

MATH 167PS Project: San Francisco Parking Citation Data Wrangling

P.R, R.Y, Van Ngo

Motivation

Analyzing Parking Citations in San Francisco to identify any racial and/or economic disparities across neighborhoods and investigating any other variables such as parking infrastructure, permits, etc. that play a role.



Datasets Merged

-2018 San Francisco Citation Data (Public SF Database)

Citation Number	Citation Issued DateTime	Violation	Violation Description	Citation Location	Vehicle Plate State	Vehicle Plate	Fine Amount	Date Added	coord
PD30304794	01/01/2018 12:24:00 AM	V22500E	DRIVEWAY	99 FARALLONES ST	CA	7ZLS533	110	04/26/2021 12:00:00 AM	(-122.45591601499996, 37.713888990000044)
PD31110472	01/01/2018 12:39:00 AM	V22500H	DBL PARK	100 BLK OFARRELL ST	CA	7GSR366	110	04/30/2020 12:00:00 AM	(-122.40647036599995, 37.78669290600004)

-Tract Coordinates Data(Public SD Database)

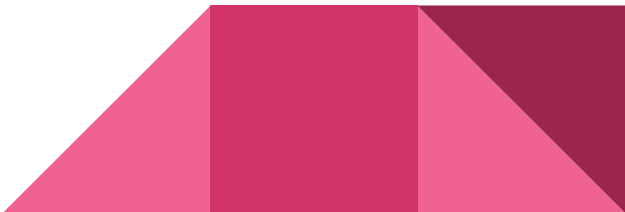
tract	coord
165.00	[[-122.446471, 37.775802], [-122.44477999999999...

-Tract Population Demographics (2018 Federal Financial Council Census)

Tract Code	Tract Income Level	Distressed or Under	Tract Median Family Income %	2018 FFIEC Est. MSA/MD non-Family Income	2018 Est. Tract Median Family Income	2015 Tract Median Family Income	Tract Population	Tract Minority %	Minority Population	Owner Occupied Units	1- to 4-Family Units
101.00	Moderate	No	78.78	116400.0	91700.0	81729.0	3798.0	52.95	2011.0	346.0	357.0
102.00	Upper	No	143.49	116400.0	167022.0	148864.0	4172.0	16.61	693.0	826.0	823.0

Data Cleaning Process

- Assigning Tract to Citation data based on geolocation coordinates
 - Checking if a coordinate is contained in a MULTIPOLYGON object
 - 4+ hour runtime
 - Saved data to csv to save runtime
- Removing 'Nonsensical' Violations
 - If Violation Description stated 'No Violation'
 - If Violation Amount noted \$0
- Removing 9 Tracts with unknown demographics
 - To avoid inconsistencies from information collected from a different source
 - Removal valid if not enough information available per government census



SUMMARY ON CITATION DATA

- Total citations: 1,020,944
- Total citations revenue: \$91,795,968
- Average revenue per citation: \$89.91
- Percentage of in-state license plates: 95.7
- Type of violations: 119
- Geolocation Coordinates
 - Required to connect to a tract code



SUMMARY ON TRACT DATA

- 197 Tracts within San Francisco
 - Used as an index to connect Citation Data to Income Data
- MULTIPOLYGON Coordinates
 - Used as an identifier of Tract for Citation Data



SUMMARY ON INCOME DATA

- 197 rows of data
- 5 Variables Pulled for Each Tract Code
- Tract Income Level - 4 Income Classes: Low, Moderate, Middle, and Upper
- Tract Population
- Tract Minority %
- Owner Occupied Units
- Family Occupied Units
- 2018 Estimated Tract Median Family Income



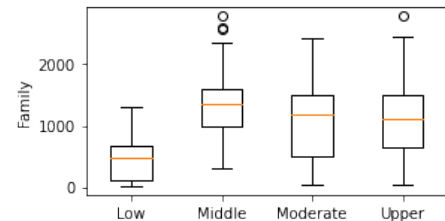
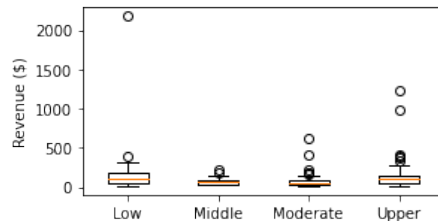
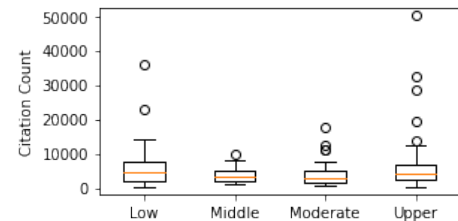
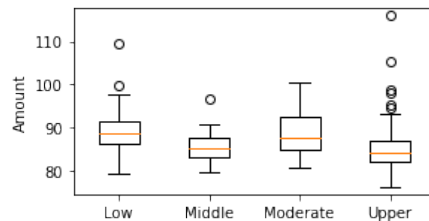
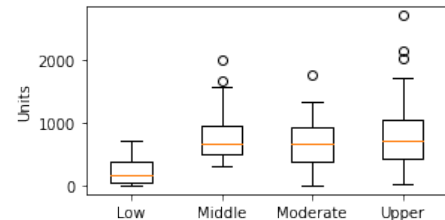
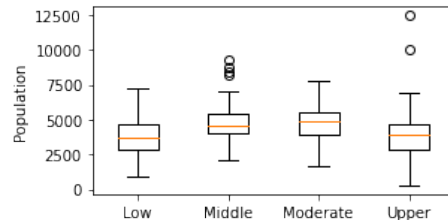
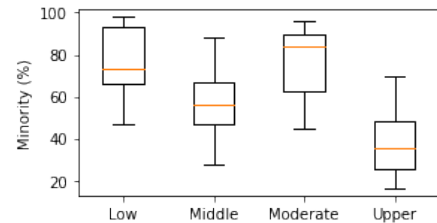
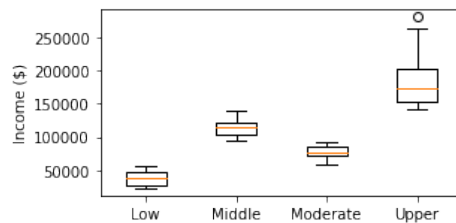
Data Wrangling Process

- Tract Grouped Dataset
 - Grouped by Tract Code and Tract Income Level, took averages
 - Added a count column
 - Added an average revenue per capita column by dividing the revenue times the counts by the average population
- Income Class Grouped Dataset
 - Grouped by Income Class, took averages
- Violation Type Grouped Dataset
 - Subsetted by Tract Income Level, Violation Description, and Fine Amount
 - Grouped by Violation Description, took count



Summary Statistics

- Upper income:
 - lowest Minority %
 - highest income
 - BUT median for citation counts, and average revenue/fine amount are slightly below others
- Lower income:
 - Higher minority %
 - lower income
 - less units occupied
 - BUT considerable average higher citation cost and count
- More outliers in upper income class

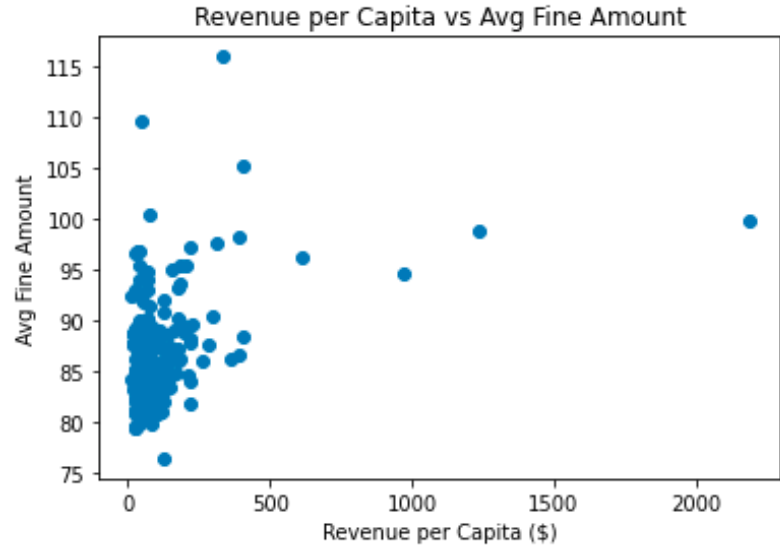
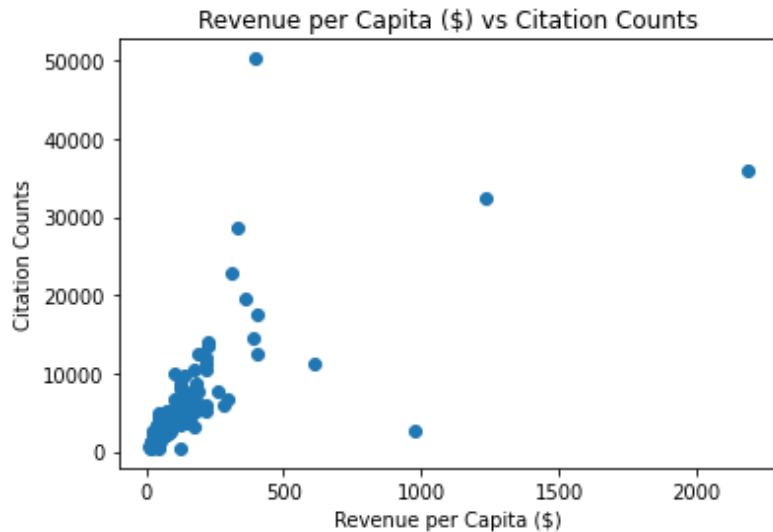


Results on Tract Grouped Data

Tract Code	Class	AVG Median Income	AVG Population	AVG Tract Minority %	AVG Owner Units Occupied	AVG Fine Amount	Avg Family Units	Counts	Revenue per Capita
101.00	Moderate	91700.0	3798.0	52.95	346.0	88.339376	357.0	17488	406.761190
102.00	Upper	167022.0	4172.0	16.61	826.0	87.231281	823.0	8574	179.271572
103.00	Middle	103887.0	4387.0	47.14	507.0	88.409938	1272.0	2576	51.913380
104.00	Middle	118577.0	5148.0	41.82	795.0	87.584086	1430.0	4210	71.625680
105.00	Upper	190035.0	2589.0	49.52	371.0	98.729609	130.0	32379	1234.749324
...
614.00	Middle	138784.0	6140.0	52.30	1154.0	81.668402	1923.0	4418	58.764007
615.00	Upper	192316.0	12511.0	50.50	2729.0	98.232947	251.0	50183	394.023180

- 4 Continuous Predictors
- 1 Categorical Predictor: Income Class
- 3 Possible Response Variables:
 - Citation counts, Avg Revenue per capita, Avg Fine Amount

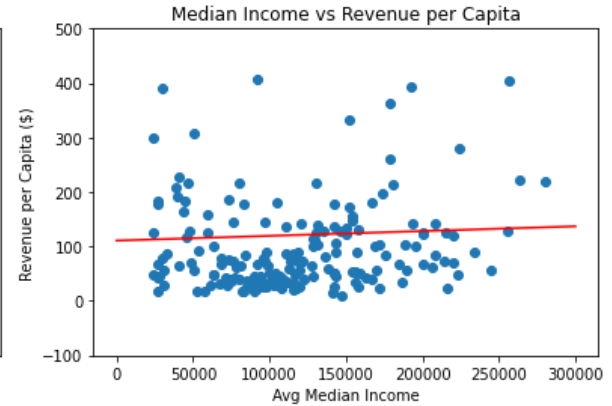
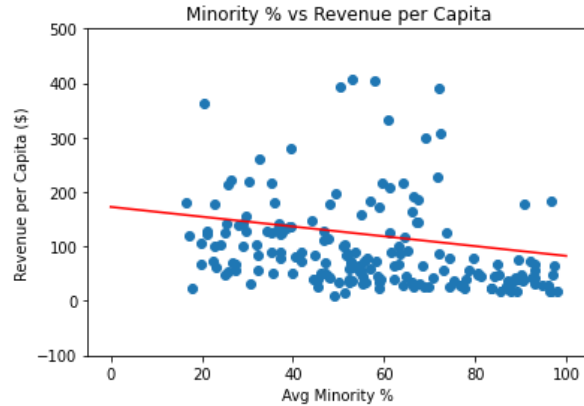
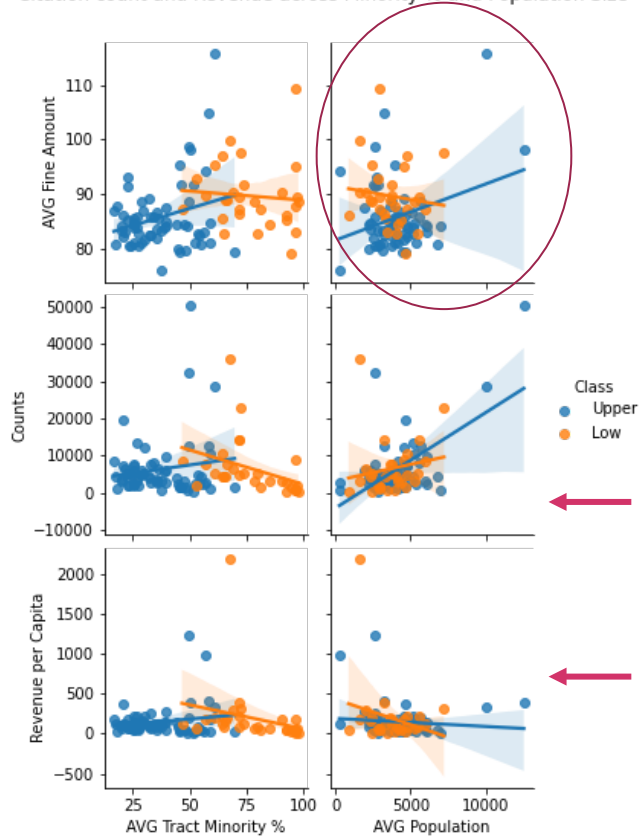
Results on Tract Grouped Data



- Citation revenue and counts closely associated
- Average fine amount shows significantly higher exponential rate

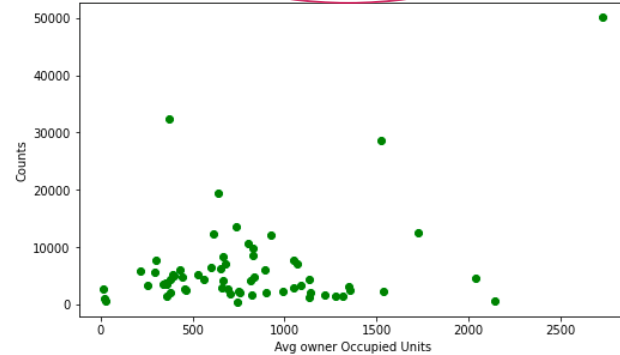
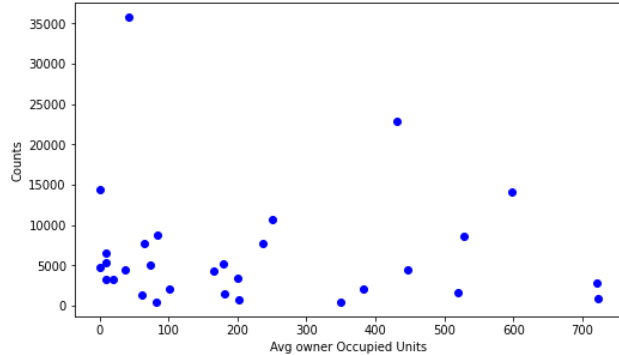
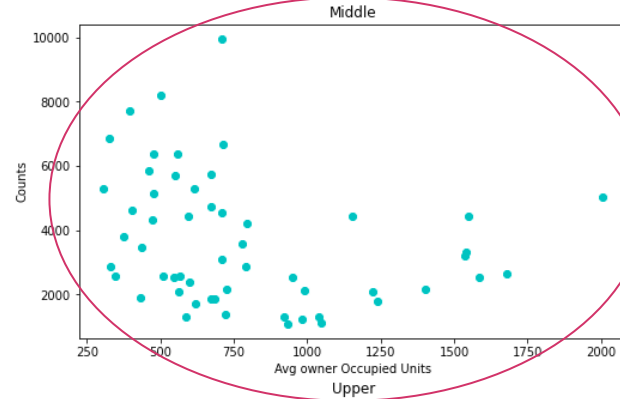
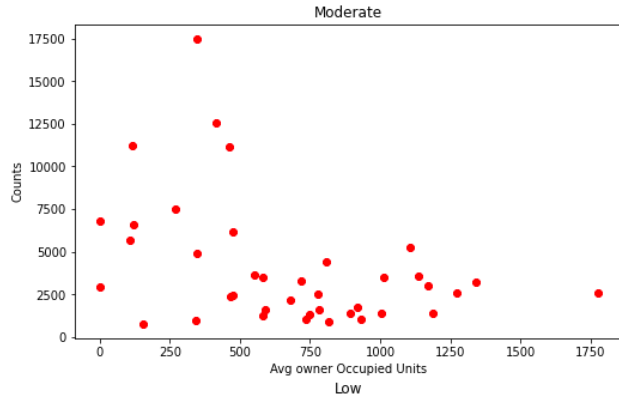
Results on Tract Grouped Data

Citation count and Revenue across Minority % and Population Size



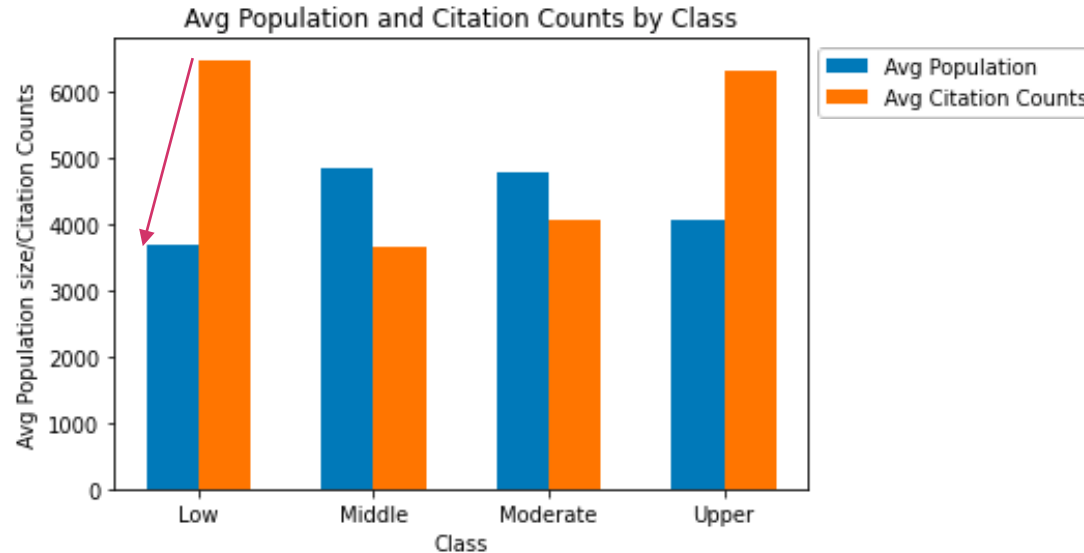
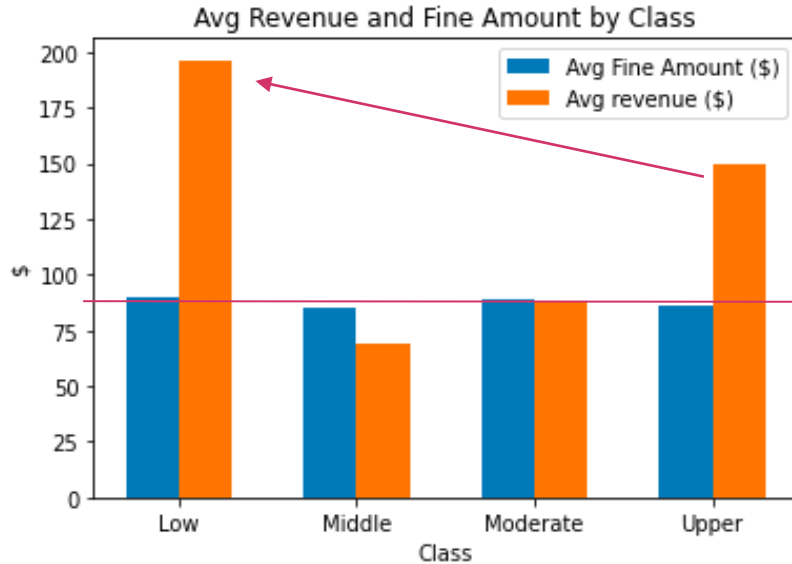
- Opposite trends between classes for population size and average fine amount
- Initial analysis doesn't seem to show disparity against minority populations.

Results on Tract Grouped Data



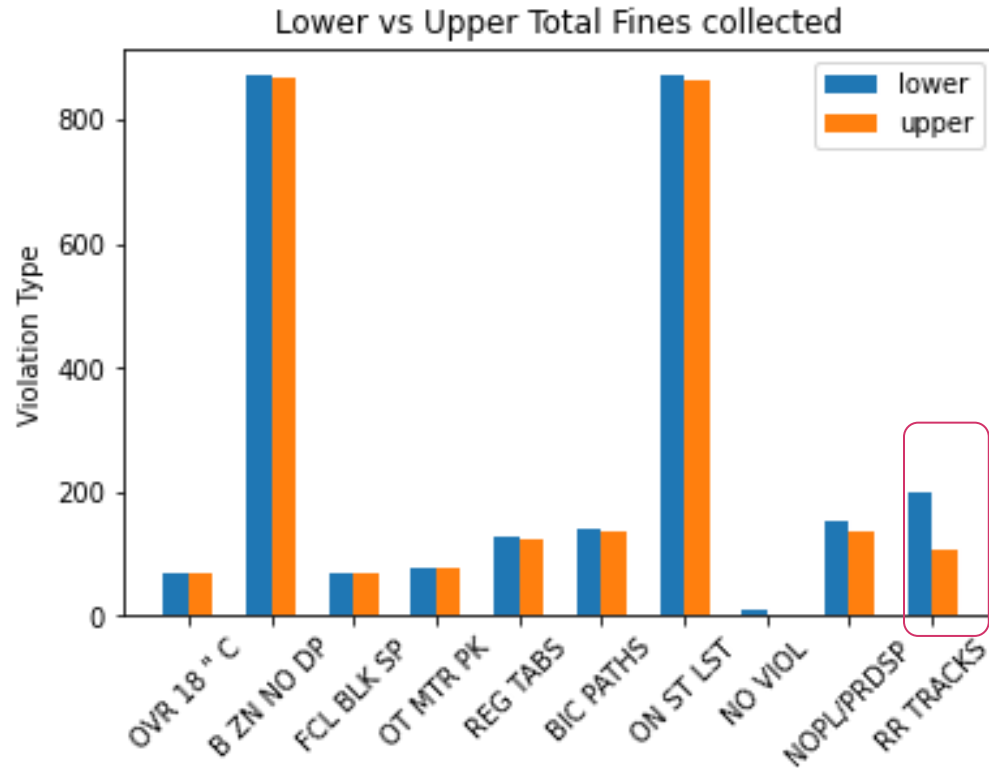
- Associations point to high citation frequency for middle class neighbourhoods with lower units occupied, but had higher income.

Results on Class Grouped Data



- Low class: High revenue & citation counts despite lower average population and on par Average Fine Amount

Violation Type Investigation



- Lower class pay higher average fine amounts compared to upper class for ~46.3% types of violations.
- For example, lower class paid \$199.38 for 'RR Tracks' violation while upper class paid \$105.60

Conclusion

- Disparity Found for Low Income Tracts
 - Lower class paid more than the upper class for 46.3% of the types of citations averaging to \$3.72 more.
 - Upper class paid more than the lower class for 18.29% of the types of citations averaging to \$1.80 more.
 - Generally, lower class had higher citation frequency and revenue despite lower population.
- Relationship Found for Medium Income: Owner Occupied Units and Citation Frequency
 - High citation frequency associated with low-owner occupied units
 - Speculating suburbs



Discussion/Future Analyses

- Due its descriptive nature, no conclusive evidence proving disparity
- Plotting Geolocation based heat maps
 - Frequency
 - Total Revenue
- Time Series analysis
 - Average Revenue per Capita
- Testing and fitting a predictive model
 - More demographics collected
 - More research into citation practices/regulations



References

References:

1. Chicago's Parking Meter Deal a Lesson in "Worst Practices", *BGA*,
<https://www.bettergov.org/news/chicagos-parking-meter-deal-a-lesson-in-worst-practices/>
1. Thomas. How Much 25 Major Cities Make in Parking Revenue Per Capita, *Top View NYC*,
<https://www.topviewnyc.com/packages/how-much-25-major-cities-make-in-parking-ticket-revenue-per-capita>
1. The Debt Spiral: How Chicago's Vehicle Ticketing Prices Unfairly Burden Low Income and Minority Communities (June 2018). *Woodstock Institute*, <https://woodstockinst.org/wp-content/uploads/2018/06/The-Debt-Spiral-How-Chicagos-Vehicle-Ticketing-Practices-Unfairly-Burden-Low-Income-and-Minority-Communities-June-2018.pdf>
1. Parking Violations and Fines - SF Transportation Code Penalty Schedule (2022). *SFMTA*,
https://www.sfmta.com/sites/default/files/reports-and-documents/2020/10/fy_2021_fees_and_fines_effective_1.1.21.pdf

Datasets Used

Citation Data:

SFMTA (2018). Parking Citations, *DataSF*. <https://data.sfgov.org/Transportation/SFMTA-Parking-Citations/ab4h-6ztd/data>

Income Data:

Federal Financial Institutions Examination Council (2018). FFIEC Census Reports, *FFIEC*.

<https://www.ffiec.gov/census/report.aspx?year=2018&state=06&msa=&county=075&tract=&report=demographic&page=1>

Tract Data:

SFMTA (2010). Census 2010: Tracts for San Francisco, *DataSF*.

<https://data.sfgov.org/Geographic-Locations-and-Boundaries/Census-2010-Tracts-for-San-Francisco/rarb-5ahf>



Questions.