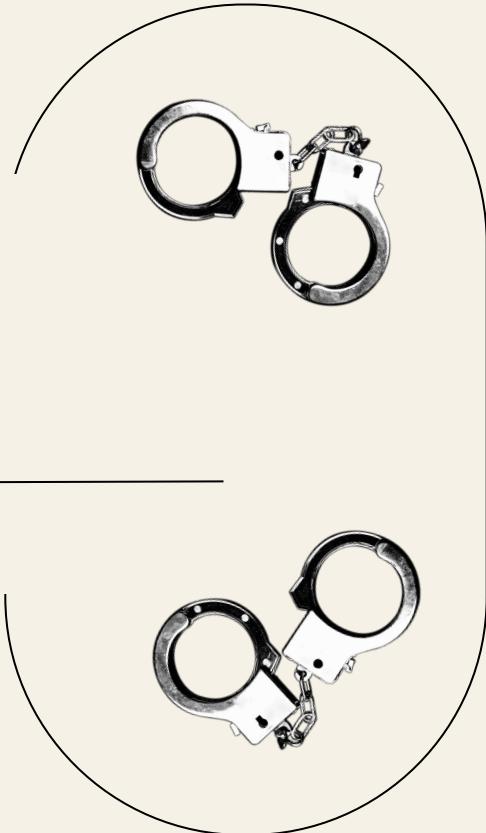
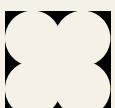
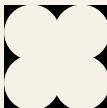




Arrest Rates in the DMV

Sophia Rutman, Trey Roark, Rachna Rawalpally,
Zoo Un Park, Lizzie Healy



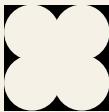


**How have the arrest rates
in the DMV area changed
over the past 10 years, and
what trends or patterns
can be identified?**





SUPPORTING RESEARCH QUESTIONS



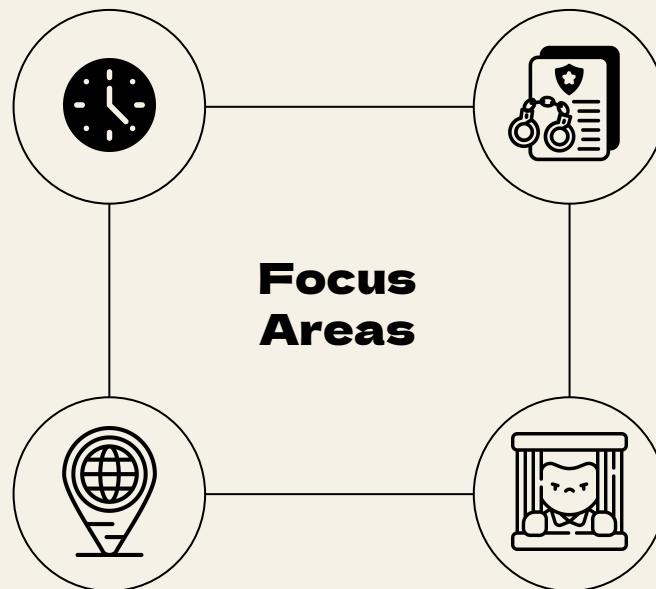
TEMPORAL

Historical Patterns and Chronological Analysis

GEOSPATIAL

Spatial Trends and Area-focused Analysis

Focus Areas

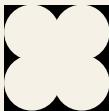


CATEGORICAL

Arrest Reason Dynamics and Distributions

JUVENILE

Intergenerational Comparative Trends



ABOUT OUR DATA

1 Metropolitan Police Database

Encompassing 2013 - 2023

Demographics, Geolocations, Arrest Reason, etc.



2

Row Bind

Features remained consistent within data across time

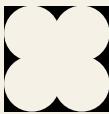


3

Juvenile Add-on

To investigate our last question, we added Juvenile records



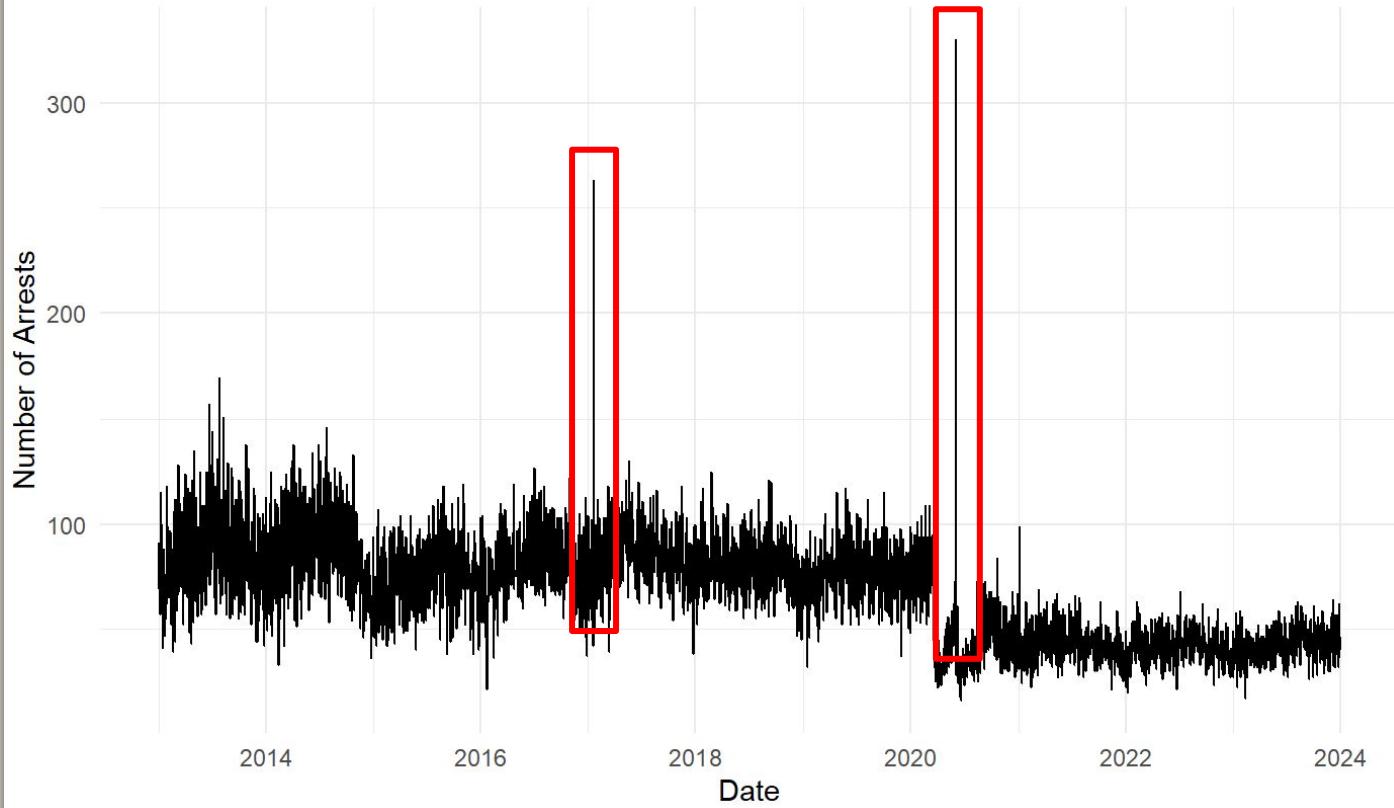


1. Temporal

Over the past 10 years in the DMV, what trends and anomalies are present among adult arrest rates?

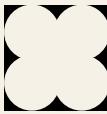


Time Series of Daily Arrests





OUTLIER ANALYSIS



Inauguration Protest

01-20-2017



263 Arrests

George Floyd Protest

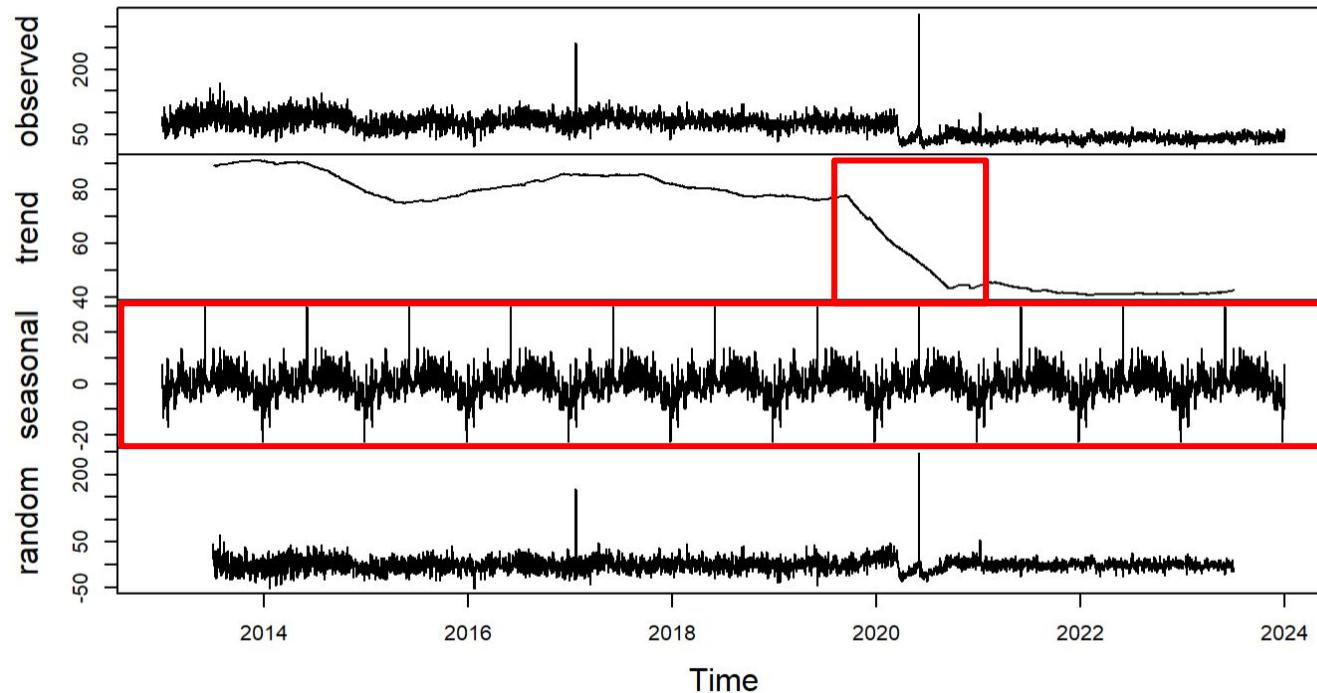
06-01-2020



330

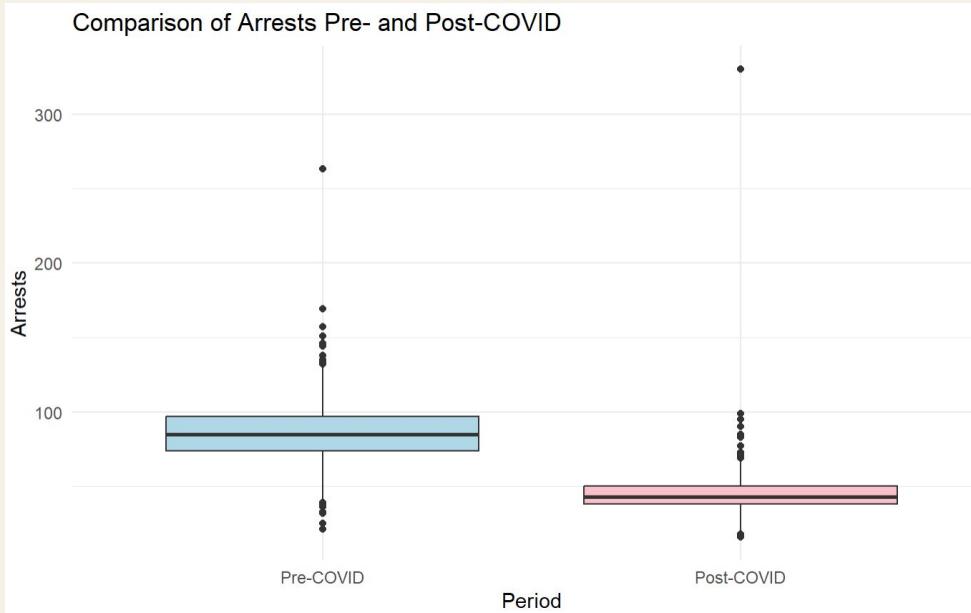


Decomposition of additive time series



COVID-19

Comparison of Arrests Pre- and Post-COVID



$$H_0: \mu_{\text{Pre}} - \mu_{\text{Post}} = 0$$

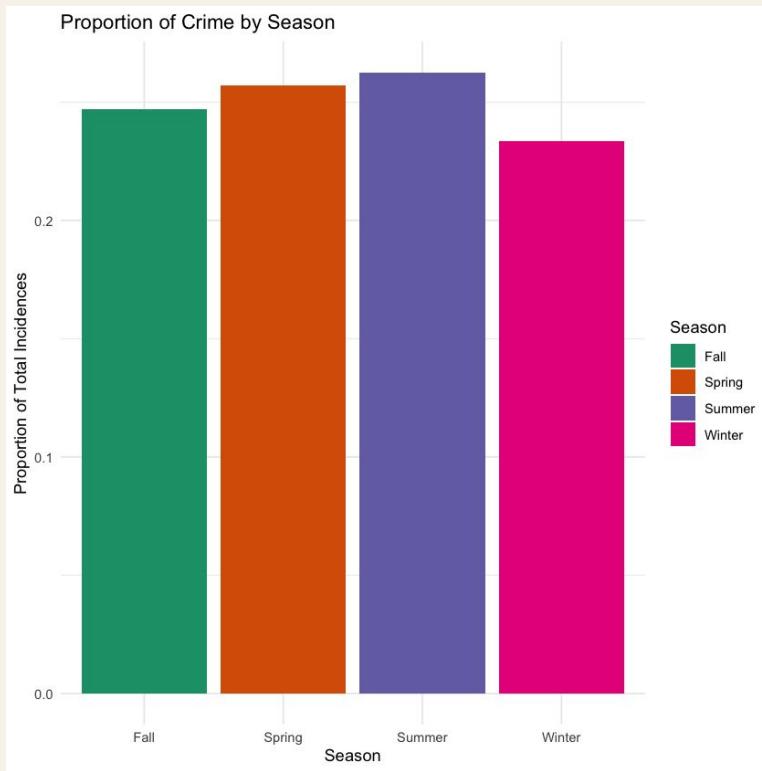
$$H_A: \mu_{\text{Pre}} - \mu_{\text{Post}} \neq 0$$

Conclusion: Statistically Significant Difference

t-stat	df	p-value	95% CI Low	95% CI High
382.03	81,109	< 2.2e-16	39.87240	40.28364



Seasonal



H_0 : Crime counts are seasonally distributed

H_A : Not seasonally distributed

	Winter	Spring	Summer	Fall
	64,310	70,752	72,309	68,045

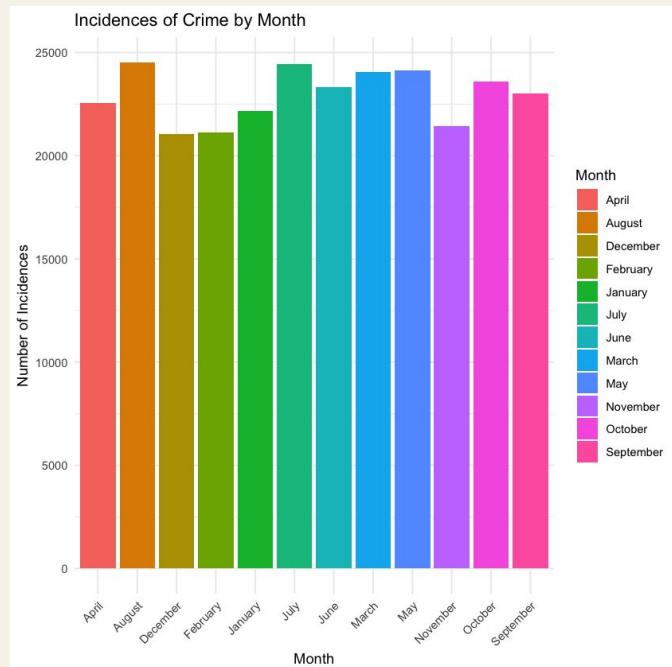
	Fall	Spring	Summer
Spring	2.7e-16		
Summer	< 2e-16	1.0e-05	
Winter	< 2e-16	< 2e-16	< 2e-16



Monthly



Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
22,153	21,122	24,066	22,561	24,125	23,317	24,459	24,533	23,031	23,576	21,438	21,035



Chi-Square
Statistic: **2.2e-16**

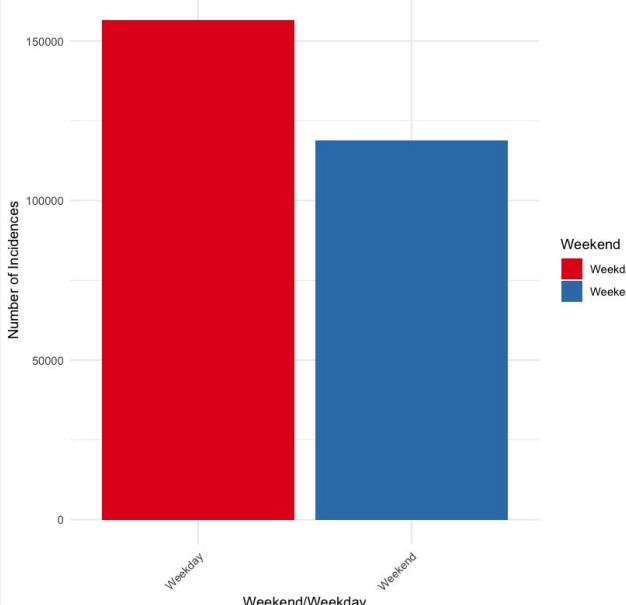


Daily

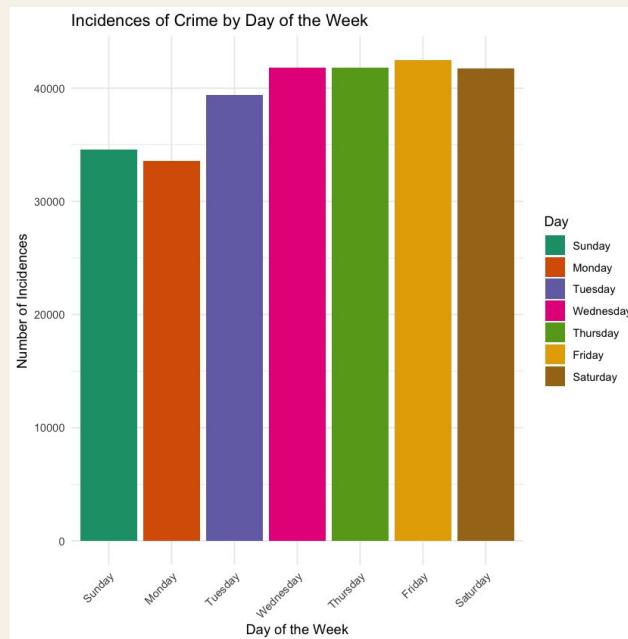


Sun	Mon	Tues	Weds	Thurs	Fri	Sat
34,604	33,598	39,374	41,814	41,799	42,458	41,769

Incidences of Crime by Weekend/Weekday



Incidences of Crime by Day of the Week



Chi-Square Statistic:
2.2e-16

Weekend T-statistic:
0.8905



TEMPORAL CONCLUSIONS



Temporal Analysis

PROTESTS

COVID-19

SEASONALITY

FURTHER

Outliers in our data correlated with protest event reports

Statistical Significance between the difference of average arrest rates before and after COVID-19

Crime peaks in the summer months of July and August and occurs more frequently later in the week

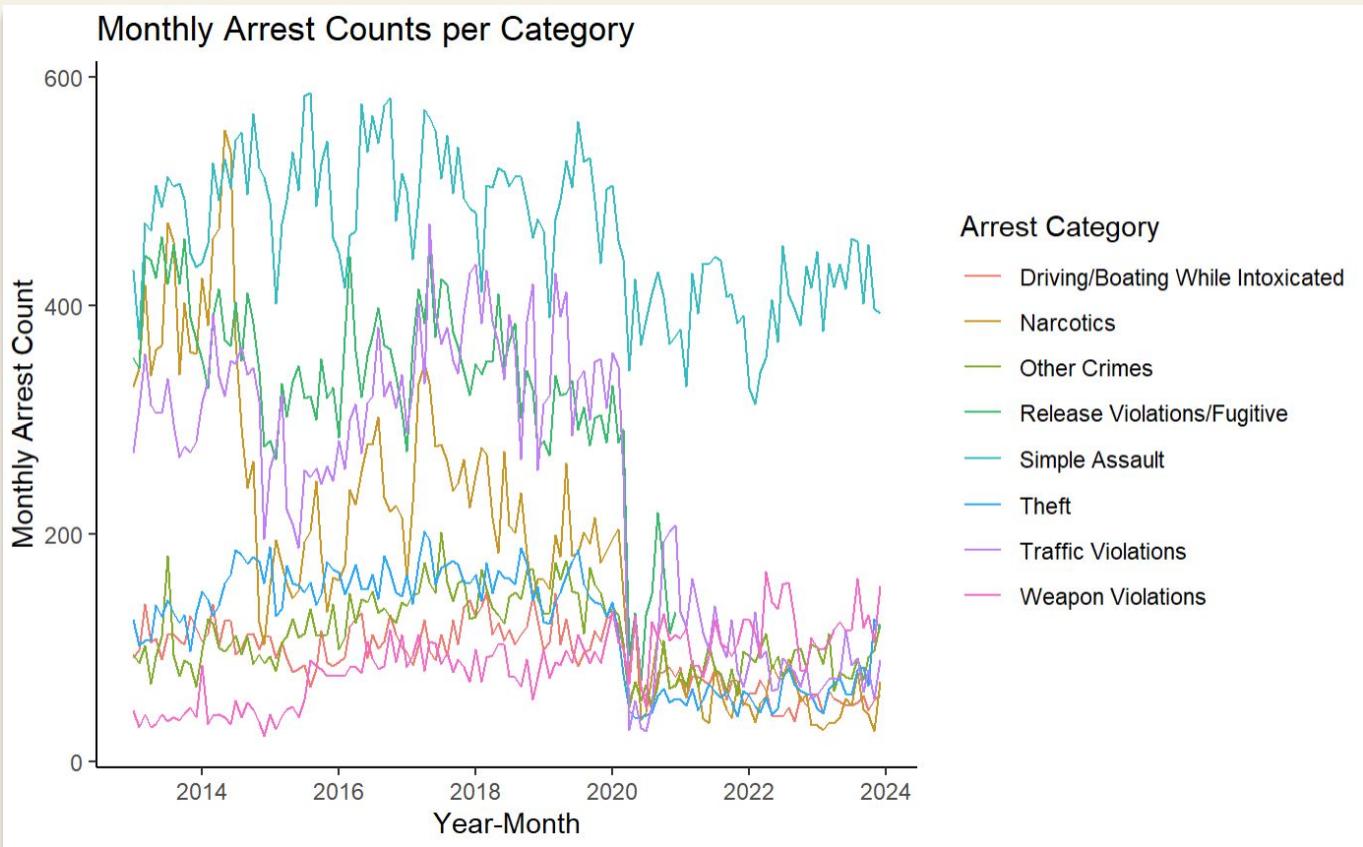
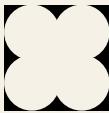
Exogenous Variables
Lag Reduction
SARIMA



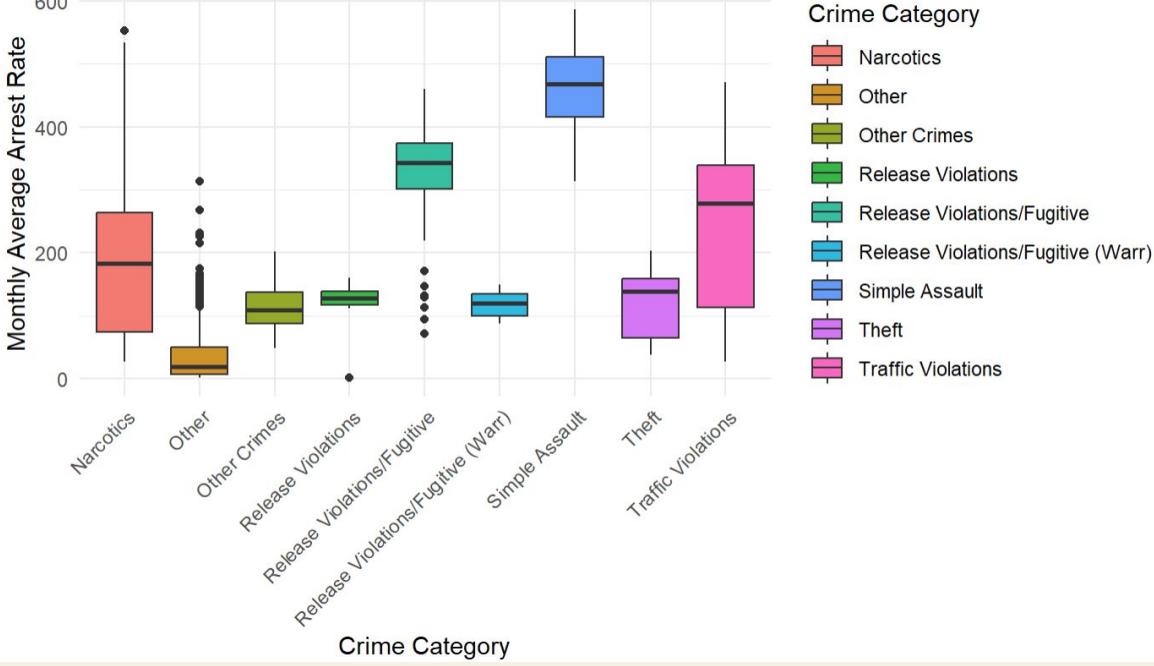
2. Arrest Category

Are there differences between the categorizations of arrest rates?





Monthly Average Arrest Rates by Crime Category


 $H_0: \mu_1 = \mu_2 = \dots = \mu_n$

 $H_A: At least one \neq 0$

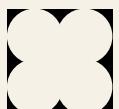
Conclusion: Statistically Significant Difference
***30/36 groups according to a Tukey test**

ANOVA	f-stat	p-value
Arrest Category	1914	<2e-16



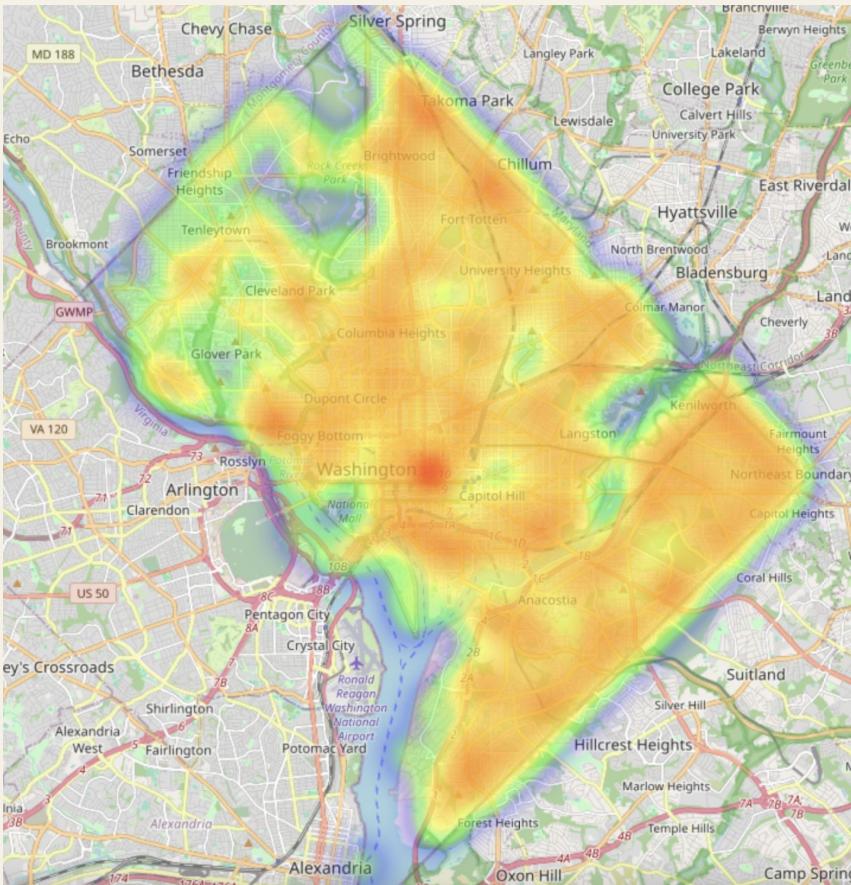
3. Geospatial Analysis

**What Impact Do Districts Have on Arrest
Counts?**





Trends Across Districts

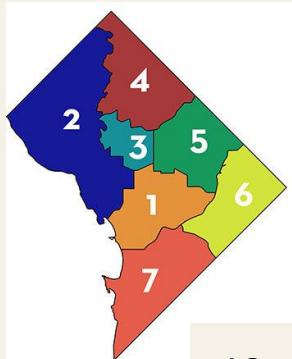


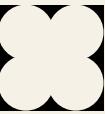
Anova Test:

H_0 : No difference in arrest counts across different districts

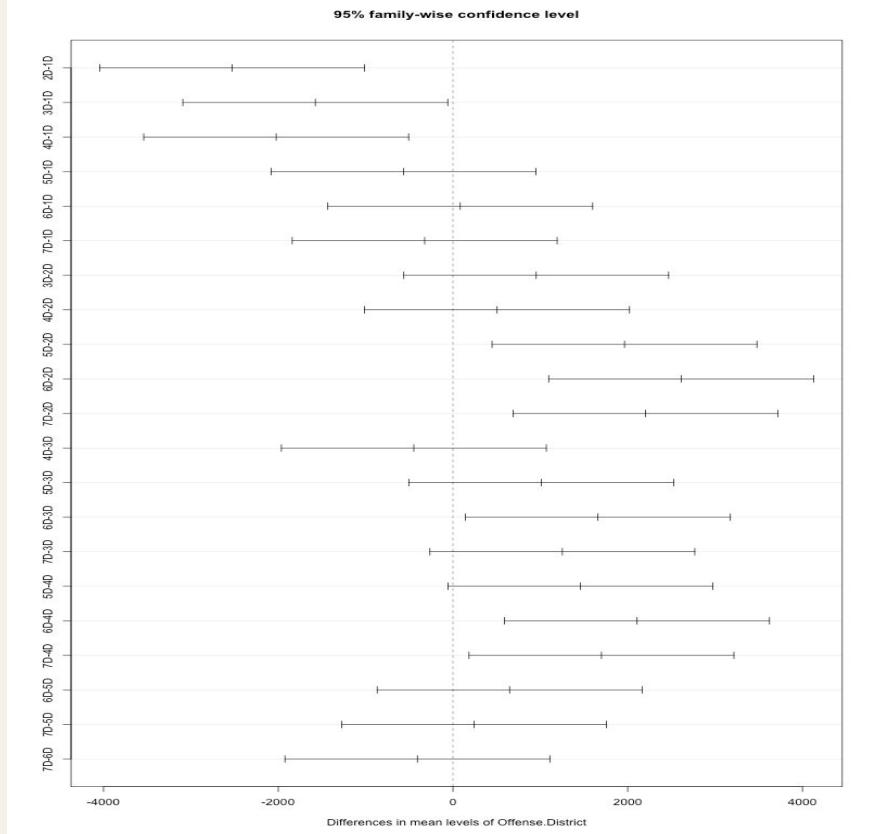
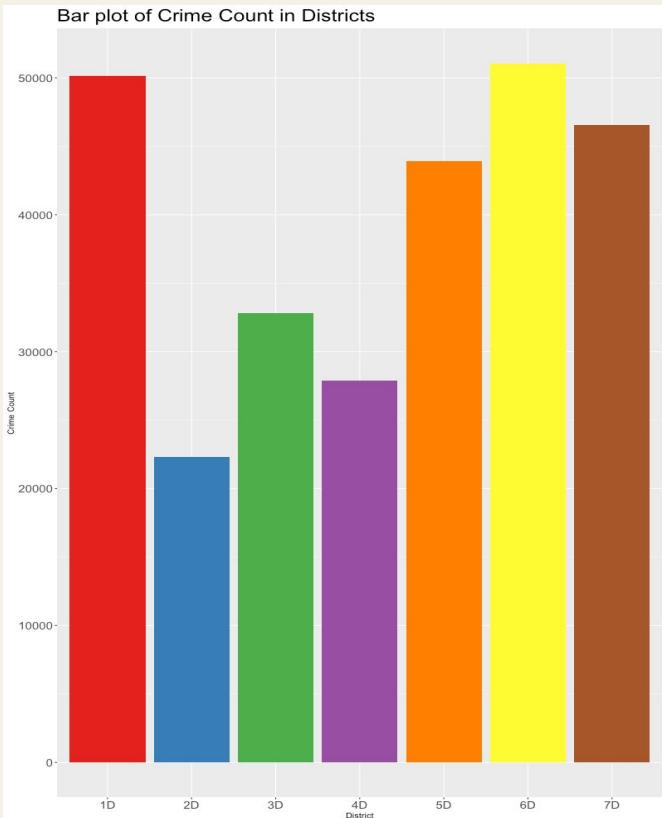
H_A : Difference in arrest counts across different districts

F-value: 8.734
P-value: 4.21e-07



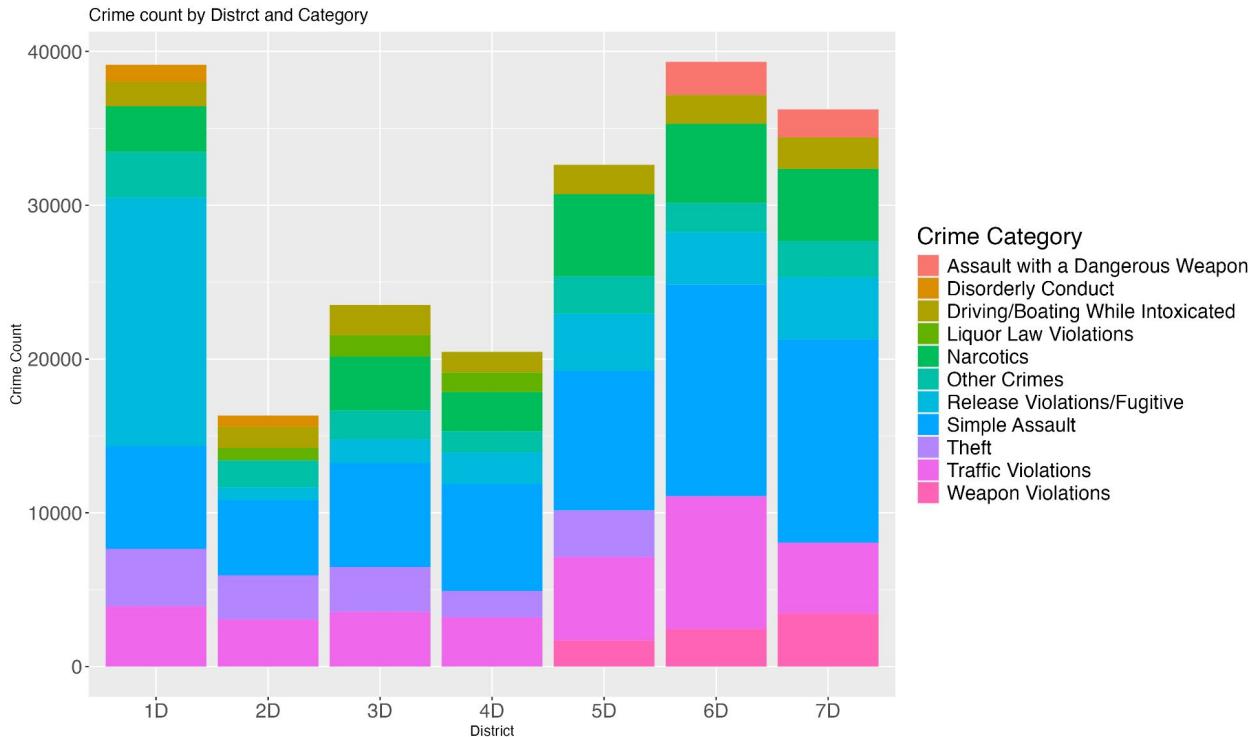


Differences in Districts





Crime Category by Districts



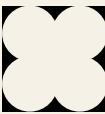
Chi-Square test:

H_0 : District and Crime Category are independent

H_A : District and Crime Category are dependent

P-value: < 2.2e-16

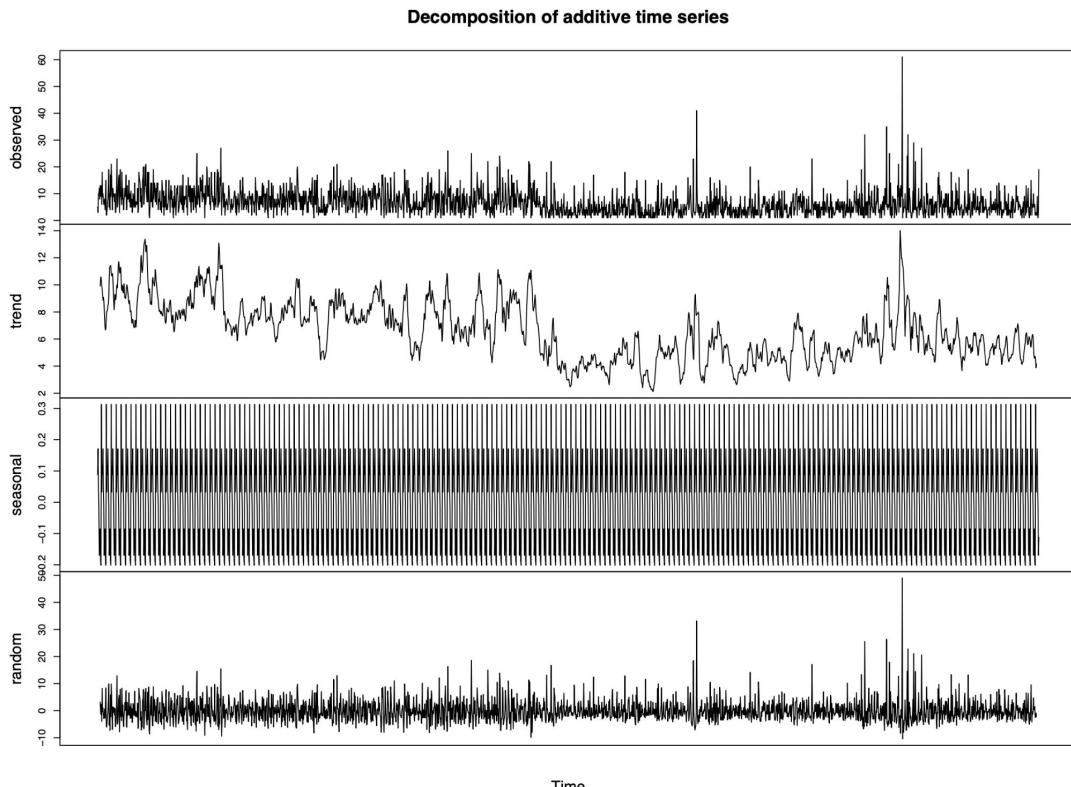




4. Age Analysis

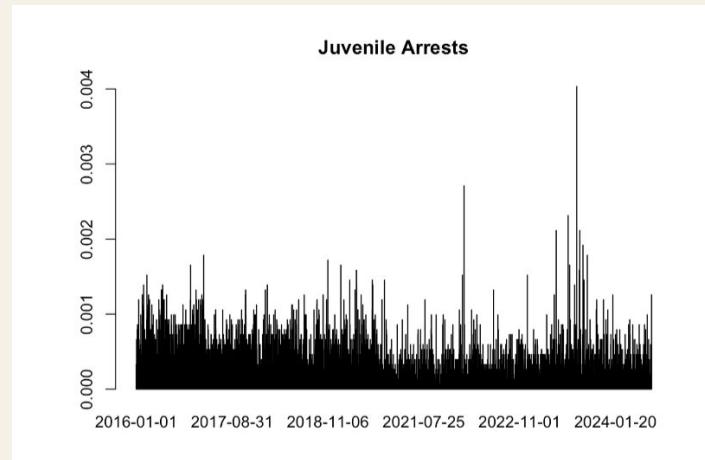
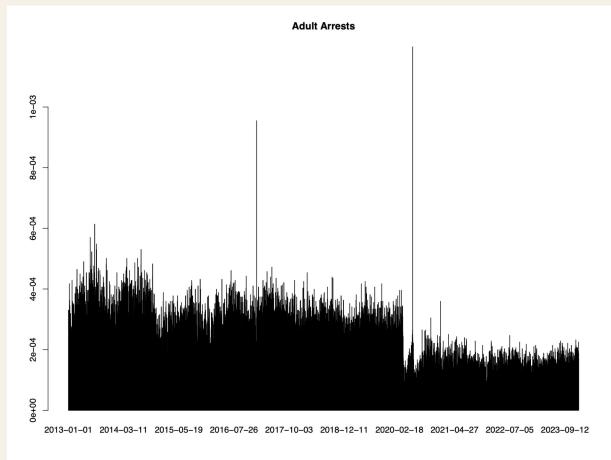
How does crime differ within age groups?







Juvenile vs. Adult Analysis



H_0 : Both datasets are sampled from the same distribution

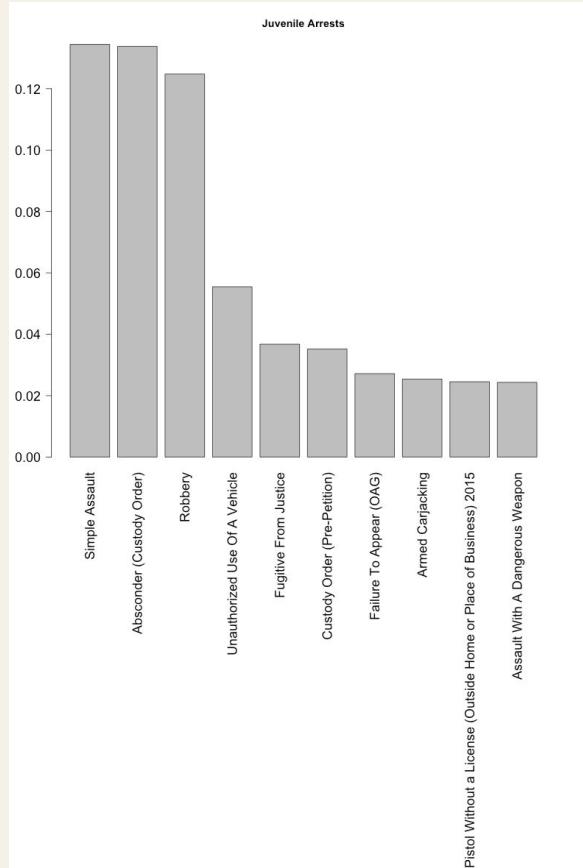
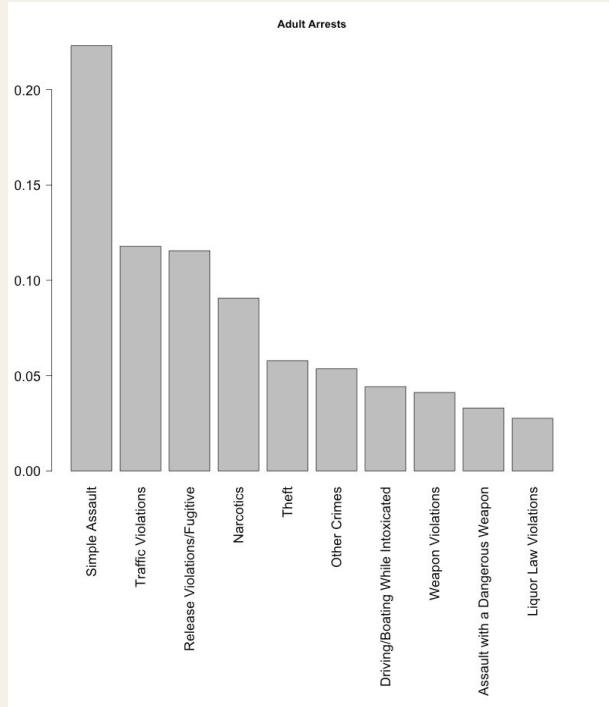
H_a : Datasets sampled from different distributions

Kolmogorov-Smirnov (KS) test results:

D = 0.59376
P < 2e-16



Juvenile vs. Adult Analysis



H_0 : Juvenile arrests and Adult Arrests are independent variables

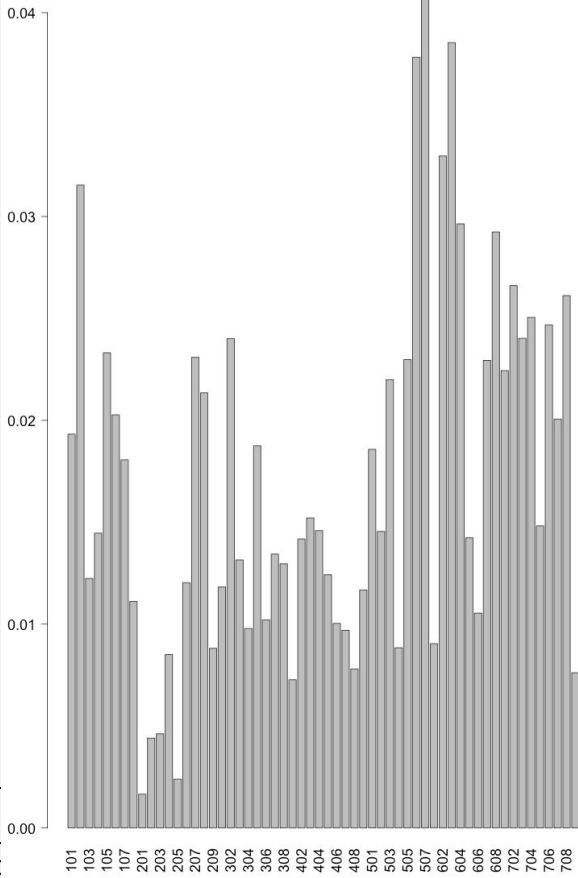
H_0 : Juvenile arrests and Adult Arrests are dependent on one another



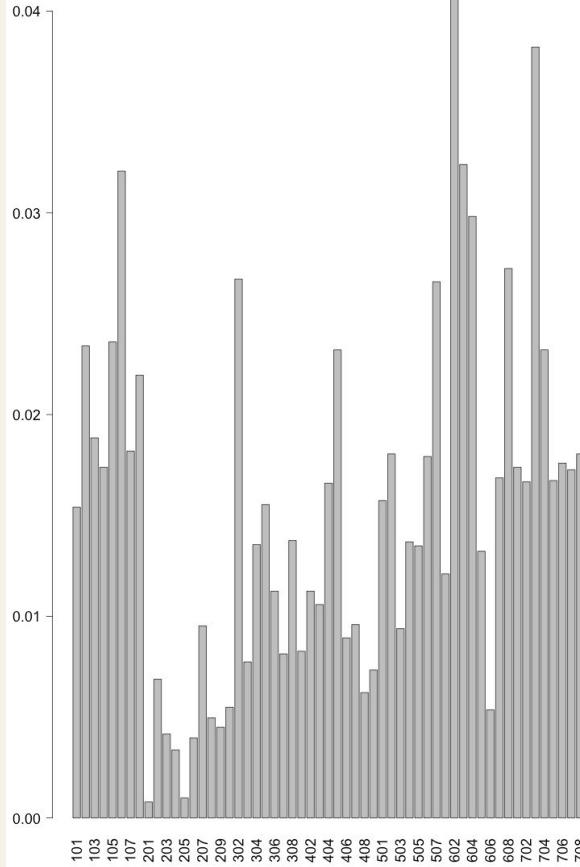
G test results:
 $G = 83058$
 $p = 1$



Adult Arrests



Juvenile Arrests



H_0 : Both datasets are sampled from the same distribution.

H_a : Datasets sampled from different distributions.

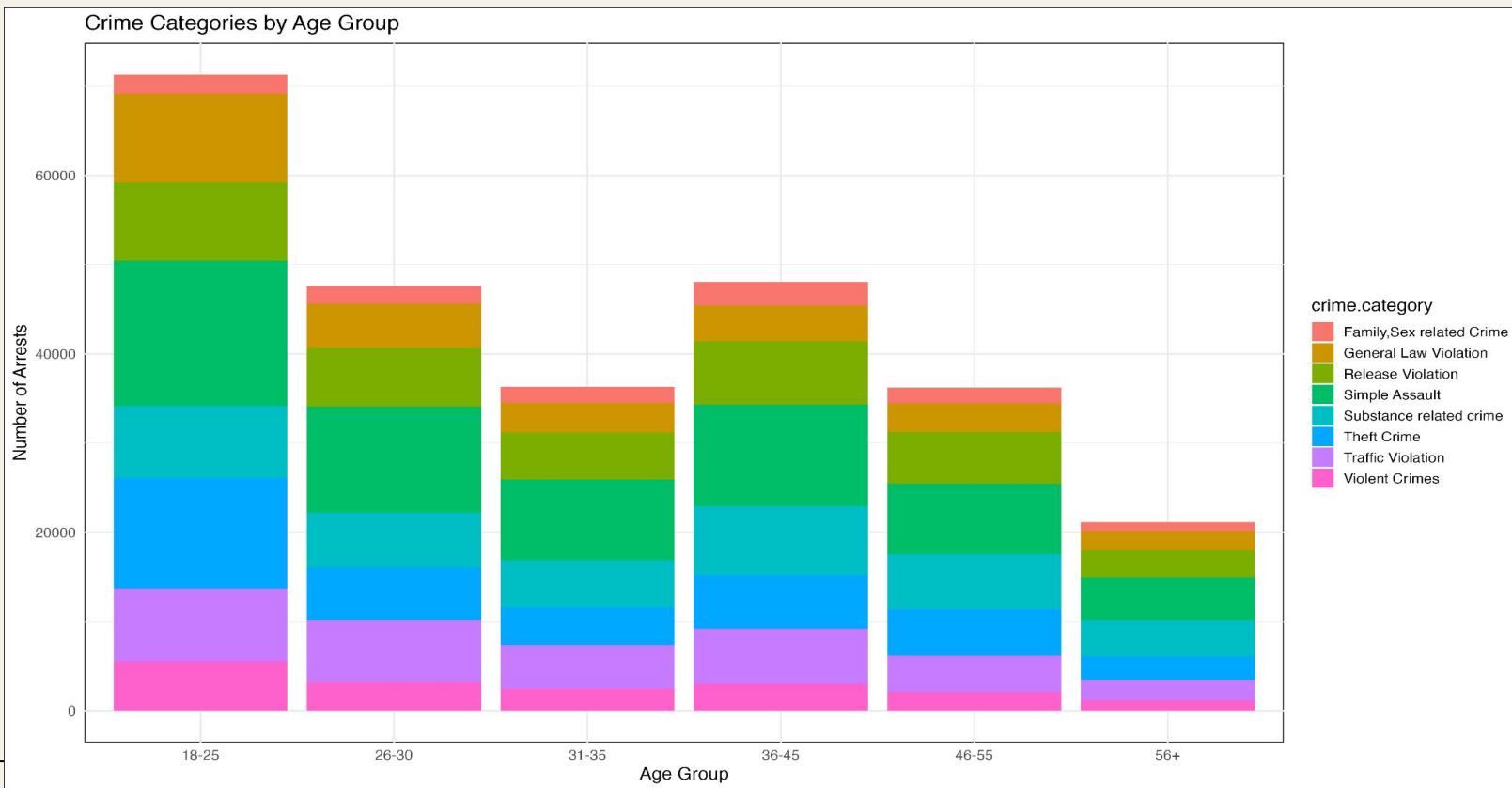
KS test:

D = 0.18542

P = 0.2238

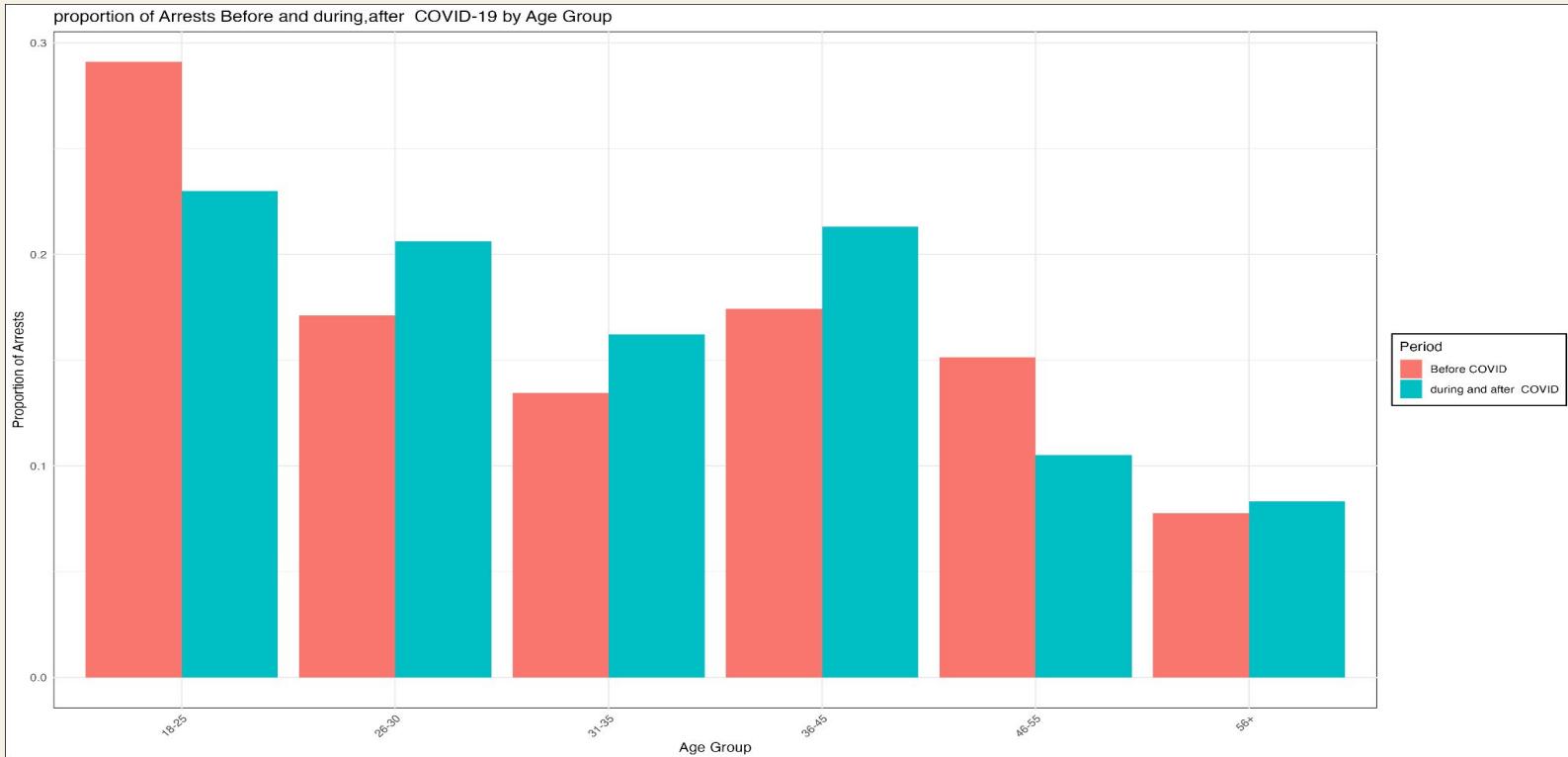
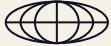


Crimes by adult age group





Proportion of before vs during(after) covid





Chi square test

H_0 : There is no difference in the arrest before after COVID-19

H_A : There is a difference in the arrest before and during, after COVID-19.

P-value

<2.2e-16

T-test

H_0 : There is no difference in the average number of arrests before and after COVID-19 for each age groups.

H_A : The average number of arrests after COVID-19 is greater than the average number of arrests before COVID-19 for each age group.

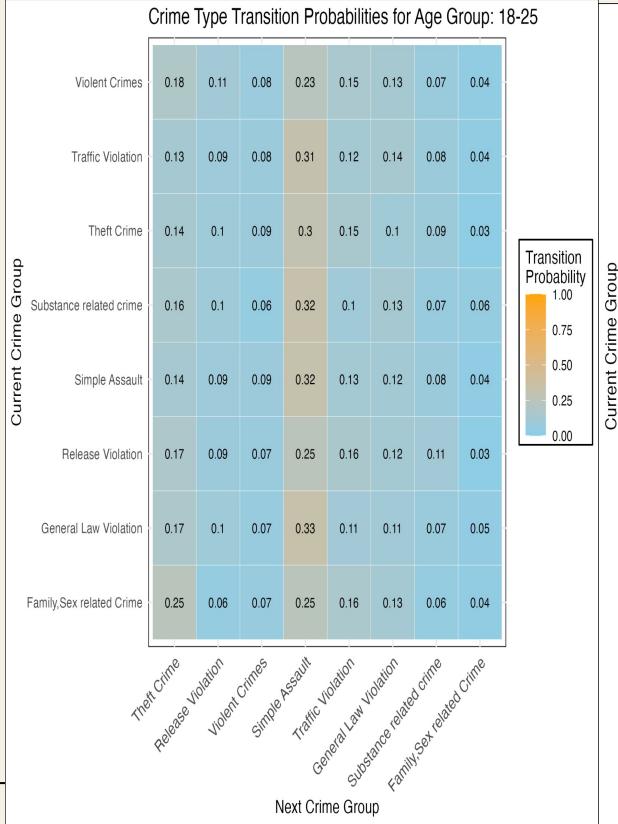
Age group	T statistics	P value
18-25	2.962981	0.006866264
26-30	2.397204	0.016120549
31-35	2.393612	0.016225157
36-45	2.369572	0.016901319
45-55	3.080407	0.005945772
56 or more	2.577878	0.011985974



Transition matrix



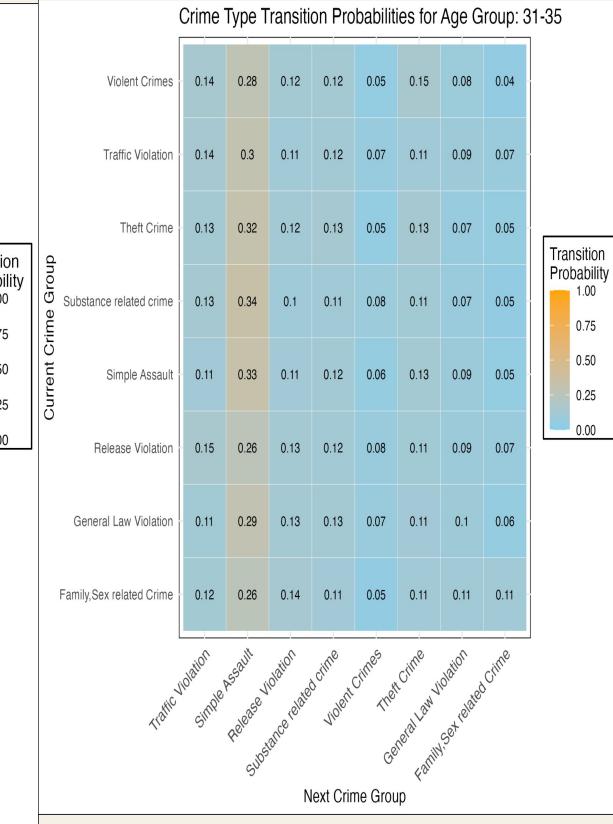
Crime Type Transition Probabilities for Age Group: 18-25



Crime Type Transition Probabilities for Age Group: 26-30

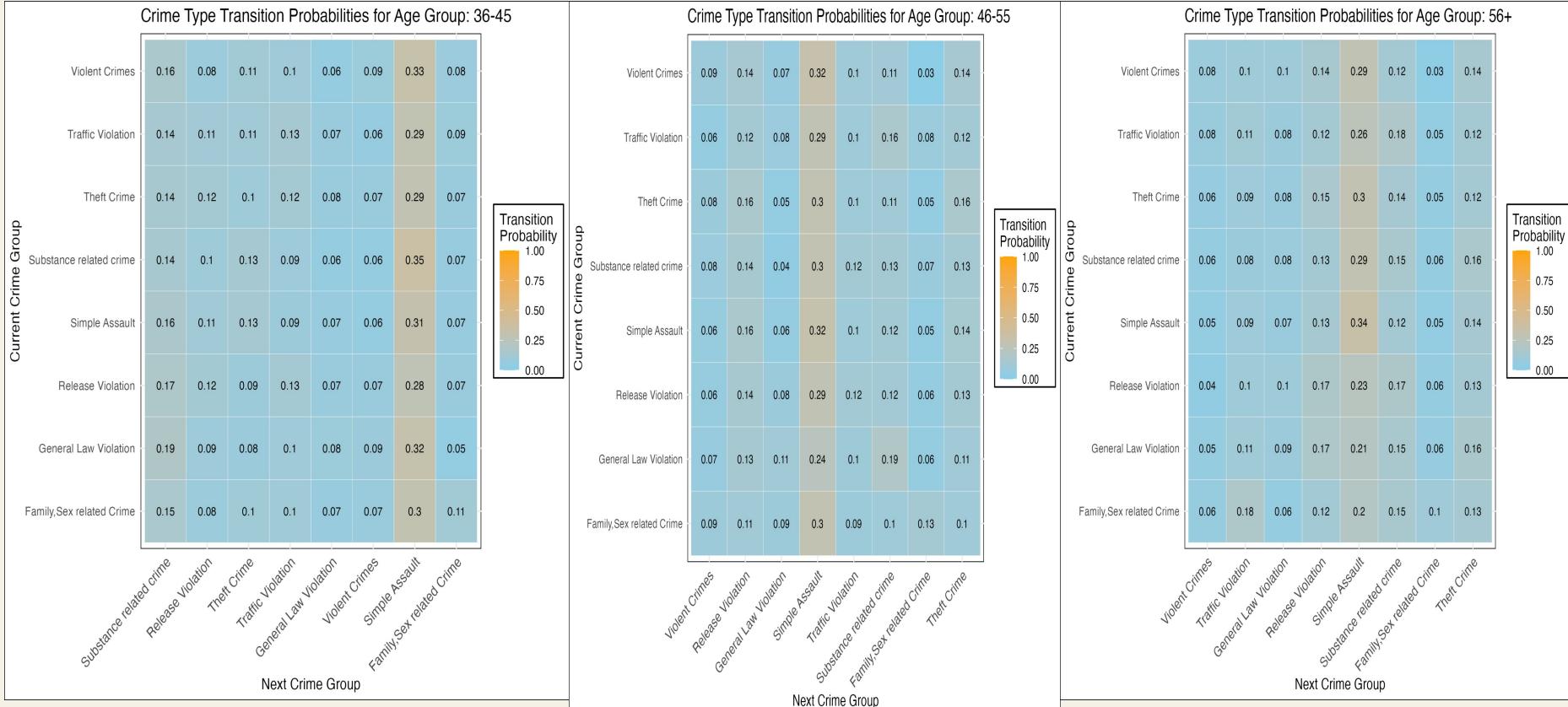


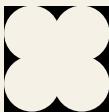
Crime Type Transition Probabilities for Age Group: 31-35





Transition matrix





GEOSPATIAL / AGE CONCLUSIONS



Analysis

DISTRICTS



Significant differences in arrest rates across districts, and with crime categories

JUVENILE



Significantly different arrest rates across time and between categories, but similar geographically

FURTHER



COVID-19 tests for Juvenile Data



References

Metropolitan Police Department. "Data and Statistics." [Mpdc, mpdc.dc.gov/node/1379551](https://mpdc.mpdc.dc.gov/node/1379551). Accessed 20 Nov. 2024.

Tobin, Michael B. "Police Foundation Releases Report on 2017 Presidential Inauguration." *Police Foundation Releases Report on 2017 Presidential Inauguration*, 10 July 2018, policecomplaints.dc.gov/release/police-foundation-releases-report-2017-presidential-inauguration.

Bowser, Muriel. "Stay Home DC." *Coronavirus*, 20 Mar. 2020, coronavirus.dc.gov/stayhome.

HOUSE COMMITTEE ON NATURAL RESOURCES STAFF. "On Anniversary of June 1 Crackdown on Peaceful Protesters in Lafayette Square, Ranking Member Grijalva Releases Report with New Evidence on the Trump Administration's Involvement: The House Committee on Natural Resources." *Natural Resources Committee*, 1 June 2023, democrats-naturalresources.house.gov/media/press-releases/on-anniversary-of-june-1-crackdown-on-peaceful-protesters-in-lafayette-square-ranking-member-grijalva-releases-report-with-new-evidence-on-the-trump-administrations-involvement.

"Pairwise.t.Test: Pairwise T Tests." RDocumentation, www.rdocumentation.org/packages/stats/versions/3.6.2/topics/pairwise.t.test. Accessed 3 Dec. 2024.

Yulia, et al. "Pairwise T-Test : Excellent Reference You Will Love." Datanovia, www.datanovia.com/en/lessons/pairwise-t-test/#google_vignette. Accessed 3 Dec. 2024.

"G-TEST." Wikipedia, Wikimedia Foundation, 2 Feb. 2024, en.wikipedia.org/wiki/G-test#:~:text=for%20some%20cell%20case%20the,sense%20of%20Hodges%20and%20Lehmann. Accessed 03 Dec. 2024.

How. (2021, October 4). Congress Heights on the Rise. Congress Heights on the Rise.
<https://www.congressheightsontherise.com/blog/how-to-find-your-dc-police-district-and-police-service-area>





THANK YOU!

Questions?

