

**UNDERSTANDING RESIDENTS'
ATTITUDES TOWARDS SERVICES
AND SAFETY ISSUES BY
GEODEMOGRAPHICS BASED ON
CITY SURVEY RESULTS**

A Case Study in the City of Westminster

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Table of Contents

<i>Abstract</i>	5
<i>Declaration</i>	6
<i>List of Figures</i>	7
<i>List of Tables</i>	9
<i>List of Acronyms and Abbreviations</i>	10
<i>Acknowledgements</i>	11
<i>Chapter 1: Introduction</i>	13
1.1 Overview	13
1.2 Objectives	14
1.3 Scope of the Research	15
<i>Chapter 2: Literature Review</i>	17
2.1 Geodemographics Definition	17
2.2 Geodemographics Applications	18
2.3 Westminster.....	22
<i>Chapter 3: Methodology</i>	26
3.1 Data Source	26
3.1.1 Westminster City Survey Results 2018.....	26
3.1.2 Crime Data.....	27
3.1.2 Westminster LSOA Shapefile.....	27
3.2 Statement of Ethics.....	27
3.3 Data Processing	28
3.3.1 ACORN Group Distribution.....	30
3.3.2 Index of Service Usage Rate and Satisfaction.....	30
3.3.3 Service Requirement	34
3.3.4 Attitudes towards Local Area and Safety Issues.....	37
3.3.5 Crime Distribution	40
3.4 Clustering	40
3.4.1 Clustering for Index of Service Usage Rate and Satisfaction	43
3.4.2 Clustering for Service Requirement	45
3.4.3 Clustering for Attitudes towards Local Area and Safety Issues	46
<i>Chapter 4: Results</i>	48
4.1 ACORN Group Distribution Map	48
4.2 Attitudes towards Service	49
4.2.1 Index of Service Usage Rate and Satisfaction.....	49
4.2.2 Service Requirement	57

4.2.3 Comparation between Index of Service Usage Rate and Satisfaction and Service Requirement.....	64
4.3 Attitudes towards Local Area and Safety Issues	65
<i>Chapter 5: Conclusion and Future Work.....</i>	<i>70</i>
5.1 Research Summary	70
5.2 Limitations of the Study.....	71
5.3 Recommendations for Future Work	72
<i>References.....</i>	<i>73</i>
Appendices.....	77
Annex A. Distribution Histograms of Personal Information of Participants in Each LSOA	77
Annex B. Relevant Questions in City Survey Questionnaire 2018	83
Annex C. Original Percentages of Service Usage Rate in Q5 and Satisfaction in Q6	87
Annex D. Original Scores and Clustering Results of Index of Service Usage Rate and Satisfaction	88
Annex E. Original Scores and Clustering Results of Service Requirement	89
Annex F. Clustering Results of Index of Service Usage Rate and Satisfaction and Service Requirement	90
Annex G. Original Scores and Clustering Results of Attitudes towards Local area and safety Issues	91

Abstract

Geodemographics is an effective and widely used method for market targeting and public management. This research attempts to expand its research scope and combine it with Westminster City Survey Results 2018 to discover residents' attitudes towards council services and safety issues in the City of Westminster. Three main dimensions are analysed in this research by two clustering algorithms for 105 selected Lower Layer Super Output Areas (LSOA) in Westminster.

The three dimensions are as follows. In the Index of Service Usage Rate and Satisfaction dimension, LSOAs are classified into 11 clusters by Partitioning Around Medoids (PAM) while aggregated into 3 clusters by Hierarchical Agglomerative Clustering (HAC). In the Service Requirement dimension, LSOAs are divided into 9 clusters by PAM while merged into 3 clusters by HAC. In the Attitudes towards Local Area and Safety Issues, LSOAs are cut down into 2 clusters by PAM while joined into 3 clusters by HAC. Characteristics of classification results are investigated by contrasting the Z-scores of each cluster. Distribution maps of classification results are created and compared with distribution maps of ACORN group and total crime count to seek for relationships. Distribution maps on the Index of Service Usage Rate and Satisfaction doesn't present evident relationship with ACORN group distribution. Distribution maps on the Service Requirement show some relations to ACORN group distribution map and area attributes. Distribution maps on Attitudes towards Local Area and Safety Issues claim no obvious correlations with the crime distribution map.

Finally, suggestions and recommendations are put forward for Westminster City Council to better Westminster residents' enjoyment of local policies, services, and activities. This study also provides a new perspective and methodology for government management.

Declaration

I, Yafei Ye, hereby declare that this dissertation is all my own original work and that all sources have been acknowledged. It is 10338 words in length.

Signature:

Date:

List of Figures

Figure 1. Map of Index of Multiple Deprivation (Composite Rank).....	23
Figure 2. Concentration of Residents	24
Figure 3. Median Household Income	24
Figure 4. Median Property Price.....	24
Figure 5. Criminal & Anti-Social Incidents.....	24
Figure 6. Income Deprivation.....	24
Figure 7. Social Exclusion.....	24
Figure 8. Heatmap of Coefficients on Index of Service Usage Rate and Satisfaction	31
Figure 9. Boxplots for Index of Service Usage Rate and Satisfaction	32
Figure 10. Frequency Distribution Histograms for Index of Service Usage Rate and Satisfaction.....	34
Figure 11. Heatmap of Coefficients on Service Requirement.....	35
Figure 12. Boxplots for Service Requirement	36
Figure 13. Frequency Distribution Histograms for Service Requirement	37
Figure 14. Heatmap of Coefficients on Attitudes towards Local area and safety issues.....	38
Figure 15. Boxplots for Attitudes towards Local area and safety issues.....	39
Figure 16. Frequency Distribution Histograms for Attitudes towards Local area and safety issues	39
Figure 17. Average Silhouette Width of PAM for Index of Service Rate and Satisfaction.....	44
Figure 18. Average Silhouette Width of HAC for Index of Service Rate and Satisfaction.....	44
Figure 19. Silhouette Plot of PAM for Index of Service Rate and Satisfaction	45
Figure 20. Silhouette Plot of HAC for Index of Service Rate and Satisfaction	45
Figure 21. Average Silhouette Width of PAM for Service Requirement.....	46
Figure 22. Average Silhouette Width of HAC for Service Requirement	46
Figure 23. Silhouette Plot of PAM for Service Requirement	46
Figure 24. Silhouette Plot of HAC for Service Requirement	46
Figure 25. Average Silhouette Width of PAM for Attitudes towards Local Area and Safety Issues	47
Figure 26. Average Silhouette Width of HAC for Attitudes towards Local Area and Safety Issues	47
Figure 27. Silhouette Plot of PAM, HAC (k=2) and HAC (k=3) for Attitudes towards Local Area and Safety Issues	47
Figure 28. Maps of ACORN Group Distribution in Westminster	48
Figure 29. Cluster Plot of PAM for Index of Service Usage Rate and Satisfaction..	49
Figure 30. Cluster Plot of HAC for Index of Service Usage Rate and Satisfaction ..	49
Figure 31. Cluster Dendrogram for Index of Service Usage Rate and Satisfaction ..	55
Figure 32. Cluster Map of PAM for Index of Service Usage Rate and Satisfaction.	57
Figure 33. Cluster Map of HAC for Index of Service Usage Rate and Satisfaction .	57
Figure 34. Cluster Plot of PAM for Service Requirement.....	58
Figure 35. Cluster Plot of HAC for Service Requirement.....	58
Figure 36. Cluster Dendrogram for Service Requirement.....	61
Figure 37. Cluster Map of PAM for Service Requirement.....	63
Figure 38. Cluster Map of HAC for Service Requirement	64

Figure 39. Heatmap of Coefficients on Index of Service Usage Rate and Satisfaction and Service Requirement.....	65
Figure 40. Cluster Plot of PAM for Attitudes towards Local Area and Safety Issues	65
Figure 41. Cluster Plot of HAC for Attitudes towards Local Area and Safety Issues	65
Figure 42. Cluster Dendrogram for Attitudes towards Local Area and Safety Issues	67
Figure 43. Cluster Map of PAM for Attitudes towards Local Area and Safety Issues	68
Figure 44. Cluster Map of HAC for Attitudes towards Local Area and Safety Issues	69
Figure 45. Map of Total Crime Count from October 2017 to September 2018	69
Figure 46. Distribution Histogram of Gender	77
Figure 47. Distribution Histogram of Age.....	77
Figure 48. Distribution Histogram of Working Status	78
Figure 49. Distribution Histogram of House Right	78
Figure 50. Distribution Histogram of Accommodation Type	79
Figure 51. Distribution Histogram of Living Time in Current Property	79
Figure 52. Distribution Histogram of Living Time in WCC.....	80
Figure 53. Distribution Histogram of Social Grade	80
Figure 54. Distribution Histogram of Wellbeing Status.....	81
Figure 55. Distribution Histogram of Background.....	81
Figure 56. Distribution Histogram of ACORN Groups	82

List of Tables

Table 1. Descriptive Statistics for Index of Service Usage Rate and Satisfaction	32
Table 2. Descriptive Statistics for Service Requirement	36
Table 3. Descriptive Statistics for Attitudes towards Local area and safety issues...	39
Table 4. PAM Medoids and HCA Centroids for Index of Service Usage Rate and Satisfaction.....	55
Table 5. PAM Medoids and HCA Centroids for Service Requirement.....	62
Table 6. PAM Medoids and HCA Centroids for Attitudes towards Local Area and Safety Issues	67
Table 7. Original Percentages of Service Satisfaction in Q5 and Usage Rate in Q6.87	
Table 8. Original Scores and Clustering Results of Index of Service Usage Rate and Satisfaction.....	88
Table 9. Original Scores and Clustering Results of Service Requirement	89
Table 10. Clustering Results of Index of Service Usage Rate and Satisfaction and Service Requirement.....	90
Table 11. Original Scores and Clustering Results of Attitudes towards Local area and safety issues	91

List of Acronyms and Abbreviations

ACORN	A Classification of Residential Neighbourhoods
CDRC	Consumer Data Research Centre
DCLG	Department for Communities and Local Government
DWP	Department of Work and Pensions
ESRC	Economic and Social Research Council
GLA	The Greater London Authority
HAC	Hierarchical Agglomerative Clustering
IMD	Index of Multiple Deprivation
LOAC	The London Output Area Classification
LSOA	Lower Layer Super Output Areas
MET	Metropolitan Police
MYE	Mid-Year Population Estimate
OA	Output Area
OAC	The Output Area Classification
ONS	The Office for National Statistics
PAM	Partitioning Around Medoids
TOAC	The Temporal Output Area Classification
WCC	Westminster City Council

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Chapter 1: Introduction

1.1 Overview

With the rapid development of information technology in today's society, it has become the goal of more and more governments and enterprises to accurately grasp the characteristics and needs of residents and customers. Geodemographics can effectively help users achieve this goal by classifying population into geographic areas. As a collaboration project with Westminster City Council (WCC), this research tries to divide Lower Layer Super Output Areas (LSOAs) in the City of Westminster into several categories to understand their needs and attitudes towards the local area based on categories' features.

WCC is committed to better understand the characteristics and desires of residents. WCC has more than 10 years of experience in conducting their city surveys, which including almost every aspect of residents' lives. Each year, this survey is conducted by a professional social survey team through door-to-door random selection of face-to-face interviews. In 2018, more than 2600 residents in Westminster participated in the city survey, which included a wide variety of issues in regard to service satisfaction, service requirement, positive and negative local features, community cohesion, safety, and so on. This research is conducted according to the 2018 Westminster City Survey Results.

1.2 Objectives

In order to make a more in-depth and detailed analysis, this study only chooses two parts of the city survey - broadly speaking, one part focusing on issues with services and the other on safety – and performs data analyses on these aspects of geodemographics separately. As there is no certain evidence to prove any algorithms is more sophisticated in geodemographics, this research tries to employ two algorithms – Partitioning Around Medoids (PAM) and hierarchical agglomerative clustering (HAC), to deal with the same datasets and compare the results. The objectives of this research can be subdivided into the following seven points:

- 1) Classify LSOAs in Westminster into clusters based on the comprehensive score of service usage rate and satisfaction by utilizing PAM and HAC, explore characteristics of each clusters, draw classification maps, and compare final clustering results;
- 2) Classify LSOAs in Westminster into clusters according to the importance paid to the specific services by using PAM and HAC, investigate features of each clusters, produce classification maps, and contrast final classification results;
- 3) Compare the results of objective 1 and 2 to discover the relationship between the index of service usage rate and satisfaction and service requirement;
- 4) Classify LSOAs in Westminster into clusters on the basis of provisions to local area and safety issues by employing PAM and HAC, discover

- features of each clusters, create classification maps, and contrast final classification results;
- 5) Compare results from objective 4 with crime distribution map to investigate relationship between attitudes towards local area and safety issues and number of crimes;
 - 6) Contrast the results of objective 1, 2 and 4 with ACORN group distribution maps to analyse whether residents' attitudes towards service and safety issues are related with ACORN geodemographic classifications;
 - 7) Give suggestions for the WCC based on classification results to assist the WCC in shaping policies, providing services, and tailoring targeted campaigns.

1.3 Scope of the Research

The scope of this research encompasses the City of Westminster. As an inner borough of London holding city status, the City of Westminster has a population of 247,614 in late 2017. It has a total of 128 LSOAs, with an average population of around 2,000 in each LSOA.

Westminster is not only a world-renowned tourism area, with the possession of numerous national landmarks, such as Westminster Abbey, Houses of Parliament, Buckingham Palace, Big Ben, and so on, but also a place of multiculturalism, marked by the diverse range of activities that are held every

day by people from all types of cultures and backgrounds. Oxford Street, Piccadilly Circus, Soho, Trafalgar Square and West End in this area provide countless sources of entertainment as well. In addition, the local economy of Westminster holds significant influence from international spheres, as many multinational organisations set their headquarters in this area.

With the highly diverse backgrounds also come divergent socio-economic conditions for the residents. As such, there holds great value and meaning in performing geodemographic studies of the residents who live in Westminster.

Chapter 2: Literature Review

2.1 Geodemographics Definition

Geodemographics, in a literal sense, it is a combination of geography and demographics, analysing demographic attributes of people by their living locations (Leventhal, 2016). It is commonly thought that geodemographics originated from Charles Booth's (1903) study of deprivation in London by employing 1981 UK census data, which created maps based on generalized index of wealth and poverty at the street level. From then on, many sociologists started to pay a lot attention on geodemographic segmentation.

There are two core principles to support the value of geodemographics:

- 1) Compared to people chosen randomly, it is much more likely for people who live in an identical neighbourhood to have similar features. This principle is derived from Tobler's (1970 & 2004) first law of geography: "everything is related to everything else, but near things are more related than distant things." Another phenomenon seen in geodemographic research is that like-minded people tend to aggregate together in the same space, and within that space residents are often reinforced into developing similar characteristics (Harris, Sleight, & Webber, 2005, p 17);
- 2) Neighbourhoods can be classified into categories based on their residents' characteristics. In the same category, neighbourhoods are more likely to contain similar residents, though they may be much farther away in geography.

Geodemographics has many powerful strengths, such as the ability of locating socio-economic segments in universal coverage and its simplicity in analysis (Leventhal, 2016, p 10-11). Meanwhile, it also has certain drawbacks. First of all, whether the residents in the same neighbourhood are alike sufficiently to be investigated together is sometimes a questionable assumption (Adnan, et al., 2010; Gale, et al., 2014; Leventhal, 2016, p 12). The practices derived from inaccurate geodemographic results may cause detrimental recommendations and discrimination. However, being too granular with analysis of geodemographics data, going as far down as to the individual level, can also cause issues in regard to personal data protection (Gale, 2014). Therefore, this research attempts to perform geodemographic analysis as accurately as possible while respecting residents' privacy.

2.2 Geodemographics Applications

Geodemographics has been widely used in academic research, government management and market targeting areas based on various datasets all around the world.

The most prevailing data utilized by geodemographics is census data, because it includes the most official, complete and comprehensive statistics (Gale, et al., 2016; Vickers & Rees, 2007). As the UK census data in 2001 firstly began to be freely available for publics without a strict license, the 'Open Geodemographics' project was established by researchers from University College London and the University of Liverpool (Open Geodemographics, 2016). With the aim of offering a substitute for users who cannot afford

expensive commercial geodemographic systems, all datasets, shapefiles, codes of this project are transparent and free to obtain; all data processing and analysing procedures are explained in detail and reproducible; and all classification maps are public-accessible on the Consumer Data Research Centre (CDRC) Maps website. Longley (2005) claims that this project has been widely considered as the catalyst for advancement of geodemographics in the UK.

In light of research objectives, the most effective variables for Open Geodemographics are selected from census data by consulting with stakeholders. After converting data into percentages, transferring them by log 10, and standardizing them by range standardization, three main open classifications are produced by k-means clustering algorithm:

- 1) The Output Area Classification (OAC) at the UK national level in partnership with the Office for National Statistics (ONS) is constructed thoroughly based on the 2011 UK census data, which are comprised of 8 Supergroups, 26 Groups, and 76 Subgroups (Gale, et al., 2016);
- 2) The London Output Area Classification (LOAC) was developed in partnership with the Greater London Authority (GLA), which divides London into 8 Supergroups and 21 Groups (Longley and Singleton, 2014);
- 3) The Temporal Output Area Classification (TOAC) which analyses the geodemographic transformation between 2001 and 2011 is produced by the Economic and Social Research Council (ESRC) (Open Geodemographics, 2016).

As geodemographics is actually a combination of science and art (Gale, et al., 2016; Lansley, G. and Cheshire, J., 2018), Open Geodemographics also uses pen portraits, bar plots, radial plots and drawing classification maps by R to help users understand the geodemographic results more easily.

Except for OAC, LOAC and TOAC which demonstrates the overall demographic characteristics of areas, there are also many other geodemographic research on specific social fields, such as education (Hamnett and Butler, 2011; Wang, 2014; Williams and Wang, 2014; Xiang, et al., 2018), health (Abbas, Ojo, and Orange, 2009; Clark, et al., 2017; Stafford and Marmot, 2003; Tickle, et al., 2000; Wang, 2012), migration (Dennett and Stillwell, 2011), crime (Craglia, Haining, and Signoretta, 2001), and public policy (Ashby and Longley, 2005; Batey, Brown and Pemberton, 2008). In consonance with these research, valuable suggestions are handed out for public management.

Meanwhile, many geodemographic segmentation systems are built for commercial using, for example Claritas Prizm and Tapestry in the USA, Psyte HD in Canada, and ACORN and Mosaic in the UK (Wikipedia, 2019).

As the first commercial geodemographic system, ACORN (A Classification of Residential Neighbourhoods) from CACI Ltd. is prompted by the release of 1971 machine-readable census data in the UK. Its predecessor is a national inner-city deprivation classification in wards and parishes level produced by Richard Webber (1977). ACORN's objective is to help users understand customers' behaviour, attitudes and lifestyle so as to provide suitable services or products to meet consumers' needs. The latest version of ACORN was

released in 2017, which consists of 6 categories: ‘Affluent Achievers’, ‘Rising Prosperity’, ‘Comfortable Communities’, ‘Financially Stretched’, ‘Urban Adversity’, and ‘Not Private Households’. The 6 categories are further subdivided into 18 groups and 62 types in postcode level (Acorn's CACI, 2017b). Apart from census data, ACORN uses a series of massive datasets such as Lifestyle Surveys, Land Registry Data, Private Rental Information, Department of Work and Pensions (DWP) Benefits Data, Population Density Indicator, and so on. In addition, once new suitable data sources are discovered, they will be tested through various methods, such as inspecting supplier’s own validation systems and cross-checking the same information from several suppliers. Once datasets are proved to be reliable, they will be supplemented in real time. The algorithms utilized for classification are also not fixed. Distinctive data processing methods will be used for different data sources. Once the new method is proved to perform better, the original method is replaced (Acorn's CACI, 2017a).

As a powerful competitor of ACORN, Mosaic UK from Experian segments postcodes into 15 summary groups and 66 detailed types. The aim of Mosaic is to help retailers, banks, public service and any other potential users to understand more deeply demographics, behaviours and lifestyles of UK households. While 28% of data derives from 2011 census data, the other 72% comes from Experian own Consumer View Database which consists of broad household information. Besides ensuring that only customers who grant relevant services are targeted, Mosaic also wish to send consistent messages to communicate with customers through all channels, such as direct mail and email, TV advertising and digital advertising (Experian, 2017).

As Gale Christopher etc. (2016) states that although the overall research procedure for most geodemographic projects nowadays hold no significant differences when compared to those conducted in the 1970s', the diverse range of methodology choices for every step may lead to different and distinct results depending on the method chosen. All the existing geodemographic research and classification systems mentioned above provides a lot of inspiration towards this project's data acquisition, data filtering, data processing, clustering algorithm selection and result visualization. The rich choices for each step explained above also made method selection difficult, and provided caution in carefully selecting the most suitable method for every step for this case.

Although there are more and more extensive and in-depth research and applications in these above fields, they are seldom combined with the results of city survey questionnaires to explore the geographic distribution of residents' attitudes towards council services and local area and safety issues. Therefore, this study opens up a new research direction for geodemographics.

2.3 Westminster

As reported by the City of Westminster Profile 2018 (WCC, 2018), Westminster ranks within the 30-40% most deprived of boroughs in the UK.

The divergence of deprivation level between LSOAs is massive, according to the map of Index of Multiple Deprivation (IMD)¹ 2015 (Figure 1).

From the figures presented below derived from City of Westminster Profile 2018 (WCC, 2018), Knightsbridge & Belgravia presents the least deprivation and social exclusion, lowest concentration of residents, highest household income and median property price. In contrast, Church Street and the northwest corner of Westminster is situated at the other end of the spectrum. It is also worthy to note that the crime rate in West End and St James's is much higher than other wards in Westminster.

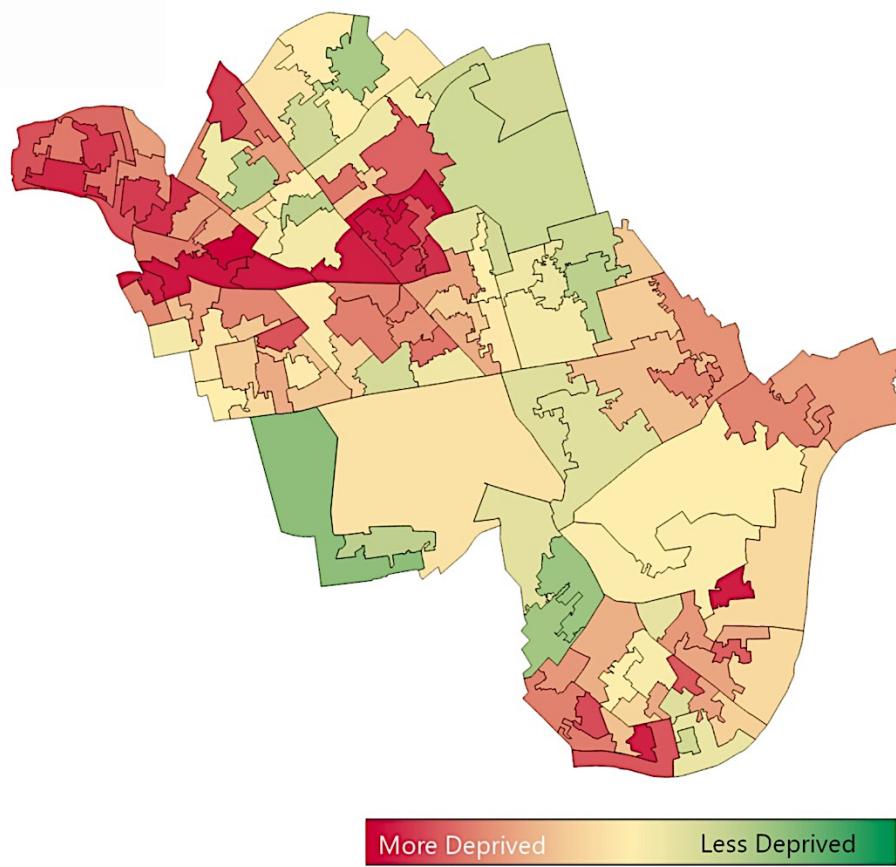


Figure 1. Map of Index of Multiple Deprivation (Composite Rank)

Source: DCLG 2015

¹ IMD combines seven aspects to measure deprivation, which are income, living environment, employment, education and skills training, crime and disorder, health & disability, and barriers to housing & service.



Figure 2. Concentration of Residents

Source: MYE ONS 2016

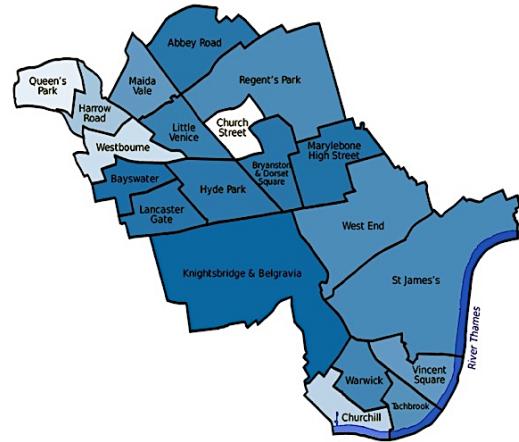


Figure 3. Median Household Income

Source: MET 2016

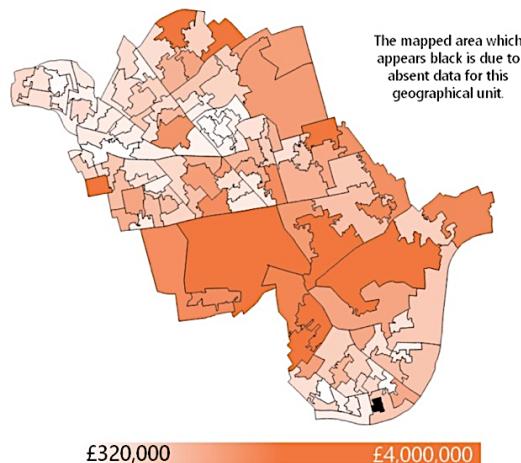


Figure 4. Median Property Price

Source: Land Registry 2017

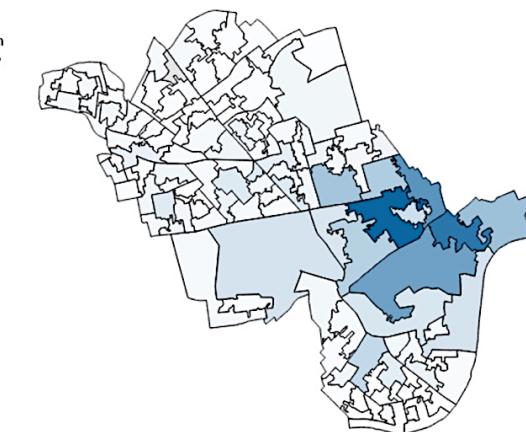


Figure 5. Criminal & Anti-Social Incidents

Source: MET 2016

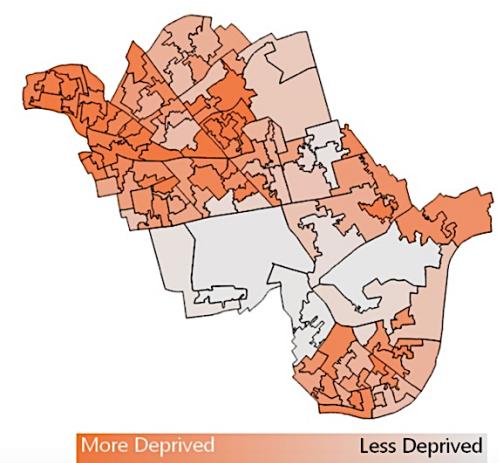


Figure 6. Income Deprivation

Source: DCLG 2015

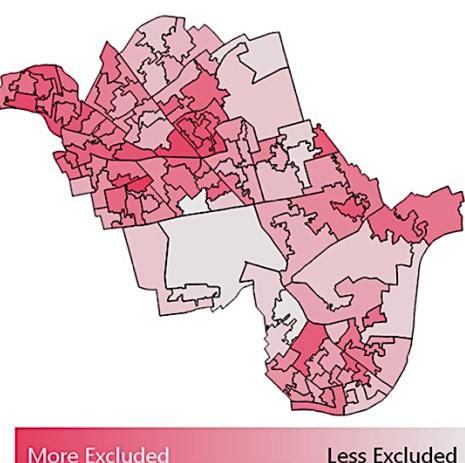


Figure 7. Social Exclusion

Source: DCLG 2015

In conclusion, the development and population composition of areas in Westminster is quite uneven. This may cause residents' attitudes towards council services and local safety issues to vary greatly. This will be analysed in detail later.

Chapter 3: Methodology

3.1 Data Source

3.1.1 Westminster City Survey Results 2018

The Westminster City Survey Results 2018 are provided by WCC with a sample size of more than 2600 respondents. Except for questions about personal and household information, the city survey 2018 questionnaire includes seven specific parts: (1) Satisfaction: only having two general questions about the satisfaction degree of the way WCC is running the city and Westminster as a place to live in; (2) Services: questions are mainly about satisfaction, usage rate and attitudes of importance for accurate services; (3) Rating the council: questions concerning whether WCC is helpful; (4) Information: questions in regard to whether WCC keep in touch with residents well and by which methods; (5) Opportunity: inquiries into whether living in Westminster provides the opportunities for higher quality of life, career prospects and wellbeing, etc.; (6) Local area and safety: questions are primarily relevant to the things you like the most and the least, as relevant to environment and safety concerns; (7) Community: major inquiries are related to whether residents from different backgrounds that are proximate to each other get along well.

The data is a csv file which consists of every participant's original answer for each question. As not all participants have a postcode and not all postcodes have been investigated, the results have been aggregated into 3 levels: OA level, LSOA level, and ward level. All participants are also matched with ACORN categories, groups and types, which are contained in the csv.

3.1.2 Crime Data

The crime data are downloaded from data.police.uk by month which contains the coordinates and types of crime points and the LSOAs they belong to in csv files. The data range are selected from October 2017 to September 2018. As the city survey is conducted in September every year, the whole year's crime count between two year's survey is more representative.

3.1.2 Westminster LSOA Shapefile

The shapefile of Westminster LSOA is downloaded from CDRC (2014), whose attributes contains LSOA codes and names in Westminster.

3.2 Statement of Ethics

The City Survey Results include some personal information such as gender, age, work status, and so on, but all information has been anonymized and aggregated at the LSOA level. As a result, the participants cannot be identified. Besides, the ACORN data is obtained from CACI with permission to avoid commercial sensitivity. Both datasets above, which are not open data, are stored in the author's personal computer and can only be accessed by the password sent from WCC to ensure data security. Except for these two datasets, all other data utilized in this research are open datasets. Ethnic approval of this research was retrieved from University College London and the reference number is 16337/002.

3.3 Data Processing

All data processing procedures are operated by python. For City Survey Results, as less than half of OAs have participants, OA is not suitable to be chosen as the granularity level. In contrast, as there only 20 wards in Westminster, it is too crude to analyse at this level. Therefore, LSOA is adopted as the geography level. There is a total of 128 LSOAs in Westminster. After aggregating data into LSOA level in python, there are 124 LSOAs which have respondents. By eliminating LSOAs that possess fewer than 10 participants to reduce risk of extreme outliers and inaccurate participant representation, 105 LSOAs are left and are included in the final analysis.

Distribution plots of gender, age, working status, house right, type of accommodation, living time in current property, living time in WCC, social grade, wellbeing status, background and ACORN groups of the selected LSOAs are shown in Annex A. According to these figures, the gender and age structures of participants are balanced in general, which indicate the survey result is representative to some extent. Most people work full time, demonstrate good wellbeing, and live in a flat, maisonette or apartment that resides in a purposely built block of flats or tenement. House rights varies between different LSOAs. Residents in many LSOAs are mainly renters, while residents in others LSOAs own or share their accommodations. Few people in most LSOAs have lived at their residence for less than 3 months, and the time they have lived in Westminster as a whole is generally longer than the time they have spent in their current accommodation, which means that although they may change dwellings residents often, they do not move out of Westminster. In most LSOAs, the majority of residents belong to the Social

Grade² B - Middle Class and C1 – Lower Middle Class. As the frequency of Social Grade A – Upper Middle Class in the UK comprises of only 4% of people in 2016 (NRS, 2016), it is not unexpected that the percentage of Social Grade A is low in most LSOAs, but for E01004689 and E01004648, they are much higher than the national average. Meanwhile, in some LSOAs, Social Grade C2 – Skilled Working Class, D – Working Class, and E – Non Working take up a much higher percentage. The distribution of diverse ACORN groups in different LSOAs is also severely polarized, as some LSOAs are 100% ‘City Sophisticated’, while some are 100% ‘Struggling Estate’, which proves the poverty gap is large between different LSOAs. Non-white residents account for a considerable proportion of residents in Westminster, reinforcing the claim that Westminster is a furnace of diverse backgrounds and cultures.

If all aspects of the questionnaire are analysed, classification results would be difficult to classify. Therefore, this study only selects two major types of issues most closely related to residents' lives: service and safety. The service part is further divided into two aspects: service usage rate and satisfaction, and service requirement. While reducing the final dimensions to as few as possible to improve the clustering accuracy, the data is also filtered and combined cautiously.

² Social Grade is a demographic classification system created by National Readership Survey based on occupation. It has six grades: A – Upper Middle Class, B – Middle Class, C1 – Lower Middle Class, C2 – Skilled Working Class, D – Working Class, E – Non Working.

3.3.1 ACORN Group Distribution

There are a total of nine ACORN groups in Westminster. After calculating the percentage of each group in each LSOA into a dataframe in python, the result is output as an csv and entered into R to draw the distribution map of each group.

3.3.2 Index of Service Usage Rate and Satisfaction

Geodemographics data are usually categorical data. For example, gender has two categories: men and women. It is necessary to convert all raw data into a unified form of data. The most common calculation method is to convert all data into percentages (Gale Christopher, etc., 2016), such as by dividing the number of men by the total population in the region and multiply that by 100%.

In this part, Q1, Q2, Q4, Q5 and Q6 in the original questionnaire (Annex B) are calculated into percentages and combined into a dataframe in Python. As the satisfaction of each service is divided into five degrees, if the results of each degree are retained, the clustering dimensions will be greatly increased. Therefore, the ‘very satisfied’ degree is aggregated with ‘fairly satisfied’ to become ‘satisfied’. Other responses are eliminated. As a result, every service will only occupy one column at the end. In addition, because Q4's maintenance services such as refuse collection and street sweeping are used by all residents on a daily basis, while services such as libraries in Q6 are not used by all residents every day , the satisfaction of Q6 is multiplied by the usage rate calculated based on Q5 (the number of people who have used the service

in the last three months / the total number of participants of city survey in the LSOA) to generate the Index of Service Usage Rate and Satisfaction.

Data with high similarity will increase the weight of this dimension in clustering, which makes the clustering results deviate. Therefore, it is necessary to exclude data with high correlation. But if the two columns of highly correlated data are proved to be independent and important for classification, they can be artificially retained (Gale Christopher, etc., 2016). As none of the coefficient scores between services are greater than ± 0.8 which is considered as a critical value of high correlation (Lansley, G. and Cheshire, J., 2018), all services are stored for clustering purposes later (Figure 8). The descriptive statistics of the final retained data are shown in table 1.

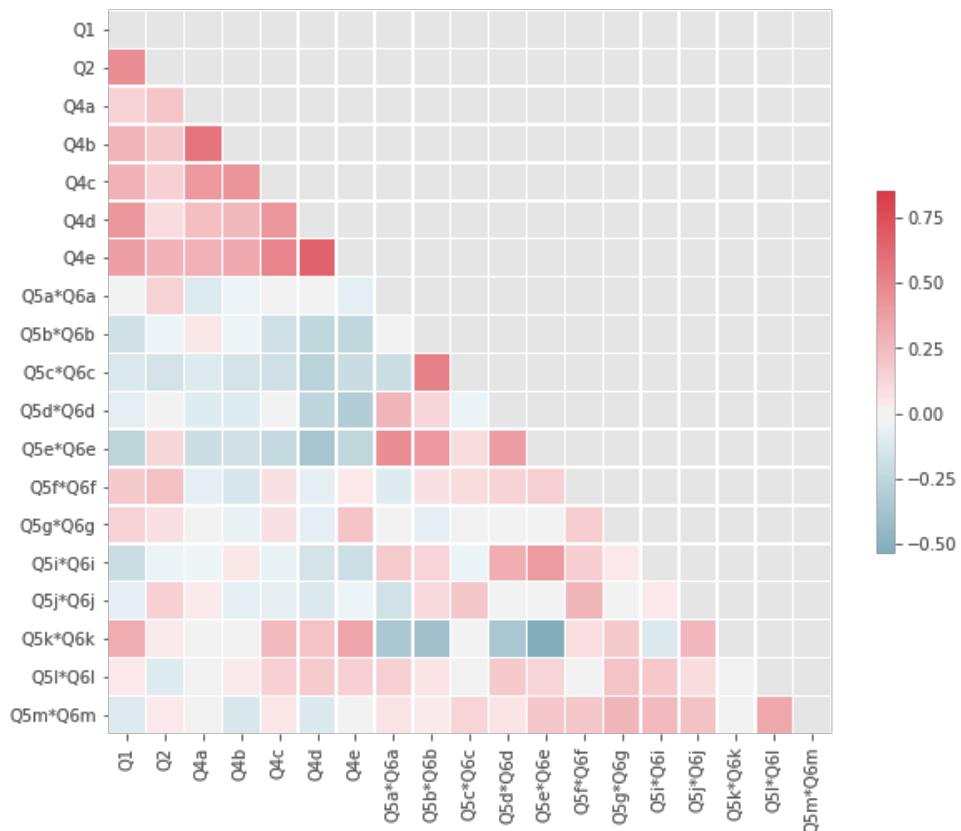


Figure 8. Heatmap of Coefficients on Index of Service Usage Rate and Satisfaction

Index	Index of Service Usage Rate and Satisfaction	n	Min	Median	Mean	SD	Max
Q1	WCC Running City	105	0.5714	0.8929	0.8795	0.1012	1.0000
Q2	Westminster Place To Live	105	0.6429	0.9429	0.9233	0.0822	1.0000
Q4a	Refuse Collection	105	0.5238	0.9487	0.9334	0.0768	1.0000
Q4b	Street Sweeping	105	0.5455	0.9286	0.9115	0.0931	1.0000
Q4c	Street Lighting	105	0.4545	0.9286	0.8927	0.1135	1.0000
Q4d	Road Maintenance	105	0.5000	0.8667	0.8555	0.1194	1.0000
Q4e	Pavement Maintenance	105	0.2857	0.8571	0.8354	0.1482	1.0000
Q5a*Q6a	Libraries	105	0.0000	0.2500	0.2525	0.1273	0.6190
Q5b*Q6b	On Street Recycling Facilities Bins	105	0.0000	0.3810	0.3884	0.2005	0.9333
Q5c*Q6c	Door To Door Recycling Collections	105	0.0000	0.3214	0.3392	0.2218	0.8947
Q5d*Q6d	Swimming Pools & Sports Facilities	105	0.0000	0.1429	0.1545	0.1132	0.6154
Q5e*Q6e	Parks & Open Spaces	105	0.0000	0.5455	0.5242	0.2209	1.0000
Q5f*Q6f	Parking Services	105	0.0000	0.2000	0.2284	0.1469	0.5833
Q5g*Q6g	Noise Service	105	0.0000	0.0286	0.0429	0.0534	0.2143
Q5i*Q6i	Provision For Cyclists	105	0.0000	0.0667	0.0783	0.0816	0.4286
Q5j*Q6j	Council Website	105	0.0000	0.2692	0.2912	0.1654	0.7619
Q5k*Q6k	Council Tax Services	105	0.0667	0.4286	0.4479	0.1854	0.8571
Q5l*Q6l	Westminster Employment Services	105	0.0000	0.0345	0.0446	0.0545	0.2292
Q5m*Q6m	Registration Services	105	0.0000	0.0000	0.0369	0.0524	0.2857

Table 1. Descriptive Statistics for Index of Service Usage Rate and Satisfaction

The boxplots of every service are displayed below. There are some outliers in many of the services. As the outliers vary among services, which reflect that some LSOAs has special attitudes towards particular services, those outliers were preserved.

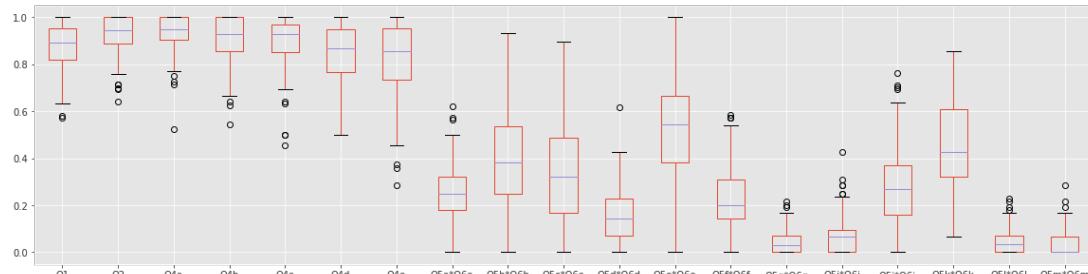


Figure 9. Boxplots for Index of Service Usage Rate and Satisfaction

The frequency distribution histograms are skewed (Figure 10), as most LSOAs tend to be satisfied with street lighting, but are unsatisfied or seldom use noise service, employment service and registration service.

Because outliers have a serious impact on algorithms such as K-means that calculate the sum of the minimum distances from each point to the cluster centre in a category, many clustering algorithms require that the data is normally distributed. Therefore, it is necessary to transform skew data into

normal distribution. According to the difference between left and right deviations, log10, square, etc. are common conversion methods. Due to the different distribution bias of each variables in the data, it is time intensive to test diverse index or logarithm values for every skewed variable based on experience. Box-Cox transformation provides an excellent solution. It chooses the range of the value of λ automatically, which can pass multiple normal distribution tests at a certain confidence level for each variable. Its formula is shown like below:

$$y_i(\lambda) = \begin{cases} (y_i^\lambda - 1)/\lambda & (\lambda \neq 0) \\ \log(y_i) & (\lambda = 0) \end{cases} \quad (1)$$

However, as all services are equal and will be compared later, it is not suitable to adopt different transformation methods to make data normally distributed. As the skew degrees and directions are different between services, it is impossible to make all services distributed normally by using unified λ . Therefore, the best solution is to keep the original data and choose clustering algorithms that are robust for outliers in later clustering steps.

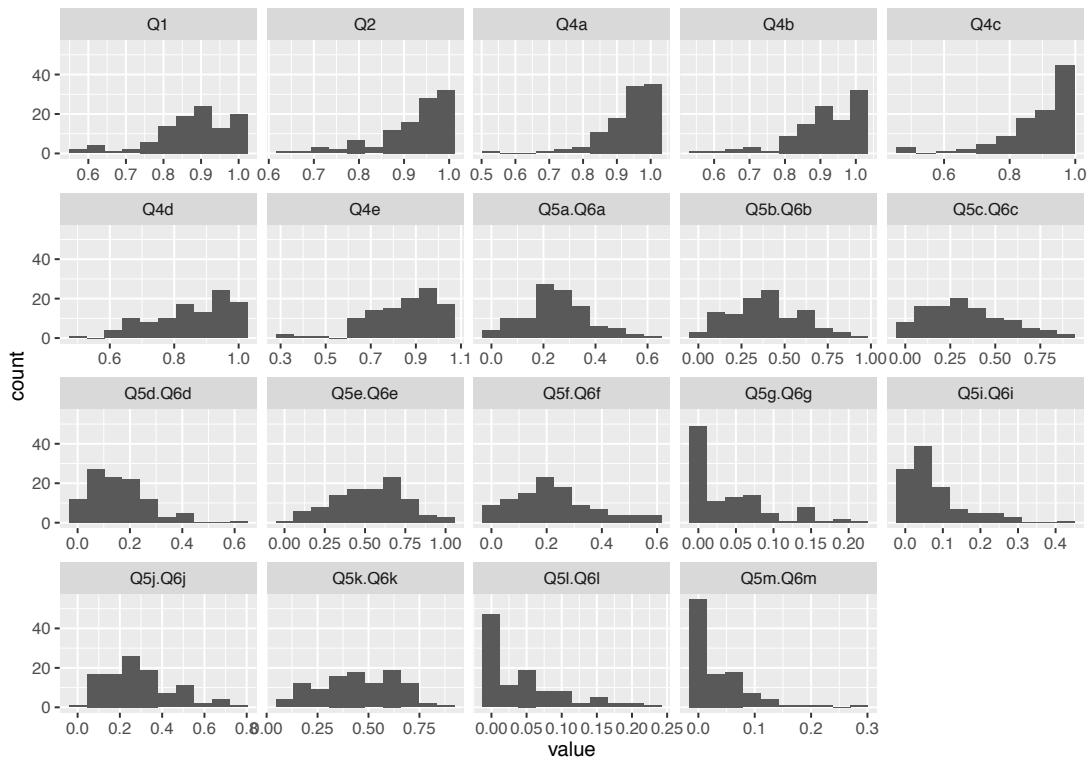


Figure 10. Frequency Distribution Histograms for Index of Service Usage Rate and Satisfaction

3.3.3 Service Requirement

As Q8 in the city survey asks for the top 3 most important local services provided by WCC, service requirement scores are calculated based on this question, for if residents require this specific service, they will grant it more importance. Different weights are set for the top 1, 2 and 3 services. The equation calculating the service requirement score is as below, with SR signifying the score of service requirement, and t₁, t₂ and t₃ representing the top 1st, 2nd and 3rd most important services.

$$SR = t_1 \times 1 + t_2 \times \frac{2}{3} + t_3 \times \frac{1}{3} \quad (2)$$

As some services are paid little attention in almost every LSOA, only the top 20 services are selected for analysis. The coefficients score between these 20 services are all among -0.8 to 0.8 (Figure 11); as such, all 20 services are retained. The descriptive statistics of final service requirement scores are shown below (Table 2). For the same reasons explained in the Index of Service Usage Rate and Satisfaction section above, outliers (Figure 12) are kept and data is not transferred (Figure 13).

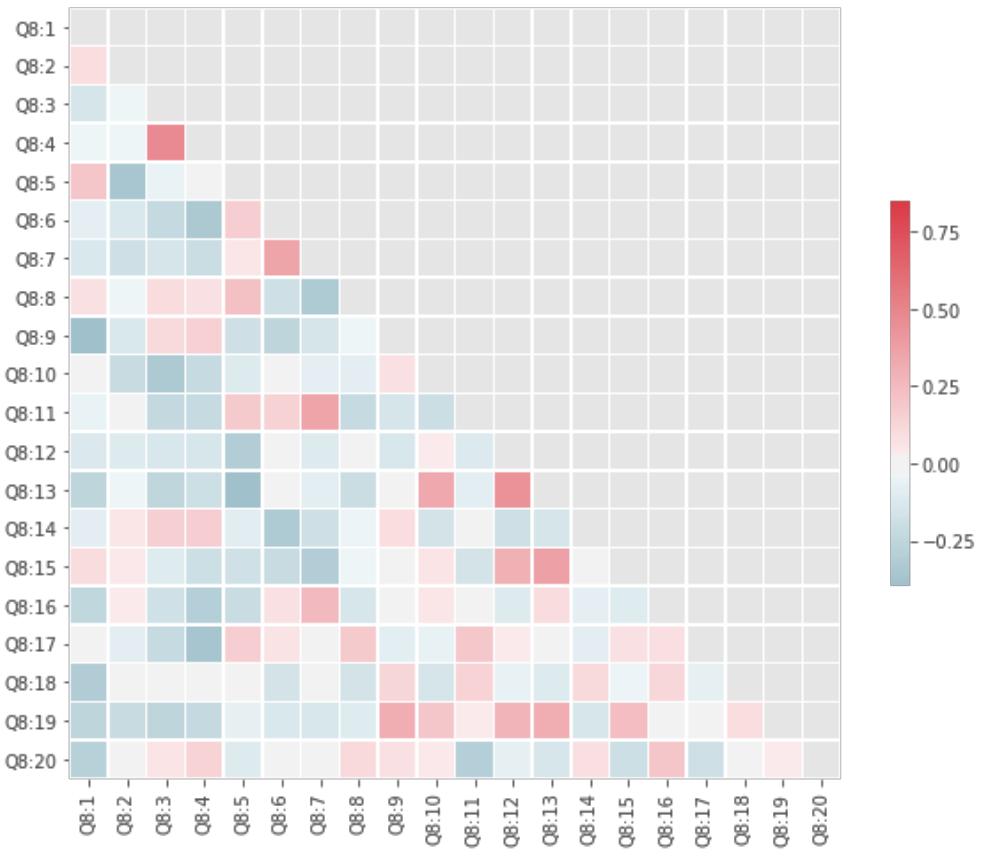


Figure 11. Heatmap of Coefficients on Service Requirement

Index	Service Requirement	n	Min	Median	Mean	SD	Max
Q8:1	Refuse collection	105	0.0000	0.2099	0.2186	0.1439	0.5556
Q8:2	Parks open spaces	105	0.0000	0.1556	0.1678	0.1011	0.5048
Q8:3	Street sweeping	105	0.0000	0.1212	0.1419	0.1090	0.5111
Q8:4	Street lighting	105	0.0000	0.1146	0.1282	0.0907	0.4048
Q8:5	Care of older people	105	0.0000	0.1111	0.1165	0.0867	0.4286
Q8:6	Environmental health	105	0.0000	0.1076	0.1155	0.0953	0.5397
Q8:7	Provision of council social housing	105	0.0000	0.0952	0.1146	0.0975	0.3828
Q8:8	Facilities for young people	105	0.0000	0.0643	0.0868	0.0830	0.4023
Q8:9	Markets	105	0.0000	0.0614	0.0857	0.0874	0.4000
Q8:10	Planning services	105	0.0000	0.0667	0.0807	0.0721	0.4242
Q8:11	Care of vulnerable children and families	105	0.0000	0.0714	0.0772	0.0643	0.2762
Q8:12	On street recycling facilities bins	105	0.0000	0.0455	0.0588	0.0622	0.3535
Q8:13	Door to door recycling collections	105	0.0000	0.0476	0.0582	0.0671	0.4167
Q8:14	Libraries	105	0.0000	0.0496	0.0571	0.0563	0.2857
Q8:15	Parking services	105	0.0000	0.0370	0.0516	0.0559	0.3125
Q8:16	Provision of affordable housing	105	0.0000	0.0286	0.0480	0.0609	0.3077
Q8:17	Mental health services	105	0.0000	0.0345	0.0479	0.0503	0.2308
Q8:18	Nursery primary schools	105	0.0000	0.0351	0.0458	0.0503	0.2857
Q8:19	Adult education	105	0.0000	0.0286	0.0435	0.0571	0.2639
Q8:20	Employment support	105	0.0000	0.0202	0.0369	0.0489	0.1905

Table 2. Descriptive Statistics for Service Requirement

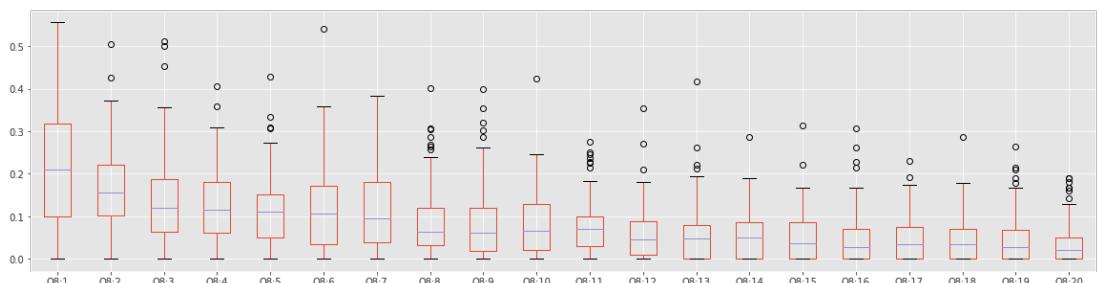


Figure 12. Boxplots for Service Requirement

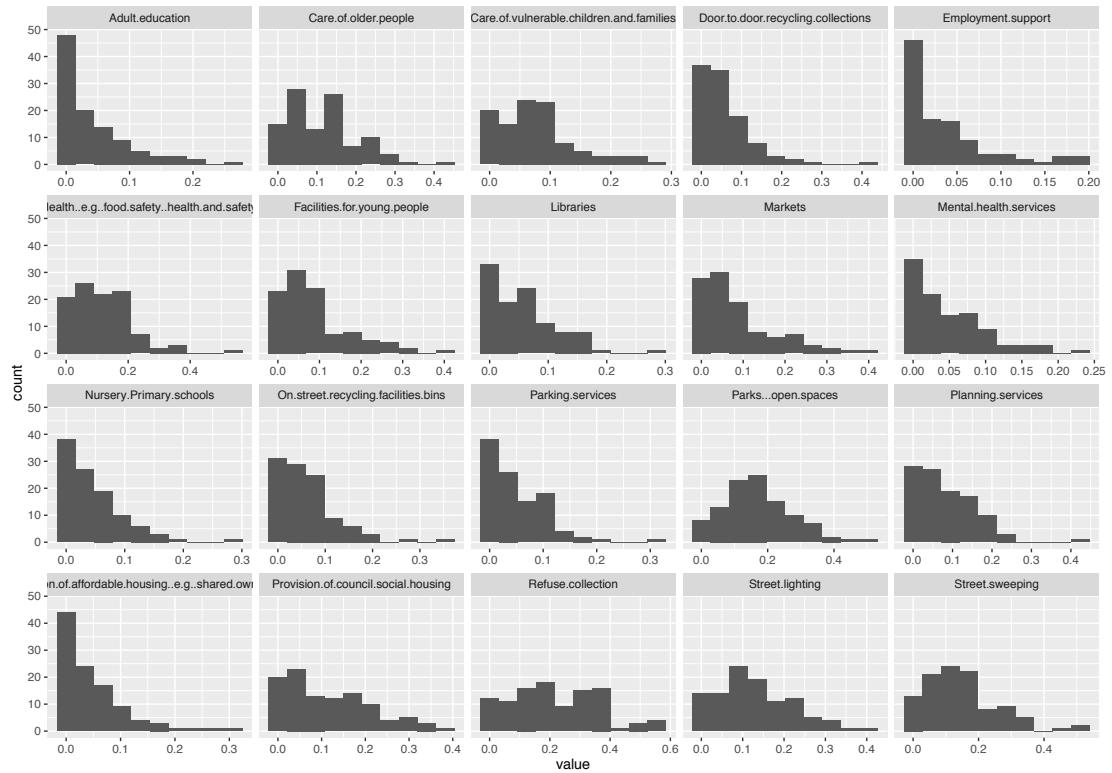


Figure 13. Frequency Distribution Histograms for Service Requirement

3.3.4 Attitudes towards Local Area and Safety Issues

Q17 in the questionnaire asks residents whether the issues listed below are considered problems for them, such as people being drunk or rowdy, which can represent residents' attitudes towards local area and safety issues. As the answers are divided into four degrees, 'a very big problem' is combined with 'a fairly big problem', while other choices are eliminated. When checking the correlations between different issues, we find that all issues are positive correlated with each other (Figure 14). The coefficient scores between 'people homeless on the streets' and 'people begging on the street', and between 'issues related to licensed premises' and 'issues related to commercial properties' are higher than 0.8. It makes sense that people begging on the street are usually homeless, while licensed premises are often the commercial properties that hold activities which may disturb residents' lifestyles. Therefore,

'people begging on the street' and 'issues related to commercial properties' are combined with other issues that represent them similarly to cut down on number of variables and ensure all issues are weighted equally. The final descriptive statistics of different local area and safety issues are shown in table 3.

Again, all data are reserved including outliers in the original version (Figure 15 & Figure 16).

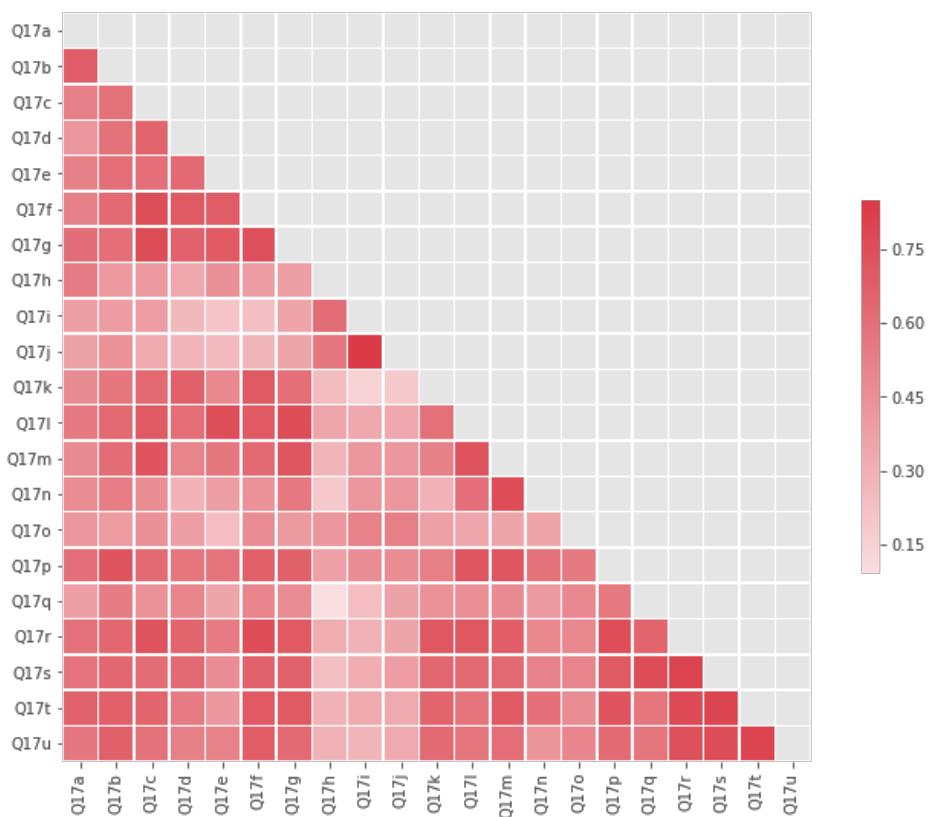


Figure 14. Heatmap of Coefficients on Attitudes towards Local area and safety issues

Index	Issues Are Problems	n	Min	Median	Mean	SD	Max
Q17a	Rubbish And Litter	105	0.0000	0.1481	0.1800	0.1422	0.7143
Q17b	People Being Drunk	105	0.0000	0.1364	0.1556	0.1289	0.5556
Q17c	People Showing Hostility Or Prejudice	105	0.0000	0.0625	0.0864	0.1020	0.5417
Q17d	Noisy Neighbours	105	0.0000	0.0741	0.1105	0.1066	0.5000
Q17e	Young People Behaving Anti-Socially	105	0.0000	0.1481	0.1855	0.1492	0.6190
Q17f	Families Causing Crime	105	0.0000	0.0698	0.1022	0.1182	0.5238
Q17g	Vandalism, Graffiti	105	0.0000	0.0714	0.1090	0.1124	0.4583
Q17h	People Using Or Dealing Drugs	105	0.0000	0.2857	0.3139	0.2170	1.0000
Q17i	People Homeless	105	0.0000	0.2500	0.2941	0.2099	1.0000
Q17k	Street Entertainment	105	0.0000	0.0588	0.0921	0.1033	0.4583
Q17l	Violence Among Young People	105	0.0000	0.1429	0.1678	0.1436	0.6190
Q17m	Dangerous/Aggressive Dogs	105	0.0000	0.0714	0.1233	0.1311	0.5417
Q17n	Dog Fouling On Pavements	105	0.0000	0.1429	0.2031	0.1795	0.7222
Q17o	Poor Air Quality	105	0.0000	0.1875	0.2232	0.1858	0.7857
Q17p	Smoking In Public Places	105	0.0000	0.1429	0.1676	0.1446	0.7619
Q17q	Noise From Building Sites	105	0.0000	0.1429	0.1812	0.1596	0.6667
Q17r	Issues Licensed Premises	105	0.0000	0.0714	0.1104	0.1285	0.6250
Q17t	Issues Deliveries To Residential Properties	105	0.0000	0.0882	0.1128	0.1192	0.5833
Q17u	Short-Term Lettings	105	0.0000	0.0714	0.0991	0.1127	0.5417

Table 3. Descriptive Statistics for Attitudes towards Local area and safety issues

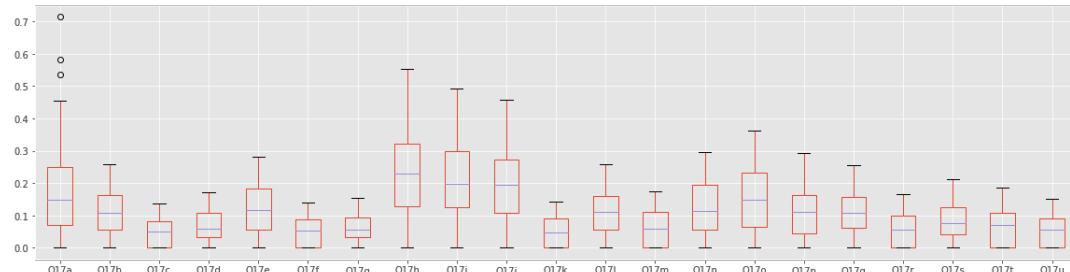


Figure 15. Boxplots for Attitudes towards Local area and safety issues

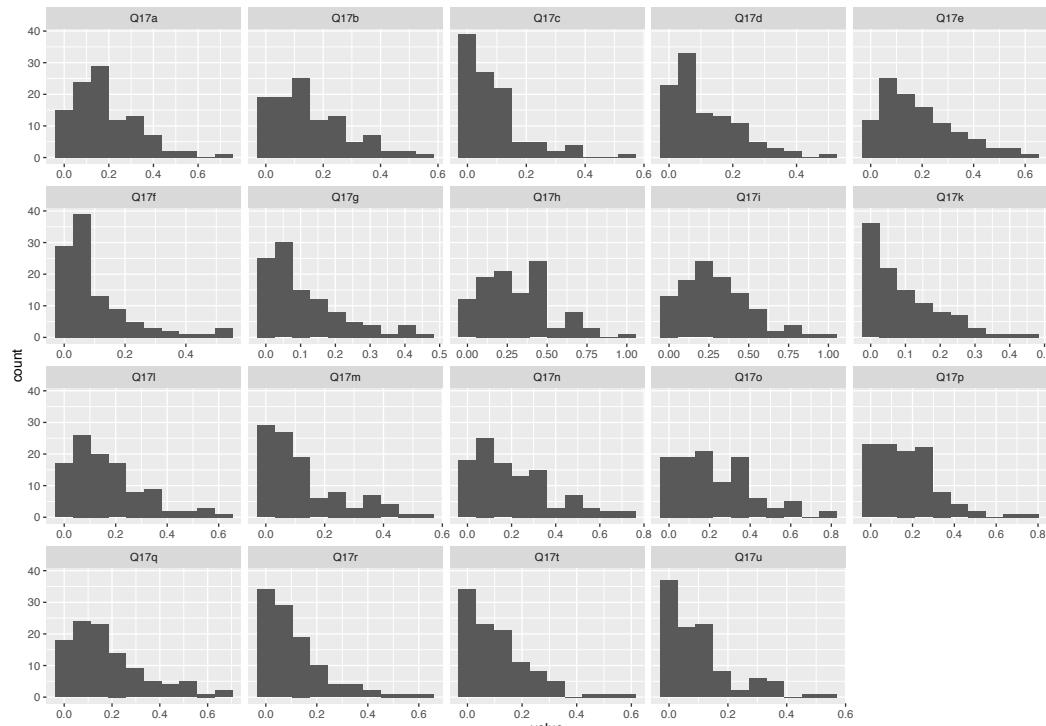


Figure 16. Frequency Distribution Histograms for Attitudes towards Local area and safety issues

3.3.5 Crime Distribution

As crime data can only be downloaded by month, 12 csv files downloaded from data.police.uk are reshaped into one dataframe in python to calculate the yearly crime count in every LSOA by 'sum' function and output the result as a csv file. After this csv file is coded and analysed in R, the crime distribution map from October 2017 to September 2018 are drawn.

3.4 Clustering

There are two traditional clustering strategies: partitional clustering and hierarchical clustering. As an example, the most frequently used algorithm for geodemographics - K-means clustering algorithm – is a form of partitional clustering (Kaufman and Rousseeuw, 2009). Meanwhile, many more modern advanced algorithms such as fuzzy logic (Cuong, Lanzi and Thong, 2012; Grekousis and Thomas, 2012; Son, 2015), genetic algorithms (Adnan, et al., 2010), artificial neural networks (Nourani, Ejlali, and Alami, 2011) are more applicable nowadays to analyze multi-dimensional big data for more rapid and accurate calculations.

As only 105 LOSAs need to be analysed, sophisticated algorithms are excessive in this case while basic algorithms are sufficient. As mentioned before, k-means is not suitable in this case as it is sensitive to outliers and skewed data. As another standard algorithm belonging to partitional clustering, Partitioning Around Medoids (PAM) is more robust than k-means, as it seeks the minimum of the sum of the dissimilarity but not the sum of the Euclidean distances (Kaufman and Rousseeuw, 2009, p 68). During PAM, k points

among samples are designated as centres randomly, while other points are allocated to the closest centres. Then, each medoid m is replaced by non-medoid point o and the procedure above is repeated. If the sum of the distance of points to their new medoid is less than before, swap m and o ; otherwise, keep m until all points have been tried. As all points in the sample need to be tested, the iteration times for big data are giant. However, as there are only 105 points in this case, PAM is suitable for this research.

Different from partitional clustering which break up dataset into groups, Hierarchical Agglomerative Clustering (HAC), which merges the two closest points into a group and then combines the two nearest groups until they are aggregated all into one, is also a commonly used algorithm for geodemographics which works well for skewed data. For HAC, there are several methods to measure distance, such as ‘complete’, ‘single’, ‘average’, ‘centroids’, ‘ward’. ‘Single’ stands for the distance between the closest points in two clusters and aggregate two groups with the closest distance. In contrast, ‘complete’ compares the distance between the furthest points in each pair of clusters. ‘Average’ calculates the average distance of all pairwise points in two clusters and join groups with minimum average distance, while ‘centroids’ contrast the distance between the centres (means) of each two clusters. ‘Ward’ is a more complex method which compare the distance deviation to the cluster centroids between pre-merge and post-merge, and select two groups with the least increment to merge (Murtagh and Legendre, 2014). Based on different methods, the hierarchy of clustering may vary greatly. Agglomerative coefficient (AC) can be employed to choose the best method. It describes the strength of HAC structure. The formula for AC is displayed below. For each

point i , the $m(i)$ in the formula is equal to the dissimilarity to the cluster it joined at the beginning divided by the dissimilarity to the cluster it aggregated at the end. AC takes values from 0 to 1, and being close to 1 means the cluster structure is pretty reasonable.

$$AC = 1 - m(i) \quad (3)$$

Because clustering prefers to give variables with larger values or standard deviation higher weight, it is essential to standardize variables before clustering. Common standardization methods are z-score standardization and range standardization. The formula for z-score standardization are displayed like below, where μ is the mean of the sample, σ is the standard deviation of the sample.

$$z = \frac{x - \mu}{\sigma} \quad (4)$$

Range standardization, on the other hand, divides the distance to the minimum value by the distance between then maximum and minimum, and as a result, all scaled values are between 0 and 1.

$$R_i = \frac{x_i - x_{min}}{x_{max} - x_{min}} \quad (5)$$

Z-score standardization is more suitable for algorithms sensitive to high standard deviation, as it can cut down the effect of difference of standard deviations among different variables more effectively, while range

standardization is more convenient for algorithms which need values of input between 0 to 1.

In the next steps, PAM and HAC are conducted together to the same datasets to compare results. As none of them need the input data ranges from 0 to 1, and both of them are sensitive to high standard deviation, z-score standardization is employed to all data before clustering. As R is a completely free software and contains rich packages to do clustering and produce elegant interactive visualization maps, it is selected as the clustering and visualization software.

3.4.1 Clustering for Index of Service Usage Rate and Satisfaction

By utilizing ‘agnes’ function in R, we can calculate AC in different HAC methods conveniently. The results in the view of index of service usage and satisfaction denotes that ‘ward’ gets the highest AC among ‘single’, ‘complete’, ‘average’ and ‘ward’, which is 0.84. Accordingly, ‘ward’ is chosen as the method for HAC.

Because the number of clusters both for PAM and HAC also need to be decided before clustering, silhouette width is employed to assist in decision making. The silhouette width reflects how close a point in a cluster to the points in the neighbour cluster. The formula for silhouette width is displayed below, as a_i refers to the average distance between i and all other points in the same cluster, while b_i stand for the average distance between i and all points in the nearest cluster. When silhouette width is close to 1 means this point is

clustered well, while close to 0 means it locates in the boundary of two clusters, and when negative, presents that it may be placed to the wrong cluster. The ‘fviz_nbclust’ function in R can calculate the average silhouette width of all points for different numbers of cluster k. When setting the maximum cluster number to 15 and the distance measure method as ‘euclidean’, the k getting the highest average silhouette width for PAM is 11, and for HAC is 3 (Figure 17 & Figure 18).

$$S_i = (b_i - a_i) / \max(a_i, b_i) \quad (6)$$

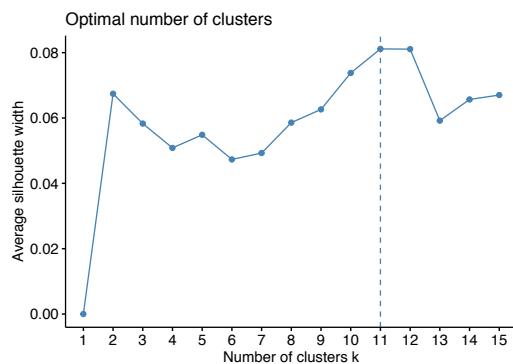


Figure 17. Average Silhouette Width of PAM for Index of Service Rate and Satisfaction

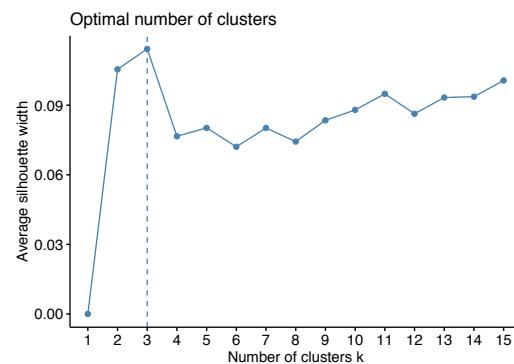


Figure 18. Average Silhouette Width of HAC for Index of Service Rate and Satisfaction

Utilizing ‘silhouette’ function combined with ‘plot’ function in R, silhouette plots of all point are produced when k chosen 11 in PAM and k chosen 3 in HAC (Figure 19 & Figure 20). Cluster 1, 2, 10, 11 of PAM behave well as all points in these clusters have positive silhouette width, while more points in cluster 9 are closer to neighbour clusters. In HAC, some points in cluster 1 is negative in silhouette width, while other two behave comparatively well.

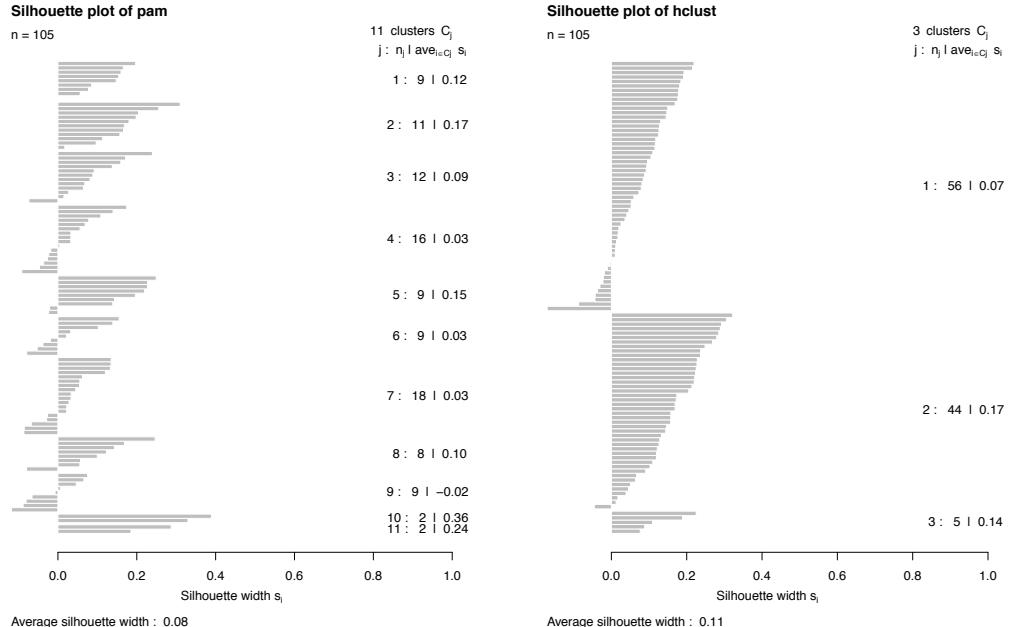


Figure 19. Silhouette Plot of PAM for Index of Service Rate and Satisfaction

Figure 20. Silhouette Plot of HAC for Index of Service Rate and Satisfaction

3.4.2 Clustering for Service Requirement

Again, ‘ward’ method achieves the highest AC which is 0.77 and is designated for HAC. As it is lower than AC for index of service usage rate and satisfaction, the HAC structure for service requirement behave worse than the HAC structure for index of service usage rate and satisfaction.

The silhouette width is also used to find the suitable cluster numbers for service requirement. However, the k corresponding to the highest average silhouette width is 2 for both two algorithms, which is too rough. As a result, the k when average silhouette width ranks the second highest was chosen instead. For PAM, it is 9, and for HAC, it is 3.

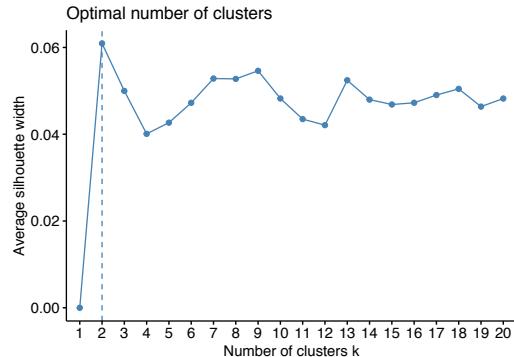


Figure 21. Average Silhouette Width of PAM for Service Requirement

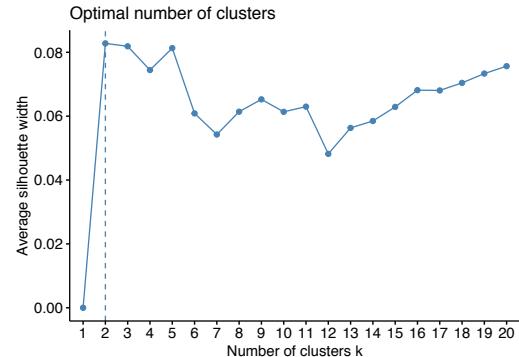


Figure 22. Average Silhouette Width of HAC for Service Requirement

As figure 23 and 24 shows, the average silhouette width for all clusters in both PAM and HAC are positive, though some points have negative values.



Figure 23. Silhouette Plot of PAM for Service Requirement

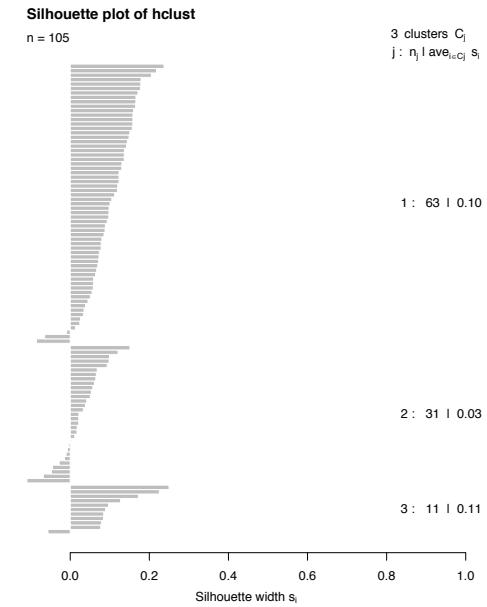


Figure 24. Silhouette Plot of HAC for Service Requirement

3.4.3 Clustering for Attitudes towards Local Area and Safety Issues

Once more, ‘ward’ method obtains the highest AC which is 0.92, the highest among these three aspects, which demonstrates the HAC structure for attitudes towards local area and safety issues is more ideal.

When k is larger than 2, the silhouette width decreases rapidly (Figure 25), so $k = 2$ is chosen for PAM. There is a huge gap between $k = 3$ and larger in HAC. Though the total average silhouette width for $k = 2$ is a little larger than $k = 3$, there are fewer points have negative silhouette width when $k = 3$ as figure 27 shows. Under comprehensive consideration, $k = 3$ is selected for HAC.

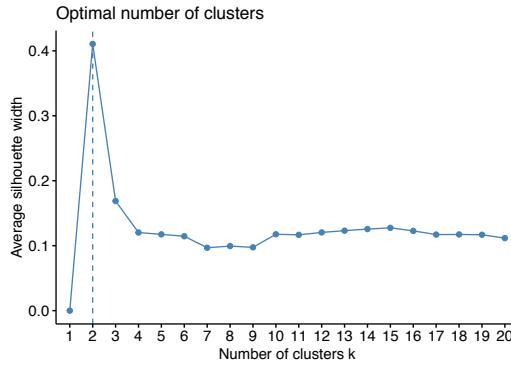


Figure 25. Average Silhouette Width of PAM for Attitudes towards Local Area and Safety Issues

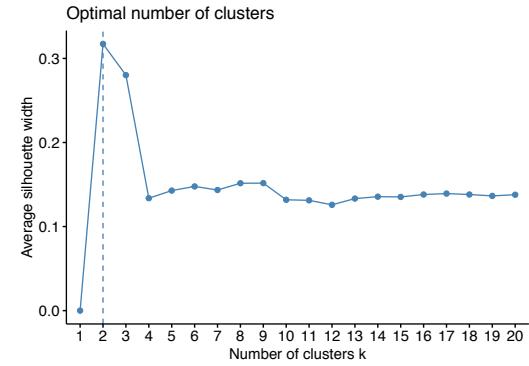


Figure 26. Average Silhouette Width of HAC for Attitudes towards Local Area and Safety Issues

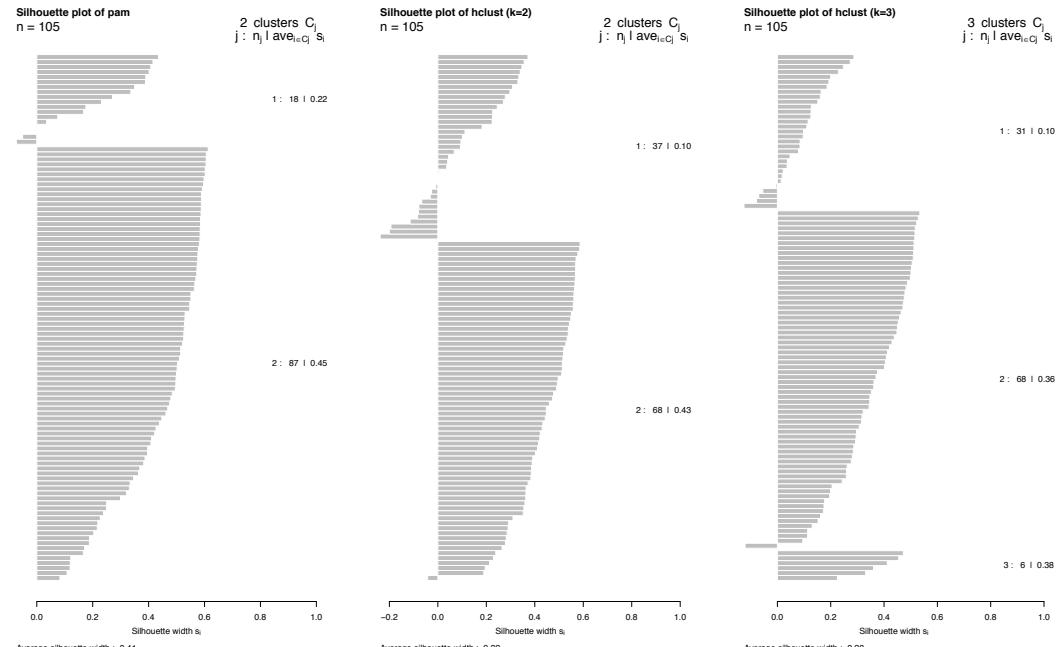


Figure 27. Silhouette Plot of PAM, HAC ($k=2$) and HAC ($k=3$) for Attitudes towards Local Area and Safety Issues

Chapter 4: Results

4.1 ACORN Group Distribution Map

The maps of the distribution of every ACORN group in Westminster (Figure 28) match well with the map of Index of Multiple Deprivation Map (Figure 1).

The lavish lifestyles are gathered in Knightsbridge & Belgravia, while City Sophisticates are spread more widely. The struggling Estates are concentrated in Queen's Park, Westbourne, Church Street, Churchill, Tachbrook, and E010333595 in West End.

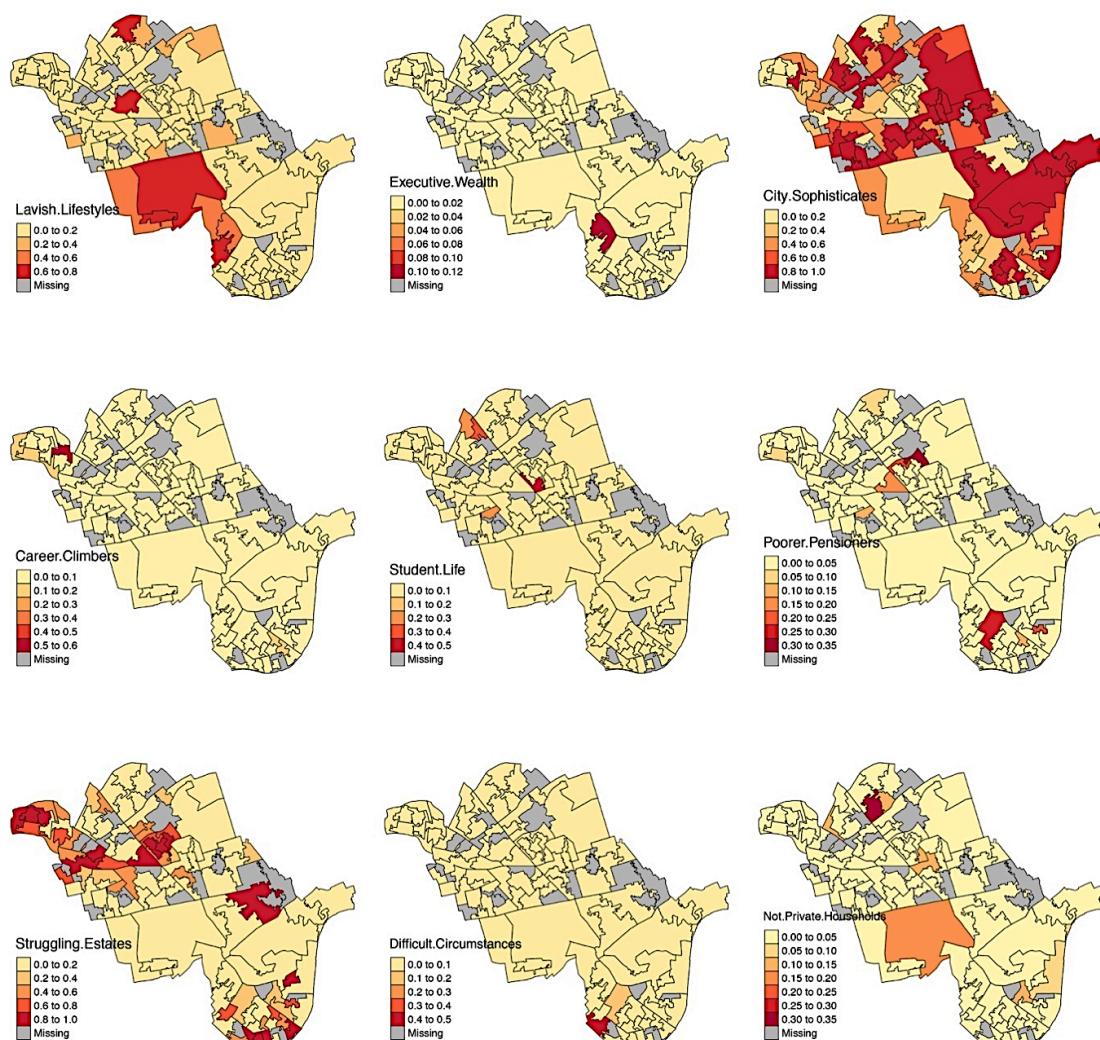


Figure 28. Maps of ACORN Group Distribution in Westminster

4.2 Attitudes towards Service

4.2.1 Index of Service Usage Rate and Satisfaction

Cluster plots produced by ‘fviz_cluster’ function in R can visualise the clustering results more intuitively. It presents points into two principal component axes which explain the most information. The plot of PAM indicates some clusters, such as cluster 1 and 9, are very close, while the clusters of HAC are more dispersed though still possess some overlapping areas. Overall, the results when k chosen 11 in PAM and 3 in HAC can still reflect characteristics of the Index of Service Usage Rate and Satisfaction for different LSOAs to some extent.

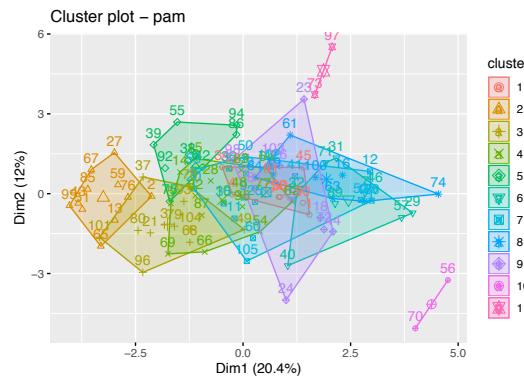


Figure 29. Cluster Plot of PAM for Index of Service Usage Rate and Satisfaction

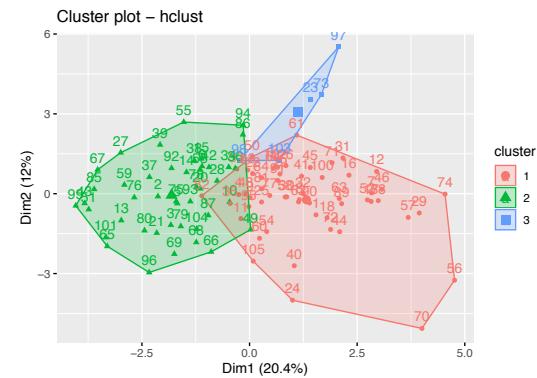


Figure 30. Cluster Plot of HAC for Index of Service Usage Rate and Satisfaction

The result for HAC is shown in figure 31. The z-scores for every service of medoids for PAM and the centroids for HAC are displayed in figure 32 which can represent the characteristics of clusters. As 0 is the average score for each service, if the z-score is higher than 0, it means residents in this cluster use more or feel more satisfied with this service. When it is higher than 1 or lower than -1, it is a notable feature for this cluster, which is emphasized by

black thick boarders in table 4. Names and analyses are given to every group based on these features and the detailed original information of every LSOA is presented in Annex C and D.

The result of PAM is more biased as almost every cluster are armed with some values higher than 1 or lower than -1. The description of each cluster for PAM are explained below:

- 1) PAM Cluster 1 - Parking Demanders: LSOAs in this cluster have significant higher usage rate for parking services. The z-score for other services are among -1 to 1, which means the usage rate for these services are close to the average;
- 2) PAM Cluster 2 - Busy Commuters: This cluster possesses higher satisfaction for WCC running city, and road & pavement maintenance. Meanwhile, the residents in this cluster tend to participate less in recycling, sports and outdoor activities. On the basis of these characteristics, people living in the LSOAs of this cluster can be assumed to be busy in commuting and working more, and have less time for leisurely activities;
- 3) PAM Cluster 3 - Homebody: People in this cluster seldomly walk or play in parks or open spaces. They also use parking services less. Thus, it can be predicted that they prefer to stay at home;
- 4) PAM Cluster 4 - Information Seekers: LSOAs belonging to this cluster possesses remarkable usage of the council website which proves that

residents living in this LSOAs actively engage with information provided by the council;

- 5) PAM Cluster 5 - Employment Focus: Residents in this cluster have higher utilization and satisfaction of Westminster employment services, which means that services provided by the WCC in job provisions play a higher value in these areas and may derive higher benefits from additional employment services;
- 6) PAM Cluster 6 – Environment Conscious: This cluster tends to be stricter in street lighting and road & pavement maintenance, which claims WCC should spend more effort on these aspects in these areas. Residents in these LSOAs are much more conscious of the environment of their local streets. They also use both street and door to door recycling much more than other LSOAs, but feel less satisfied with these services as compared to other clusters. This suggests that residents in these areas are more environment-friendly and may be paying more attention to recycling, and as such, WCC can still make more improvements in this aspect. They also spend more time and feel content in local parks and open spaces, which means they are in favour of outdoor activities in their respective areas;
- 7) PAM Cluster 7 - Refuse Unsatisfied: This cluster is more balanced than others, as none of the features are higher than 1 or lower than -1. However, residents involve in these LSOAs are less satisfied with refuse collection and WCC running city. If WCC can focus more on

collecting rubbish in these areas, it is possible that the satisfaction of these area can raise quickly;

- 8) PAM Cluster 8 - Young Outdoors: Residents in these LSOAs tend to be unhappy with road maintenance and pavement maintenance, while using parks & open spaces and swimming pools & sports facilities frequently. These tendencies indicate that they usually go out for sports and leisure activities and have high expectation of road and pavement maintenance, which may be correlated with outdoor running. On the contrary, they utilize council tax service less than other clusters, which may be because they can be exempted for council taxes as students or other special identities;
- 9) PAM Cluster 9 – Volatility Stressors: The usage rate of the registration service is much higher than other clusters. As this service is for citizenship, births, deaths and marriages, it means many residents in these LSOAs are new comers or are experiencing new stages of life, such as being parents, husbands, wives. At the same time, the score for satisfaction of Westminster as the place to live is the lowest among all clusters. It may because they are not adapted to the new environment or new phase of lives and feel stressful. WCC can provide more help such as engaging more with this community or providing resources for easier integration and process transition;
- 10)PAM Cluster 10 – City Unsatisfied: Residents in this cluster are very unsatisfied with many aspects of Westminster, especially for street sweeping and lighting. As there are only two LSOAs belonging to this

cluster, E01004718 and E01004733, it is very necessary for WCC to improve the street cleanliness and facilities in these two LSOAs. Of note, the survey participants in E01004733 almost never use the library or play in parks or open spaces. WCC can try to improve their sense of outdoor activities and engagement with publicly available resources;

11)PAM Cluster 11 - Adventurous Newcomers: For E01004736 and E01033597, they are very satisfied with many fields of WCC. The most notable feature is high usage rate and satisfaction for provision for cyclists, which shows many residents in these two LSOAs often use bicycles. WCC can offer more matched facilities or services for bicycles in these area in the future. As the usage of registry service is the highest among all clusters, it stands a good chance that there are many immigrants or people similar to those in cluster 9. However, in contrast to cluster 9, they adapt well to their new environment or new stages of their lives. They use more libraries, swimming pools, sports facilities, parks and open stages, and show great passions in job seeking. It is worthy to note that for this cluster the satisfaction of WCC running the city is the lowest. This may be due to unfamiliarity with WCC. WCC can invest more efforts in engaging them more in council activities and make them become city supporters.

The clustering result for HAC is more comprehensive than PAM, which can present residents' preference in a more general orientation.

1) HAC Cluster 1 - Environment Unsatisfied: The residents in these LSOAs are more likely to feel unsatisfied with WCC running the city,

Westminster as a place to live, and street cleanliness and maintenance compared to HAC cluster 2. This indicates WCC need to spend more resources and time in making residents' living and travelling more conveniently and safe in these areas;

- 2) HAC Cluster 2 – Outdoor Facilities Unsatisfied: Residents in these areas generally feel more satisfied with their living environment than average, while feel unsatisfied with outdoor facilities, such as parks and swimming pools. WCC should focus more on outdoor facilities in these areas;
- 3) HAC Cluster 3 – New Comers: This cluster is similar to the combination of PAM clusters 9 and 11. Like the suggestion for PAM cluster 9 and 11, WCC should contact more with this cluster to make them feel more familiar with Westminster and improve their council engagement. In addition, people tend to engage in noise services more than the other two clusters, which suggests that they may prefer a quieter environment as the environment of these areas may be noisier than other areas.

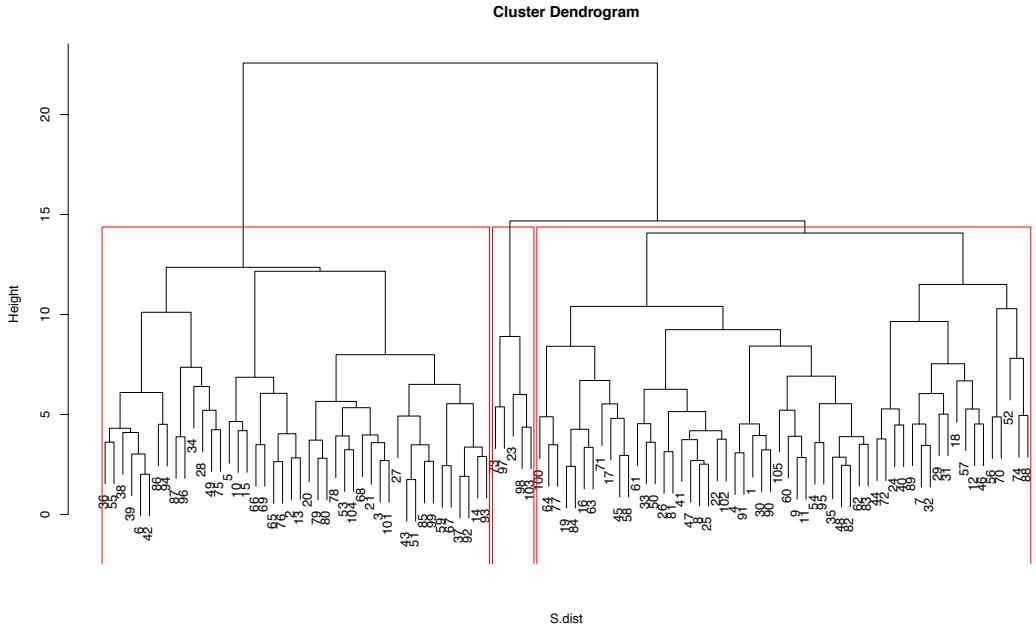


Figure 31. Cluster Dendrogram for Index of Service Usage Rate and Satisfaction

Index	Service Usage * Satisfaction	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	H1	H2	H3
Q1	WCC Running City	0.72	1.19	0.84	-0.19	0.90	-0.79	0.06	-0.22	-0.79	-0.61	-0.93	-0.40	0.54	-0.31
Q2	Westminster As Place To Live	0.35	0.51	-0.37	0.93	0.93	0.24	0.24	0.50	-1.99	-1.28	0.93	-0.16	0.30	-0.85
Q4a	Refuse Collection	-0.37	0.87	0.40	-0.04	0.10	-0.62	-0.99	0.40	-0.17	-2.68	0.87	-0.41	0.46	0.50
Q4b	Street Sweeping	-0.58	0.95	0.18	-0.05	0.00	-0.58	-0.58	0.95	0.52	-3.93	0.95	-0.42	0.54	-0.03
Q4c	Street Lighting	0.11	0.95	0.32	-0.08	0.69	-1.07	-0.06	-0.63	0.59	-3.86	0.32	-0.44	0.52	0.42
Q4d	Road Maintenance	-0.78	1.21	0.61	0.43	0.72	-1.42	0.25	-1.48	-0.13	-0.31	0.61	-0.55	0.66	0.35
Q4e	Pavement Maintenance	0.15	1.11	0.87	-0.30	0.71	-1.01	0.53	-1.54	0.30	-2.57	0.15	-0.54	0.69	-0.10
Q5*6a	Libraries	-0.86	0.18	0.54	-0.16	0.56	0.04	0.26	-0.02	0.22	-1.98	1.94	0.10	-0.22	0.81
Q5*6b	On Street Recycling Facilities Bins	-0.04	-1.59	-0.33	0.03	0.12	1.48	0.34	0.73	-0.74	0.78	0.91	0.21	-0.32	0.45
Q5*6c	Door To Door Recycling Collections	-0.67	-1.06	0.24	0.67	0.33	1.18	-0.37	-0.56	-0.45	1.34	-0.56	0.15	-0.19	0.06
Q5*6d	Swimming Pools & Sports Facilities	0.74	-1.06	-0.42	0.28	-0.33	-0.36	-0.61	1.47	0.75	-0.56	1.79	0.36	-0.57	0.98
Q5*6e	Parks & Open Spaces	-0.22	-1.90	-1.08	-0.37	0.02	1.25	0.60	1.35	0.16	-1.55	1.51	0.40	-0.59	0.70
Q5*6f	Parking Services	1.36	0.32	-1.31	0.50	-0.35	0.58	-0.58	-0.34	-0.47	-0.32	0.39	0.04	-0.05	-0.06
Q5*6g	Noise Service	0.09	-0.16	-0.80	-0.37	-0.80	-0.27	-0.80	-0.80	-0.05	-0.80	-0.80	-0.11	0.00	1.21
Q5*6i	Provision For Cyclists	0.21	0.31	-0.52	-0.10	0.12	0.09	-0.26	-0.08	0.02	0.15	4.29	0.05	-0.33	2.29
Q5*6j	Council Website	-0.90	-0.30	-0.46	1.47	-0.16	0.14	-0.38	-0.03	-0.79	0.44	0.83	-0.03	0.01	0.23
Q5*6k	Council Tax Services	0.92	0.75	0.86	0.59	0.12	-0.41	-0.57	-1.84	-0.04	-0.45	-1.26	-0.41	0.51	0.03
Q5*6l	Westminster Employment Services	0.05	-0.19	-0.82	-0.39	1.34	0.75	-0.29	-0.16	-0.09	-0.82	1.80	-0.20	0.02	2.07
Q5*6m	Registration Services	-0.70	-0.05	-0.70	0.63	-0.14	0.39	-0.16	-0.70	1.59	-0.70	3.39	-0.06	-0.22	2.59

Table 4. PAM Medoids and HCA Centroids for Index of Service Usage Rate and Satisfaction

In contrast to the results with PAM and HAC, it was discovered that most LSOAs in PAM cluster 1, 6, 7, 8 & 10 belong to HAC cluster 1, while all LSOAs in PAM cluster 2, 3, 5 are contained by HAC cluster 2. Half of PAM cluster 4 consists of residents in HAC cluster 1, while another half is associated with HAC cluster 2, which means it is a more neutral cluster. Some of PAM cluster 9 and all of PAM cluster 11 are embodied by HAC cluster 3. As the average silhouette width for PAM cluster 9 is negative (Figure 19), its composition is

more complex than those from other clusters and can be analysed more deeply in further investigation by the WCC.

The cluster maps of PAM and HAC are presented below. There is no obvious similarity between cluster map of PAM (Figure 32) with ACORN group distribution maps (Figure 28) and the index of multiple deprivation map (Figure 1). This reflects that the service usage and satisfaction of residents for specific services don't have strong relationship with their demographic classification. One of LSOAs belonging to PAM Cluster 11 – Adventurous Newcomers is in St James's. As this LSOA concludes St James's Park and Piccadilly Circus, and is near West End, it's no wonder why many residents in this LSOA are satisfied with and use services a lot. However, the LSOA adjacent is pertaining to PAM Cluster 10 - City Unsatisfied. It's necessary and worthy for WCC to figure out why neighbouring areas have wide variations for services.

There are some links between the cluster map of HAC (Figure 33) with the map of the index of multiple deprivation (Figure 1). LSOAs in less deprived wards, such as Knightsbridge & Belgravia, West End and St James's are more outdoor facilities unsatisfied, while LSOAs in other area are more likely to be environment unsatisfied.

In conclusion, for the aim of providing more suitable and high-quality council services for residents, classifying LSOAs by the answers for service usage and satisfaction questions directly is more sufficient and effective than analysing resident's personal information indirectly. WCC can lay particular emphasis on the service improvement according to the categories of LSOAs.

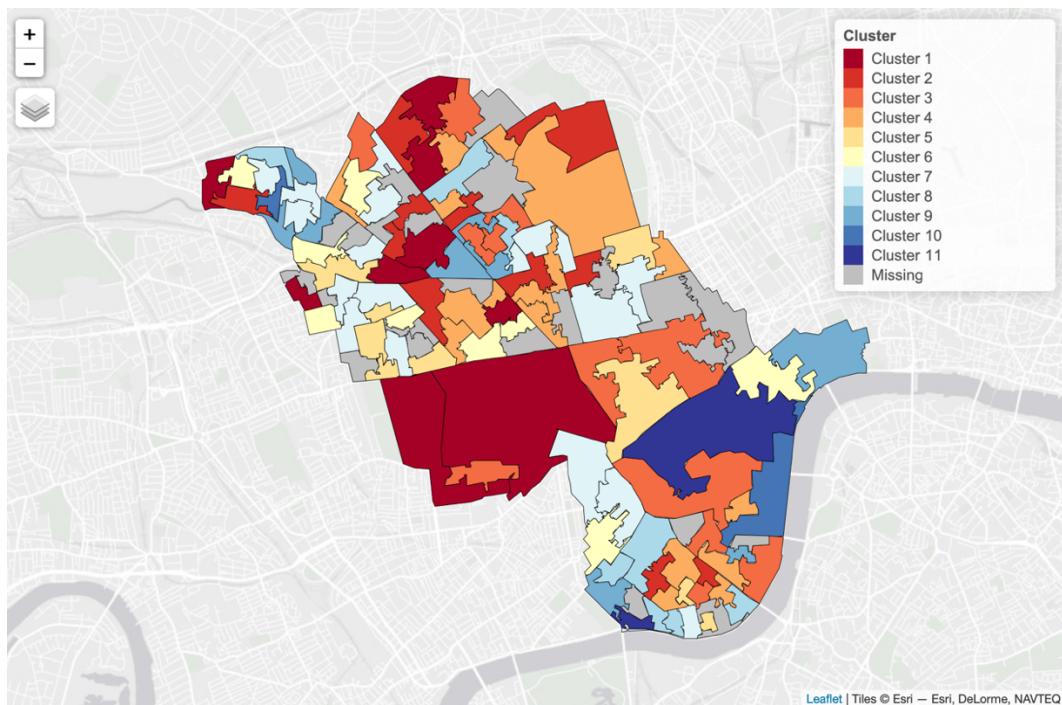


Figure 32. Cluster Map of PAM for Index of Service Usage Rate and Satisfaction

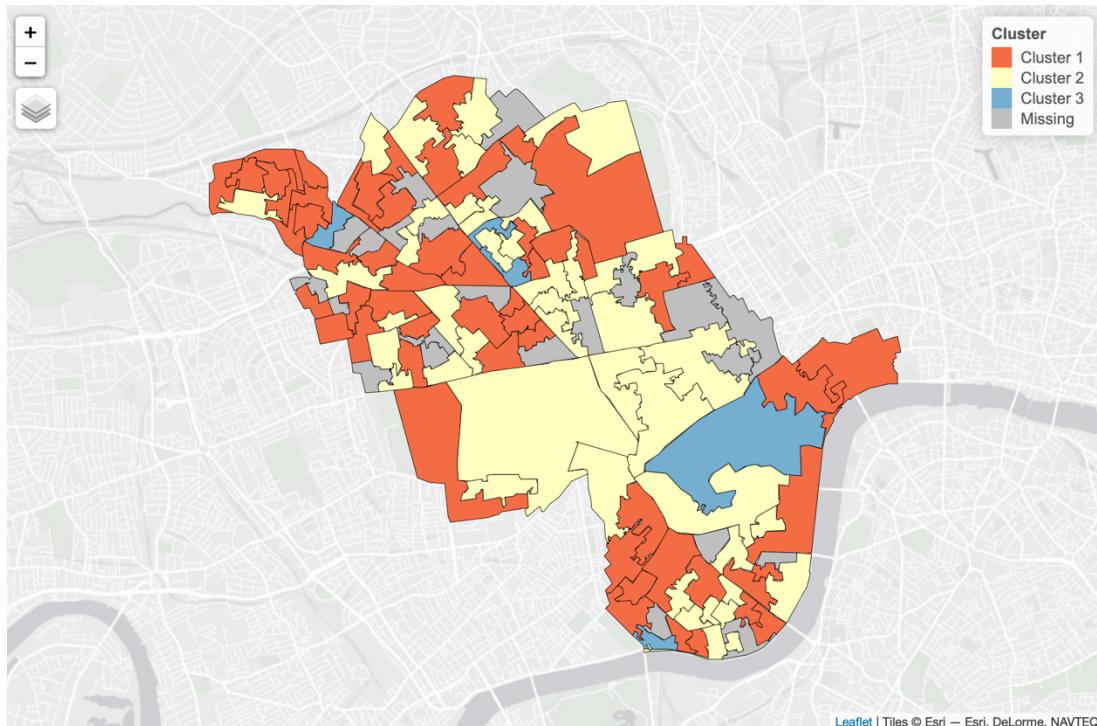


Figure 33. Cluster Map of HAC for Index of Service Usage Rate and Satisfaction

4.2.2 Service Requirement

Both the cluster plots of PAM and HAC overlap significantly, which implies the input data is difficult to cluster and the clustering results may be inaccurate to a certain degree. However, the clustering results can still serve as a reference.

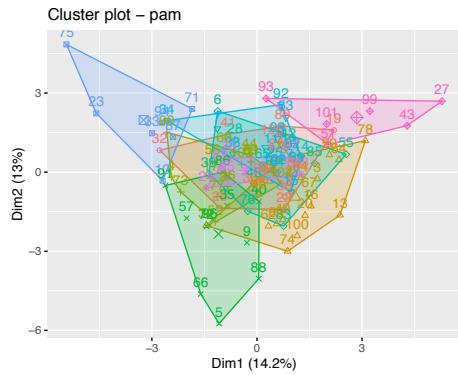


Figure 34. Cluster Plot of PAM for Service Requirement

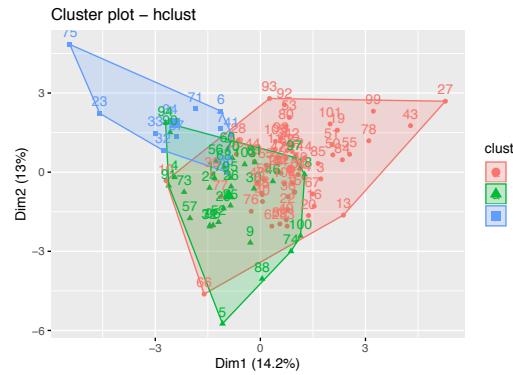


Figure 35. Cluster Plot of HAC for Service Requirement

In viewing centres of clusters, the results for PAM are more well-directed, as every cluster calculated by PAM has an obvious emphasis in one or two specific service. On the contrary, the centres for HAC are more comprehensive.

- 1) PAM Cluster 1 – Outdoor Enthusiasts: The residents in this cluster tend to consider parks and open spaces as more important features. In opposite, they incline to pay less attention in the offering of council social housing and facilities for youth;
- 2) PAM Cluster 2 – Street Lighting Demanders: People in this cluster think street lighting is more essential than any other services, while they care less for planning services. Though not obvious, they are also concerned more with care of the elder (who may need street lighting more while walking, for example), and less with markets, mental health services and adult education compared to other clusters;
- 3) PAM Cluster 3 – Newly Formed Families: This cluster shows solicitude for the provision of affordable housing and nursery primary schools,

which indicates many residents in this cluster are newly formed families or recently had children;

- 4) PAM Cluster 4 – Vulnerable Families: People in this cluster believe that provision of council social housing is more crucial. The rent of council social housing is usually much cheaper than those per market rate and can provide long-term tenancy to reduce the pressure of eviction due to expiration of rent, which are usually allocated to people who have difficulties in living and are managed by council directly. Meanwhile, the consciousness paid to environmental health and vulnerable children and families are slightly higher than other clusters. Therefore, it can be inferred that the rate for vulnerable families in these areas may be higher than other LSOAs;
- 5) PAM Cluster 5 – Young Vibes: People in this cluster emphasize their attention in facilities for young people, which claims that many residents in this cluster are youth or have youth in their families;
- 6) PAM Cluster 6 – Environment Concerned: People in this cluster think refuse collection, parking service, parks and open spaces are much more crucial than facilities such as libraries, which shows their preference towards maintenance of cleaner outdoor facilities and local environments;
- 7) PAM Cluster 7 – City Engagement: People in this cluster shows evident care for adult education. More people in this cluster pay more attentions to planning services, recycling services and facilities, and parking services than any other clusters. This tendency presents that residents

in this cluster are more engaged with city services. In addition, residents in these areas are likely more middle aged, as they care less about services for the young and elder. They also pay less attention to daily services such as refuse collection and street sweeping;

- 8) PAM Cluster 8 – Essential Hardships: People in this cluster consider employment support as the most critical service, while they also pay close attention to council social housing, affordable housing and mental health services. These tendencies show that many residents in this cluster are likely lower income and worry more about employment and housing costs. WCC should provide more opportunities for jobs and housing for this group of people;
- 9) PAM Cluster 9 – Passionate Professional: Similar to cluster 8, residents in this cluster demonstrate greater attention to employment support. However, in contrast to cluster 8, they did not present with stresses in finding housing, but do care more about street sweeping and lighting. This group may be relatively better off and so instead of focusing on housing costs they are able to afford more attention to improving the appearance of their local environment. They also demonstrate great passions in libraries, markets, planning services and facilities for youth, which shows they are overall more engaged with social and public activities enthusiastically.

Most LSOAs are distributed to cluster 1 and 2, which are more balanced and have wider age ranges, while cluster 3 are less even.

- 1) HAC Cluster 1 – Youth & the Elderly: The importance paid by people in this cluster for the care for the elder, the facilities for the young and the clean and lighting of the environment are slightly higher than H cluster 2, which matches more with the requirement of the young and elderly;
- 2) HAC Cluster 2 – Middle Age & Family: People in these clusters tend to pay more attention to employment, housing and family related services, which means they are more likely to be middle aged;
- 3) HAC Cluster 3 – City Engagement: The importance emphasised in recycling, adult education, parking services and planning services are much higher than other two clusters, which shows they are more environmental-friendly, and committed to self-improvement and public engagement.

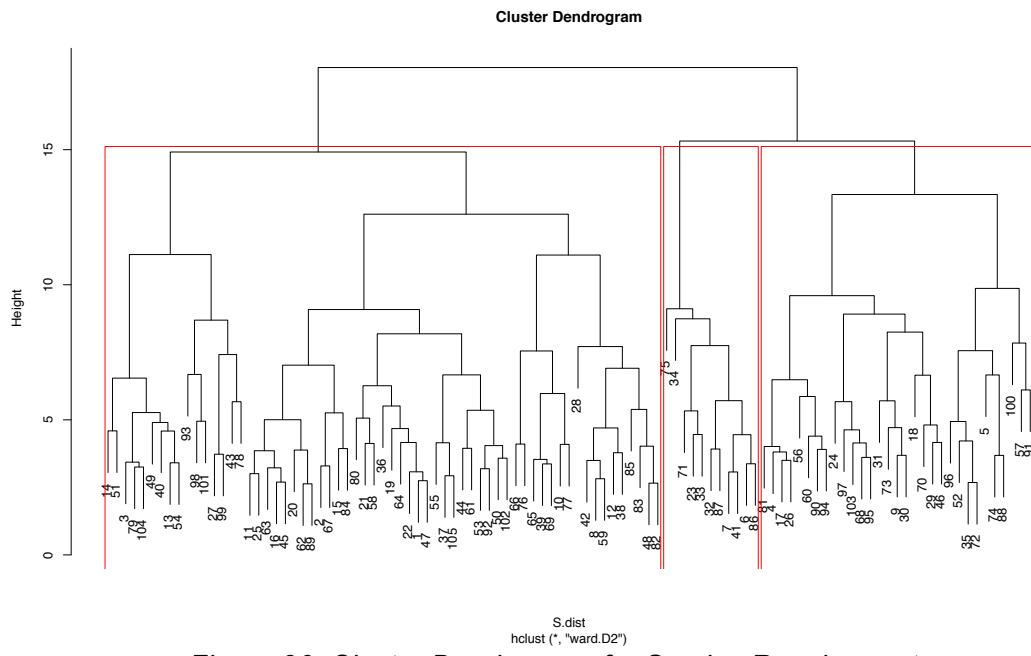


Figure 36. Cluster Dendrogram for Service Requirement

Index	Service Requirement	P1	P2	P3	P4	P5	P6	P7	P8	P9	H1	H2	H3
Q8:1	Refuse collection	-0.34	0.23	-0.13	-0.24	0.19	1.21	-1.52	-1.18	-1.52	0.28	-0.40	-0.48
Q8:2	Parks open spaces	1.65	0.38	0.41	-0.22	-0.18	1.05	-0.70	-1.02	-0.48	0.01	-0.02	0.01
Q8:3	Street sweeping	-0.24	0.71	-0.95	-0.15	0.55	0.23	-1.07	-0.71	1.97	0.24	-0.39	-0.30
Q8:4	Street lighting	0.51	1.14	-0.78	-0.72	-0.35	0.42	-0.89	-0.35	2.00	0.44	-0.70	-0.56
Q8:5	Care of older people	-0.90	0.59	0.41	0.30	-0.43	-0.66	-1.05	-0.79	0.30	0.19	-0.11	-0.80
Q8:6	Environmental health	-0.08	0.20	0.59	1.51	-0.84	-0.84	0.54	-0.04	-1.21	-0.28	0.56	0.01
Q8:7	Provision of council social housing	-1.18	0.57	-0.49	2.31	-0.64	-0.56	-0.18	1.27	-0.69	-0.34	0.81	-0.34
Q8:8	Facilities for young people	-1.05	-0.45	-0.13	-0.79	2.65	0.10	-1.05	-0.27	0.68	0.28	-0.38	-0.51
Q8:9	Markets	-0.65	-0.98	0.11	-0.27	-0.28	0.25	0.40	-0.98	0.93	0.09	-0.24	0.18
Q8:10	Planning services	-0.72	-1.12	0.07	0.51	-0.15	-0.62	1.88	0.66	0.86	-0.17	0.04	0.86
Q8:11	Care of vulnerable children and families	0.32	0.31	-0.46	0.36	-0.38	-0.65	-0.09	-0.94	-0.83	-0.14	0.37	-0.21
Q8:12	On street recycling facilities bins	-0.62	-0.75	0.43	0.00	-0.10	0.20	1.76	0.08	-0.56	-0.17	-0.10	1.23
Q8:13	Door to door recycling collections	0.61	-0.50	-0.58	-0.25	-0.08	-0.51	2.03	0.56	-0.87	-0.34	0.02	1.90
Q8:14	Libraries	0.54	-0.38	-0.51	-1.01	0.23	-1.01	-0.56	0.96	1.10	0.10	-0.03	-0.51
Q8:15	Parking services	-0.38	-0.28	-0.07	-0.55	-0.30	1.21	1.21	-0.07	-0.92	-0.06	-0.26	1.08
Q8:16	Provision of affordable housing	-0.29	0.00	1.25	0.18	0.08	-0.40	0.38	1.06	-0.79	-0.36	0.86	-0.35
Q8:17	Mental health services	-0.38	-0.71	0.56	-0.54	0.27	-0.24	0.47	0.97	-0.95	-0.01	0.12	-0.27
Q8:18	Nursery primary schools	0.29	-0.20	0.79	-0.50	-0.21	-0.20	0.04	0.04	-0.91	-0.06	0.29	-0.48
Q8:19	Adult education	-0.26	-0.76	-0.26	0.27	-0.15	-0.14	2.99	-0.18	0.49	-0.19	-0.01	1.10
Q8:20	Employment support	-0.34	-0.50	0.22	-0.75	0.50	0.22	-0.75	2.51	3.14	-0.08	0.28	-0.33

Table 5. PAM Medoids and HCA Centroids for Service Requirement

Based on Annex E, most of PAM Cluster 5, 6, 9 belong to HAC Cluster 1, all of PAM Cluster 8 is included in HAC Cluster 2, and PAM Cluster 7 is similar to HAC Cluster 3. The corresponding characteristics of these clusters are also similar, which proves the classification results of both algorithms have some reference value by the side. Differences between PAM and HAC results for service requirement are larger than those for the index of service usage rate and requirement, which shows they may represent a different view of service requirement. WCC can take these two outcomes into consideration comprehensively when formulating policies, providing services and taking targeted actions.

In summary, the requirement of residents for services largely depend on their own attributes, such as age and family structure, indicated from the clustering results. As the ACORN group distribution map (Figure 28) presents the geography distribution of demographics, the cluster maps of both PAM and HAC for service requirement also show some relations with it. LSOAs in Knightsbridge & Belgravia, where lavish lifestyles are concentrated, tend to request more sophisticated services such as adult education and are more

publicly engaged. The cluster maps are also strongly related with the attributes of areas. Residents in LSOAs near Regent's park and Hyde park have higher preferences for outdoor activities and are more environment conscious, while residents living in commercial areas such as West End and St James's pay more attention to employment and housing. It's efficient for WCC to provide services and formulate policies based on the population attributes and regional attributes, and consider the clustering results in this dimension as a powerful reference.

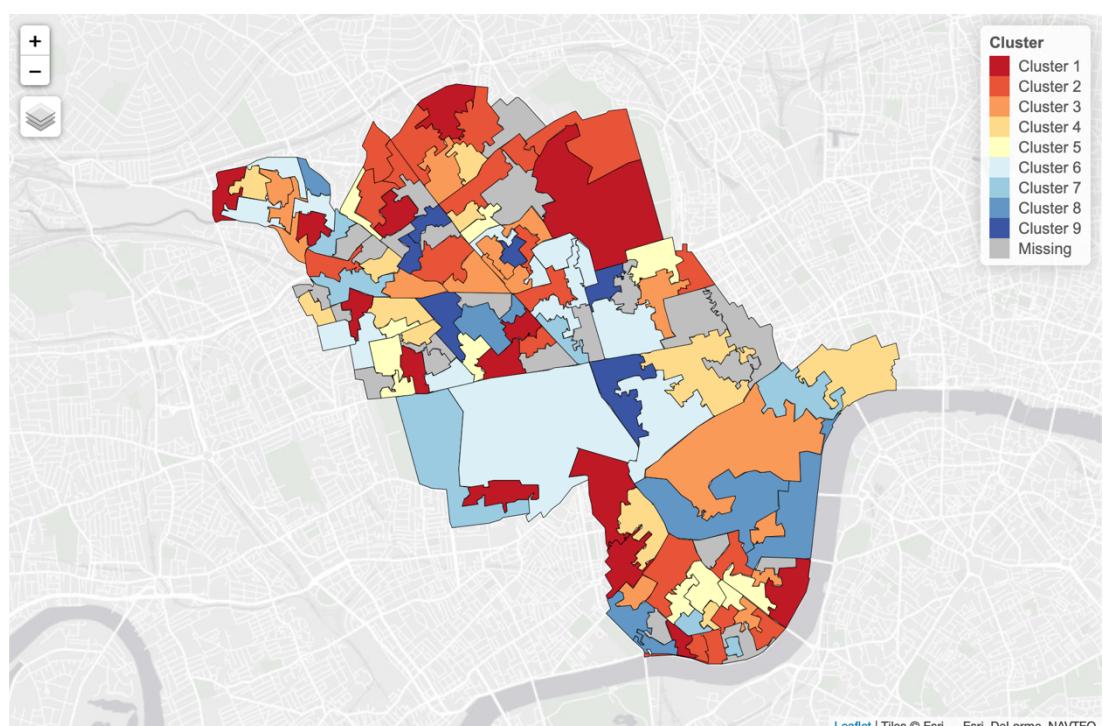


Figure 37. Cluster Map of PAM for Service Requirement

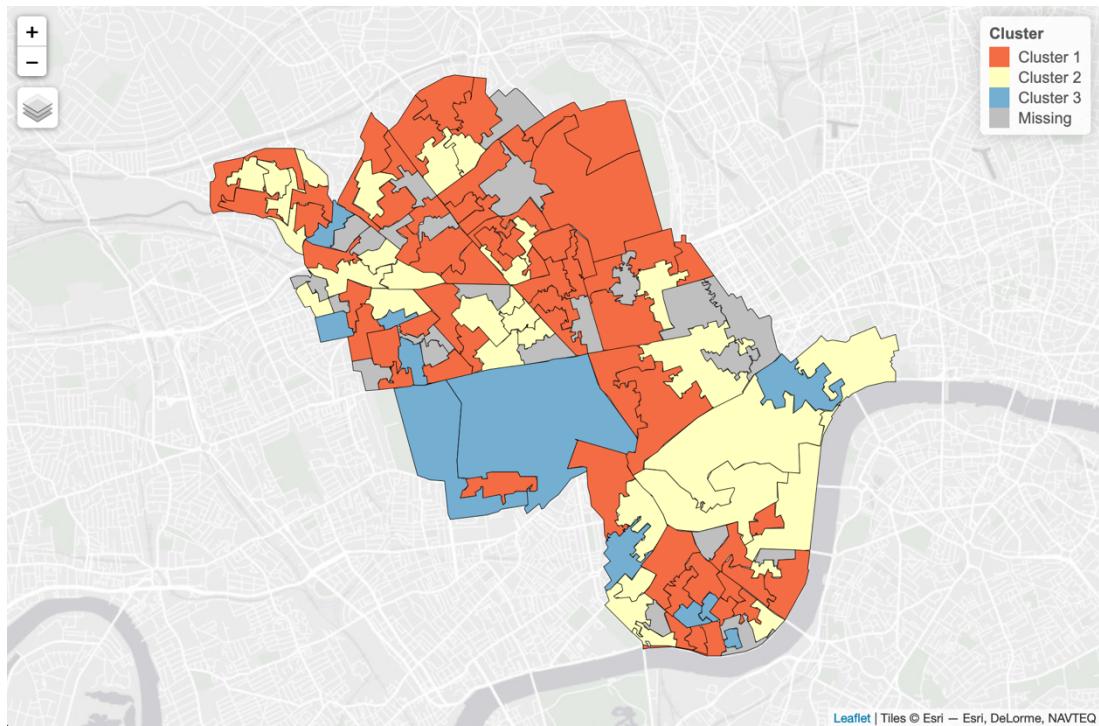


Figure 38. Cluster Map of HAC for Service Requirement

4.2.3 Comparation between Index of Service Usage Rate and Satisfaction and Service Requirement

Annex F shows there are no significant relationships between the Index of Service Usage Rate and Satisfaction and Service Requirement. This may be due to different input variables, as the services are not the same between the two dimensions. It is also possible that there are gaps between service usage & satisfaction and service requirement. The correlation heatmap also shows that except for the coefficient between road maintenance and pavement maintenance is higher than 0.6, other relationships do not have nearly strong correlations.

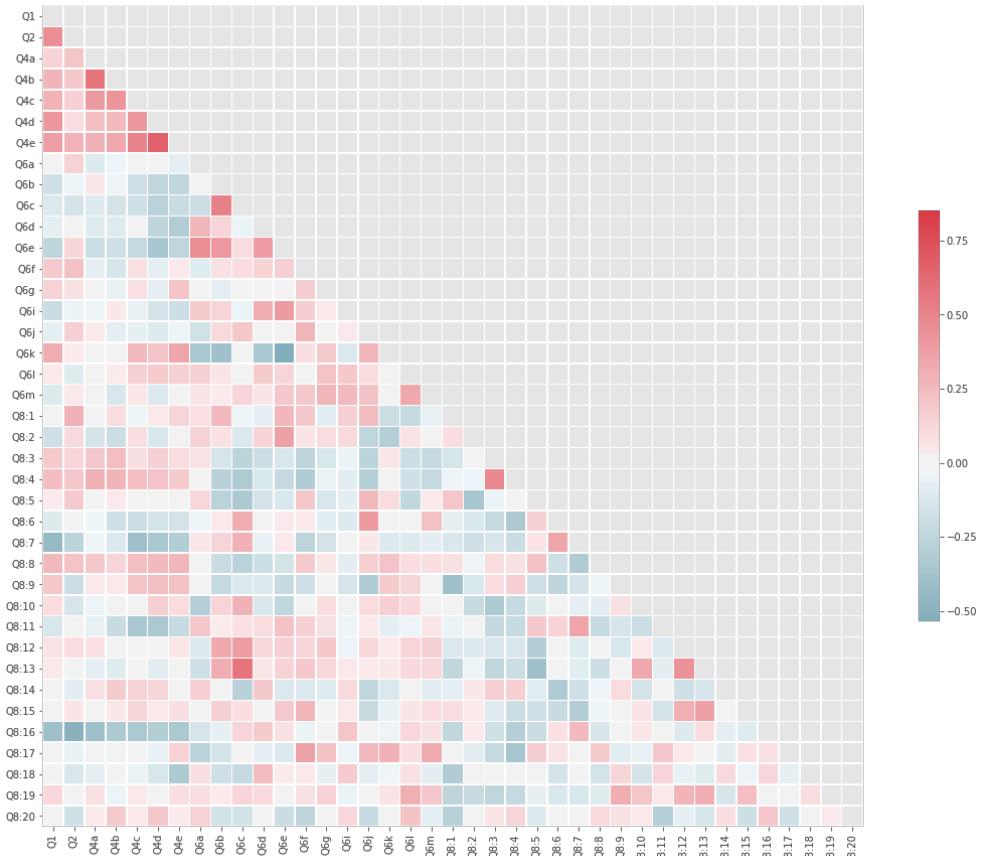


Figure 39. Heatmap of Coefficients on Index of Service Usage Rate and Satisfaction and Service Requirement

4.3 Attitudes towards Local Area and Safety Issues

The cluster plots (Figure 40 & 41) demonstrate both PAM and HAC have good clustering performance.

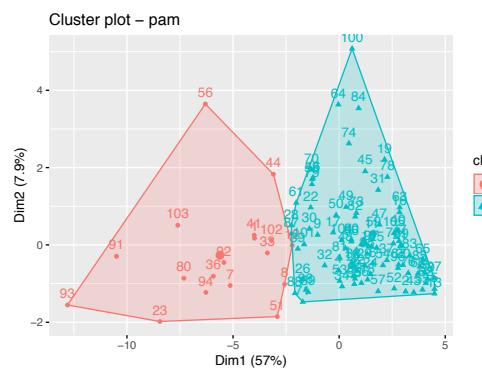


Figure 40. Cluster Plot of PAM for Attitudes towards Local Area and Safety Issues

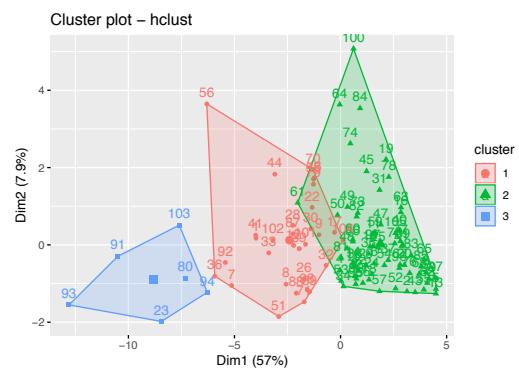


Figure 41. Cluster Plot of HAC for Attitudes towards Local Area and Safety Issues

The clustering results for attitudes towards local area and safety issues are quite straightforward and contrastive.

- 1) PAM Cluster 1 – Concern for local area and safety issues: as LSOAs in this clusters get positive scores for all local area and safety issues, it means people in these LSOAs tend to consider these issues as problems, especially for ‘street entertainment’, ‘dangerous/aggressive dogs’, ‘issues related to deliveries to residential properties’ and so on. More actions need to be taken in these areas to reduce or regular these local area and safety issues, so as to improve residents’ feeling of safety in these areas;
- 2) PAM Cluster 2 – Lack of Perceivement of local area and safety issues: In contrast, LSOAs in this clusters tend to think these issues are not a big problem as the z-score for every issue is negative.

The clustering result for HAC is similar to PAM, while it divides the negative group more meticulously.

- 1) HAC Cluster 1 – Slight Concern for local area and safety issues: the z-score for every problem issue is among 0 to 1, which means people in these LSOAs tend to deem these issues as problems but do not feel very unsafe;
- 2) HAC Cluster 2 – Lack of Perceivement of local area and safety issues: Similar to PAM cluster 2, residents in these LSOAs incline to feel safe about these local area and safety issues;

3) HAC Cluster 3 – Strong Concern for local area and safety issues:
almost all issues got a score higher than 1, presenting people in this cluster worry about these local area and safety issues much more than the average.

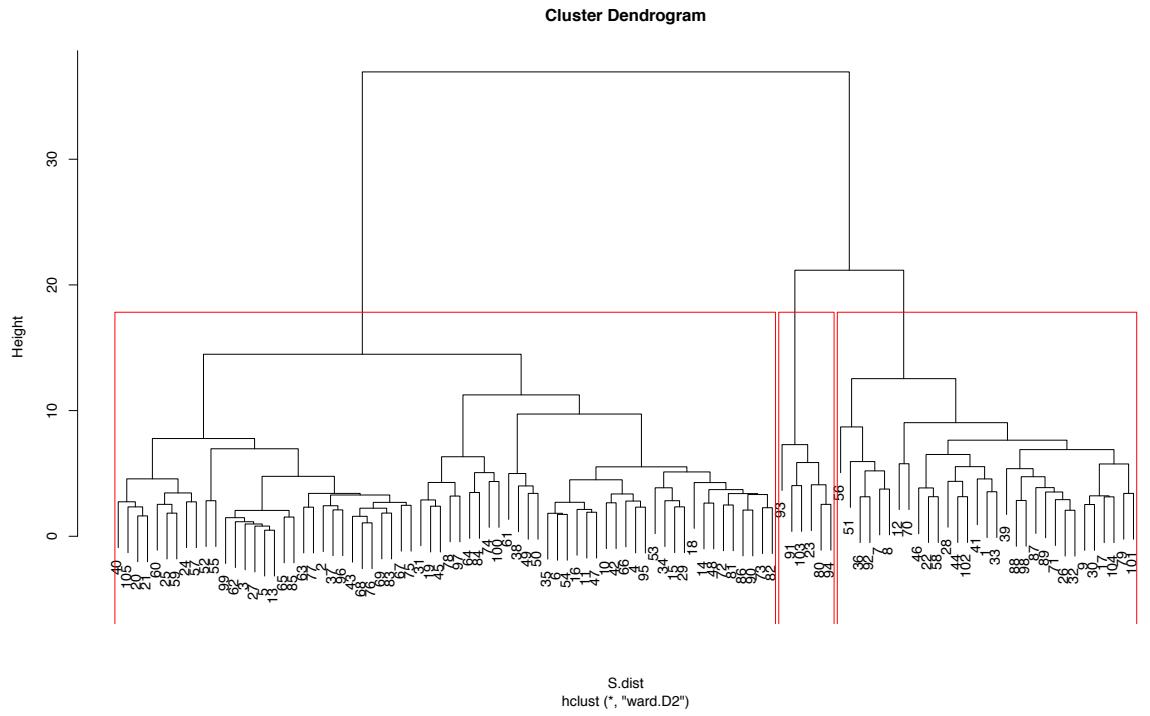


Figure 42. Cluster Dendrogram for Attitudes towards Local Area and Safety Issues

Index	Issues Are Problems	P1	P2	H1	H2	H3
Q17a	Rubbish And Litter	0.90	-0.06	0.68	-0.44	1.52
Q17b	People Being Drunk	1.48	-0.54	0.73	-0.50	1.87
Q17c	People Showing Hostility Or Prejudice	1.04	-0.57	0.46	-0.46	2.84
Q17d	Noisy Neighbours	0.77	-0.50	0.60	-0.49	2.40
Q17e	Young People Behaving Anti-Socially	1.08	-0.48	0.73	-0.48	1.74
Q17f	Families Causing Crime	0.76	-0.14	0.55	-0.51	2.96
Q17g	Vandalism, Graffiti	0.74	-0.46	0.58	-0.49	2.53
Q17h	People Using Or Dealing Drugs	0.15	0.00	0.47	-0.32	1.18
Q17i	People Homeless	1.16	-0.18	0.33	-0.23	0.91
Q17k	Street Entertainment	2.09	-0.62	0.46	-0.42	2.39
Q17l	Violence Among Young People	0.97	-0.57	0.56	-0.45	2.23
Q17m	Dangerous/Aggressive Dogs	1.99	-0.07	0.63	-0.46	1.95
Q17n	Dog Fouling On Pavements	1.23	-0.34	0.43	-0.29	1.11
Q17o	Poor Air Quality	0.45	0.03	0.50	-0.33	1.19
Q17p	Smoking In Public Places	1.50	-0.96	0.54	-0.44	2.17
Q17q	Noise From Building Sites	1.27	-0.24	0.46	-0.35	1.60
Q17r	Issues Licensed Premises	1.83	-0.19	0.53	-0.48	2.71
Q17t	Issues Deliveries To Residential Properties	1.96	-0.71	0.58	-0.45	2.13
Q17u	Short-Term Lettings	1.85	0.13	0.62	-0.46	2.02

Table 6. PAM Medoids and HCA Centroids for Attitudes towards Local Area and Safety Issues

According to Annex G which shows the classification result for each LSOA in this dimension, HAC Cluster 3 are all belonging to PAM Cluster 1, and HAC Cluster 2 are all pertaining to PAM Cluster 2, while HAC Cluster 3 is divided into HAC Cluster 1 and 2. For LSOAs which worry more about local area and safety issues, it's more urgent for WCC to manage these issues in these area.

Comparing final cluster maps with total crime count map (Figure 45) from October 2017 to September 2018, ACORN group distribution maps (Figure 28), and the index of multiple deprivation map (Figure 1), it can be seen that there is no evident relationship between them. Therefore, it is meaningful to analyse residents' attitudes towards local area and safety issues which can help WCC improve residents' feeling for safety more directly. The reasons why different clusters have different attitudes towards local area and safety issues are also worthy for further research.

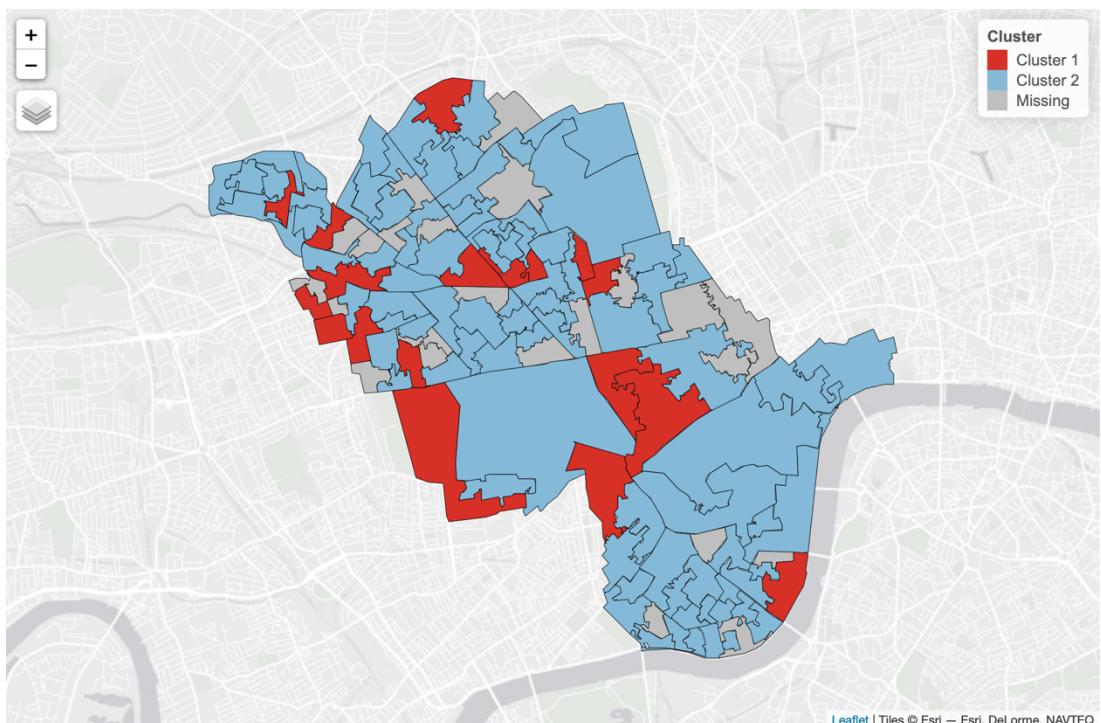


Figure 43. Cluster Map of PAM for Attitudes towards Local Area and Safety Issues

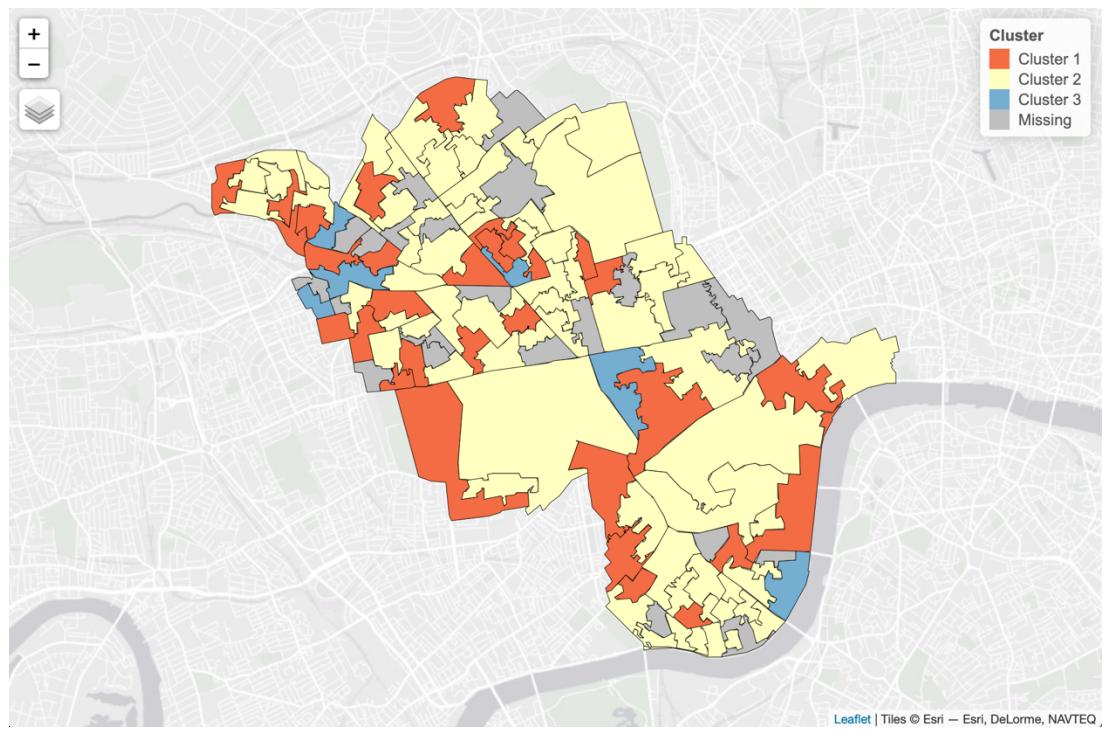


Figure 44. Cluster Map of HAC for Attitudes towards Local Area and Safety Issues

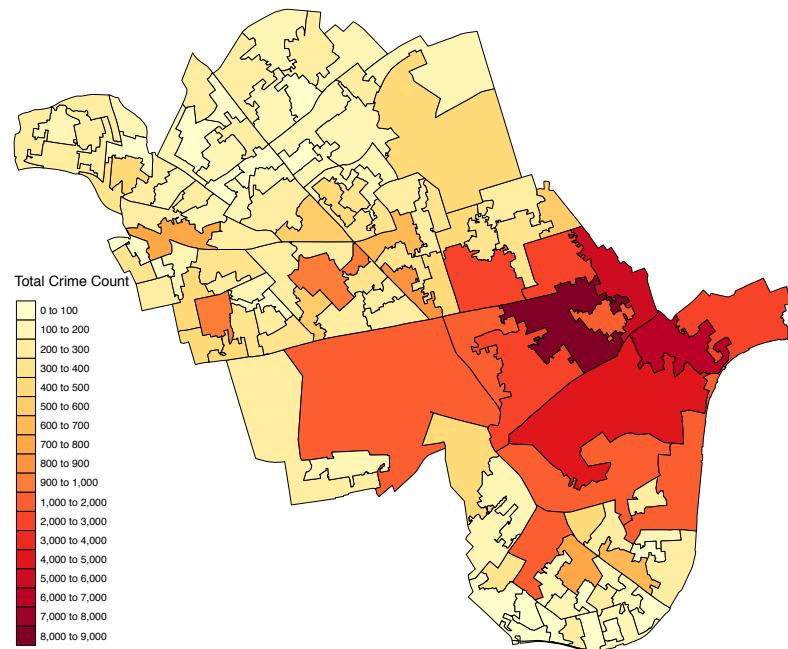


Figure 45. Map of Total Crime Count from October 2017 to September 2018

Chapter 5: Conclusion and Future Work

5.1 Research Summary

This study constructs geodemographic classification systems according to the service and safety parts in the Westminster City Survey 2018. For three different dimensions - Index of Service Usage Rate and Satisfaction, Service Requirement, and Attitudes towards Local Area and Safety Issues, PAM and HAC are employed to build clusters of 105 sorted LSOAs in Westminster separately.

For the Index of Service Usage Rate and Satisfaction, 105 LSOAs are divided into 11 clusters by PAM finally, as every cluster shows preference for particular services. While for HCA, they are aggregated into 3 groups, which are more general and reflect the biased attitudes for environment services and outdoor facilities in different LSOAs. Comparing the cluster map of PAM to ACORN Group Distribution Maps, no evident relationships are found, while the cluster map of HAC has some links with them.

For the Service Requirement, LSOAs are broken up into 9 categories by PAM, as each category presents high demand for specific service while pay less attention to some other services. While for HAC, they are merged into 3 clusters, which reflects more on distinct demand among different age ranges and family structures. In contrasting these two maps produced by the clustering results to ACORN Group Distribution Map and the Index of Multiple Deprivation Map, some relationships are discovered. These two clustering maps also shows great correlations with the properties of LSOAs.

For the Attitudes towards Local Area and Safety Issues, LSOAs are cut into two groups by PAM, one having high tolerance for local area and safety issues, while for the second group the opposite is true. LSOAs are joined into 3 clusters by HAC, which are highly concerning for, slight concern for, and lack of perception of local area and safety issues. Comparing cluster maps drawn by these two clustering results with ACORN Group Distribution Map and Total Crime Count Map from October 2017 to September 2018, no obvious relationships are discovered. Based on the clustering results in these three dimensions, suggestions related to the policy making, service offering and event holding are provided for WCC.

5.2 Limitations of the Study

There are a few limitations to this study.

In the aspect of sample size, this study may be limited by its sample size, especially for some of the smaller LSOAs, and as such, the research results may deviate from reality in some way.

In the dimensions of research, only two dimensions, ‘service’ and ‘safety’, have been chosen, and they do not cover all aspects of residents’ lives.

In the clustering process, for the overall average silhouette width for two dimensions - Index of Service Usage Rate and Satisfaction, and Service Requirement, the score is low, and some points have negative scores, indicating that the classification results may have certain errors. However, detailed analysis of these points with low scores has not been carried out.

In analysis of these results, though the characteristics of clusters are interpreted, and some speculations are made, the reasons for the formation of these features are not investigated in depth. Though clusters are located to maps and compared with other maps to analyse relationships, no further analysis of the causes of such geographical distributions is conducted.

5.3 Recommendations for Future Work

WCC can set LSOA as a unit to distribute questionnaires to ensure that each LSOA has a certain number of representative samples in the future. For LSOAs belonging to different clusters, corresponding questions can be added to investigate the reasons for forming characteristics. In-depth analysis can also be made to the LSOAs which behave worse in clustering to make the classification more accurate. What's more, the methodology used in this research can be applied to other areas of residents' lives, to understand them more comprehensively.

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Appendices

Annex A. Distribution Histograms of Personal Information of Participants in Each LSOA

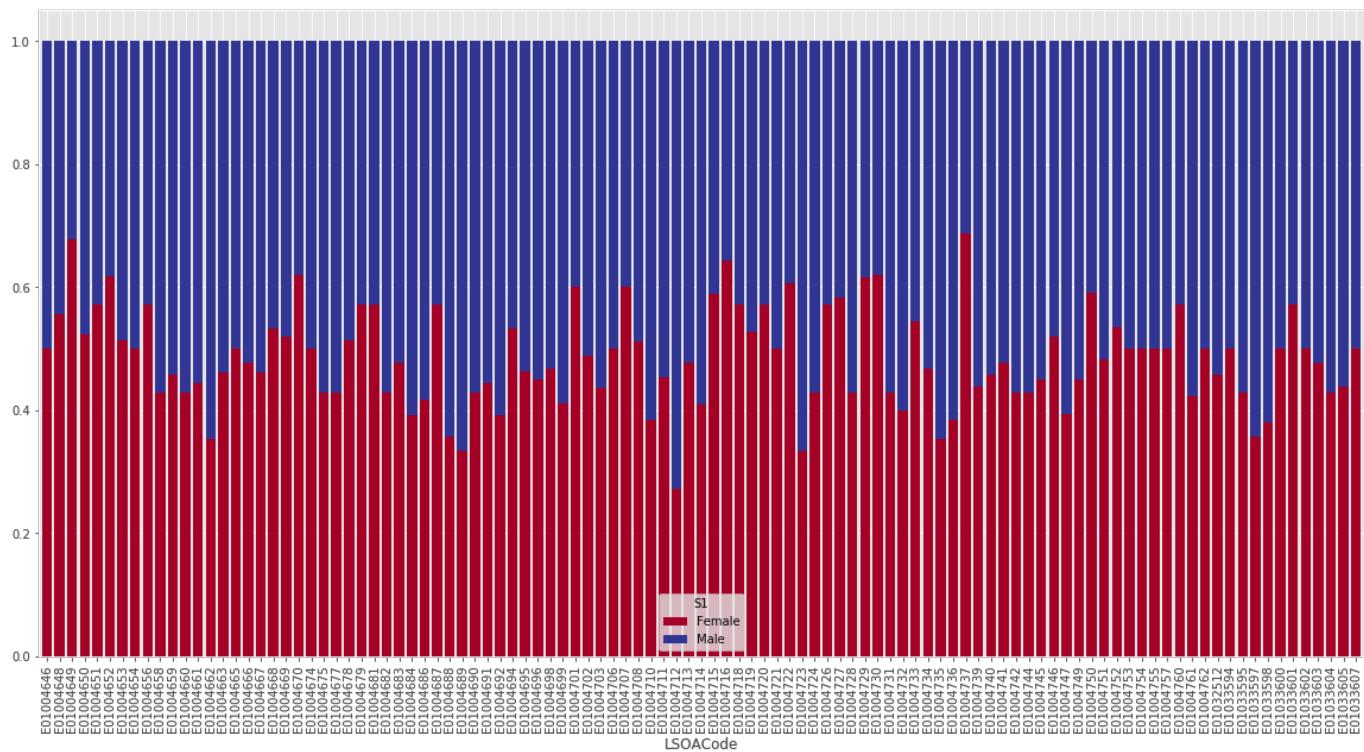


Figure 46. Distribution Histogram of Gender

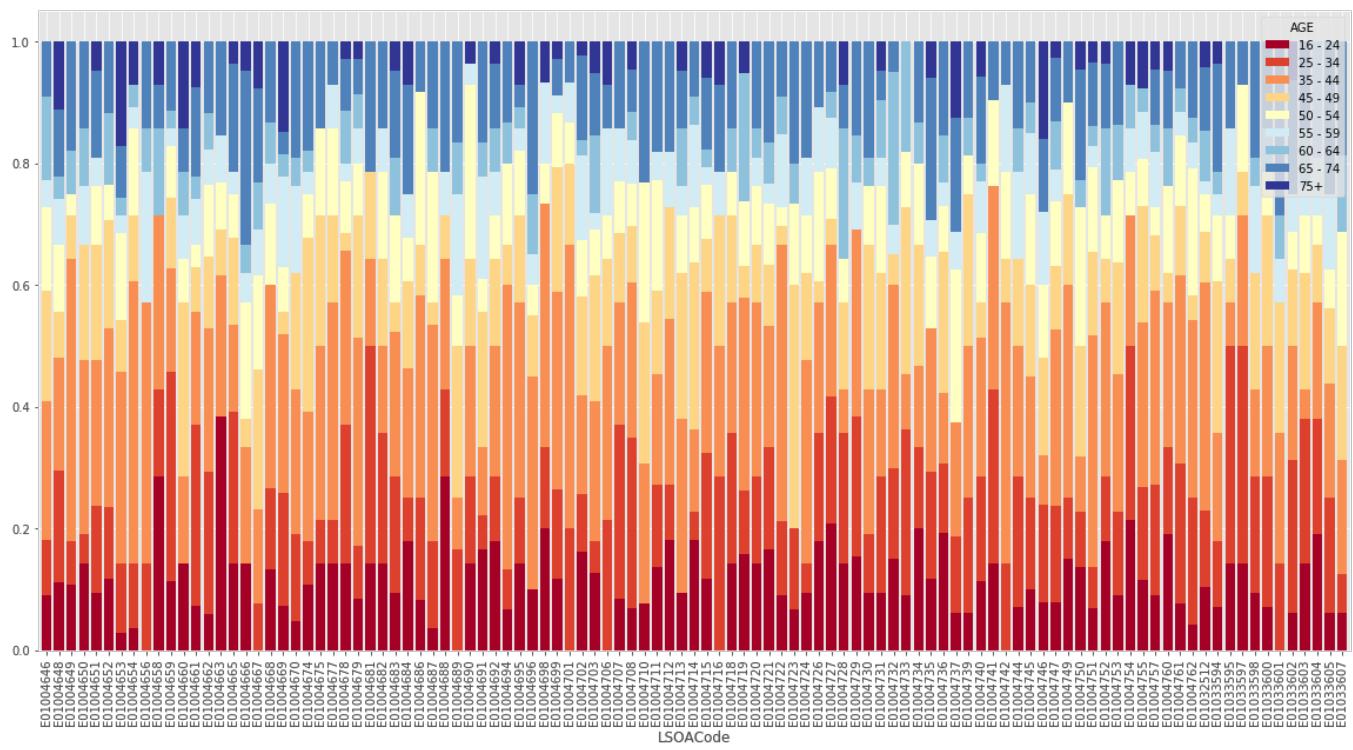


Figure 47. Distribution Histogram of Age

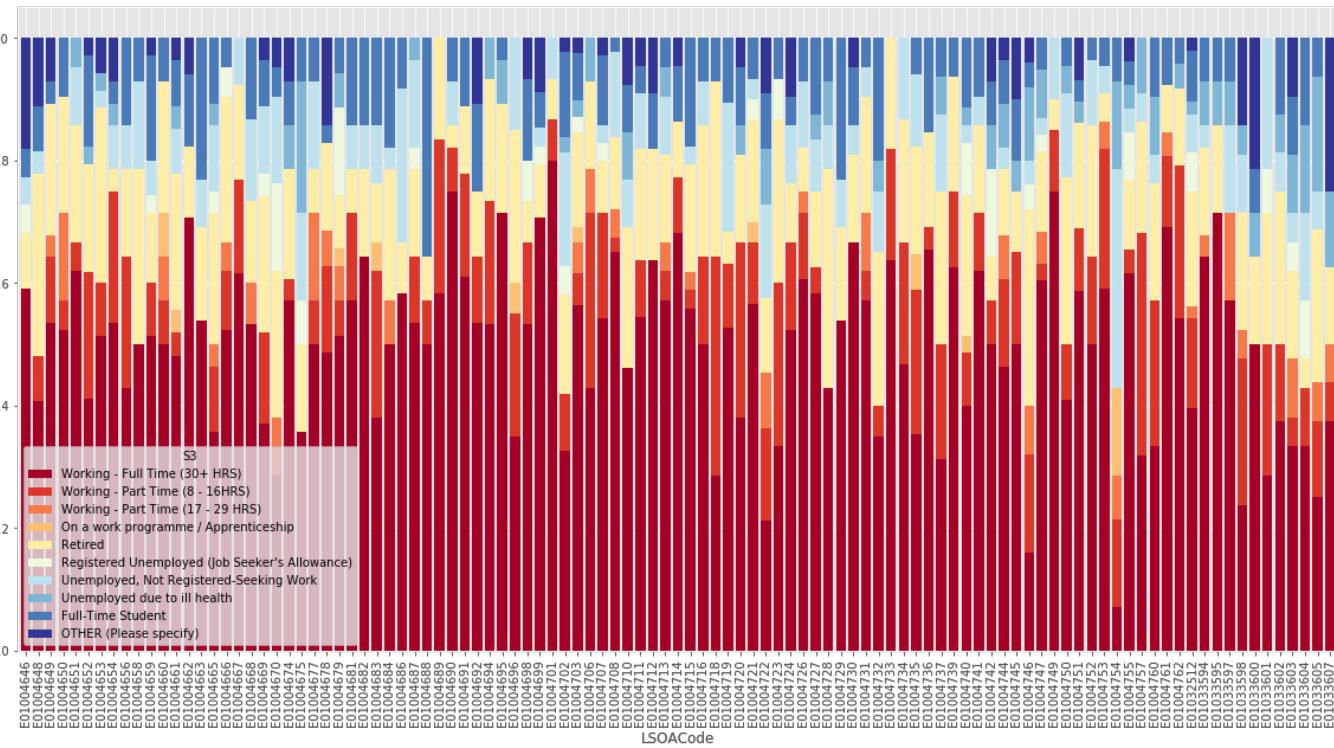


Figure 48. Distribution Histogram of Working Status

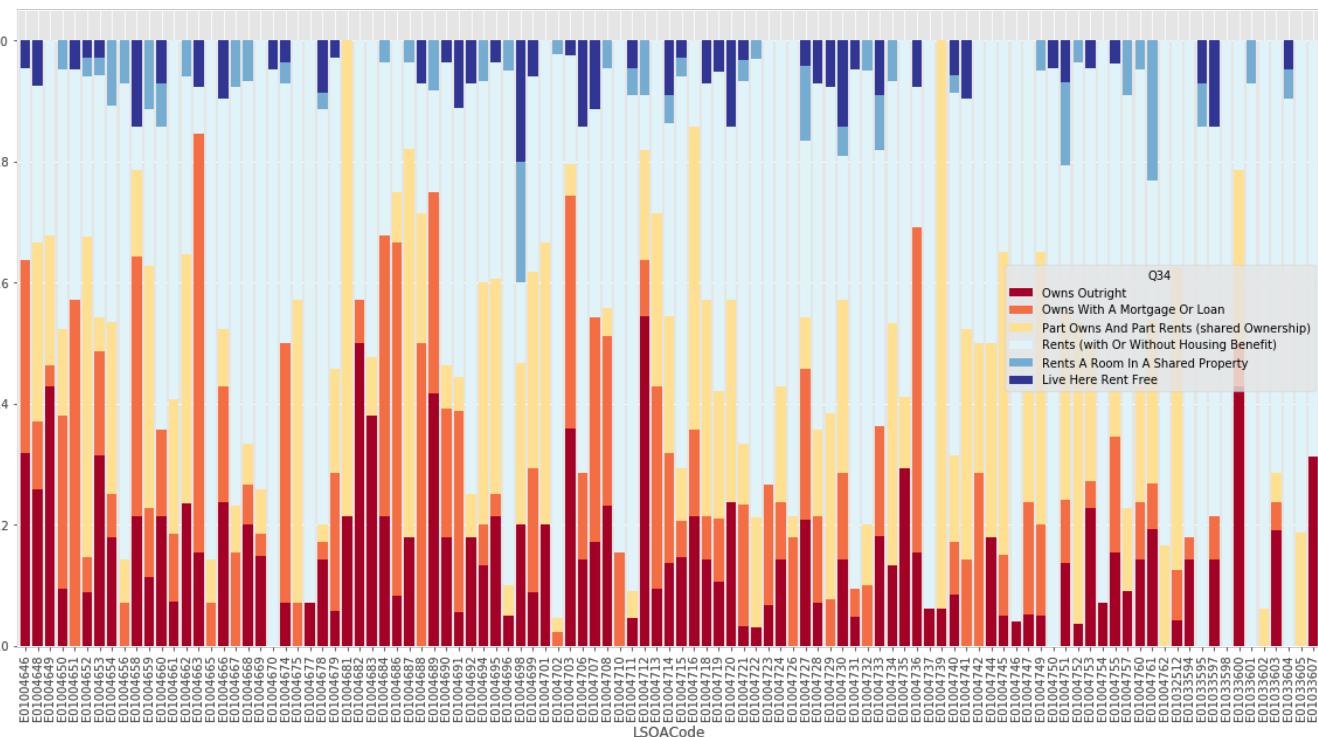


Figure 49. Distribution Histogram of House Right

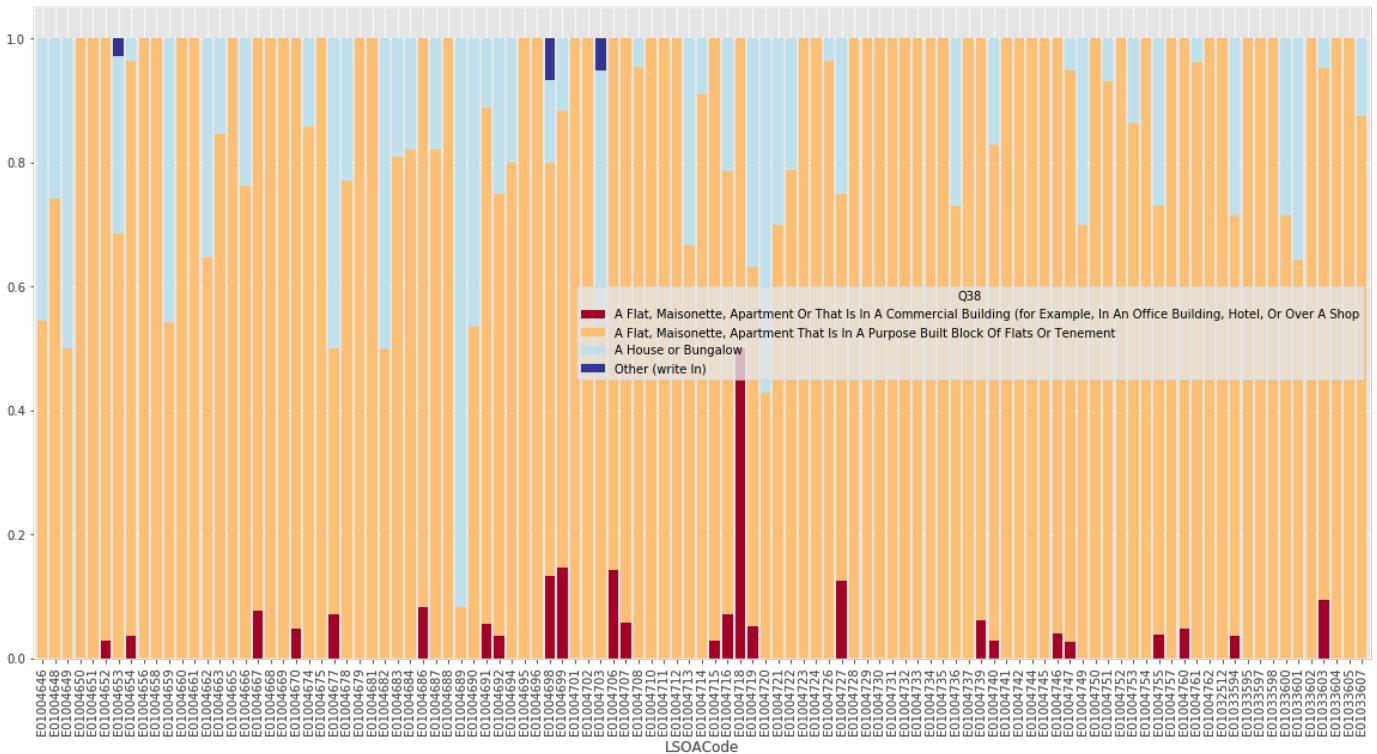


Figure 50. Distribution Histogram of Accommodation Type

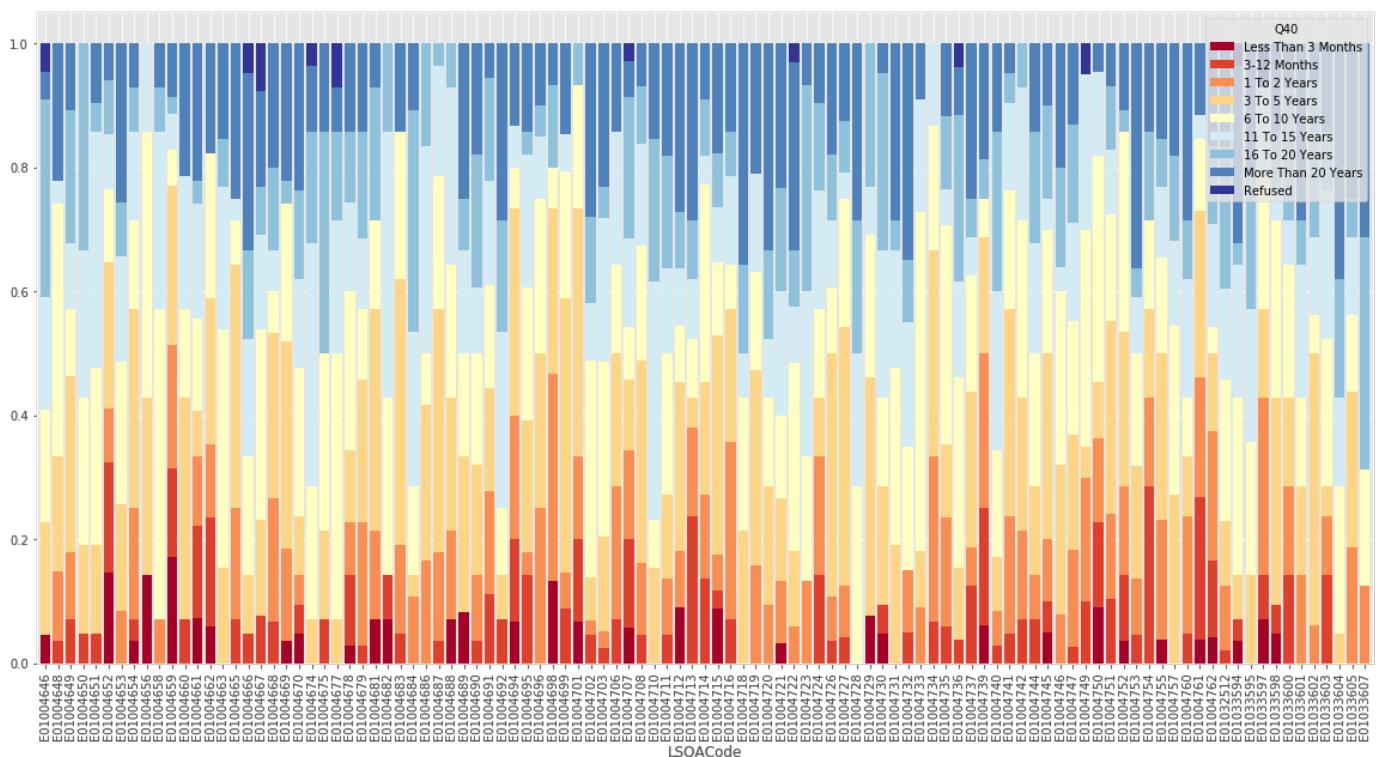


Figure 51. Distribution Histogram of Living Time in Current Property

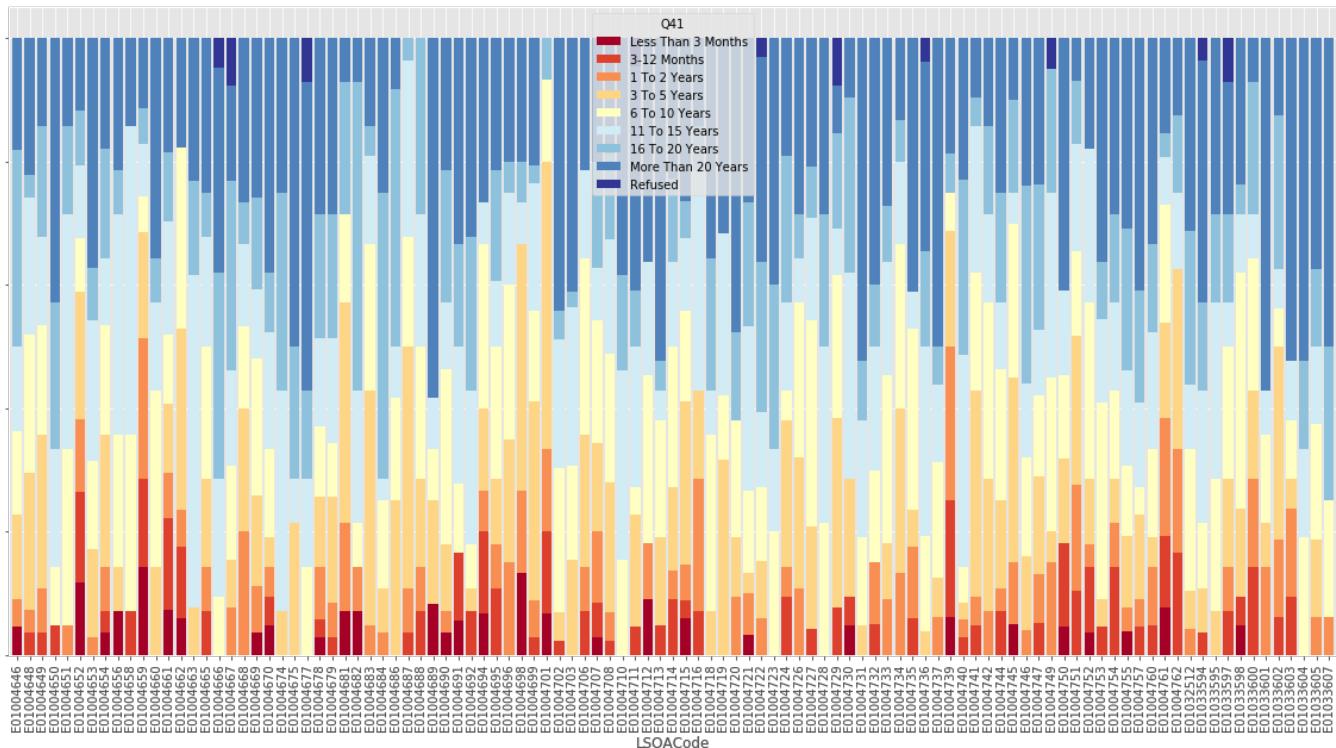


Figure 52. Distribution Histogram of Living Time in WCC

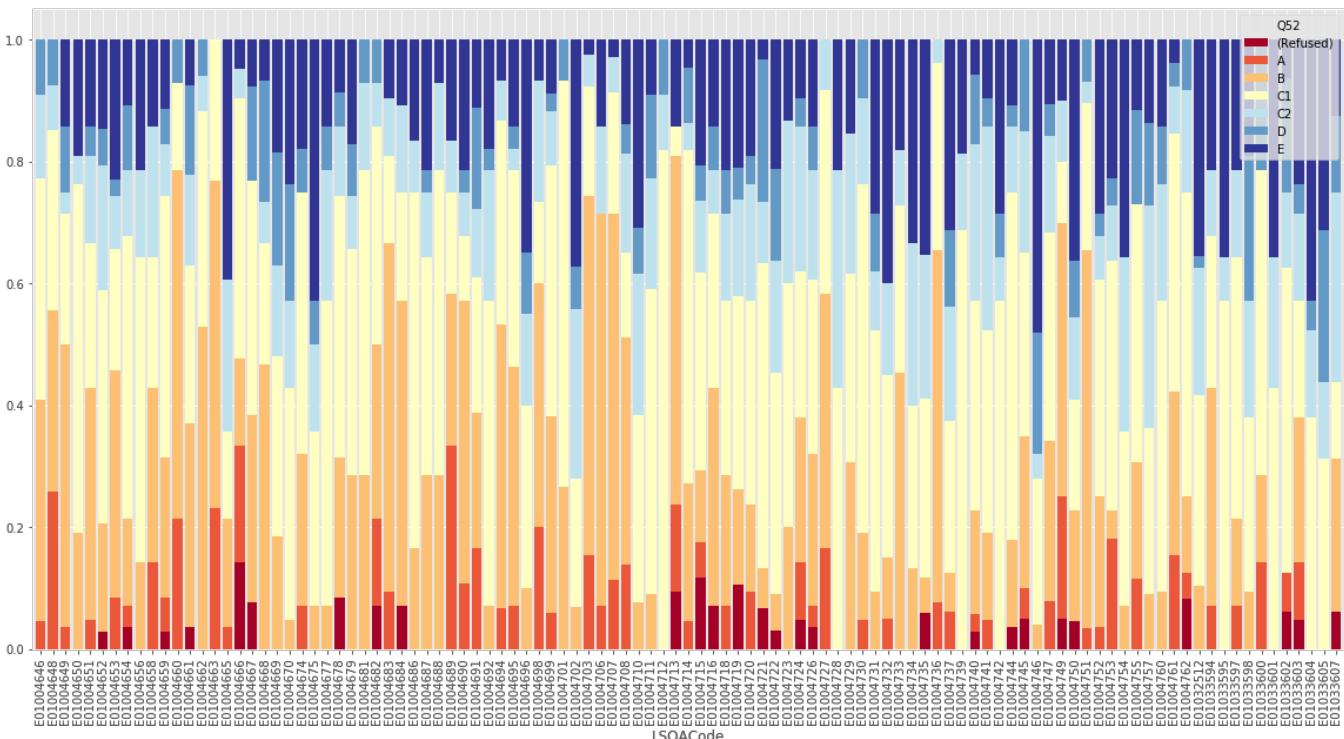


Figure 53. Distribution Histogram of Social Grade

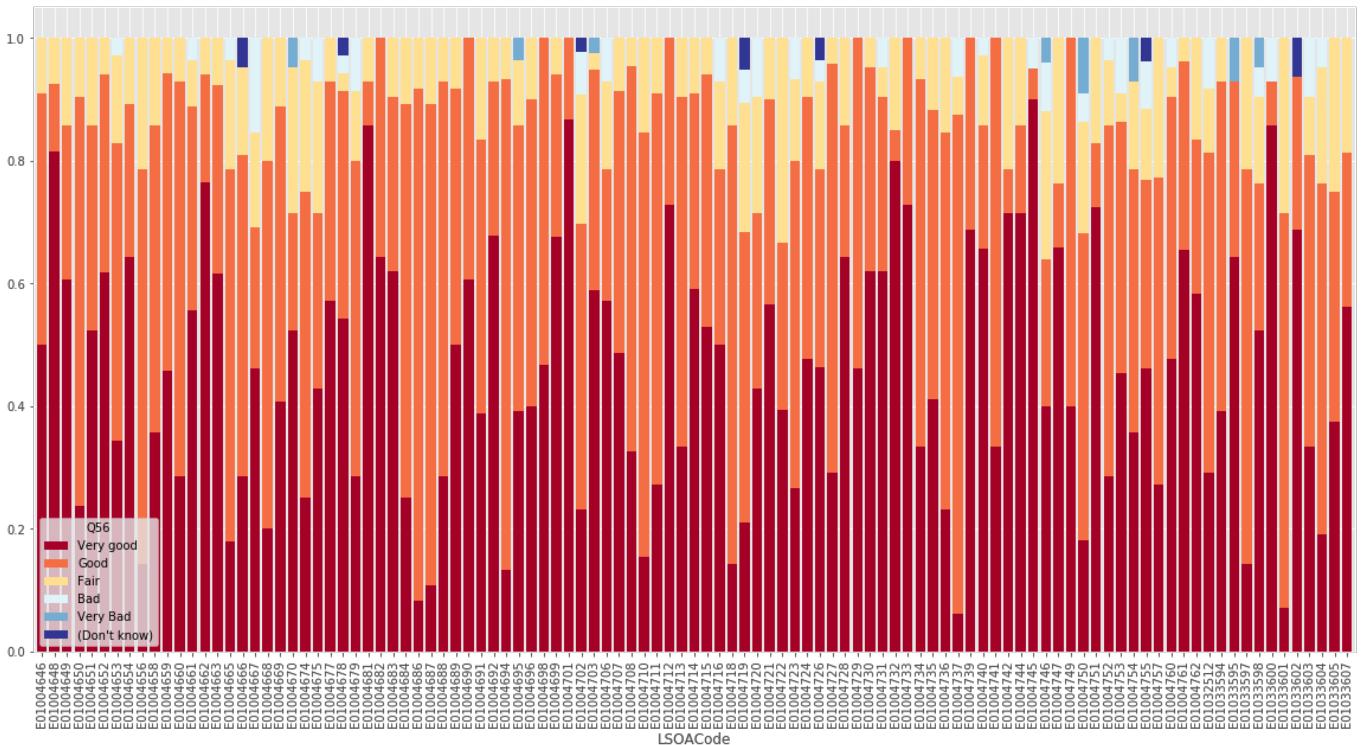


Figure 54. Distribution Histogram of Wellbeing Status

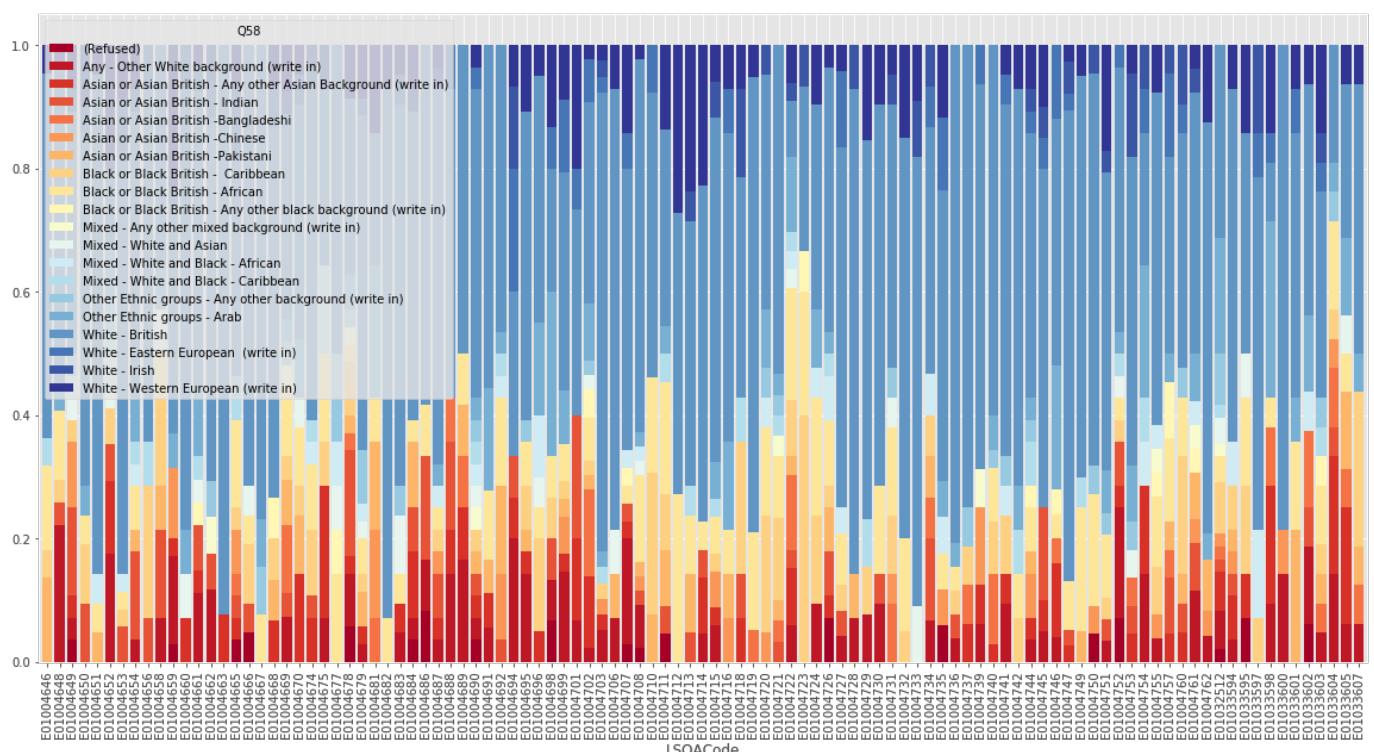


Figure 55. Distribution Histogram of Background

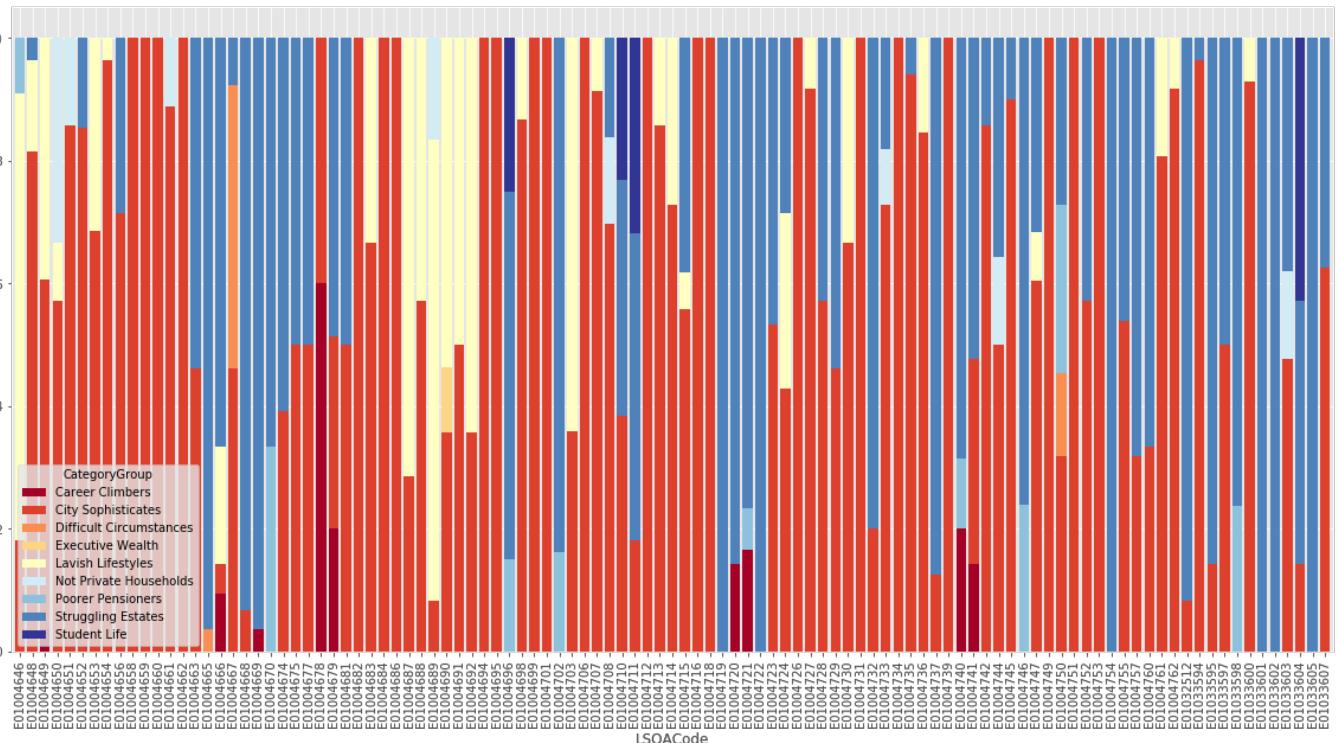


Figure 56. Distribution Histogram of ACORN Groups

Annex B. Relevant Questions in City Survey Questionnaire 2018

SATISFACTION

- Q1. SCREEN (R) How satisfied or dissatisfied are you with the way Westminster City Council is running the City?
SINGLE CODE ONLY

VERY SATISFIED	1	
FAIRLY SATISFIED	2	
NEITHER SATISFIED NOR DISSATISFIED	3	
FAIRLY DISSATISFIED	4	
VERY DISSATISFIED	5	
NO OPINION	6	NOT ON SCREEN

- Q2. SCREEN (R) How satisfied or dissatisfied are you with this area as a place to live?
SINGLE CODE ONLY

VERY SATISFIED	1	
FAIRLY SATISFIED	2	
NEITHER SATISFIED NOR DISSATISFIED	3	
FAIRLY DISSATISFIED	4	
VERY DISSATISFIED	5	
NO OPINION	6	NOT ON SCREEN

SERVICES

- Q4. SCREEN (R) I am going to read out a number of different types of services that are provided in your area. I would like you to tell me how satisfied or dissatisfied you are overall with Westminster City Council's...
 RANDOMISE ORDER. SINGLE CODE ONLY FOR EACH QUESTION.

		VERY SATISFIED	FAIRLY SATISFIED	NEITHER SATISFIED NOR DISSATISFIED	FAIRLY DISSATISFIED	VERY DISSATISFIED	DON'T KNOW
							NOT ON SCREEN
A	Refuse collection	1	2	3	4	5	6
B	Street sweeping	1	2	3	4	5	6
C	Street lighting	1	2	3	4	5	6
D	Road maintenance	1	2	3	4	5	6
E	Pavement maintenance	1	2	3	4	5	6

- Q5. SCREEN (R) Which, if any, of these Westminster City Council provided services have you or members of your household used or benefited from in the last three months?
RANDOMISE ORDER. MULTI-CODE OK
 IF USE A SERVICE THEN ASK Q6 A - M WHERE APPLICABLE

A	Libraries	1
B	On-street recycling facilities/bins	2
C	Door to door recycling collections	3
D	Swimming pools & sports facilities	4
E	Parks & open spaces	5
F	Parking services	6
G	Noise service	7
H	Provision for cyclists	8
I	Council website (westminster.gov.uk)	9
J	Council Tax services	10
L	Westminster Employment Services	11
M	Registration Services (Births, Deaths & Marriages)	12

Q6. SCREEN (R) For each of the services you or members of your household use I would like you to tell me how satisfied or dissatisfied you are overall with Westminster City Council's...

READ OUT A - M FOR SERVICES USED (FROM Q5). SINGLE CODE ONLY FOR EACH QUESTION.

		VERY SATISFIED	FAIRLY SATISFIED	NEITHER SATISFIED NOR DISSATISFIED	FAIRLY DISSATISFIED	VERY DISSATISFIED	DON'T KNOW
							NOT ON SCREEN
A	Libraries	1	2	3	4	5	6
B	On-street recycling facilities/bins	1	2	3	4	5	6
C	Door to door recycling collections	1	2	3	4	5	6
D	Swimming pools & sports facilities	1	2	3	4	5	6
E	Parks & open spaces	1	2	3	4	5	6
F	Parking services	1	2	3	4	5	6
G	Noise service	1	2	3	4	5	6
H	Provision for cyclists	1	2	3	4	5	6
I	Council website (westminster.gov.uk)	1	2	3	4	5	6
J	Council Tax services	1	2	3	4	5	6
L	Westminster Employment Services	1	2	3	4	5	6
M	Registration Services (Births, Deaths & Marriages)	1	2	3	4	5	6

Q8. SCREEN (R) Looking at this list, what are your top 3 most important local services provided by Westminster City Council.

ALPHABETICAL ORDER. MULTI-CODE UP TO 3 ONLY.

Adult education	1	
Care of older people	2	
Care of vulnerable children and families	3	
Childcare and play facilities	4	
City Inspectors	5	
Door to door recycling collections	6	
Drug and alcohol services	7	
Employment support	8	
Environmental Health (e.g. food safety, health and safety, pest control)	9	
Facilities for young people	10	
Highway maintenance	11	
Libraries	12	
Markets	13	
Mental health services	14	
Noise service	15	
Nursery/Primary schools	16	
On-street recycling facilities/bins	17	
Parking services	18	
Parks & open spaces	19	
Planning services	20	
Provision for cyclists	21	
Provision of affordable housing (e.g. shared ownership)	22	
Provision of council/social housing	23	
Refuse collection	24	
Services for people with disabilities	24	
Sexual health services	26	
Street lighting	27	
Street sweeping	28	
Support for the homeless	29	
Swimming pools & sports facilities	30	
None of these	31	
Don't know	32	NOT ON SCREEN

LOCAL AREA AND SAFETY

Q17. SCREEN (R) Thinking about this local area, to what extent if at all do you think these issues are a problem... READ OUT STATEMENTS A - U. START AT RANDOM TICK BOX. SINGLE CODE FOR EACH

			A VERY BIG PROBLEM	A FAIRLY BIG PROBLEM	NOT A VERY BIG PROBLEM	NOT A PROBLEM AT ALL	DON'T KNOW
							NOT ON SCREEN
<input type="checkbox"/>	A	...rubbish and litter lying around	1	2	3	4	5

	B	...people being drunk or rowdy	1	2	3	4	5
	C	...people showing hostility or prejudice based on disability, race, religion, transgender identity or sexual orientation	1	2	3	4	5
<input type="checkbox"/>	D	...noisy neighbours or loud parties	1	2	3	4	5
	E	... young people behaving anti-socially	1	2	3	4	5
	F	...particular families in your neighbourhood causing crime and anti-social behaviour	1	2	3	4	5
	G	...vandalism, graffiti and other deliberate damage	1	2	3	4	5
<input type="checkbox"/>	H	...people using or dealing drugs	1	2	3	4	5
	I	...people homeless on the streets	1	2	3	4	5
	J	... people begging on the streets	1	2	3	4	5
<input type="checkbox"/>	K	... street entertainment and busking	1	2	3	4	5
	L	...violence among young people	1	2	3	4	5
	M	...dangerous/aggressive dogs	1	2	3	4	5
	N	...dog fouling on pavements	1	2	3	4	5
<input type="checkbox"/>	O	...poor air quality	1	2	3	4	5
	P	...smoking in public places	1	2	3	4	5
	Q	...noise from building sites	1	2	3	4	5
	R	...issues related to licensed premises (e.g. people drinking/smoking outside, blocked pavements, deliveries, etc.)	1	2	3	4	5
<input type="checkbox"/>	S	...issues related to commercial properties(e.g. noise, blocked pavements, deliveries)	1	2	3	4	5
	T	...issues related to deliveries to residential properties (such as orders from websites, shopping deliveries or deliveries from takeaways)	1	2	3	4	5
	U	...short-term letting of your neighbour's properties (e.g. people staying for short business or holiday breaks) PROMPT: Airbnb for example	1	2	3	4	5

Annex C. Original Percentages of Service Usage Rate in Q5 and Satisfaction in Q6

LSOA code	LSOA name	Q5a	Q5b	Q5c	Q5d	Q5e	Q5f	Q5g	Q5i	Q5j	Q5k	Q5l	Q5m	Q6a	Q6b	Q6c	Q6d	Q6e	Q6f	Q6g	Q6i	Q6j	Q6k	Q6l	Q6m	P cluster	H cluster
E01004646	Westminster 002A	0.32	0.27	0.27	0.27	0.59	0.36	0.14	0.00	0.23	0.73	0.09	0.00	1.00	1.00	1.00	1.00	0.92	0.75	1.00	1.00	0.50	1.00	1.00	1	1	
E01004650	Westminster 002C	0.14	0.38	0.24	0.24	0.52	0.52	0.10	0.10	0.14	0.62	0.05	0.00	1.00	1.00	0.80	1.00	0.91	0.82	0.50	1.00	1.00	1.00	1.00	1	1	
E01004684	Westminster 015C	0.21	0.29	0.14	0.36	0.46	0.39	0.14	0.04	0.43	0.54	0.11	0.04	0.83	0.88	1.00	0.70	0.92	0.82	1.00	1.00	0.83	0.93	1.00	1.00	1	1
E01004688	Westminster 019B	0.21	0.14	0.29	0.43	0.64	0.29	0.07	0.07	0.14	0.43	0.07	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1	1	
E01004689	Westminster 019C	0.08	0.67	0.67	0.08	0.42	0.58	0.17	0.25	0.17	0.42	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1	2	
E01004703	Westminster 007B	0.23	0.59	0.54	0.28	0.74	0.64	0.03	0.18	0.18	0.41	0.03	0.03	0.78	0.96	1.00	0.91	0.97	0.80	1.00	1.00	1.00	1.00	1.00	1	1	
E01004720	Westminster 0020	0.04	0.38	0.57	0.76	0.24	0.67	0.52	0.00	0.10	0.19	0.52	0.00	0.05	0.63	1.00	0.94	1.00	0.93	1.00	1.00	0.75	0.73	0.00	1	1	
E01004757	Westminster 010C	0.14	0.50	0.59	0.18	0.55	0.36	0.14	0.09	0.27	0.64	0.00	0.09	0.67	0.91	0.69	1.00	1.00	1.00	1.00	1.00	0.79	1.00	1.00	1	1	
E01004760	Westminster 014E	0.29	0.48	0.48	0.43	0.52	0.43	0.14	0.14	0.33	0.62	0.10	0.00	1.00	1.00	0.80	0.89	0.91	0.67	0.67	0.33	0.86	1.00	1.00	1	1	
E01004648	Westminster 002B	0.26	0.22	0.26	0.04	0.44	0.48	0.00	0.07	0.37	0.59	0.00	0.00	1.00	1.00	1.00	1.00	0.92	0.77	1.00	1.00	1.00	1.00	1.00	2	2	
E01004661	Westminster 012C	0.15	0.07	0.15	0.00	0.30	0.19	0.04	0.00	0.33	0.78	0.04	0.04	1.00	1.00	0.75	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1	2		
E01004681	Westminster 016A	0.50	0.07	0.00	0.07	0.29	0.14	0.00	0.07	0.07	0.36	0.14	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2	2	
E01004701	Westminster 007A	0.13	0.07	0.00	0.07	0.33	0.07	0.07	0.07	0.13	0.73	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	2	2	
E01004712	Westminster 008C	0.09	0.27	0.09	0.09	0.27	0.09	0.09	0.00	0.00	0.64	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1	2		
E01004721	Westminster 004D	0.30	0.10	0.33	0.03	0.40	0.37	0.20	0.00	0.07	0.50	0.86	0.00	0.07	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	1	2		
E01004728	Westminster 003D	0.00	0.07	0.43	0.00	0.00	0.29	0.00	0.07	0.50	0.86	0.00	0.07	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2	2	
E01004730	Westminster 001D	0.24	0.05	0.05	0.38	0.43	0.14	0.05	0.33	0.62	0.00	0.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2	2	
E01004740	Westminster 021A	0.11	0.06	0.23	0.09	0.23	0.37	0.06	0.11	0.46	0.74	0.06	0.09	0.75	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	0.96	1.00	1.00	2	2
E01004751	Westminster 022C	0.28	0.07	0.10	0.03	0.10	0.28	0.03	0.10	0.24	0.62	0.03	0.03	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	2	2	
E01033600	Westminster 007F	0.36	0.07	0.00	0.07	0.21	0.14	0.00	0.00	0.07	0.79	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2	2	
E01004649	Westminster 001A	0.32	0.32	0.43	0.11	0.29	0.04	0.00	0.04	0.25	0.61	0.00	0.00	1.00	1.00	0.92	1.00	1.00	1.00	1.00	1.00	0.86	1.00	1.00	3	2	
E01004670	Westminster 009A	0.19	0.43	0.43	0.05	0.10	0.05	0.05	0.00	0.29	0.52	0.05	0.00	0.75	0.89	0.89	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	3	2	
E01004692	Westminster 019F	0.21	0.32	0.46	0.25	0.39	0.18	0.11	0.04	0.14	0.50	0.04	0.04	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	
E01004710	Westminster 002D	0.15	0.54	0.62	0.00	0.46	0.00	0.00	0.00	0.23	0.38	0.00	0.08	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	
E01004731	Westminster 020A	0.14	0.19	0.33	0.10	0.14	0.00	0.00	0.00	0.19	0.29	0.10	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	
E01004742	Westminster 022A	0.43	0.57	0.07	0.14	0.29	0.07	0.00	0.14	0.07	0.50	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	
E01004744	Westminster 020D	0.32	0.11	0.25	0.04	0.32	0.18	0.07	0.07	0.14	0.50	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	
E01004745	Westminster 021C	0.20	0.05	0.10	0.05	0.30	0.15	0.00	0.00	0.05	0.60	0.05	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	
E01004762	Westminster 011E	0.33	0.21	0.17	0.13	0.38	0.17	0.08	0.00	0.33	0.38	0.08	0.00	0.88	1.00	1.00	1.00	0.89	0.75	1.00	1.00	1.00	1.00	1.00	3	2	
E0103395	Westminster 013E	0.00	0.50	0.86	0.00	0.21	0.00	0.00	0.00	0.36	0.57	0.00	0.00	1.00	1.00	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	
E01033602	Westminster 009H	0.19	0.25	0.25	0.06	0.25	0.25	0.00	0.00	0.13	0.69	0.06	0.00	1.00	0.75	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	
E01033605	Westminster 009K	0.19	0.25	0.13	0.13	0.38	0.06	0.00	0.06	0.13	0.56	0.00	0.00	1.00	1.00	1.00	1.00	0.83	0.00	1.00	1.00	0.89	1.00	1.00	3	2	
E01004551	Westminster 003A	0.24	0.33	0.33	0.00	0.24	0.57	0.00	0.00	0.76	0.71	0.00	0.14	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	4	2	
E01004558	Westminster 012B	0.21	0.29	0.43	0.21	0.43	0.79	0.07	0.07	0.50	0.86	0.07	0.07	1.00	0.75	0.83	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	4	2	
E01004662	Westminster 012D	0.18	0.29	0.24	0.29	0.59	0.24	0.06	0.06	0.47	0.53	0.06	0.00	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	0.89	1.00	4	2	
E01004663	Westminster 012E	0.31	0.15	0.23	0.31	0.46	0.85	0.00	0.23	0.69	0.69	0.08	0.00	0.75	1.00	1.00	1.00	0.78	0.89	1.00	1.00	1.00	1.00	1.00	4	2	
E01004682	Westminster 016A	0.07	0.57	0.57	0.21	0.57	0.36	0.14	0.00	0.43	0.57	0.00	0.14	0.67	1.00	1.00	1.00	0.67	0.88	1.00	1.00	1.00	1.00	1.00	4	2	
E01004727	Westminster 008D	0.25	0.00	0.29	0.25	0.71	0.38	0.00	0.25	0.71	0.63	0.00	0.04	1.00	0.86	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	4	1	
E01004729	Westminster 020B	0.08	0.31	0.15	0.00	0.38	0.38	0.08	0.08	0.77	0.77	0.00	0.08	1.00	1.00	1.00	1.00	0.80	0.90	1.00	1.00	1.00	1.00	1.00	4	2	
E01004732	Westminster 020B	0.05	0.40	0.15	0.05	0.15	0.05	0.00	0.60	0.70	0.05	0.05	0.00	1.00	1.00	1.00	1.00	0.95	0.88	1.00	1.00	1.00	1.00	1.00	4	2	
E01004741	Westminster 024F	0.38	0.38	0.48	0.10	0.62	0.19	0.00	0.19	0.57	0.67	0.00	0.05	0.75	1.00	1.00	1.00	0.67	0.75	1.00	1.00	1.00	1.00	1.00	4	1	
E01004747	Westminster 021E	0.18	0.47	0.39	0.18	0.45	0.26	0.11	0.05	0.53	0.55	0.05	0.05	0.86	1.00	1.00	1.00	0.94	0.94	1.00	1.00	0.75	1.00	1.00	6	1	
E01004749	Westminster 022B	0.35																									

Annex D. Original Scores and Clustering Results of Index of Service Usage

Rate and Satisfaction

LSOACode	Q1	Q2	Q4a	Q4b	Q4c	Q4d	Q4e	Q5a*6a	Q5b*6b	Q5c*6c	Q5d*6d	Q5e*6e	Q5f*6f	Q5g*6g	Q5i*6i	Q5j*6j	Q5k*6k	Q5l*6l	Q5m*6m	P cluster	P neighbor	P sil_width	H cluster	H neighbor	H sil_width
E01004646	0.95	0.95	0.77	0.73	0.91	0.50	0.68	0.32	0.27	0.27	0.27	0.55	0.27	0.14	0.00	0.23	0.73	0.05	0.00	1	7	0.15	1	2	0.12
E01004650	0.95	0.95	0.90	0.86	0.90	0.76	0.86	0.14	0.38	0.19	0.24	0.48	0.43	0.05	0.10	0.14	0.62	0.05	0.00	1	7	0.20	1	2	-0.02
E01004684	0.86	0.89	0.89	0.82	0.89	0.64	0.71	0.18	0.25	0.14	0.25	0.43	0.32	0.14	0.04	0.36	0.50	0.11	0.04	1	4	0.15	1	2	0.09
E01004688	0.93	0.93	0.86	0.93	0.86	1.00	0.93	0.21	0.14	0.29	0.43	0.64	0.29	0.07	0.07	0.14	0.43	0.07	0.00	1	7	0.00	1	2	-0.02
E01004689	1.00	1.00	1.00	0.83	0.83	0.92	0.08	0.67	0.67	0.08	0.42	0.58	0.17	0.25	0.17	0.42	0.00	0.00	1	5	0.08	2	1	0.05	
E01004703	0.92	0.95	0.95	0.92	0.92	0.74	0.72	0.18	0.56	0.54	0.26	0.72	0.51	0.03	0.18	0.18	0.41	0.03	0.03	1	8	0.09	1	2	0.12
E01004720	0.95	0.86	0.95	0.90	0.81	0.95	0.81	0.24	0.57	0.71	0.24	0.62	0.52	0.00	0.10	0.14	0.38	0.00	0.00	1	5	0.06	1	2	0.05
E01004757	0.91	0.95	0.86	0.82	0.86	0.64	0.73	0.09	0.45	0.41	0.18	0.55	0.36	0.14	0.09	0.27	0.50	0.00	0.09	1	6	0.16	1	2	0.13
E01004760	0.95	0.95	0.95	0.86	0.76	0.76	0.81	0.29	0.48	0.38	0.38	0.48	0.29	0.10	0.05	0.29	0.62	0.10	0.00	1	5	0.17	1	2	0.06
E01004768	1.00	1.00	1.00	1.00	0.93	0.93	0.26	0.22	0.26	0.04	0.41	0.37	0.00	0.07	0.37	0.59	0.00	0.00	2	3	0.16	2	1	0.24	
E01004661	0.93	1.00	1.00	1.00	0.85	0.93	0.93	0.15	0.07	0.11	0.00	0.30	0.19	0.04	0.00	0.33	0.74	0.04	0.04	2	3	0.20	2	1	0.28
E01004681	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.07	0.00	0.07	0.29	0.14	0.00	0.07	0.07	0.36	0.14	0.00	0.00	2	5	0.02	2	1	0.22
E01004701	1.00	1.00	1.00	1.00	1.00	1.00	0.13	0.07	0.00	0.07	0.33	0.07	0.07	0.13	0.67	0.00	0.00	2	3	0.20	2	1	0.31		
E01004712	1.00	1.00	1.00	1.00	1.00	1.00	0.09	0.27	0.09	0.09	0.27	0.09	0.09	0.00	0.00	0.64	0.00	0.00	2	3	0.10	2	1	0.29	
E01004721	0.97	1.00	0.97	0.97	0.97	0.97	0.30	0.10	0.33	0.00	0.40	0.33	0.20	0.00	0.30	0.60	0.03	0.00	2	3	0.18	2	1	0.23	
E01004728	0.93	0.93	1.00	1.00	0.93	0.93	0.00	0.07	0.43	0.00	0.00	0.29	0.00	0.07	0.50	0.86	0.00	0.07	2	4	0.11	2	1	0.24	
E01004730	1.00	1.00	1.00	1.00	1.00	1.00	0.24	0.05	0.05	0.05	0.38	0.43	0.14	0.05	0.33	0.62	0.00	0.05	2	3	0.31	2	1	0.27	
E01004740	0.97	0.94	0.94	0.97	0.94	0.91	0.97	0.09	0.06	0.23	0.09	0.23	0.37	0.06	0.09	0.46	0.71	0.06	0.09	2	4	0.17	2	1	0.25
E01004751	1.00	0.97	1.00	1.00	1.00	1.00	0.28	0.07	0.10	0.03	0.10	0.28	0.03	0.10	0.24	0.59	0.03	0.03	2	3	0.26	2	1	0.32	
E01033600	1.00	1.00	1.00	1.00	1.00	1.00	0.36	0.07	0.00	0.07	0.21	0.14	0.00	0.00	0.07	0.79	0.00	0.00	2	3	0.17	2	1	0.29	
E01004649	0.96	0.89	0.96	0.93	0.93	0.96	0.32	0.32	0.39	0.11	0.29	0.04	0.00	0.04	0.21	0.61	0.00	0.00	3	2	0.14	2	1	0.22	
E01004670	0.90	0.95	0.86	1.00	1.00	0.90	0.95	0.14	0.38	0.38	0.05	0.10	0.05	0.05	0.00	0.29	0.48	0.05	0.00	3	2	0.09	2	1	0.22
E01004692	1.00	1.00	1.00	1.00	1.00	1.00	0.21	0.32	0.46	0.25	0.39	0.18	0.11	0.00	0.14	0.50	0.04	0.00	3	2	0.07	2	1	0.23	
E01004710	1.00	1.00	1.00	1.00	0.85	0.69	0.62	0.15	0.46	0.62	0.00	0.00	0.23	0.38	0.00	0.08	3	4	0.06	2	1	0.01			
E01004731	0.81	0.81	1.00	1.00	1.00	1.00	0.76	0.14	0.19	0.33	0.10	0.14	0.00	0.00	0.19	0.29	0.10	0.00	3	2	0.24	2	1	0.12	
E01004742	0.93	0.93	1.00	1.00	1.00	1.00	0.71	0.43	0.57	0.07	0.14	0.29	0.07	0.00	0.14	0.50	0.00	0.00	3	2	0.08	2	1	0.13	
E01004744	0.79	0.79	1.00	0.89	0.96	1.00	0.93	0.32	0.11	0.25	0.04	0.32	0.18	0.07	0.07	0.14	0.50	0.00	0.00	3	2	0.09	2	1	0.16
E01004745	0.80	0.90	1.00	0.90	0.95	0.95	1.00	0.20	0.05	0.10	0.05	0.30	0.15	0.00	0.00	0.05	0.60	0.05	0.00	3	2	0.02	2	1	0.23
E01004762	0.92	0.92	0.96	0.98	0.86	0.96	0.88	0.29	0.21	0.17	0.13	0.33	0.13	0.08	0.00	0.33	0.38	0.08	0.00	3	2	0.03	2	1	0.17
E01033595	0.93	0.79	1.00	1.00	0.93	0.93	1.00	0.00	0.50	0.86	0.00	0.14	0.00	0.00	0.36	0.57	0.00	0.00	3	2	0.16	2	1	0.17	
E01033602	1.00	0.81	1.00	1.00	0.94	1.00	1.00	0.19	0.19	0.25	0.00	0.00	0.00	0.13	0.69	0.06	0.00	3	2	0.07	2	1	0.28		
E01033605	0.81	0.88	1.00	1.00	1.00	1.00	0.75	0.88	0.19	0.25	0.13	0.31	0.00	0.00	0.13	0.50	0.00	0.00	3	2	0.17	2	1	0.13	
E01004651	0.86	1.00	0.86	0.95	0.95	0.95	0.91	0.33	0.33	0.00	0.24	0.57	0.00	0.00	0.76	0.71	0.00	0.14	4	2	0.11	2	1	0.12	
E01004658	1.00	0.86	0.86	0.71	0.86	0.93	0.79	0.21	0.21	0.36	0.57	0.07	0.07	0.50	0.79	0.00	0.07	4	1	-0.03	2	1	0.02		
E01004662	1.00	1.00	0.94	1.00	0.88	0.94	0.94	0.18	0.29	0.43	0.29	0.47	0.24	0.06	0.06	0.47	0.47	0.06	0.00	4	5	-0.09	2	1	0.16
E01004663	0.92	1.00	0.92	0.92	1.00	0.85	1.00	0.23	0.15	0.23	0.23	0.38	0.54	0.00	0.23	0.54	0.62	0.00	0.08	4	2	0.03	2	1	0.09
E01004682	0.86	1.00	1.00	1.00	0.79	0.86	0.79	0.07	0.57	0.57	0.14	0.50	0.29	0.14	0.00	0.36	0.57	0.00	0.14	4	1	0.03	2	1	0.07
E01004708	0.86	1.00	0.93	0.91	0.88	0.91	0.79	0.23	0.40	0.49	0.19	0.44	0.30	0.02	0.07	0.53	0.56	0.02	0.07	4	5	0.17	1	2	-0.04
E01004715	0.87	0.94	0.94	0.85	0.86	0.74	0.71	0.21	0.53	0.18	0.08	0.06	0.03	0.47	0.38	0.00	0.00	4	3	-0.02	1	2	0.01		
E01004724	0.76	0.90	0.90	0.95	0.81	0.71	0.71	0.24	0.38	0.43	0.19	0.62	0.48	0.00	0.05	0.48	0.43	0.00	0.05	4	1	0.06	1	2	0.11
E01004727	0.83	1.00	0.96	1.00	0.96	0.71	0.67	0.25	0.00	0.25	0.25	0.71	0.29	0.00	0.25	0.71	0.63	0.00	0.04	4	8	0.08	1	2	0.02
E01004729	0.77	0.92	0.92	0.85	0.69	0.85	1.00	0.08	0.31	0.00	0.38	0.31	0.08	0.00	0.69	0.69	0.00	0.00	4	2	0.07	2	1	0.06	
E01004732	0.80	0.80	0.95	0.95	0.85	0.90	0.90	0.05	0.40	0.15	0.05	0.15	0.15	0.05	0.05	0.60	0.70	0.05	0.05	4	3	-0.05	2	1	0.16
E01004741	0.86	1.00	1.00	1.00	0.81	0.81	0.76	0.29	0.38	0.10	0.16	0.48	0.40	0.08	0.13	0.52	0.65	0.02	0.05	4	6	0.14	1	2	0.00
E01004747	0.92	0.92	0.95	0.95	0.94	0.94	0.94	0.32	0.41	0.12	0.16	0.53	0.41	0.04	0.09	0.31	0.37	0.09	0.06	6	1	0.10	1	2	0.22
E01004683	0.57	0.95	0.90	0.67	0.67	0.67	0.67	0.24	0.52	0.67	0.19	0.81	0.24	0.00	0.10	0.33	0.29	0.00	0.10	6	7	0.14	2	1	0.14
E01004686	0.67	1.00	0.92	0.83	0.																				

Annex E. Original Scores and Clustering Results of Service Requirement

L5OACode	Q8:1	Q8:2	Q8:3	Q8:4	Q8:5	Q8:6	Q8:7	Q8:8	Q8:9	Q8:10	Q8:11	Q8:12	Q8:13	Q8:14	Q8:15	Q8:16	Q8:17	Q8:18	Q8:19	Q8:20	P cluster	P neighbor	P sil_width	H cluster	H neighbor	H sil_width	
E01004646	0.11	0.35	0.12	0.14	0.15	0.14	0.05	0.08	0.00	0.09	0.03	0.06	0.14	0.02	0.02	0.11	0.06	0.06	0.00	0.00	1	2	0.14	1	2	0.09	
E01004668	0.14	0.37	0.21	0.20	0.09	0.00	0.00	0.21	0.05	0.02	0.00	0.10	0.07	0.16	0.00	0.07	0.02	0.07	0.00	0.00	4	5	0.09	1	2	0.16	
E01004674	0.32	0.29	0.00	0.12	0.08	0.18	0.11	0.11	0.06	0.00	0.11	0.00	0.02	0.10	0.00	0.02	0.05	0.04	0.00	0.02	1	2	0.09	1	2	0.08	
E01004683	0.28	0.50	0.07	0.10	0.07	0.18	0.22	0.00	0.00	0.02	0.12	0.03	0.13	0.00	0.00	0.15	0.00	0.00	0.03	0.00	1	2	0.13	2	1	0.06	
E01004684	0.07	0.35	0.10	0.00	0.01	0.21	0.10	0.08	0.06	0.10	0.14	0.04	0.00	0.17	0.06	0.04	0.07	0.02	0.00	0.04	3	0.11	0.11	2	1	0.01	
E01004687	0.07	0.24	0.04	0.05	0.07	0.18	0.12	0.04	0.11	0.08	0.13	0.14	0.26	0.00	0.10	0.05	0.02	0.00	0.00	0.07	7	-0.07	3	2	1	0.13	
E01004691	0.56	0.43	0.00	0.09	0.15	0.00	0.02	0.04	0.06	0.06	0.13	0.00	0.00	0.11	0.04	0.00	0.06	0.02	0.00	0.00	6	0.06	1	2	1	0.12	
E01004692	0.26	0.23	0.16	0.19	0.06	0.04	0.17	0.05	0.14	0.13	0.00	0.03	0.11	0.06	0.00	0.00	0.00	0.00	0.00	0.00	1	6	-0.01	1	3	0.12	
E01004698	0.16	0.33	0.24	0.11	0.07	0.13	0.04	0.04	0.00	0.09	0.07	0.13	0.11	0.04	0.07	0.00	0.00	0.00	0.13	0.00	3	6	-0.03	3	1	0.08	
E01004707	0.17	0.33	0.12	0.17	0.04	0.11	0.00	0.00	0.03	0.03	0.10	0.02	0.10	0.09	0.03	0.03	0.03	0.06	0.03	0.02	6	0.19	1	2	1	0.10	
E01004720	0.32	0.14	0.10	0.10	0.13	0.04	0.00	0.00	0.06	0.06	0.18	0.07	0.05	0.16	0.05	0.07	0.08	0.08	0.03	0.02	3	0.03	1	2	1	0.07	
E01004727	0.30	0.20	0.16	0.16	0.03	0.16	0.04	0.00	0.06	0.00	0.03	0.03	0.08	0.00	0.09	0.00	0.14	0.00	0.00	0.00	5	2	0.04	1	2	0.06	
E01004745	0.00	0.37	0.17	0.12	0.05	0.03	0.00	0.07	0.23	0.05	0.10	0.03	0.00	0.15	0.12	0.02	0.12	0.17	0.07	0.00	3	0.03	1	2	1	0.07	
E01033607	0.15	0.30	0.11	0.17	0.06	0.00	0.09	0.00	0.26	0.15	0.08	0.00	0.11	0.02	0.00	0.00	0.00	0.06	0.00	0.00	6	0.07	1	3	1	0.08	
E01004648	0.28	0.06	0.30	0.15	0.23	0.07	0.04	0.10	0.00	0.01	0.11	0.07	0.10	0.07	0.06	0.00	0.09	0.09	0.02	0.00	2	6	0.07	1	2	0.17	
E01004649	0.12	0.08	0.27	0.30	0.11	0.25	0.17	0.06	0.20	0.05	0.00	0.01	0.00	0.00	0.08	0.01	0.01	0.00	0.04	0.04	2	3	0.05	1	2	0.09	
E01004661	0.21	0.07	0.35	0.27	0.26	0.17	0.17	0.12	0.04	0.00	0.07	0.02	0.00	0.00	0.05	0.04	0.01	0.02	0.02	0.00	2	4	0.17	1	2	0.16	
E01004665	0.25	0.21	0.22	0.23	0.17	0.13	0.17	0.05	0.00	0.10	0.01	0.02	0.04	0.04	0.05	0.01	0.04	0.00	0.00	0.01	1	0.13	1	2	1	0.13	
E01004669	0.21	0.15	0.21	0.12	0.26	0.14	0.31	0.14	0.11	0.00	0.06	0.02	0.00	0.09	0.07	0.00	0.04	0.00	0.00	0.00	2	4	0.12	1	2	0.10	
E01004686	0.14	0.33	0.08	0.08	0.14	0.19	0.08	0.00	0.25	0.00	0.03	0.00	0.11	0.17	0.11	0.00	0.08	0.00	0.00	0.00	2	1	-0.06	2	1	0.06	
E01004703	0.34	0.20	0.09	0.17	0.07	0.13	0.12	0.03	0.03	0.03	0.12	0.03	0.05	0.03	0.03	0.07	0.08	0.00	0.00	0.00	2	1	-0.03	1	2	0.10	
E01004706	0.29	0.33	0.01	0.07	0.07	0.00	0.21	0.05	0.00	0.05	0.00	0.00	0.10	0.00	0.02	0.17	0.05	0.00	0.00	0.00	2	1	-0.08	2	1	-0.03	
E01004710	0.33	0.10	0.05	0.36	0.13	0.33	0.18	0.05	0.03	0.08	0.13	0.00	0.08	0.05	0.00	0.05	0.00	0.00	0.00	0.05	2	4	0.04	1	2	0.04	
E01004711	0.36	0.18	0.09	0.30	0.15	0.03	0.06	0.05	0.02	0.08	0.08	0.00	0.17	0.09	0.02	0.00	0.03	0.03	0.05	0.00	2	6	-0.06	1	2	0.21	
E01004715	0.20	0.05	0.32	0.22	0.14	0.18	0.05	0.06	0.02	0.16	0.05	0.06	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	6	0.03	1	2	1	0.15	
E01004724	0.21	0.16	0.11	0.13	0.22	0.14	0.19	0.16	0.05	0.02	0.16	0.02	0.06	0.05	0.00	0.10	0.08	0.00	0.00	0.00	2	1	0.11	1	2	0.07	
E01004726	0.37	0.10	0.06	0.11	0.14	0.20	0.16	0.05	0.08	0.07	0.06	0.04	0.05	0.00	0.06	0.01	0.00	0.00	0.00	0.00	6	0.03	1	2	1	0.08	
E01004730	0.24	0.13	0.19	0.30	0.27	0.03	0.00	0.10	0.02	0.10	0.13	0.00	0.05	0.03	0.00	0.16	0.08	0.00	0.00	0.00	2	6	0.06	1	2	0.18	
E01004737	0.31	0.02	0.19	0.04	0.25	0.13	0.27	0.04	0.02	0.02	0.23	0.00	0.00	0.13	0.00	0.02	0.08	0.04	0.06	0.00	2	4	0.03	2	1	-0.01	
E01004742	0.29	0.14	0.45	0.17	0.05	0.00	0.12	0.00	0.07	0.00	0.07	0.00	0.00	0.29	0.07	0.00	0.00	0.00	0.00	0.00	2	1	-0.01	1	2	0.13	
E01004744	0.11	0.17	0.15	0.24	0.05	0.13	0.20	0.04	0.02	0.10	0.04	0.04	0.04	0.04	0.07	0.00	0.06	0.06	0.01	0.00	3	2	3	-0.05	1	2	0.03
E01004750	0.36	0.06	0.26	0.15	0.27	0.00	0.00	0.03	0.02	0.00	0.02	0.00	0.15	0.17	0.00	0.00	0.09	0.00	0.00	0.00	2	6	-0.01	1	2	0.18	
E01004755	0.30	0.10	0.11	0.15	0.14	0.08	0.19	0.17	0.00	0.00	0.18	0.04	0.04	0.07	0.00	0.05	0.08	0.01	0.03	0.00	2	5	0.10	1	2	0.07	
E01033601	0.02	0.24	0.10	0.19	0.24	0.02	0.31	0.05	0.00	0.00	0.24	0.02	0.00	0.02	0.00	0.00	0.25	0.00	0.00	0.00	2	1	0.04	2	1	0.00	
E01004650	0.06	0.11	0.05	0.04	0.13	0.17	0.17	0.02	0.00	0.03	0.08	0.10	0.05	0.02	0.11	0.11	0.04	0.08	0.13	0.00	3	7	0.17	2	1	0.06	
E01004666	0.05	0.13	0.11	0.10	0.16	0.03	0.00	0.05	0.00	0.03	0.13	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.00	0.00	3	1	0.01	2	1	-0.04	
E01004670	0.14	0.11	0.15	0.11	0.10	0.04	0.00	0.03	0.00	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	4	1	0.01	1	2	0.05	
E01004679	0.23	0.15	0.13	0.28	0.15	0.06	0.00	0.06	0.13	0.08	0.00	0.03	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	4	1	-0.06	2	1	0.02	
E01004696	0.12	0.03	0.15	0.23	0.22	0.28	0.28	0.00	0.10	0.15	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4	2	0.03	1	2	-0.01	
E01004719	0.23	0.12	0.09	0.12	0.05	0.14	0.35	0.00	0.04	0.25	0.21	0.14	0.05	0.00	0.11	0.02	0.00	0.00	0.00	0.00	4	2	0.04	2	3	0.05	
E01004729	0.28	0.13	0.00	0.00	0.31	0.18	0.28	0.10	0.00	0.13	0.18	0.03	0.00	0.00	0.08	0.23	0.00	0.00	0.00	0.00	4	3	0.07	1	2	-0.06	
E01004735	0.18	0.15	0.13	0.06	0.26	0.34	0.02	0.06	0.12	0.10	0.06	0.04	0.00	0.02	0.02	0.06	0.00	0.00	0.00	0.00	4	3	0.14	2	1	0.09	
E01004752	0.21	0.11	0.10	0.19	0.13	0.18	0.08	0.06	0.03	0.14	0.04	0.14	0.07	0.01	0.02	0.00	0.04	0.11	0.06	0.00	4	3	-0.08	3	1	-0.06	
E01004753	0.28	0.24	0.23	0.08	0.04	0.09	0.07	0.02	0.04	0.01	0.06	0.11	0.14														

Annex F. Clustering Results of Index of Service Usage Rate and Satisfaction and Service Requirement

Table 10. Clustering Results of Index of Service Usage Rate and Satisfaction and Service Requirement

Annex G. Original Scores and Clustering Results of Attitudes towards Local area and safety issues

LsoaCode	Q17a	Q17b	Q17c	Q17d	Q17e	Q17f	Q17g	Q17h	Q17i	Q17k	Q17l	Q17m	Q17n	Q17o	Q17p	Q17q	Q17r	Q17t	Q17u	P cluster	P neighbor	P sil_width	H cluster	H neighbor	H sil_width	
E01004675	0.43	0.36	0.36	0.50	0.36	0.36	0.43	0.36	0.43	0.43	0.57	0.36	0.36	0.43	0.29	0.43	0.50	0.43	0.21	1	2	0.41	3	1	0.41	
E01004745	0.35	0.40	0.35	0.35	0.40	0.35	0.40	0.65	0.40	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	1	2	0.44	3	1	0.36	
E01004760	0.38	0.43	0.33	0.33	0.62	0.52	0.43	0.76	0.52	0.29	0.62	0.43	0.48	0.52	0.76	0.52	0.57	0.33	0.33	1	2	0.42	3	1	0.47	
E01004762	0.58	0.50	0.54	0.42	0.50	0.50	0.46	0.50	0.54	0.46	0.46	0.54	0.50	0.58	0.67	0.67	0.63	0.58	0.54	1	2	0.39	3	1	0.46	
E01035212	0.21	0.31	0.29	0.31	0.27	0.46	0.31	0.44	0.40	0.27	0.35	0.31	0.40	0.35	0.40	0.31	0.38	0.31	0.33	1	2	0.40	3	1	0.23	
E01033604	0.43	0.38	0.38	0.29	0.52	0.52	0.33	0.71	0.62	0.24	0.57	0.29	0.33	0.43	0.48	0.33	0.33	0.19	0.19	1	2	0.39	3	1	0.33	
E01004654	0.29	0.14	0.18	0.07	0.29	0.18	0.11	0.25	0.18	0.11	0.29	0.39	0.54	0.18	0.21	0.46	0.39	0.14	0.07	1	2	-0.05	1	2	0.16	
E01004660	0.14	0.43	0.00	0.21	0.07	0.29	0.00	0.36	0.36	0.21	0.00	0.00	0.14	0.79	0.14	0.50	0.29	0.29	0.29	1	2	-0.07	1	2	0.10	
E01004688	0.43	0.21	0.14	0.29	0.21	0.21	0.71	0.29	0.29	0.21	0.21	0.21	0.14	0.21	0.21	0.21	0.29	0.21	0.21	1	2	0.07	1	2	0.27	
E01004702	0.37	0.19	0.12	0.19	0.42	0.14	0.14	0.67	0.58	0.14	0.44	0.14	0.12	0.63	0.30	0.35	0.16	0.14	0.12	1	2	0.00	1	2	0.25	
E01004712	0.00	0.27	0.09	0.27	0.36	0.27	0.27	0.00	0.36	0.00	0.27	0.45	0.00	0.27	0.36	0.09	0.27	0.27	0.27	1	2	0.00	1	2	0.16	
E01036003	0.24	0.24	0.19	0.29	0.53	0.14	0.19	0.43	0.38	0.19	0.24	0.19	0.24	0.57	0.33	0.24	0.14	0.10	0.19	1	2	0.04	1	2	0.29	
E01004646	0.32	0.27	0.18	0.36	0.27	0.18	0.32	0.50	0.36	0.09	0.32	0.18	0.36	0.36	0.36	0.27	0.27	0.27	0.09	1	2	0.18	1	3	0.23	
E01004653	0.40	0.29	0.17	0.09	0.31	0.17	0.23	0.20	0.23	0.11	0.49	0.37	0.66	0.26	0.43	0.49	0.40	0.29	0.31	1	2	0.27	1	3	0.09	
E01004691	0.33	0.56	0.22	0.22	0.28	0.28	0.28	0.39	0.28	0.28	0.39	0.72	0.33	0.28	0.56	0.22	0.33	0.28	0.1	1	2	0.34	1	3	-0.05	
E01004698	0.33	0.13	0.27	0.13	0.40	0.20	0.40	0.40	0.47	0.13	0.27	0.13	0.33	0.53	0.13	0.27	0.27	0.27	0.33	1	2	0.17	1	3	0.20	
E01004718	0.71	0.36	0.14	0.00	0.21	0.21	0.29	0.64	0.79	0.14	0.29	0.43	0.71	0.79	0.50	0.07	0.14	0.50	0.36	1	2	0.23	1	3	0.01	
E01004761	0.31	0.35	0.19	0.19	0.35	0.19	0.19	0.35	0.54	0.31	0.31	0.38	0.42	0.31	0.38	0.38	0.35	0.35	0.31	1	2	0.35	1	3	-0.01	
E01004648	0.15	0.00	0.00	0.07	0.15	0.04	0.04	0.00	0.00	0.00	0.04	0.00	0.19	0.07	0.04	0.15	0.04	0.00	0.00	2	1	0.58	2	1	0.49	
E01004649	0.07	0.04	0.00	0.00	0.04	0.00	0.00	0.07	0.07	0.00	0.04	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	2	1	0.61	2	1	0.53	
E01004650	0.14	0.00	0.05	0.10	0.14	0.05	0.14	0.29	0.19	0.19	0.24	0.14	0.33	0.19	0.14	0.19	0.19	0.05	0.05	2	1	0.43	2	1	0.18	
E01004651	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2	1	0.58	2	1	0.51	
E01004652	0.09	0.06	0.09	0.03	0.12	0.09	0.12	0.26	0.12	0.06	0.12	0.15	0.18	0.12	0.09	0.09	0.00	0.02	0.00	2	1	0.58	2	1	0.44	
E01004658	0.14	0.14	0.07	0.00	0.00	0.00	0.14	0.21	0.29	0.14	0.09	0.21	0.14	0.14	0.07	0.07	0.14	0.07	0.07	2	1	0.53	2	1	0.36	
E01004659	0.17	0.09	0.03	0.06	0.11	0.09	0.06	0.31	0.26	0.03	0.09	0.11	0.14	0.23	0.03	0.14	0.09	0.03	0.11	2	1	0.59	2	1	0.43	
E01004661	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2	1	0.58	2	1	0.51	
E01004662	0.06	0.06	0.12	0.24	0.12	0.12	0.06	0.18	0.24	0.06	0.12	0.06	0.24	0.29	0.24	0.18	0.00	0.12	0.12	2	1	0.48	2	1	0.26	
E01004663	0.15	0.08	0.00	0.15	0.08	0.00	0.08	0.23	0.08	0.15	0.08	0.08	0.23	0.23	0.23	0.23	0.23	0.08	0.08	2	1	0.46	2	1	0.26	
E01004665	0.04	0.04	0.00	0.04	0.04	0.04	0.04	0.36	0.32	0.00	0.04	0.04	0.04	0.04	0.04	0.18	0.04	0.00	0.04	2	1	0.59	2	1	0.48	
E01004667	0.15	0.31	0.00	0.08	0.15	0.08	0.00	0.38	0.00	0.23	0.08	0.00	0.15	0.00	0.00	0.15	0.08	0.00	0.00	2	1	0.48	2	1	0.28	
E01004668	0.13	0.00	0.00	0.00	0.13	0.00	0.07	0.07	0.60	0.53	0.00	0.07	0.00	0.13	0.27	0.13	0.27	0.00	0.00	0.00	2	1	0.53	2	1	0.37
E01004669	0.11	0.04	0.00	0.07	0.15	0.04	0.00	0.48	0.08	0.11	0.11	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	2	1	0.57	2	1	0.45	
E01004670	0.14	0.10	0.00	0.05	0.10	0.05	0.00	0.38	0.10	0.00	0.10	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.05	2	1	0.61	2	1	0.50	
E01004677	0.14	0.14	0.21	0.07	0.21	0.07	0.14	0.14	0.14	0.00	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.00	2	1	0.53	2	1	0.35	
E01004678	0.17	0.09	0.03	0.06	0.26	0.09	0.06	0.20	0.11	0.03	0.09	0.06	0.31	0.26	0.09	0.06	0.06	0.03	0.03	2	1	0.57	2	1	0.41	
E01004681	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2	1	0.59	2	1	0.52	
E01004683	0.19	0.05	0.00	0.10	0.05	0.05	0.05	0.10	0.24	0.10	0.10	0.05	0.19	0.24	0.14	0.05	0.14	0.19	0.2	1	0.53	2	1	0.36		
E01004686	0.25	0.17	0.08	0.17	0.17	0.00	0.00	0.42	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.08	0.08	0.00	0.00	2	1	0.53	2	1	0.35
E01004689	0.33	0.17	0.00	0.08	0.08	0.08	0.08	0.08	0.17	0.07	0.00	0.25	0.33	0.08	0.42	0.08	0.17	0.17	0.17	2	1	0.39	2	1	0.16	
E01004690	0.11	0.17	0.07	0.04	0.24	0.21	0.21	0.07	0.07	0.25	0.18	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.11	2	1	0.57	2	1	0.41	
E01004692	0.04	0.07	0.07	0.07	0.18	0.04	0.11	0.14	0.29	0.04	0.00	0.11	0.25	0.00	0.04	0.18	0.00	0.00	0.05	2	1	0.58	2	1	0.45	
E01004694	0.07	0.20	0.00	0.07	0.20	0.07	0.07	0.33	0.20	0.03	0.17	0.07	0.30	0.03	0.10	0.07	0.00	0.03	0.00	2	1	0.40	2	1	0.20	
E01004696	0.15	0.15	0.00	0.00	0.35	0.00	0.05	0.45	0.20	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	2	1	0.55	2	1	0.41	
E01004699	0.06	0.03	0.00	0.00	0.06	0.02	0.15	0.24	0.09	0.03	0.08	0.18	0.21	0.38	0.15	0.26	0.09	0.15	0.03	2	1	0.47	2	1	0.28	
E01004701	0.00	0.07	0.00	0.07	0.13	0.00	0.05	0.13	0.07	0.00	0.07	0.00	0.07	0.00	0.07	0.00	0.07	0.00	0.07	2	1	0.59	2	1	0.50	
E01004703	0.28	0.10	0.08	0.05	0.13	0.00	0.10	0.16																		