

London Workplace Zones Classification

Technical Report

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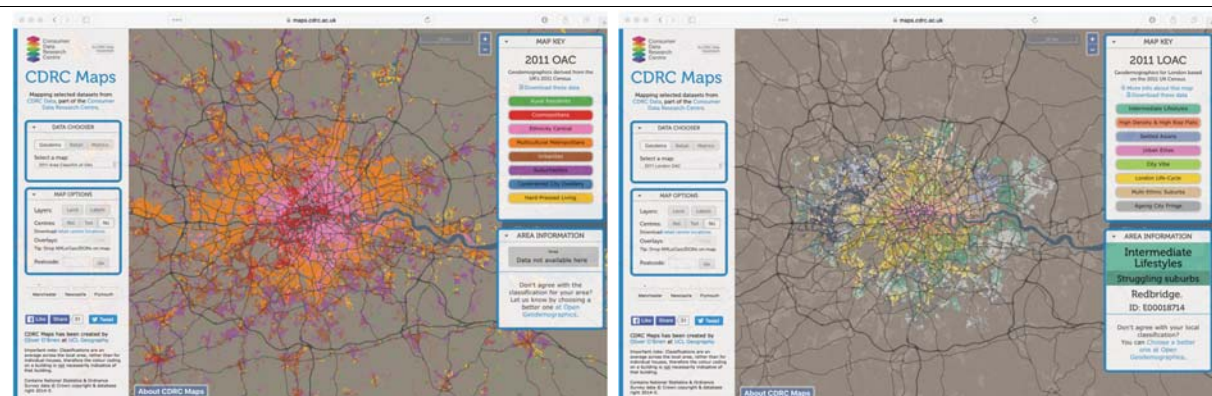
1. Introduction

Recent years have seen growing interest in supplementing geodemographic classifications of residential neighbourhoods with classification of workplace zones – specifically the CoWZ project (<http://cowz.geodata.soton.ac.uk>) of England and Wales developed at the University of Southampton. As with residential classifications, there are concerns that a countrywide (England and Wales) classification may be insufficiently sensitive to the distinctive characteristics of London as a world city (see Singleton and Longley 2015). This issue is evident when we compare a map of the Office for National Statistics Output Area Classification (OAC) (Gale et al, 2016), with the London Output Area Classification (LOAC) (Singleton et al, 2015). Despite the data inputs being held constant, LOAC offers far greater differentiation relative to OAC because the reference distribution is London rather than the U.K. as a whole. This is an example of a bespoke geodemographic, built to better represent this unique spatial extent.

Figure 1: Enhancements to a nationally optimised geodemographic system (left) for use in Greater London (right) (Source: [HTTP://MAPS.CDRC.AC.UK](http://maps.cdrc.ac.uk))

A) Output Area Classification (OAC)

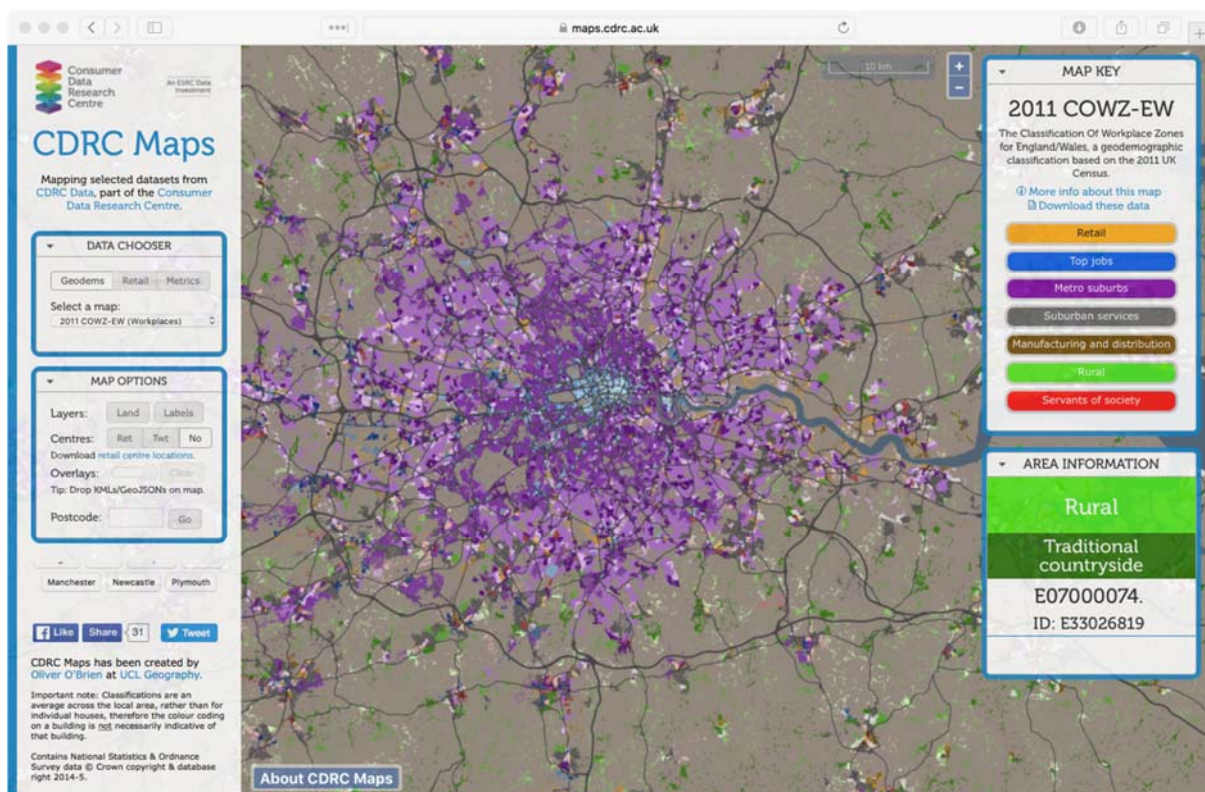
B) London Output Area Classification (LOAC)



Following the 2011 Census of the Population, a new output geography was built for England and Wales that aimed to better represent working over residential population distributions. These zones are called Workplace Zones (WZ), and are created by either splitting or merging Output Areas (Martin et al, 2013). This geography and associated Census outputs offered new potential to create geodemographics of the workplace populations thereby making it possible to augment conventional Census based residential classifications.

This project extends work conducted for the national extent by the University of Southampton (CoWZ: [HTTP://COWZ.GEODATA.SOTON.AC.UK/](http://cowz.geodata.soton.ac.uk/)) to devise a workplace typology for Greater London. As with the residential classification OAC, the CoWZ classification at the most aggregate level has limited differentiation within London. It is also restricted to data drawn from the 2011 Census of Population, which to some extent limits its applicability and remit some six years after the data were collected.

Figure 2: The Classification of Workplace Zones within London (Source: [HTTP://MAPS.CDRC.AC.UK](http://maps.cdrc.ac.uk))



The aims of this study were:

1. To produce a grouping of Census workplace zones that are most similar but to make distinctions as appropriate. Census input variables were augmented by other sources in order to enrich and update the 2011 Census. The number of

appropriate groupings and Sub Groupings was to be determined as part of the classification.

2. Consultation with stakeholders during the creation process. This was effected via meetings of a Classification Steering Group to ensure that the final product met the requirements of end users.
3. Supporting uses that include but are not limited to: economic planning for diversification and regeneration of areas; transport planning in terms of the networks, accessibility and transport behaviour modelling and influence; understanding of the mismatch of skills in the local labour force and required by employers; and sustainability of employment and prosperity.
4. To evaluate potential input measures and devise a transparent classification methodology.

2. Classification Framework

Candidate inputs to the typology were assembled around six domains identified in consultation with stakeholder groups as factors that shape and sustain workplace geography. The results of the stakeholder consultation extended the conception of workzones as represented in CoWZ and brought focus to the need to represent:

- ***Employment Structure***: captures the mix and type of industry and occupations
- ***Dynamism / Attractiveness***: captures both long and short term indicators of change
- ***Employee characteristics***: the skills and other characteristics of workers
- ***Job characteristics***: the nature of work undertaken, including hours worked and full / part time mix
- ***Commuting / connections***: location accessibility and travel-to-work patterns
- ***Residential context***: the residential setting of the workplace

Within each of these domains, a series of sub domains and candidate indicators were considered as inputs to the evaluation. As with the CoWZ classification, many variables were sourced from the 2011 Census of Population¹. A series of other secondary data that capture specific additional indicators related to dynamism and attractiveness of London, retail structure and transportation were evaluated.

¹ Census data were obtained from Nomis: [HTTPS://WWW.NOMISWEB.CO.UK/CENSUS/2011](https://www.nomisweb.co.uk/census/2011); and for those Tables selected, all variables from these were considered for evaluation as presented with the exception of age and health, where bands were created.

TABLE 1: CLASSIFICATION FRAMEWORK AND INITIAL VARIABLE SELECTION

Domain	Sub Domain	Measure*
Employment Type	Employment	Worker density (WP101EW) Worker industry % (WP605EW)
	Occupation Types	Worker occupation % (WP606EW)
	Retail Density	Density of retailers (CDRC / LDC+) Density of retailers by category (CDRC / LDC)
Dynamism / Attractiveness	Change	Workplace % change 2009 – 2015 (IDBR&) Employee % change 2009 – 2015 (IDBR)
	Nighttime Economy	Night time economy businesses % (CDRC / LDC)
Employee Characteristics	Demographic	Age All / Male / Female % 16-24 (WP1101EW) Age All / Male / Female % 25-39 (WP1101EW) Age All / Male / Female % 40-64 (WP1101EW) Age All / Male / Female % 65-74 (WP1101EW)
	Diversity	Ethnic group % (WP201EW) Country of birth categories % (WP203EW) Length of residence in the UK categories % (WP803EW)
	Socio-economic	General health categories % (WP302EW) Tenure categories % (WP403EW)

Job Characteristics	Qualifications	Qualification categories % (WP501EW)
	Working day	Employment status categories % (WP601EW) Hours worked categories% (WP604EW)
	NS-SEC	NS-SeC top level categories % (WP607EW)
Commuting / Connections	Distance / Accessibility	Distance travelled to work categories % (WP702EW) Average distance travelled to work (WP702EW) Public Transport Accessibility Levels (PTAL) (TfL [^]) Workers from outside of London % (WF02EW)
	Mode	Transport mode categories % (WP703EW)
Residential Context	Demography	Age 16-24 % (QS103EW) Age 65 + % (QS103EW) Old age dependency ratio (QS103EW)
	Socio-economic	Socially rented % (KS402EW) Economically Inactive: Students % (KS601EW) Economically Inactive: Looking after family / home % (KS601EW) Economically Inactive: Retired % (KS601EW)
	Family structure	Lone parent in part-time employment % (KS107EW) Lone parent in full-time employment % (KS107EW) Dependent children in household: All ages % (KS106EW)
	Education	Qualification Bands % (KS501EW)
	Residential Mix	Ratio OA Total Domicile Pop to WZ Work Day Total Pop

Notes: *= Where appropriate the Census table evaluated is featured in brackets; += Supplied by ESRC Consumer Data Research Centre (CDRC); &= Supplied by the Office for National Statistics ([HTTP://BIT.LY/2QFOKML](http://bit.ly/2QFOKML)); ^= PTAL data were created by TfL and are available: [HTTP://BIT.LY/2RALR8B](http://bit.ly/2RALR8B).

3. Building a Workplace Zone Geodemographic

The classification was created in a series of stages that are summarised as follows:

1. Data Sourcing and Preparation
2. Variable Evaluation, Final Selection and Standardisation
3. Building of Typology using Cluster Analysis
4. Describing the Clusters

3.1 Data Sourcing and Preparation

The first stage in building the classification was to assemble a range of attributes from disparate data sources. These inputs were all required at the scale of the Workplace Zone which is the geography to be clustered. In addition to the assembly of inputs that were available at Workplace Zone geography, there was a range of other considerations related to the aggregation of point data into Workplace Zones, the manipulation of residential data from Output Areas into Workplace Zones and the definition of a residential context for each Workplace Zone.

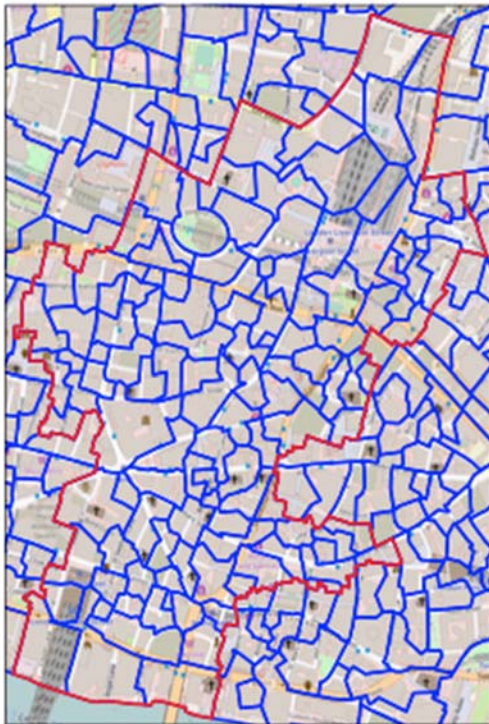
3.1.1 Census Inputs for Residential and Work Zone Geography

As noted in Table 1, a range of Workplace Zone (Work) and Output Area (Residential) attributes were assembled, with the Census tables of interest also specified. Such inputs were downloaded in bulk from NOMIS through an automated process, creating a single data frame along with associated metadata. For the Workplace Zone data these were downloaded for the extent of the Greater London; in addition to this extent, Output Area data were also acquired for areas bordering Greater London, for use when calculating Workplace Zone residential context measures.

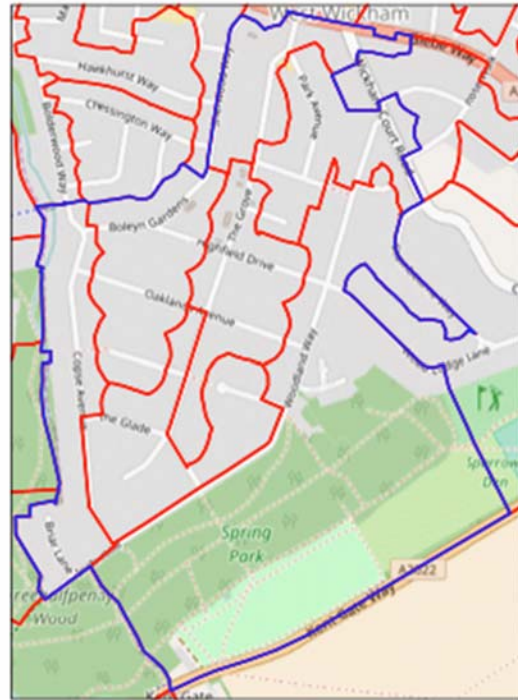
The correspondence between OAs and WZs was identified using zonal shapefiles and the Office for National Statistics Postcode Directory (ONSPD) alongside the 2011 Census Postcode headcount data.

Figure 3(A) illustrates the overlapping geographies of OAs and WZs for the Output Area "E00166755", which is one of the largest in central London. It is large because it has a very low residential population, yet, when plotted over the Workplace Zones, the high workplace population is evident given the high numbers of divisions. The opposite situation is illustrated by Figure 3(B) where a single WZ is matched with multiple OAs.

FIGURE 3: THE INTERSECTING OA AND WZ GEOGRAPHY



A) An area of Central London, illustrating a large OA, divided into multiple WZ



B) An area of South London, illustrating a WZ that is created from multiple OA

The relationship between OA and WZ geographies are important for two sets of input measure; the first are in the calculation of a ratio between the residential and workplace population within each WZ, and the second, in establishing the “residential context” of each workplace zone.

The former measure requires that the residential data that are supplied at OA geography be apportioned into WZs; thus requiring merging or splitting. A common way in which such adjustments can be achieved is by using the 2011 Census Postcode headcount data. These are records of the unit postcode population counts on Census night in 2011. The Postcode headcount data were geocoded using an ONSPD file matched as closely as possible to the April 2011 Census date (May 2011) and downloaded from the UK Data Service. Unfortunately, at the time this file was released, the boundaries for the 2011 OA or 2011 WZ codes had not yet been released, and so a point-in-polygon operation was used with the coordinates ascribed within the ONSPD and appropriate boundary files.

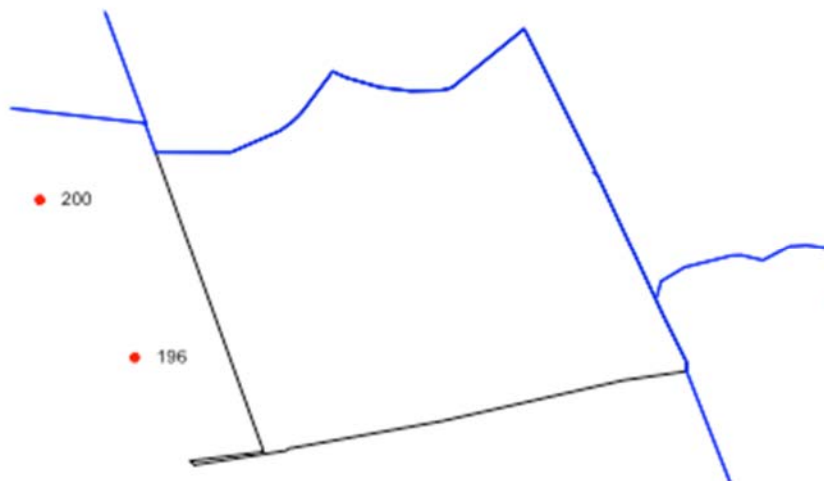
Next, the total population counts were calculated for every intersection between an OA and WZ. This created scores that were used to apportion OA resident population into WZs (see Table 2).

TABLE 2: AN EXAMPLE OF OA WZ POPULATION PROPORTIONS

OA CODE	WZ CODE	OA Intersection Population	Total OA Population	Proportion
E00000001	E33032173	194	194	1.00
E00000003	E33032173	250	250	1.00
E00000005	E33032173	367	367	1.00
E00000007	E33028816	6	123	0.05
E00000007	E33028817	11	123	0.09
E00000007	E33028818	106	123	0.86

The population for all but 10 of Greater London's 25,053 OAs could be assigned to WZs using this method. An example OA that was unmatched is shown in Figure 4, in which the black lines representing OA boundaries, blue lines delineate the WZ boundaries and red points identify the postcode centroids. The issue with these OA is that no postcode centroids are located within them (remember these represent a central location for multiple addresses). However, where the entire extent of an OA is contained within a WZ, the nested WZ is selected for the area.

FIGURE 4: AN EXAMPLE OF A MISSING WZ OA MATCH



The frequency distribution of OA splits are shown in Figure 5 and the spatial distribution of OAs that are split is mapped in Figure 6.

FIGURE 5: A HISTOGRAM OF THE FREQUENCY OF OA SPLITS WITH AT LEAST ONE POSTCODE ATTRIBUTED A HEADCOUNT

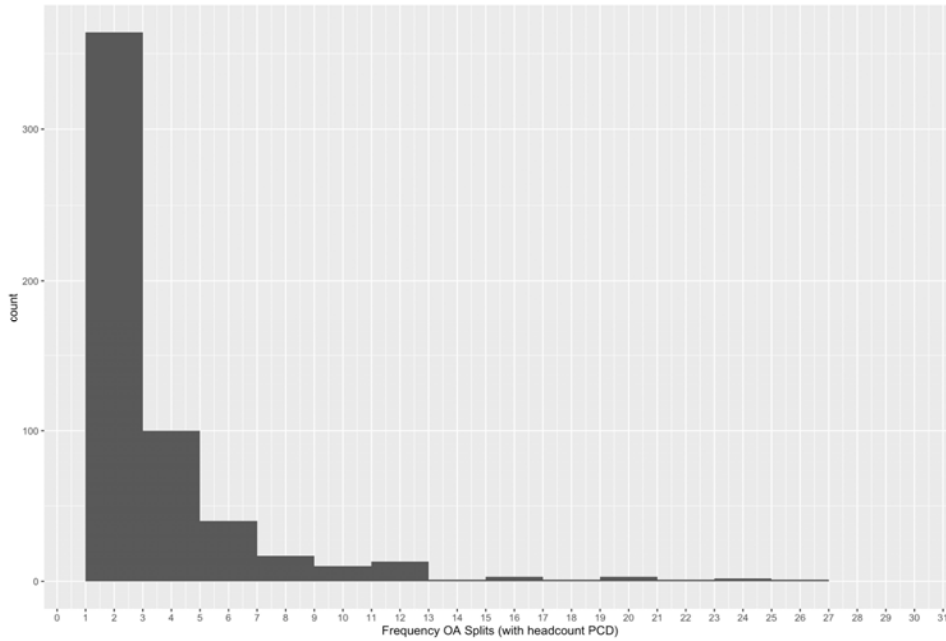
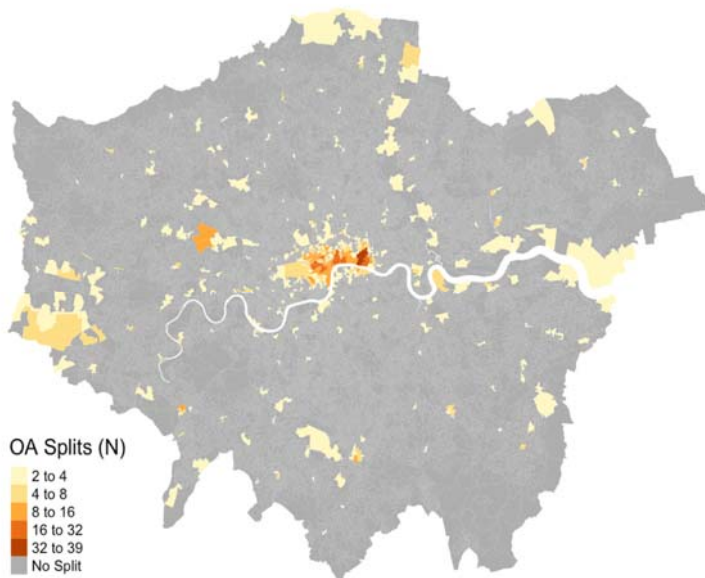


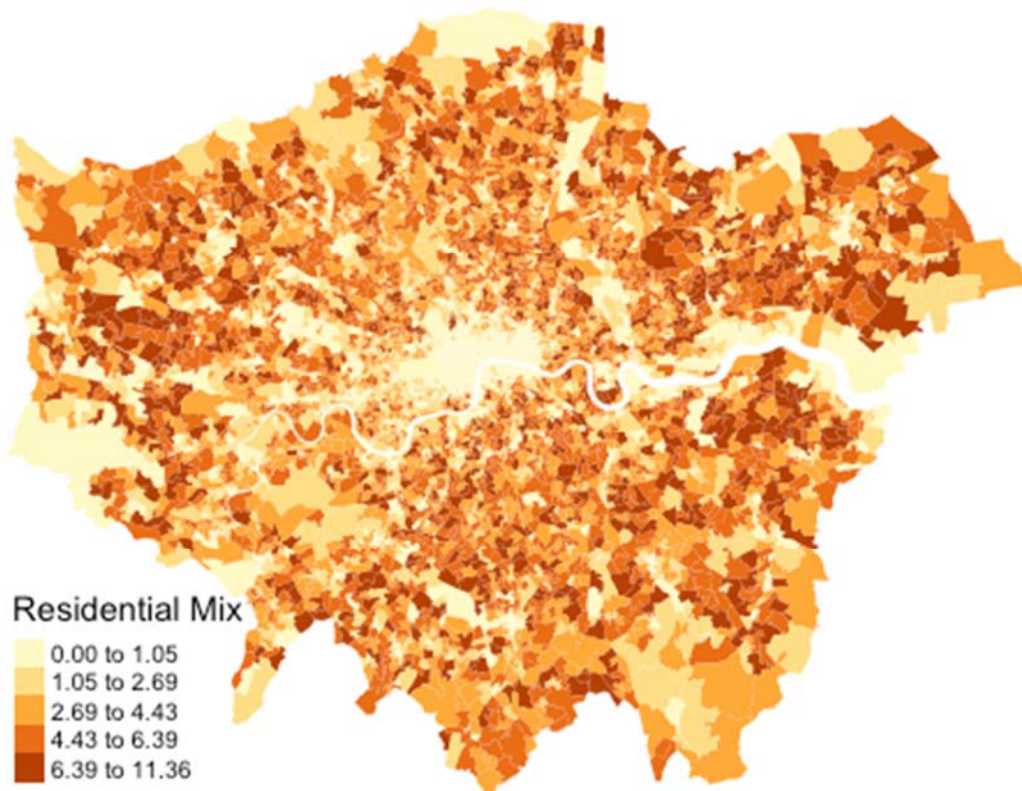
FIGURE 6: A MAP SHOWING THE FREQUENCY OF OA SPLITS WITH AT LEAST ONE POSTCODE ATTRIBUTED A HEADCOUNT



After appending the total residential population ("QS103EW0001") to the table containing the OA - WZ proportional splits, the total residential population within each WZ was calculated. These values were used to create a ratio with the total workplace population ("WP605EW0001"). The over-all residential population was considered rather

than the proportion of the population of working age; with the rationale being to capture the balance between these two uses of space in their entirety. These are mapped in Figure 7, where high values are found in areas more strongly associated with residential populations.

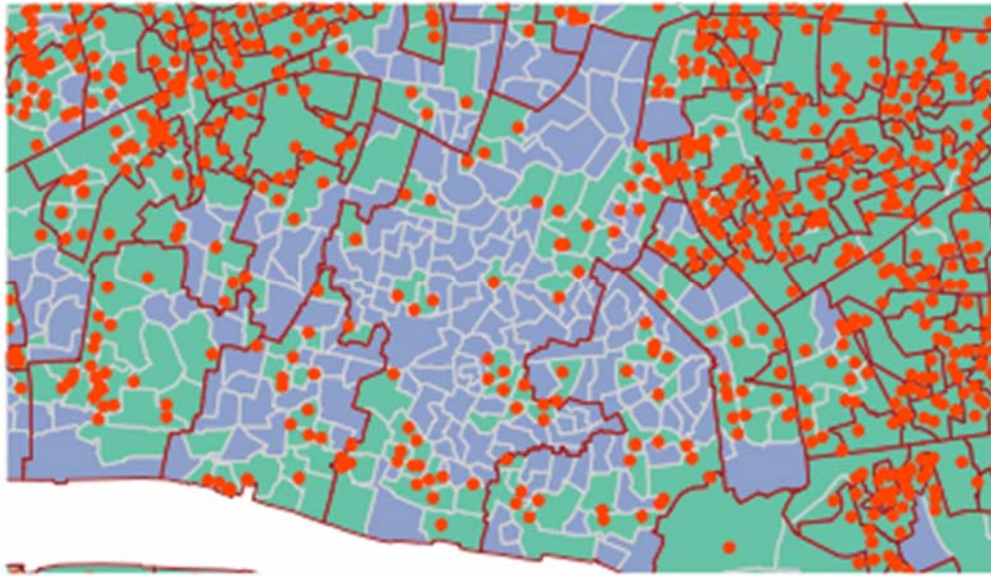
FIGURE 7: WORKPLACE AND RESIDENTIAL BALANCE OF POPULATION



3.1.2 Residential Context

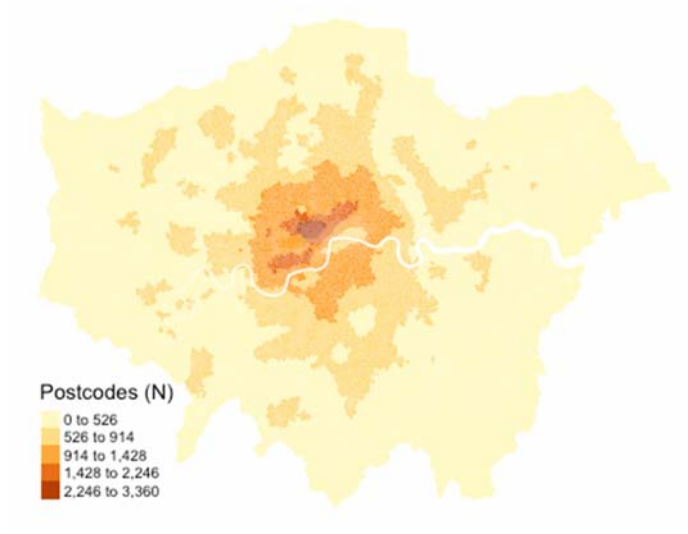
The next stage was to develop a measure of residential context for each WZ. However, simply using the apportionment and matching method described in the previous subsection would be inappropriate in that "context" would be coincident with the borders of each WZ, and would be void for WZs with no residential populations. This is entirely logical for a workplace zone to be entirely devoid of residents (or at least recorded by postcode centroids), as is apparent within some of the large and highly partitioned OAs within central London. Figure 8 highlights the WZs (shown in purple) where values are missing given the distribution of headcount postcodes (shown as red dots).

FIGURE 8: WORKPLACE ZONES WITHOUT RESIDENTIAL POSTCODES



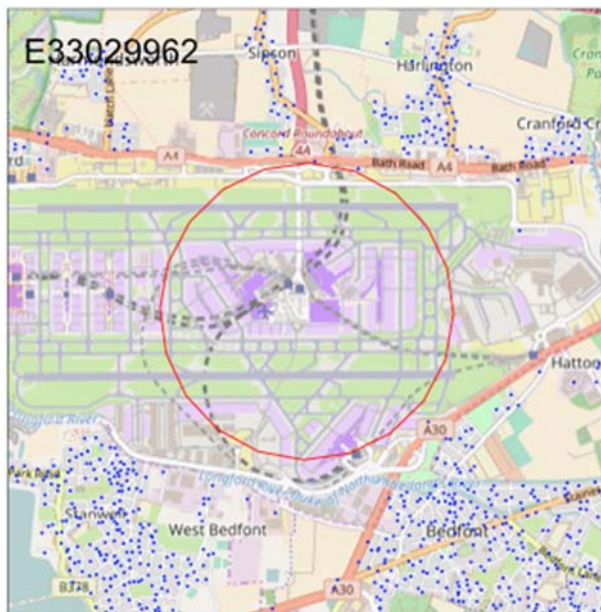
For every Workplace zone, we considered context using a radial buffer. This was defined as being an approximate 15 minute walk to the WZ, calculated using a population weighted centroid, a 1,250m distance threshold and an average 5km / hr pedestrian walking speed. A point in polygon operation using these boundaries and the OA data apportioned by the Postcode Headcount locations was then conducted. For some of the buffers surround the perimeter zones to the GLA boundary these extended beyond this extent, and as such, was the reason why census data for those areas surrounding Greater London were also integrated, thus creating a more uniform measure for the whole of the Greater London Authority. Within each WZ assigned buffer, the contextual Census data were then summed. A frequency map of the postcode centroids within each buffer is shown in Figure 9.

FIGURE 9: THE NUMBER OF HEADCOUNT POSTCODE POINTS WITHIN EACH BUFFER MAPPED BY WZ



However, this method left a number of areas without any residential context, that is, scores of zero. This happened where no residential postcodes were captured by the buffer that was fit to the centroid of each WZ. However, upon manual inspection of these zones, they could reasonably be assigned zero scores. These included: E33029962, E33029913, E33029911, E33029977; which all sat within the Heathrow or other industrial areas. An example is shown in Figure 9 which sits over Heathrow Airport; the buffer is delineated by the red circle and the postcode centroids by blue dots.

FIGURE 9: AN EXAMPLE WZ WITH NO RESIDENTIAL CONTEXT



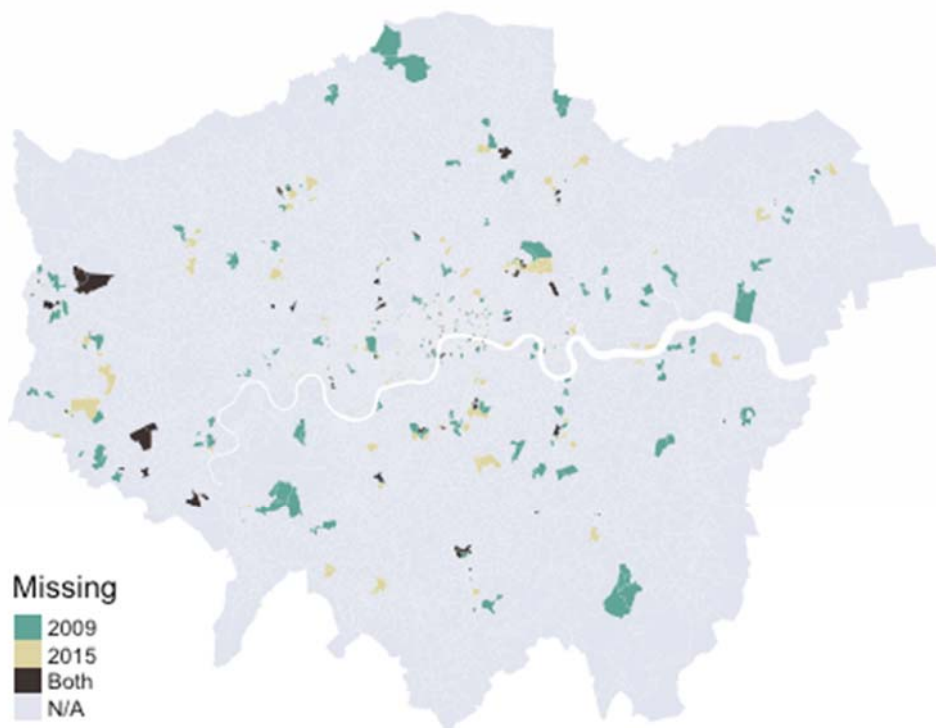
3.1.3 Business Dynamics

The Inter-Departmental Business Register (IDBR) data contain an estimate of the frequencies of employees and workplaces within each workplace zone during 2009-2015, and are used in this instance to create a measure representing change within each WZ.

However, upon checking, the workplace data are complete for each WZ, but the employee data have various values that have been suppressed for reasons of disclosure control. Furthermore, the other workplace values are rounded to the nearest five and employee counts to the nearest 100. It should also be noted that in 2015 the IDBR extended the coverage of businesses to include a population of solely PAYE-based businesses which had previously been excluded.

There are around 200-300 missing employee values in each year, but as we are particularly interested in the 2009 and 2015 data as we will be calculating percentage change rates from these values. Figure 10 maps those locations where values are missing in either or both years.

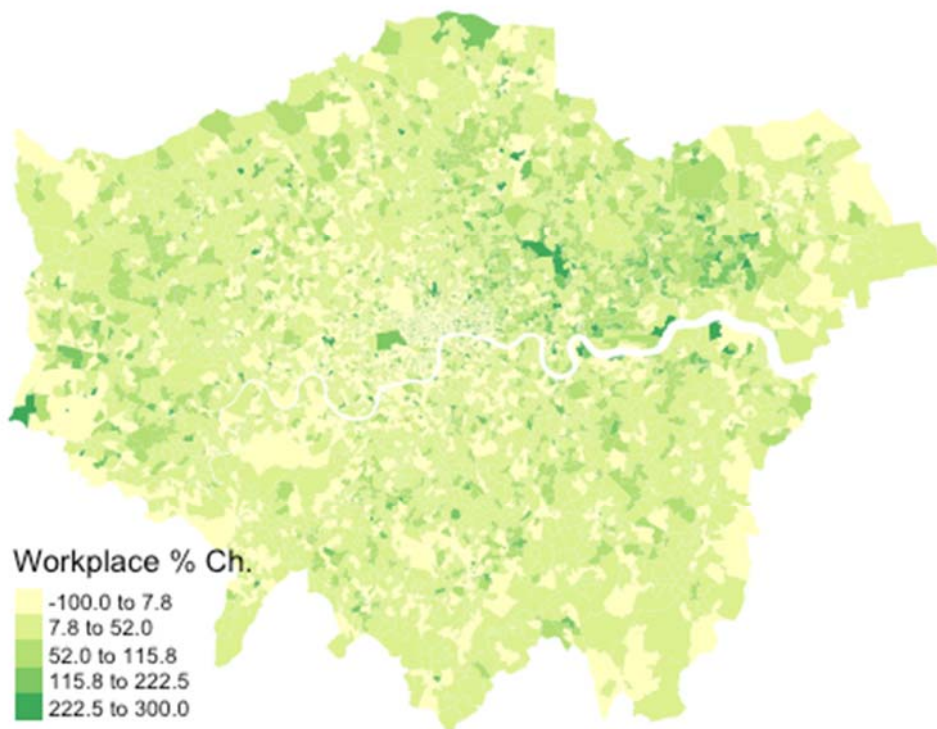
FIGURE 10: MISSING VALUES IN THE EMPLOYEE ATTRIBUTES OF THE IDBR



Given these issues, quite significant imputation of the values would be necessary for inclusion of the data; and as such these were excluded. However, the records for workplaces were complete, and were included in the evaluation.

In the following example, we calculate the proportional change between 2009 and 2015. Given that some 2009 values are zero, we have added 0.00001 to avoid dividing by zero. Although this enables the calculations to be made, it does have the undesirable effect of creating some extreme outliers. In order to reduce the impact of these outliers we replaced some of the highest values by capping these to the 99th quantile. The results are shown in Figure 11.

FIGURE 11: WORKPLACE FREQUENCY CHANGE 2009-2015



3.1.4 Retail and the Night Time Economy

Data concerning retail land use within Greater London are collected by the Local Data Company (LDC) and were obtained through the Consumer Data Research Centre. These detail the locations of retail units at address level, including records of occupancy/vacancy characteristics over time. For this analysis we consider attributes that relate to 2016. Data cleaning entailed:

- Converting lat / lon co-ordinates to Easting and Northings

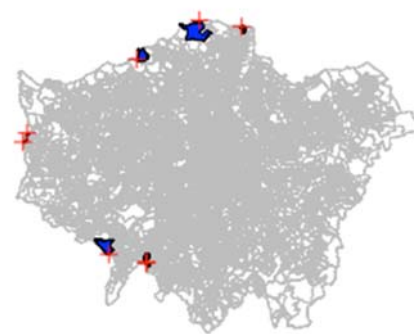
- For retail units without the above, using a date appropriate ONSPD file to append an easting or northing using the postcode
- Point in polygon operation to assign within the WZ boundaries

However, within the LDC data there are nine records without WZ codes: these are known to have a postcode centroids within London, but the LDC co-ordinates lie just outside of the GLA boundary. These are shown in Figure 12A and were assigned their nearest WZ (see Figure 12B).

FIGURE 12: LDC UNITS LOCATED OUTSIDE OF GREATER LONDON



A) RETAIL UNIT LOCATION



B) ASSIGNMENT OF WZ

For each workplace zone the following were then calculated based on the LDC categorization of retailers:

- Density of night-time economy businesses
- Density of retailers
- Density of comparison retailers
- Density of convenience retailers
- Density of leisure retailers
- Density of services retailers

"Night-time economy businesses" were defined as:

- LDC designations "Bars, Pubs & Clubs", "Off Licences", "Restaurants";
- LDC sub category designations of "Cafes & Fast Food" defined as "Fast Food Takeaway", "Take Away Food Shops", "Fish & Chip Shops", "Pizza Takeaway", "Chinese Fast Food Takeaway", "Indian Takeaway", "Fast Food Delivery"; and
- LDC sub category designations of "Entertainment" defined as "Amusement Parks & Arcades", "Theatres & Concert Halls", "Cinemas", "Snooker, Billiards & Pool Halls", "Bowling Alleys".

The category "Petrol Filling Stations" was removed from all calculations.

3.1.5 Transport Accessibility / London Commuting

Subsequent to the introduction of the WZ geography for the 2011 Census, enhanced origin destination flow data have also been produced, linking origin OAs to destination WZs. We used these flows to calculate the balance between those commuting into London versus those from outside. Scores were created by appending a population count for London versus non London commuters to each OA. We then summed the flows for each WZ. Thus, each WZ is characterized by a percentage of workers that commutes from outside of Greater London, shown in Figure 13.

FIGURE 13: A MAP SHOWING THE % OF WORKERS WITHIN EACH WZ WHO COMMUTED FROM OUTSIDE OF GREATER LONDON



In addition to the mode choice data from the Census, and the external commuters, transport accessibility was also used as an input measure. This was assembled from the 2015 Public Transport Accessibility Levels (PTAL: [HTTP://BIT.LY/2RALR8B](http://bit.ly/2RALR8B)) scores that record

the distances from frequently used public transport services. These data have been calculated for each WZ, and were imported without manipulation.

3.1.6 Calculating rates, evaluating inputs, and standardisation

The final stage of data preparation was to calculate rates for the Census attributes within each Workplace Zone, and then to combine these with other data inputs. This created a unified set of inputs for the evaluation. A lookup table was created that specified both the numerator and denominator Census variable combinations necessary to calculate rates.

A series of non percentage score Census attributes were also required. Some were selected directly out of the Census tables such as the Workplace Density ("WP102EW0003") and the Average distance travelled to work ("WP702EW0013") whereas others required further calculation such as the percentage of Non UK workers and a dependency ratio. Finally, an index of industrial diversity (WP605EW: Industry - Workplace population) was created as a Simpson's Index, as shown in Figure 14.

FIGURE 14: DIVERSITY OF INDUSTRY TYPES



Finally, a single unified master input file was created that collated all of the input measures together, including all Census and non-Census sources.

3.2 Variable Evaluation, Final Selection and Standardisation

3.2.1 Overview

The first stage in the evaluation was to examine the initial variable set and look for potentially problematic attributes; in particular, variables that might have:

- Very low variability - these offer limited discriminating power
- High correlation (over .8 (+or-)) - many highly correlated variables can unduly impact cluster formation
- Similar distributions or low counts and might be conflated

The full table is large, and so only the first few rows are presented here in Table 3: the full table appears in Appendix A Table 1.

TABLE 3: CANDIDATE INPUT VARIABLES SUMMARY STATISTICS (SEE APPENDIX A FOR THE FULL TABLE).

Variable	Mean	Median	SD	Min	Max	Census Table	ID
Workplace % change 2009 - 2015	31.0	22.2	53.4	-100.0	300.0		IDBR_C_9_15
Comparison retail density	1.3	0.1	4.3	0.0	94.0		LDC_COMP
Convenience retail density	0.3	0.0	1.0	0.0	23.1		LDC_CONV
Retailer density	4.4	0.9	8.8	0.0	163.0		LDC_FR
Leisure retail density	1.5	0.2	3.5	0.0	39.7		LDC_LEI
Night time retail / leisure density	1.1	0.1	2.8	0.0	37.1		LDC_NTB
Service retail density	0.9	0.1	1.8	0.0	27.3		LDC_SER
Aged 16-24	13.3	12.6	4.6	0.0	35.7	QS103EW	R_16_24
Aged 65+	10.2	9.9	3.7	0.0	37.2	QS103EW	R_64plus
Residential Churn	78.3	80.8	15.9	0.0	94.6	ukmig008	R_Churn

Based on these initial statistics and mapping of the variables, several were highlighted to be problematic, and in the main, exhibited very little variability around the

mean/median. These are presented below along with the full text label and where appropriate the Census table from which they are derived:

- LDC_CONV (Leisure retail density)
- LDC_COMP (Leisure retail density)
- LDC_LEI (Leisure retail density)
- LDC_SER (Service retail density)
- W_Agric (A Agriculture, forestry and fishing; WP605EW)
- W_Elect (D Electricity, gas, steam and air conditioning supply; WP605EW)
- W_extraterritorial (U Activities of extraterritorial organisations and bodies; WP605EW)
- W_HouseholdEmp (T Activities of households as employers; WP605EW)
- W_Water (E Water supply; sewerage, waste management and remediation activities; WP605EW)
- W_Mining (B Mining and quarrying; WP605EW)
- W_F65p (Female 65-74; WP1101EW)
- W_Nafrica (Africa: North Africa; WP203EW)
- W_BadHealth (Bad & Very Bad Health; WP302EW)
- W_GoodHealth (Good & Very Good Health; WP302EW)
- W_Mixed_Other (Mixed/multiple ethnic group: Other Mixed; WP201EW)
- W_Mixed_WA (Mixed/multiple ethnic group: White and Asian; WP201EW)
- W_Mixed_WBA (Mixed/multiple ethnic group: White and Black African; WP201EW)
- W_Mixed_WBC (Mixed/multiple ethnic group: White and Black Caribbean; WP201EW)
- W_OthBlac (Black/African/Caribbean/Black British: Other Black; WP201EW)
- W_Other_EthnicG (Other ethnic group: Any other ethnic group; WP201EW)
- W_White_Gypsy (White: Gypsy or Irish Traveller; WP201EW)
- W_Motorcycle (Motorcycle, scooter or moped; WP703EW)
- W_Taxi (W_Taxi; WP703EW)
- W_SE_Pt (Self-employed with employees: Part-time; WP601EW)

3.2.2 Variable Standardisation

Prior to exploring the correlations, range standardization was implemented so that all variables were measured on a 1-0 scale, and was preferable over other standardisation methods such as z-scores to limit the overall impact of outliers. No normalisation (e.g. log) was implemented, as we deem this an unnecessary manipulation that can have variable impacts locally within the attribute space, and we have built successful classification within other context following this method (Spielman and Singleton, 2015).

3.2.3 Variable Standardisation and Correlation

Highly correlated variables can have potentially deleterious impacts on clustering results, effectively placing additional weight onto a particular dimension. As such, it is preferable that these correlations be minimized; and particularly so when they are measuring similar attributes, and as such add limited extra information into the clustering process. These are visualized in Figure 15. All variable pairs with a correlation coefficient of + or - .8 were investigated, and for each of these variables, the sum of their correlation with all other variables taken. The larger the score, the more correlated the variable is with the other input variables. From the pairs, the variable with the higher score is identified for potential removal. The correlations, scores and variables suggested for removal are shown in Table 4.

FIGURE 15: CORRELATION MATRIX

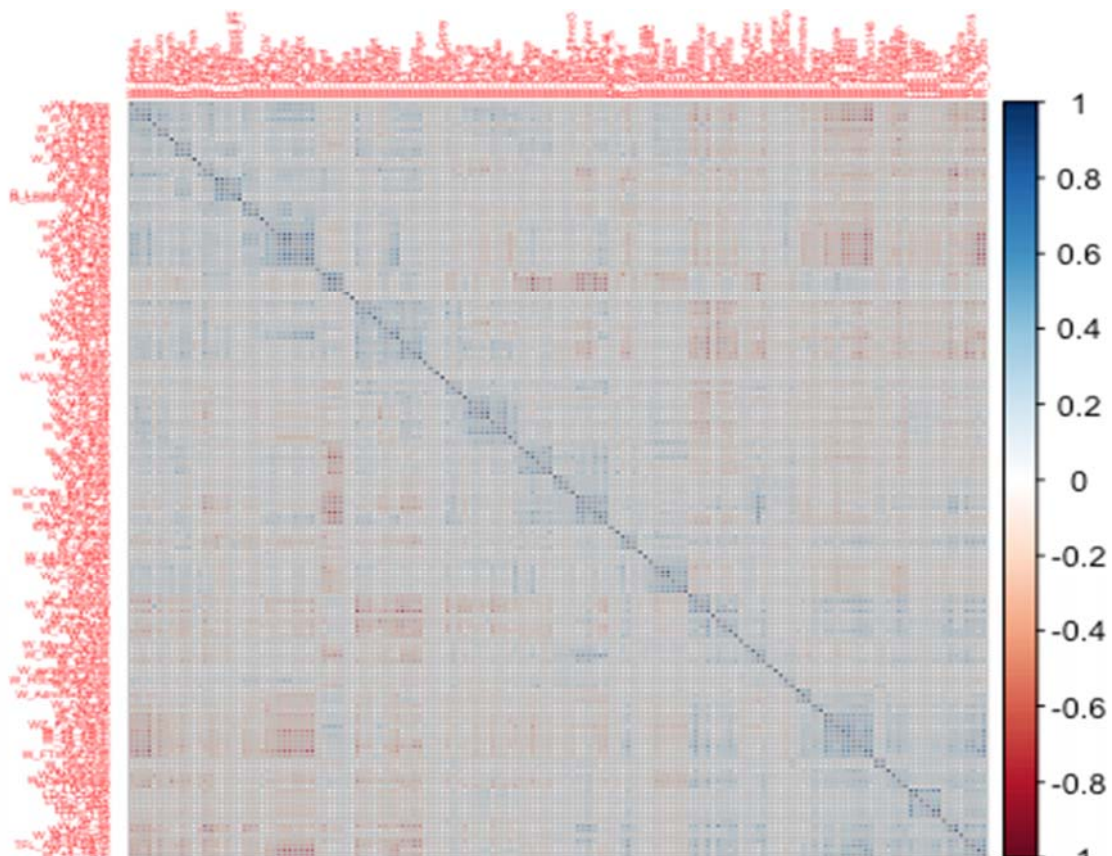


TABLE 4: PAIRS OF VARIABLES THAT ARE STRONGLY (POSITIVELY OR NEGATIVELY) CORRELATED; WITH SUGGESTIONS FOR REMOVAL.

Variable 1	Variable 2	Correlation	Sum Correlation (V1)	Sum Correlation (V2)	Remove Variable
Comparison retail density	Retailer density	0.81	18.57	26.66	Retailer density
Leisure retail density	Night time retail / leisure density	0.96	26.55	24.88	Leisure retail density
Economically Inactive: Retired	Aged 65-74	0.93	29.38	20.77	Economically Inactive: Retired
Old age dependency ratio	Economically Inactive: Retired	0.87	27.68	29.38	Economically Inactive: Retired
Old age dependency ratio	Aged 65-74	0.89	27.68	20.77	Old age dependency ratio
Born in the UK	Europe: United Kingdom: Total	1.00	33.74	33.74	Tied (Same Variable)
Work mainly at or from home	Work mainly at or from home	1.00	34.91	34.91	Tied (Same Variable)
Female 16-24	All 16-24	0.90	20.98	21.50	All 16-24
Male 16-24	All 16-24	0.85	20.23	21.50	All 16-24
All 40-64	All 25-39	-0.84	38.58	41.78	All 25-39
Average distance (km)	60km and over	0.91	32.16	35.60	Average distance (km)
Female 65-74	All 65-74	0.82	25.88	29.02	All 65-74
Male 65-74	All 65-74	0.89	25.24	29.02	All 65-74
Africa: Central and Western Africa	Black/African/Caribbean/Black British: African	0.94	22.04	23.46	Black/African/Caribbean/Black British: African
Resident in UK: 5 years or more but less than 10 years	Born in the UK	-0.86	29.15	33.74	Born in the UK
Resident in UK: 10 years or more	Born in the UK	-0.82	33.63	33.74	Born in the UK
The Americas and the Caribbean: The Caribbean: Total	Black/African/Caribbean/Black British: Caribbean	0.88	23.42	21.95	The Americas and the Caribbean: The Caribbean: Total
Middle East and Asia: Eastern Asia: Total	Asian/Asian British: Chinese	0.80	14.48	13.17	Middle East and Asia: Eastern Asia: Total
4. Small employers and own account workers	Employee: Full-time	-0.82	40.39	44.34	Employee: Full-time
Part-time: 16 to 30 hours worked	Employee: Full-time	-0.84	44.17	44.34	Employee: Full-time
Full-time: 31 to 48 hours worked	Employee: Full-time	0.82	35.42	44.34	Employee: Full-time
Work mainly at or from home	Self-employed without employees: Full-time	0.82	34.91	32.82	Work mainly at or from home
Level 4 qualifications and above	Level 1 qualifications	-0.83	42.28	35.48	Level 4 qualifications and above

Level 4 qualifications and above	No qualifications	-0.82	42.28	40.36	Level 4 qualifications and above
No fixed place	Self-employed without employees: Full-time	0.81	39.36	32.82	No fixed place
Part-time: 16 to 30 hours worked	Employee: Part-time	0.89	44.17	39.08	Part-time: 16 to 30 hours worked
7 Sales and customer service occupations	G Wholesale, retail trade repair of motor vehicles and motor cycles	0.85	22.66	21.47	7 Sales and customer service occupations
Middle East and Asia: Southern Asia: Total	Asian/Asian British: Indian	0.81	25.49	18.22	Middle East and Asia: Southern Asia: Total
Self-employed without employees: Full-time	Self-employed without employees: Part-time	0.83	32.82	36.30	Self-employed without employees: Part-time
Work mainly at or from home	Self-employed without employees: Part-time	0.92	34.91	36.30	Self-employed without employees: Part-time
Work mainly at or from home	Self-employed without employees: Part-time	0.92	34.91	36.30	Self-employed without employees: Part-time
4. Small employers and own account workers	Self-employed without employees: Part-time	0.84	40.39	36.30	4. Small employers and own account workers
4. Small employers and own account workers	Self-employed without employees: Full-time	0.87	40.39	32.82	4. Small employers and own account workers
No fixed place	4. Small employers and own account workers	0.89	39.36	40.39	4. Small employers and own account workers
Worker / Residential population mix	4. Small employers and own account workers	0.85	39.58	40.39	4. Small employers and own account workers
Train	40km to less than 60km	0.84	45.58	42.74	Train
PTAL average	Train	0.82	41.86	45.58	Train
Resident in UK: 5 years or more but less than 10 years	Europe: United Kingdom: Total	-0.86	29.15	33.74	Europe: United Kingdom: Total
Resident in UK: 10 years or more	Europe: United Kingdom: Total	-0.82	33.63	33.74	Europe: United Kingdom: Total
Driving a car or van	Underground, metro, light rail or tram	-0.81	39.30	44.03	Underground, metro, light rail or tram
Resident in UK: 10 years or more	White: English/Welsh/Scottish/Northern Irish/British	-0.84	33.63	34.70	White: English/Welsh/Scottish/Northern Irish/British
Europe: United Kingdom: Total	White: English/Welsh/Scottish/Northern Irish/British	0.95	33.74	34.70	White: English/Welsh/Scottish/Northern Irish/British
Born in the UK	White: English/Welsh/Scottish/Northern Irish/British	0.95	33.74	34.70	White: English/Welsh/Scottish/Northern Irish/British
Work mainly at or from home	Self-employed without employees: Full-time	0.82	34.91	32.82	Work mainly at or from home
Worker / Residential population mix	5km to less than 10km	-0.80	39.58	36.35	Worker / Residential population mix
Worker / Residential population mix	No fixed place	0.93	39.58	39.36	Worker / Residential population mix

Worker / Residential population mix	Work mainly at or from home	0.85	39.58	34.91	Worker / Residential population mix
Worker / Residential population mix	Self-employed without employees: Part-time	0.83	39.58	36.30	Worker / Residential population mix
Worker / Residential population mix	Work mainly at or from home	0.85	39.58	34.91	Worker / Residential population mix

Based on the correlations and those variables identified for removal in

Table 4 above; these were accepted in all cases, apart from:

- Retailer density (LDC_FR) - this was picked out as correlated with Comparison retail density (LDC_COMP), which as shown earlier, has a more problematic distribution. Retail density in absolute terms we also determined to be more useful in the delimitation of aggregate area characteristics.
- Worker / Residential population mix (WZ_OA_MIX) - this represents a more parsimonious choice given this had a range of correlations with No fixed place (W_NoFixPI) and 5km to less than 10km (W_5_10km); which were all removed instead. Work mainly at or from home (W_WkHome) and "4. Small employers and own account workers" (W_Smaller) also correlated, however, these were retained given their significance to a workplace classification.
- 4. Small employers and own account workers (W_Smaller) - this variable was picked out as correlating to No fixed place (W_NoFixPI); Self-employed without employees: Full-time (W_SE_Ft); Worker / Residential population mix (WZ_OA_MIX) and Self-employed without employees: Part-time (W_SE_Pt2). Again, 4. Small employers and own account workers (W_Smaller) represents a parsimonious choice so the other variables were removed, with the exception of Worker / Residential population mix (WZ_OA_MIX) which will be retained as discussed earlier.
- Old age dependency ratio (R_OldRatio) - this residential context variable had high correlation with Aged 65-74 (R_64plus), Economically Inactive: Retired (R_IA_Ret). As such, Old age dependency ratio (R_OldRatio) represents a more parsimonious choice.
- Level 4 qualifications and above (W_L4) was highly correlated with No qualifications (W_NoQual) and Level 1 qualifications (W_L1). However, we feel it is relevant to include numbers of people with low versus high qualifications. As such, we opted creating a banding of the level 0/1, 2/3 banded qualifications, but also retaining Level 4 qualifications and above (W_L4).
- All 25-39 (W_25_39) was highly correlated with All 40-64 (W_40_64) and represent the core working age population. In this instance we decided to conflate these variables.

As such, the final set of variables identified to remove are shown in Table 5.

TABLE 5: VARIABLES TO REMOVE; HIGHLIGHTING IF THEY WERE FLAGGED FOR REMOVAL FOR THEIR DISTRIBUTION OR CORRELATION.

Description	Distribution	Correlation	Domain	Census Table	Variable
5km to less than 10km	0	1	Commuting / Connections	WP702EW	W_5_10km

Average distance (km)	0	1	Commuting / Connections	WP702EW	W_AvDist
No fixed place	0	1	Commuting / Connections	WP702EW	W_NoFixPI
Work mainly at or from home	0	1	Commuting / Connections	WP702EW	W_WkHome
Work mainly at or from home	0	1	Commuting / Connections	WP703EW	W_home
Motorcycle, scooter or moped	1	0	Commuting / Connections	WP703EW	W_Motorcycle
Taxi	1	0	Commuting / Connections	WP703EW	W_Taxi
Train	0	1	Commuting / Connections	WP703EW	W_Train
Underground, metro, light rail or tram	0	1	Commuting / Connections	WP703EW	W_UnderG
All 16-24	0	1	Employee Characteristics	WP1101EW	W_16_24
All 25-39	0	1	Employee Characteristics	WP1101EW	W_25_39
All 40-64	0	1	Employee Characteristics	WP1101EW	W_40_64
All 65-74	0	1	Employee Characteristics	WP1101EW	W_65p
Female 65-74	1	0	Employee Characteristics	WP1101EW	W_F65p
Black/African/Caribbean/Black British: African	0	1	Employee Characteristics	WP201EW	W_Afr
Mixed/multiple ethnic group: Other Mixed	1	0	Employee Characteristics	WP201EW	W_Mixed_Other
Mixed/multiple ethnic group: White and Asian	1	0	Employee Characteristics	WP201EW	W_Mixed_WA
Mixed/multiple ethnic group: White and Black African	1	0	Employee Characteristics	WP201EW	W_Mixed_WBA
Mixed/multiple ethnic group: White and Black Caribbean	1	0	Employee Characteristics	WP201EW	W_Mixed_WBC
Black/African/Caribbean/Black British: Other Black	1	0	Employee Characteristics	WP201EW	W_OthBlac
Other ethnic group: Any other ethnic group	1	0	Employee Characteristics	WP201EW	W_Other_EthnicG
White: English/Welsh/Scottish/Northern Irish/British	0	1	Employee Characteristics	WP201EW	W_White
White: Gypsy or Irish Traveller	1	0	Employee Characteristics	WP201EW	W_White_Gypsy
The Americas and the Caribbean: Total Caribbean	0	1	Employee Characteristics	WP203EW	W_Carr
Middle East and Asia: Eastern Asia: Total	0	1	Employee Characteristics	WP203EW	W_EastAsia
Africa: North Africa	1	0	Employee Characteristics	WP203EW	W_Nafrica

Middle East and Asia: Southern Asia: Total	0	1	Employee Characteristics	WP203EW	W_Sasia
Europe: United Kingdom: Total	0	1	Employee Characteristics	WP203EW	W_UK
Bad & Very Bad Health	1	0	Employee Characteristics	WP302EW	W_BadHealth
Good & Very Good Health	1	0	Employee Characteristics	WP302EW	W_GoodHealth
Born in the UK	0	1	Employee Characteristics	WP803EW	W_BUK
Comparison retail density	1	1	Employment Structure		LDC_COMP
Convenience retail density	1	0	Employment Structure		LDC_CONV
Leisure retail density	1	1	Employment Structure		LDC_LEI
Service retail density	1	0	Employment Structure		LDC_SER
A Agriculture, forestry and fishing	1	0	Employment Structure	WP605EW	W_Agric
D Electricity, gas, steam and air conditioning supply	1	0	Employment Structure	WP605EW	W_Elect
U Activities of extraterritorial organisations and bodies	1	0	Employment Structure	WP605EW	W_extraterritorial
T Activities of households as employers	1	0	Employment Structure	WP605EW	W_HouseholdEmp
B Mining and quarrying	1	0	Employment Structure	WP605EW	W_Mining
E Water supply; sewerage, waste management and	1	0	Employment Structure	WP605EW	W_Water
7 Sales and customer service occupations	0	1	Employment Structure	WP606EW	W_Sales
Level 1 qualifications	0	1	Job Characteristics	WP501EW	W_L1
No qualifications	0	1	Job Characteristics	WP501EW	W_NoQual
Employee: Full-time	0	1	Job Characteristics	WP601EW	W_Ftime
Self-employed with employees: Full-time	0	1	Job Characteristics	WP601EW	W_SE_Ft
Self-employed with employees: Part-time	1	0	Job Characteristics	WP601EW	W_SE_Pt
Self-employed without employees: Part-time	0	1	Job Characteristics	WP601EW	W_SE_Pt2
Part-time: 16 to 30 hours worked	0	1	Job Characteristics	WP604EW	W_PT1630
Economically Inactive: Retired	0	1	Residential Context	KS601EW	R_IA_Ret
Aged 65+	0	1	Residential Context	QS103EW	R_64plus

3.3 Building of Typology using Cluster Analysis

3.3.1 Treatment of Residential Context

The final selected variables were clustered to draw associations between WZs sharing similar characteristics. Although there are various methods by which this could be achieved, we adopted a procedure that mirrored the UK CoWZ, involving fitting k-means, and run from the top down – thus creating the most aggregate groups first. A second tier was then implemented, and the resulting Groups and Sub Groups described.

In the process of testing potential solutions, it was found that the inclusion of the residential context data within the typology had confounding effects upon the classification which, to some extent, were not unexpected given the different geographic distributions from which the data are drawn. The result of inclusion was a smoothing away of interesting patterns within central London, particularly around retail, and distinctive banding around the outermost areas of Greater London. These unwanted effects were absent when the residential context variables were removed.

3.3.2 Estimating Group Cluster Frequency

The first stage in building the geodemographic was to select an appropriate number of Groups. Two popular visualization techniques include a clustergrams (Figure 16) and scree plot (Figure 17). As is the case with many highly dimensional clustering / geodemographic examples, the scree plot is less useful in determining potential solutions. The value of these charts lies in enabling the analyst to discern marked change in within the sum of squares when the number of clusters is incremented, albeit that change tends to be smooth in most geodemographic examples. The clustergram plots a number of different k values on the x axis, with the y axis representing the PCA weighted mean of the cluster. Such diagrams highlight separation between the clusters and also stability (manifest in the splits between different values of k. A scree plot presents the k values on the x axis, and the within sum of squares is plotted on the y. The rate of decline in the weighted sum of squares is assessed with respect to increments in k, with a parsimonious model achieving a trade off between classification complexity and performance. Based on the results and exploration of a range of solutions, five clusters appeared to be an effective initial partitioning of the data. Although six clusters also produced a useful result, two of the clusters were quite similar with some differentiation in terms of ethnic composition of the employees; but not enough to warrant a new group level cluster within the typology.

FIGURE 16: A CLUSTERGRAM SHOWING POTENTIAL CLUSTERING SOLUTIONS

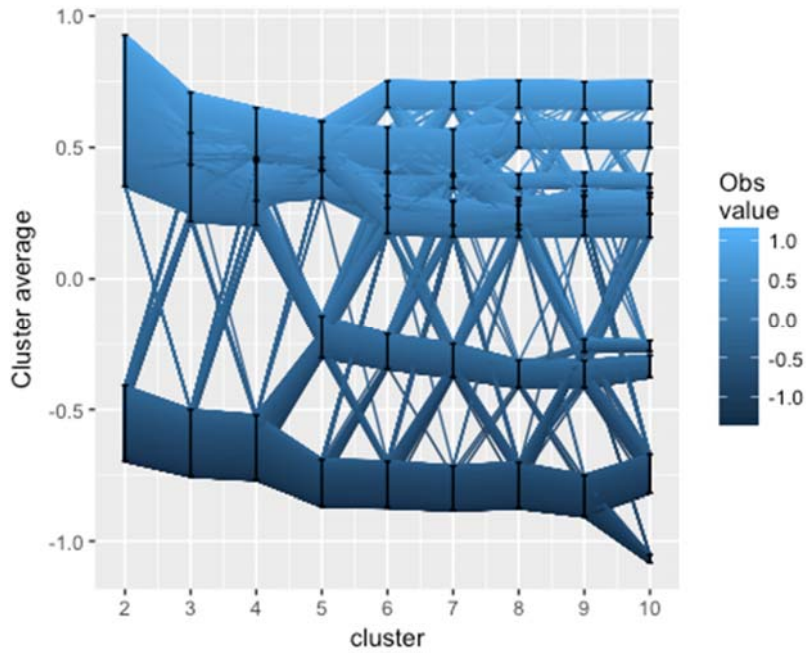
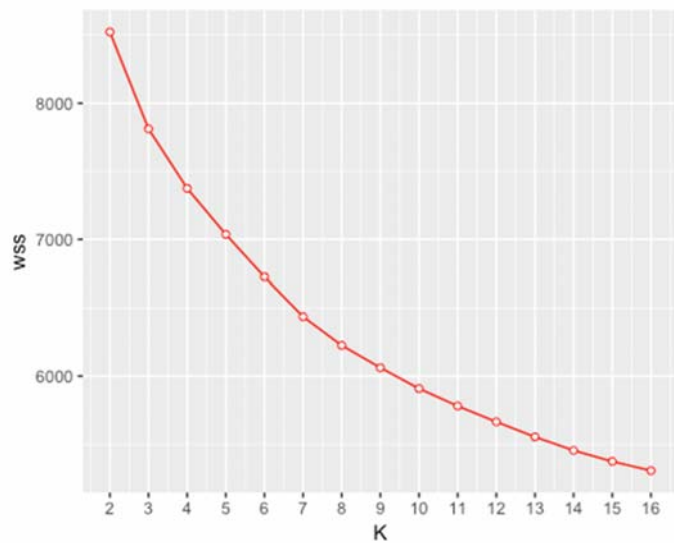


FIGURE 17: A SCREE PLOT SHOWING POTENTIAL CLUSTERING SOLUTIONS



3.3.3 Group Clustering Results

A summary of the cluster distribution is shown in Table 6. Both the workplace population and numbers of workplace zones are reasonably evenly distributed, except for one cluster, B, that contains nearly a third of the population. These are also mapped for the Greater London Extent in Figure 18.

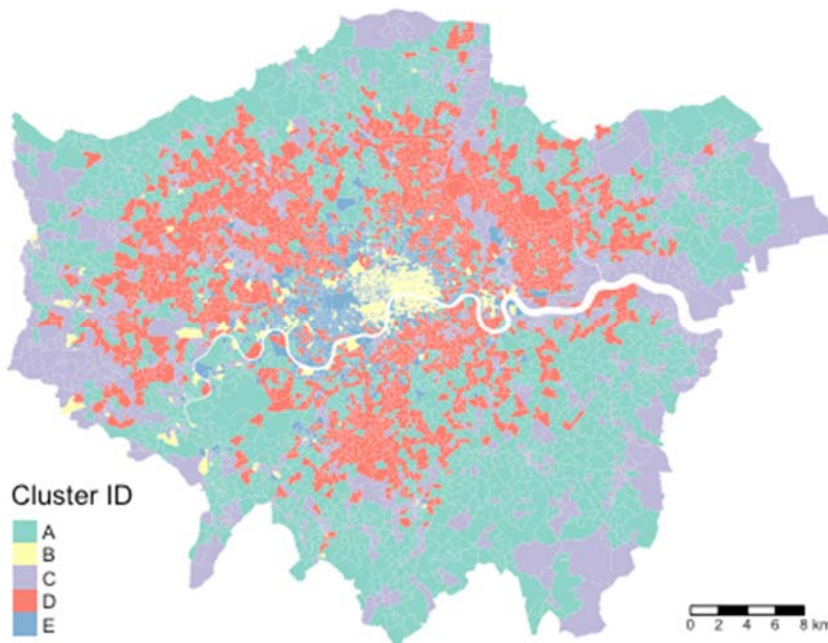
After the cluster analysis had been completed, inspection of the results showed that a few Workplace Zones in London showed implausibly high average commuting distances. On investigation, five of these areas appeared to include high proportions of workers that had been wrongly coded to the workplace. Since the census Workplace Statistics may not reflect the true characteristics of these areas, the results of the classification may also be wrong, and these workplace zones have been suppressed in the published classification, but are included in group results given here.

The WZs affected are: E33029995 and E33029999 in Hillingdon; E33033419 in Ealing; E33035423 in Merton; and E33032391 in Barnet. They have been labelled as Group F, Subgroup FF "Data not Available" in the published classification.

TABLE 6: GROUP LEVEL CLUSTERING RESULTS

Clusters	Total Population	WZ Frequency	Total Population Pct.	WZ Pct.
A	830552	1774	18.5	21.8
B	1464405	1668	32.5	20.5
C	814008	1443	18.1	17.7
D	724861	1766	16.1	21.7
E	666655	1503	14.8	18.4

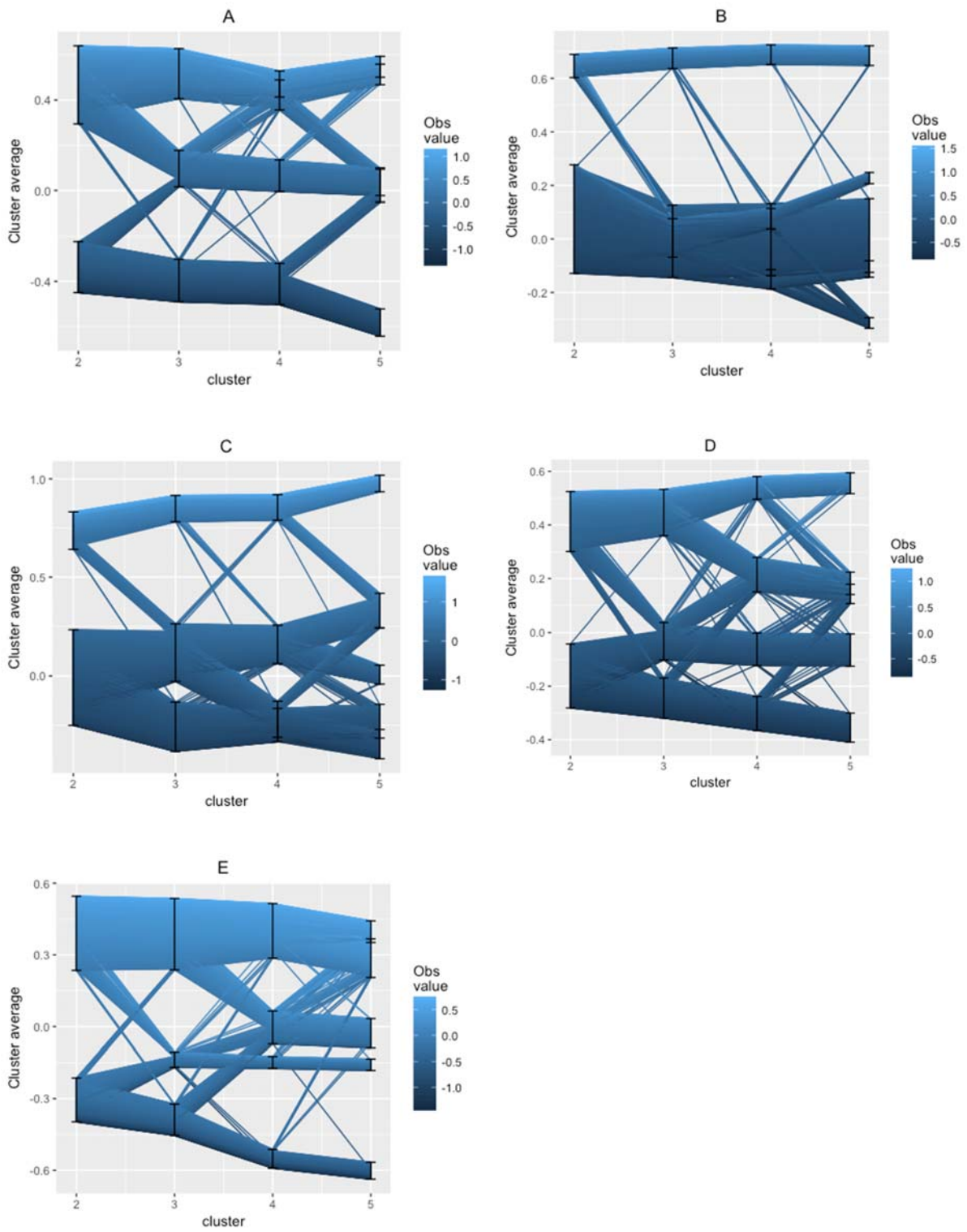
Figure 18: Group Level Clustering Results Mapped



3.3.4 Sub Group Clustering

The second tier of the classification was created by splitting the original input data by the new Group partitions. Within each of these Groups, Clustergrams were fit to explore a range of potential splits to create Sub Groups. These are presented in Figure 19.

Figure 19: Potential Sub Group splits viewed through Clustergrams



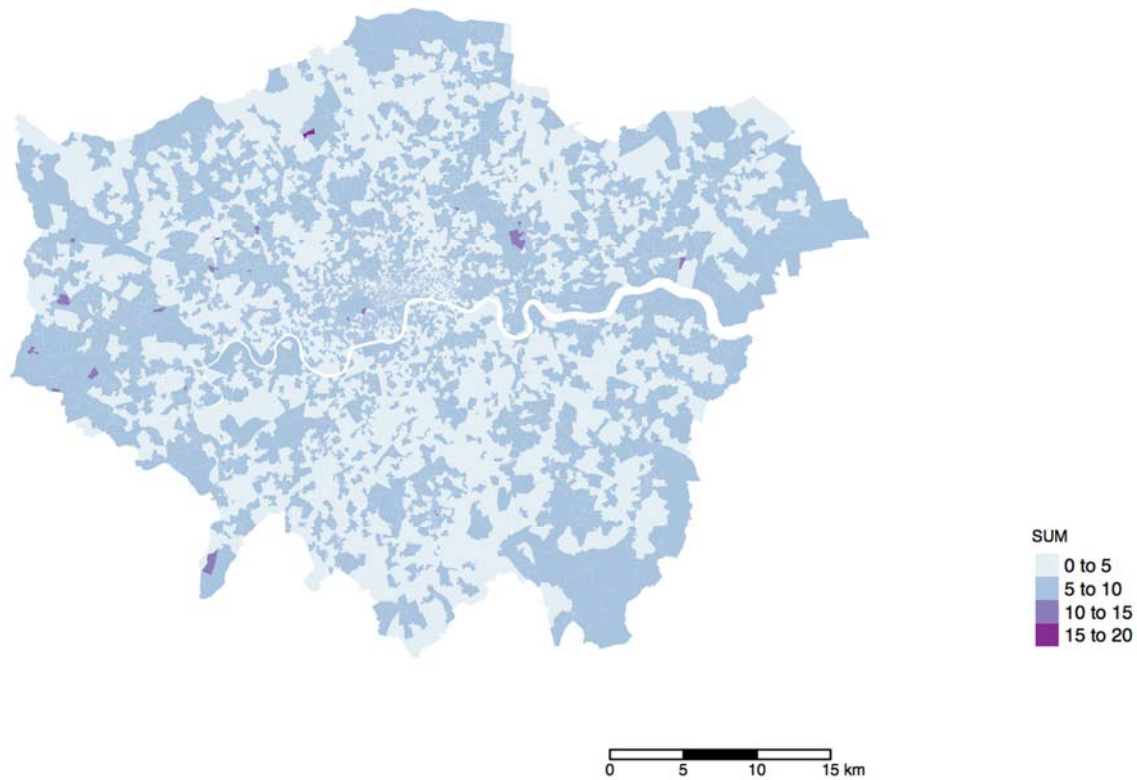
After exploration of a range of results, those Sub Groups that showed the most effective partitioning in terms of within and between Group differentiation are presented in Table 7. All groups were partitioned into two with the exception of D, which split into three Sub Groups.

Table 7: Cluster distribution

Sub Group	Total Population	WZ Frequency	Total Population Pct.	WZ Pct.
A1	554110	1064	12.3	13.0
A2	276442	710	6.1	8.7
B1	406049	294	9.0	3.6
B2	1058356	1374	23.5	16.9
C1	211154	407	4.7	5.0
C2	602854	1036	13.4	12.7
D1	233217	571	5.2	7.0
D2	194466	535	4.3	6.6
D3	297178	660	6.6	8.1
E1	431987	945	9.6	11.6
E2	234668	558	5.2	6.8

After building the Sub Group tier of the classification it was possible to examine the cluster fit of each WZ by comparing the relative difference between the input attributes for the zone and their assigned Sub Group cluster mean. This creates a score for each input variable and can be summed for each area, thus creating an overall measure. A higher score indicates a poorer fit, as the WZ attributes are further from their cluster mean. From Figure 20, it is clear that there is a reasonably even fit, with no particular spatial pattern emerging.

FIGURE 20: CLUSTER FIT



3.4 Describing the clusters

3.4.1 Overview

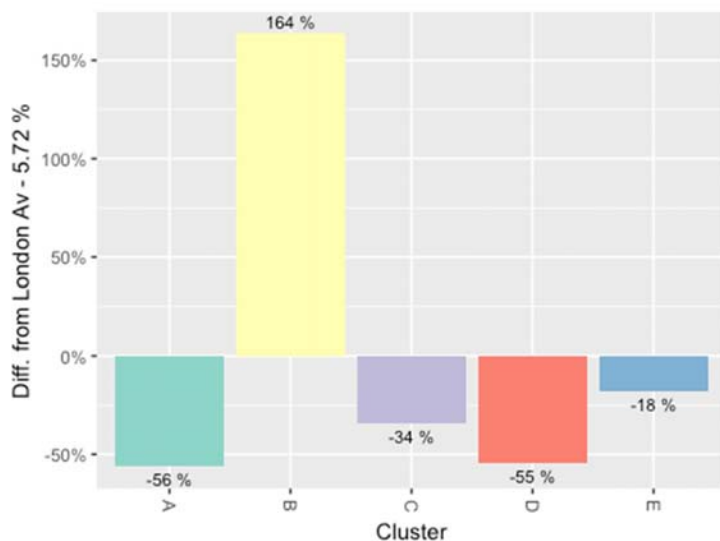
There are various ways in which the clusters can be described: however, we have adopted some standard practices that we have implemented previously; including index scores, propensity graphs, maps / visual exploration.

We first associated a set of data (in this case all the original input data) to the coded WZ, and calculate the propensity for these variables relative to the London average. Commonly these scores are presented as an index score, where 100 equates to the average, 50 a half, and 200 as double. It is common practice to examine scores with an index of over 120; however, also considering those scores that may be as a result of a low count within Greater London. For each cluster, those variables that have a score

over 120 were selected, and are presented in the profiles presented in the following section.

A further descriptive tool that is commonly used is to draw radar charts, with each axis pertaining to a single variable; the derived shapes are often useful in the characterisation of different cluster characteristics. However, for this application this technique was problematic given the volume of input variables; and proved not useful as a visual tool. As such, an alternative graphical method was implemented, so that for each variable a single bar chart was generated; with the bars representing the percentage above or below the Greater London average, which is printed on the y axis of the chart. There are a great number of these charts, so they are presented in Appendix B; although an example is shown in Figure 21.

FIGURE 21: AN EXAMPLE PROPENSITY CHART: FINANCE AND INSURANCE ACTIVITIES



The geographic distribution of each cluster was mapped and a summary web map produced². This was important as it also enabled additional insight to be garnered when exploring these clusters using GIS.

Finally, on the basis of all these information sources, the Groups and Sub Groups were assigned provisional names and summary descriptions. These were presented, amended and ratified by the LWZC steering group. The final hierarchy of labels are presented below; and the fuller profiles and descriptions in the next two sections.

² [HTTPS://URBANANALYTICS.CARTO.COM/BUILDER/BAF3F72E-4133-11E7-A54C-0E3FF518BD15/EMBED](https://urbananalytics.carto.com/builder/BAF3F72E-4133-11E7-A54C-0E3FF518BD15/EMBED)
[Accessed 6th June 2017]

- **Group – A: Residential Services**
 - A1: Predominantly older, local education and health workers
 - A2: Lowly qualified workers in construction and allied local trades
- **Group – B: City Focus**
 - B1: Dynamic financial centres with extended operating hours
 - B2: Professional, retail and leisure Services in dynamic central locations
- **Group – C: Infrastructure Support**
 - C1: Younger customer service workers in wholesale or retail occupations
 - C2: Blue collar, manufacturing and transport services
- **Group – D: Integrating and Independent Service Providers**
 - D1: Health care support staff and routine service occupations
 - D2 Locally sourced, home helps and domestic or manual workers
 - D3: Travelling or home-based general service providers
- **Group – E: Metropolitan Destinations**
 - E1: High street destinations and domestic employers
 - E2: Accessible retail, leisure and tourist services
- **F- Data Not Available**
 - FF: Data not available

3.4.1.1 Dynamics

The dynamics of Work Place Zones were explored through our SmartStreet Sensor project³. We mapped the location of 196 footfall sensor to 285 Work Place Zones (Figure 22 and 23). It should be noted that these are not distributed evenly between clusters (see Table 8), or spatially, with Westminster over represented by WZ with at least one sensor (103 in total).

³ <http://www.localdatacompany.com/smartstreetsensor-project>

FIGURE 22: SPATIAL DISTRIBUTION OF THE SENSORS

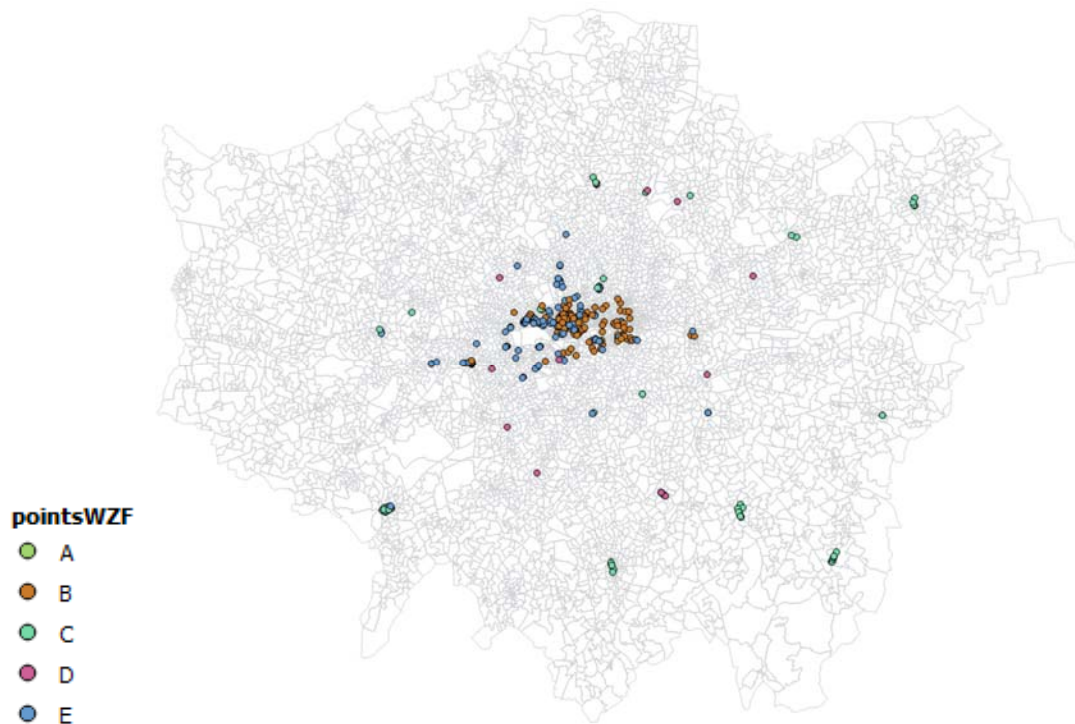


FIGURE 23: LONDON CENTRAL AREA. THE VAST MAJORITY OF SENSOR ARE INSIDE ZONES TYPE B AND E

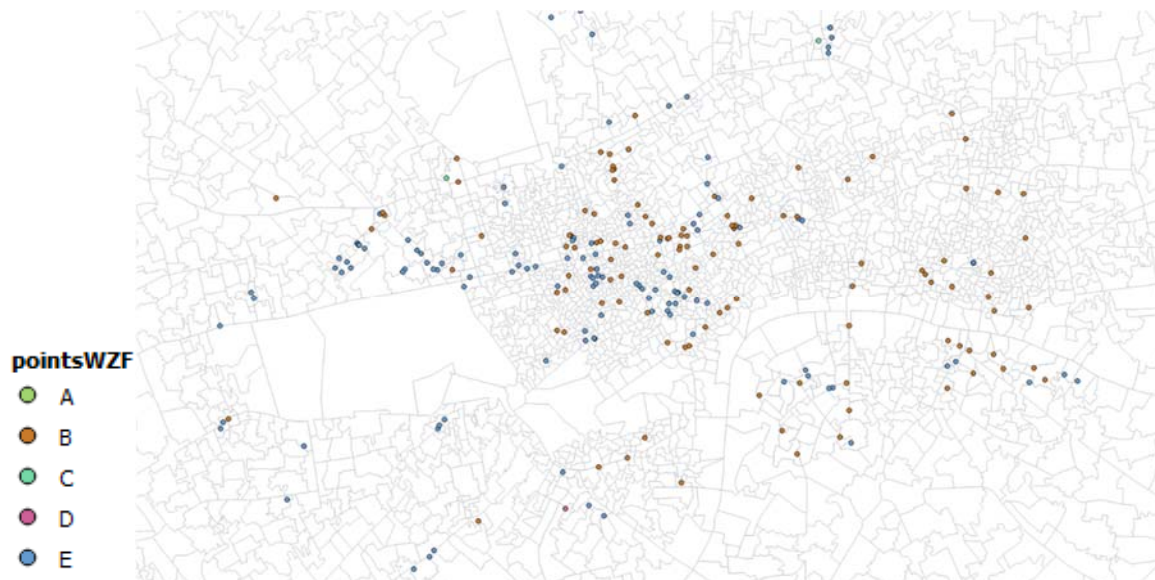


TABLE 8: CLUSTER DISTRIBUTION

WZ Type	Number of sensors
A	2
B	55
C	39
D	10
E	90

To investigate the footfall profile, we averaged all the counts for each sensor by WZ, from March 6th (Monday) to March 31st (Friday) 2017, distinguishing between Weekdays and Weekends. All the averages are weighted. See Figures 24-27.

FIGURE 24: AVERAGE OF FOOTFALL BY TIME OF THE DAY, WEEKDAYS (GROUPS)

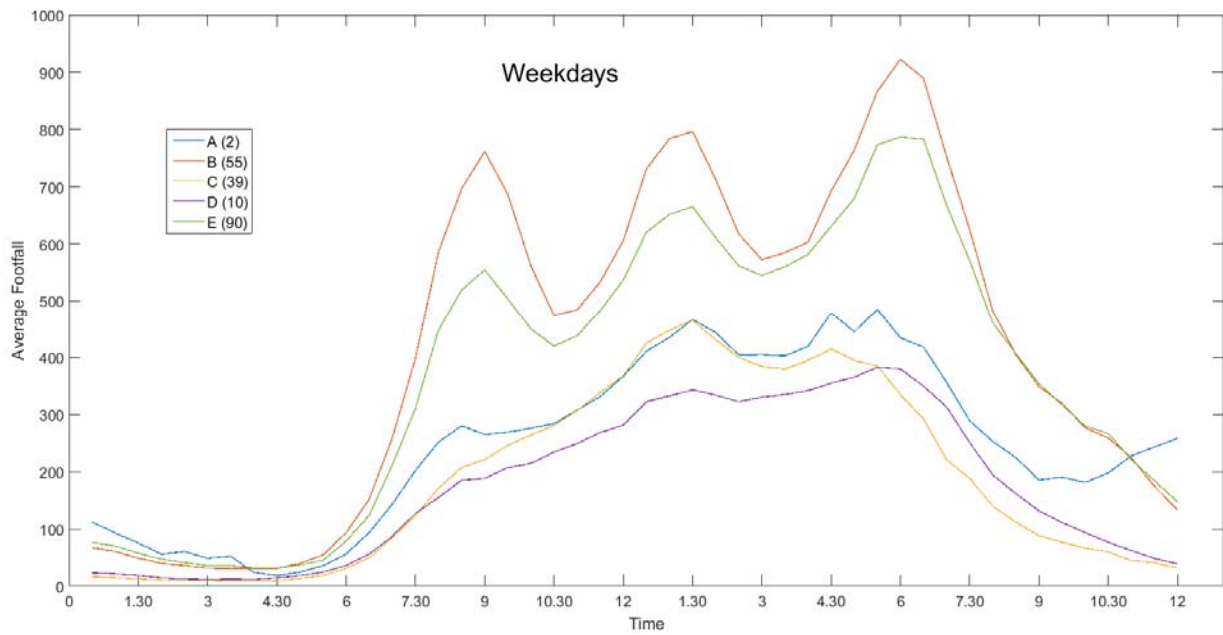


FIGURE 25: AVERAGE OF FOOTFALL BY TIME OF THE DAY, WEEKENDS (GROUPS)

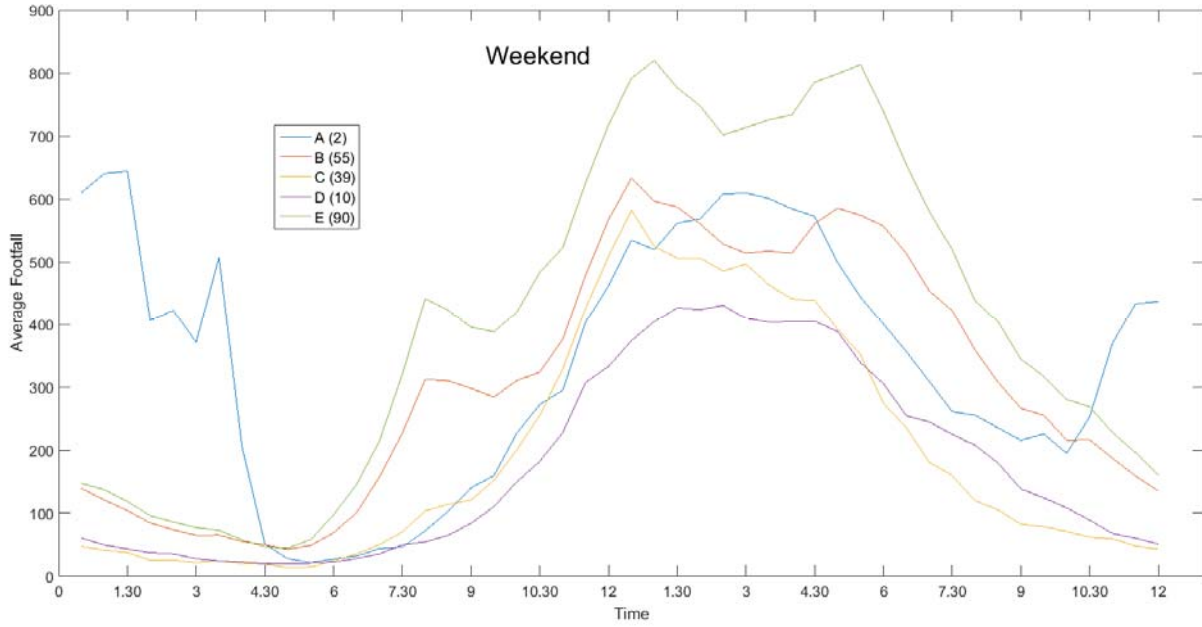


FIGURE 26: AVERAGE OF FOOTFALL BY TIME OF THE DAY, WEEKDAYS (SUB GROUPS)

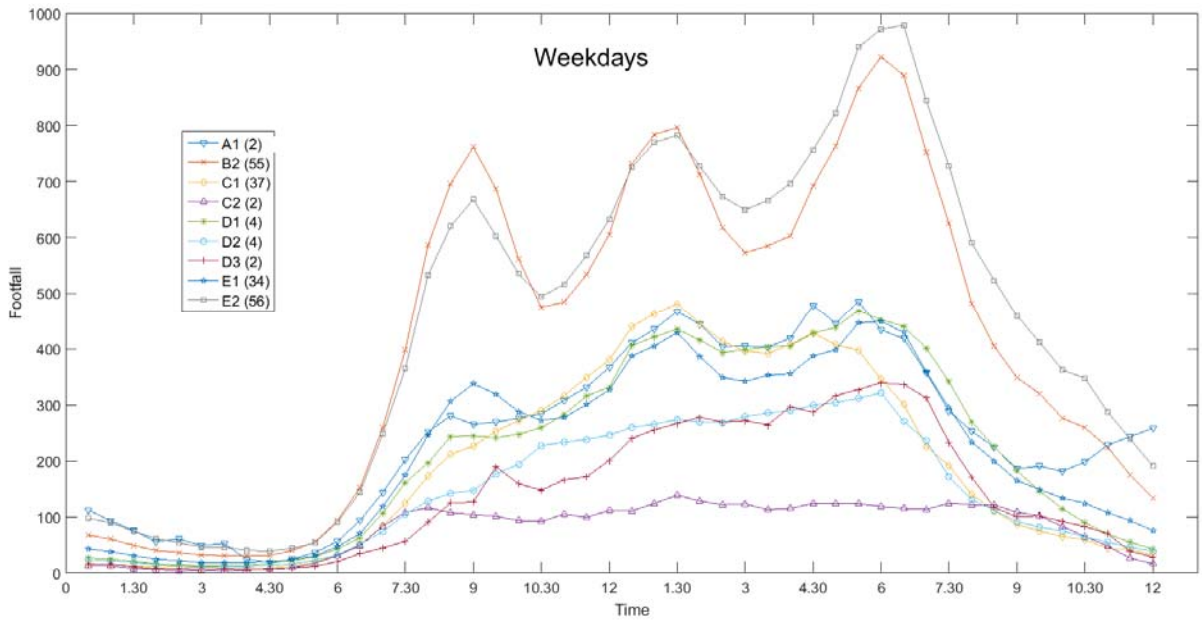
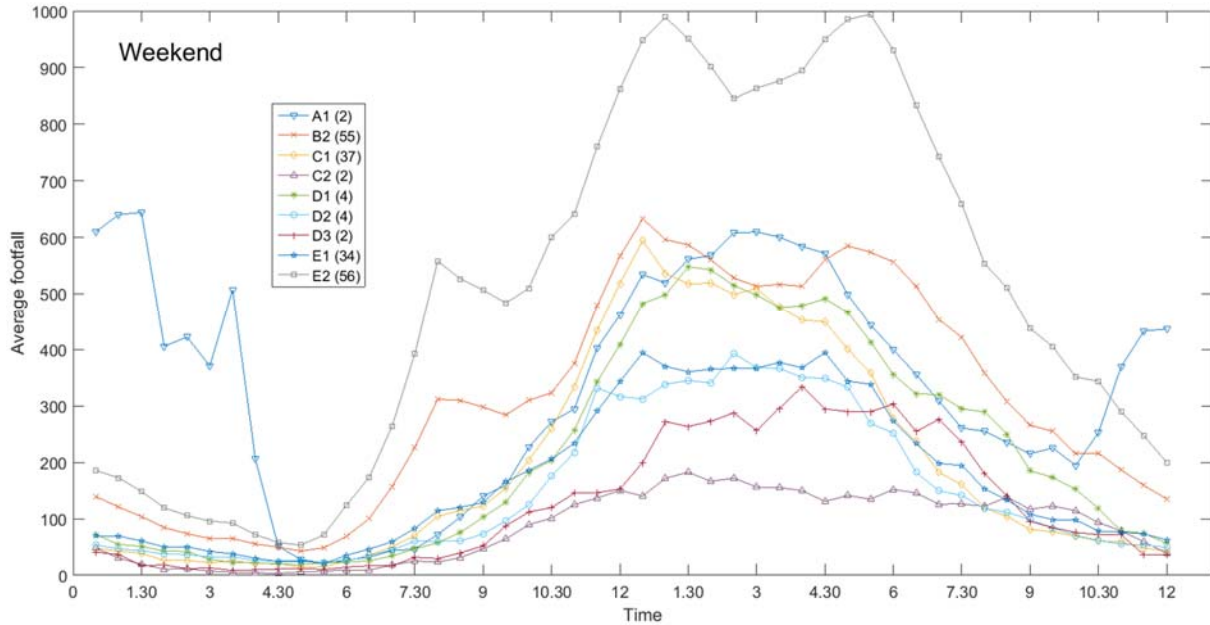


FIGURE 27: AVERAGE OF FOOTFALL BY TIME OF THE DAY, WEEKENDS (SUB GROUPS)



3.4.2 Cluster Profiles

Profiles of each group and sub group are presented in a separate user guide to the LWZC, offering summary maps, descriptive profiles and details of each variable that scores 120 or more on average for that group or sub group. Visual and interactive representations, along with the raw data for download can be found on the London DataStore at: [HTTPS://DATA.LONDON.GOV.UK/CENSUS/LWZC/](https://data.london.gov.uk/census/lwzc/) or the Consumer Research Data Centre at: [HTTPS://MAPS.CDRC.AC.UK/#/GEODEMOGRAPHICS/LCOWZ17/](https://maps.cdrc.ac.uk/#/geodemographics/lcowz17/)

References

Gale, C, A. Singleton and P. Longley (2016). "Creating the 2011 area classification for output areas (2011 OAC)". In: *Journal of Spatial Information Science*, pp. 1-27. URL: <HTTP://DX.DOI.ORG/10.5311/JOSIS.2016.12.232>.

Martin, D, S. Cockings and A. Harfoot (2013) "Development of a geographical framework for Census workplace data". In: *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, pp. 585-602. URL: <HTTP://DX.DOI.ORG/10.1111/J.1467-985X.2012.01054.X>.

Singleton, A. and P. Longley (2015). "The internal structure of Greater London: a comparison of national and regional geodemographic models". In: *Geo: Geography and Environment* 2.1, pp. 69-87. URL: <HTTP://DX.DOI.ORG/10.1002/GEO2.7>.

Spielman, S. and A. Singleton (2015). "Studying Neighborhoods Using Uncertain Data from the American Community Survey: A Contextual Approach". In: *Annals of the Association of American Geographers* 105.5, pp. 1003-1025. URL: <HTTP://DX.DOI.ORG/10.1080/00045608.2015.1052335>.

Appendix A

Appendix Table 1: Candidate input data summary statistics (Full Table)

<i>Variable</i>	<i>Mean</i>	<i>Median</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>Census Table</i>	<i>ID</i>
Born in the UK	60.898	61.647	14.276	10.943	96.500	WP803EW	W_BUK
Resident in UK: 10 years or more	19.921	19.108	7.594	1.000	53.917	WP803EW	W_Res10p
Resident in UK: 2 years or more but less than 5 years	6.237	5.780	3.434	0.000	24.595	WP803EW	W_Res2_5
Resident in UK: 5 years or more but less than 10 years	8.799	8.457	3.966	0.000	31.136	WP803EW	W_Res5_10
Resident in UK: Less than 2 years	4.145	3.571	2.881	0.000	32.673	WP803EW	W_ResL2Y
Bicycle	3.430	2.736	2.763	0.000	22.540	WP703EW	W_Bike
Bus, minibus or coach	12.390	11.292	6.447	0.680	58.954	WP703EW	W_Bus
Driving a car or van	28.158	26.883	19.228	0.000	86.614	WP703EW	W_CarVan
On foot	7.714	7.031	4.223	0.000	53.511	WP703EW	W_Foot
Work mainly at or from home	11.711	8.457	11.808	0.000	61.680	WP703EW	W_home
Motorcycle, scooter or moped	1.086	0.889	0.920	0.000	12.077	WP703EW	W_Motorcycle
Passenger in a car or van	1.784	1.488	1.460	0.000	11.183	WP703EW	W_Passenger
Taxi	0.468	0.280	0.677	0.000	13.443	WP703EW	W_Taxi
Train	14.890	9.537	13.084	0.000	70.703	WP703EW	W_Train
Underground, metro, light rail or tram	17.886	14.823	13.412	0.000	60.000	WP703EW	W_UnderG
10km to less than 20km	15.980	14.500	9.540	0.000	50.175	WP702EW	W_10_20km
2km to less than 5km	16.109	15.078	7.119	0.585	63.179	WP702EW	W_2_5km
20km to less than 30km	4.413	3.627	3.294	0.000	28.012	WP702EW	W_20_30km
30km to less than 40km	2.210	1.554	2.055	0.000	14.179	WP702EW	W_30_40km
40km to less than 60km	2.733	1.550	3.107	0.000	25.586	WP702EW	W_40_60km
5km to less than 10km	19.409	19.201	8.586	0.585	55.298	WP702EW	W_5_10km
60km and over	3.549	2.195	3.977	0.000	81.295	WP702EW	W_60kmP
Average distance (km)	14.718	12.845	8.939	1.776	329.905	WP702EW	W_AvDist
Less than 2km	11.668	11.017	7.339	0.000	64.891	WP702EW	W_ComL2km
No fixed place	12.218	8.265	12.794	0.000	63.132	WP702EW	W_NoFixPl
Work mainly at or from home	11.711	8.457	11.808	0.000	61.680	WP702EW	W_WkHome
1. Higher managerial, administrative and professional occupations	15.781	12.411	10.960	0.407	82.379	WP607EW	W_HighMan
3. Intermediate occupations	12.991	11.813	5.946	0.201	58.932	WP607EW	W_Int
2. Lower managerial, administrative and professional occupations	29.591	28.807	9.458	6.472	67.890	WP607EW	W_LowMan
5. Lower supervisory and technical occupations	5.912	4.950	4.178	0.000	48.162	WP607EW	W_LowSup

7. Routine occupations	7.309	6.113	6.013	0.000	60.000	WP607EW	W_Routine
6. Semi-routine occupations	10.401	9.050	6.873	0.000	60.481	WP607EW	W_SemiR
4. Small employers and own account workers	13.670	11.828	10.142	0.000	67.203	WP607EW	W_Smaller
4 Administrative and secretarial occupations	11.330	9.881	6.131	1.311	71.590	WP606EW	W_Administrative
9 Elementary occupations	9.479	8.178	6.477	0.000	69.918	WP606EW	W_Element
1 Managers, directors and senior officials	12.698	12.081	5.513	0.483	41.860	WP606EW	W_Managers
8 Process, plant and machine operatives	4.958	3.159	6.084	0.000	66.323	WP606EW	W_Plant
2 Professional occupations	20.357	18.358	11.794	0.000	84.141	WP606EW	W_Professional
7 Sales and customer service occupations	6.960	4.152	8.713	0.000	77.169	WP606EW	W_Sales
6 Caring, leisure and other service occupations	8.593	7.615	6.548	0.000	44.551	WP606EW	W_Service
5 Skilled trades occupations	9.244	8.000	6.515	0.000	42.731	WP606EW	W_SkilledT
3 Associate professional and technical occupations	16.381	14.605	8.756	0.913	77.692	WP606EW	W_Technical
Workplace industry type diversity	0.781	0.832	0.141	0.099	0.920	WP605EW	WZ_IND_DIV
I Accommodation and food service activities	6.750	4.425	8.167	0.000	79.537	WP605EW	W_Accom
N Administrative and support service activities	6.061	4.727	5.641	0.000	69.196	WP605EW	W_Admin
A Agriculture, forestry and fishing	0.067	0.000	0.299	0.000	15.700	WP605EW	W_Agric
R,S Arts, entertainment and recreation; other service	6.728	5.019	7.233	0.000	90.543	WP605EW	W_Arts
F Construction	7.487	5.319	7.311	0.000	68.950	WP605EW	W_Constr
P Education	10.490	4.300	14.460	0.000	86.514	WP605EW	W_Edu
D Electricity, gas, steam and air conditioning supply	0.237	0.000	1.527	0.000	79.157	WP605EW	W_Elect
L Real estate activities	2.400	1.176	4.298	0.000	65.816	WP605EW	W_Estate
U Activities of extraterritorial organisations and bodies	0.240	0.000	2.033	0.000	67.723	WP605EW	W_extraterritorial
K Financial and insurance activities	5.722	2.041	12.180	0.000	94.393	WP605EW	W_Finance
Q Human health and social work activities	9.428	6.073	11.700	0.000	90.343	WP605EW	W_Health
T Activities of households as employers	0.397	0.000	0.909	0.000	17.636	WP605EW	W_HouseholdEmp
J Information and communication	6.515	3.882	9.005	0.000	84.799	WP605EW	W_IT
C Manufacturing	3.357	1.852	5.693	0.000	77.966	WP605EW	W_Manu
B Mining and quarrying	0.103	0.000	0.726	0.000	20.883	WP605EW	W_Mining

O Public administration and defence; compulsory social security	4.384	1.382	10.515	0.000	93.656	WP605EW	W_Public
M Professional, scientific and technical activities	11.063	7.024	12.782	0.000	94.909	WP605EW	W_Science
H Transport and storage	5.066	2.470	8.925	0.000	87.521	WP605EW	W_Transport
E Water supply; sewerage, waste management and remediation activities	0.402	0.000	1.795	0.000	44.699	WP605EW	W_Water
G Wholesale and retail trade; repair of motor vehicles and motor cycles	13.104	8.835	13.537	0.000	90.027	WP605EW	W_Wholesale
Full-time: 31 to 48 hours worked	56.972	55.649	10.521	18.644	91.147	WP604EW	W_FTWork3148
Full-time: 49 or more hours worked	15.759	14.653	6.937	0.668	74.953	WP604EW	W_FTWork49
Part-time: 15 hours or less worked	9.251	9.115	5.250	0.000	44.697	WP604EW	W_PT15less
Part-time: 16 to 30 hours worked	18.019	18.849	8.021	0.481	58.354	WP604EW	W_PT1630
Employee: Full-time	57.292	55.063	18.046	3.421	94.363	WP601EW	W_Ftime
Full-time student	4.344	3.437	3.514	0.000	41.162	WP601EW	W_FTStud
Employee: Part-time	17.336	16.743	8.161	1.006	65.133	WP601EW	W_Ptime
Self-employed with employees: Full-time	3.754	3.445	2.523	0.000	26.538	WP601EW	W_SE_Ft
Self-employed without employees: Full-time	10.668	8.951	7.764	0.000	89.336	WP601EW	W_SE_Ft2
Self-employed with employees: Part-time	0.836	0.665	0.763	0.000	5.802	WP601EW	W_SE_Pt
Self-employed without employees: Part-time	5.770	4.582	5.029	0.000	30.462	WP601EW	W_SE_Pt2
Apprenticeship	1.927	1.460	1.679	0.000	14.340	WP501EW	W_Apprent
Level 1 qualifications	10.611	9.859	4.753	0.429	33.898	WP501EW	W_L1
Level 2 qualifications	11.874	11.296	4.237	0.813	32.151	WP501EW	W_L2
Level 3 qualifications	11.553	11.250	3.310	0.391	35.354	WP501EW	W_L3
Level 4 qualifications and above	45.820	45.068	15.835	5.597	89.938	WP501EW	W_L4
No qualifications	8.397	7.768	5.159	0.000	33.621	WP501EW	W_NoQual
Other qualifications	9.819	8.728	5.275	0.000	39.286	WP501EW	W_OtherQual
Owned: Total	56.167	55.858	12.608	8.058	94.511	WP403EW	W_Owned
Private rented: Total	27.642	27.412	9.743	3.101	66.445	WP403EW	W_Private_Rent
Living rent free	1.028	0.803	1.305	0.000	80.992	WP403EW	W_Rent_Free
Social rented: Total	13.848	11.871	8.511	0.826	58.052	WP403EW	W_SocRent
Bad & Very Bad Health	1.499	1.406	0.828	0.000	6.081	WP302EW	W_BadHealth
Good & Very Good Health	90.566	90.476	3.125	78.199	98.851	WP302EW	W_GoodHealth
The Americas and the Caribbean: The Caribbean: Total	1.464	1.011	1.455	0.000	13.636	WP203EW	W_Carr
Central and South America	1.402	1.075	1.356	0.000	30.841	WP203EW	W_CSAmer

Africa: Central and Western Africa	3.097	2.099	3.132	0.000	35.144	WP203EW	W_CWAfrica
Middle East and Asia: Eastern Asia: Total	1.182	0.846	1.683	0.000	49.770	WP203EW	W_EastAsia
Middle East and Asia: Middle East: Total	1.287	0.838	1.550	0.000	21.938	WP203EW	W_MidE
Africa: North Africa	0.610	0.419	0.754	0.000	20.330	WP203EW	W_Nafrica
Europe: Other Europe: EU countries: Accession countries April 2001 to March 2011: Total	6.271	4.755	5.182	0.000	41.388	WP203EW	W_NewEU
Country of birth non UK	551.33	400.50	613.33	102.43	11402.309	WP203EW	W_NoUK
Europe: Other Europe: EU countries: Member countries in March 2001: Total	4.572	3.723	3.442	0.000	48.759	WP203EW	W_OldEU
Middle East and Asia: Southern Asia: Total	7.212	4.808	7.481	0.000	68.285	WP203EW	W_Sasia
Africa: South and Eastern Africa	4.229	3.770	2.359	0.000	25.938	WP203EW	W_SEAfrica
Middle East and Asia: South-East Asia: Total	1.552	1.153	1.562	0.000	23.019	WP203EW	W_SEAsia
Europe: United Kingdom: Total	60.898	61.647	14.276	10.943	96.500	WP203EW	W_UK
Black/African/Caribbean/Black British: African	4.954	3.687	4.186	0.000	41.534	WP201EW	W_Afr
Other ethnic group: Arab	0.797	0.496	1.160	0.000	20.913	WP201EW	W_Arab
Asian/Asian British: Bangladeshi	1.589	0.725	3.242	0.000	46.076	WP201EW	W_Bang
Black/African/Caribbean/Black British: Caribbean	3.482	2.569	2.932	0.000	24.888	WP201EW	W_Car
Asian/Asian British: Chinese	1.389	1.087	1.955	0.000	71.889	WP201EW	W_Chin
Asian/Asian British: Indian	6.230	4.197	6.620	0.000	72.614	WP201EW	W_Indian
Mixed/multiple ethnic group: Other Mixed	1.015	0.912	0.724	0.000	11.009	WP201EW	W_Mixed_Other
Mixed/multiple ethnic group: White and Asian	0.824	0.753	0.553	0.000	4.825	WP201EW	W_Mixed_WA
Mixed/multiple ethnic group: White and Black African	0.473	0.370	0.470	0.000	11.333	WP201EW	W_Mixed_WBA
Mixed/multiple ethnic group: White and Black Caribbean	0.845	0.719	0.661	0.000	8.304	WP201EW	W_Mixed_WBC
Asian/Asian British: Other Asian	4.132	3.333	3.009	0.000	34.951	WP201EW	W_Oth_As
Black/African/Caribbean/Black British: Other Black	1.209	0.909	1.124	0.000	13.514	WP201EW	W_OthBlac
Other ethnic group: Any other ethnic group	1.820	1.502	1.376	0.000	13.523	WP201EW	W_Other_EthnicG
Asian/Asian British: Pakistani	1.896	1.142	2.513	0.000	35.589	WP201EW	W_Pak
White: English/Welsh/Scottish/Northern Irish/British	51.992	52.688	16.569	1.660	93.913	WP201EW	W_White
White: Gypsy or Irish Traveller	0.053	0.000	0.136	0.000	1.881	WP201EW	W_White_Gypsy
White: Irish	2.216	2.016	1.316	0.000	20.270	WP201EW	W_White_Irish
White: Other White	15.085	14.198	7.665	0.529	55.946	WP201EW	W_White_Other

All 16-24	10.892	9.604	5.763	1.078	64.717	WP1101EW	W_16_24
All 25-39	42.097	41.574	9.847	13.232	76.869	WP1101EW	W_25_39
All 40-64	44.283	44.832	10.402	7.534	75.125	WP1101EW	W_40_64
All 65-74	2.728	2.350	1.868	0.000	14.184	WP1101EW	W_65p
Female 16-24	5.572	4.739	3.612	0.000	42.962	WP1101EW	W_F16_24
Female 25-39	19.215	18.969	6.087	0.885	57.426	WP1101EW	W_F25_39
Female 40-64	19.896	18.886	8.293	2.740	53.571	WP1101EW	W_F40_64
Female 65-74	1.110	0.878	0.962	0.000	7.869	WP1101EW	W_F65p
Male 16-24	5.320	4.746	2.947	0.000	29.947	WP1101EW	W_M16_24
Male 25-39	22.882	22.548	7.140	5.190	54.020	WP1101EW	W_M25_39
Male 40-64	24.387	23.507	7.723	2.755	67.355	WP1101EW	W_M40_64
Male 65-74	1.619	1.351	1.211	0.000	10.897	WP1101EW	W_M65p
Density (number of persons per hectare)	306.629	47.859	828.270	0.348	34486.667	WP101EW	W_Density
Proportion of commuting from outside of London	0.176	0.155	0.105	0.000	0.890	WF02EW	WZ_F_Outside
Aged 16-24	13.283	12.562	4.618	0.000	35.681	QS103EW	R_16_24
Aged 65+	10.163	9.885	3.677	0.000	37.225	QS103EW	R_64plus
Old age dependency ratio	0.828	0.749	0.451	0.000	4.129	QS103EW	R_OldRatio
Economically Inactive: Looking after family / home	4.669	4.629	1.625	0.000	9.791	KS601EW	R_IA_Fam
Economically Inactive: Retired	7.292	6.734	2.850	0.000	21.712	KS601EW	R_IA_Ret
Economically Inactive: Students	3.899	3.808	1.602	0.000	14.929	KS601EW	R_IA_Stu
No Qualification	14.920	14.536	6.025	0.000	35.890	KS501EW	R_NoQual
Socially Rented	24.449	23.881	12.856	0.000	59.539	KS402EW	R_SocRent
Lone parent in full-time employment	24.515	25.137	6.505	0.000	55.686	KS107EW	R_LoneParent_FT
Lone parent in part-time employment	25.709	26.334	5.902	0.000	57.738	KS107EW	R_LoneParent_PT
Dependent children in household: All ages	25.574	26.349	10.470	0.000	59.213	KS106EW	R_DepChild
Workplace % change 2009 - 2015	30.987	22.222	53.363	-100.0	299.999		IDBR_C_9_15
Comparison retail density	1.340	0.059	4.259	0.000	94.029		LDC_COMP
Convenience retail density	0.349	0.005	0.958	0.000	23.134		LDC_CONV
Retailer density	4.353	0.861	8.835	0.000	163.048		LDC_FR
Leisure retail density	1.475	0.154	3.491	0.000	39.747		LDC_LEI
Night time retail / leisure density	1.070	0.080	2.809	0.000	37.097		LDC_NTB
Service retail density	0.851	0.119	1.781	0.000	27.258		LDC_SER
PTAL average	29.807	17.409	30.206	0.000	188.323		TFL_AvPTAI2015
Worker / Residential population mix	2.436	1.814	2.402	0.000	11.365		WZ_OA_MIX

Appendix Table 2: Variables included in the cluster analysis

Description	Domain	Census_Table	Name
PTAL average	Commuting / Connections		TFL_AvPTAI2015
Proportion of commuting from outside of London	Commuting / Connections	WF02EW	WZ_F_Outside
Less than 2km	Commuting / Connections	WP702EW	W_ComL2km
2km to less than 5km	Commuting / Connections	WP702EW	W_2_5km
10km to less than 20km	Commuting / Connections	WP702EW	W_10_20km
20km to less than 30km	Commuting / Connections	WP702EW	W_20_30km
30km to less than 40km	Commuting / Connections	WP702EW	W_30_40km
40km to less than 60km	Commuting / Connections	WP702EW	W_40_60km
60km or over	Commuting / Connections	WP702EW	W_60kmP
Bus, minibus or coach	Commuting / Connections	WP703EW	W_Bus
Driving a car or van	Commuting / Connections	WP703EW	W_CarVan
Passenger in a car or van	Commuting / Connections	WP703EW	W_Passenger
Bicycle	Commuting / Connections	WP703EW	W_Bike
On foot	Commuting / Connections	WP703EW	W_Foot
Workplace % change 2009 - 2015	Dynamism / Attractiveness		IDBR_C_9_15
Night time retail / leisure density	Dynamism / Attractiveness		LDC_NTB
Female 16-24	Employee Characteristics	WP1101EW	W_F16_24

Male 16-24	Employee Characteristics	WP1101EW	W_M16_24
Female 25-39	Employee Characteristics	WP1101EW	W_F25_39
Male 25-39	Employee Characteristics	WP1101EW	W_M25_39
Female 40-64	Employee Characteristics	WP1101EW	W_F40_64
Male 40-64	Employee Characteristics	WP1101EW	W_M40_64
Male 65-74	Employee Characteristics	WP1101EW	W_M65p
White: Irish	Employee Characteristics	WP201EW	W_White_Irish
White: Other White	Employee Characteristics	WP201EW	W_White_Other
Asian/Asian British: Indian	Employee Characteristics	WP201EW	W_Indian
Asian/Asian British: Pakistani	Employee Characteristics	WP201EW	W_Pak
Asian/Asian British: Bangladeshi	Employee Characteristics	WP201EW	W_Bang
Asian/Asian British: Chinese	Employee Characteristics	WP201EW	W_Chin
Asian/Asian British: Other Asian	Employee Characteristics	WP201EW	W_Oth_As
Black/African/Caribbean/Black British: Caribbean	Employee Characteristics	WP201EW	W_Car
Other ethnic group: Arab	Employee Characteristics	WP201EW	W_Arab
Country of birth non UK	Employee Characteristics	WP203EW	W_NoUK
Europe: Other Europe: EU countries: Member countries in March 2001: Total	Employee Characteristics	WP203EW	W_OldEU

Europe: Other Europe: EU countries: Accession countries April 2001 to March 2011: Total	Employee Characteristics	WP203EW	W_NewEU
Africa: Central and Western Africa	Employee Characteristics	WP203EW	W_CWAfrica
Africa: South and Eastern Africa	Employee Characteristics	WP203EW	W_SEAfrica
Middle East and Asia: Middle East: Total	Employee Characteristics	WP203EW	W_MidE
Middle East and Asia: South-East Asia: Total	Employee Characteristics	WP203EW	W_SEAsia
Central and South America	Employee Characteristics	WP203EW	W_CSAmer
Living rent free	Employee Characteristics	WP403EW	W_Rent_Free
Private rented: Total	Employee Characteristics	WP403EW	W_Private_Rent
Social rented: Total	Employee Characteristics	WP403EW	W_SocRent
Owned: Total	Employee Characteristics	WP403EW	W_Owned
Resident in UK: Less than 2 years	Employee Characteristics	WP803EW	W_ResL2Y
Resident in UK: 2 years or more but less than 5 years	Employee Characteristics	WP803EW	W_Res2_5
Resident in UK: 5 years or more but less than 10 years	Employee Characteristics	WP803EW	W_Res5_10
Resident in UK: 10 years or more	Employee Characteristics	WP803EW	W_Res10p
Retailer density	Employment Structure		LDC_FR
Density (number of persons per hectare)	Employment Structure	WP101EW	W_Density
C Manufacturing	Employment Structure	WP605EW	W_Manu
F Construction	Employment Structure	WP605EW	W_Constr

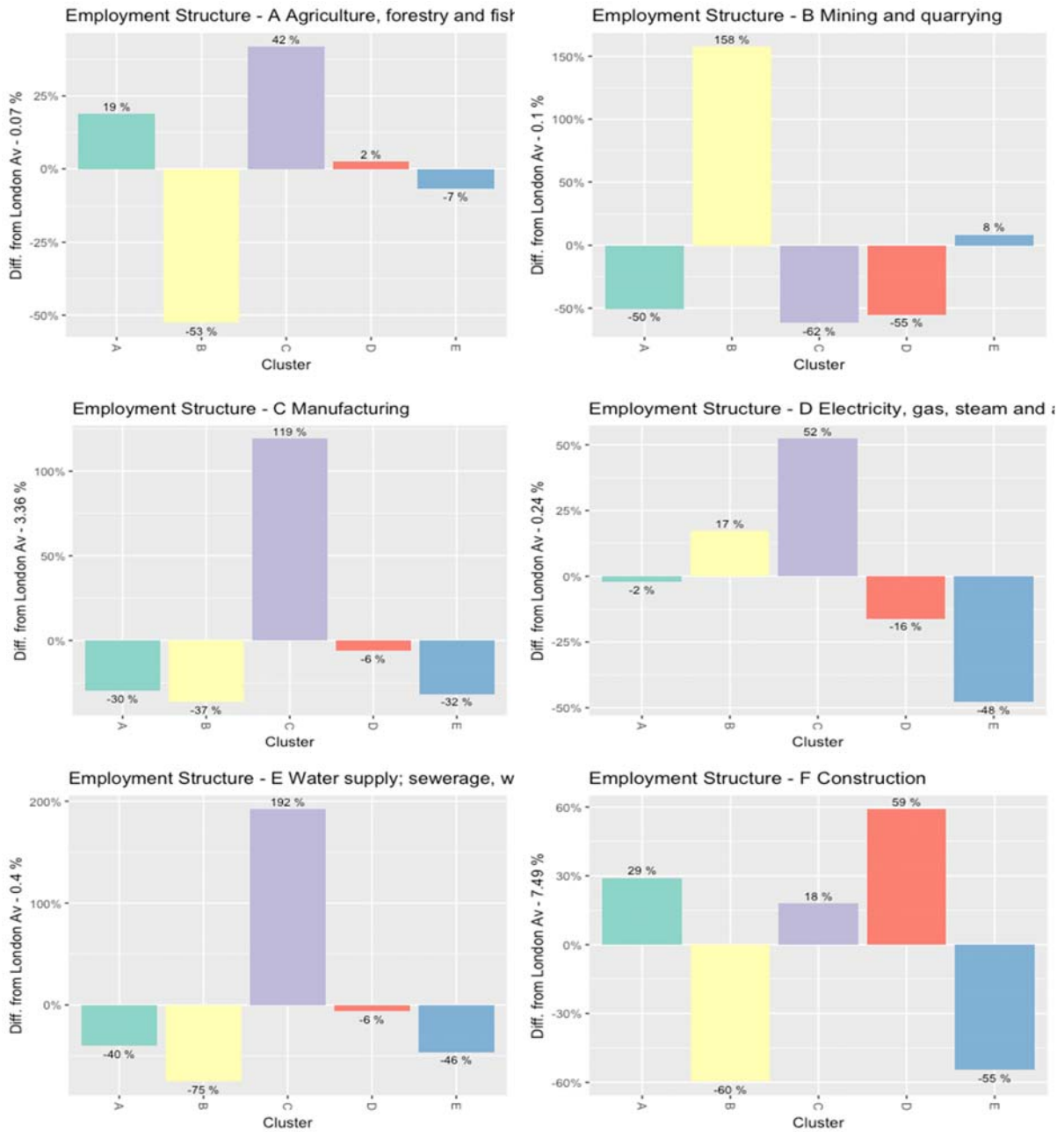
G Wholesale and retail trade; repair of motor vehicles and motor cycles	Employment Structure	WP605EW	W_Wholesale
H Transport and storage	Employment Structure	WP605EW	W_Transport
I Accommodation and food service activities	Employment Structure	WP605EW	W_Accom
J Information and communication	Employment Structure	WP605EW	W_IT
K Financial and insurance activities	Employment Structure	WP605EW	W_Finance
L Real estate activities	Employment Structure	WP605EW	W_Estate
M Professional, scientific and technical activities	Employment Structure	WP605EW	W_Science
N Administrative and support service activities	Employment Structure	WP605EW	W_Admin
O Public administration and defence; compulsory social security	Employment Structure	WP605EW	W_Public
P Education	Employment Structure	WP605EW	W_Edu
Q Human health and social work activities	Employment Structure	WP605EW	W_Health
R,S Arts, entertainment and recreation; other service	Employment Structure	WP605EW	W_Arts
1 Managers, directors and senior officials	Employment Structure	WP606EW	W_Managers
2 Professional occupations	Employment Structure	WP606EW	W_Professional
3 Associate professional and technical occupations	Employment Structure	WP606EW	W_Technical
4 Administrative and secretarial occupations	Employment Structure	WP606EW	W_Administrative
5 Skilled trades occupations	Employment Structure	WP606EW	W_SkilledT

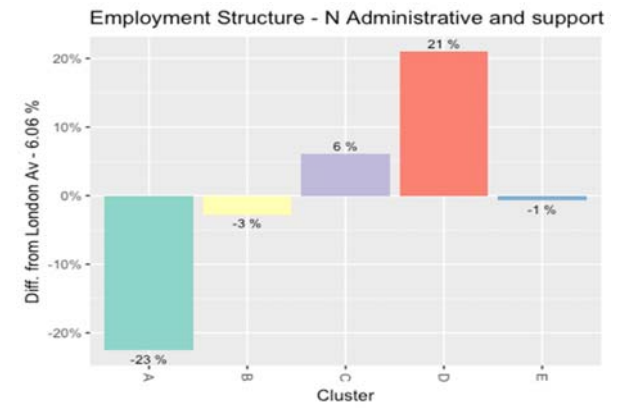
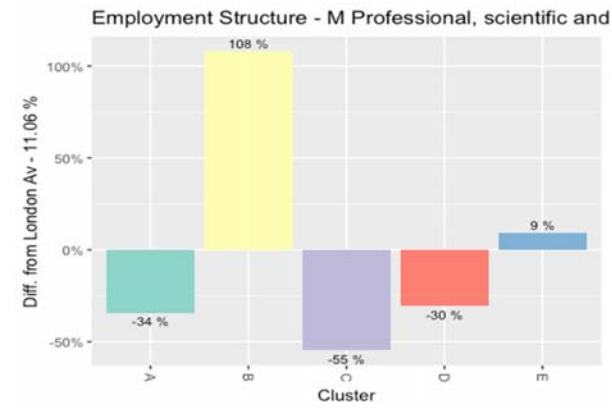
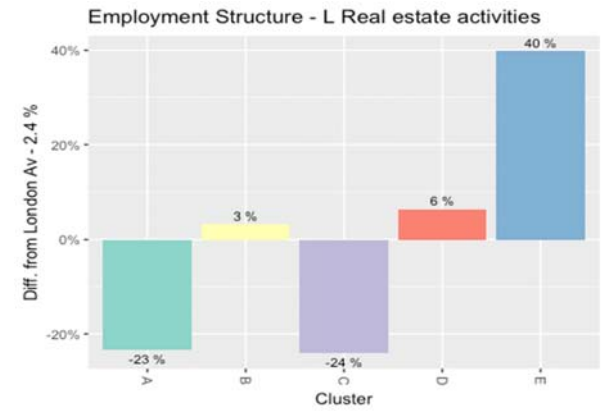
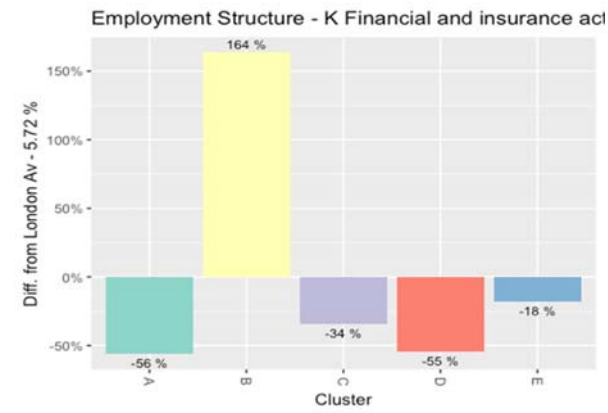
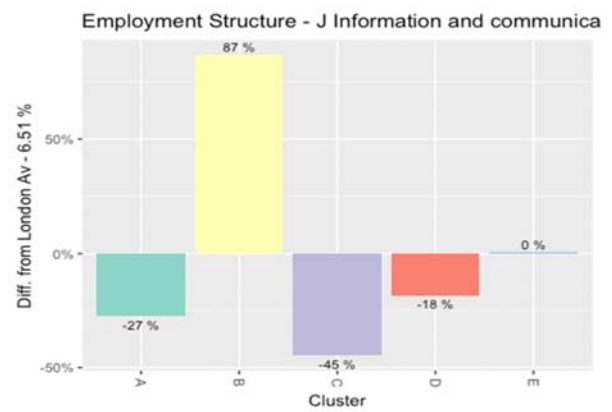
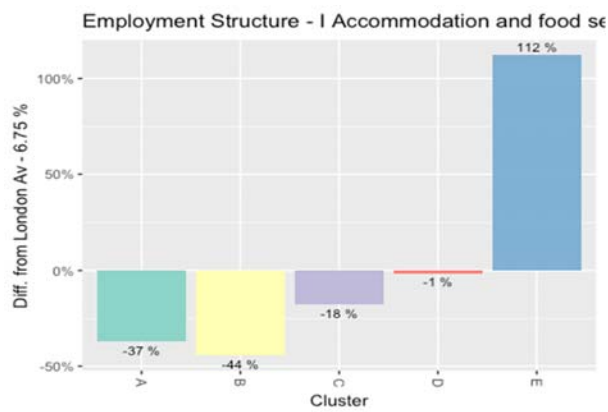
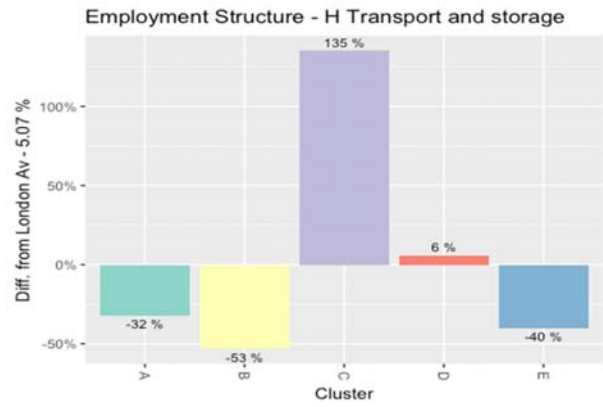
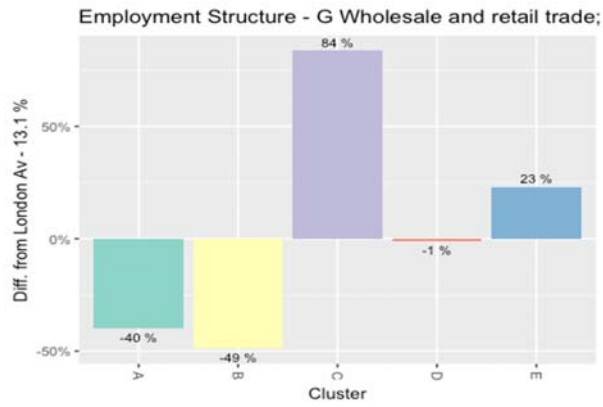
6 Caring, leisure and other service occupations	Employment Structure	WP606EW	W_Service
8 Process, plant and machine operatives	Employment Structure	WP606EW	W_Plant
9 Elementary occupations	Employment Structure	WP606EW	W_Element
Workplace industry type diversity	Employment Structure	WP605EW	WZ_IND_DIV
Level 2 qualifications	Job Characteristics	WP501EW	W_L2
Level 3 qualifications	Job Characteristics	WP501EW	W_L3
Level 4 qualifications and above	Job Characteristics	WP501EW	W_L4
Apprenticeship	Job Characteristics	WP501EW	W_Appent
Other qualifications	Job Characteristics	WP501EW	W_OtherQual
Employee: Part-time	Job Characteristics	WP601EW	W_Ptime
Self-employed without employees: Full-time	Job Characteristics	WP601EW	W_SE_Ft2
Full-time student	Job Characteristics	WP601EW	W_FTStud
Full-time: 49 or more hours worked	Job Characteristics	WP604EW	W_FTWork49
Full-time: 31 to 48 hours worked	Job Characteristics	WP604EW	W_FTWork3148
Part-time: 15 hours or less worked	Job Characteristics	WP604EW	W_PT15less
1. Higher managerial, administrative and professional occupations	Job Characteristics	WP607EW	W_HighMan
2. Lower managerial, administrative and professional occupations	Job Characteristics	WP607EW	W_LowMan

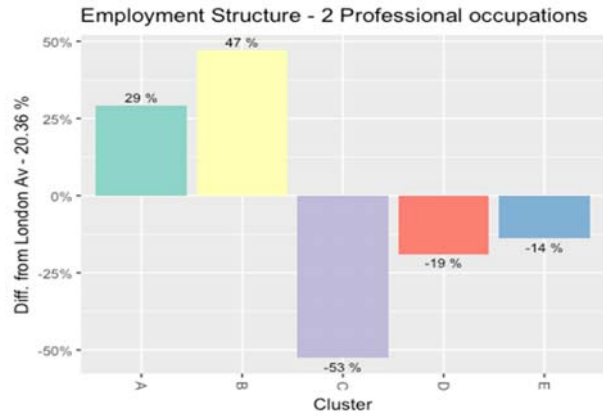
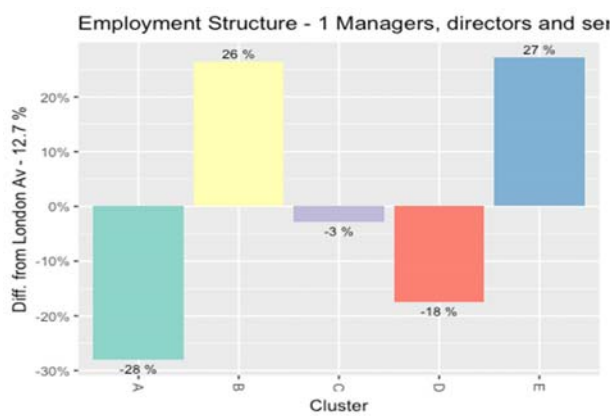
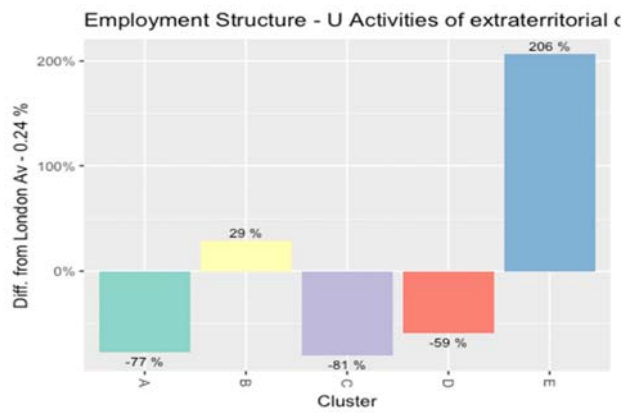
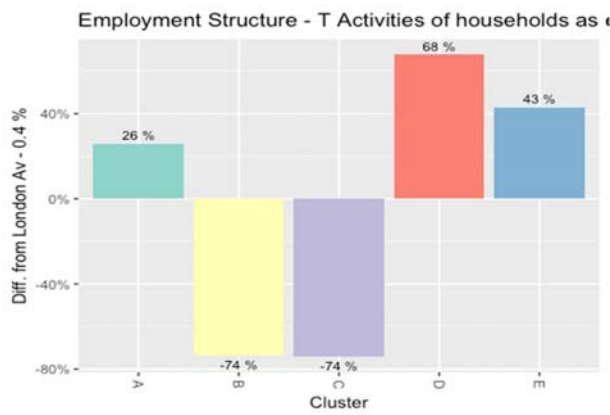
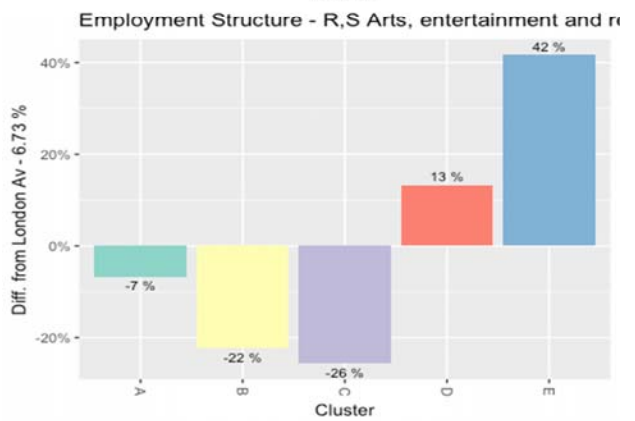
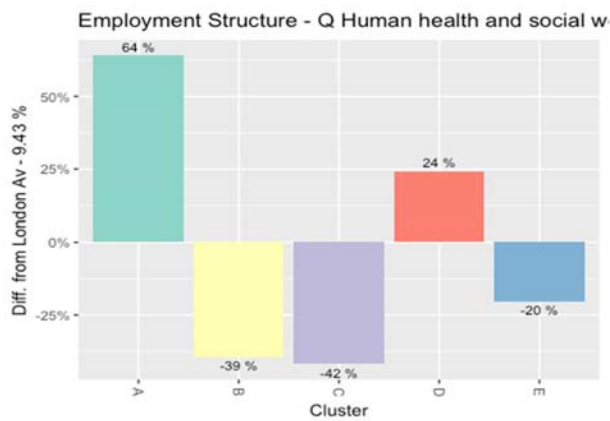
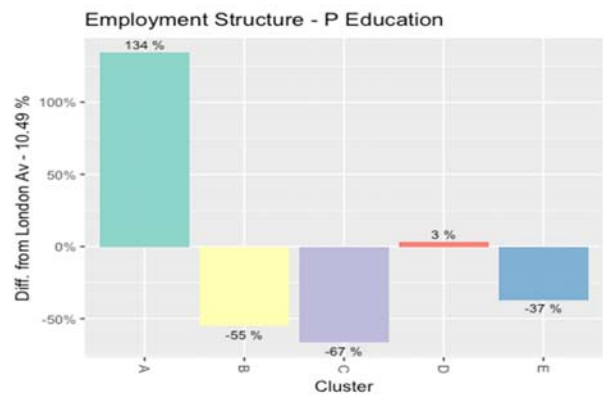
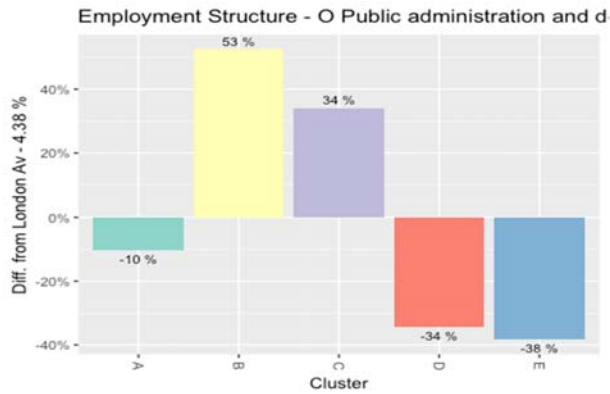
3. Intermediate occupations	Job Characteristics	WP607EW	W_Int
4. Small employers and own account workers	Job Characteristics	WP607EW	W_Smaller
5. Lower supervisory and technical occupations	Job Characteristics	WP607EW	W_LowSup
6. Semi-routine occupations	Job Characteristics	WP607EW	W_SemiR
7. Routine occupations	Job Characteristics	WP607EW	W_Routine
Worker / Residential population mix	Residential Context		WZ_OA_MIX

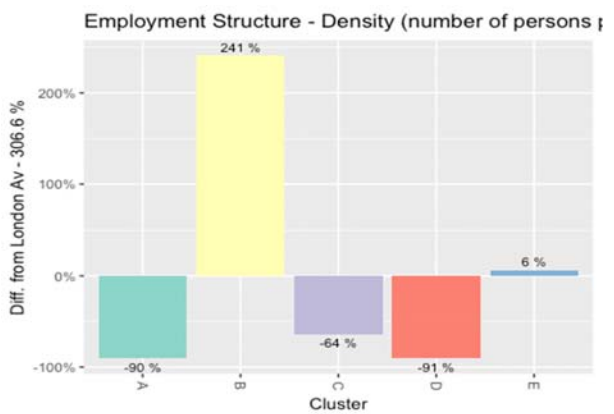
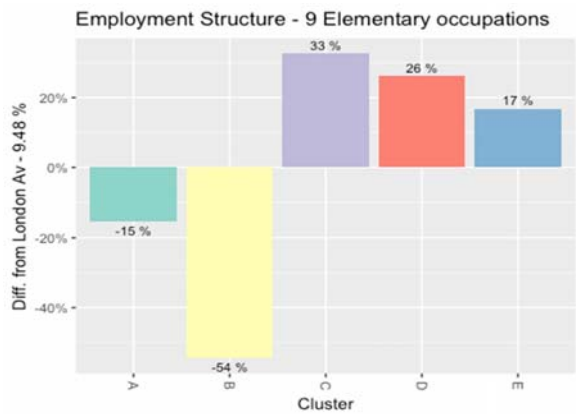
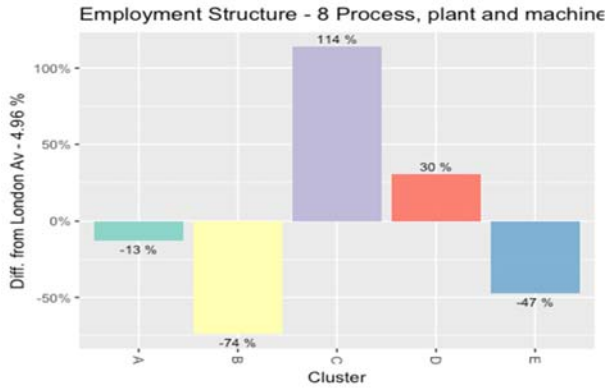
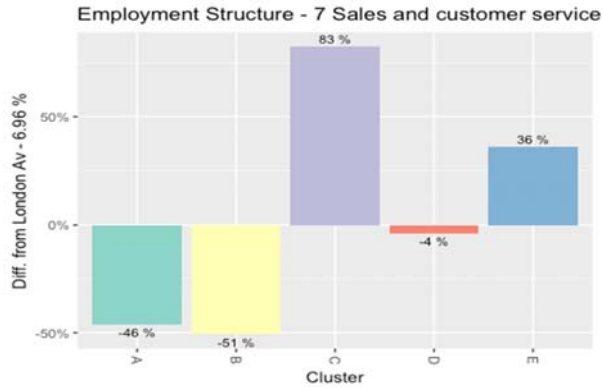
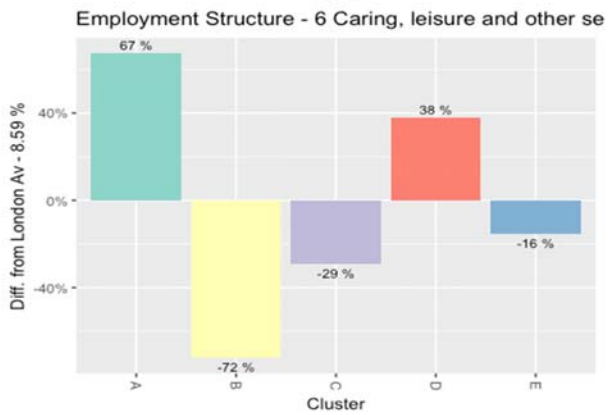
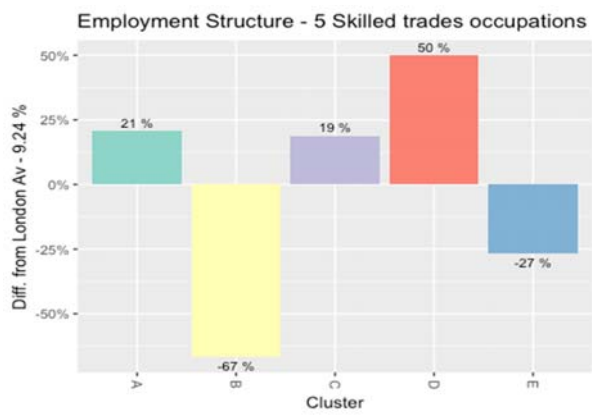
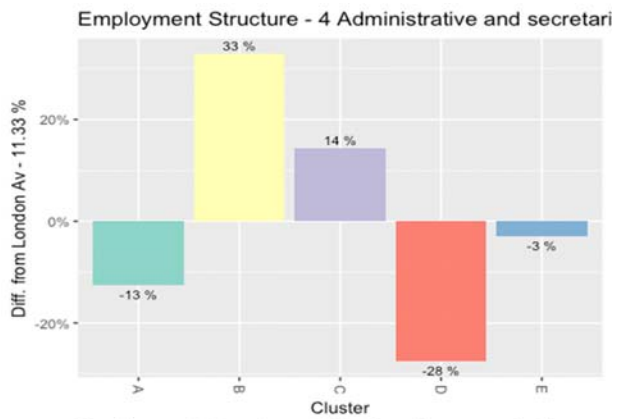
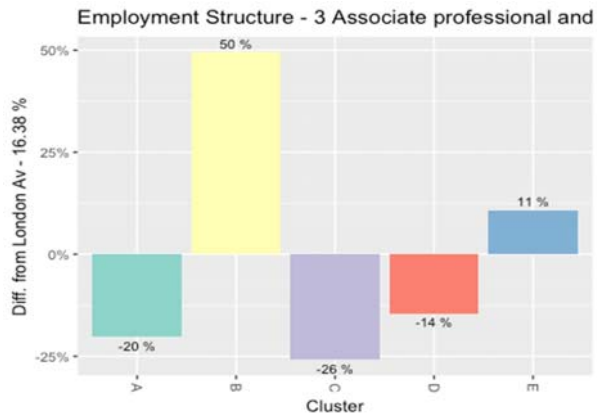
Appendix B

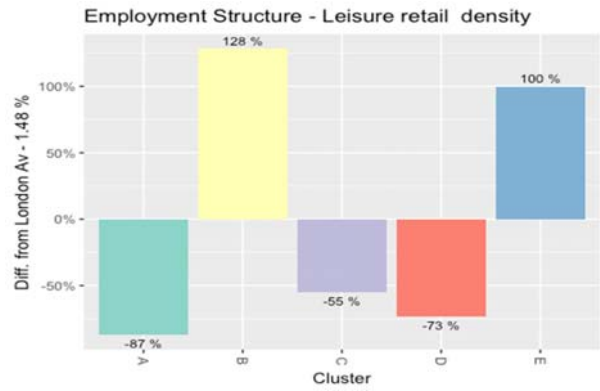
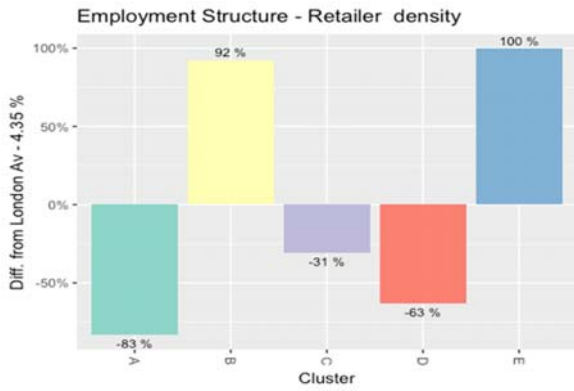
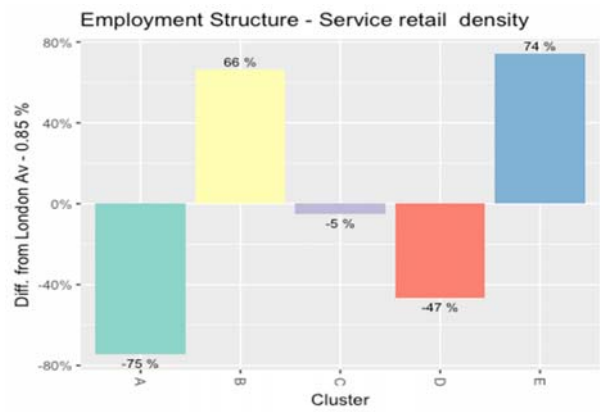
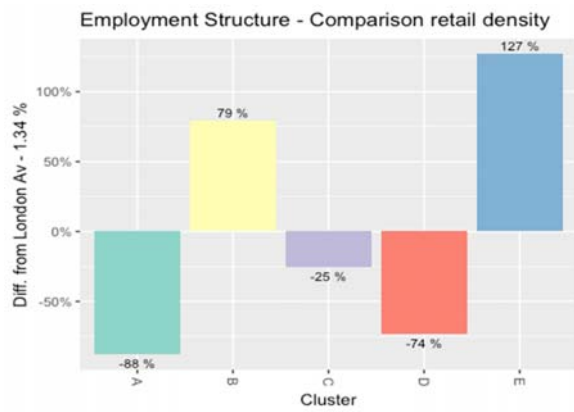
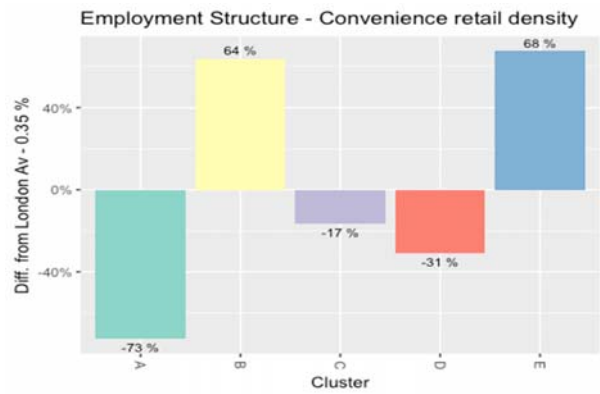
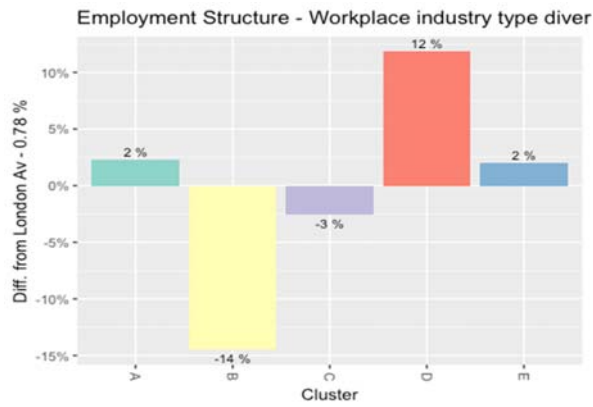
The following charts show how under or over represented each variables is for the clusters groups in comparison with the London average.

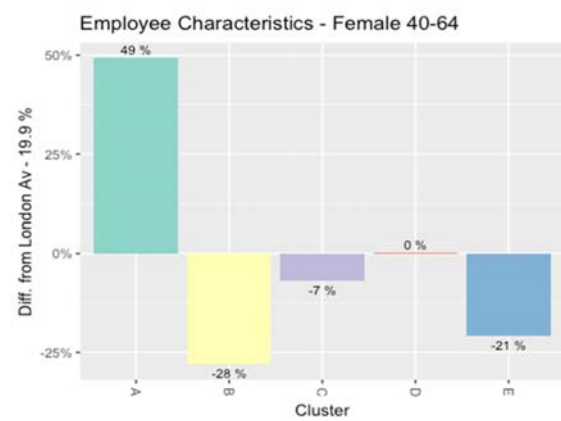
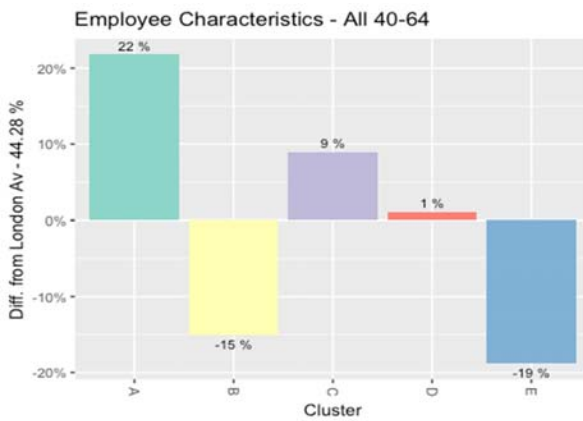
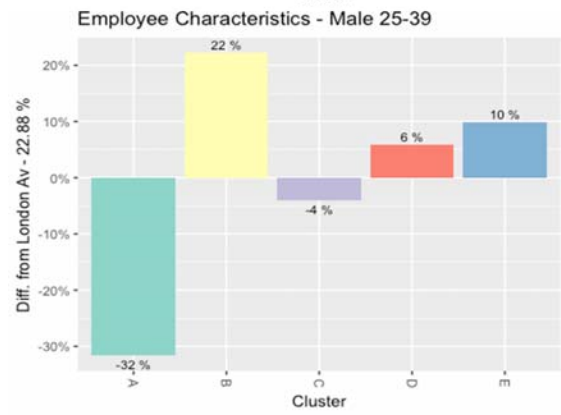
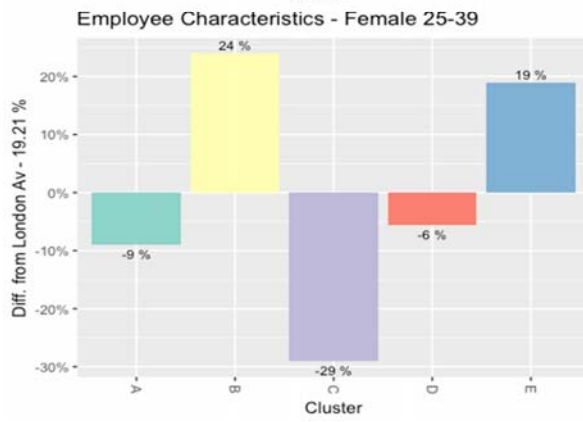
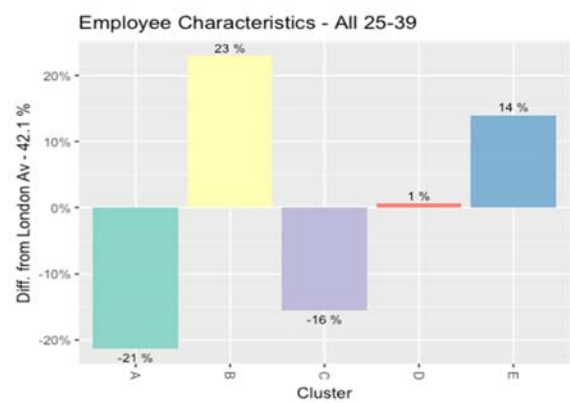
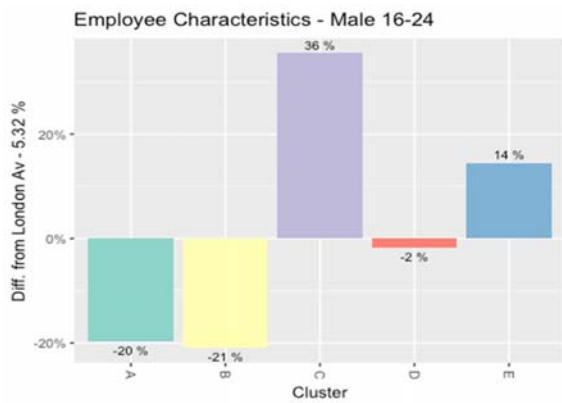
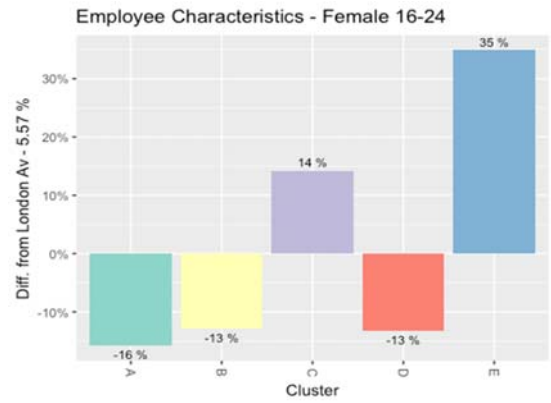
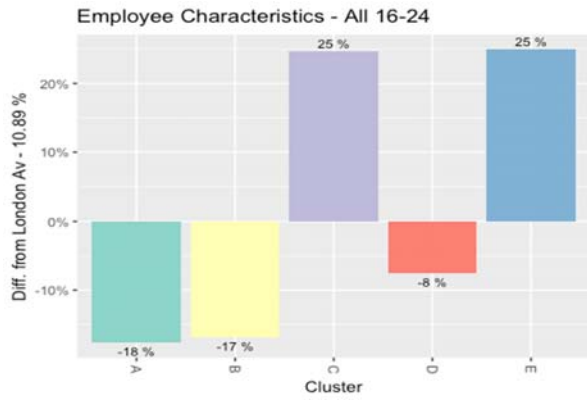


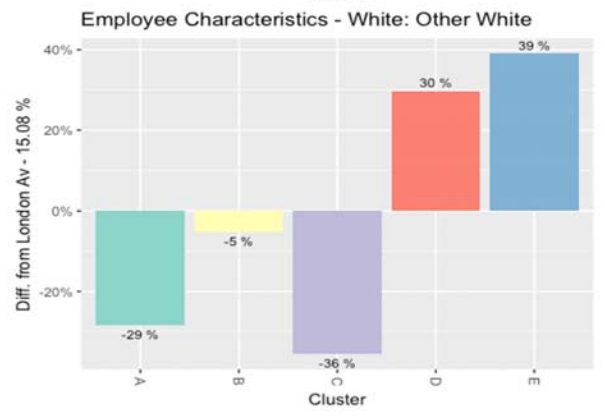
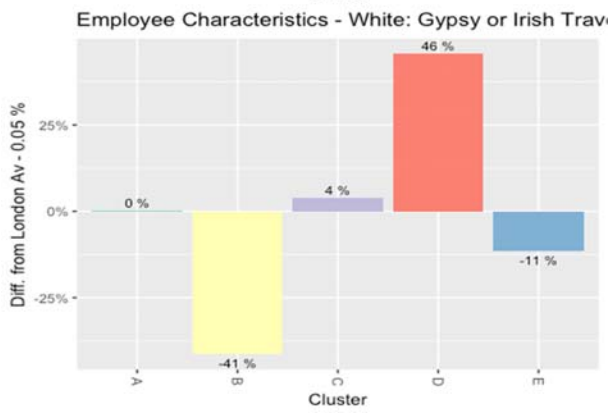
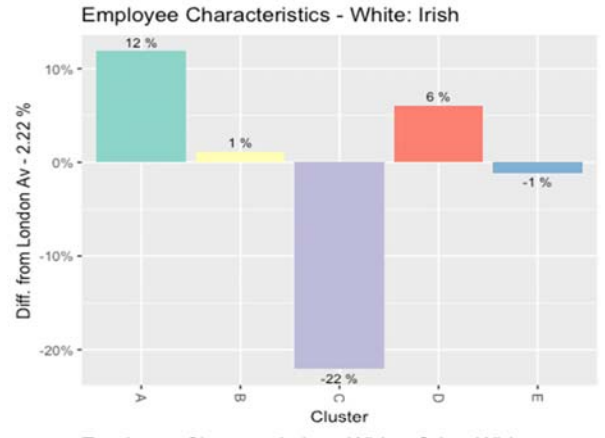
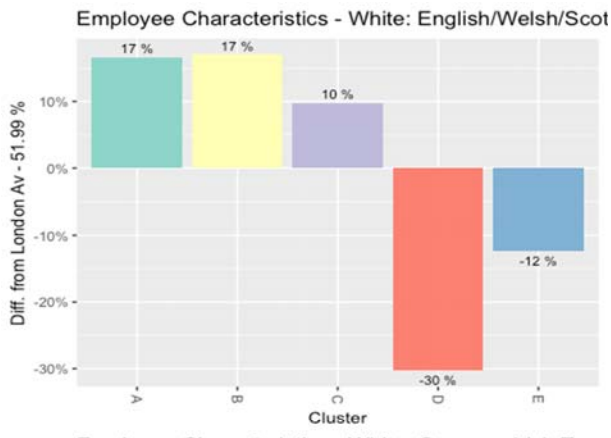
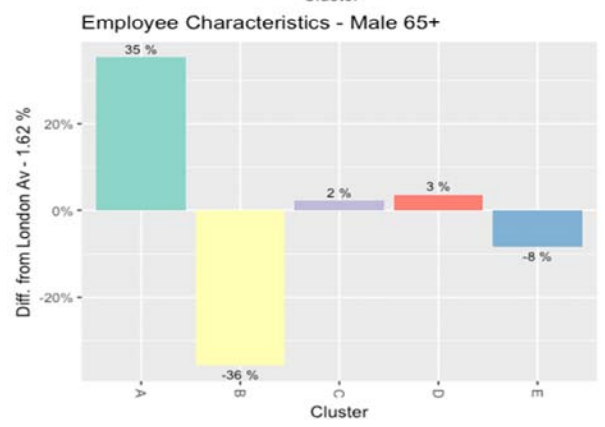
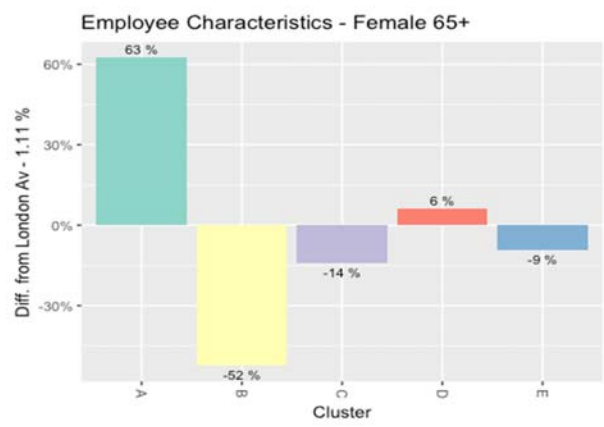
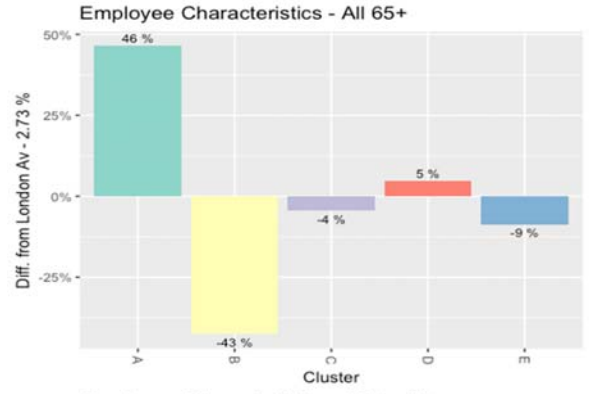
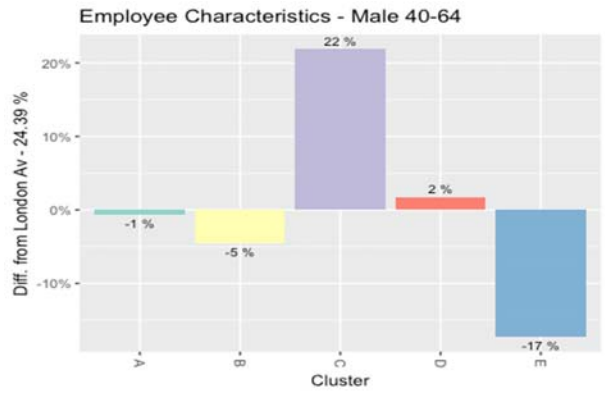


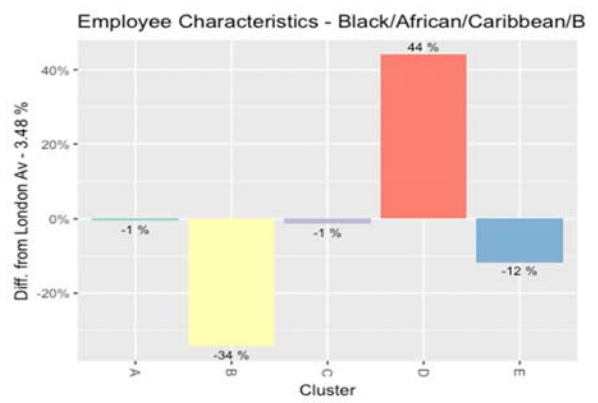
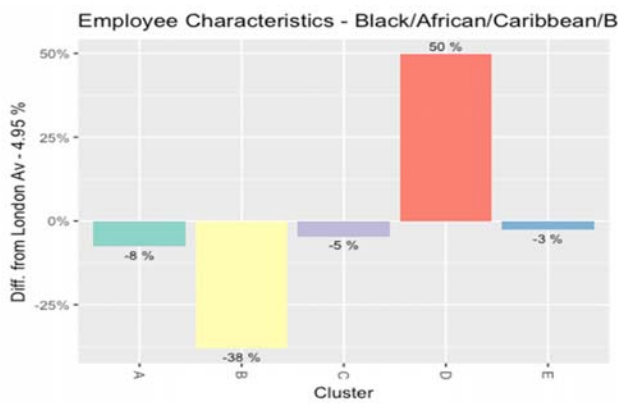
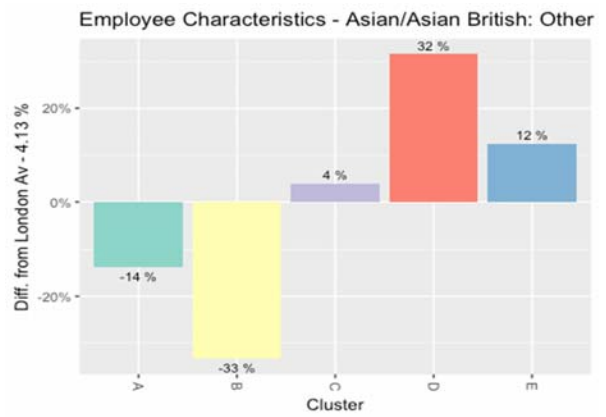
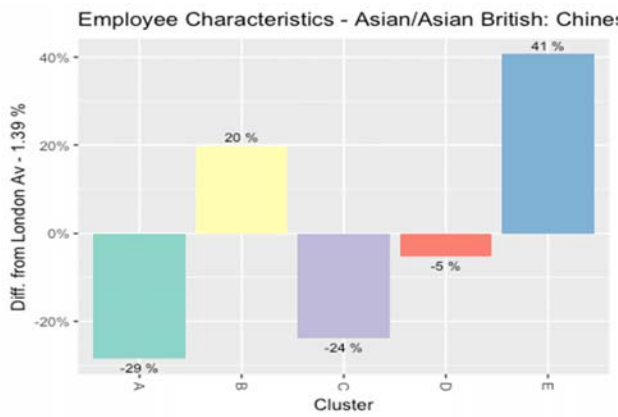
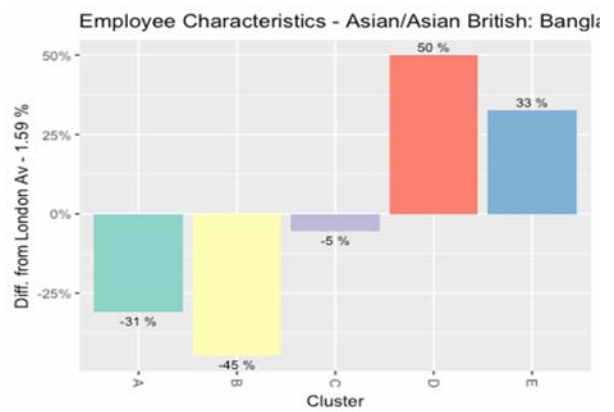
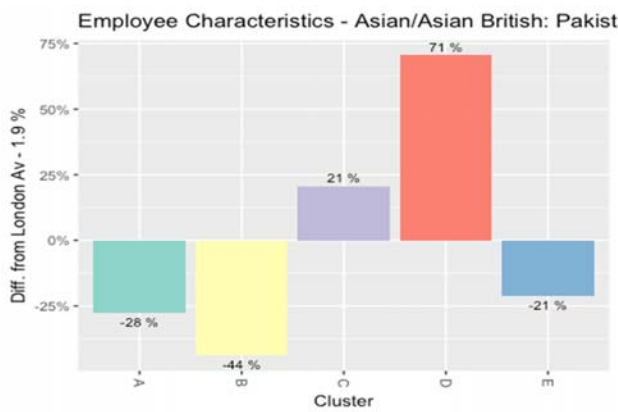
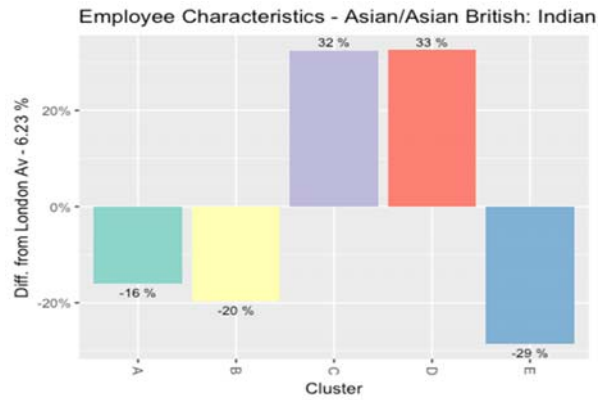
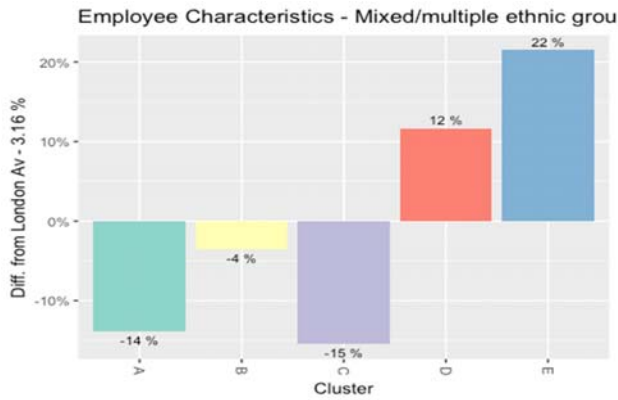


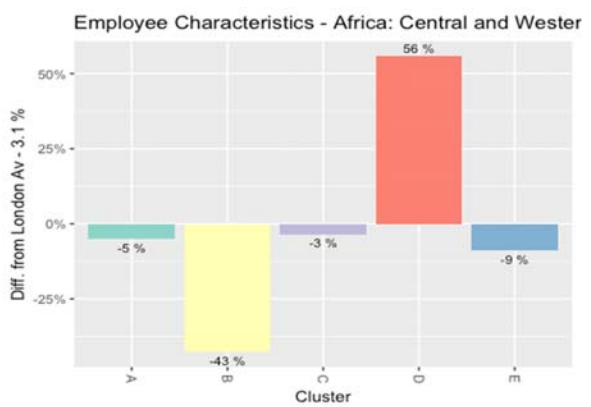
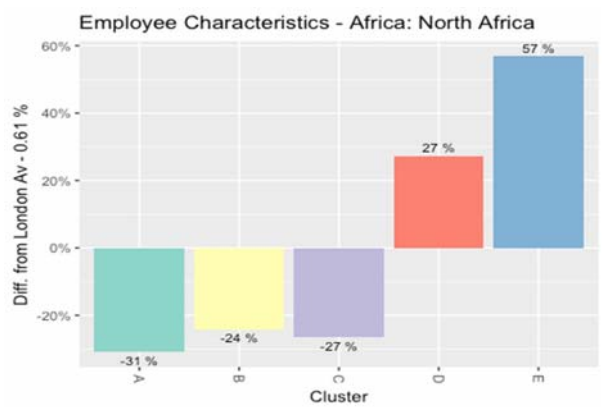
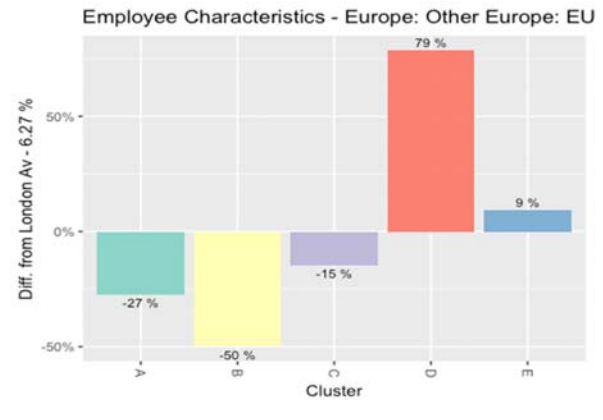
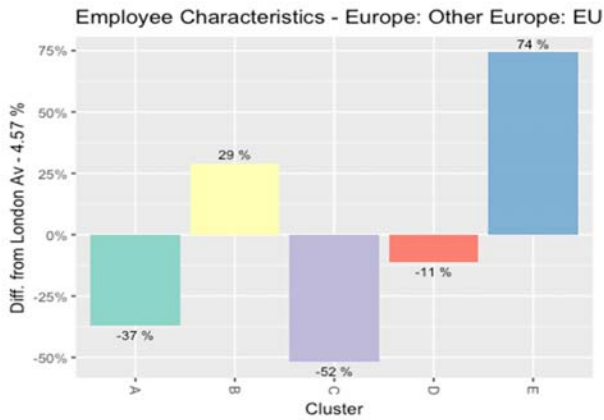
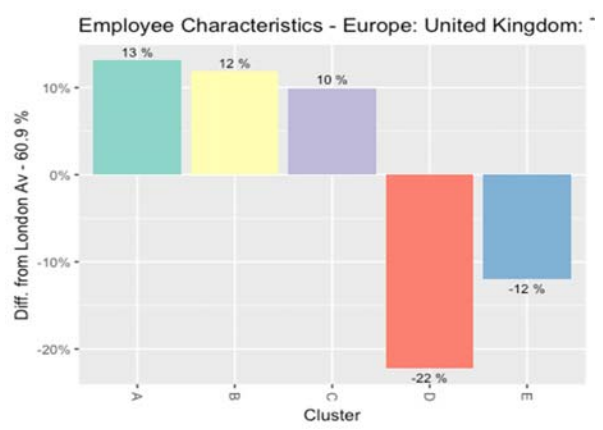
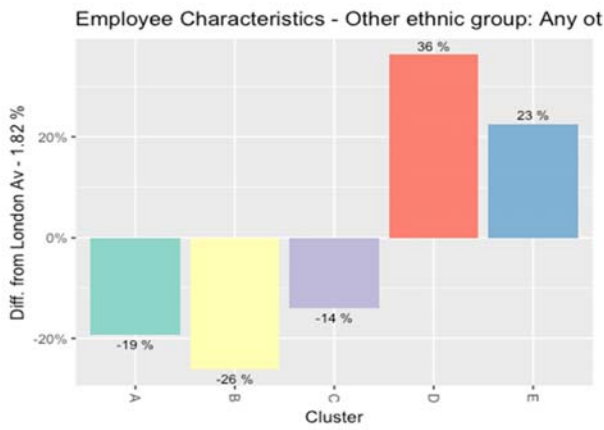
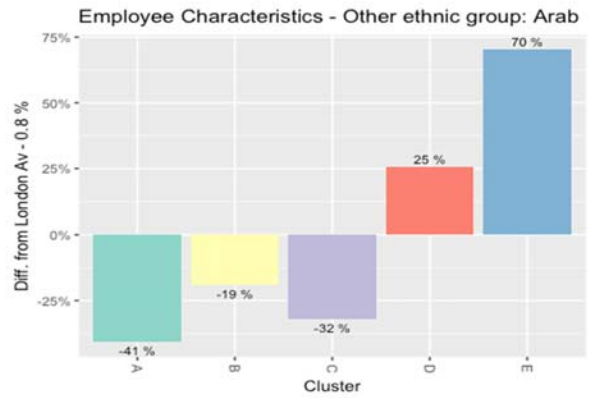
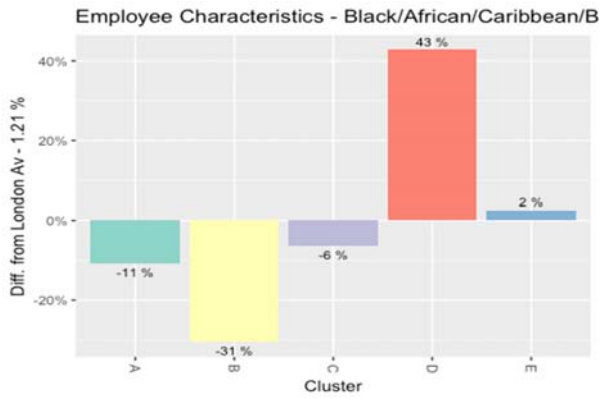


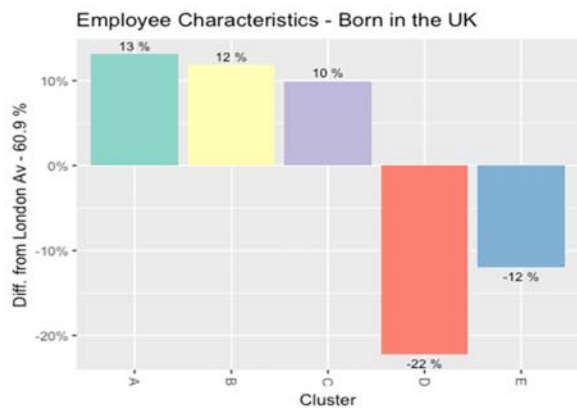
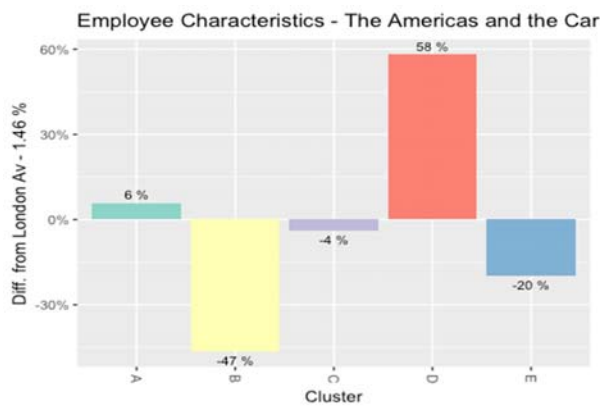
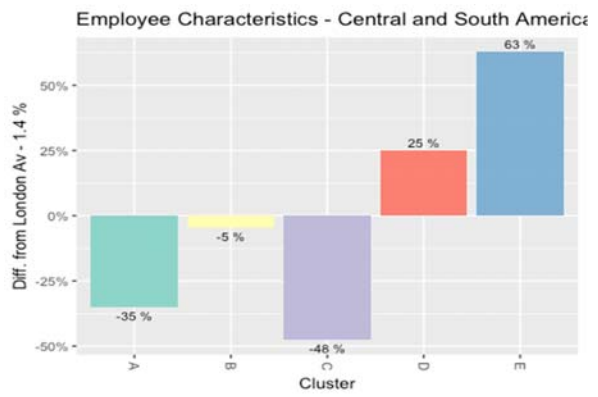
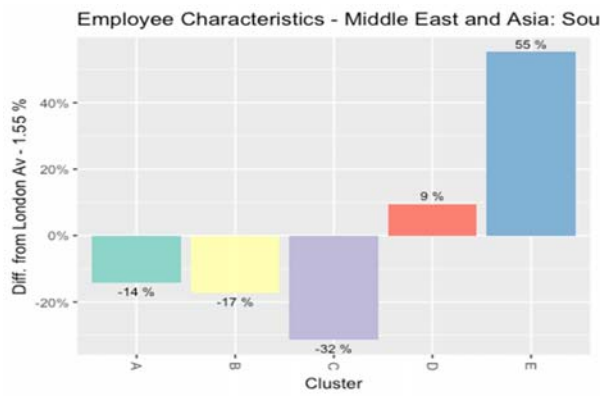
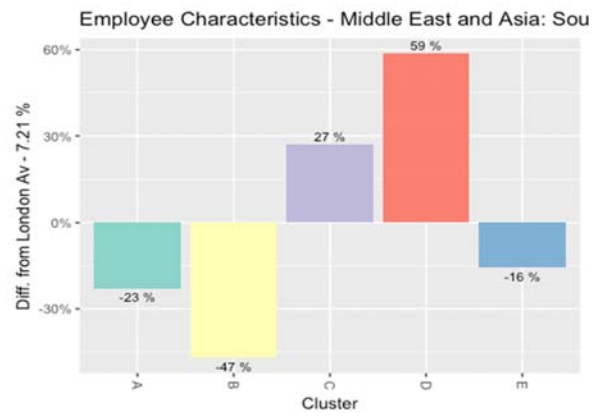
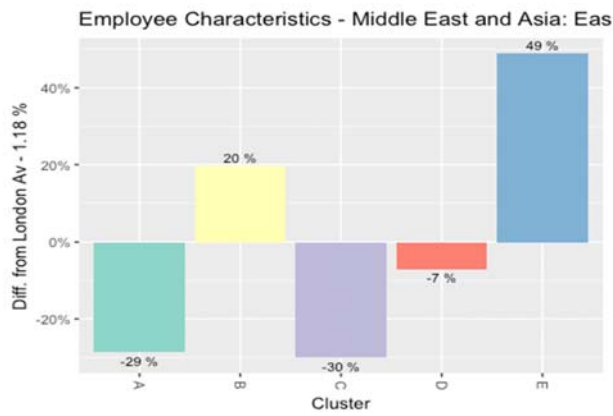
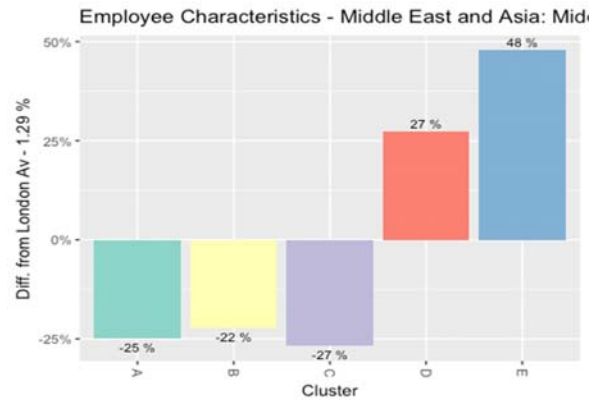
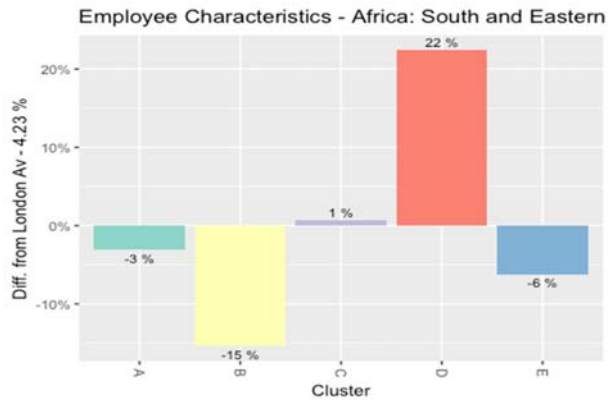


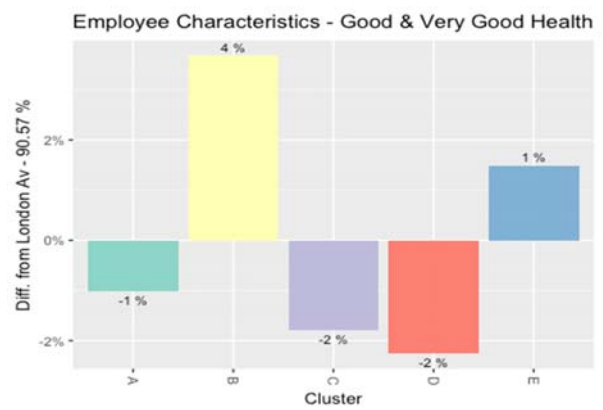
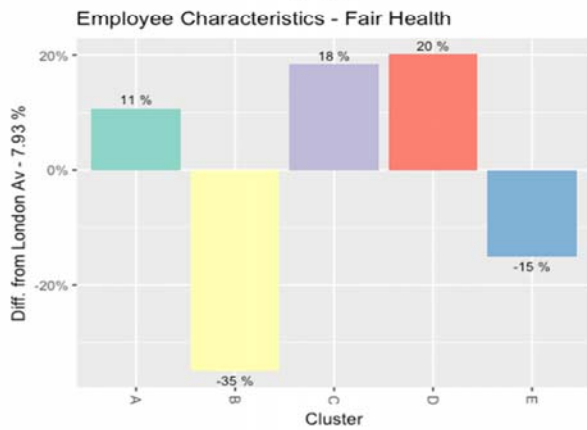
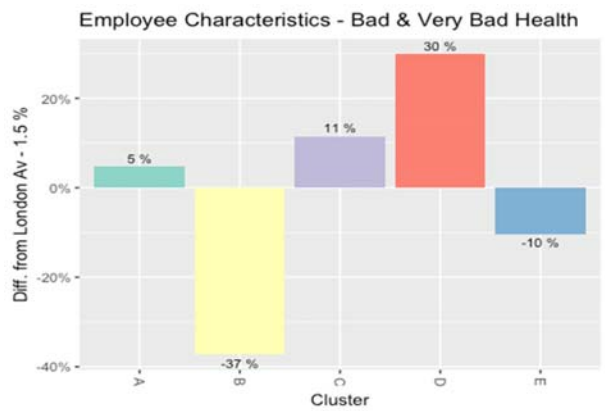
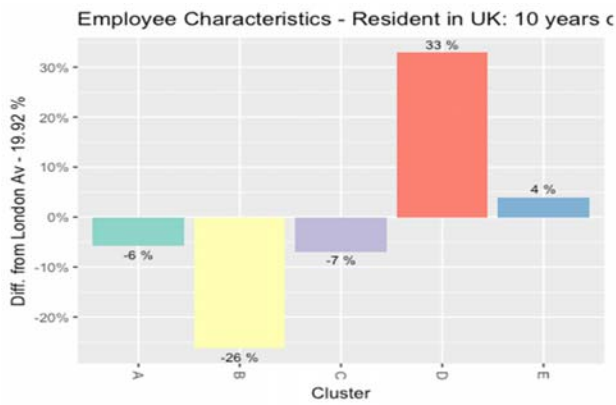
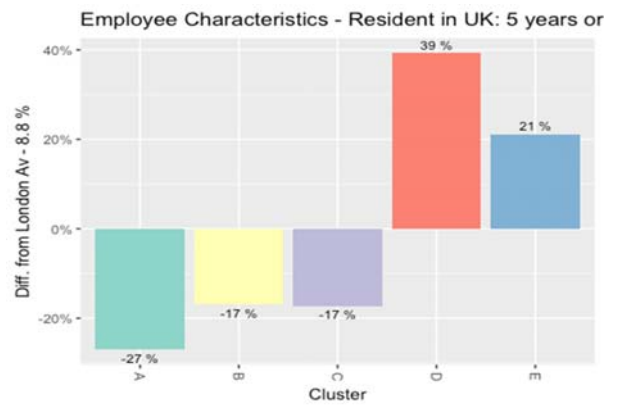
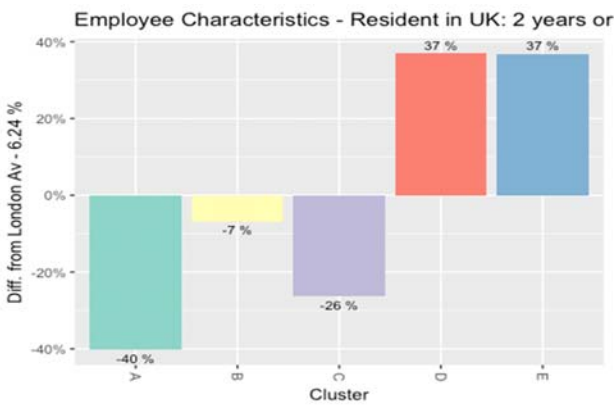
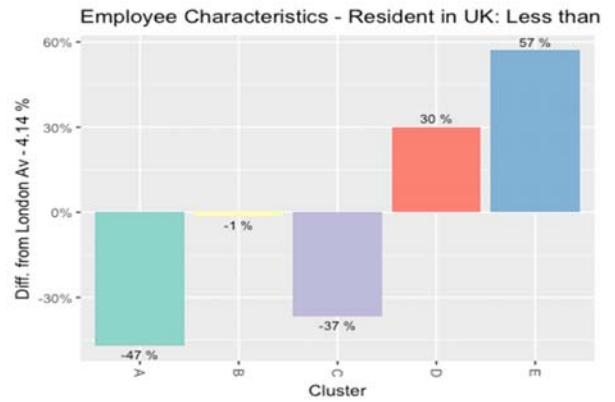
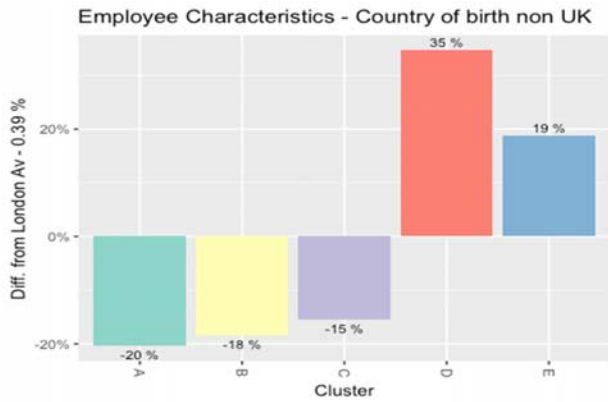


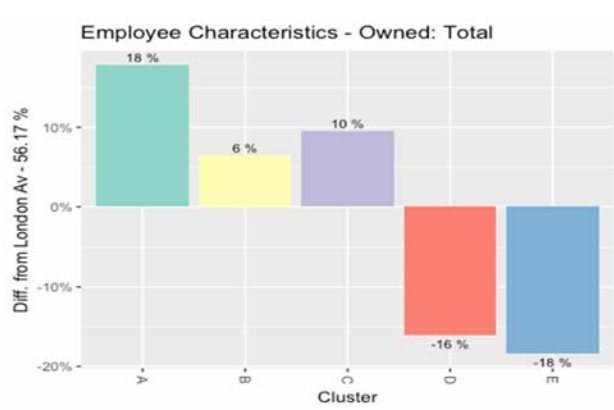
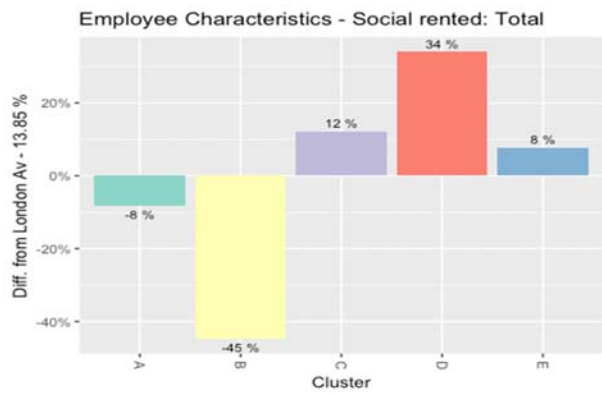
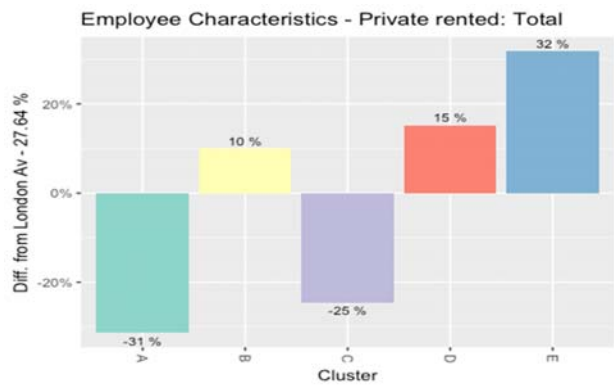
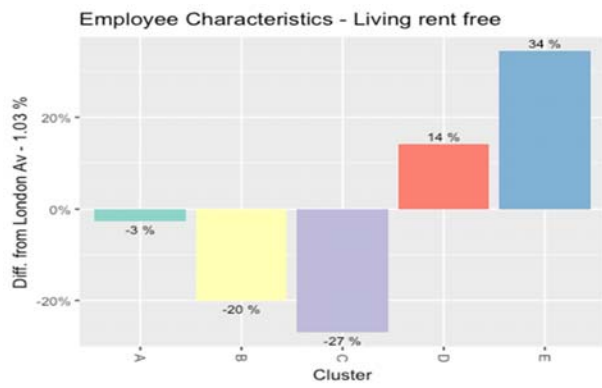


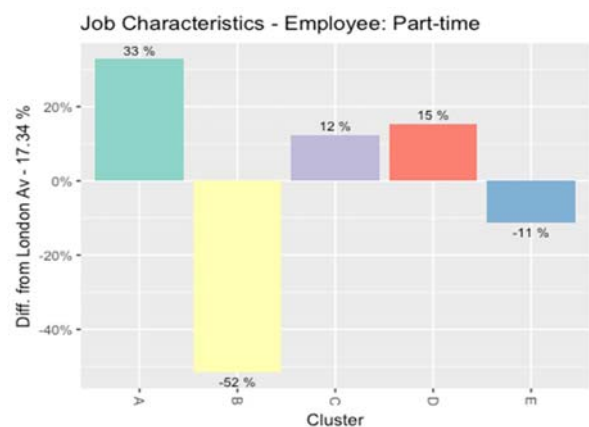
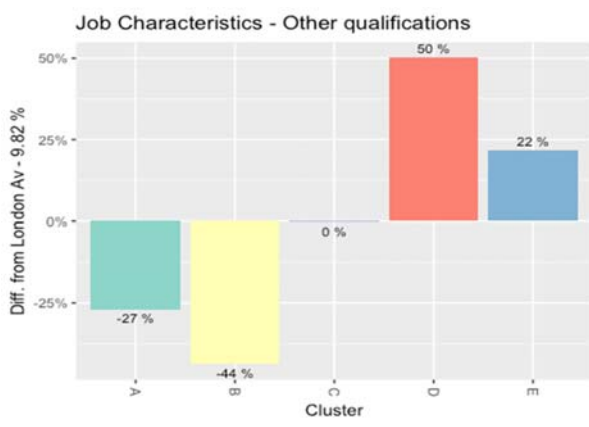
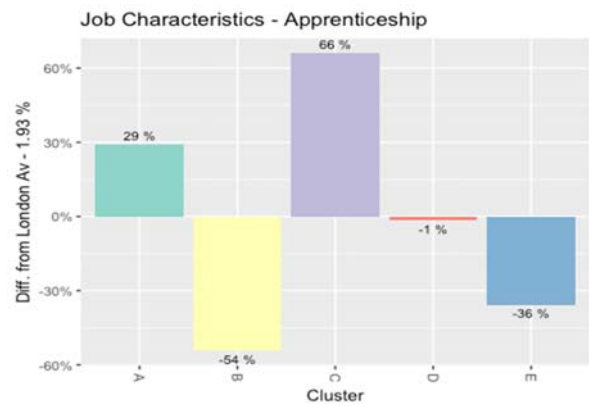
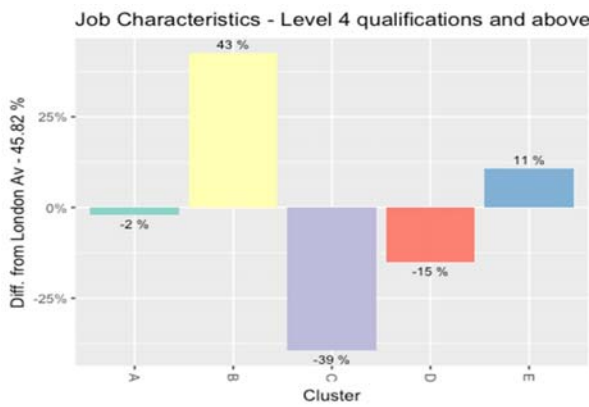
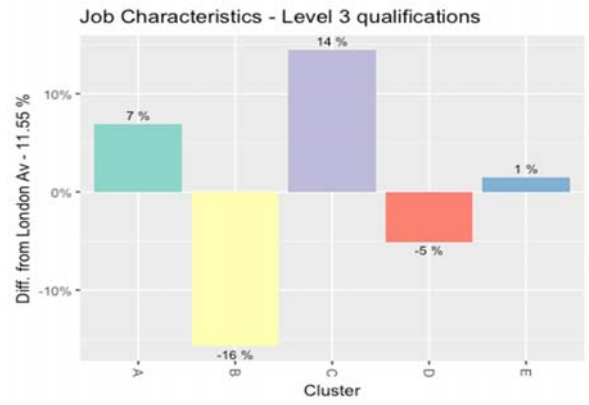
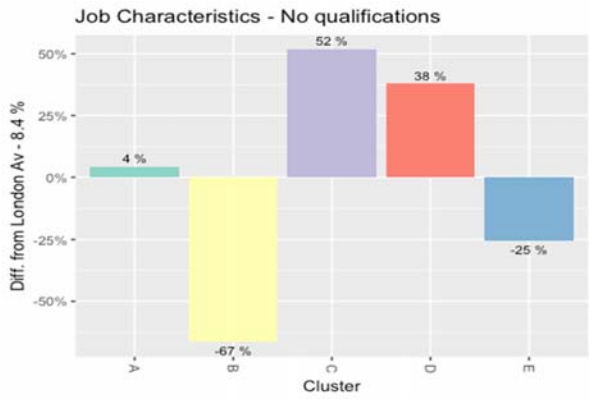




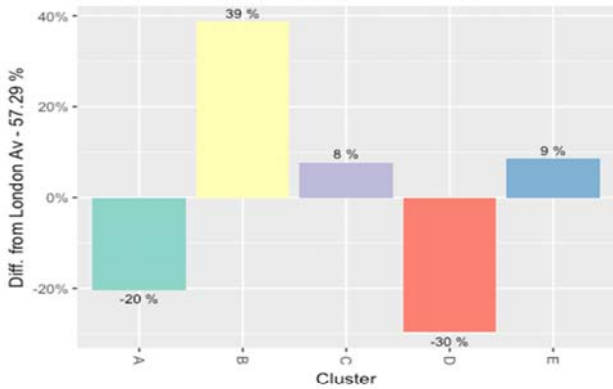




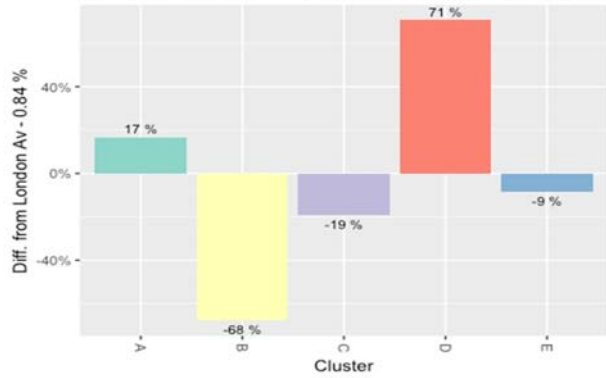




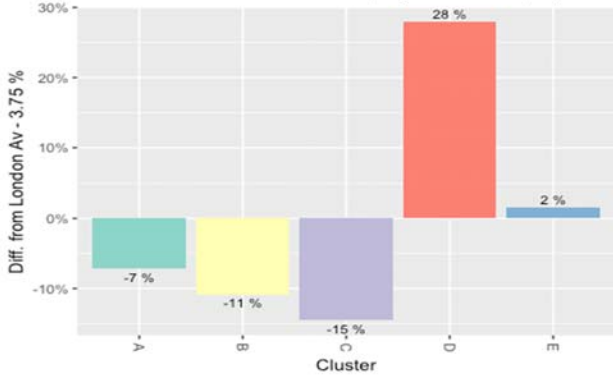
Job Characteristics - Employee: Full-time



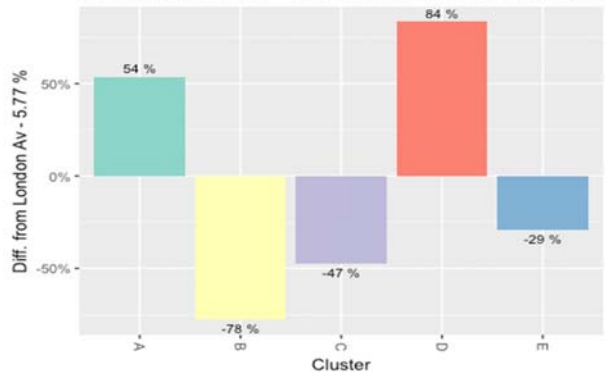
Job Characteristics - Self-employed with employees: F



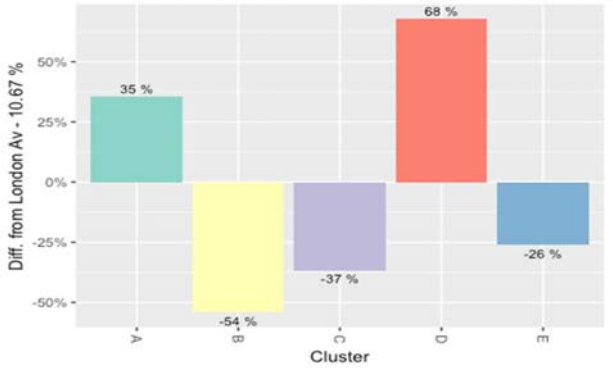
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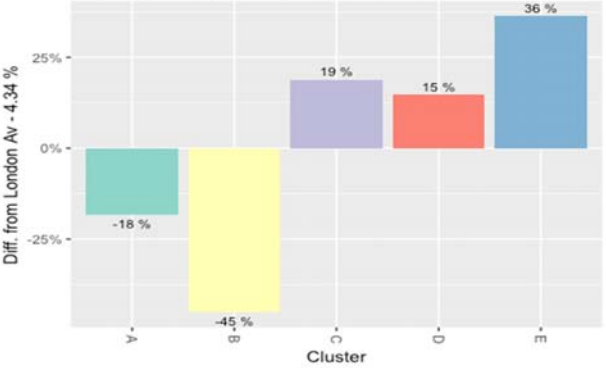
Job Characteristics - Self-employed without employee



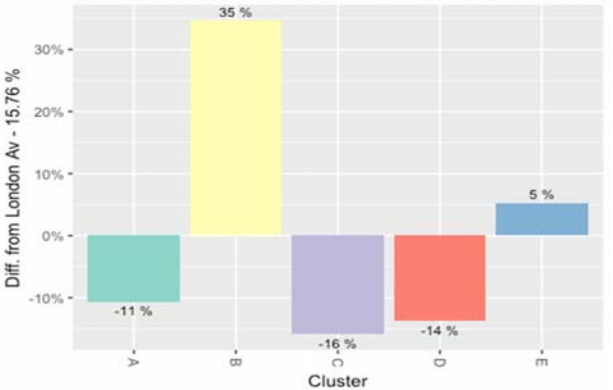
Job Characteristics - Self-employed without employee



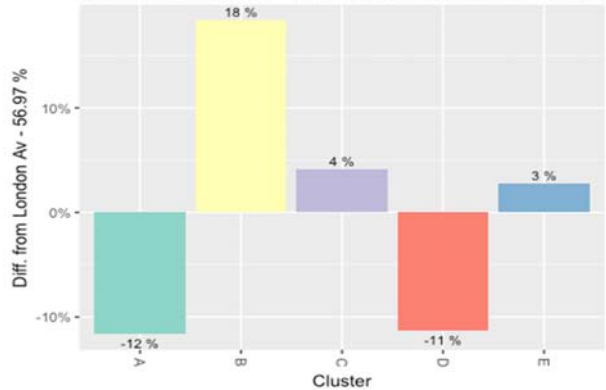
Job Characteristics - Full-time student

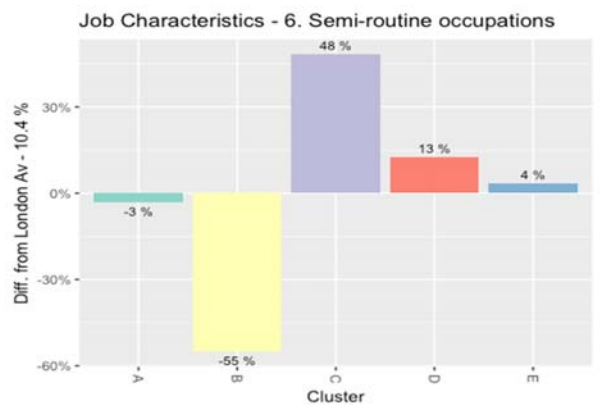
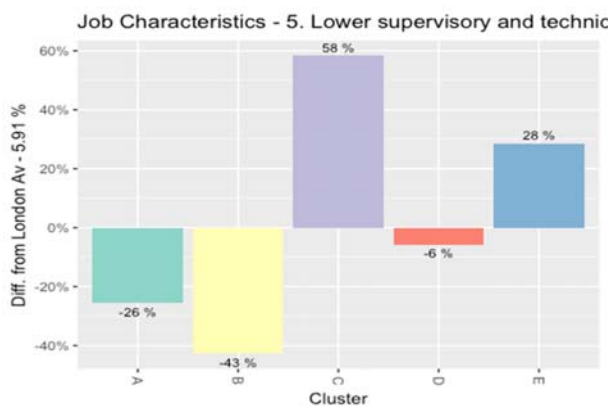
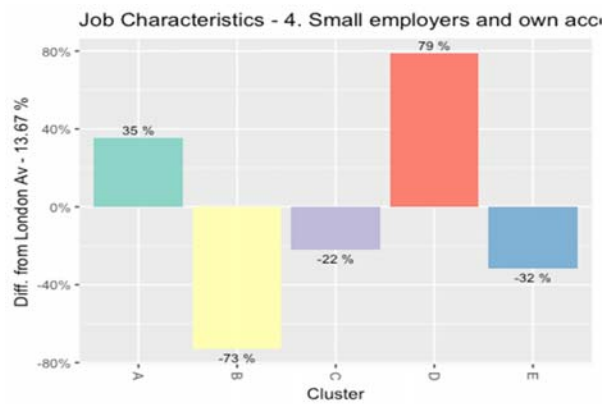
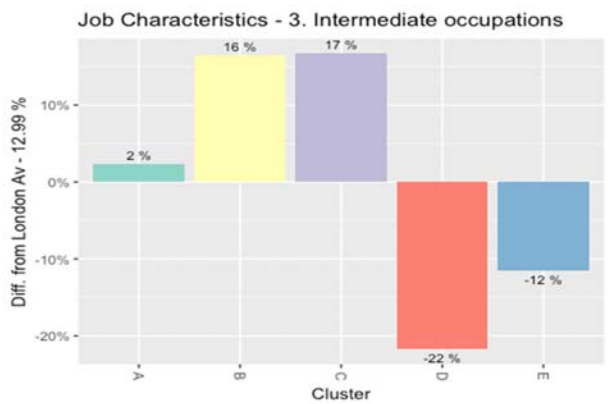
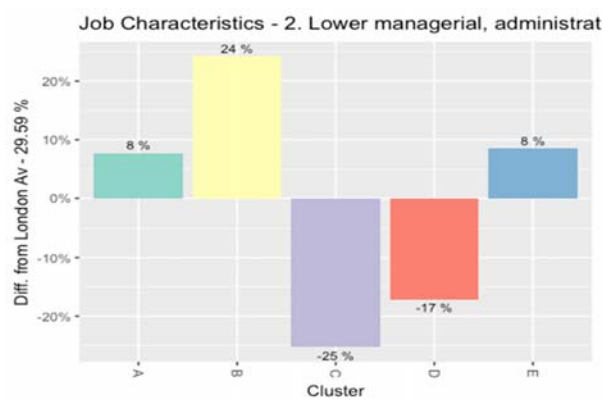
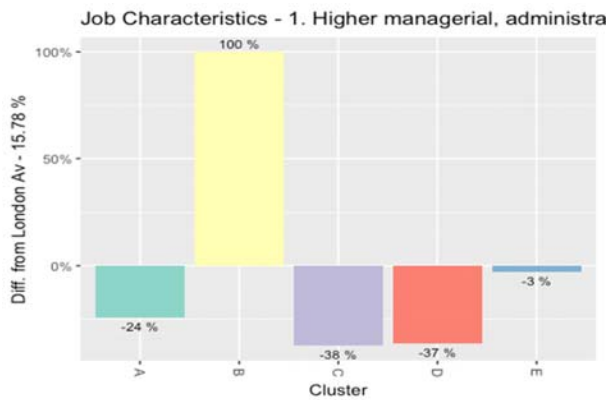
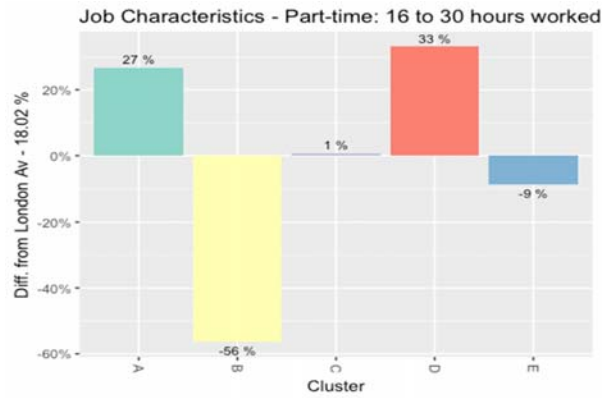
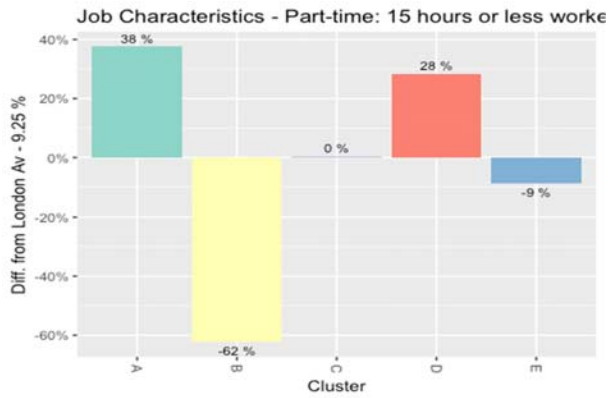


Job Characteristics - Full-time: 49 or more hours work



Job Characteristics - Full-time: 31 to 48 hours worked





Job Characteristics - 7. Routine occupations

