

# Comparative analysis of the wards in the city of Derby (United Kingdom) based on venue information, price house and criminality rate

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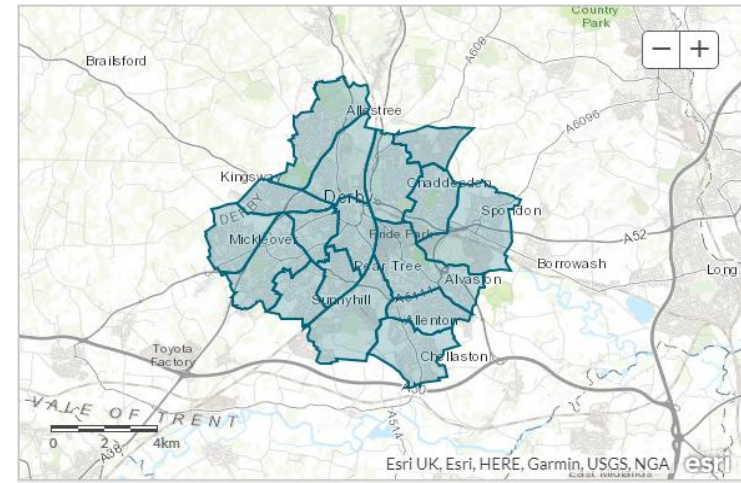
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# Introduction / Business Problem

## Derby:

- City in United Kingdom
- Divided into 17 wards.
- City with one of highest proportions of advanced manufacturing jobs in UK
  - Rolls-Royce plc, Toyota, Bombardier have manufacturing plants in/around Derby
- Significant amount of employees relocating to Derby for job reasons
- Key decision to make – where to rent/purchase a property?



Map of Derby and its wards.

Source: <https://info4derby.derby.gov.uk/>

## Project Focus:

- Comparison of Derby wards based on Median house prices, Criminality Rate and available venues.

# Data Sources

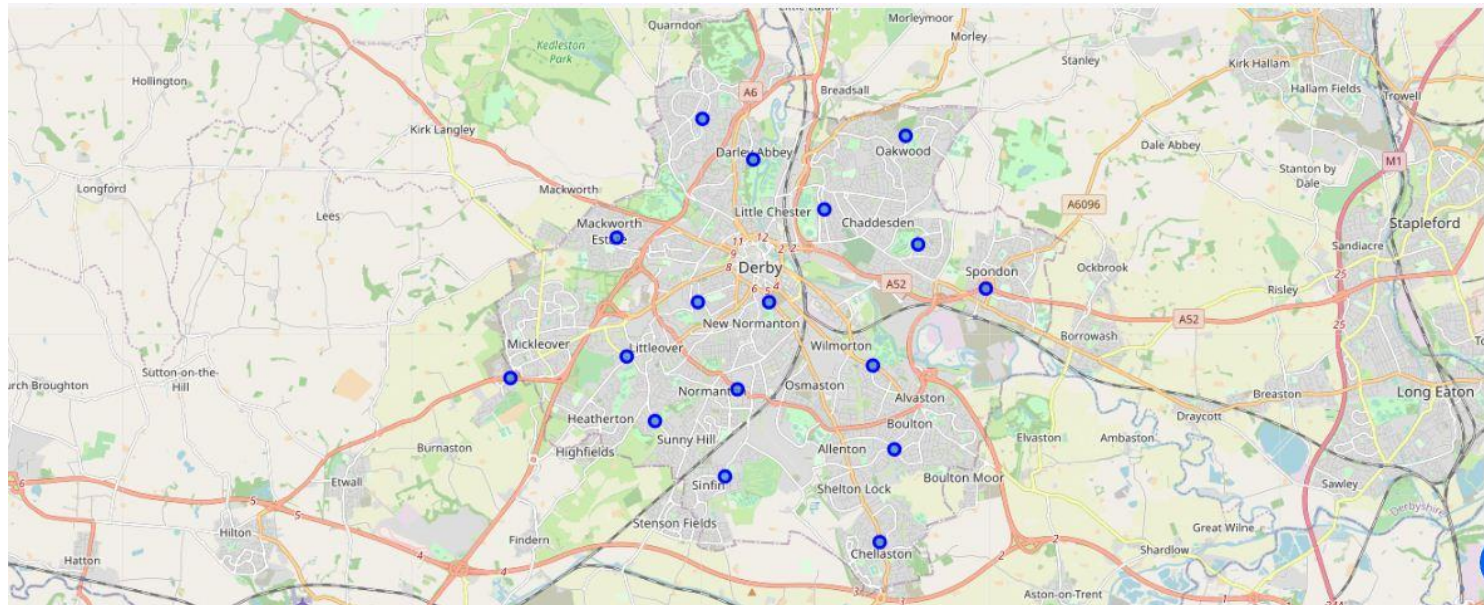
The following information will be used in the project

1. Existing venues in Derby wards – via Foursquare API:  
<https://developer.foursquare.com/>
2. Coordinates of central locations in each ward – via Google Maps:  
<https://www.google.com/maps>
3. Criminality rate in each of Derby ward in the period May 2019 – May 2020, measured as rate of crimes per 1000 population -  
<https://info4derby.derby.gov.uk/crime-and-community-safety/reports/>
4. Median price paid for all property types in each of the Derby wards during Q1 2019, expressed in GBP -  
<https://info4derby.derby.gov.uk/housing/report/view/d867ba1e909244c8ac75f97294cb7b93/E05001767>

# Methodology

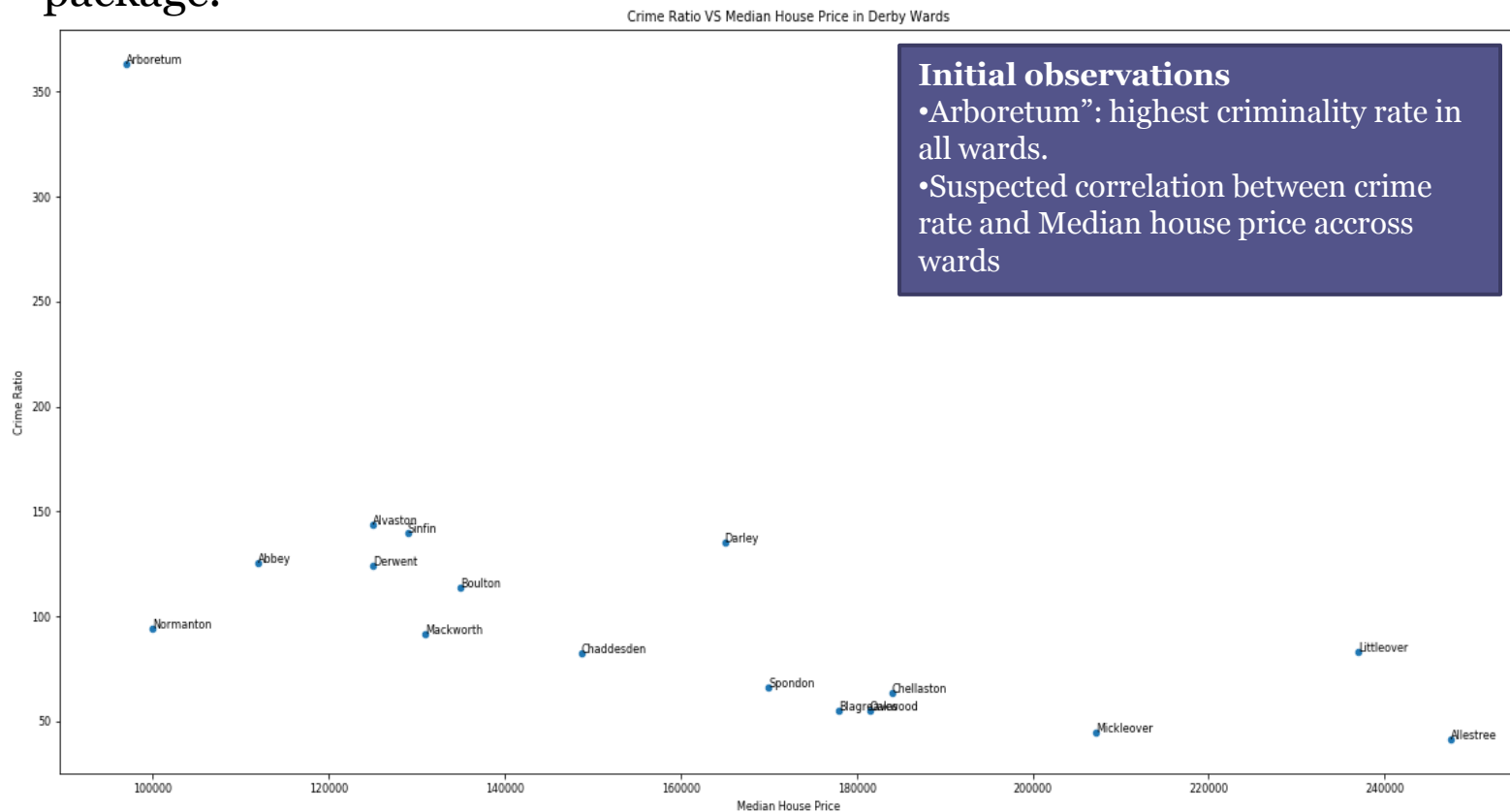
1. Import gathered data into a Jupyter Notebook as a Pandas Dataframe to start the analysis
2. Plot the map of Derby indicating the locations of the 17 wards using Folium package, using the coordinates information in the Dataframe

	Ward	Median House Price	Crime Ratio	Latitude	Longitude
0	Abbey	112000	125.3	52.915000	-1.495000
1	Allestree	247500	41.3	52.948348	-1.493778
2	Alvaston	124975	143.7	52.903394	-1.442030
3	Arboretum	97000	363.4	52.914987	-1.473701
4	Blagreaves	178000	55.2	52.893152	-1.508161
5	Boulton	135000	114.0	52.887999	-1.435588
6	Chaddesden	148725	82.5	52.925382	-1.428161
7	Chellaston	184000	63.7	52.870911	-1.440029
8	Darley	165000	135.0	52.940987	-1.478267
9	Derwent	125000	124.1	52.931858	-1.456803
10	Littleover	237000	83.1	52.904978	-1.516901
11	Mackworth	131000	91.6	52.926670	-1.520060
12	Mickleover	207250	44.7	52.901000	-1.552000
13	Normanton	99998	94.1	52.899000	-1.483000
14	Oakwood	181500	54.8	52.945314	-1.432160
15	Sinfin	129000	139.9	52.883000	-1.487000
16	Spondon	170000	65.9	52.917295	-1.407517



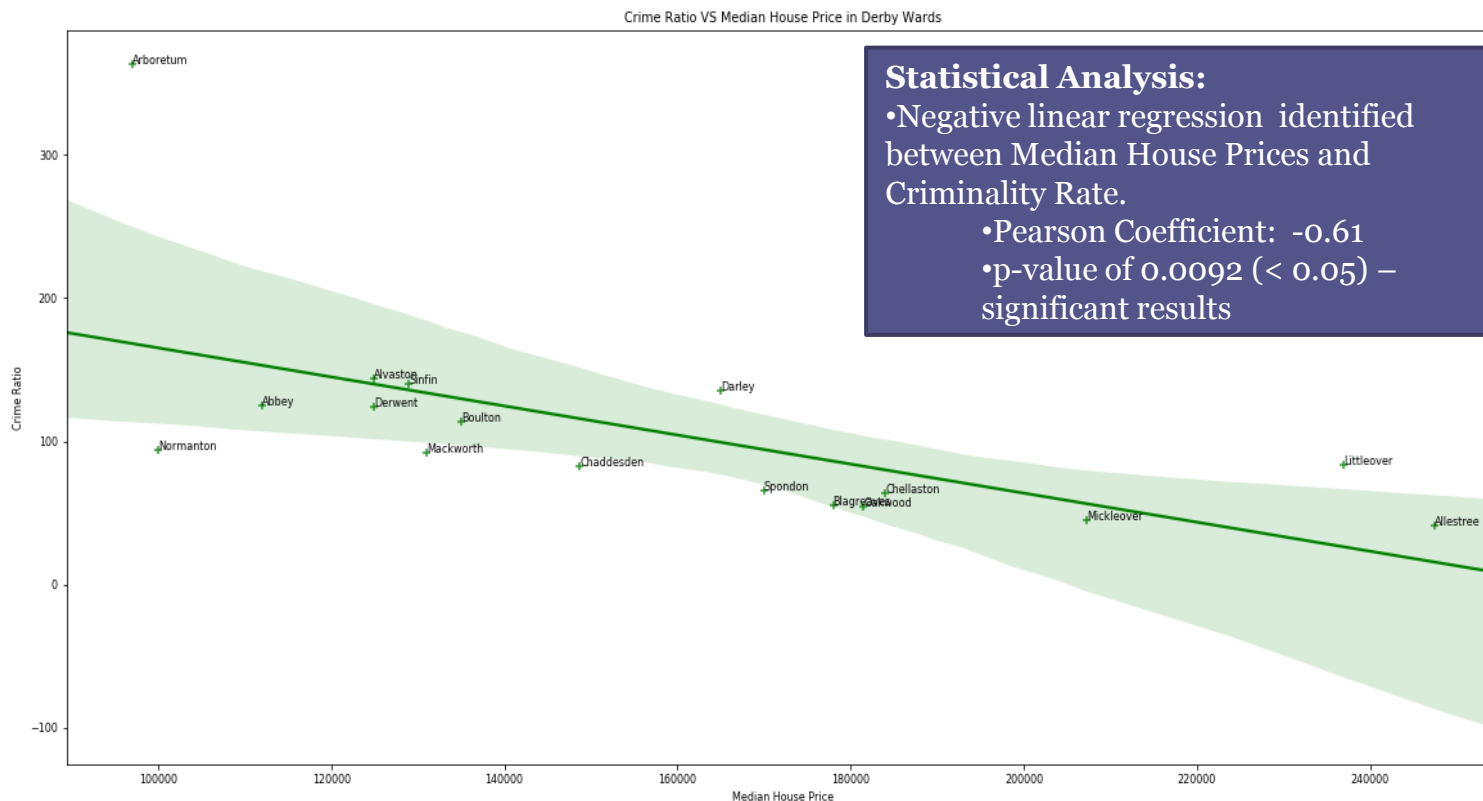
# Methodology

## 3. Analysis of Median House Prices (x axis) VS Criminality Rate (y axis) across 17 Derby Wards with a Scatter Plot, created using Matplotlib Pyplot package.



# Methodology

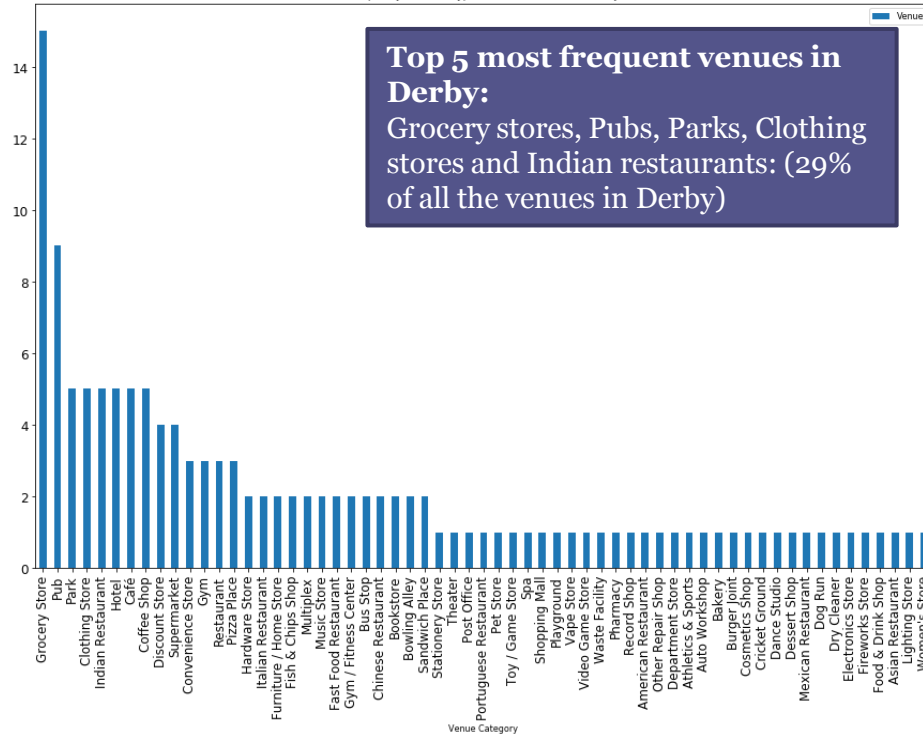
4. Statistical Analysis of Median House Prices (x axis) VS Criminality Rate (y axis) across 17 Derby Wards.
- Regression Plot created using the Seaborn package
  - Pearson coefficient and p-value obtained using Scipy package



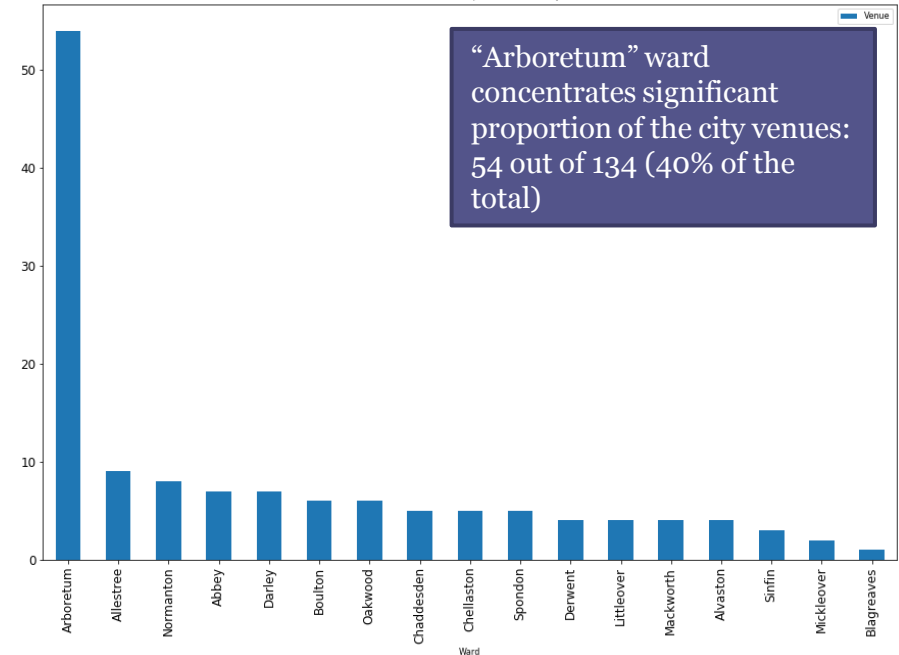
# Methodology

## 5. Gathering of venue information for Derby wards from API Foursquare (venues within 650m of central point in each ward) => 134 venues

Frequency of venue types across all wards in Derby



Number of Venues per ward in Derby





# Methodology

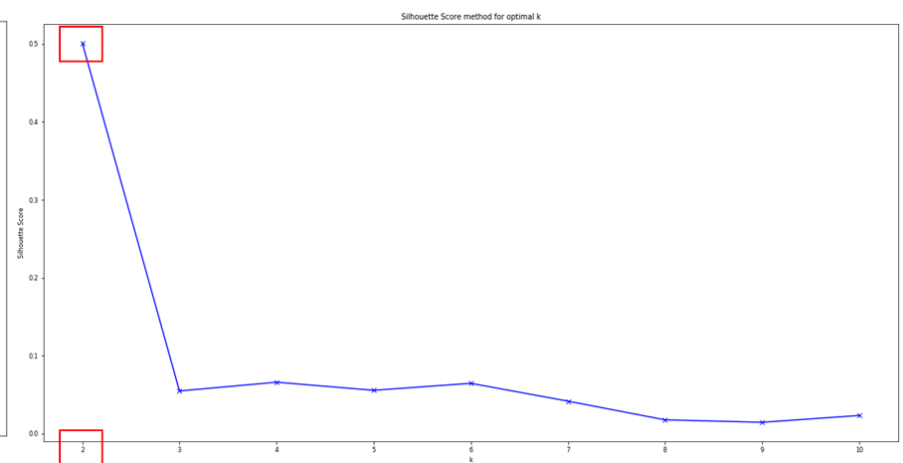
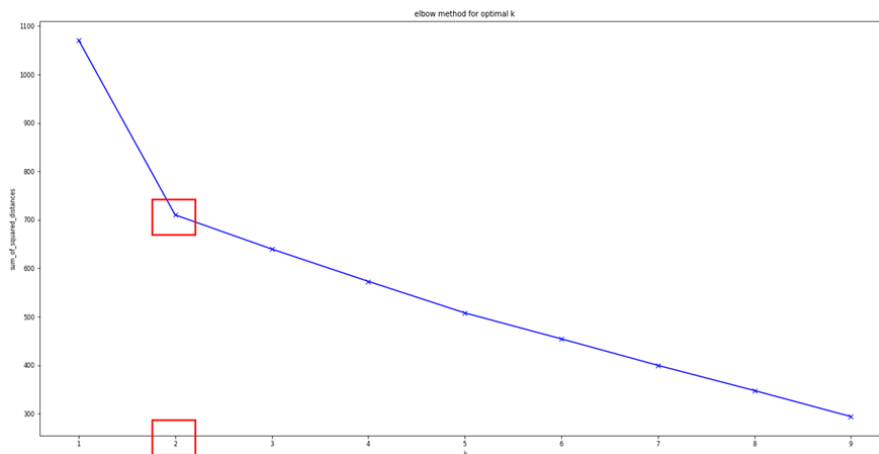
## 6. Calculation of top 10 most frequent venue types in each Derby Ward

	Ward	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	10th Most Common Venue
0	Abbey	Pub	Dry Cleaner	Convenience Store	Hotel	Indian Restaurant	Park	Discount Store	Department Store	Dessert Shop	Women's Store
1	Allestree	Grocery Store	Shopping Mall	Bakery	Café	Pizza Place	Fish & Chips Shop	Fireworks Store	Fast Food Restaurant	Electronics Store	Dry Cleaner
2	Alvaston	Furniture / Home Store	Hardware Store	Park	Pet Store	Grocery Store	Food & Drink Shop	Fish & Chips Shop	Fireworks Store	Fast Food Restaurant	Electronics Store
3	Arboretum	Clothing Store	Coffee Shop	Café	Music Store	Indian Restaurant	Grocery Store	Discount Store	Restaurant	Sandwich Place	Gym / Fitness Center
4	Blagreaves	Indian Restaurant	Women's Store	Cricket Ground	Furniture / Home Store	Food & Drink Shop	Fish & Chips Shop	Fireworks Store	Fast Food Restaurant	Electronics Store	Dry Cleaner
5	Boulton	Dance Studio	Gym	Other Repair Shop	Hotel	Pub	Record Shop	Discount Store	Department Store	Dessert Shop	Women's Store
6	Chaddesden	Bus Stop	Waste Facility	Hotel	Supermarket	Pub	Women's Store	Department Store	Dessert Shop	Discount Store	Dog Run
7	Chellaston	Grocery Store	Supermarket	Chinese Restaurant	Cosmetics Shop	Fish & Chips Shop	Fireworks Store	Food & Drink Shop	Fast Food Restaurant	Cricket Ground	Dry Cleaner
8	Darley	Pub	Convenience Store	Park	Athletics & Sports	Hotel	Restaurant	Discount Store	Department Store	Dessert Shop	Dry Cleaner
9	Denwent	Grocery Store	Playground	Cricket Ground	Furniture / Home Store	Food & Drink Shop	Fish & Chips Shop	Fireworks Store	Fast Food Restaurant	Electronics Store	Dry Cleaner
10	Littleover	Park	Fireworks Store	Bus Stop	Women's Store	Cricket Ground	Furniture / Home Store	Food & Drink Shop	Fish & Chips Shop	Fast Food Restaurant	Electronics Store
11	Mackworth	Lighting Store	Grocery Store	Vape Store	Auto Workshop	Dry Cleaner	Department Store	Dessert Shop	Discount Store	Dog Run	Women's Store
12	Mickleover	Post Office	Gym	Women's Store	Cricket Ground	Furniture / Home Store	Food & Drink Shop	Fish & Chips Shop	Fireworks Store	Fast Food Restaurant	Electronics Store
13	Normanton	Grocery Store	Fast Food Restaurant	Pub	Discount Store	Multiplex	Bowling Alley	Pizza Place	Hotel	Electronics Store	Cricket Ground
14	Oakwood	Gym	Dog Run	Pub	Spa	Food & Drink Shop	Grocery Store	Fish & Chips Shop	Fireworks Store	Fast Food Restaurant	Electronics Store
15	Sinfin	Indian Restaurant	Coffee Shop	Convenience Store	Women's Store	Dance Studio	Furniture / Home Store	Food & Drink Shop	Fish & Chips Shop	Fireworks Store	Fast Food Restaurant
16	Spondon	Grocery Store	Fish & Chips Shop	Café	Discount Store	Cricket Ground	Furniture / Home Store	Food & Drink Shop	Fireworks Store	Fast Food Restaurant	Electronics Store

# Methodology

7. Application of unsupervised Machine Learning techniques to cluster Derby wards using K-means algorithm.
  - a) Creation of a dataframe including Median House Price, Crime Ratio and venue types (“one-hot” encoded technique) for each ward.
  - b) Normalisation of dataset using Standard Scaler package from Sklearn.
  - c) Estimation of k (optimum number of clusters) for K-means Clustering, using Elbow Method and Silhouette Method.

**K = 2 is the optimum number of clusters**

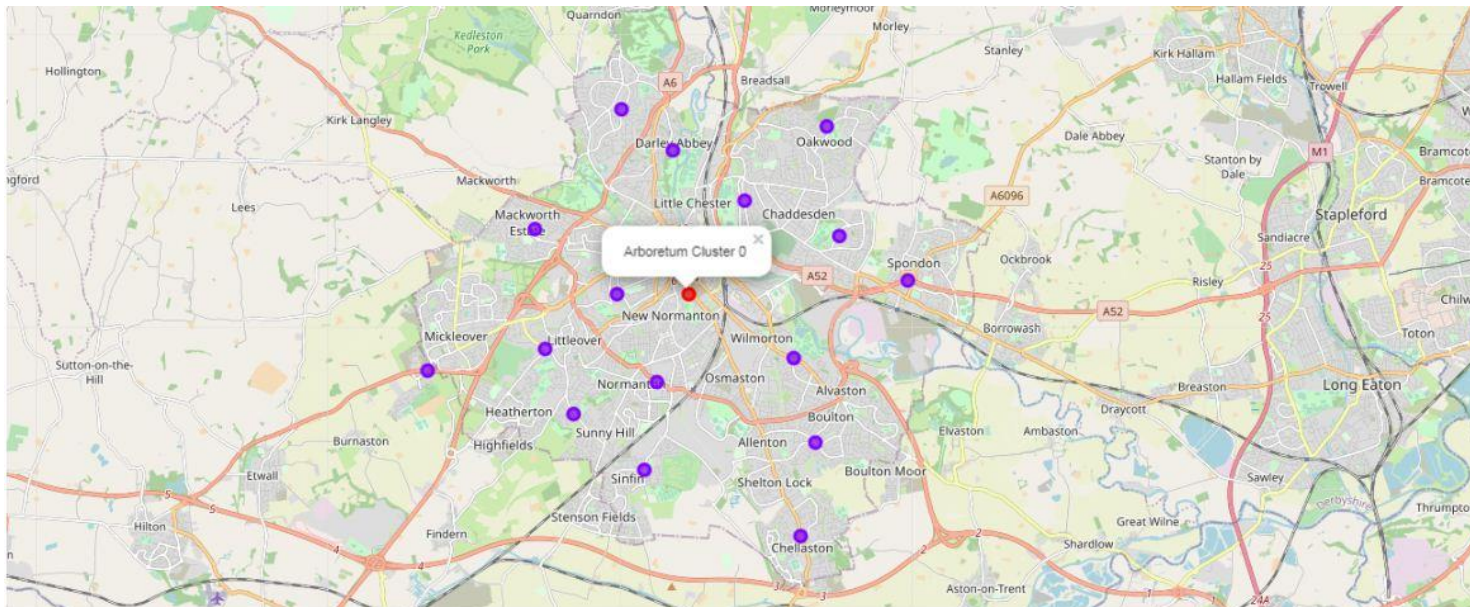


# Methodology

8. Cluster of Derby wards using K-means clustering with  $K=2$ .

- a) Cluster 0 – containing the “Arboretum” ward.
- b) Cluster 1 – containing the remaining 16 wards.

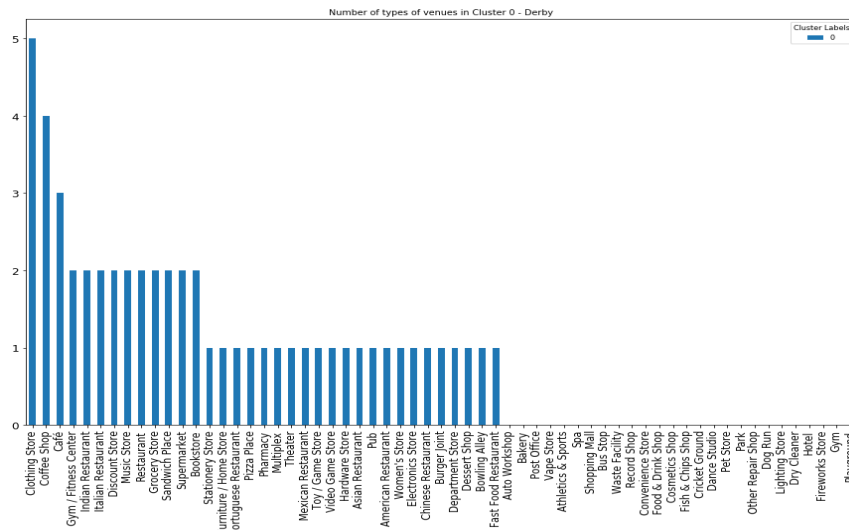
9. Folium map to visualize the clustered wards in Derby.



# Results

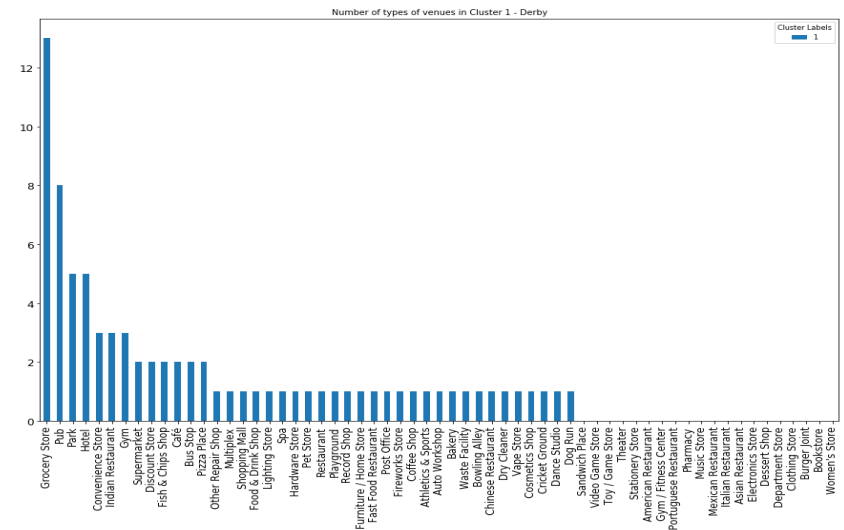
## Cluster 0

- Wards: 1 (Arboretum)
- Number of venues: 54 (40% of total)
- Median House Price -£97,000
- Average crime rate of 363.4.
- Top 5 most frequent venues
  - Clothing Stores, Coffee Shops, Cafes, Gyms/Fitness Centers and Indian Restaurants.



## Cluster 1

- Wards: 16 (all others except Arboretum)
- Number of venues: 80 (60% of total)
- Median House Price - £160,996.8
- Average crime rate of 91.18.
- Top 5 most frequent venues
  - Grocery Stores, Pubs, Parks, Hotels and Convenience Stores.



# Discussion / Recommendations

- **Cluster 0**, covers the “Arboretum” ward which includes most of the leisure offers in the city, and presents the cheapest properties and the highest criminality rate in the city of Derby.
- **Cluster 1**, which covers the remaining 16 wards gathers the more residential and quieter areas of the city, with lower criminality rates and more expensive properties.

## Recommendations:

- **Case A:** potential buyer looking for a safe and quiet area to settle down, the information in this report would suggest to avoid the area included in “Cluster 0”, and focusing his/her search in the areas included in “Cluster 1”.
- **Case B:** potential buyer or renter interested in having a great variety of leisure venues in the near proximity, and is not particularly bothered about criminality rates, the information in this report would suggest him/her to focus the search in the area included in “Cluster 0”.

# Discussion / Recommendations

## **Next Steps:**

- Complete further analysis to compare the 16 wards included in the “Cluster 1”, and categorized as Residential areas.
- In order to do this, it would be suggested to repeat the methodology included in the previous sections to cluster the residential areas into smaller groups.

# Conclusions

- This report is focused on analyzing and comparing the 17 wards in which the city of Derby according to the median house prices in each ward during Q1 2019, the criminality rate during May 2019-May 2020 in each ward and the existing venues in each area.
- It was estimated that there is a negative linear relationship between the crime rates and the median house prices in the various Derby wards, and a linear regression line can be fitted to explain this relationship.
- The application of a K-means clustering algorithm in the normalised data for each of the 17 Derby wards containing available venues, Crime Rate and Median house prices in each of them allowed to cluster the city wards into 2 groups:
  - Cluster 0 - containing most of the leisure venues in the city, with the lowest house prices and the highest criminality rates, including the Arboretum ward.
  - Cluster 1 - containing the residential areas of the city, which present a reduced number of venues per ward, higher house prices and lower criminality rates than in cluster 0.
- The information of this report can be considered useful those for potential home buyers or renters, or people moving to Derby in order to make informed decisions about where to search on a property based on their personal preferences and the main characteristics of the wards in Derby.