The Tip of the Iceberg of Domestic Violence

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We're walking on thin ice.

Last year's stay-at-home orders saved an untold number of lives. But they also may have fueled an increase in domestic violence in the United States. These reports suggest that the unintended consequences of pandemic lockdowns included a rise in calls for assistance and legal counsel from victims of domestic abuse and intimate partner violence. People of all ages and varying living arrangements experience domestic violence. Researchers have found convincing evidence suggesting that shelter-in-place strategies have differential impacts on families experiencing IPV.

According to the World Health Organization, domestic-violence cases have increased dramatically worldwide since the start of the pandemic. In May 2021, through the American Rescue Plan, the Biden administration funneled $49 million in aid and financial assistance for victims who have been trapped with their abusers during the pandemic. Just last week, NYC's Mayor Bill de Blasio allocated $5 million to expand mental-health services in domestic-violence shelters. Domestic violence suddenly became more visible not only in legislation but also in our social media feeds, in the public conversation, and our news headlines over the last two years. This led us to dig deeper into domestic violence complaints across NYC's police precincts to understand how the pandemic may have impacted domestic violence reporting in the city.

Stay-at-home orders and the stresses and financial instability triggered by the COVID-19 pandemic are expected to have resulted in an uptick in the occurrence of domestic violence. But at the same time, studies have indicated that a large number of domestic violence cases go unreported, which makes it difficult to assess just how bad the pandemic has been for domestic violence. While it is extremely challenging to estimate the number of domestic violence cases, we do have access to NYPD domestic violence complaints data and we used that to assess trends and patterns with the assumption that the complaints represent a scaled down version of actual cases.[1]

In order to establish a baseline for comparison against the recorded domestic violence complaints during the pandemic months of 2020, we forecasted how many complaints each precinct in NYC would have if 2020 were a normal year. We found that while the monthly variation for the recorded complaints was more erratic once the pandemic hit compared to the three years prior, the complaint counts were not always higher than the corresponding

[1] A limitation of our study is that this assumption may not always be true - even the scale that we are referring to may be distorted.

forecasted complaint counts. We also found that the largest differences between forecasted and actual complaints were observed in the outer boroughs, which may be an indication that these neighborhoods were experiencing something during the pandemic that aggravated the underreporting of domestic violence. Particularly, South Bronx, Eastern Brooklyn, and Eastern Queens saw considerably more potential underreporting than other parts of the city. While underreporting is observed in certain months, there is no obvious pattern that can explain the variation we observe in 2020. This may be because of a change in people's likelihood to report a complaint during the pandemic. While tech abuse, financial coercion and being trapped in with abusers may have prevented some victims from reporting a complaint, being at home more often may have increased the visibility of violence in their homes, or in their neighbors' homes, and therefore increased the rates at which people reported a domestic-violence complaint.

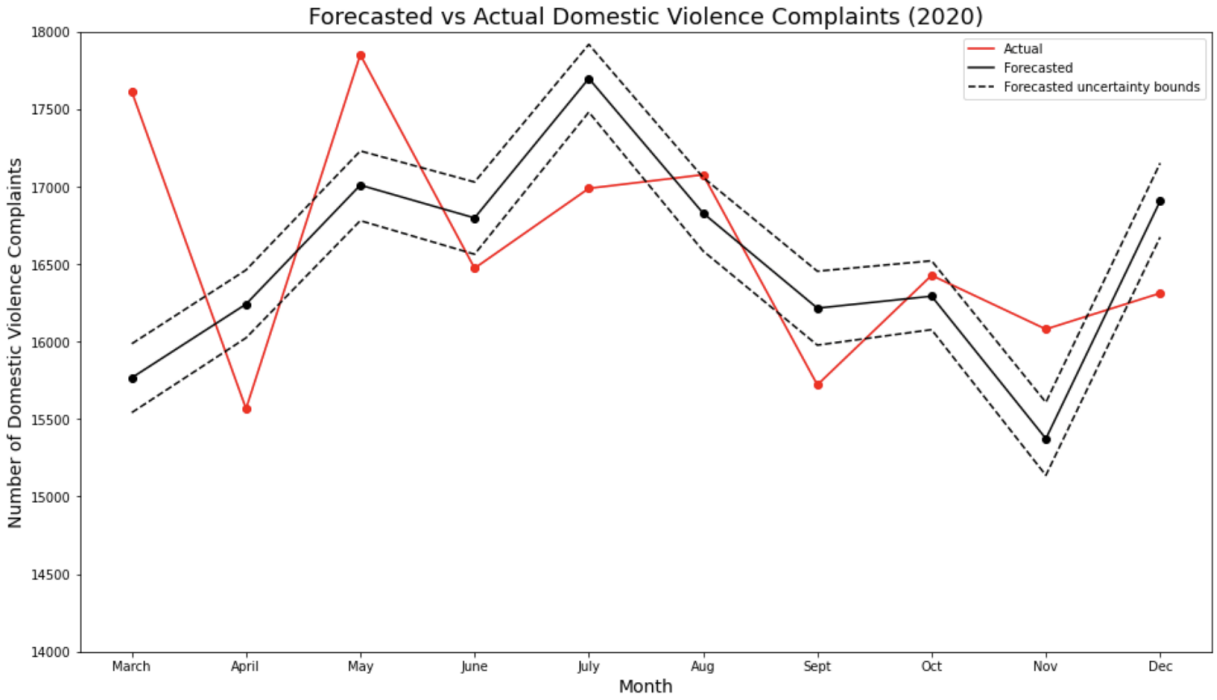


Figure 1: Forecasted vs reported domestic violence complaints in NYC for 2020 pandemic months

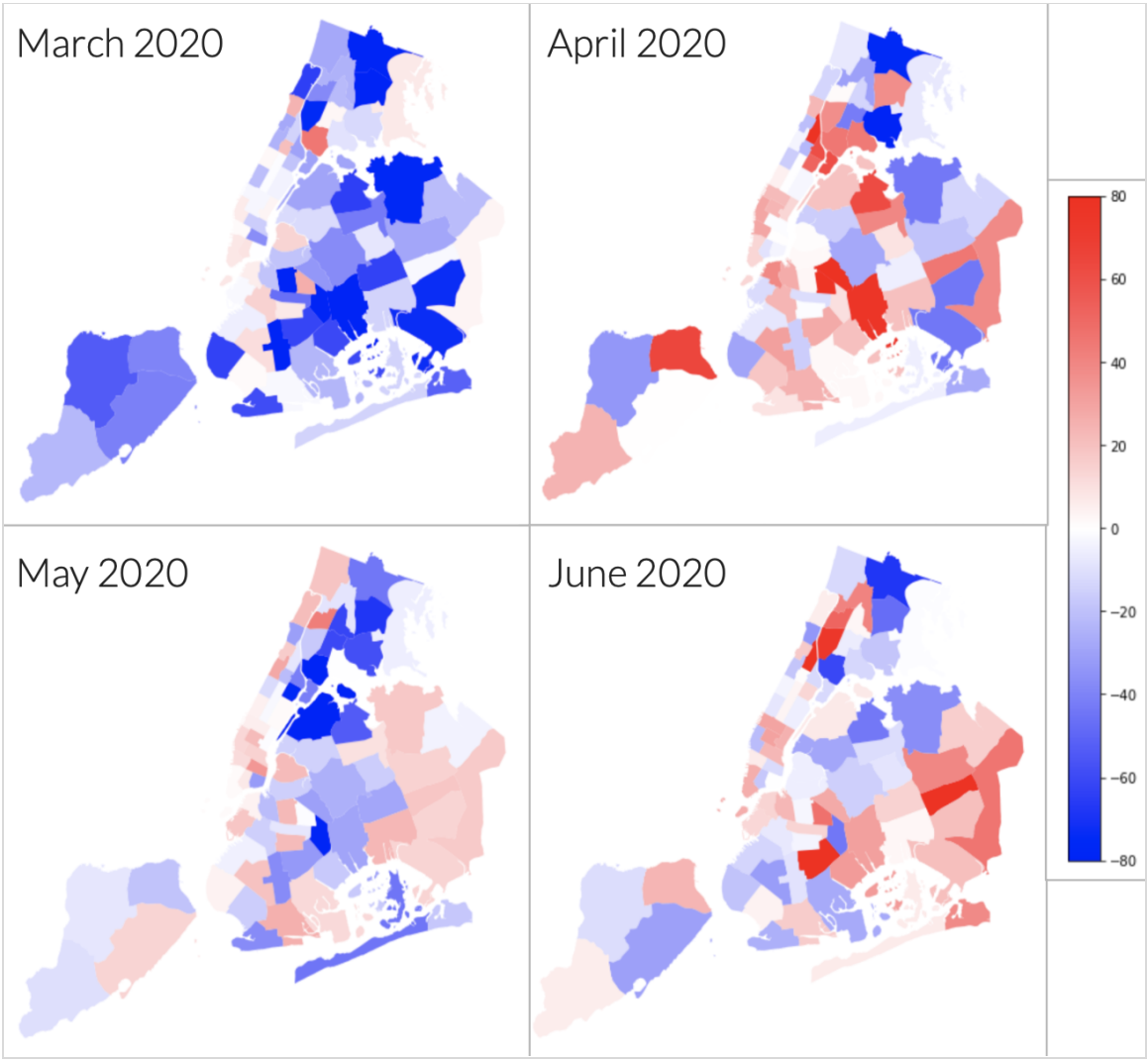


Figure 2: Map showing the difference between forecasted and reported domestic violence complaints across precincts

While the pandemic worsened the situation and brought a lot of attention to the rise in domestic violence cases, the truth is that it only represents the tip of the iceberg. Most domestic violence cases go unreported and are often “submerged” under the ocean, where they are invisible to the public eye. It is equally if not more important to understand the root cause of the problem.

Pre-COVID trends suggest that there is a monthly variation in domestic violence complaints, with complaints typically skyrocketing in July (summer peaks?) and dropping below average in February. This is strange, but interesting—given our previous assumptions that stay-at-home would increase the occurrence of domestic violence in homes, we might expect domestic violence to be lower in the month of July when people are out and about in the summer months and higher in February when they may have no choice but to be indoors because of cold weather. Our data clearly shows that that is not the case. Is it simply that people are able to go

out and get more access to help in the warmer months and so we see the number of complaints go up? Perhaps they are too afraid to call from inside their homes in February? There's no way of knowing from the data we have.

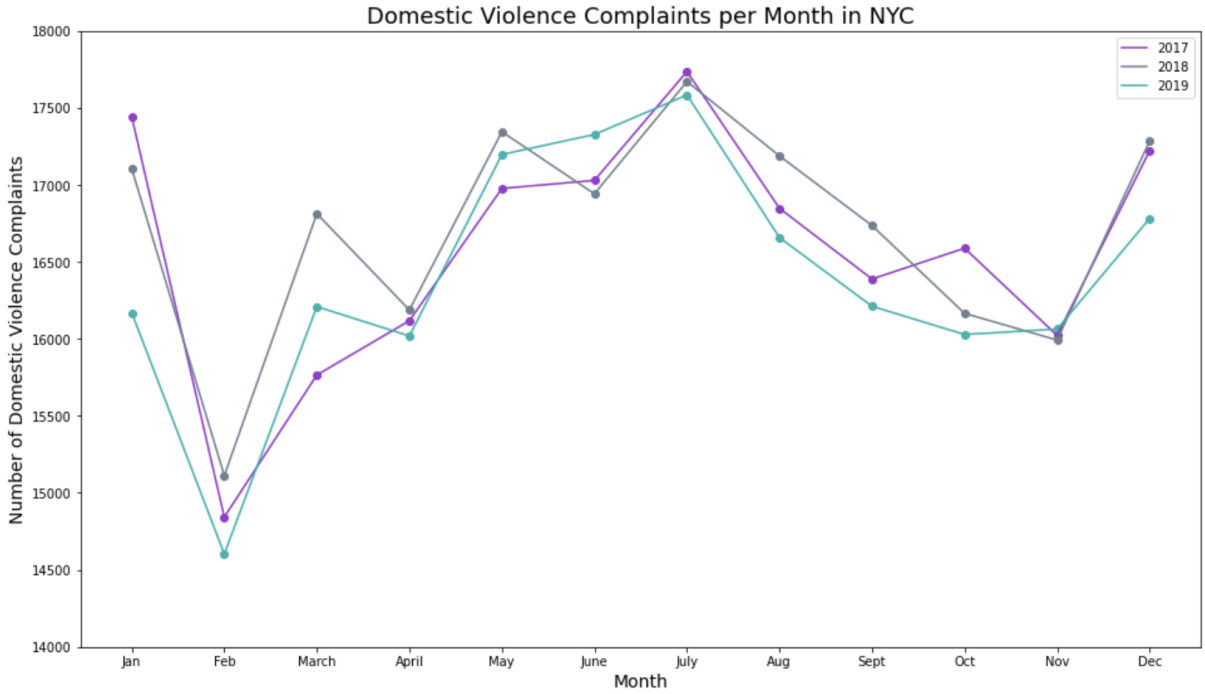


Figure 3: Domestic violence complaints per month in NYC (2017-2019)

Because the complaints across precincts come in a somewhat erratic fashion, we looked at some neighborhood factors that might affect the domestic-violence complaints coming in from various precincts. It is important to note that the complaints and calls for help do not reflect actual occurrence of domestic violence, given that not everyone feels comfortable calling law enforcement to report a domestic violence or intimate partner violence complaint. In particular, young adults, Black, and Latino communities may not feel comfortable pursuing the police.

Using data sourced from the census and correlating it with domestic violence complaints, we found that lower median income and higher unemployment rates across precincts correlates with more domestic violence complaints. Moreover, if a precinct has a lower fraction of its population with a Bachelor's degree, it is likely to report more domestic violence complaints. Precincts with higher white population fractions tend to have a lower number of complaints, while precincts with higher black population fractions tend to have a higher number of complaints.

The neighborhood factors studied in isolation highlight the overarching trends, but it's important to study the combined effect of all potential demographic characteristics in order to get a holistic view of their impact on domestic violence complaints. So, what if we combine all of those explanations for domestic violence complaints together in one piece?

- It turns out that although our earlier investigation showed a relationship between median income and domestic violence complaints, the impact of median income on domestic violence complaints diminishes when we include other factors such as the race of a neighborhood or education levels. This is because the effect of income is, unfortunately, often captured by race and education levels. For instance, white, college-educated families tend to have higher median incomes.
- The presence of white people decreases the likelihood of a domestic-violence report per person in a given precinct, while the presence of black people increases the likelihood of a report by the same magnitude.
- When considering people's living situations, precincts with high fractions of people living alone or with an unmarried partner tend to have higher numbers of domestic violence complaints. Conversely, neighborhoods that have large fractions of people who live with their spouse tend to have fewer domestic violence complaints.
- In every potential interpretation, we realize that strikingly, precincts with the highest fractions of people with a Bachelor's degree have some of the lowest domestic-violence complaints.

These "neighborhood factors" indicate that more educated, non-Black precincts with a higher fraction of people living with their spouse are likely to have fewer domestic violence complaints relative to less educated, Black precincts with different living arrangements. On the one hand, it can be hard to make any conclusions from these findings: is there a higher occurrence of domestic violence in predominantly Black precincts with low education or do people in these precincts just have a higher tendency to call and report occurrences of domestic violence? But on the other hand, there is plenty of evidence and studies that suggest that Black communities, especially poor Black communities, are less likely to call the police when there is a crime to report. These communities have historically faced police bias and may not feel it worth the risk of calling the police or law enforcement and choose instead to suffer in silence.

Generally, these numbers are quite noisy as well—we know that averaging an entire precinct's level of educational attainment, race, and living arrangement provides quite a limited view of what *really* goes on. In a perfect world, we would have data points for each individual, telling us in detail their demographics and whether they filed a domestic violence complaint or not. This would allow us to better understand the factors that influence domestic violence reports.

Can we say that our study proves that we can substantially reduce domestic violence by making sure everyone gets a Bachelor's degree before they turn 25, that Black people be completely dispersed across neighborhoods so as not to ever allow them to concentrate in any given neighborhood, and that no one ever lives alone? Absolutely not. But we can say with certainty that our study highlights the depressing fact that we have not made much progress when it comes to reducing domestic violence—while the pandemic increases stress levels and financial instability leading to increased mental health issues and intimate partner violence and domestic violence, the patterns and hubs of these domestic violence complaints remain virtually the same as they were before the pandemic.

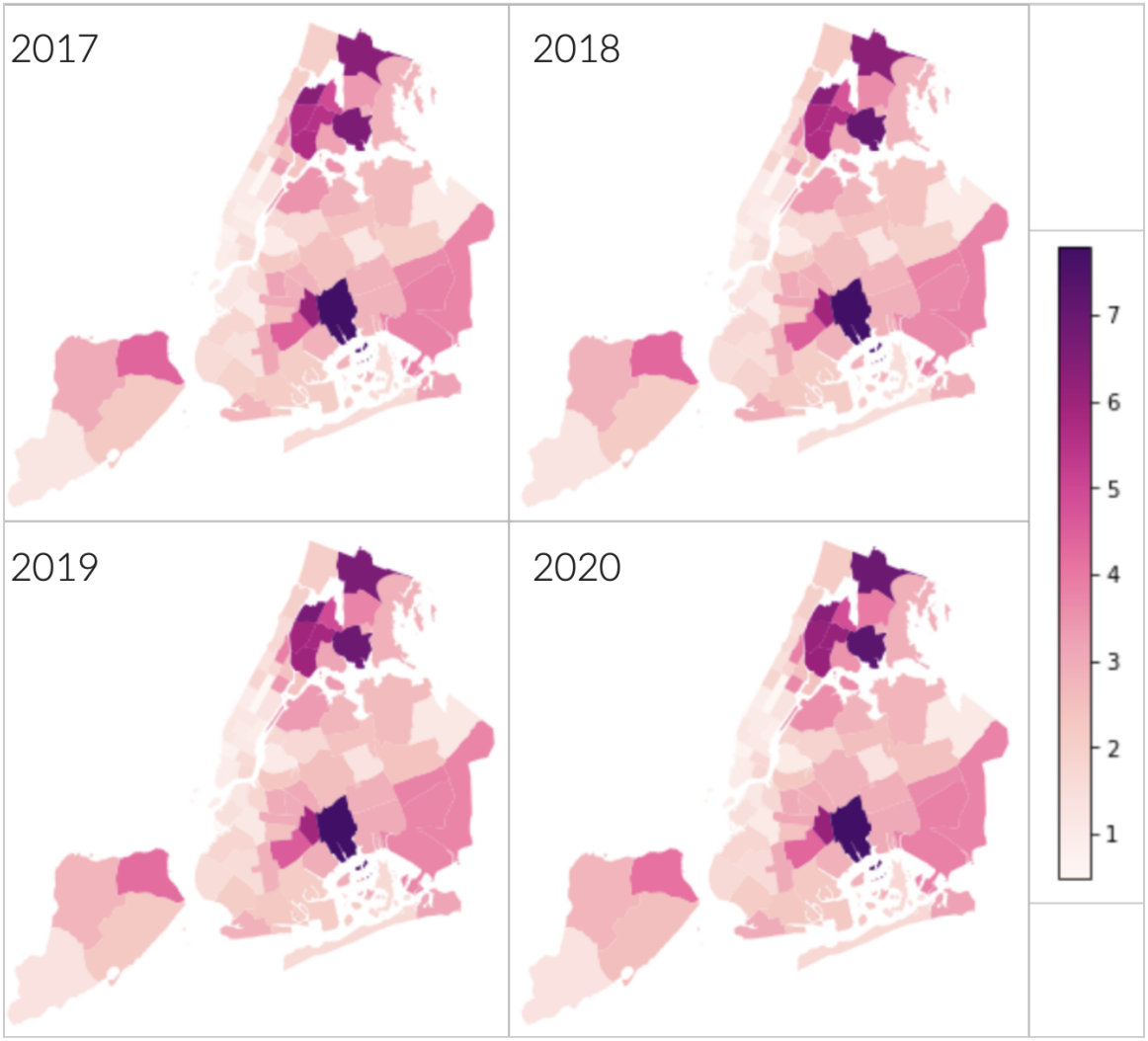


Figure 4: Map showing the per capita domestic violence complaints (as % of population) in NYC over the years

Perhaps the most important finding from this study is that individuals experience domestic violence differently. This makes the data very noisy and often not truly representative of actual domestic violence. A large number of domestic violence cases go unreported—young adults and Black and Hispanic communities may not feel comfortable calling law enforcement or pursuing the police—so using this data as the ground truth is not ideal. Domestic violence is experienced by the youth, the married, the divorced, inside and outside homes, through technology and in the absence of it, and it happens by various means including but not limited to financial or sexual coercion, physical threats, and social-media threats. While the pandemic took the world on an emotional rollercoaster, people's experiences with stress greatly depend on their individual circumstances. This indicates a greater need for support services in the NYC precincts, particularly in the non-white, resource-constrained communities in the outer boroughs in Eastern Brooklyn and South Bronx.

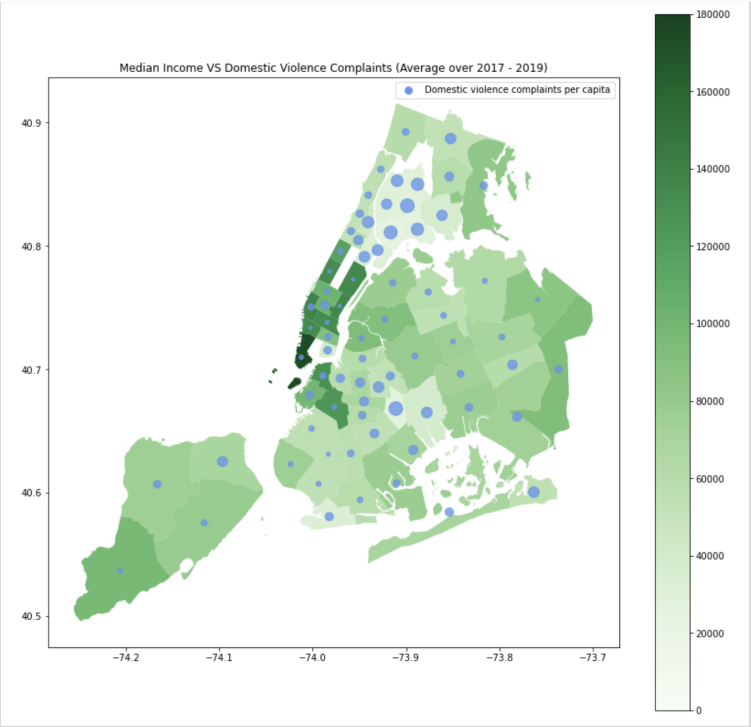
Of course, just considering domestic violence reports in and of itself is already one of our greatest limitations. Domestic violence goes under the radar all the time. In an interview with Day One, a non-profit that works with young adults primarily from medium- to low-income communities, we found that their referrals went up significantly after the COVID-19 outbreak, particularly from the Brooklyn District Attorney's office, the Bronx District Attorney's office, and the Manhattan District Attorney's office. They are now receiving about 40% more requests from young people for legal protection, most of which continue to come through referrals from District Attorney's offices and online referrals through Google and not so much through schools as they continue to remain online.

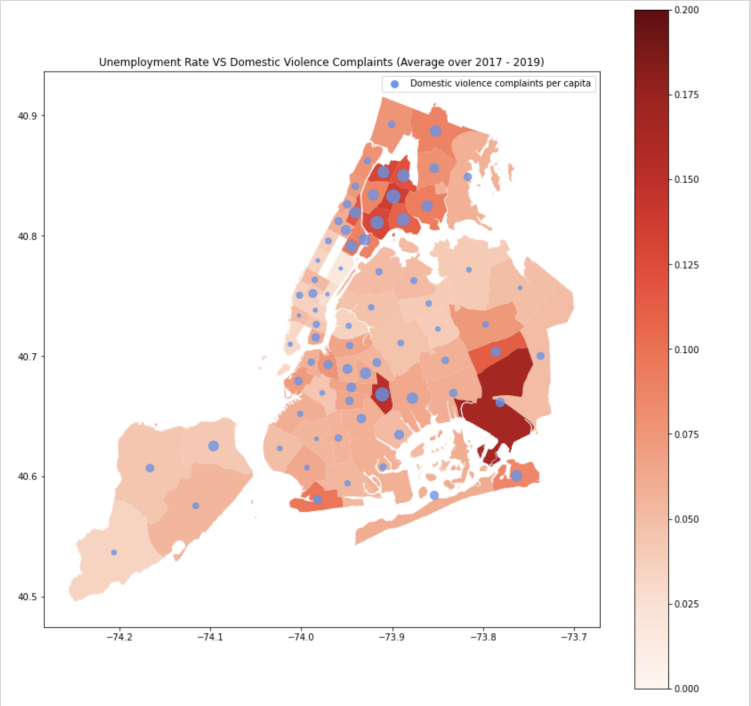
Before the pandemic, it was a lot easier for victims to walk into a family justice center and get the help that they needed. Many social justice groups and non-profits like Day One are co-located in schools. When schools were fully in-person, a student could just walk into an office and ask for help, but when schools went remote there was an increased reliance on phones or the capacity to text or email to access help. "We were worried about young people so we tried to do an assessment of what would be the safest way to connect with young people," says Billye Jones, the Director of Programs at Day One, "we had a volunteer do an Instagram live at 3pm everyday so people could DM during the live and ask for help." To better understand how clients can be contacted, these organizations are conducting assessments with their clients, and attempting to come up with code words that can help them contact their clients and check in on them. While local groups like Day One continue to take action to provide support services to victims and survivors of domestic violence and intimate partner violence, top-down government support and funding is needed to address the city's mis-reported and erratic domestic violence problem.

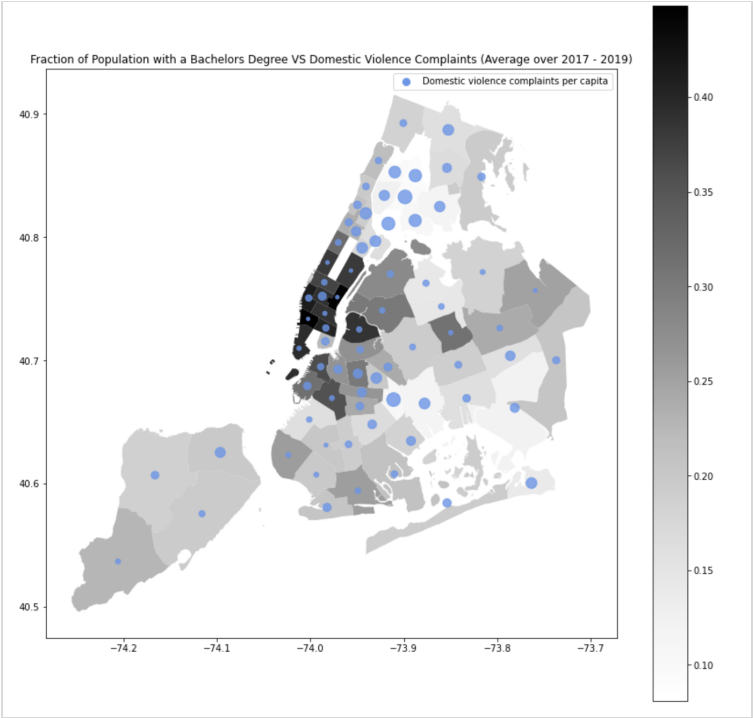
Additional figures

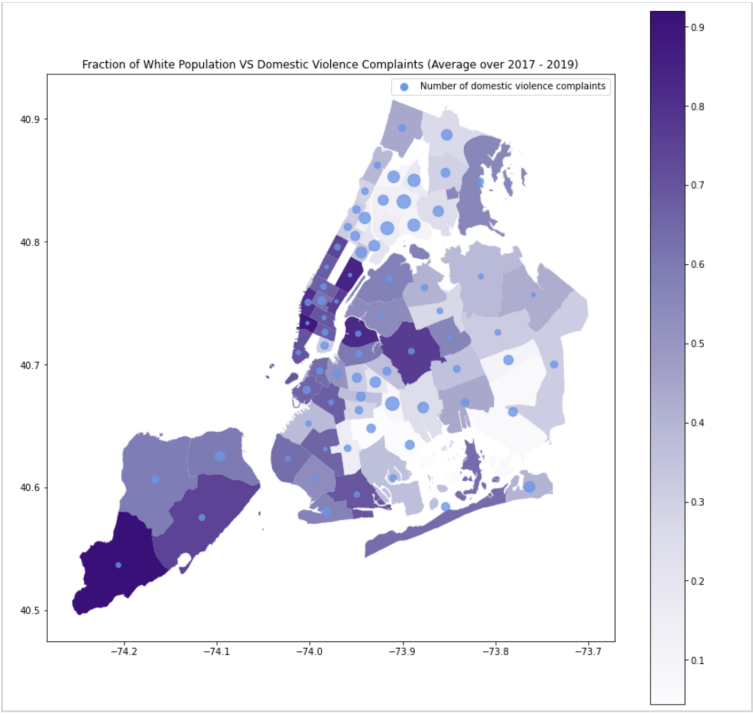
The following figures map the relationship between domestic violence complaints and neighborhood factors - median income, unemployment rate, educational attainment, white

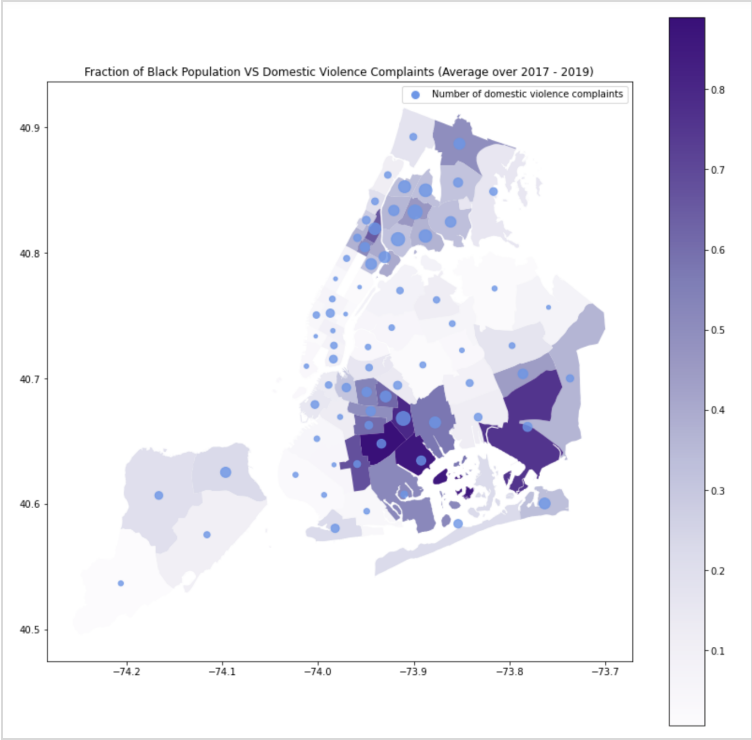
population fraction, and black population fraction.






Fraction of Population with a Bachelors Degree VS Domestic Violence Complaints (Average over 2017 - 2019)
Domestic violence complaints per capita
40.9
40.8
40.7
40.6
40.5
−74.2
−74.1
−74.0
−73.9
−73.8
−73.7
0.40
0.35
0.30
0.25
0.20
0.15
0.10


Fraction of White Population VS Domestic Violence Complaints (Average over 2017 - 2019)
Number of domestic violence complaints
40.9
40.8
40.7
40.6
40.5
−74.2
−74.1
−74.0
−73.9
−73.8
−73.7
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1


Fraction of Black Population VS Domestic Violence Complaints (Average over 2017 - 2019)
Number of domestic violence complaints
40.9
40.8
40.7
40.6
40.5
−74.2
−74.1
−74.0
−73.9
−73.8
−73.7
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Code

All the code and data to reproduce this study can be found here.

Appendix notes (technical explanations)

Time-series analysis/forecast
While most of the time-series analysis conducted using Prophet is automated, we did customize various hyperparameters to suit our analysis. We used the linear growth model instead of the logistic growth model as we don't expect our dependent variable to reach a saturation point. Since our data is at a monthly resolution, there were a lot of abrupt changes in the trajectory of the trend-line, and Prophet's automated change point detection allowed the model to incorporate these changes. We applied the yearly seasonality settings along with the default US holiday schedule to our model. We used 2017 - 2019 domestic violence complaints data to forecast the 2020 business as usual (BAU) trend-line (which was used to compare against the 2020 actual complaints trend-line), and we did not include any additional regressors. Before computing the 2020 BAU trend-line, we validated our model by forecasting the 2019 trend-line using 2017-2018 data as training data.

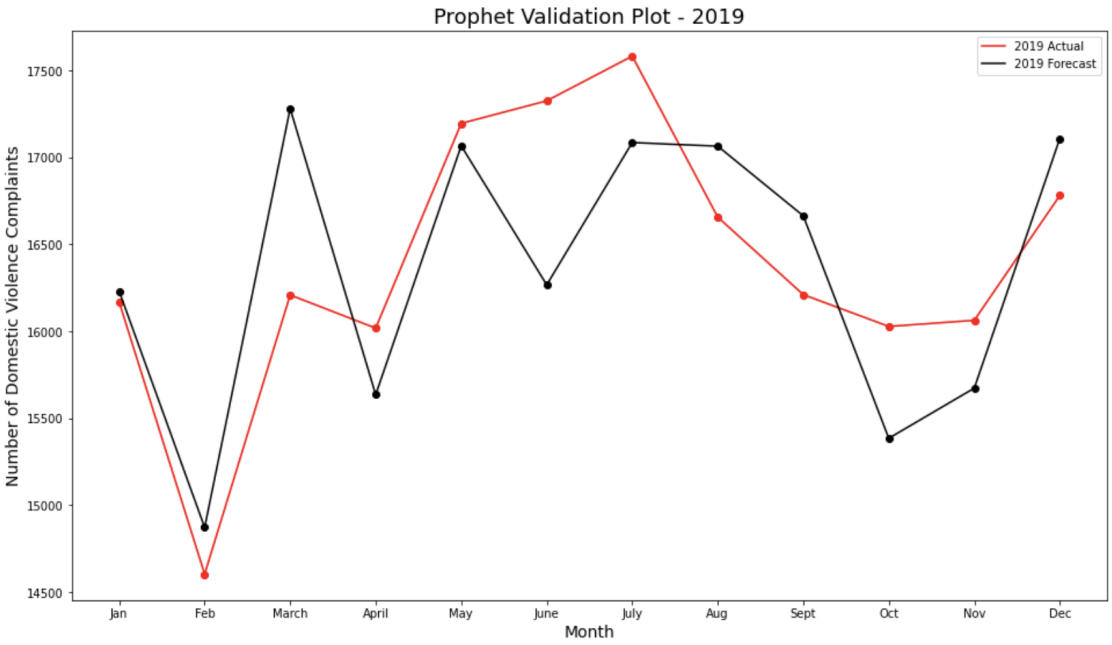


Figure 1. Prophet validation plot

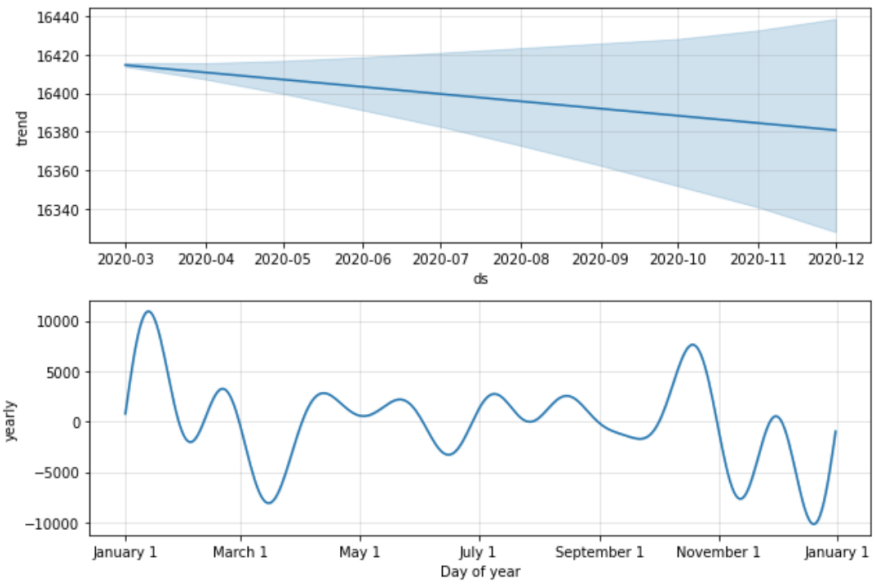


Figure 2. Overall trend and yearly (seasonal) trend for the forecasting model

Linear Regression

We utilized Python's statsmodels library to run some multivariate linear regressions with different variables. For each regression, we observed p-values to determine statistical significance (mostly using significance at the 10% level), and adjusted our additional regressions appropriately based on significance. We ran multiple regressions with different interpretations, allowing us to contrast the potential perspectives we can view the problem. Furthermore, to help us solve potential problems with heteroskedasticity, we used HC1 errors (robust standard errors) as well as standardized data to have μ = 0 and σ = 1.

After running

$$num\_complaints = \alpha + \beta_1 black + \beta_2 med\_income + \beta_3 single + \beta_4 bachelor + \epsilon$$

We noticed that median income was statistically insignificant and proceeded to remove it from our analysis.

Our baseline regression is as follows:

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	-3.192e-16	0.063	-5.05e-15	1.000	-0.124	0.124
avg_bachelors_frac	-0.8747	0.127	-6.905	0.000	-1.123	-0.626
avg_single_frac	0.5484	0.084	6.554	0.000	0.384	0.712
avg_black_frac	0.3048	0.092	3.330	0.001	0.125	0.484

Figure 3: Baseline regression output

We ran a variety of regressions with different variables, such as replacing avg_black_frac with avg_white_frac, to see the changes in the coefficient values which would give us insights on potential omitted variable bias and better ideas of the impacts. For example, when we add avg_white_frac and avg_single_frac with avg_bachelors_frac, we notice that the coefficient strength for fraction of Bachelors degrees goes down, which is likely due to the fact that part of the effect is explained away by the addition of those correlated predictors.

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	-3.192e-16	0.066	-4.81e-15	1.000	-0.130	0.130
avg_bachelors_frac	-0.8188	0.133	-6.146	0.000	-1.080	-0.558
avg_single_frac	0.5723	0.086	6.687	0.000	0.405	0.740
avg_white_frac	-0.2988	0.088	-3.387	0.001	-0.472	-0.126

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	-3.192e-16	0.065	-4.89e-15	1.000	-0.128	0.128
avg_black_frac	0.1806	0.113	1.599	0.110	-0.041	0.402
avg_liveswspouse_frac	-0.4454	0.090	-4.960	0.000	-0.621	-0.269
avg_bachelors_frac	-0.4264	0.074	-5.729	0.000	-0.572	-0.281

Figure 4: Additional regression outputs