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# Segmenting & Clustering of London Boroughs:

Feasible Recommendations for  
Individuals & Businesses

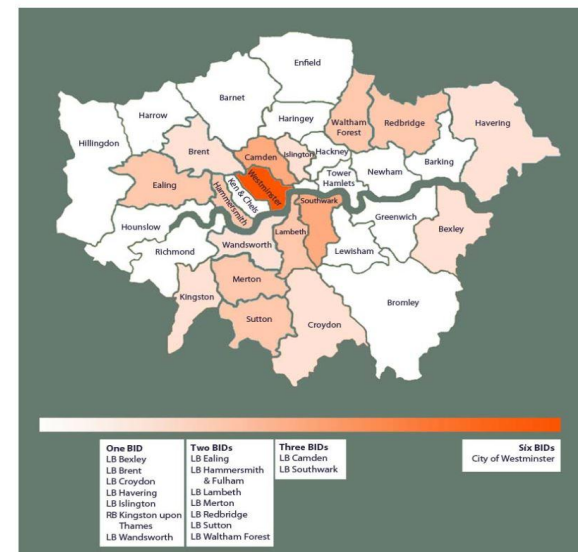
Business Proposal by,  
Sandeep Aswathnarayana

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**Sandeep Aswathnarayana**

# 1. Business Problem

- Londoners are in urgent need of family-sized social rented homes to tackle the capital's chronic overcrowding problems
- In 2018/19, London's dwelling stock saw a net increase of 35,959 dwellings compared to the year before
- The population is projected to increase to 9.7 million by 2025 (an increase of 17% from the 2011 Census) and reach 10 million by 2030
- There were over 5 million international visitors to London in 2019 Q2, up 2.3% from the same quarter a year before.
- Small firms account for almost 99% of London's businesses and nearly 50% of the capital's employment.



International students make up...

**19.6%**

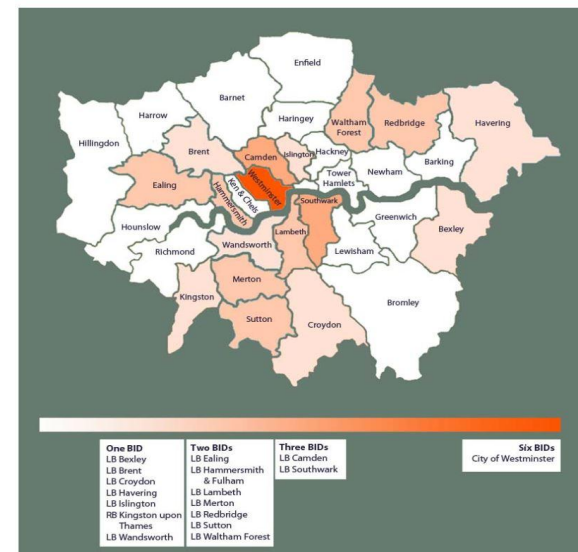
of the total student population.



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## 2. Target Audience

- Professionals or Individuals relocating to London for work
- International Students & Overseas Nationals
- Small Businesses
- Policy Makers
- Law Enforcement
- Families & Communities
- Housing & Real Estate Sector
- Voluntary Crime Prevention Movements (Ex: Neighborhood Watch)



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of the total student population.



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## 3.1. Data & Data Sources:

- [MPS Borough Level Crime Data](#) counts the number of crimes in London at the borough-level per month, based on the crime type.

	MajorText	MinorText	LookUp_BoroughName	201803	201804	201805	201806	201807	201808	201809	201810	201811
0	Arson and Criminal Damage	Arson	Barking and Dagenham	6	3	4	12	6	5	3	8	5
1	Arson and Criminal Damage	Criminal Damage	Barking and Dagenham	115	122	126	123	127	101	107	131	105
2	Burglary	Burglary - Business and Community	Barking and Dagenham	38	36	24	33	30	18	33	32	39
3	Burglary	Burglary - Residential	Barking and Dagenham	122	75	93	77	94	84	99	94	106
4	Drug Offences	Drug Trafficking	Barking and Dagenham	7	3	8	6	9	7	10	7	7

## 3.2. Data & Data Sources:

- [List of London boroughs](#) dataset will help us extract and analyze the attributes including Population Density for each of the 32 boroughs and their respective Co-ordinates.

List of boroughs and local authorities [\[ edit \]](#)

Borough	Inner	Status	Local authority	Political control	Headquarters	Area (sq mi)	Population (2013 est) <sup>[1]</sup>	Co-ordinates	<a href="#">Nr.</a> <a href="#">in</a> <a href="#">map</a>
<a href="#">Barking and Dagenham</a> <sup>[note 1]</sup>			<a href="#">Barking and Dagenham London Borough Council</a>	<a href="#">Labour</a>	<a href="#">Town Hall</a> , 1 Town Square	13.93	194,352	 <a href="#">51.5607°N 0.1557°E</a>	25
<a href="#">Barnet</a>			<a href="#">Barnet London Borough Council</a>	<a href="#">Conservative</a>	<a href="#">North London Business Park</a> , Oakleigh Road South	33.49	369,088	 <a href="#">51.6252°N 0.1517°W</a>	31
<a href="#">Bexley</a>			<a href="#">Bexley London Borough Council</a>	<a href="#">Conservative</a>	<a href="#">Civic Offices</a> , 2 Watling Street	23.38	236,687	 <a href="#">51.4549°N 0.1505°E</a>	23
<a href="#">Brent</a>			<a href="#">Brent London Borough Council</a>	<a href="#">Labour</a>	<a href="#">Brent Civic Centre</a> , Engineers Way	16.70	317,264	 <a href="#">51.5588°N 0.2817°W</a>	12
<a href="#">Bromley</a>			<a href="#">Bromley London Borough Council</a>	<a href="#">Conservative</a>	<a href="#">Civic Centre</a> , Stockwell Close	57.97	317,899	 <a href="#">51.4039°N 0.0198°E</a>	20
<a href="#">Camden</a>	✓		<a href="#">Camden London Borough Council</a>	<a href="#">Labour</a>	<a href="#">Camden Town Hall</a> , Judd Street	8.40	229,719	 <a href="#">51.5290°N 0.1255°W</a>	11
<a href="#">Croydon</a>			<a href="#">Croydon London Borough</a>	<a href="#">Labour</a>	<a href="#">Bernard Weatherill</a>	33.41			

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## 3.3. Data & Data Sources:

- The [Foursquare Venues & Places Database](#) gives the full details about a venue including location, tips, and categories. Given the scope of the project, let's use the top 50 popular venues provided by the Foursquare Developer API.

	BoroughName	Borough Latitude	Borough Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Barking and Dagenham	51.5607	0.1557	Central Park	51.559560	0.161981	Park
1	Barking and Dagenham	51.5607	0.1557	Crowlands Heath Golf Course	51.562457	0.155818	Golf Course
2	Barking and Dagenham	51.5607	0.1557	Robert Clack Leisure Centre	51.560808	0.152704	Martial Arts Dojo
3	Barking and Dagenham	51.5607	0.1557	Morrisons	51.559774	0.148752	Supermarket
4	Barking and Dagenham	51.5607	0.1557	Becontree Heath Bus Station	51.561065	0.150998	Bus Station

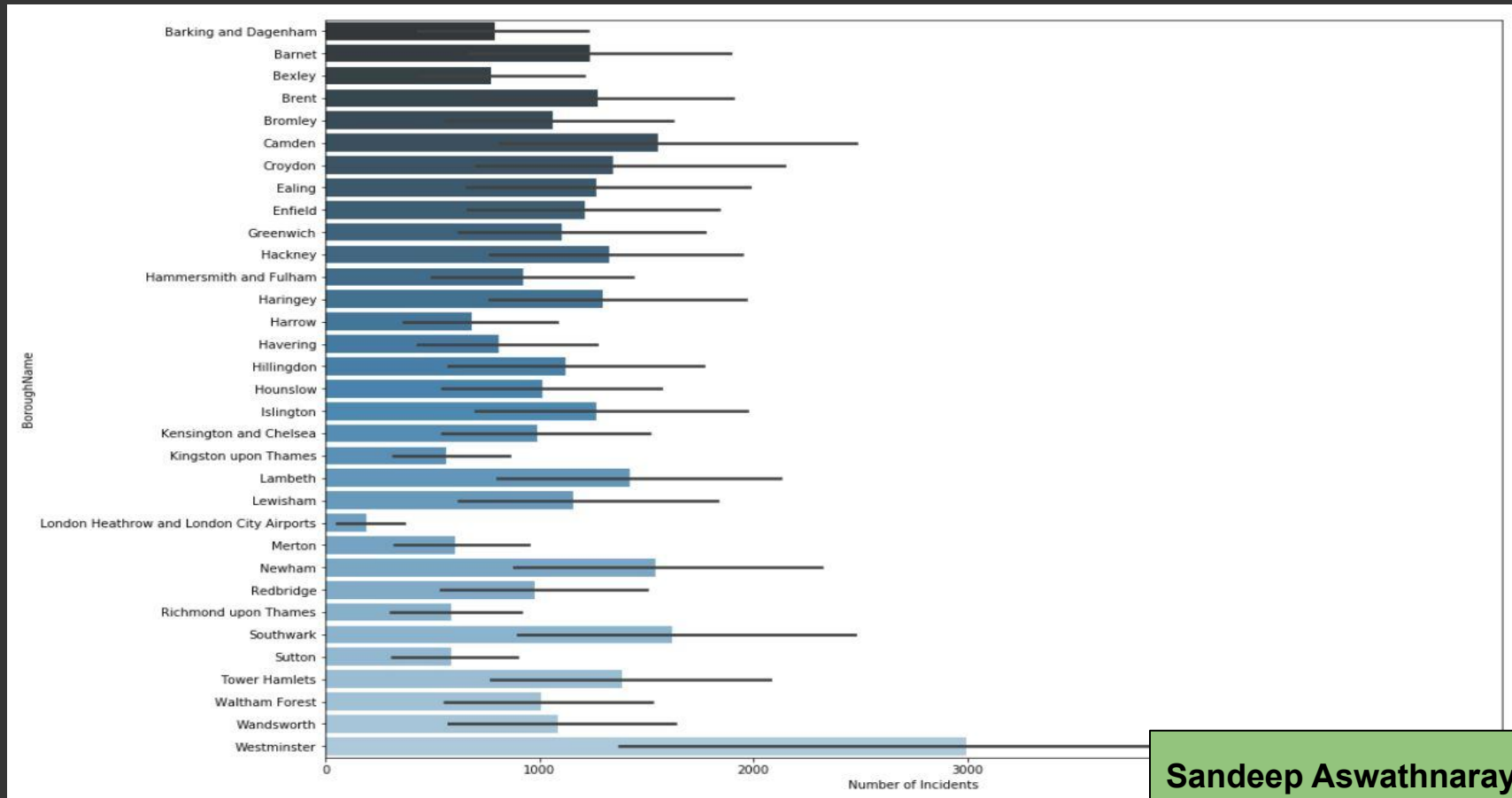
## 4.1. Exploratory Data Analysis & Visualizations:





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- Borough vs. Number of Incidents

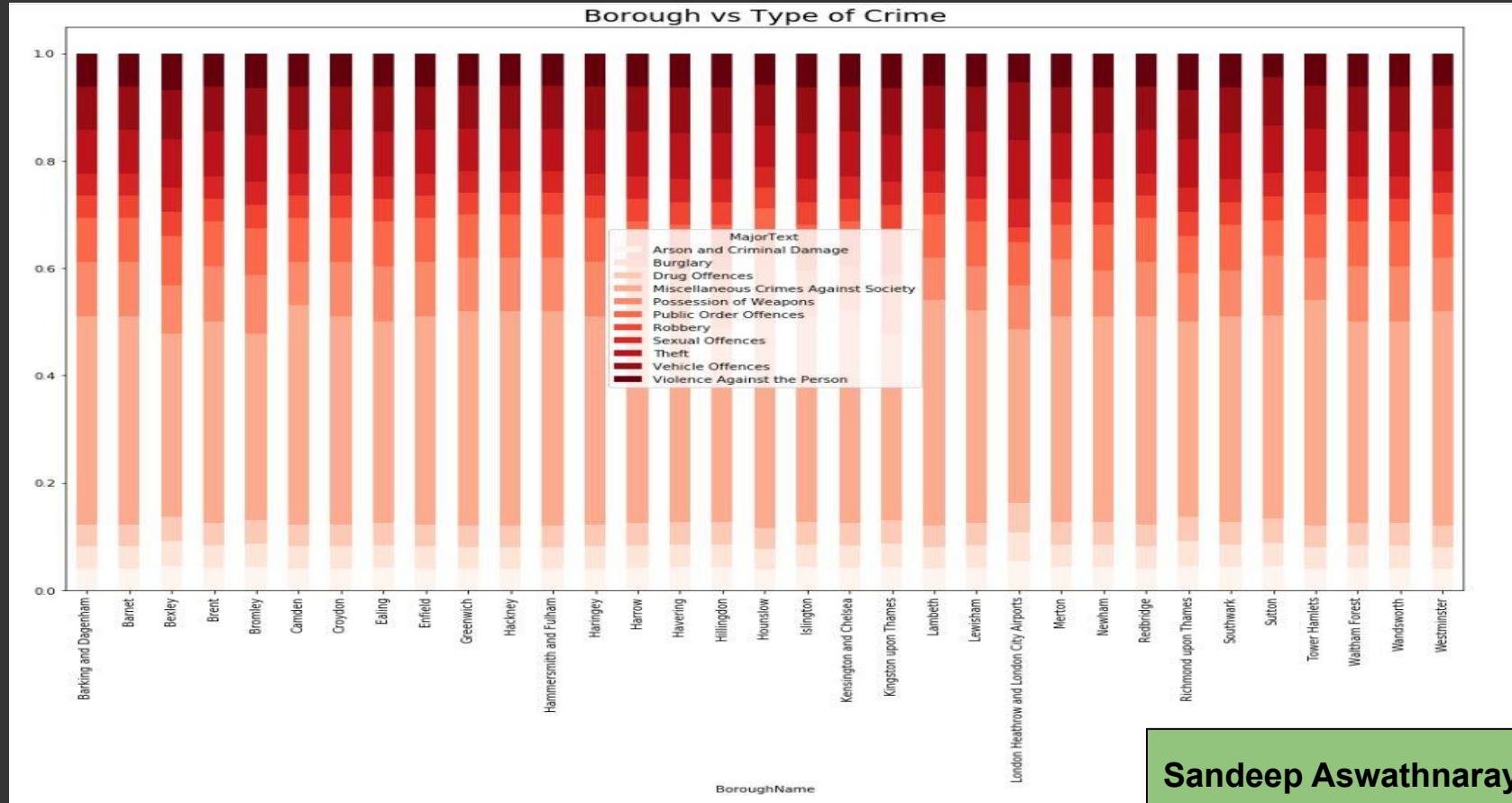


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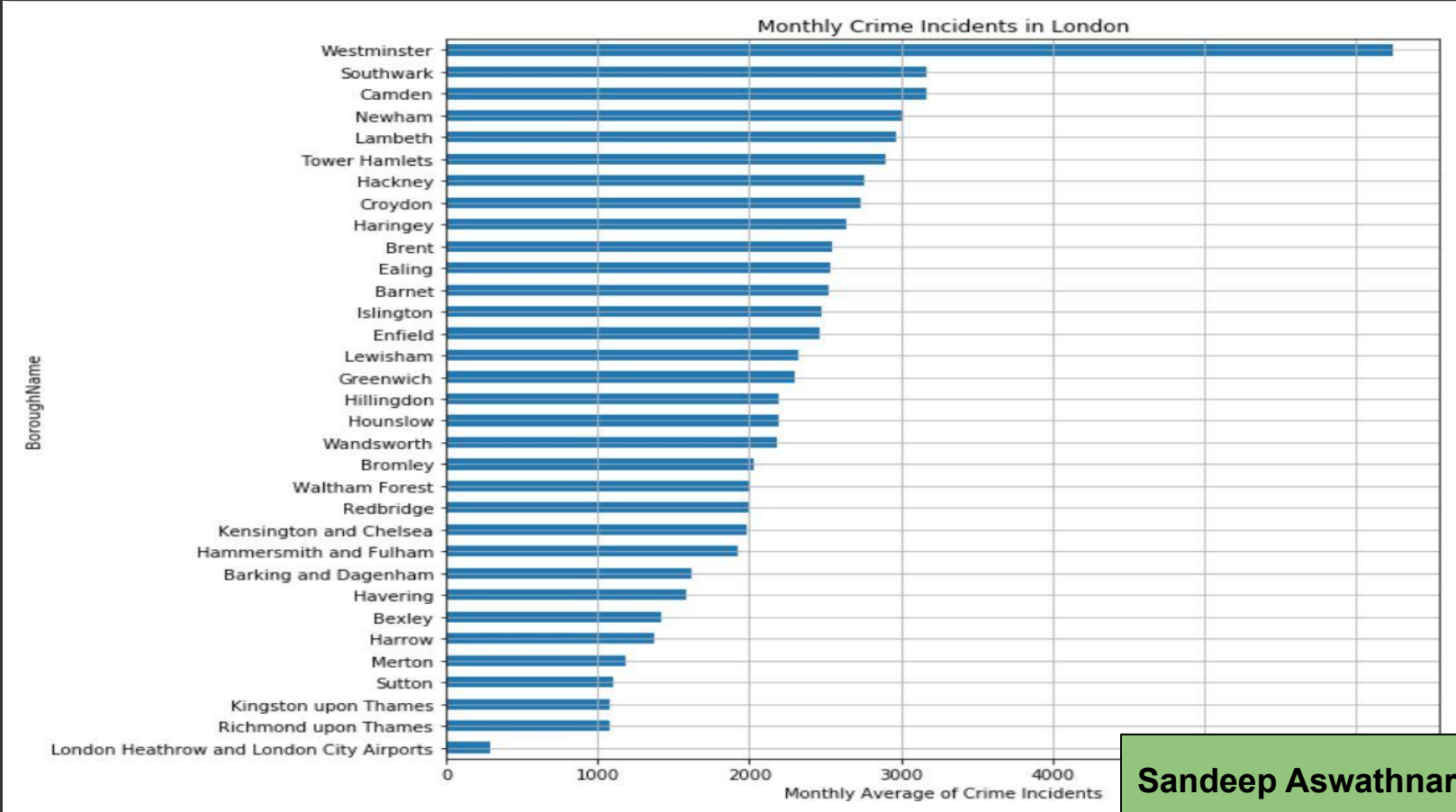
# 4.1. Exploratory Data Analysis & Visualizations:

- Borough vs. Type of Crime



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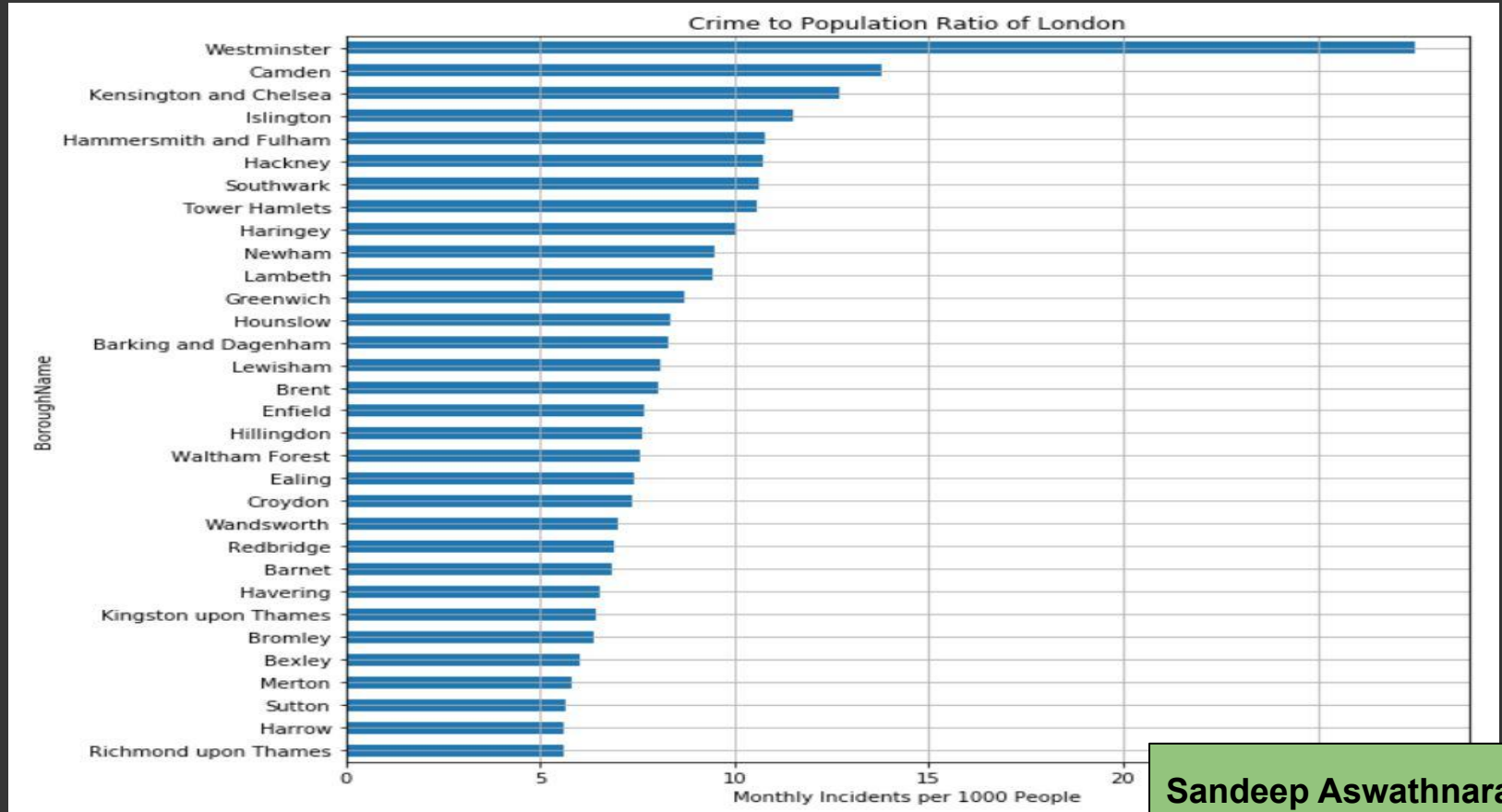
- Borough vs. Monthly Average of Crime Incidents



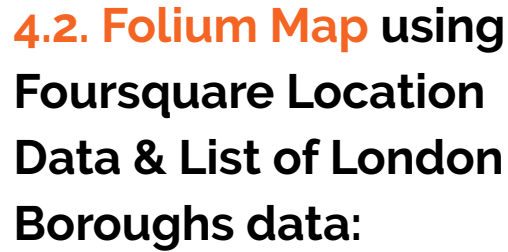
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## 4.1. Exploratory Data Analysis & Visualizations:

- Borough vs. Monthly Incidents per 1000 people



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- The visualization of all the 32 boroughs on the folium map are obtained using the 'List of London Boroughs data' including coordinates, population density of the respective boroughs.



### 4.3. Top 10 most popular venues using Foursquare Location Data

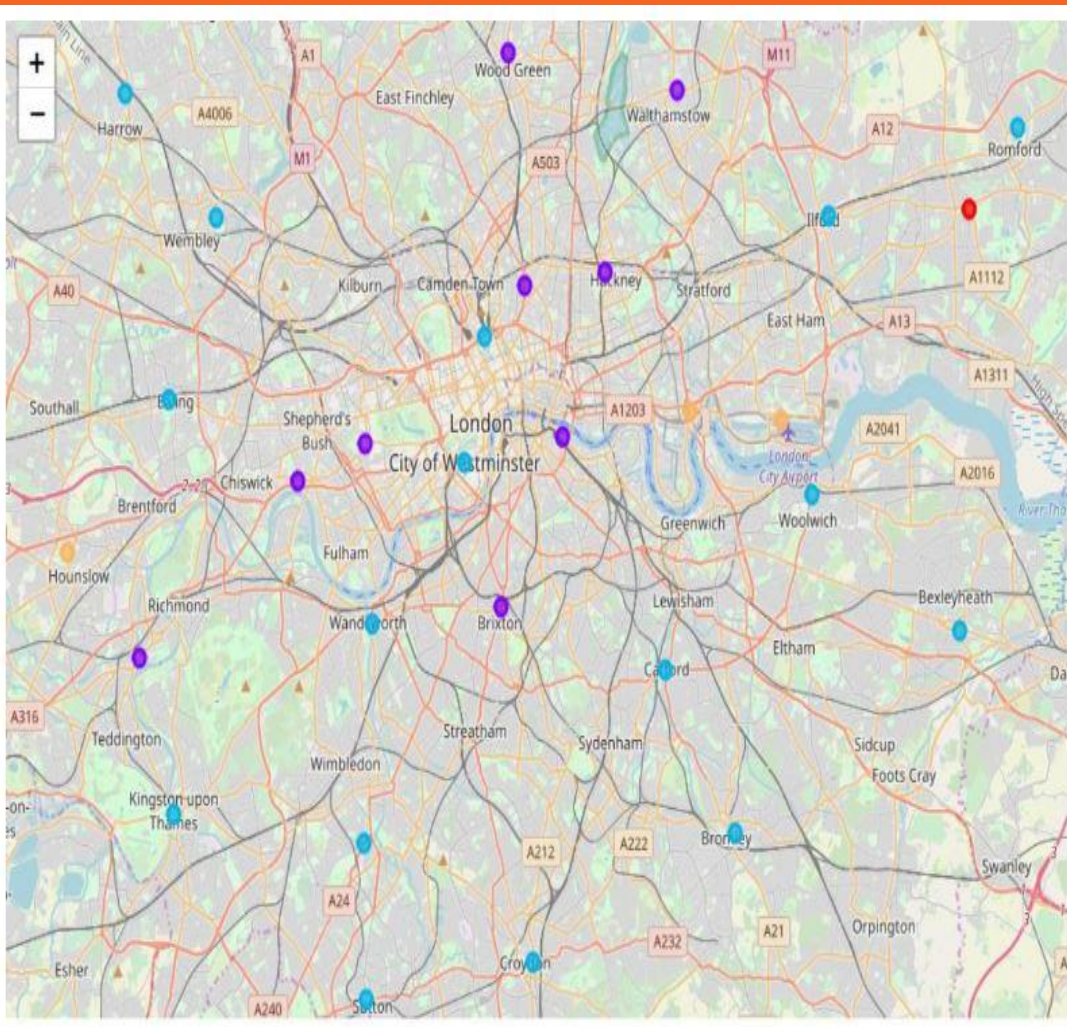
- The venues from the same boroughs are grouped together by borough names and popular categories are discovered by frequency.

Out[0]:

	BoroughName	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue
0	Barking and Dagenham	Pool	Bus Station	Supermarket	Gym / Fitness Center	Park	Martial Arts Dojo	Golf Course	Dumpling Restaurant	Fish & Chips Shop
1	Barnet	Café	Bus Stop	Yoga Studio	Cupcake Shop	Food Court	Flea Market	Fish Market	Fish & Chips Shop	Field
2	Bexley	Coffee Shop	Clothing Store	Pub	Supermarket	Italian Restaurant	Fast Food Restaurant	Pharmacy	Plaza	Grocery Store
3	Brent	Coffee Shop	Hotel	Sporting Goods Shop	Grocery Store	Clothing Store	Bar	American Restaurant	Sandwich Place	Burger Joint
4	Bromley	Coffee Shop	Clothing Store	Pizza Place	Gym / Fitness Center	Burger Joint	Bar	Burrito	Sandwich	Chocolate

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## 4.4. K-Means Clustering Analysis:

- Based on the common venue categories & characteristics, boroughs are grouped into 5 major Clusters using the Folium Map as shown.

## 4.5. Segmenting & Classification of Clusters:

Based on the observations, each cluster is named with respect to its characteristics respectively.

### 1. Cluster 0:

Characteristics: Coffee Shop, Clothing Store, etc.

	BoroughName	CrimeToPop	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue
0	Barking and Dagenham	8.317383	0	Pool	Bus Station	Supermarket	Gym / Fitness Center	Park	Martial Arts Dojo
2	Bexley	6.002829	0	Coffee Shop	Clothing Store	Pub	Supermarket	Italian Restaurant	Fast Food Restaurant
3	Brent	8.031429	0	Coffee Shop	Hotel	Sporting Goods Shop	Grocery Store	Clothing Store	Bar

	BoroughName	CrimeToPop	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue
1	Barnet	6.833736	1	Café	Bus Stop	Yoga Studio	Cupcake Shop	Food Court	Flea Market

### 2. Cluster 1:

Characteristics: Yoga Studio, Cupcake Shop, etc.

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### 3. Cluster 2:

Characteristics: Hotel, Airport, etc.

	BoroughName	CrimeToPop	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue
23	Newham	9.493485	2	Hotel	Airport Service	Airport	Pharmacy	Rafting	Sandwich Place

### 4. Cluster 3:

Characteristics: Restaurant, Theater, etc.

	BoroughName	CrimeToPop	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue
13	Harrow	5.629242	3	Indian Restaurant	Indie Movie Theater	Convenience Store	Coffee Shop	Supermarket	Electronics Store

	BoroughName	CrimeToPop	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue
16	Hounslow	8.352959	4	Park	Indian Restaurant	Airport Lounge	Fast Food Restaurant	Café	Restaurant

### 5. Cluster 4:

Characteristics: Park, Restaurant, etc.

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# 5.1. Results:

## Key Insights & Takeaways:

In May 2019 the total number of offences in London was 75717 - up 6.1% from the same month last year and up 1.2% from the previous month.

Over the last 12 months, 25 of London's 32 Boroughs have seen an increase in the number of crimes committed compared with the previous 12 months. The biggest increase was seen in Westminster (up 23.3%) while the largest fall in crime was seen in Islington (down 6.8%).

The number of crimes on the transport network in the quarter July-Sept 2019/20 (9,043) was up 15.2 per cent compared with the same quarter in 2018/19 (7,853).

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## 5.2. Evaluation Metrics

### Safety:

The Safety Score is determined by normalizing the crime to population ratio, and reversed the score such that '1' represents a neighborhood with least crime per person.

	BoroughName	CrimeToPop	Cluster Labels	Safety	Atmosphere
0	Barking and Dagenham	8.317383	0.8	0.876806	0.0
1	Barnet	6.833736	1.0	0.944609	0.9
2	Bexley	6.002829	0.8	0.982581	0.0
3	Brent	8.031429	0.8	0.889874	0.0
4	Bromley	6.397472	0.8	0.964546	0.0

### Atmosphere:

To compute Atmosphere value, an arbitrary score to each cluster is assigned based on the personal preference, given that preference is not easy to quantify without subjectivity.

Highest & Lowest scores were given to the cluster accordingly.

	BoroughName	Safety	Atmosphere	Score
1	Barnet	0.944609	0.9	1.844609
23	Newham	0.823058	1.0	1.823058
13	Harrow	0.999654	0.7	1.699654
25	Richmond upon Thames	1.000000	0.0	1.000000
27	Sutton	0.998617	0.0	0.998617
22	Merton	0.990507	0.0	0.990507
2	Bexley	0.982581	0.0	0.982581
4	Bromley	0.964546	0.0	0.964546
19	Kingston upon Thames	0.961707	0.0	0.961707
14	Havering	0.956836	0.0	0.956836
24	Redbridge	0.941911	0.0	0.941911

# 6. Discussion & Recommendations:

## Recommendations to combat Residential Burglary::

- Property Marking
- MetTrace
- Visual burglar alarm, garage burglar alarm
- Neighborhood Watch Scheme

## Recommendations to combat Business Burglary::

- Businesses need to make sure they have a monitored alarm and that it's fully operational as approved by the NSI and SSAIB
- Other Safety Devices: Anti-ram raider bollards, bolted-down safe with a time lock and anti-tamper sensors, smoke-generating devices that activate on unauthorised entry, etc.

## Recommendations to combat Motor Vehicle Theft::

- ParkMark, Thatcham Security, Always check for Cloning in the DVLA V5 Document before buying a used vehicle, Secure your engine management diagnostic port.

## 7. Limitations:

- Trade-off: One has to put up with no public transportation for commute in order to have a much safer neighborhood where one resides. As a matter of fact, proximity to public transportation make the neighborhoods more prone to crimes. As a result of this, most of the neighborhoods vote themselves out of the access to public transportation. (Ex: DART in DFW Area).
- Among the numerous factors that determine a good neighborhood, I narrowed down my research considering only the popular venues and crime incidents provided the time and scope of the project.
- To overcome the limitations of this study, we will need further data such as housing prices, proximity to the most basic services such as hospitals, grocery stores.

# 8. Conclusion:

Programs by The Mayor's Office for Policing And Crime (MOPAC):

- The Mayor investing in services that would substantially help reduce crime by supporting young people at risk of or engaged in serious violence and help them into employment, education or training: Young Londoners Fund, The London Gang Exit (LGE) Service, Stepping Stones Programme, London Needs You Alive, Safer School Officers

What MPS is doing?

- Funding the recruitment of more police officers, > 30,000
- Body-worn video cameras and mobile data tablets for officers
- Investing in a new counter-terror hub for London. Overseeing the work of the MPS on behalf of Londoners, scrutinising key issues such as the MPS Gangs Matrix, Facial Recognition technology.

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