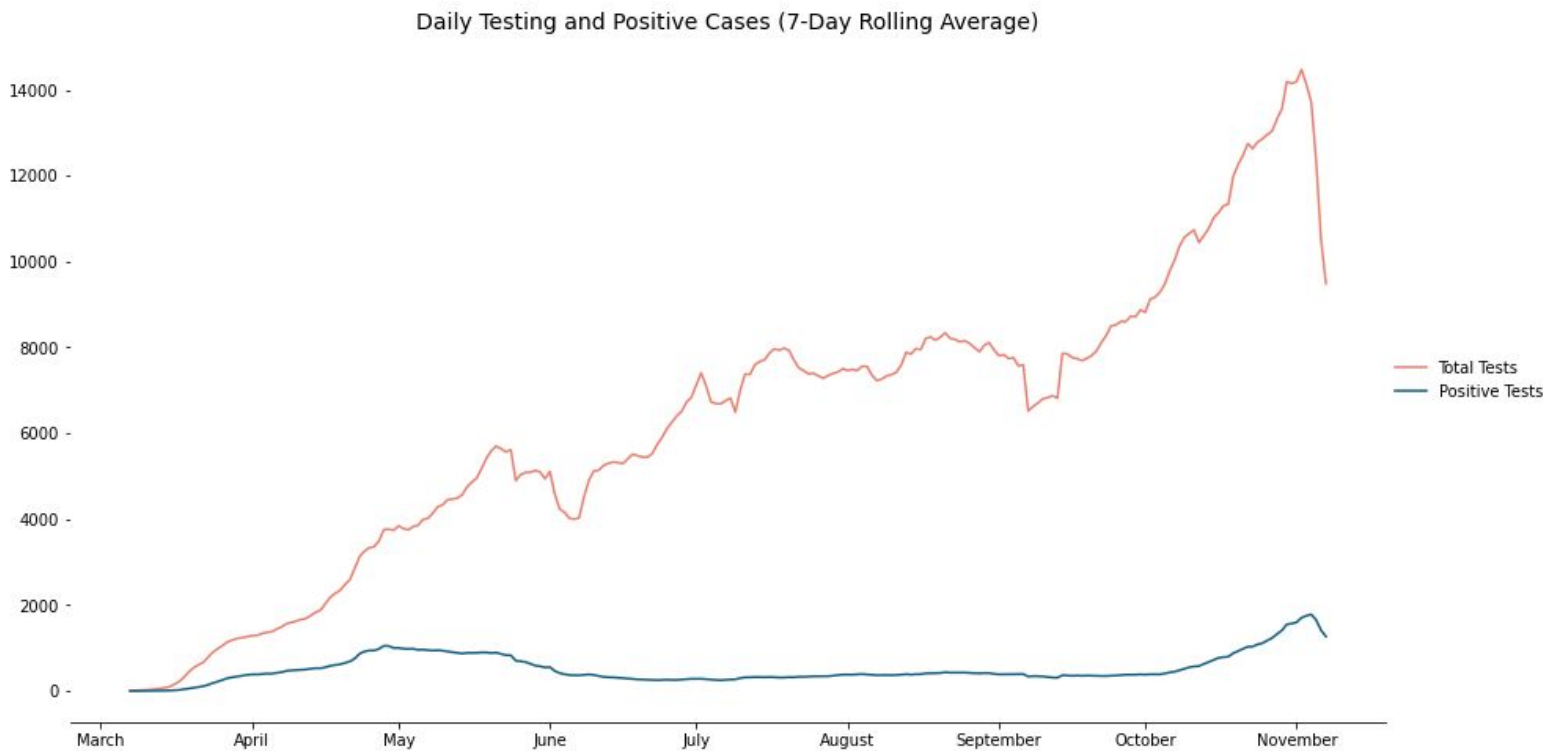
- [COVID-19 Cases, Tests, and Deaths by ZIP Code](#)
- [COVID-19 Testing Sites](#)
- [COVID-19 Daily Cases, Deaths, and Hospitalizations](#)
- [COVID-19 Daily Testing by Test](#)
- [Chicago ZIP Codes Shapefile](#)

NOAA:

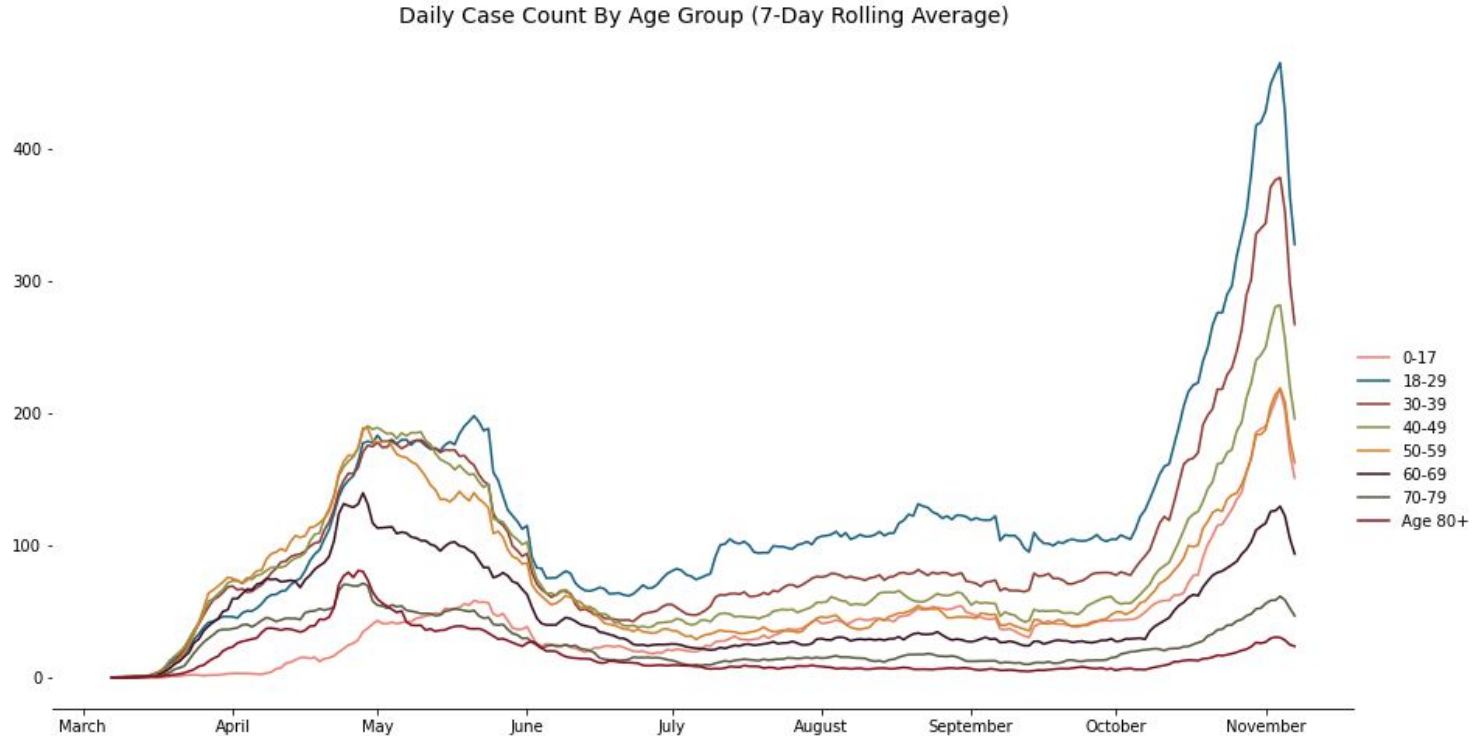
- [Average Daily Temperature and Precipitation](#)
(Historical Data)

Cases, Testing & Positivity Rates

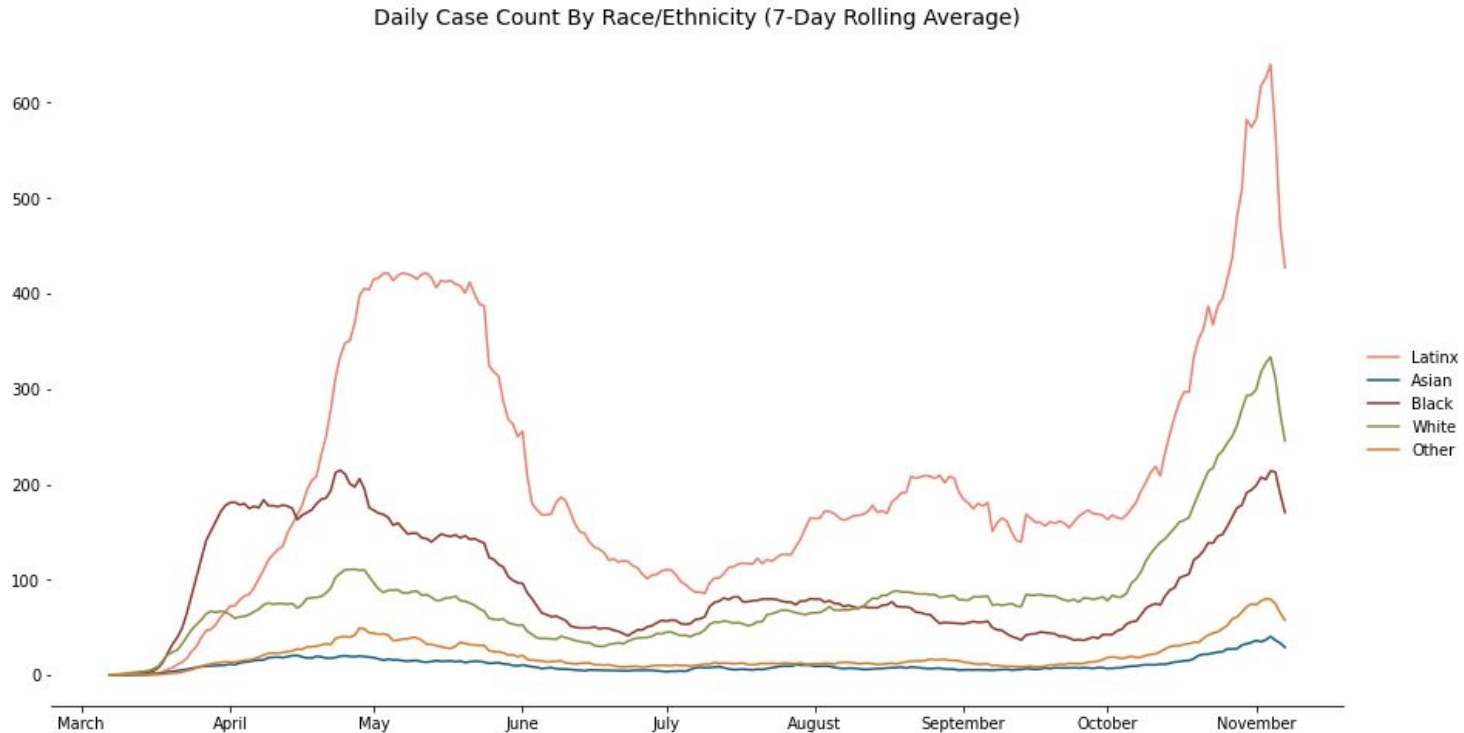
While total positive cases have surpassed the maximum number of cases in March, positivity rates appear much lower due to expanded testing



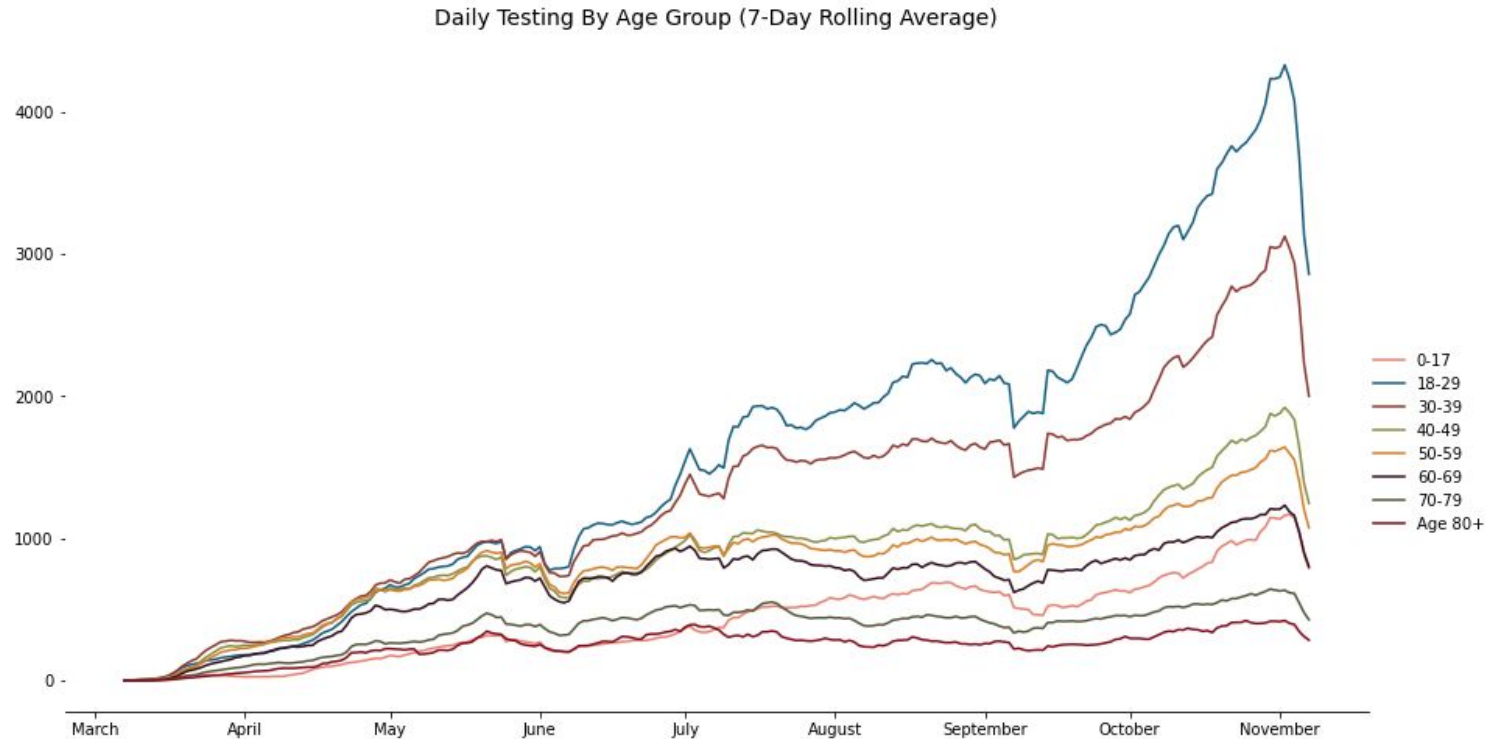
Individuals lead the City in total number of daily cases (7-day moving average)



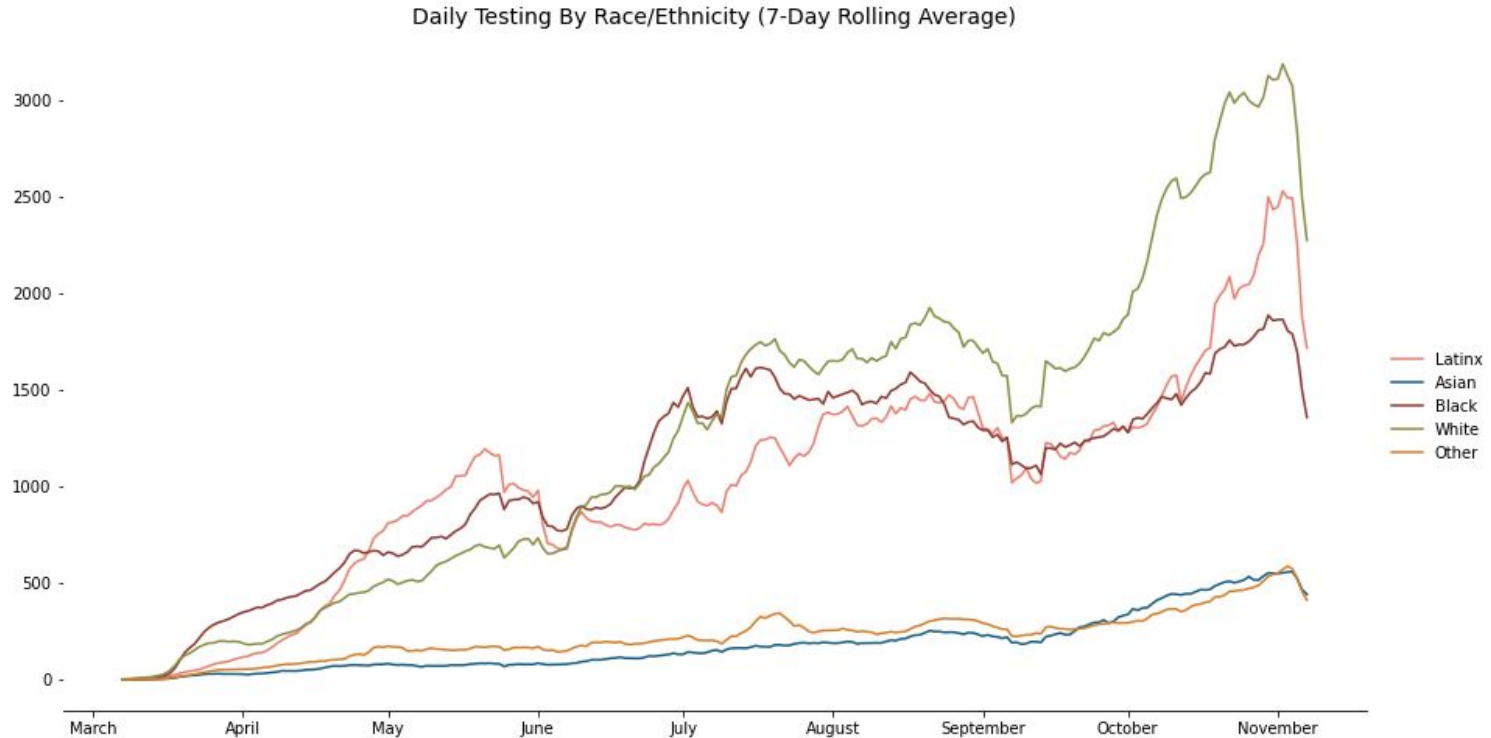
Latinx individuals also account for the highest number of daily cases consistently throughout the pandemic



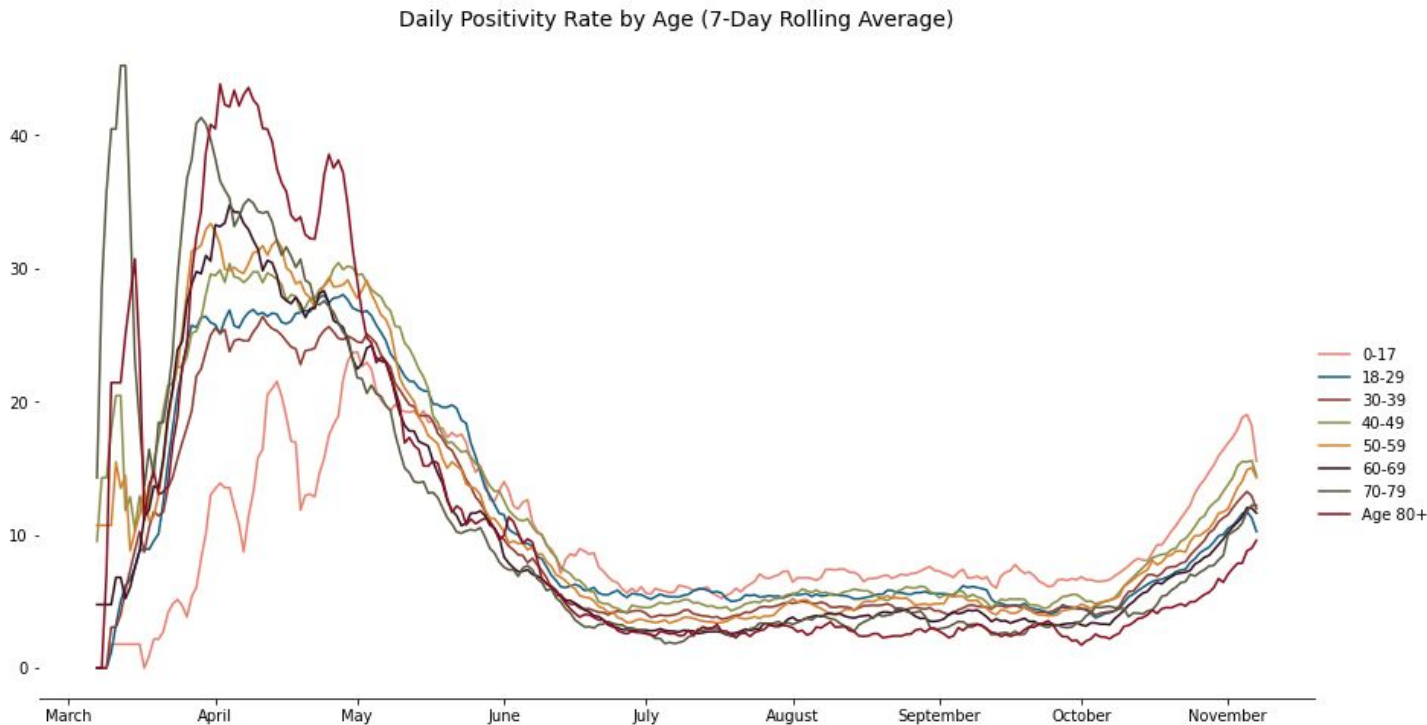
Individuals between the ages of 18 and 29 are tested at the highest rate



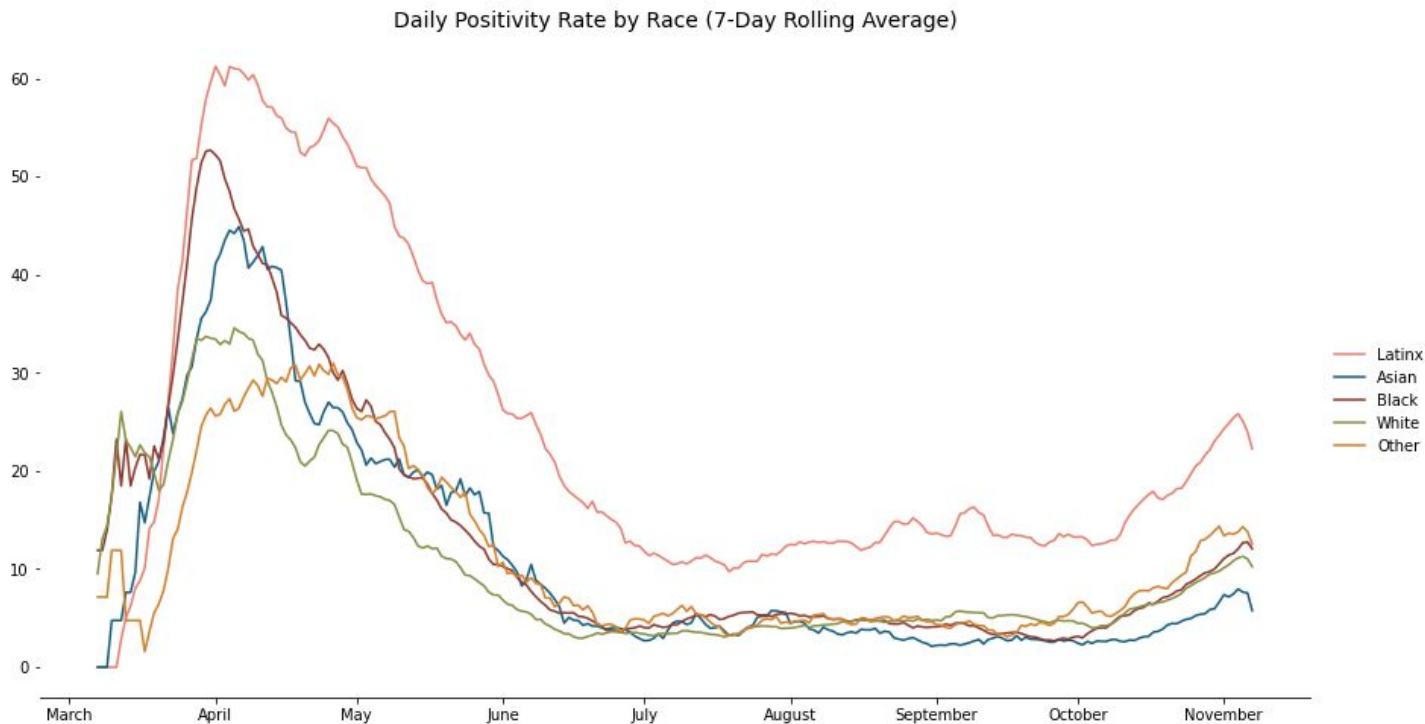
White Chicagoans tend to get tested more than other ethnic groups



Individuals younger than 17 seem to be leading the city in positivity rates



Latinx Chicagoans lead all other groups in positivity rates



Top 5 ZIP Codes for both Positivity Rates and Testing

Positivity Regression Analysis:

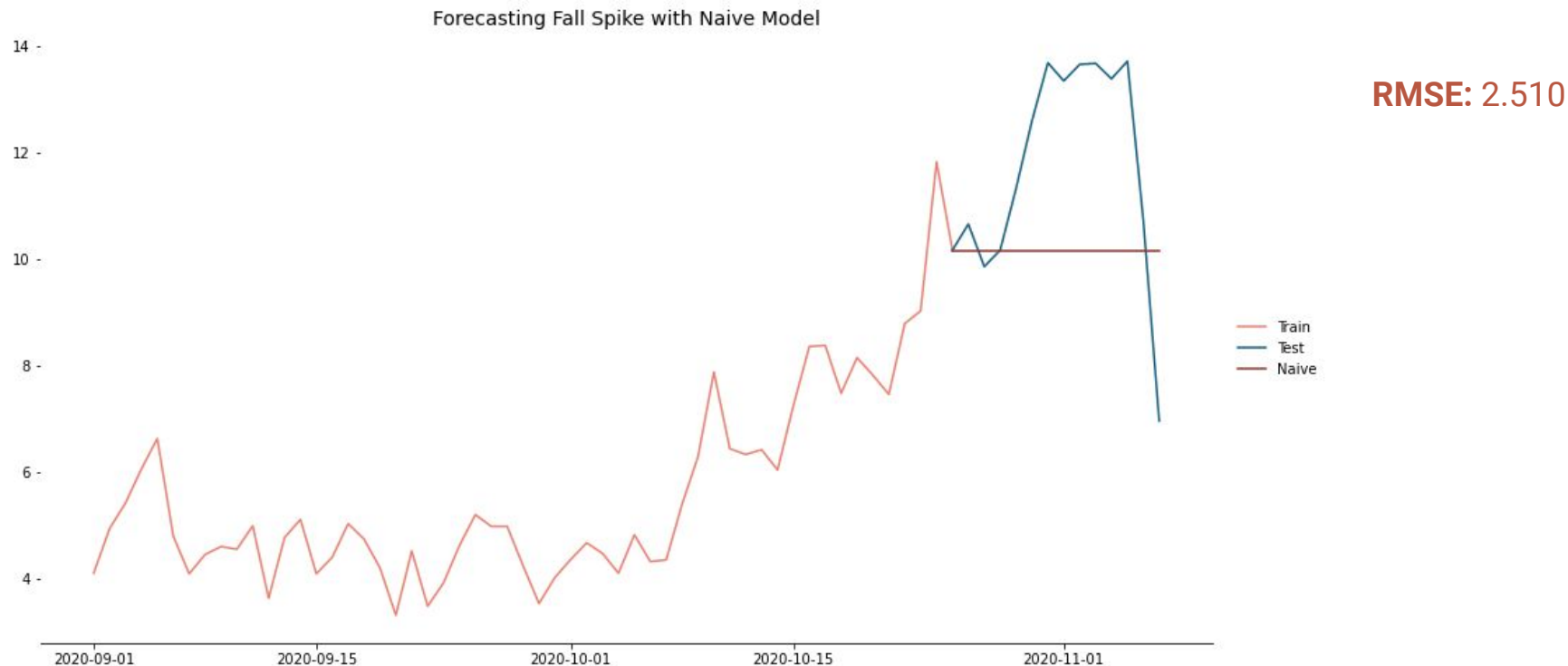
1. **Brighton Park (60632):** Primarily Latinx Neighborhood on Southwest Side (84 percent Latinx) with 19.9 percent positivity rate.
2. **Chicago Lawn (60629):** Primarily Latinx neighborhood in Chicago (71 percent Latinx) with 18.4 percent positivity rate.
3. **Clearing (60638):** Primarily White & Latinx community near Midway Airport with 30.6 percent essential workers and a positivity rate of 17.9 percent.
4. **Belmont Cragin (60639):** Primarily Latinx neighborhood (77.9 percent latinx) with 31.4 percent essential workers and a positivity rate of 17 percent.
5. **Little Village (60623):** Primarily Mexican neighborhood on the Southwest Side (66.1 percent Latinx) with positivity rate of 15.6 percent.

Testing Regression Analysis:

1. **Hyde Park/Woodlawn (60637):** Primarily Black neighborhoods home to the UChicago Campus and student body. The testing rate here is 18.2 percent.
2. **West Loop (60607):** Upscale neighborhoods directly west of downtown home to UIC and the Illinois Medical District. The testing rate here is 11.1 percent.
3. **Loop/West Loop (60606):** Wealthy area in the financial district of the city where most residents are White and few unemployed. Testing per capita is 10.6 percent.
4. **East Hyde Park (60615):** Neighborhood directly north of Hyde Park and the UChicago campus. The testing rate in this area is 10.2 percent.
5. **Wicker Park/West Town (60622):** Home to a number of students, recent graduates, and families. The testing rate here is 10 percent.

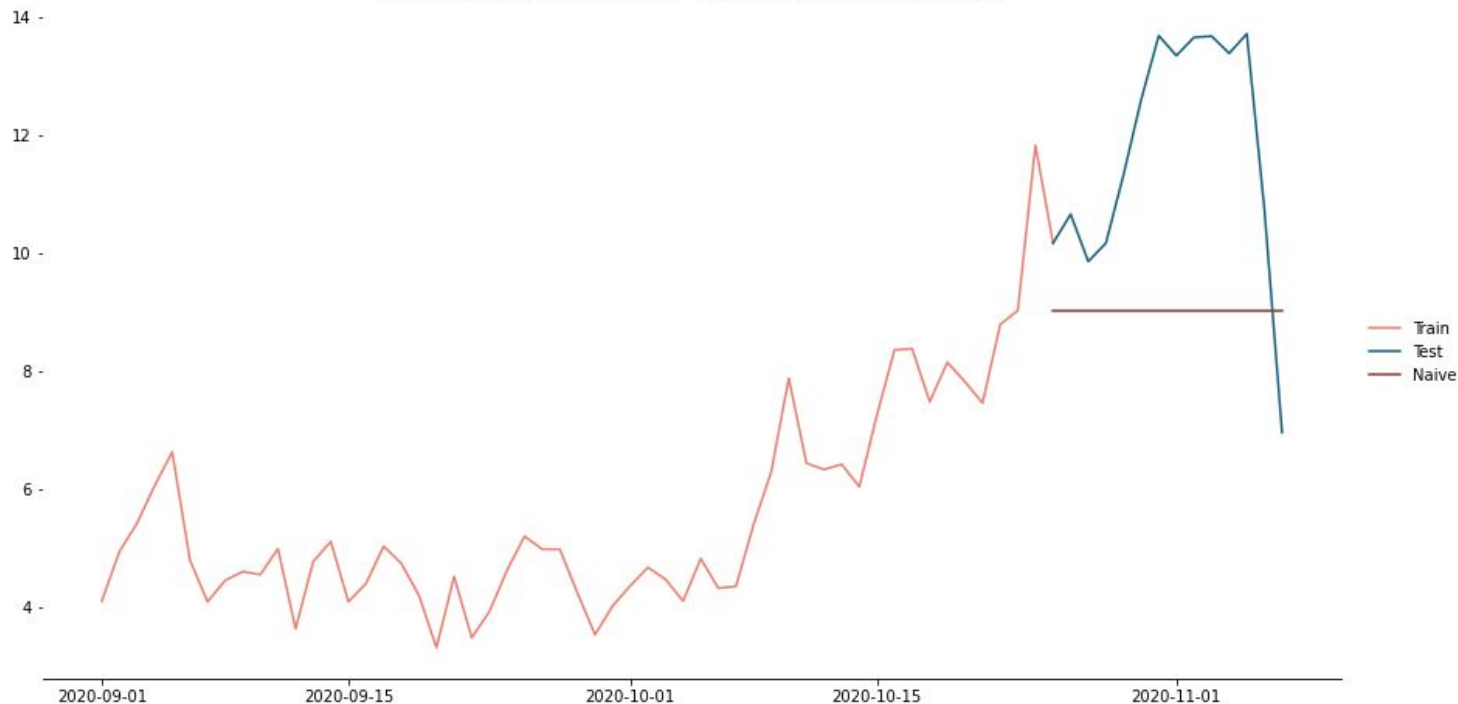
Time Series Models

Naive Model Forecast



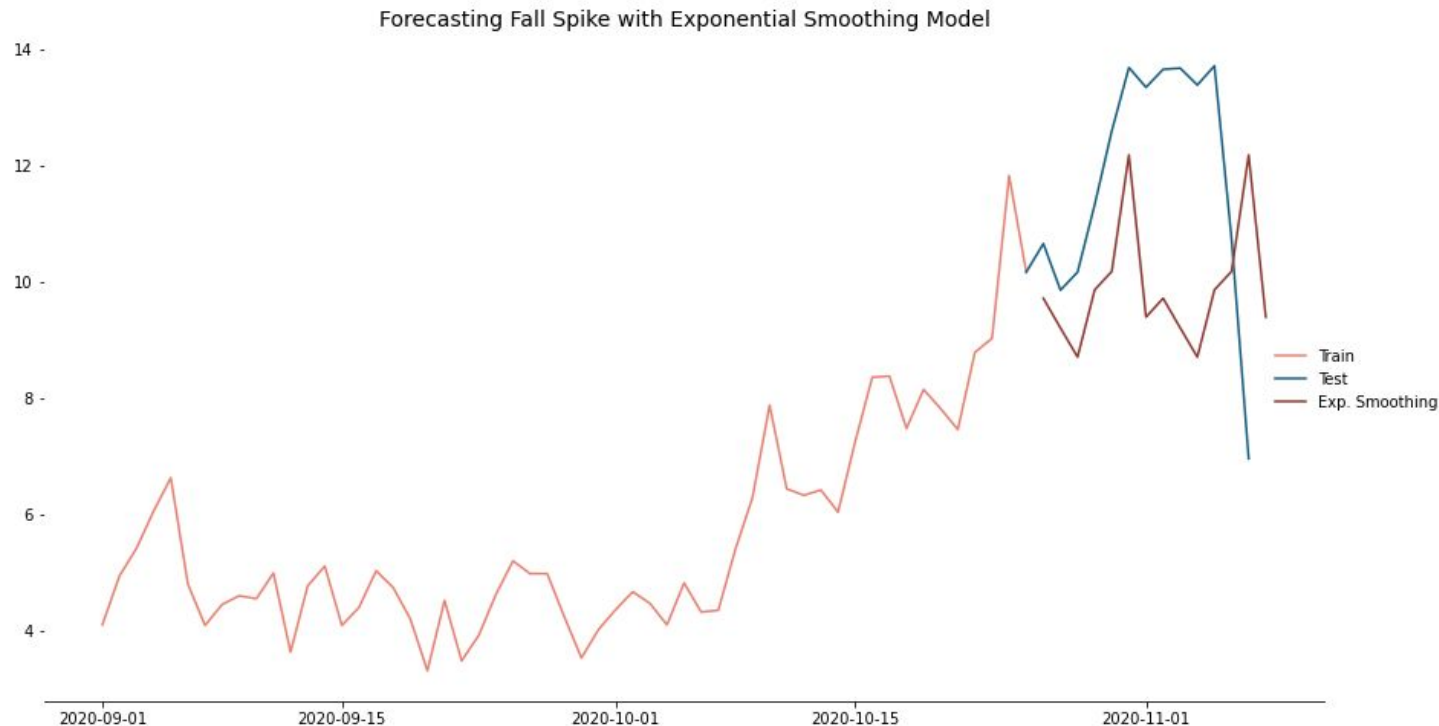
Moving Average Model

Forecasting Fall Spike with 7-Day Rolling Moving Average



RMSE: 3.330

Triple Exponential Smoothing Model



RMSE: 3.153

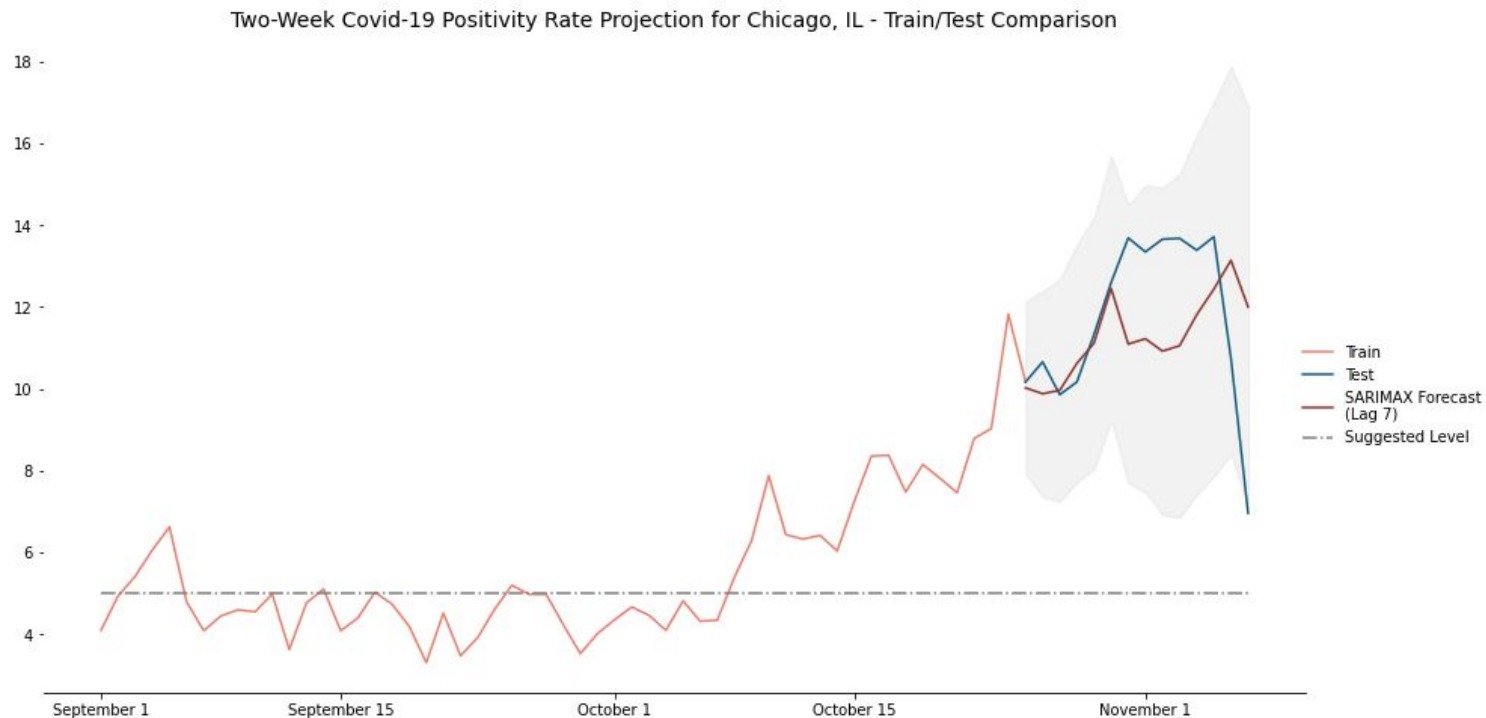
SARIMA Model

Forecasting Fall Spike with SARIMA Model



RMSE: 2.503

SARIMAX Model – Final Model



RMSE: 2.102