Ideal Locations of Bitcoin ATMs in London

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Abstract

The Bitcoin network has been growing steadily since its creation in 2009. As its price surpasses its previous all time highs, the adoption of Bitcoin and other cryptocurrencies pushes many businesses to adjust their services to their clients. Among these companies are the Bitcoin ATM (BTM) companies that enable ordinary people to buy and sell Bitcoin and other cryptocurrencies. As the upcoming bull run of the Bitcoin market is only a matter of time, the strategic installation of additional BTMs in different locations in a metropolis not only brings convenience to Bitcoin users, but also additional revenue to the BTM companies. The aim of this report is to analyze the profiles of boroughs of London and the number of BTMs in each borough, and determine the potential ideal locations of additional BTMs in the city. The relevant features in the London borough profile and the existing BTM numbers in each borough are used to group the boroughs into 5 clusters. Based on this clustering, the boroughs that might benefit from additional BTMs in the upcoming bull run are identified as follows: Hackney, Greenwich, Barkley and Dagenham, Tower Hamlets and Hounslow.

Keywords: Bitcoin, ATM, London, k-means clustering

1- Introduction

Since its creation in early 2009, the Bitcoin (BTC) network has steadily grown over the years. At the time of writing this report, one BTC is worth approximately 9160 USD with a market cap of 117.8 billion USD. While some consider BTC to be a bubble (Monaghan, 2018) and declare it dead according to 99Bitcoins (n.d.), it has survived numerous crashes in price and broke its previous all time highs. It is widely believed in the BTC community that in the next bull run, the price of one BTC will surpass its most recent all time high, which is approximately 20,000 USD (Godbole, 2020). According to the stock-to-flow cross asset model of PlanB, the price of one BTC might hit as high as 288,000 USD within the next few years (PlanB, 2020).

Given the current circumstances in the world economy that took a hard hit (Lynch, 2020) from the pandemic, the trustless, censorship resistant and decentralized nature of the Bitcoin network with its capped supply at 21 million coins offers an alternative means to ordinary people who are willing to save their earnings from currency debasement (Avi, 2019).

Currently there are numerous exchanges (Hansen, 2018) online and according to CoinATMRadar (n.d.) thousands of Bitcoin ATMs, also known as **BTMs**, around the world for people to convert their fiat currency into Bitcoin. The number of BTMs will only increase (Martinez, 2020) in the next few years. It is reported that Paypal will soon be offering crypto exchange services in its platform directly to its customers (Confidential, 2020). As the public becomes more aware of the strong fundamentals of the Bitcoin protocol, it is only expected that more institutions will offer similar services, which pushes the prevalence of the use of Bitcoin as a transfer and store of value even further. Therefore, it is wise to act early and prepare for these developments earlier than the competitors.

2- Business Problem

Although the blockchain technology on which Bitcoin is built is relatively new, the developers are continuously working on smooth and convenient user experience. From the business perspective of Bitcoin service providers, it is considerable to prepare for the growth in the Bitcoin market that will drive its next highly likely bull run. Companies that are able to provide safe and convenient user experience are more likely to benefit from the next public interest in Bitcoin. One such group of companies in this market is BTM companies that provide access to people to purchase Bitcoin using fiat currency. **The aim of this report is to analyze the profiles of boroughs of London and the number of BTMs in each borough, and determine the potential ideal locations of additional BTMs in the city.** While there are numerous factors in choosing the ideal and precise location of any atm, in this business problem the choice of location is only limited to boroughs themselves.

3- Data

The data that will be analysed in this problem are initially chosen to be the London borough profiles, current number of BTMs in each borough and areas where the common daily transactions are high, such as shopping centers and bars. Below is the summary of why and how each data is retrieved:

- **London borough profile:** The official website of London (n.d.) contains comprehensive statistical data of each borough from unemployment rates to political inclination. The data that is correlated with the BTM the most will be taken into account in the analysis. These are *proportion of the elderly*, *proportion of the out-of-work benefit claimants* and *number of active businesses*.

Elderly: As the older generations tend to be more robust towards new technology, a negative correlation is expected between the proportion of the elderly and the number of Bitcoin atms in the boroughs.

Out-of-work benefit claimants: The proportion of the out-of-work benefit claimants is another interesting data that seems to be correlated with BTMs. While a correlation does not imply causation, some consider Bitcoin as an investment against debasing fiat currency (Inman, 2020). These out-of-work claimants can potentially be looking for ways to preserve their savings through Bitcoin.

Active businesses: Generally speaking, it would be natural to expect more atms in places with more active businesses. Similarly, the number of active businesses in a borough can be an indicator of an ideal BTM location. For this reason, this data will also be used to categorize boroughs into clusters.

- **Bitcoin ATMs:** The number of existing BTMs is an indicator of potential areas to focus on and it helps us further categorize the boroughs. The number of BTMs for each borough will be found using Google Maps location data. Google Maps is used for its more accurate data on BTMs instead of Foursquare location data.
- **Shopping centers and bars:** As the traditional ATMs are often located inside or near the shopping centers, it is worth looking at whether the number of shopping centers in a borough is correlated with its number of BTMs. In addition to this, the relatively higher interest of the younger generation in Bitcoin may be a factor in the proximity of BTMs to local bars in a given borough. The number of shopping centers and bars in a borough will be found using **Foursquare location data**.

4- Methodology

In this section, the research method and data sources are explained briefly.

London borough profile: The London borough profile data is loaded from data.london.gov.uk in a dataframe with 32 boroughs (City of London is excluded as it is not a London borough) and 85 columns, 82 of which are borough features. Some of these features include:

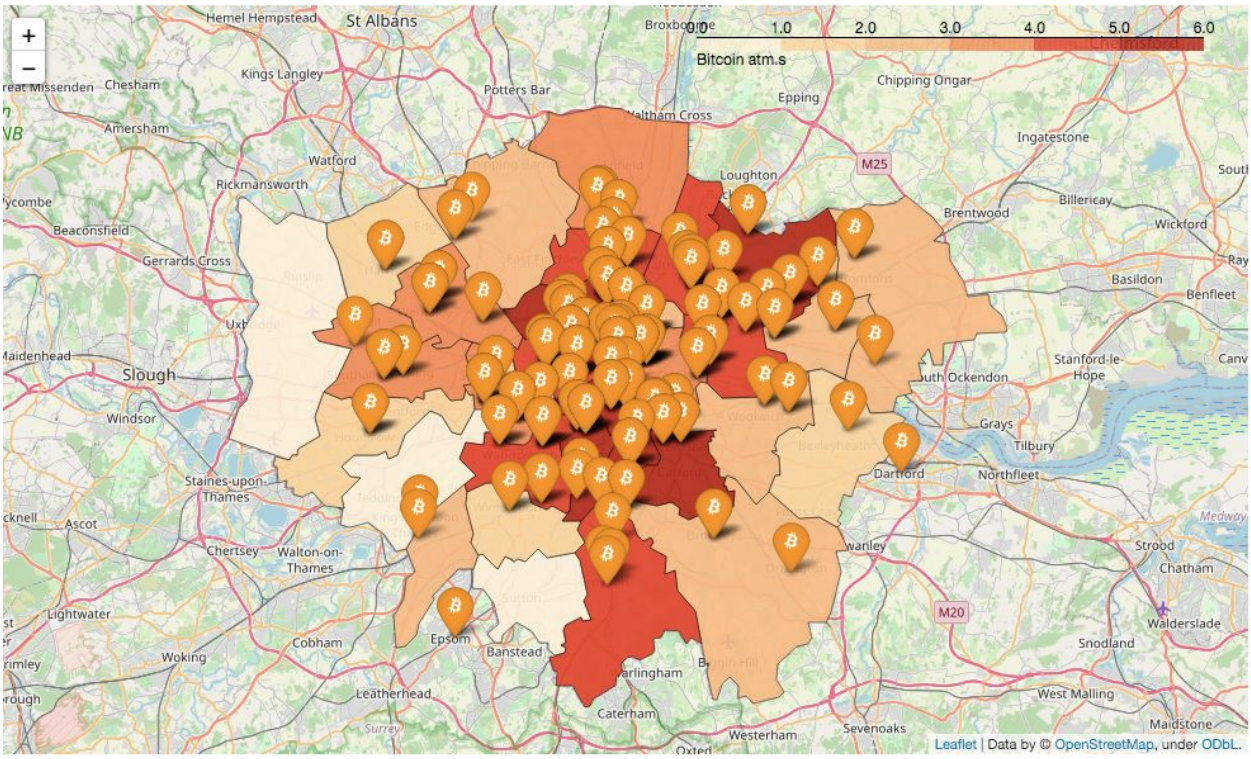
- Population density
- Average age
- Median house price
- Crime rate
- Proportion of population aged 65 and above
- Number of active businesses
- Anxiety scores etc..
- Employment rate

Out of these numerous features, only 3 are eventually selected in k-means clustering of the boroughs. These 3 features are selected based on the .corr() function as explained below.

Bitcoin ATMs: The names of the boroughs are extracted from this data frame in order to determine the latitude and longitude of the boroughs using Google Maps API key. This gives us a more accurate geographic location than Foursquare location data. In order to find the BTMs in each borough, a Google Places search was done within the radius of 5 km in each borough. Naturally, this resulted in duplicates of BTMs because some borough centers are located very close to each other. The unique BTMs are found using the *place_id* of each ATM in the json file. These BTMs are then shown in a choropleth map (Figure 1).

Figure 1

BTMs in boroughs of London



In order to find the number of BTMs in each borough, the Python library *Shapely* is used. Shapely determines whether a given geographical location lies within a polygon. Once the number of BTMs are determined, it is added to our dataframe as seen in Table 1.

Table 1

The four features in the dataframe

	Area name	Proportion of population aged 65 and over, 2015	Proportion of the working-age population who claim out-of-work benefits (%) (May-2016)	Number of active businesses, 2015	Bitcoin atm.s
0	Barking and Dagenham	9.7	10.528711	6560	2
1	Barnet	14.0	6.202135	26190	2
2	Bexley	16.6	6.776812	9075	1
3	Brent	11.3	8.258104	15745	3

Shopping centers and bars: The number of shopping centers and bars in each borough is determined using Foursquare location data. A search of “bars” and “shopping centres” is done within the radius of 500 meters separately in each borough. The total number of bars and shopping centers is then added to our dataframe as seen in Table 2.

Table 2

The five features in the dataframe

	Area name	Proportion of population aged 65 and over, 2015	Proportion of the working-age population who claim out-of-work benefits (%) (May-2016)	Number of active businesses, 2015	Bitcoin atm.s	Bars and shopping centres
0	Barking and Dagenham	9.7	10.528711	6560	2	4
1	Barnet	14.0	6.202135	26190	2	3
2	Bexley	16.6	6.776812	9075	1	6
3	Brent	11.3	8.258104	15745	3	2

5- Results

Using the data frame, the correlation between features is explored using scatter graphs and the correlation matrix. The boroughs are then clustered into 5 categories through the k-means algorithm.

5.1- Scatter graphs:

Below are the scatter graphs of BTMs and the remaining features (Figures 2-5). These scatter graphs together with the correlation matrix can show us the significant factors that are correlated with the number of BTMs in boroughs. On a side note, as you will later see, Westminster has a significantly higher number of bars & shopping centers and active businesses. This is mostly due to the fact that it is the government district. This will eventually result in Westminster being in its own cluster.

Figure 2

Bitcoin ATMs vs proportion of out-of-work benefits claimants

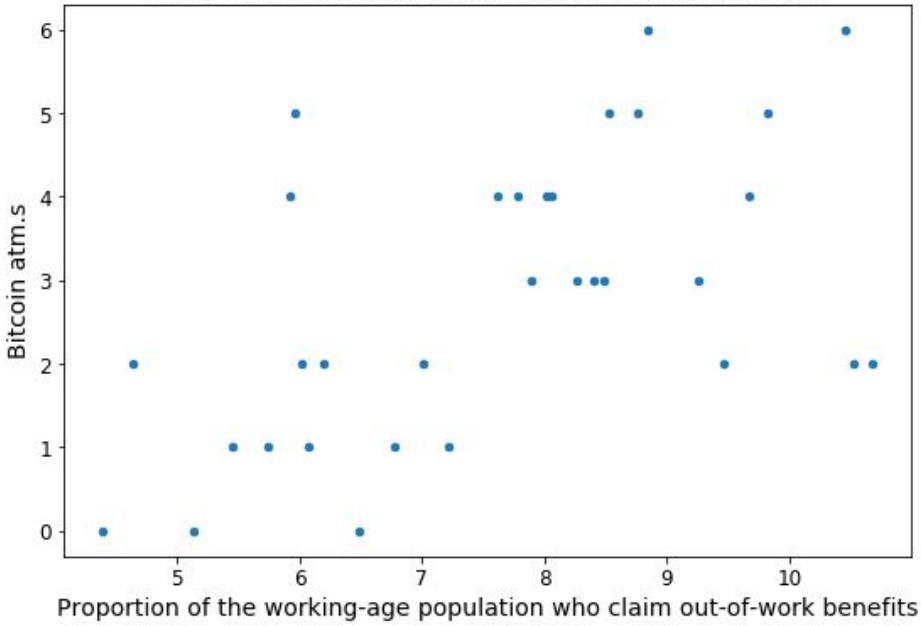


Figure 3

Bitcoin ATMs and proportion of the elderly

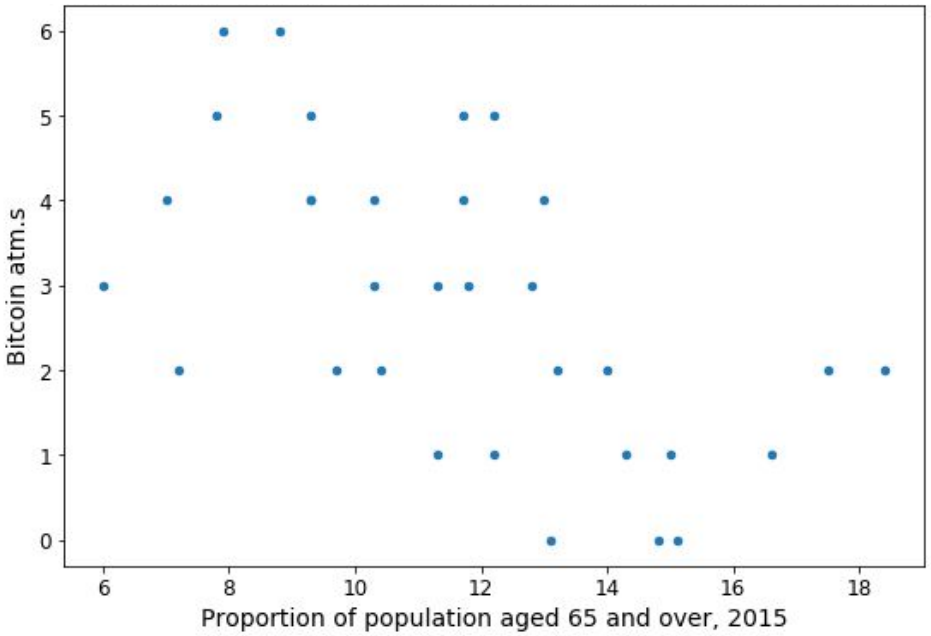


Figure 4

Bitcoin ATMs and the number of active businesses

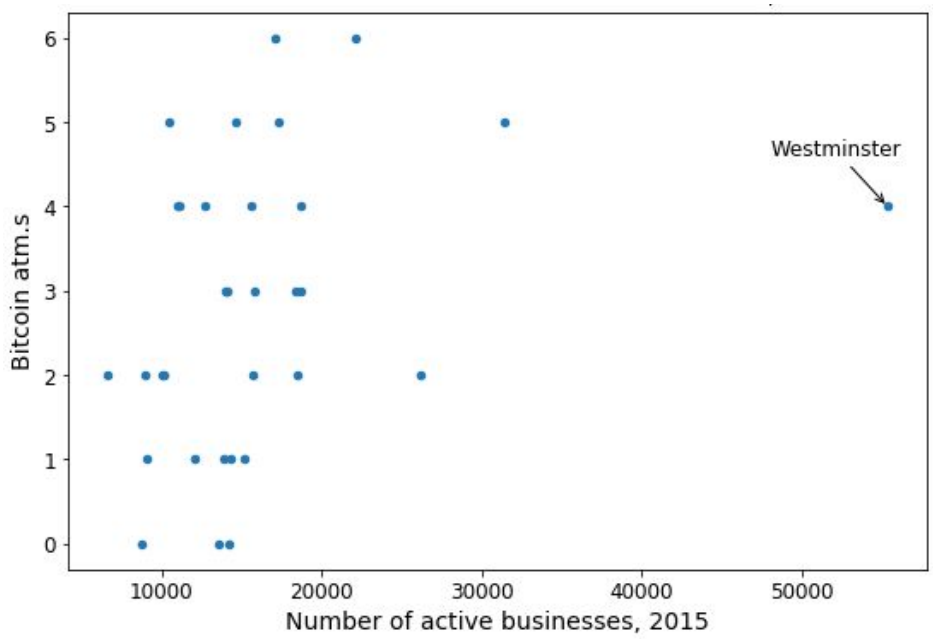
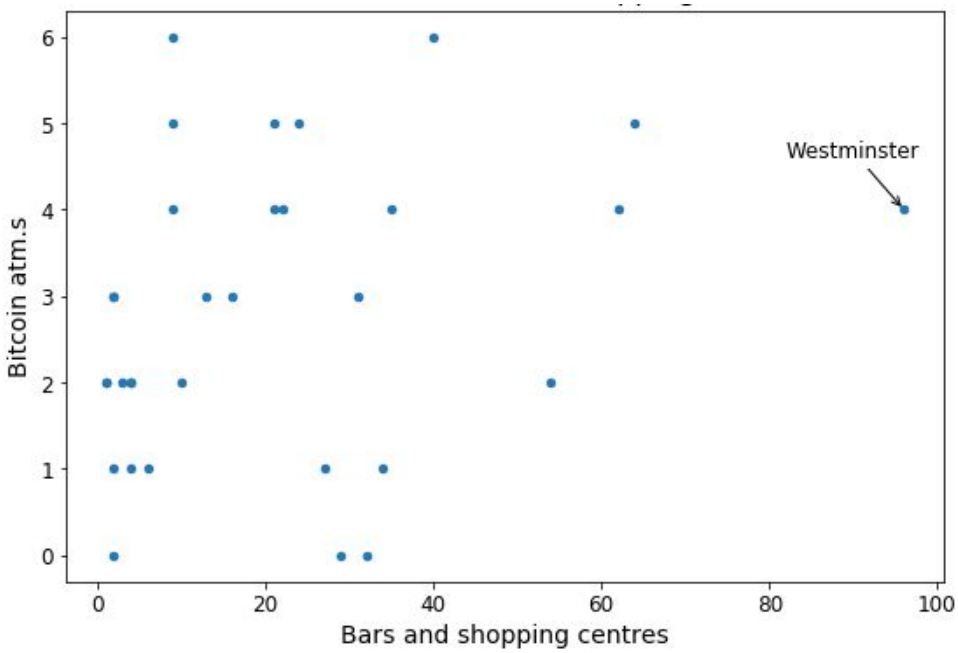


Figure 5

Bitcoin ATMs and the bars & shopping centers



The correlation matrix is obtained using .corr() function (Table 3). According to the Pearson correlation coefficients, number of BTMs is slightly negatively correlated with elderly proportion and positively with proportion of out-of-work claimants. Also, it turned out that the number of bars and shopping centers are weakly correlated to the number of BTMs in the boroughs. Therefore, it will not be included in the clustering.

Table 3

Correlation matrix of the features

	Proportion of population aged 65 and over, 2015	Proportion of the working-age population who claim out-of-work benefits (%) (May-2016)	Number of active businesses, 2015	Bitcoin atm.s	Bars and shopping centres
Proportion of population aged 65 and over, 2015	1.000000	-0.636350	-0.176849	-0.582487	-0.024383
Proportion of the working-age population who claim out-of-work benefits (%) (May-2016)	-0.636350	1.000000	0.113211	0.552708	-0.139948
Number of active businesses, 2015	-0.176849	0.113211	1.000000	0.380190	0.347912
Bitcoin atm.s	-0.582487	0.552708	0.380190	1.000000	0.267302
Bars and shopping centres	-0.024383	-0.139948	0.347912	0.267302	1.000000

5.2- Clustering:

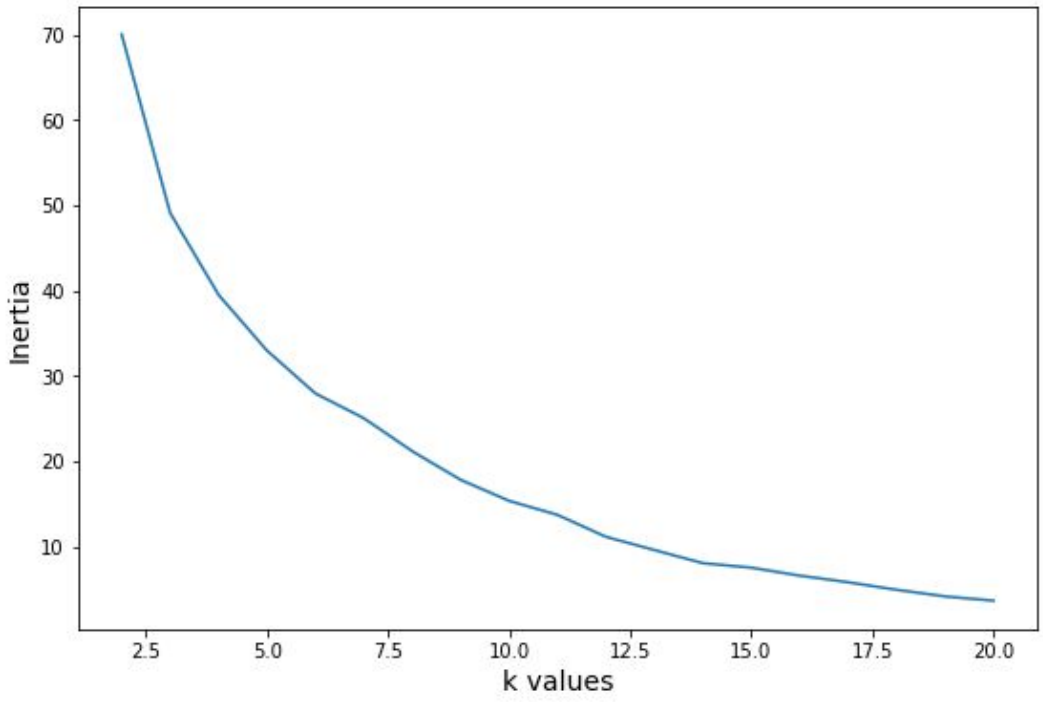
Eventually, four features are selected for the clustering of the boroughs. These are:

- proportion of the elderly
- proportion of the out-of-work benefit claimants
- number of active businesses
- number of Bitcoin ATMs

Since we have unsupervised data, the boroughs are clustered using the k-means algorithm. In Figure 6 below, we see the graph for inertia and the number of clusters. Inertia is a measure of the error for a given number of clusters.

Figure 6

Inertia vs the number of clusters, k



Although the elbow method doesn't give us a definite number of clusters, the boroughs are decided to be grouped into 5 categories. The cluster numbers 0 to 4 are then added to the dataframe. Unsurprisingly, being the government district, Westminster fell into one of the clusters (cluster 2) alone. Tables 4-7 below show the boroughs in each cluster.

Table 4

Boroughs in cluster 4

Area name	Cluster number
Barking and Dagenham	4
Greenwich	4
Hackney	4

Table 5

Boroughs in cluster 3

Area name	Cluster number
Haringey	3
Islington	3
Lambeth	3
Lewisham	3
Newham	3
Southwark	3
Tower Hamlets	3

Table 6

Boroughs in cluster 1

Area name	Cluster number
Barnet	1
Bexley	1
Bromley	1
Harrow	1
Havering	1
Hillingdon	1
Hounslow	1
Kensington and Chelsea	1
Kingston upon Thames	1
Merton	1
Richmond upon Thames	1
Sutton	1

Table 7

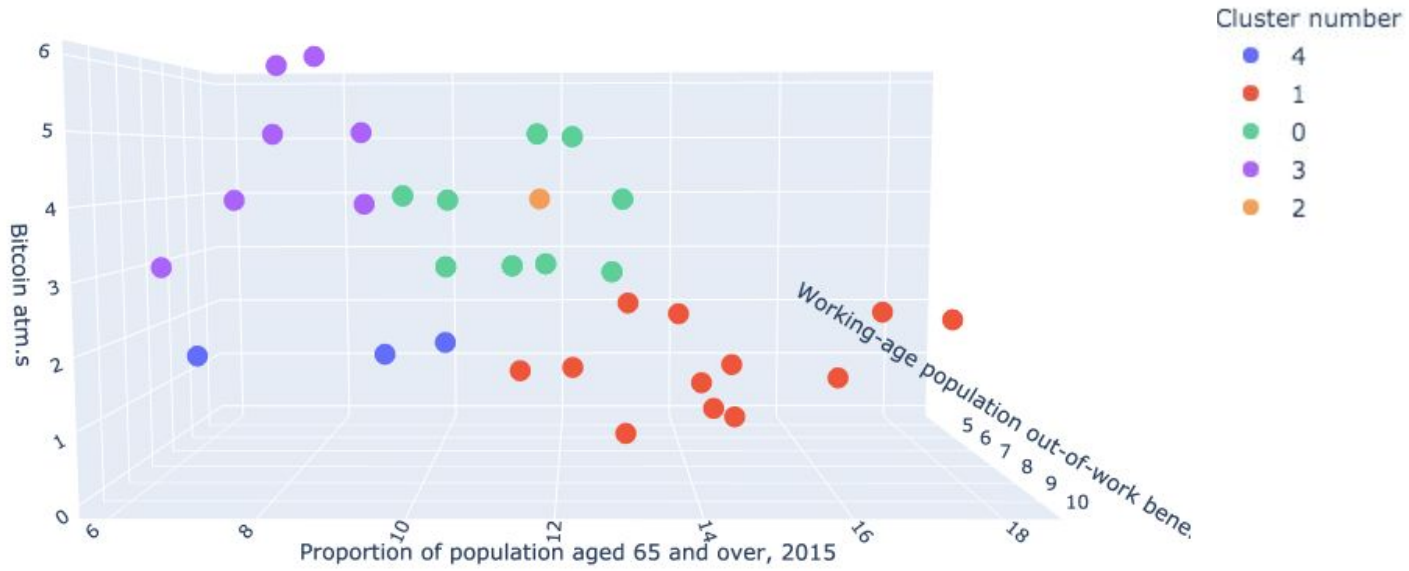
Boroughs in cluster 0

Area name	Cluster number
Brent	0
Camden	0
Croydon	0
Ealing	0
Enfield	0
Hammersmith and Fulham	0
Redbridge	0
Waltham Forest	0
Wandsworth	0

As for the visualization of these clusters, a 3D graph is constructed using *Plotly* Python library. Note that the axis of this graph excludes the number of active businesses, which is the least correlated feature.

Figure 7

3D plot of the clusters



The average number of BTMs in each cluster is given below. As you can see, cluster 3 has the boroughs with the higher number of BTMs, whereas cluster 1 has boroughs with few or no BTMs. Also note that cluster 2 has only Westminster in it.

Table 8

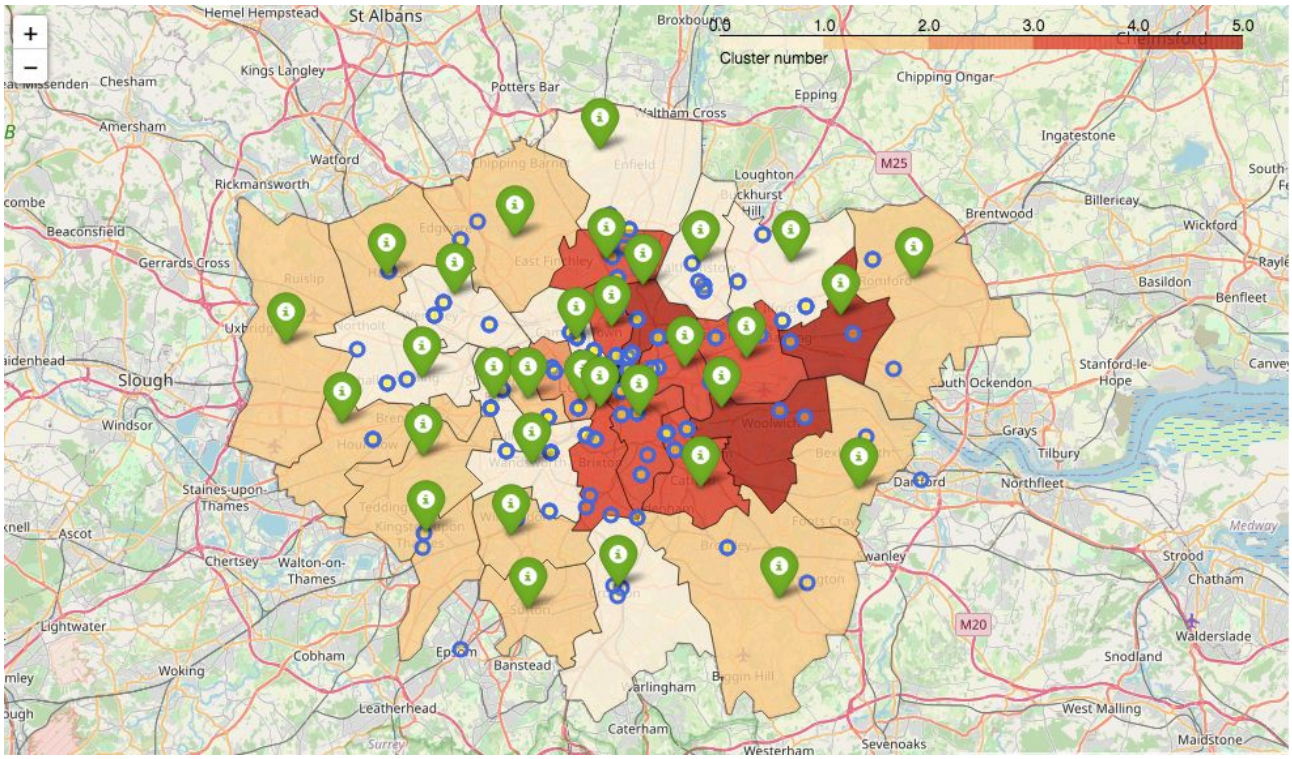
Average number of Bitcoin ATMs in each cluster

	Bitcoin atm.s
Cluster number	
0	3.777778
1	1.083333
2	4.000000
3	4.714286
4	2.000000

Finally, the boroughs and the BTMs located in them are shown on a choropleth map.

Figure 8

Choropleth map of London boroughs based on their clusters with the location of BTMs



6- Discussion

Using the data profile of each cluster, it is possible to project which boroughs will need additional BTMs in the next public interest in Bitcoin triggered by its near future bull run. It should be acknowledged that world wide adoption of Bitcoin and thus the installation of its ATMs in every borough is not far from reality. However, in the light of this report, certain boroughs should be given priority.

The three boroughs in cluster 4, namely *Hackney*, *Greenwich* and *Barkley and Dagenham* stand out with relatively younger population and high out-of-work claimant rate and yet with only 2 BTMs each. These three boroughs can potentially be hotspots for higher interest in purchasing Bitcoin in the near future. It should be considered to install one to three ATMs in each of these boroughs.

Similarly, *Tower Hamlets* in cluster 3 stands out with its low proportion of 65 and above. With its proximity to other cluster 3 members, the potential for BTM demand in this borough remains high.

In cluster 1, *Hounslow* stands out with its low proportion of population aged 65 and above, although its other features remain close to average. While it is not so close to the heart of the city, installing additional BTMs in the borough can be beneficial.

7- Conclusion

In conclusion, as the market for Bitcoin grows, the demand to purchase it conveniently increases accordingly. While the existing boroughs with more number of BTMs can still be hotspot for installing additional BTMs, some of the boroughs with currently low numbers of BTMs can benefit more from additional BTMs. These boroughs are namely Hackney, Greenwich, Berkeley and Dagenham, Tower Hamlets and Hounslow.

In the future, with more up-to-date data the clustering of the boroughs can be improved. Moreover, this analysis can be used to indicate to local business owners which boroughs are more likely to adapt to transactions with Bitcoin and other cryptocurrencies rather than the national fiat currency.

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