UC San Diego

Police Vehicle Stops Data Analysis

ECE 143 - Group 5

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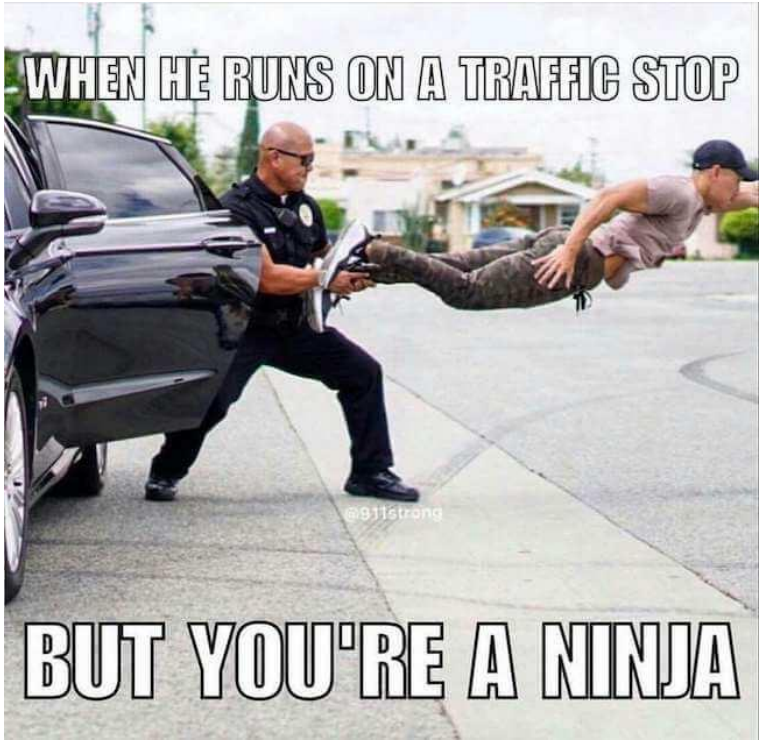
Agenda

- Overview and Motivation
- Dataset, Data processing and EDA
- Temporal Analysis
- Geospatial Analysis
- Demographic Analysis
- Summary and Conclusion



Overview And Motivation

- San Diego is densely populated urban area with huge vehicle traffic.
- Police department is continuously monitoring for better public safety.
- Can we find few insights which helps them for better resource allocation?
- Many report says that Police department has negative bias towards few demographic groups.
- Does the dataset follow this trend?

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Dataset and Data Processing

Dataset

- The Dataset gives records of car stops/pullovers by the police from Jan 2014 to June 2018 in San Diego.
- [Police Vehicle Stops - City of San Diego Open Data Portal.]
- The data also describes attributes related to the record.
- The Data is in CSV format and can be represented in Tabular form.

Columns are features/Attributes related to the pullover.

A row is a pullover record

	stop_id	stop_cause	service_area	subject_race	subject_sex	subject_age	date_time	date_stop	time_stop	sd_resident	arrested	searched	search_details_id	search_details_type	search_details_description
0	1044975	Moving Violation	110	W	0.0	24	2014-01-01 01:25:00	2014-01-01	1:25	Y	N	N	1208956.0	ActionTaken	Citation
1	1044976	Moving Violation	320	W	0.0	42	2014-01-01 05:47:00	2014-01-01	5:47	Y	N	N	1208957.0	ActionTaken	Verbal Warning
2	1044977	Moving Violation	320	L	0.0	29	2014-01-01 07:46:00	2014-01-01	7:46	Y	N	N	1208958.0	ActionTaken	Verbal Warning
3	1044978	Moving Violation	610	W	0.0	23	2014-01-01 08:10:00	2014-01-01	8:10	Y	N	N	1208959.0	ActionTaken	Citation
4	1044980	Equipment Violation	930	H	0.0	35	2014-01-01 08:35:00	2014-01-01	8:35	N	N	N	1208961.0	ActionTaken	Citation

Data processing

- Combining multiple CSV Files on both rows and Columns.
- Removing Columns that fails to provide any insights.
  - For eg: the ‘stop ID’ fails to provide meaningful insights.
- Removing NaN values.
- Encoded data replaced with original non-decoded entries.
  - For eg: For all races encoded as letters in the CSV data.

    We replaced that with the original race tag.

    ‘W’ in CSV is replaced with ‘White’.

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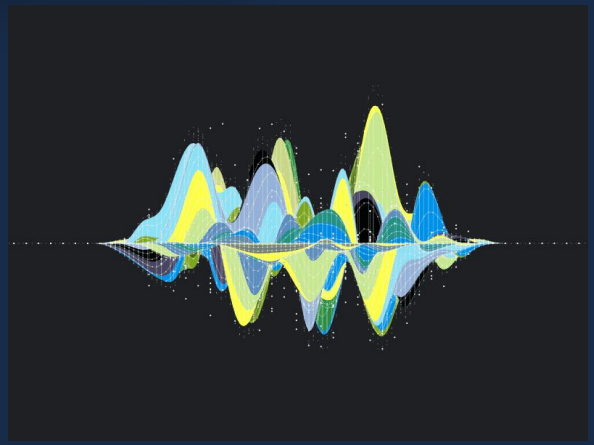
Exploratory Data Analysis(EDA)



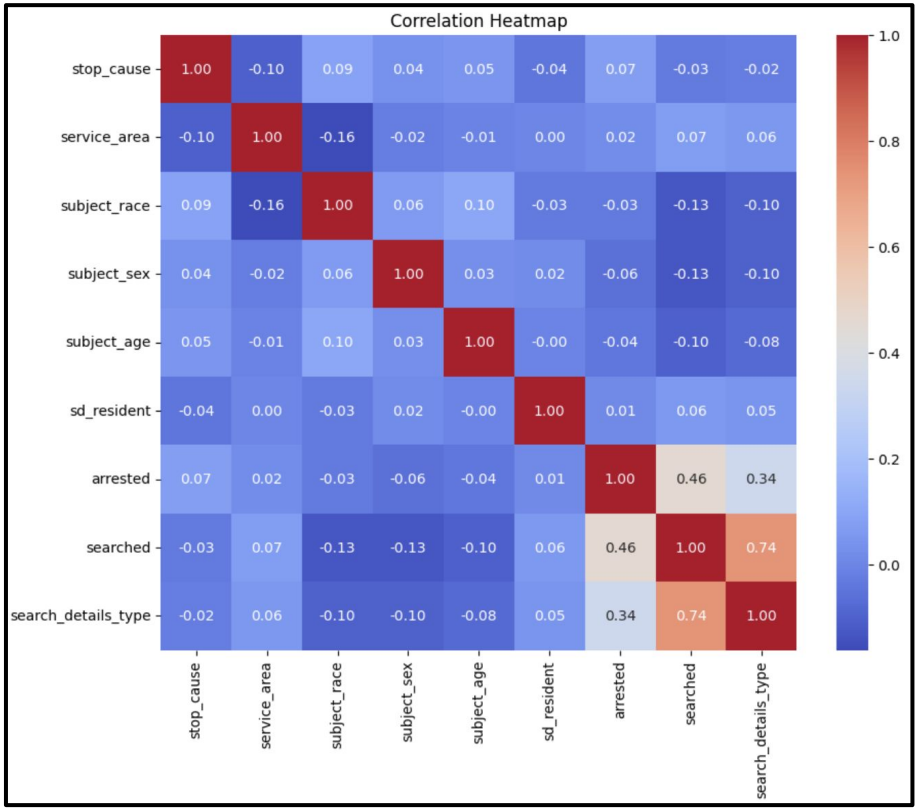
Exploratory Data analysis(EDA)

- The main purpose of EDA is to help look at data before making any assumptions.
- EDA also helps to identify important features/Attributes.
- Important features help us to form meaningful inferences.
- List of features:

stop_id	action	arrested
stop_cause	subject_age	searched
service_area	date_stop	search_details_id
subject_race	time_stop	search_details_type
subject_sex	sd_resident	search_details_description

EDA (Finding Important Features)

- Find inter-dependency between features.
- If 2 features are highly correlated use 1.
- ‘Searched’ and ‘Search_ details_type’ highly correlated so we can take only one



EDA(Important Features)

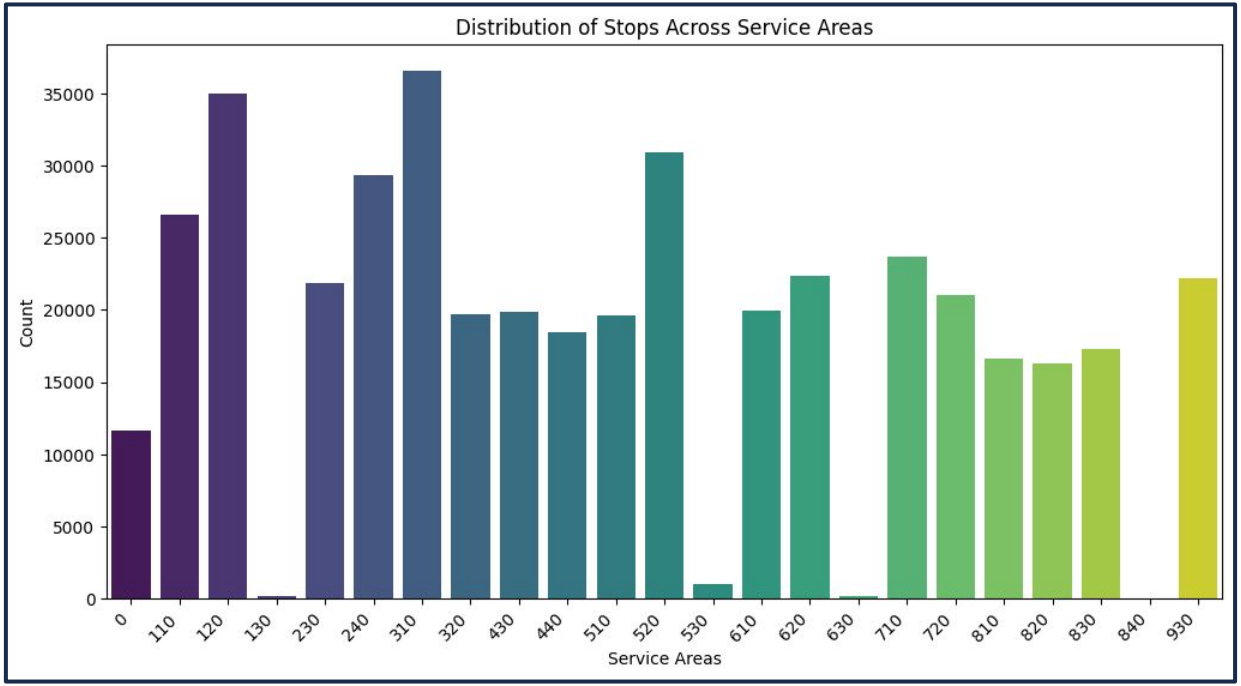
- We can’t include all features in the correlation Heatmap.
- Features related to ‘Time’ are important for Temporal Analysis.
- Binary Features are less likely to have meaningful insights.
- So some of the Important features:

Stop_cause	Subject_race	Date_stop
Service_area	Subject_age	Time_stop

- Later we decompose Date and time in sub columns of months, year, hours for plotting purposes.

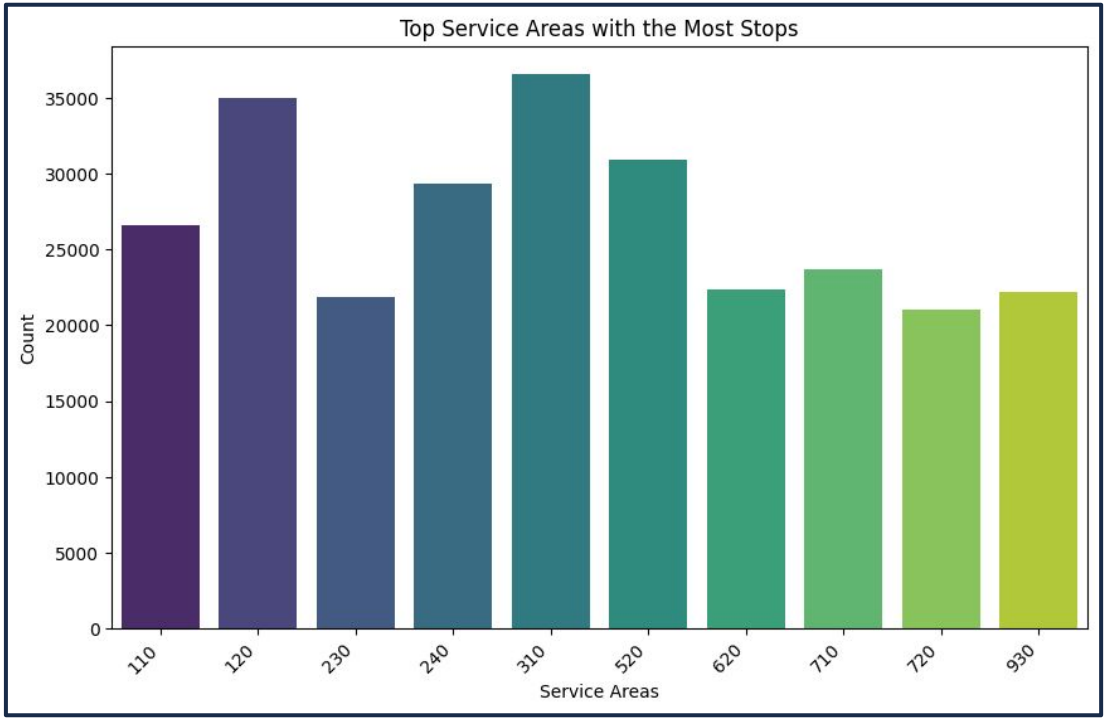
EDA(Service Area)

- Stops per Service Area Codes tell us which area has more pull over rate.
- This information can be used for Geospatial analysis of the Data.



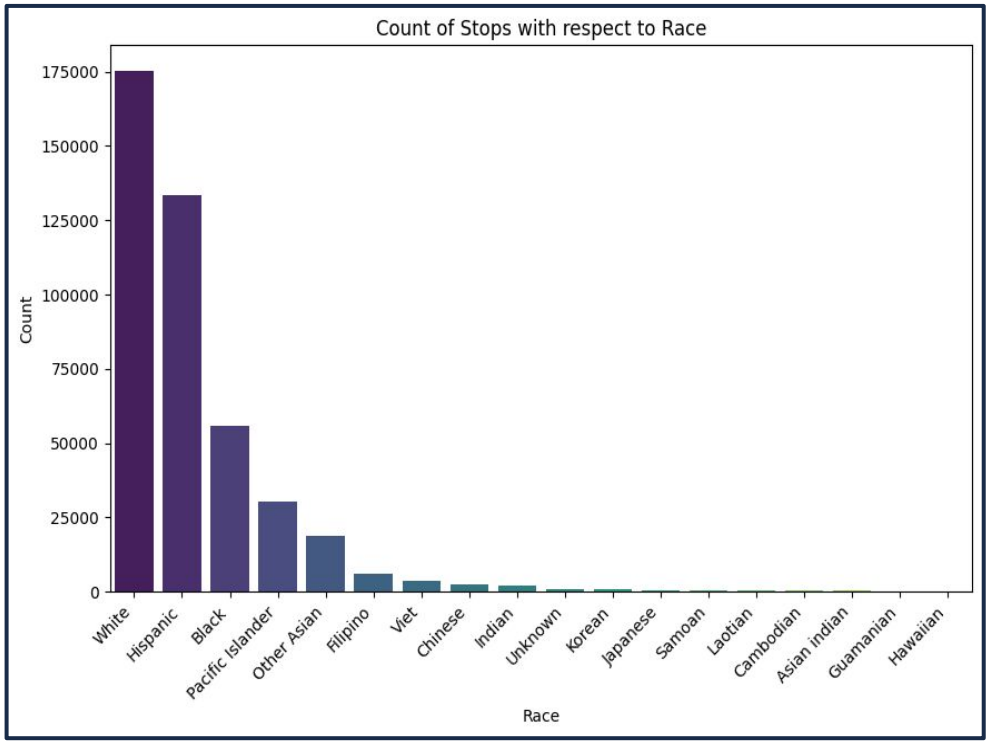
EDA(Service Area)

- Top ten service areas which has the most number of stops.
- We have referred to official San diego Service codes.



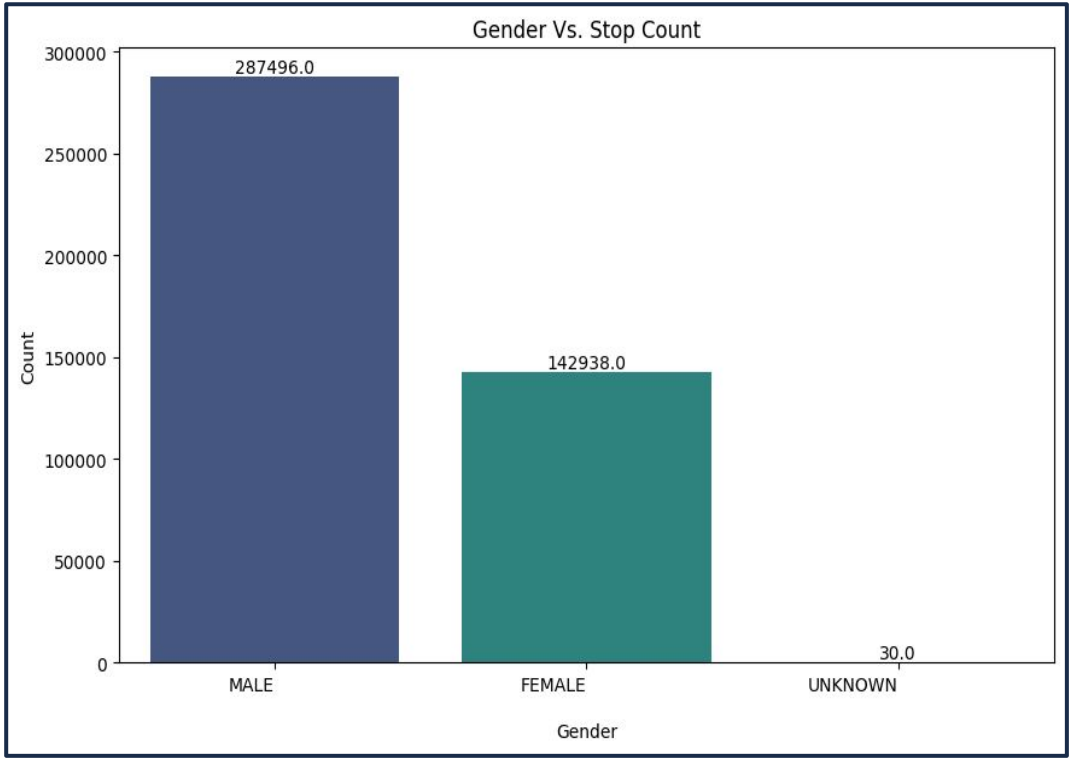
EDA(Subject Race)

- Higher chance of white individuals being pulled over, without considering population demographics.
- San Diego Demographics: Whites 45.9%, Hispanics 33.5%, Blacks 4.7%.
- Pullover rate for blacks almost 3 times in proportion, despite their population being approximately 1/10th of whites.
- City Demographic Profiles San Diego County

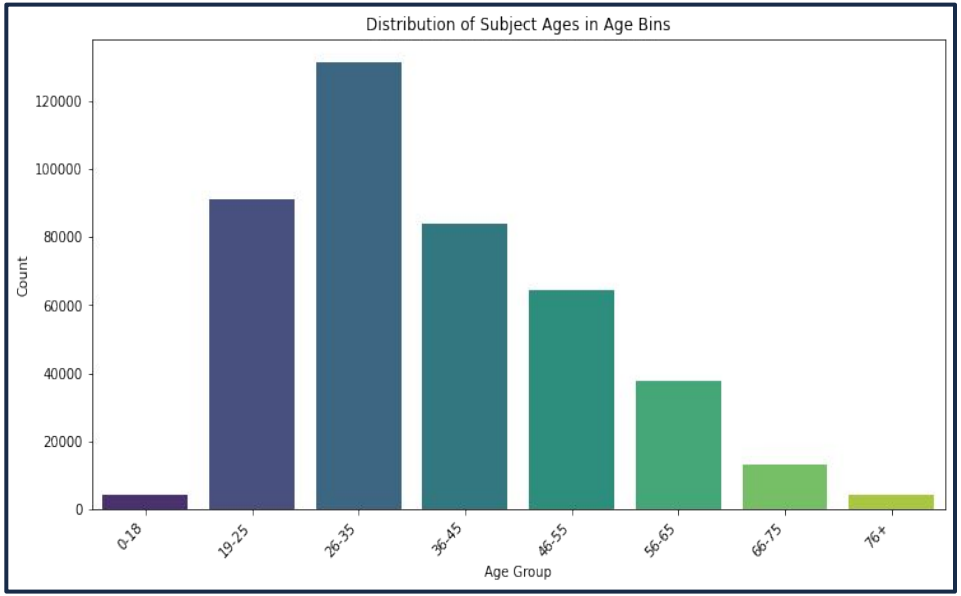


Stops Based on Genders

- Observe that we can find more number of Male Drivers pulled over as compared to Female Drivers.
- But the population of Males and Females is roughly equal in San Diego.
- So we might interpret that Male drivers are twice as likely to drive recklessly or being pulled over.
- City Demographic Profiles San Diego County

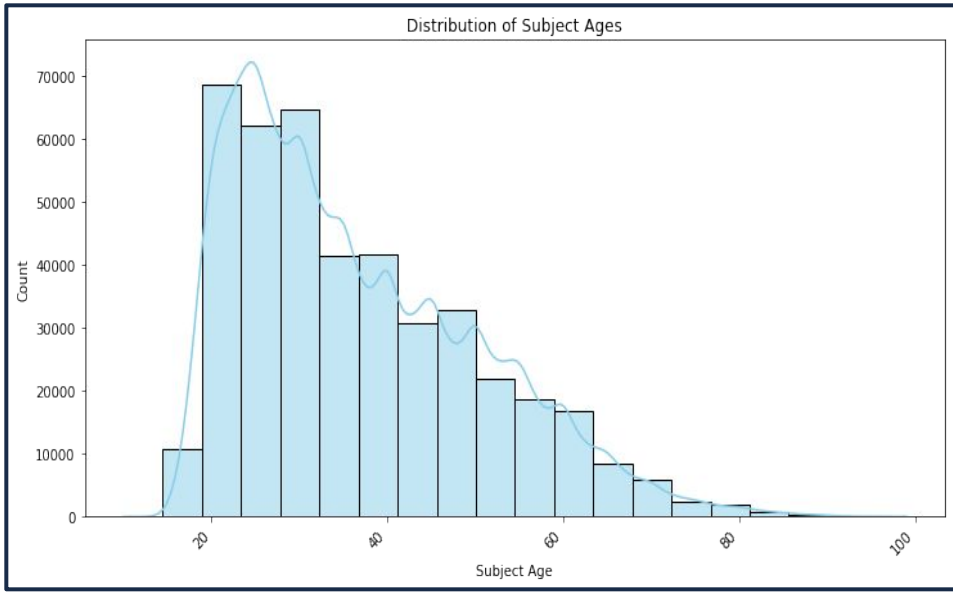


EDA(Subject Age)



- Most stops observed in the age group of 26-35.

- This age group aligns with higher numbers in San Diego demographics.



EDA

- We now have figured out our important features and done basic EDA.

- Further we can move on to work on detailed insights based on
  - Temporal Analysis
  - Geospatial Analysis
  - Demographic Analysis

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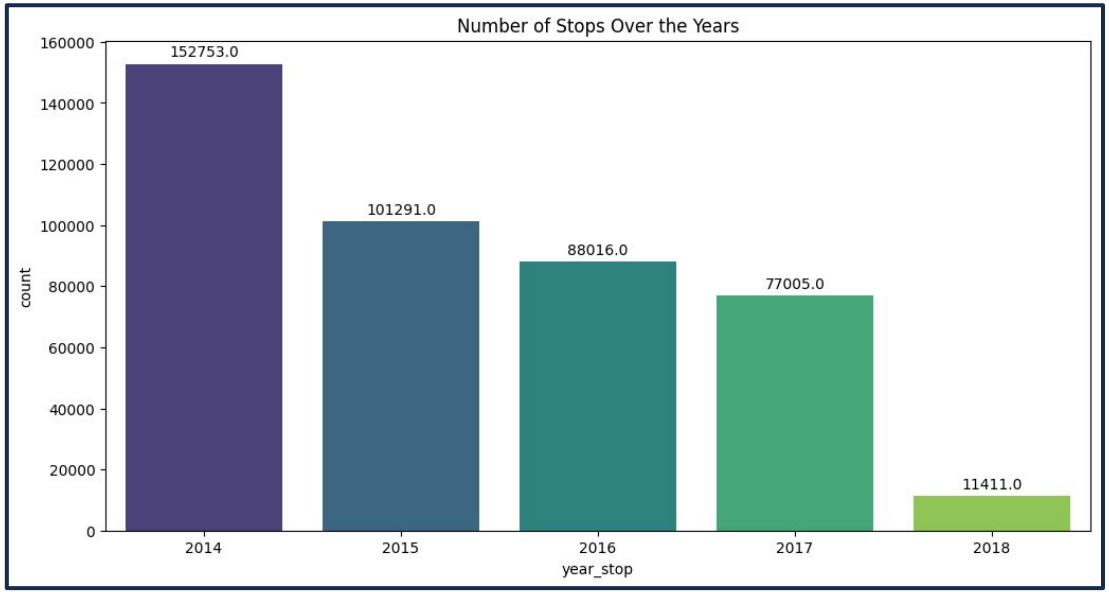
Temporal Analysis

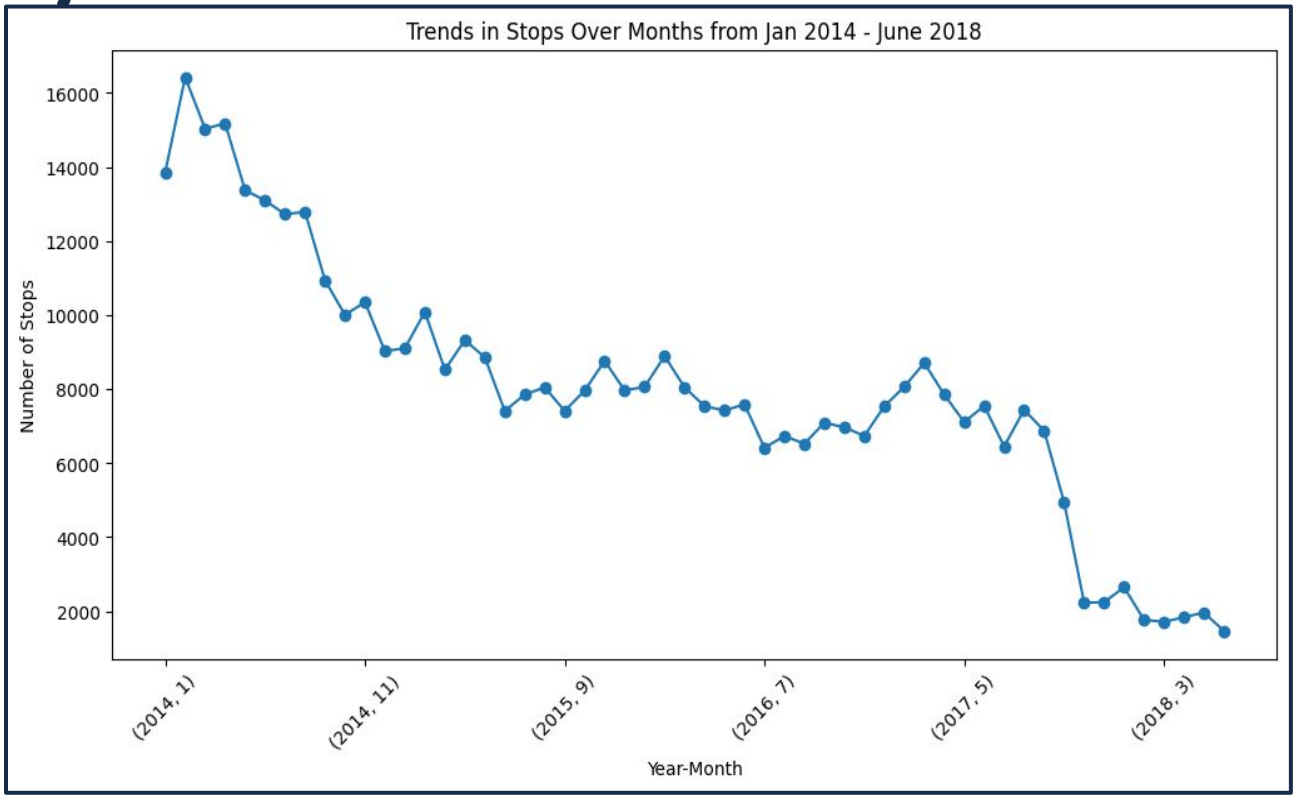
Temporal Analysis

- The number of stops per year is following a negative trend.
- There are two possible reasons for this:
  - More adherence to the law
  - Fewer Cops on roads
- 2018 cannot be considered as the data is collected till June.
- [Census of State and Local Law Enforcement Agencies, 2018 – Statistical Tables]



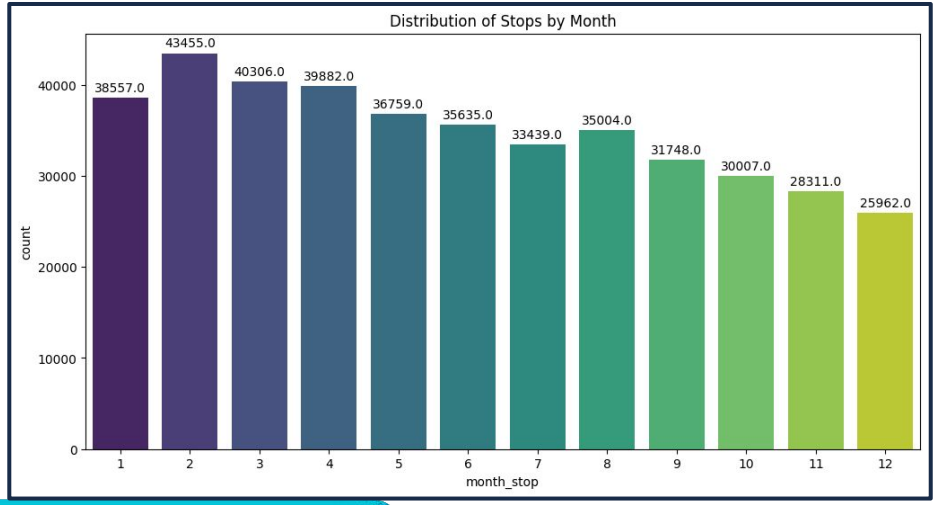
Temporal Analysis

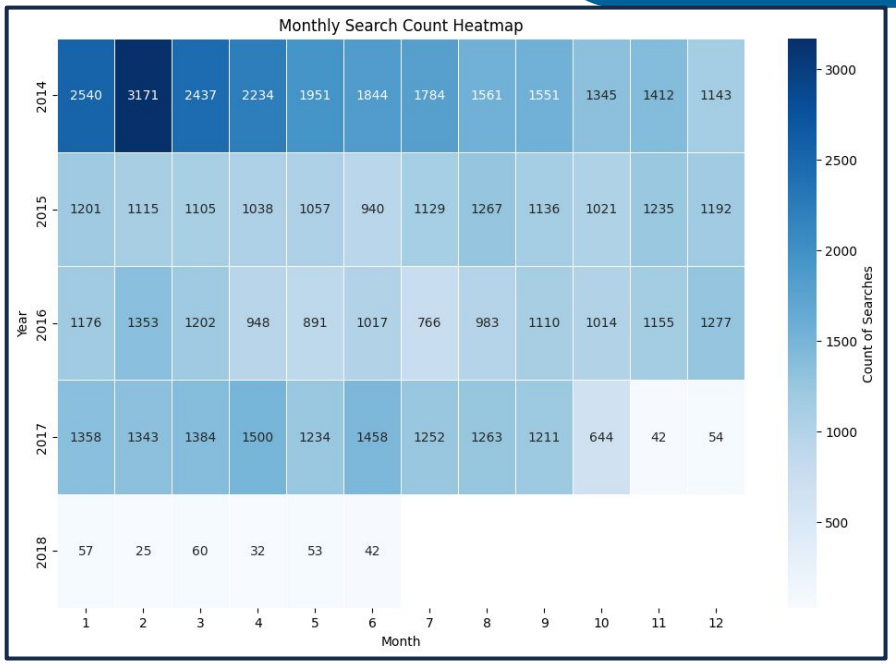
- In Support of previous Bar graph, we can see a decreasing trend over years.



Temporal Analysis

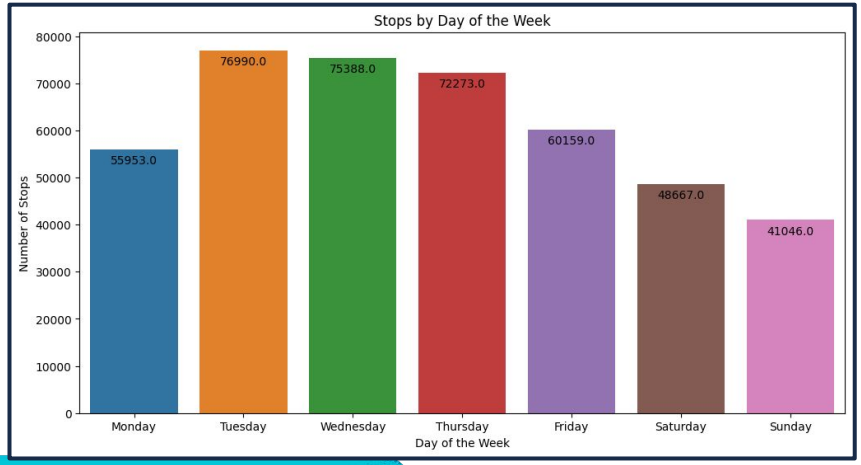
- The number of stops per month is following a negative trend.
- [NBC News Article]

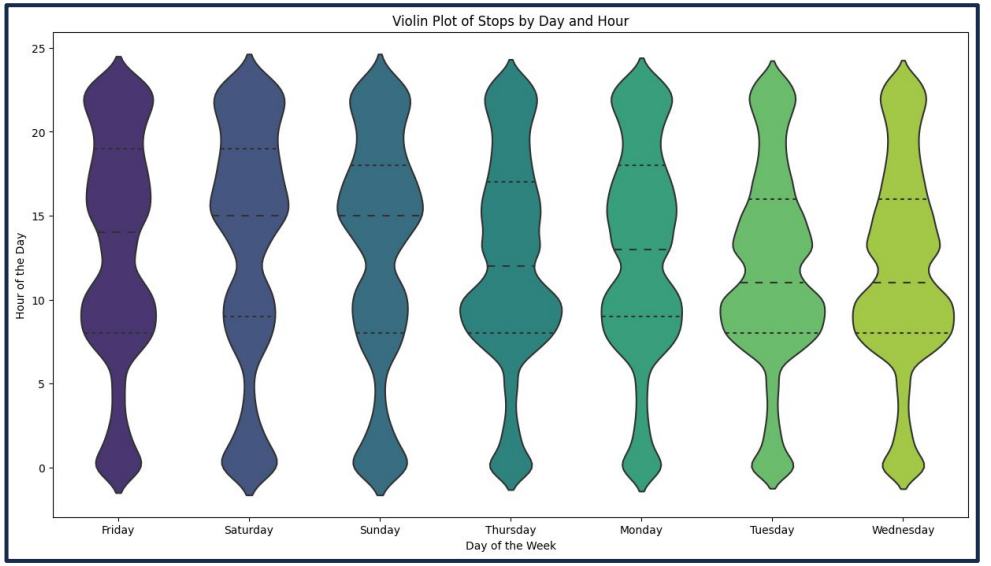




Temporal Analysis

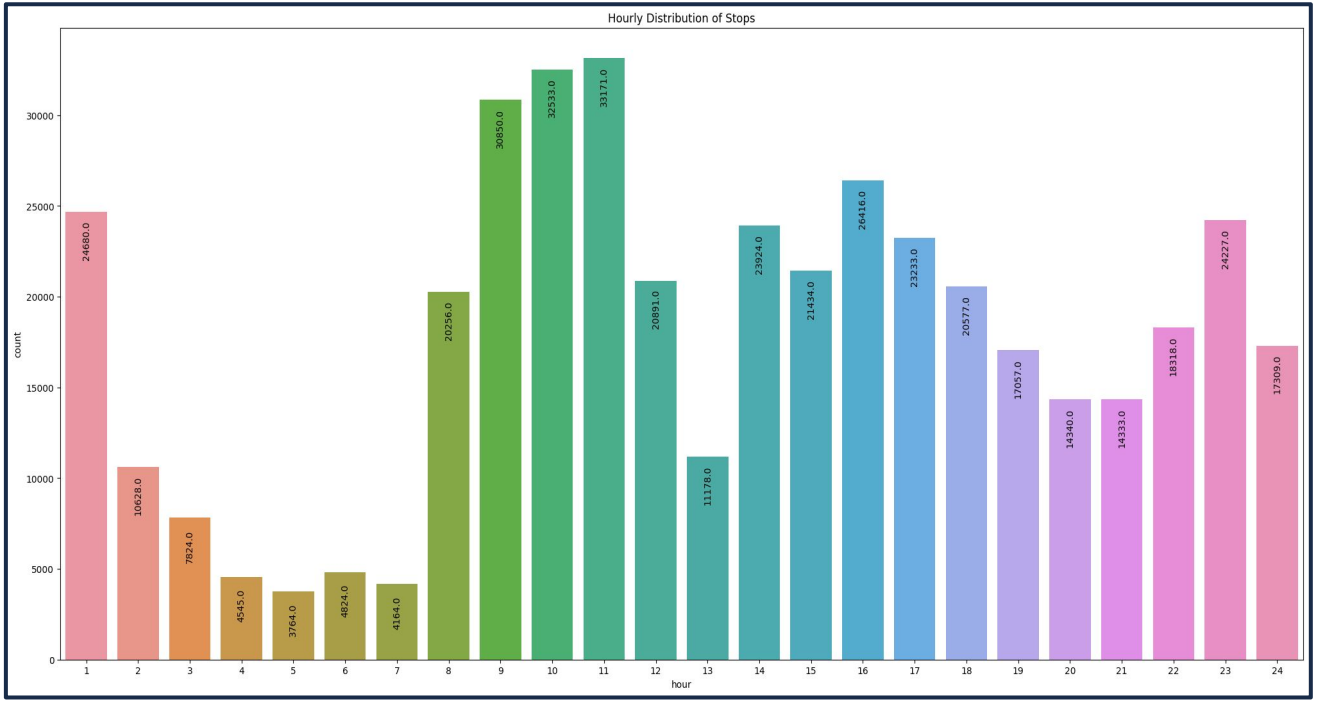
- Here we find that the Stop rate decreases from Tuesday to Sunday, Monday being an exception.
- No special reason but maybe due to public being more attentive to start.





Temporal Analysis

- Bar chart: Hours of the day vs Count.
- Higher number of stops during rush/office hours (8 to 11).
- Mornings are relatively quiet.
- Late nights show a small rise, possibly people returning from work.



Temporal Analysis - Heatmap for Days vs Hours

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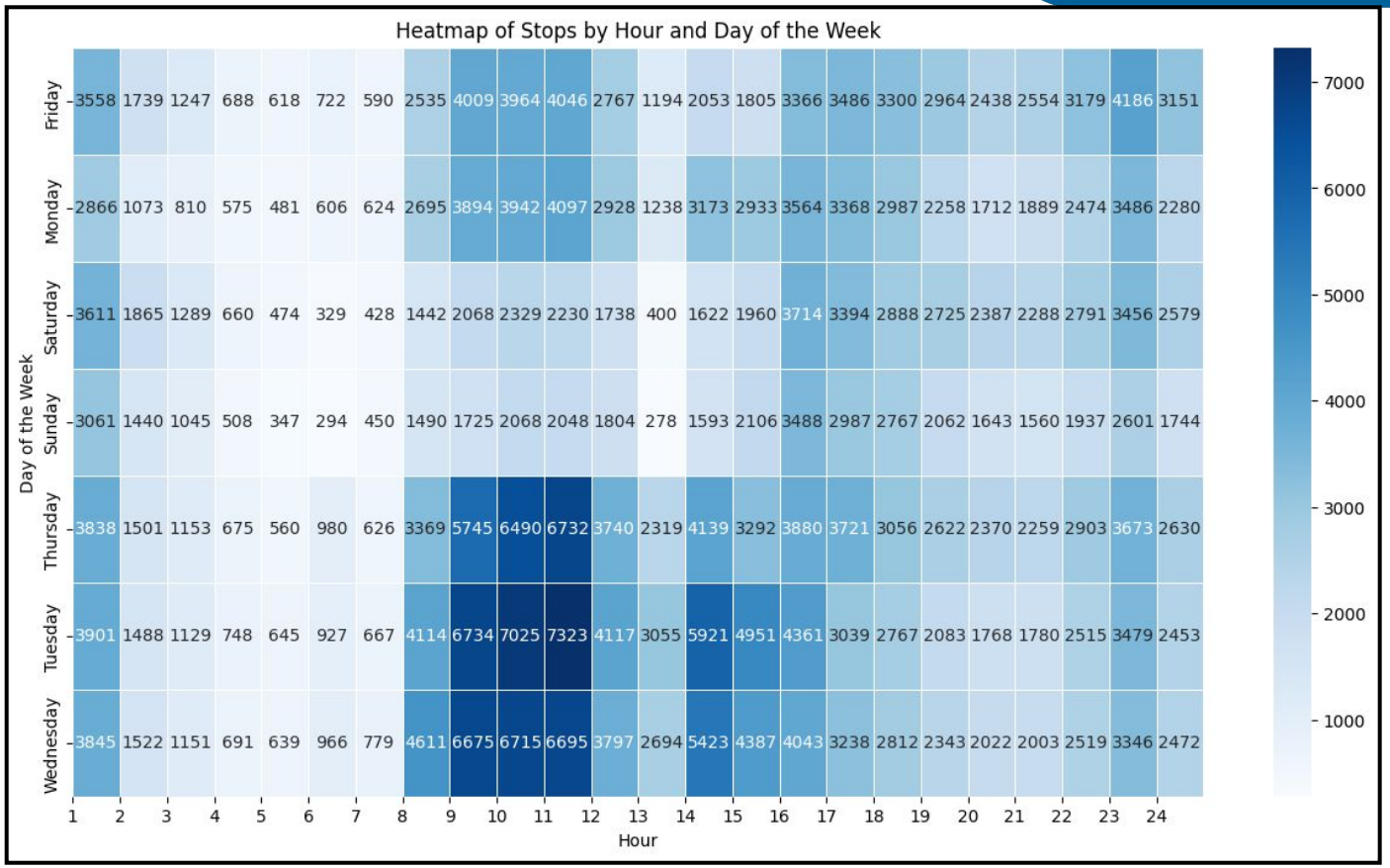
- Detailed view by days and hours using heatmap.
- Weekdays, especially office hours, show higher numbers of pullovers.
- Weekends deviate from this pattern with lower pullover rates.



Temporal Analysis - Inferences

In Summary we can say:

- Decrease in stops and pullovers from 2014 to 2018.
- General trend of more stops on weekdays, particularly during office hours.
- Feb 2014 shows a spike, but excluding it, a downward monthly trend is observed.
- Recommendation: Increase police workforce during office hours, optimize resource allocation from March to December, especially during festive days.

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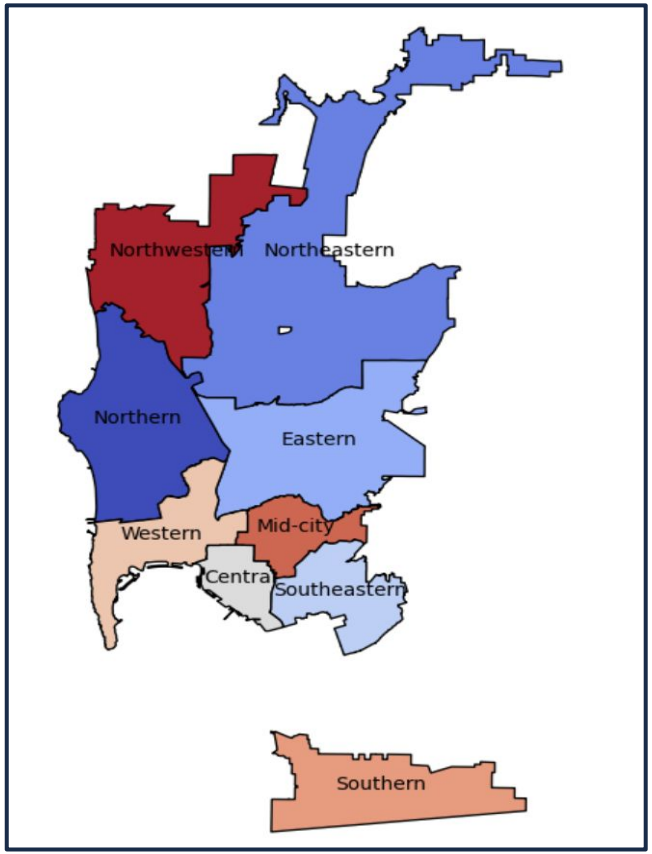
Geospatial Analysis

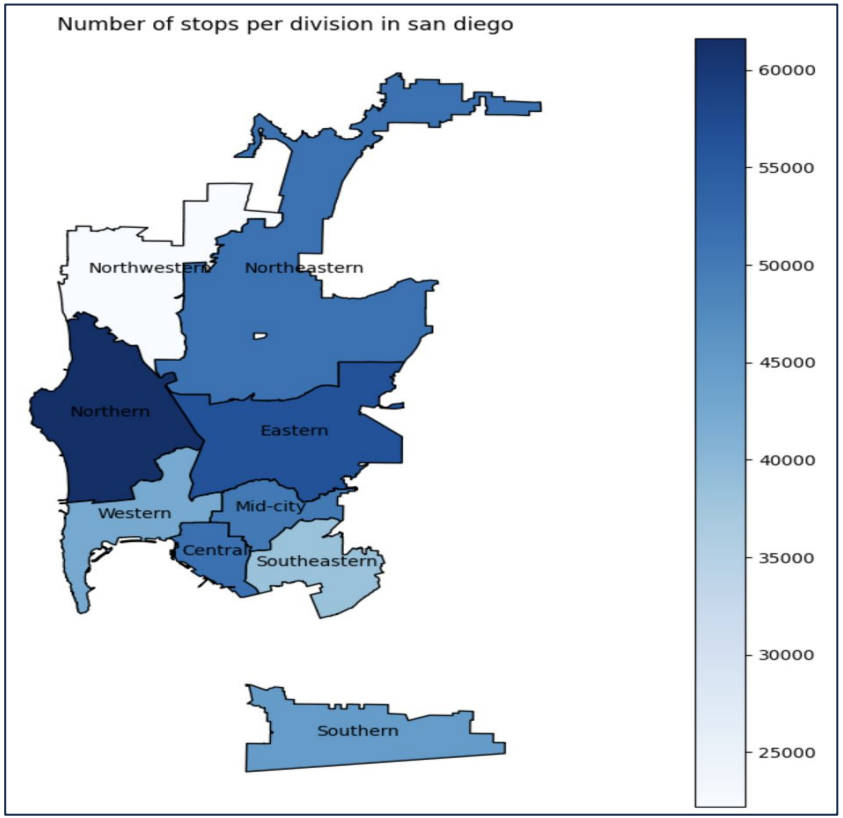
Geospatial Analysis

- Which parts of San Diego has more stops?
- Which part of San Diego has highest probability of arrest?
- Note:- The police departments has divided San Diego into 9 divisions



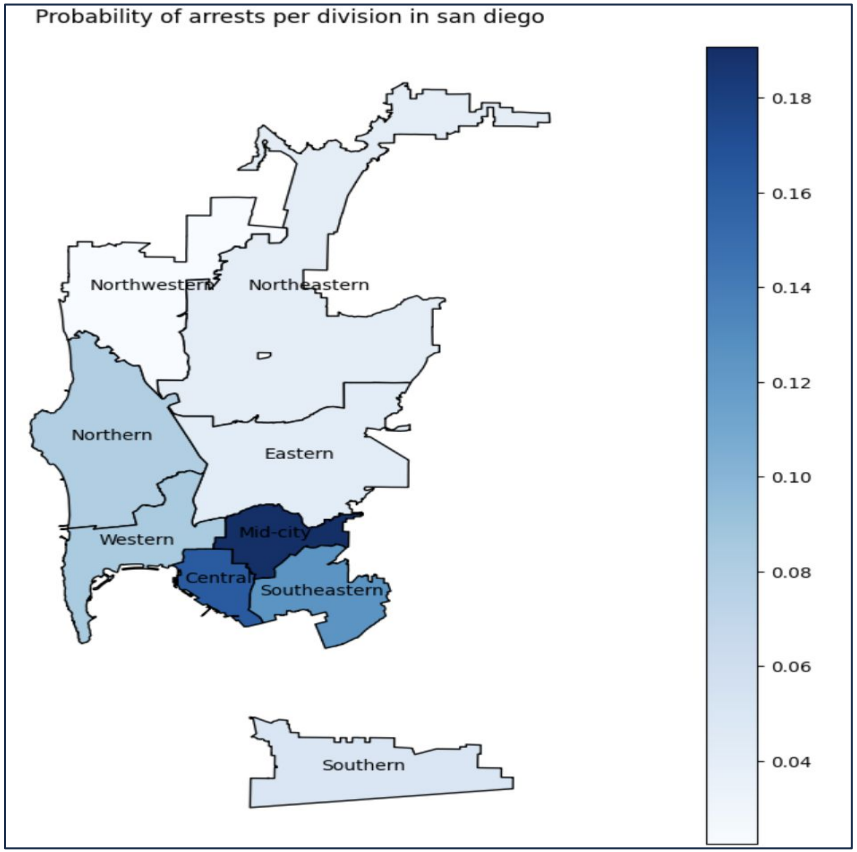
Geospatial Analysis - Most Stops

- Northern division has highest stops.
- Many tourist attractions.
- More population compared to other regions.



Geospatial Analysis - Most Arrests

- Mid-city division has highest probability of Arrests.
- Mid-city has highest probability of arrests, this could be because the area experiences high crime rate, rules violations.



Geospatial Analysis - Inference

- Northern division has more stops, due huge population and many tourist attractions.
- Helps to identify the requirement of resource allocation.
- Mid-city has highest probability of arrests, this could be because the area experiences high crime rate, rules violations.

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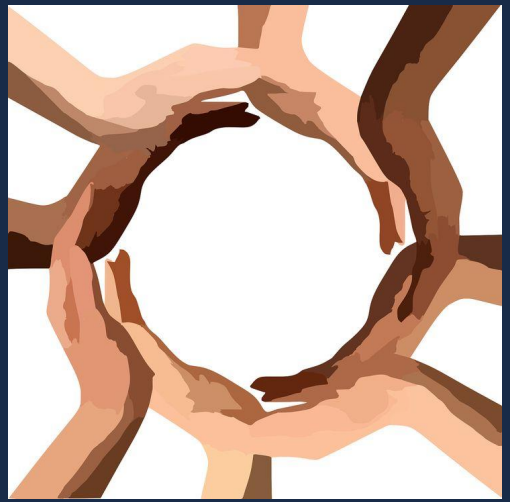
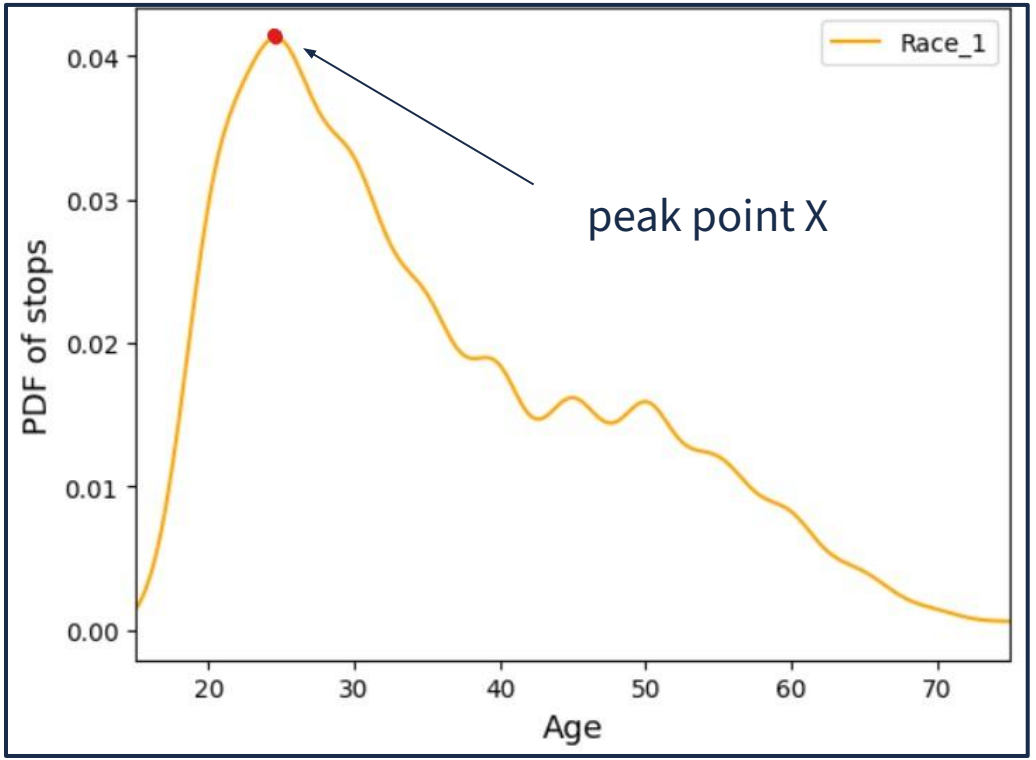
Demographic Analysis

Main Question :- Is there Bias and Discrimination against a Race or age group?



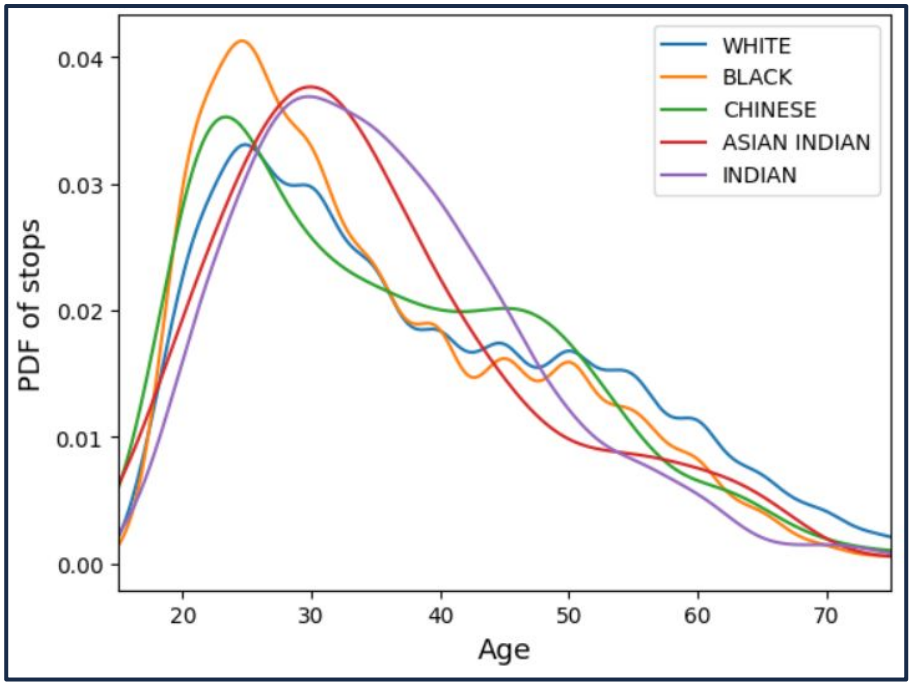
Demographic Analysis

- Point X has coordinates.
  - (27,0.04)
- P(stopping|Race, Age) = Y_coordinate.
- Probability for current example
  - P(stopping|Race_1, 27) = 0.04
- More probability means more bias towards one age group or Race.



Demographic Analysis

- From the combined graph, P(stopping|Black, 27) = 0.04 which is the highest.
- This means that a young black person will get stopped by the cops more often.
- Ideally the PDF for Races should be same. Only then we can say that Bias against anyone group is absent. But that is not the case here.



Demographic Analysis

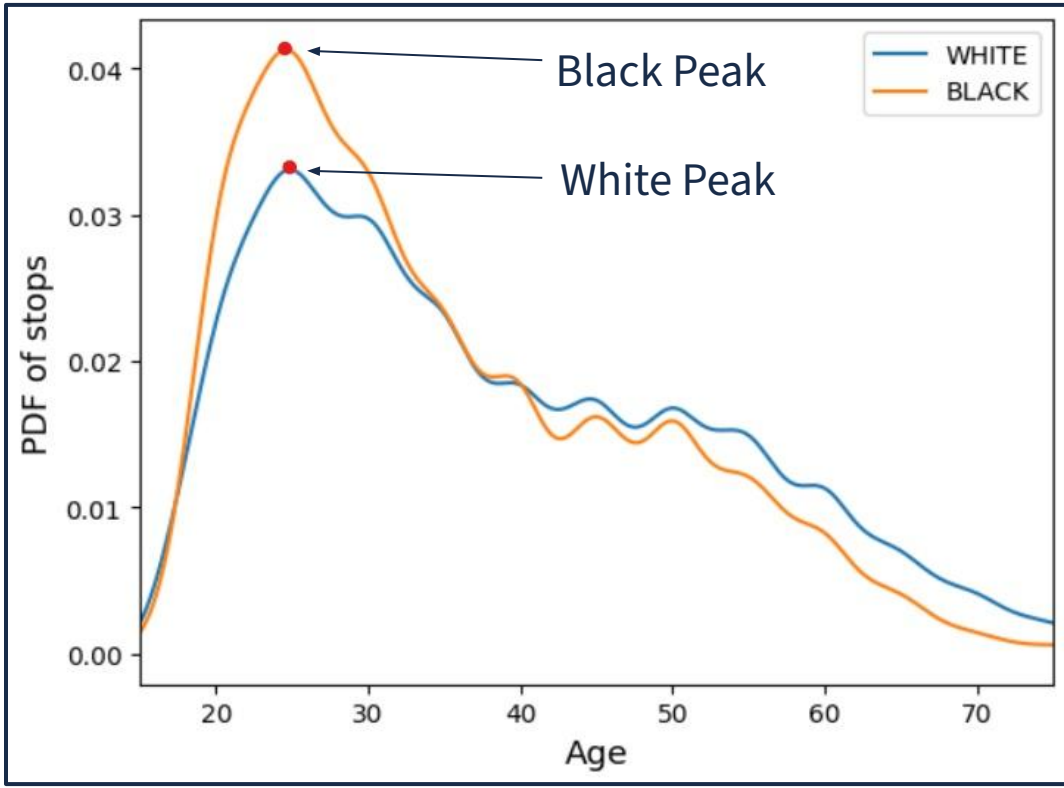
- P(stopping|Black,27) = 0.04
- P(stopping|White,27) ~ 0.032

  i.e

  P(stopping|Black, 27)>

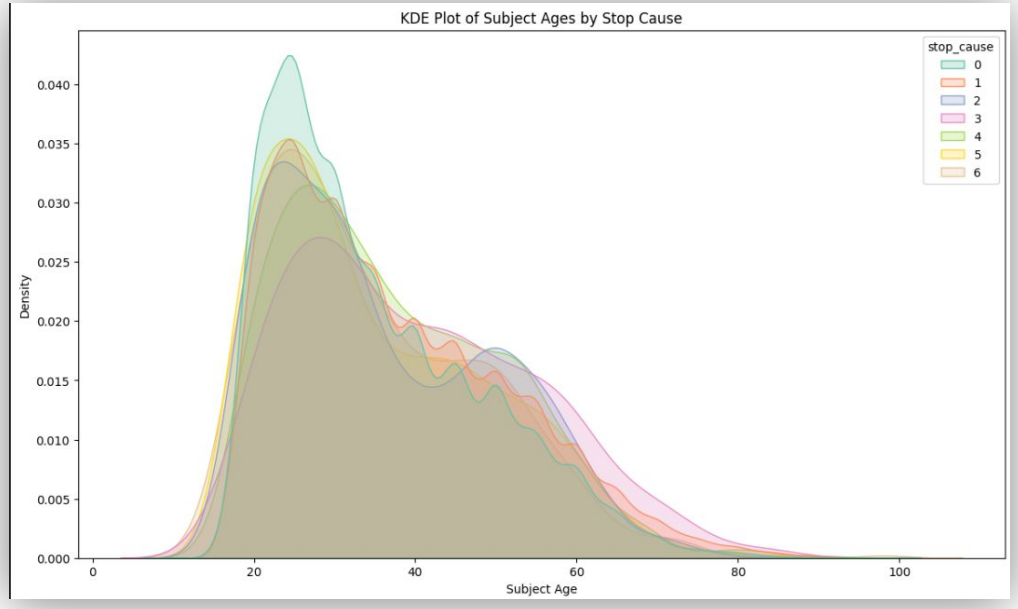
  P(stopping|White, 27)

- This means a young black person is more likely to get stopped than a young white person.



Age Vs Stop Cause

- Same trends as observed in the age vs Race graph.
- Youngsters are more likely to be stopped by the police than compared elderly folks.
- People usually stop driving cars/vehicles after 65. Hence a sudden drop in %.



Demographic Analysis-Inferences

- The probability tells that a young Black person is more likely to get stopped by the cops.
- Does this mean that there is a Race/age bias?
- The answer is no, we still need more data to analyse.

Summary/Conclusion

- **Temporal Analysis**
  By the trend of stops in a day and a year, we suggest that increasing police workforce on commute hours and holidays from March to December help to optimize the resource of police.

- **Geospatial Analysis**
  The division with higher stops require more resource allocations.

- **Demographic Analysis**
  The probability distribution indicates that there is a bias, but more evidence is needed to back the statement.

Outliers - Always follow the rules!!

Reference

- City Demographic Profiles San Diego County
- Racist Comments, Excessive Force and Offensive Behavior Revealed in San Diego Police Department Internal Affairs Cases
- https://voiceofsandiego.org/wp-content/uploads/2014/01/Vehicle-Stop-form.pdf
- RIPA police stop data - race of persons stopped - City of San Diego Open Data Portal

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