Capstone Project Week 2: Examining animal rescue data from the London Fire Brigade
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1.1. Background

Established in 1865, the London Fire Brigade is one of the largest fire fighting and rescue services in the world. The perform a wide variety of functions aside from fire fighting which of course is its primary function. While looking for an appropriate dataset for the Capstone project, a dataset for the London fire brigade jumped out at me. They have collected an interesting dataset relating to the number of animal rescues per "area" or "borough". I am an animal lover and found this to be a comprehensive set that could assist animal rescue organisations. It also amazes me that despite the London Fire Brigade having such an intense workload, they have managed to assist the community with animal rescue.

1.2. Problem

Considering the amount of rescued animals coming through from only the London Fire Brigade, what would happen to these animals if they had been found to be injured. There are also cases coming from other organisations, so this would be a first pass in determining the nature and volume of cases from one establishment in specific boroughs. I would like to select two neighbourhoods and understand if they have the capacity to deal with the rescue cases. Would there be enough animal rescue organisations in the area to cope with the number of cases coming through. Also, the type of animals being rescued would mean that specialist Veterinary services may be required and would there be enough of these service close by to help these animals. The treatment of domestic animals versus wild may require different specialists.

1.3. Interest

The project may be of interest to animal rescue organisations and Veterinary practices. There may be some areas where this information could indicate the need to open additional animal rescue centres, depending on the number of cases and types of animals rescued. The type of cases may indicate to a practitioner if there is a need to open a practice and what specialisation would be more critical i.e. domestic animals, exotic animals, as not all Veterinarians are specialised in all types of animals.

2.1. Data source

The data has been sourced from the London DataStore. It contains over 800 different datasets captured by the City of London, which includes data diligently captured by the London Firebrigade annual. Wikipedia also contains a comprehensive list of information for the boroughs in the Greater London Area. Foursquare can be used to query locations of Veterinary practices and Animal rescue centres. All sources of information and data have been referenced in the "References" portion of the report below.

2.2. Data Cleaning

The data was obtained from the London DataStore a .csv file is available for download with the following headings:

Figure 1: Available feature data

Field	Description
IncidentNumber	Unique incident code
DateTimeOfCall	Time incident was logged
CalYear	Year
FinYear	Month
TypeOfIncident	Type of incident recorded – animal rescue usually a special service
PumpCount	How many pump counts
PumpHoursTotal	How many hours spent on incident
HourlyNotionalCost(£)	Translation of hours to monetary charge per hour
IncidentNotionalCost(£)	Total cost of incident
FinalDescription	Description of the incident
AnimalGroupParent	Type of animal rescued
OriginofCall	Origin of the call
PropertyType	What type of property was animal rescued from
PropertyCategory	What type of category of property was animal rescued from
SpecialServiceTypeCategory	Category of location where animal was rescued
SpecialServiceType	Category of service type
WardCode	Ward Code
Ward	Ward
BoroughCode	Borough Code
Borough	Borough
StnGroundName	Station name
PostcodeDistrict	Postal code
Easting_m	Easting (local grid)
Northing_m	Northing (local grid)
Easting_rounded	Easting (local grid)
Northing_rounded	Northing (local grid)

At the time of the project, no other data was available to supplement the above.

Not all of the above variables will be used in the analysis. The dataset is relatively clean aside from the co-ordinate columns which may not always contain values. Many of the columns contain text values and I have converted these into categorical to make analysis easier. Since the coordinates were made available by the London Fire brigade, a data scrape was after all not necessary to obtain location data for the Boroughs.

2.3. Feature Selection

The following features have been selected for analyses:

Table 1: Final selected feature data for analysis

CalYear
PumpHoursTotal
HourlyNotionalCost(£)
WardCode
Ward
AnimalGroupParent
BoroughCode
Borough
PostcodeDistrict
Latitude
Longitude

Ward information has been deleted as the analysis will not being going into this type of detail. The coordinates received were in a local grid which cannot be plotted on maps with world coordinates. The London Fire department was kind enough to send through the coordinates into Latitude and Longitude.

I will only be looking at the incidents for 2009 – 2019). I have selected the boroughs with the most rescued animal cases, these being Enfield (count = 275) and Croydon (count = 264). These are minimal cases.

Enfield is located in the northern part of Greater London whereas Croydon is towards the central portion of London. Croydon is the more built up of the to Boroughs but does have an abundance of woods and parks where animals may live amongst people. Enfield is a market town and was historically hunting grounds. Both boroughs are located fairly close to rivers.

In summary, the London Fire Brigade rescues animals for whatever reason (especially if the RSPCA – Royal Society for the Prevention of Cruelty to Animals) is unavailable, an categorises the following types of animals that are often rescued. A special code was assigned to make the data easier to analyse:

Table 2: Summary of types of animals rescued as categorised by the London Fire Department

AnimalGroupCode	Code
Cat	0
cat	0
Bird	1
Pigeon	1
Dog	2
Fox	3
Unknown - Domestic Animal Or Pet	4
Unknown - Heavy Livestock Animal	4
Unknown - Wild Animal	4
Deer	6
Squirrel	7
Rabbit	10
Snake	11
Ferret	12
Cow	13
Sheep	15
Fish	16
Lamb	17
Horse	18
Goat	19

Figure 2: Location of London Boroughs (Croydon = 11 and Enfield = 30) (Source: https://en.wikipedia.org/wiki/List_of_London_boroughs)

I will examine the types of animals being rescued and also the relationship of the area to centres close by using foursquare API.

The data for the two boroughs were selected and plotted on the Greater London map as shown below:
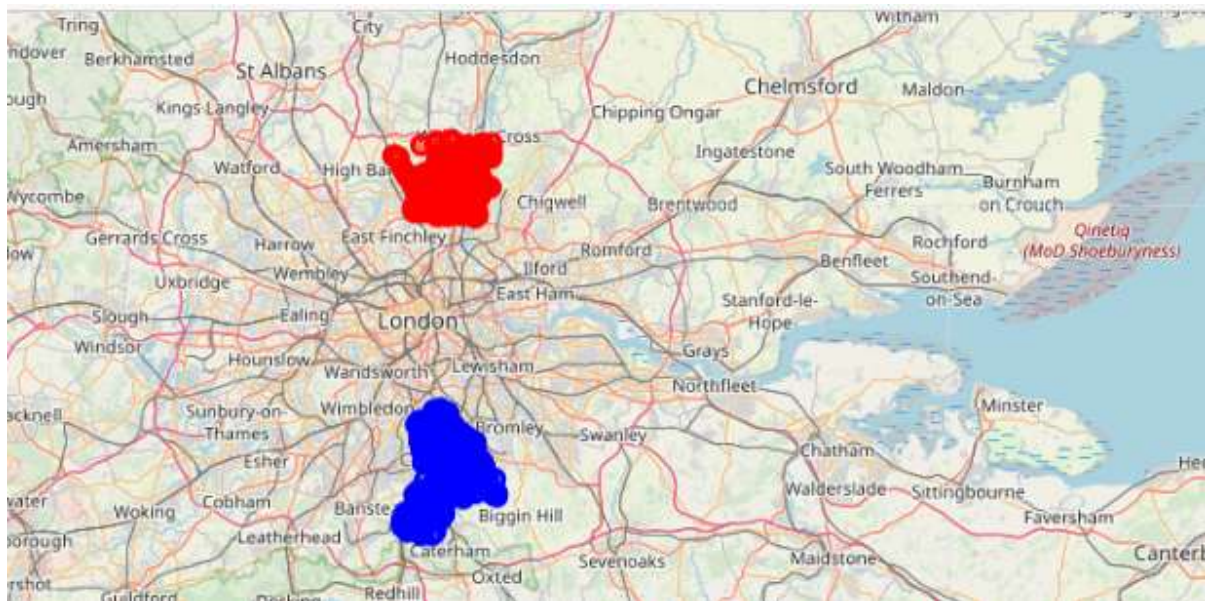

Figure 3: The data points for animal rescue incidents plotted per Borough in the Greater London

3. MethodologyExploratory Data Analysis

The data for Croydon and Enfield were selected into separated dataframes in order to make a comparison

3.1.1. Croydon Data Analysis

The points for incidents in Croydon have been shown below. There seem to be more incidents in the north of the Borough in comparison to the south. The more cases are associated with the more built up portions of Croydon.
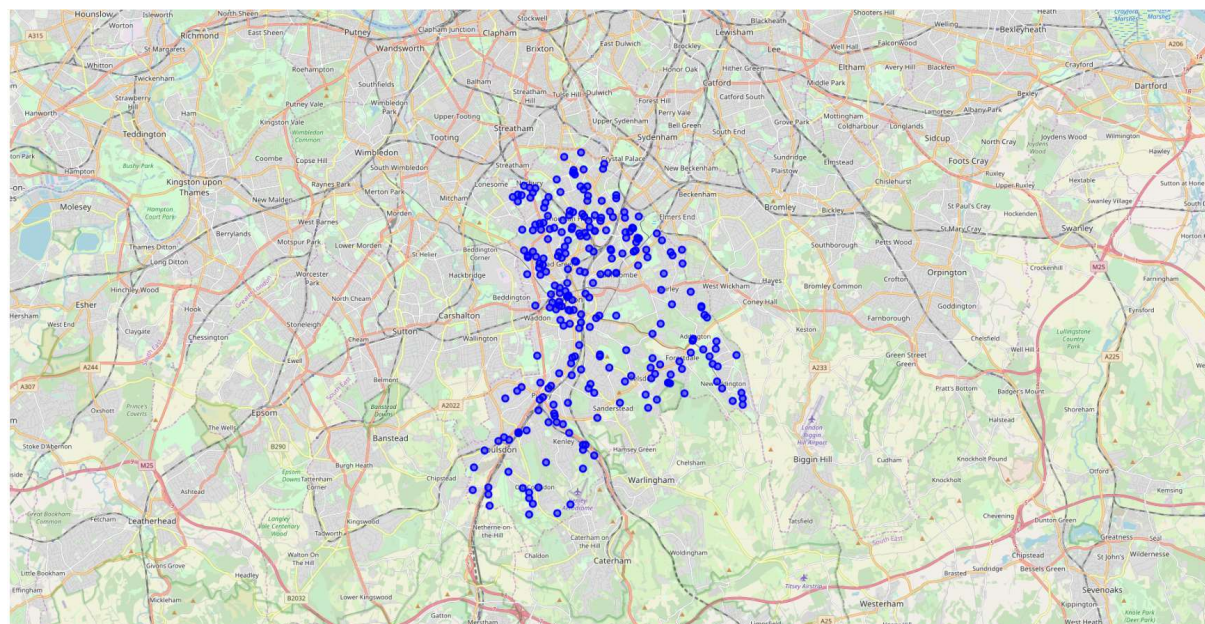

Figure 4: Animal rescue incidents plotted for Croydon

The incidents were plotted a category plot to determine what types of animals were more prevalent in the area as shown below. The majority of incidents are associate with category= 0, which are mostly cats. There is a spike at categories 1 = birds, 2 =dogs and 18 = horses.
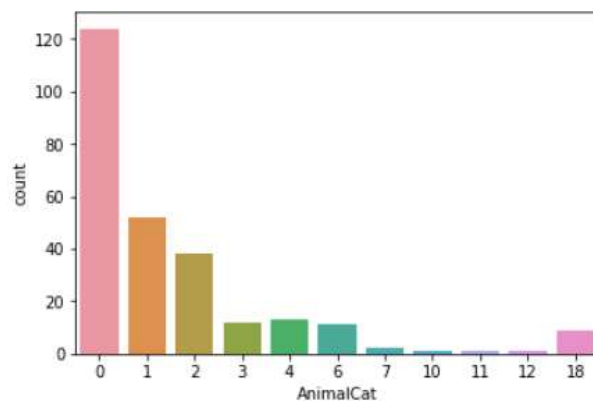

Figure 5: Animal rescue incidents plotted for Croydon per category
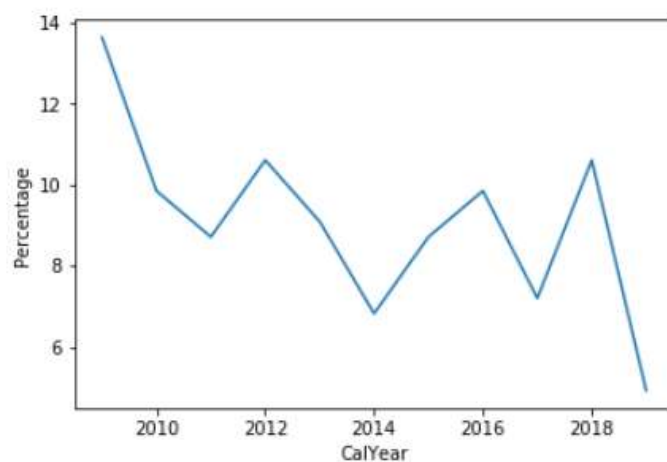

Figure 6: Animal rescue incidents plotted for Croydon per year

With each rescue, there is a time allocation, which translates into a cost. The costs for each year have remained similar for past year with the highest costs occurring in 2009 and 2018.

Table 3: Summary of annual costs associated with animal rescue incidents for Croydon

CalYear	HourlyNotionalCost(£)
2009	9,315
2010	6,760
2011	5,980
2012	7,280
2013	6,870
2014	5,300
2015	6,836
2016	8,364
2017	6,216
2018	9,319
2019	4,371

3.1.2. Enfield Data Analysis

The animal rescue incidents for Enfield have been plotted below. There does not appear to any visual patterns in the density of incidents except for most of the incidents occuring in the more built up portions of the Borough
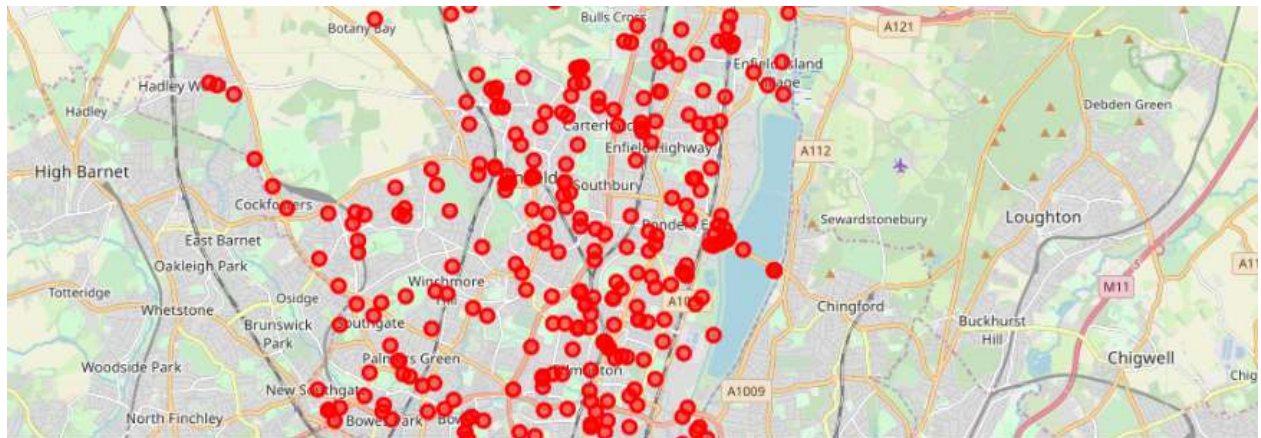

Figure 7: Animal rescue incidents plotted for Enfield

Similarly the incidents were plotted for Enfield in a category plot to determine what types of animals were more prevalent in the area as shown below. The majority of incidents are associate with category= 0, which are mostly cats. There is a spike at categories 1 = birds, 2 =dogs and 18 = horses.
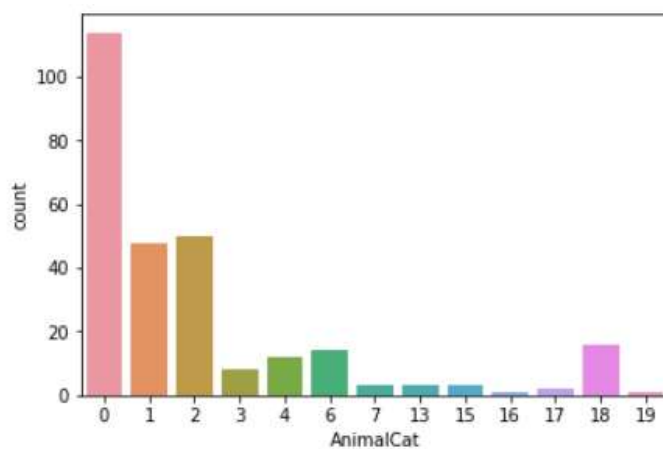

Figure 8: Animal rescue incidents plotted for Enfield per category

When looking at the amount of cases per year, it has remained fairly low with the highest about of cases in 2018.
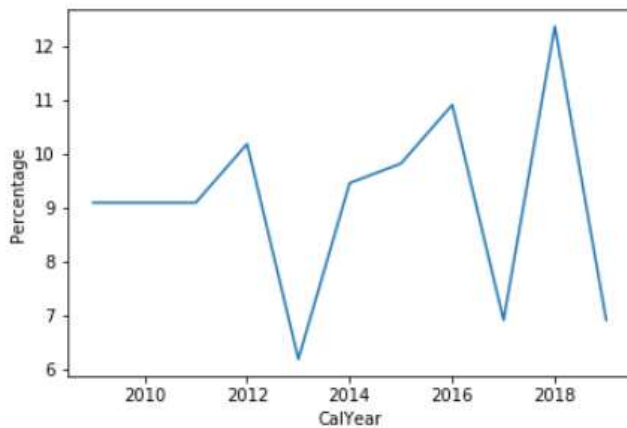
Figure 9: Animal rescue incidents plotted for Enfield per category

Table 4: Summary of annual costs associated with animal rescue incidents for Croydon

CalYear	HourlyNotionalCost(£)
2009	6,495
2010	6,500
2011	6,500
2012	7,280
2013	4,840
2014	7,645
2015	8,031
2016	9,640
2017	6,228
2018	11,267
2019	6,405

4. Foursquare API

Foursquare API was used to find the number of Veterinary services available in each area. In any rescue situation, care may be required to treat injured animals or in some cases, rehome the animal. The information extracted from Foursquare yielded the following results shown in Figure 10 and Figure 11 below. For Croydon, a total of 8 practices are available. Unfortunately when calling on foursquare no animal rescue centres are found at all. As for Enfield, a total of 7 veterinary practices are called from the API and no animal rescue centres are found. This lack of listing could more than likely be that they are generally not listed. A Google search does show rescue centres such as "Croydon animal Samaritans" in Croydon. For Enfield a Google search yields results for the RSPCA Central, West and NE London Branch, Wildlife Rescue and Ambulance service, to name a few. It is concerning that not many of these rescue centres are listed and one has to do a Google search. It would make research more difficult to determine the need to open more centres. It is also difficult to find more specialist care for the wild or more exotic type of animals that may be rescued. One would then have to rely on the information from the Veterinary practices alone.
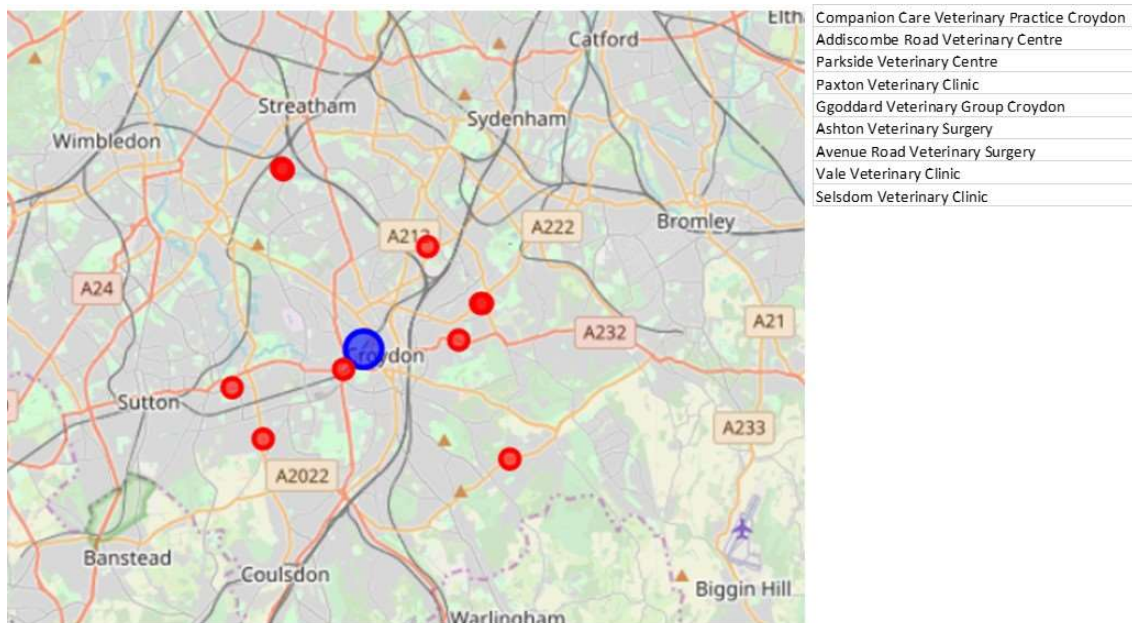
| Companion Care Veterinary Practice Croydon |
| Addiscombe Road Veterinary Centre |
| Parkside Veterinary Centre |
| Paxton Veterinary Clinic |
| Ggoddard Veterinary Group Croydon |
| Ashton Veterinary Surgery |
| Avenue Road Veterinary Surgery |
| Vale Veterinary Clinic |
| Selsdom Veterinary Clinic |

Figure 10: Locations of veterinary services for Croydon within a 5km radius

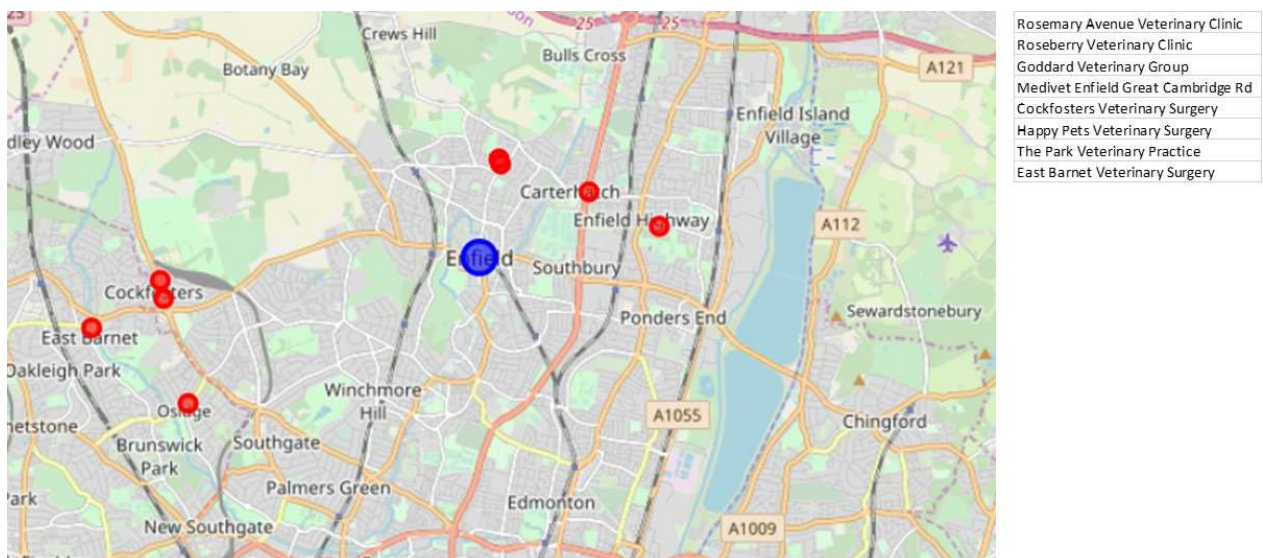| Rosemary Avenue Veterinary Clinic |
| Roseberry Veterinary Clinic |
| Goddard Veterinary Group |
| Medivet Enfield Great Cambridge Rd |
| Cockfosters Veterinary Surgery |
| Happy Pets Veterinary Surgery |
| The Park Veterinary Practice |
| East Barnet Veterinary Surgery |

Figure 11: Locations of veterinary services for Enfield within a 5km radius

5. Machine Learning

An attempt was made at machine learning, particularly the use of K-nearest neighbour. The current dataset does not lend itself to many options. There is not enough information to yield useful results. An attempt was made to model the type of animals being rescued in each area in order to make some kind prediction. The number of k used was 5 (as taken from the chart in Figure 12)The model yielded a train set accuracy of 0.99 and test set accuracy of 1.0. It does not seem that this model is valid even with the high accuracy. More data is require for further testing. The author could not obtain a jaccard index nor an F1-score to compare model versus actual. The machine learning in all honesty was not successful and more data would be required from an organisation such as the RSPCA, but this is not freely available.
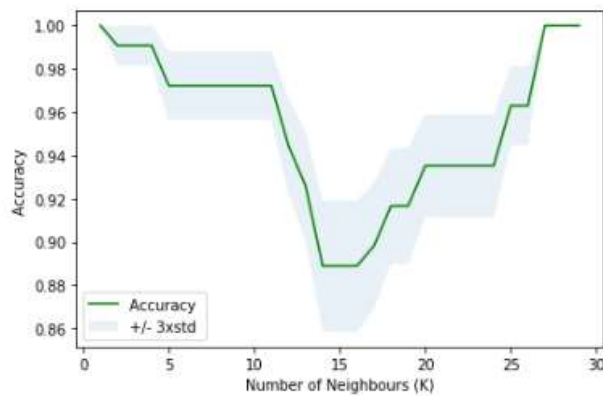
Figure 12: Chart for determining the ideal number of k

The information used in the project did not yield the desired results. The number of incidents was way too few and more data will be required to supplement the dataset. The two neighbourhoods do indicate that the more built up areas, have higher incidents of rescues. The majority of rescued animals appear to be domestic animals such as dogs and cats. The average spend on rescue activities annually by the London fire brigade appears to be consistent on an annual basis. This may be because they are not the first point of call for such incidents generally this would be the RSPCA.The costs in Croydon tend to however be more, despite the fact there are less cases. It is of concern that animal rescue centres are not listed in Foursquare, making it difficult to decide whether more animal rescue centres are required or not. There are no huge differences between the two Boroughs.

The majority of animals rescued in Croydon and Enfield are domestic animals such as dogs and cats. Within each Borough, the spread of incidents appear to be more in the built up areas instead of the parks. The data in Foursquare did not yield any animal rescue centres and based on this, one would assume that more may not be required. However in any area, there may be many animals located at various RSPCA's (as found when Googled). Veterinary practices many not be able to assist with the rehoming of lost animals. The study requires that more data is used from the RSPCA to indicate where the may be a need to open another animal rescue establishment. A challenge to analysing data lies in the availability – not many organisations are as diligent as the London Firebrigade as they capture the location of the incidents and also describe everything. The are also gracious to make this data available to the general public without restrictions

The London Fire Brigade: https://www.london-fire.gov.uk/about-us/what-we-do/ accessed 28-08-2019

The London Fire Brigade: https://en.wikipedia.org/wiki/London_Fire_Brigade accessed 28-08-2019

London Datastore: https://data.london.gov.uk accessed 27-08-2019

List of London Boroughs https://en.wikipedia.org/wiki/List_of_London_boroughs accessed 27-08-2019