



A row of doors against a dark wall. All doors are dark grey except for one, which is a vibrant red. The red door is slightly taller than the others. A horizontal dashed white line is positioned at the bottom of the doors. The floor is a light grey color.

OPTIMAL LOCATOR BASED ON PERSON CRITERIA

YALIN YENER
November 19, 2020

Introduction

Methodology

Results

Conclusions

Future Work

Bonus

Business Need: Finding optimal location (borough) to move in London.

Solution: Using **London Borough Profile** data by performing **AHP** method.

- Objectives:**
- Defining criteria that affect your decision.
 - Defining sub-criteria that affect your main criteria.
 - Comparison criteria / sub-criteria
 - Weighted criteria / sub-criteria
 - Implement model
 - Visualise result

The Analytic Hierarchy Process (AHP) is a method of “measurement through **pairwise comparisons** and relies on the **judgments of experts** to derive priority scales”

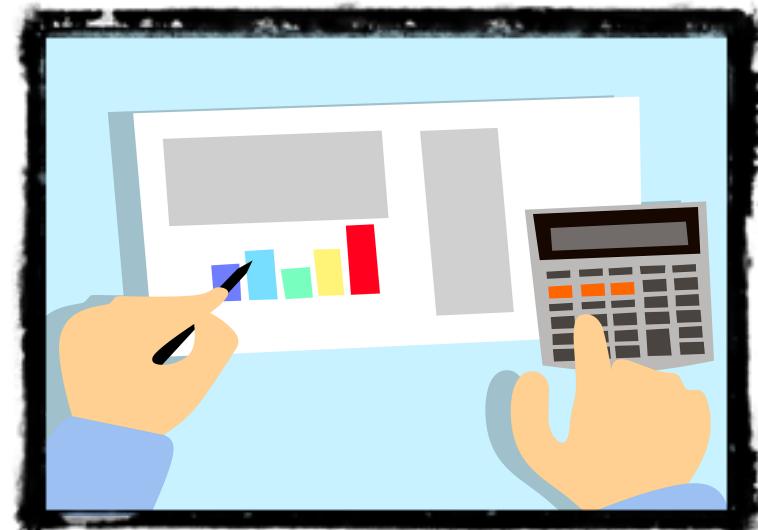
–Rosaria de F.S.M. Russo and Roberto Camanho / Procedia Computer Science



Data Acquire



Data Wrangling



Implement Model



Visualisation

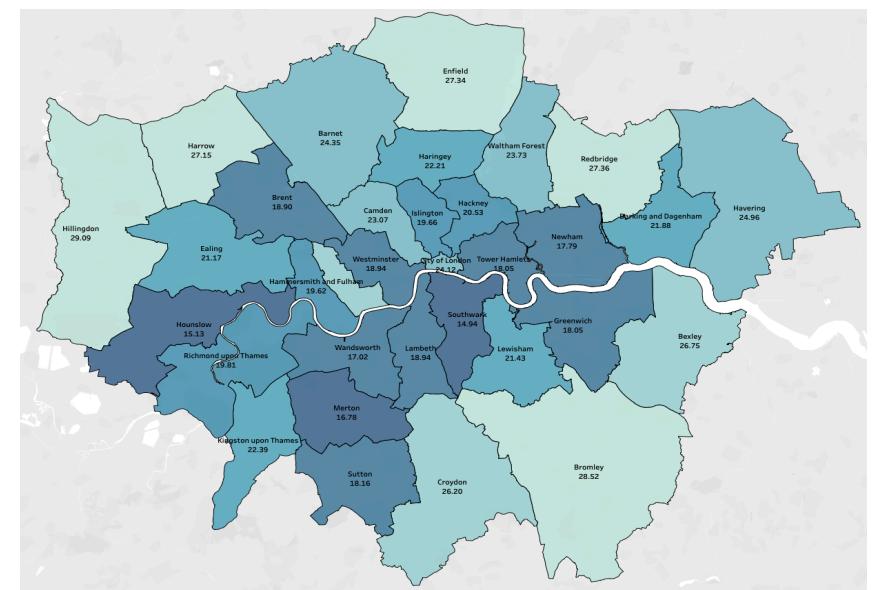
Data Acquire



Greater London Authority

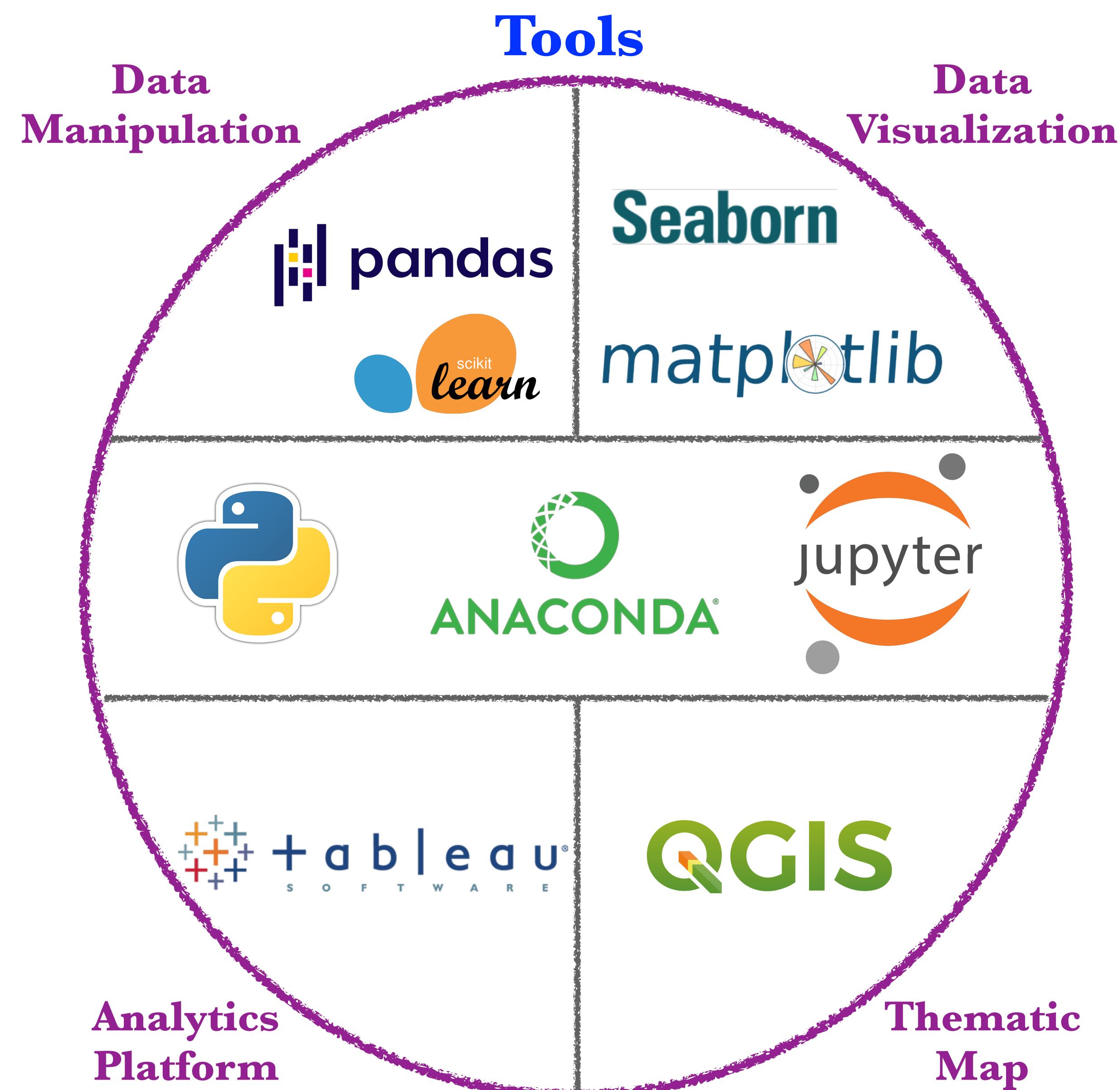
- London Borough Profile (cvs)

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OGL v2



Spatial Data

- Borough Border (geojson)

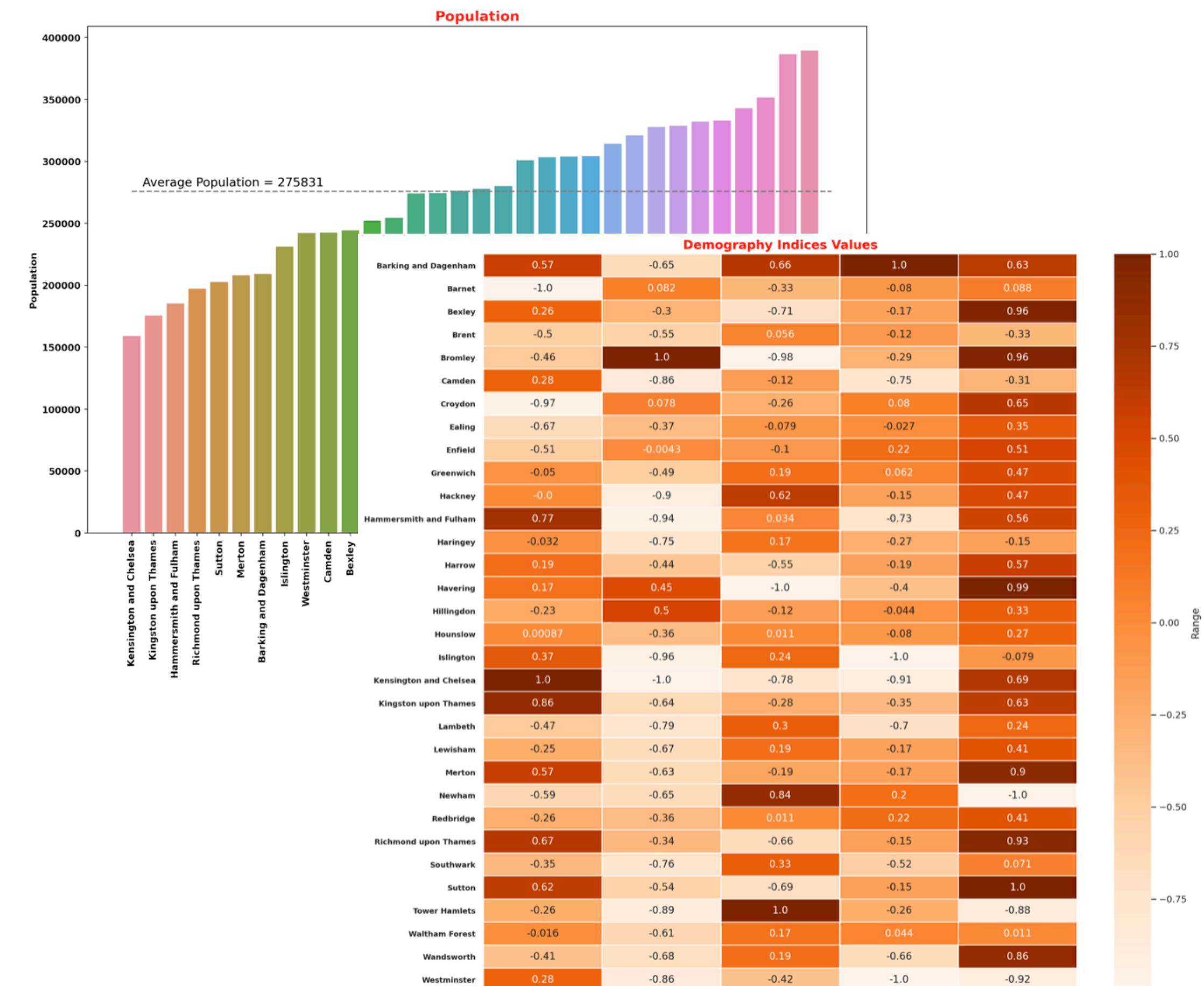


Data Wrangling

Code	Area_name	Inner_/_Outer_London	GLA_Population_Estimate_2017	GLA_Household_Estimate_2017	Inland_Area_(Hectares)	Population_density_(per_hectare)_2017	Average_Age_2017	Proportion_of_population_aged_0-15...2015	Proportion_of_population_of_working-age_2015
E09000001	City of London	Inner London	8800	5326	290	30.3	43.2	11.4	73.1
E09000002	Barking and Dagenham	Outer London	209000	78188	3,611	57.9	32.9	27.2	63.1
E09000003	Barnet	Outer London	389600	151423	8,675	44.9	37.3	21.1	64.9
E09000004	Bexley	Outer London	244300	97736	6,058	40.3	39	20.6	62.9
E09000005	Brent	Outer London	332100	121048	4,323	76.8	35.6	20.9	67.8
E09000006	Bromley	Outer London	327900	140602	15,013	21.8	40.2	19.9	62.6
E09000007	Camden	Inner London	242500	107654	2,179	111.3	36.4	17.3	71
E09000008	Croydon	Outer London	386500	159010	8,650	44.7	37	22	64.9
E09000009	Ealing	Outer London	351600	132663	5,554	63.3	36.2	21.4	56.8
E09000010	Enfield	Outer London	333000	130328	8,083	41.2	36.3	22.8	64.4
E09000011	Greenwich	Outer London	280100	113964	4,733	59.2	35	21.9	67.7
E09000012	Hackney	Inner London	274300	115417	1,905	144	33.1	20.7	72.1
E09000013	Hammersmith and Fulham	Inner London	185300	83552	1,640	113	35.7	17.4	72.3
E09000014	Haringey	Inner London	278000	115608	2,960	93.9	35.1	20	70.7
E09000015	Harrow	Outer London	252300	92557	5,046	50	38.3	20.5	64.5
E09000016	Havering	Outer London	254300	10498	11,235	22.6	40.3	19.3	62.3
E09000017	Hillingdon	Outer London	301000	110827	11,570	26	36.4	21.3	65.6
E09000018	Homelaw	Outer London	274200	105887	5,598	49	35.8	21.1	67.6
E09000019	Islington	Inner London	231200	105038	1,486	155.6	34.8	15.9	75.3
E09000020	Kensington and Chelsea	Inner London	159000	80200	1,212	131.1	39.3	16.4	69.3
E09000021	Kingston upon Thames	Outer London	175400	69849	3,726	47.1	37.1	19.6	67.2
E09000022	Lambeth	Inner London	328900	144400	2,681	122.7	34.5	17.6	74.6
E09000023	Lewisham	Inner London	303400	131076	3,515	86.3	35	20.6	70.1
E09000024	Merton	Outer London	208100	84201	3,762	55.3	36.7	20.6	67.2
E09000025	Newham	Inner London	342900	119172	3,620	94.7	32.1	22.7	70.2
E09000026	Redbridge	Outer London	304200	110708	5,642	53.9	35.8	22.8	65
E09000027	Richmond upon Thames	Outer London	197300	85108	5,741	34.4	38.8	20.7	64.5
E09000028	Southwark	Inner London	314300	134254	2,886	108.9	34.4	18.6	73.5
E09000029	Sutton	Outer London	202600	85243	4,385	46.2	38.9	20.7	64.3
E09000030	Tower Hamlets	Inner London	304000	123720	1,978	153.7	31.4	20.1	73.9
E09000031	Waltham Forest	Outer London	276200	105981	3,881	71.2	35.1	21.8	67.9
E09000032	Wandsworth	Inner London	321000	138149	3,426	93.7	35	17.8	72.8
E09000033	Westminster	Inner London	242100	118975	2,149	112.7	37.7	15.9	72.3
E13000001	Inner London		3535700	1522541	31,929	110.7	34.7	38.5	54.7
E13000002	Outer London		5299800	2079422	125,424	42.3	36.9	13.8	71.7
E12000007	London		8835500	3601963	157,215	56.2	36	13.9	73.6
E92000001	England		55609600	-	13,025,967	-	40	19	63.3
K02000001	United Kingdom		65999100	-	-	-	40.1	18.8	63.3

row data

- Removing columns (unwanted)
- Removing special characters (£)
- Dealing missing value
- Renaming column names
- Converting column types (object to float)



Insights

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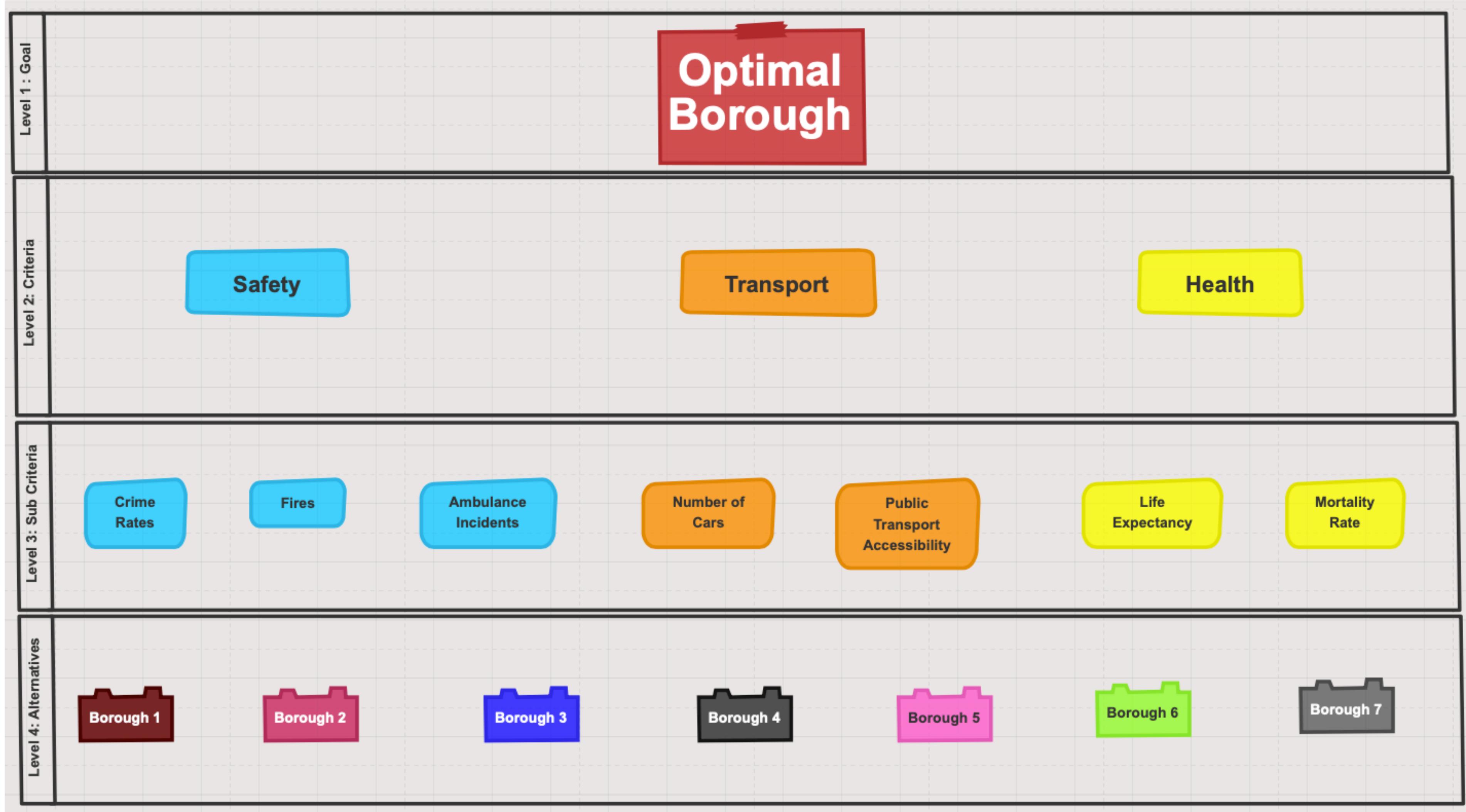
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Implement Model - AHP



Implement Model - Criteria / Sub Criteria

Demography

Population
Inland Area (hectares)
Average Age
Propor of Pop. Age (0-15)
International Migration

Diversity

% of Population Born Abroad
% of Largest Migrant Population
Main Language is Not English
New Migrant

Labour Market

Employment Rate
Household Income
% Adult Volunteered
Number of Jobs
Number of Business

Safety

Crime Rate
Fires / 1000 Population
Amb. Incident/ 100 Pop

Housing

House Price
Council Tax
New Homes

Environment

% of Area Greenspace
Total Carbon Emission
Waste Recycling Rate

Transport

Number of Cars
% of Adults Who Cycle
Public Transport Accessibility

Children

Achievement of 5 or more at GCSE
Rates of Children Looked After
% of Pupils First Language is Not English
% Children Living in out-of-work

Health

Male Life Expectancy
Female Life Expectancy
Life Satisfaction Score
Worthwhileness Score
Happiness Score
Anxiety Score
Mortality Rate

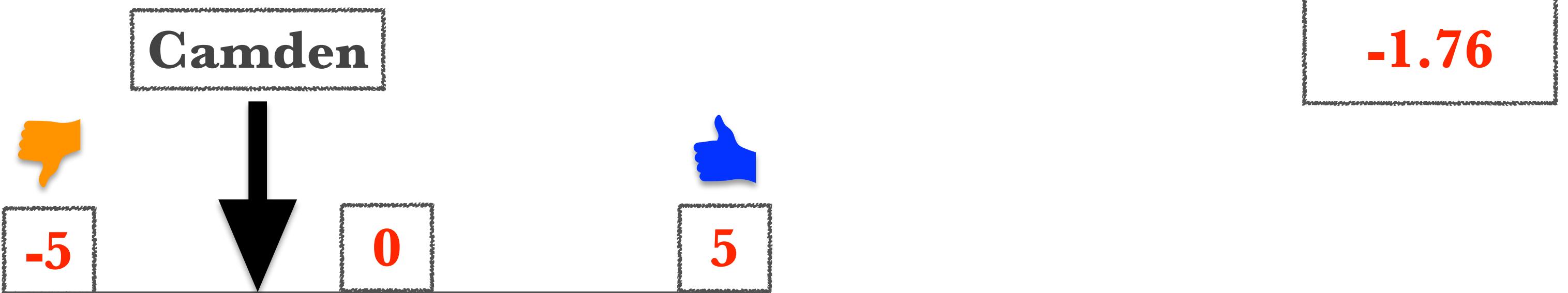
9 Criteria

37 Sub Criteria

Implement Model - Resampling

	min	max	Resample -1 	Resample 1 
Population	159000	389600	389600	159000
Inland Area	1212	15013	1212	15013
Average Age	31.40	40.30	40.30	31.40
Proportion of Age 0-15	15.90	27.20	15.90	27.20
Net International Migration	568	11182	11182	568

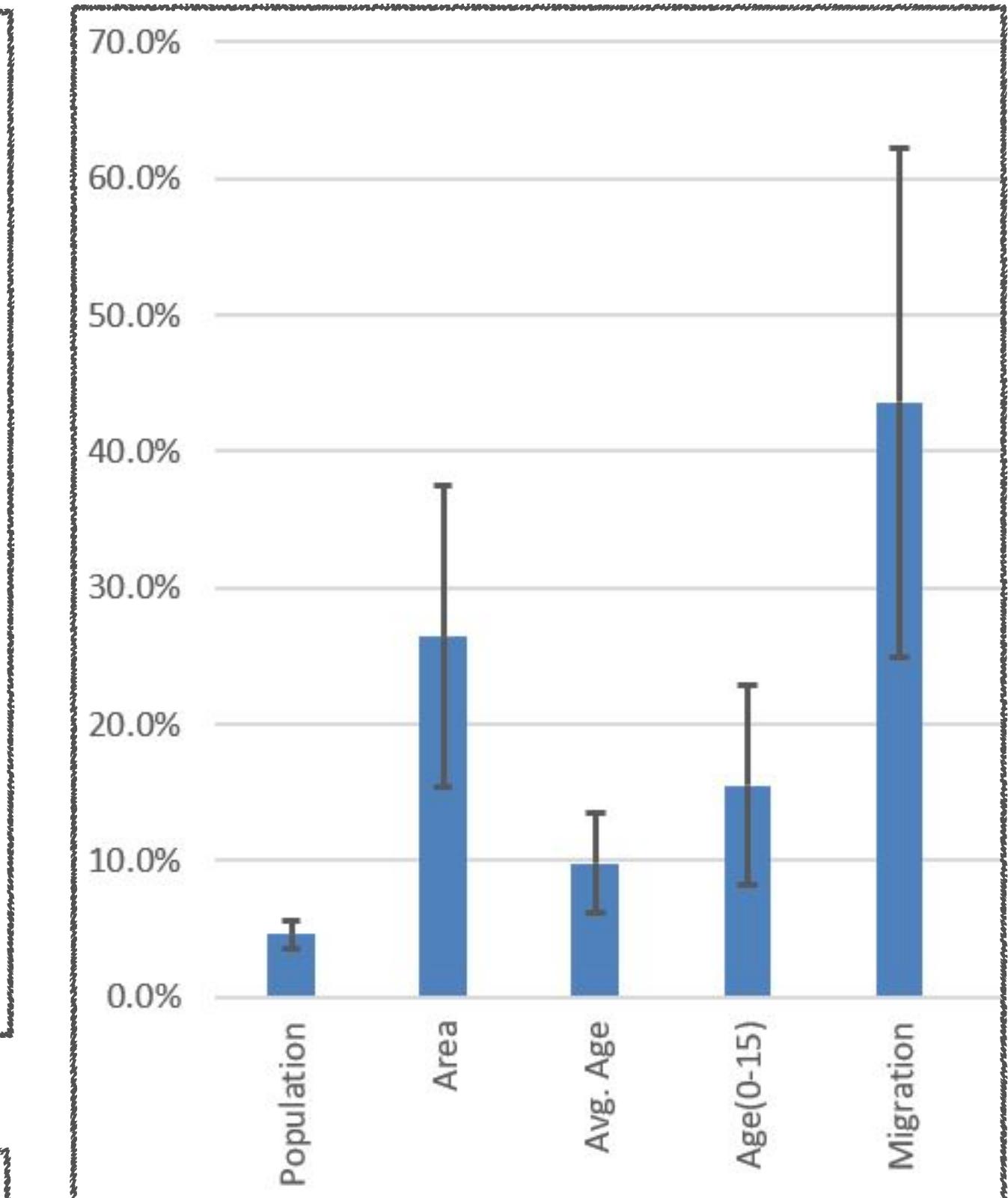
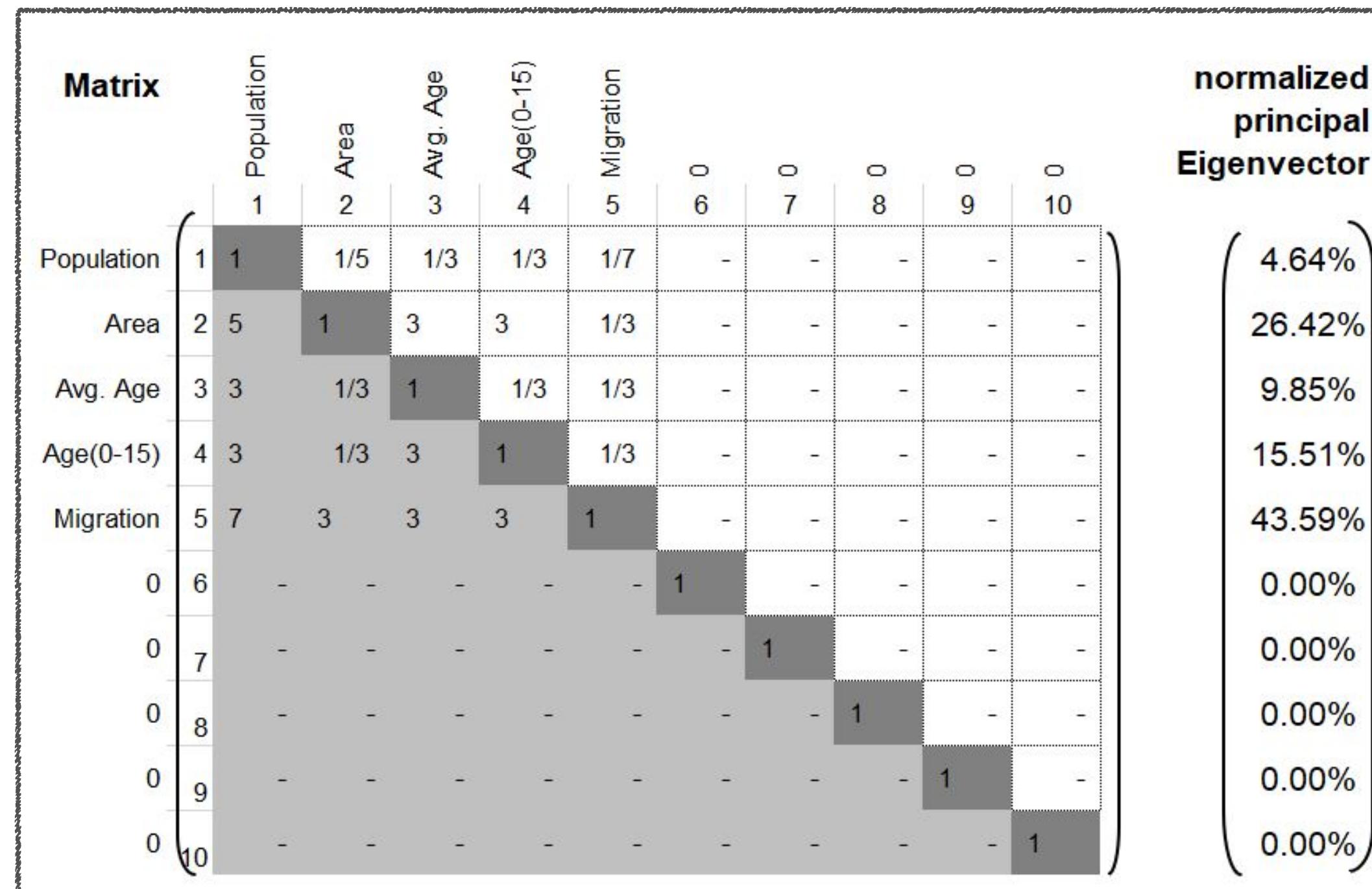
Camden Actual	Camden Resampled
242500	0.28
2179	-0.86
36.4	-0.12
17.3	-0.75
7504	-0.31



Implement Model - Criteria Weighted

Criteria		which is more important ?	Scale
A	B	A or B	(1-9)
Population	Area	B	5
	Avg. Age	B	3
	Age(0-15)	B	3
	Migration	B	7
Area	Avg. Age	A	3
	Age(0-15)	A	3
	Migration	B	3
Avg. Age	Age(0-15)	B	3
	Migration	B	3
Age(0-15)	Migration	B	3

Intensity of importance	Definition
1	Equal importance
3	Somewhat more important
5	Much more important
7	Very much more important
9	Absolutely more important
2, 4, 6, 8	Intermediate values



Criterion	Comment	Weights	+/-
1 Population	Population of Borough	4.6%	1.0%
2 Area	Inland Area (hectares)	26.4%	11.1%
3 Avg. Age	Average Age	9.8%	3.6%
4 Age(0-15)	Proportion of Population Aged 0-15	15.5%	7.3%
5 Migration	Net International Migration	43.6%	18.6%
6		0.0%	0.0%

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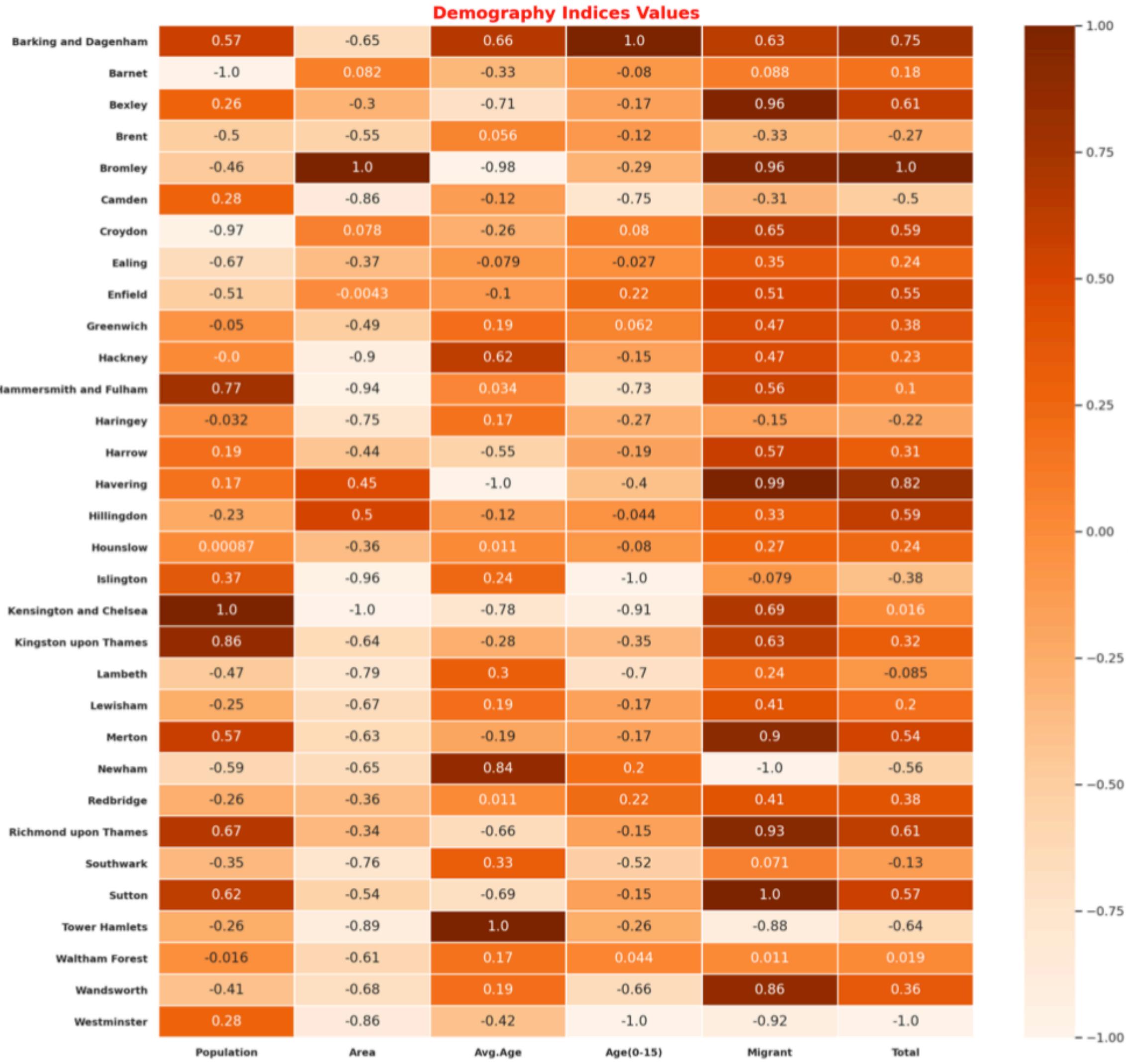
Implement Model - Sample Calculation

	Camden Actual	Camden Resample	Criteria Weighted	Weighted Result
Population	242500	0.28	4.6%	0.01
Inland Area	2179	-0.86	26.4%	-0.23
Average Age	36.4	-0.12	9.8%	-0.01
Proportion of Age 0-15	17.3	-0.75	15.5%	-0.12
Net International Migration	7504	-0.31	43.6%	-0.14

-1.76

-0.49

Visualisation - Heatmap for Demography



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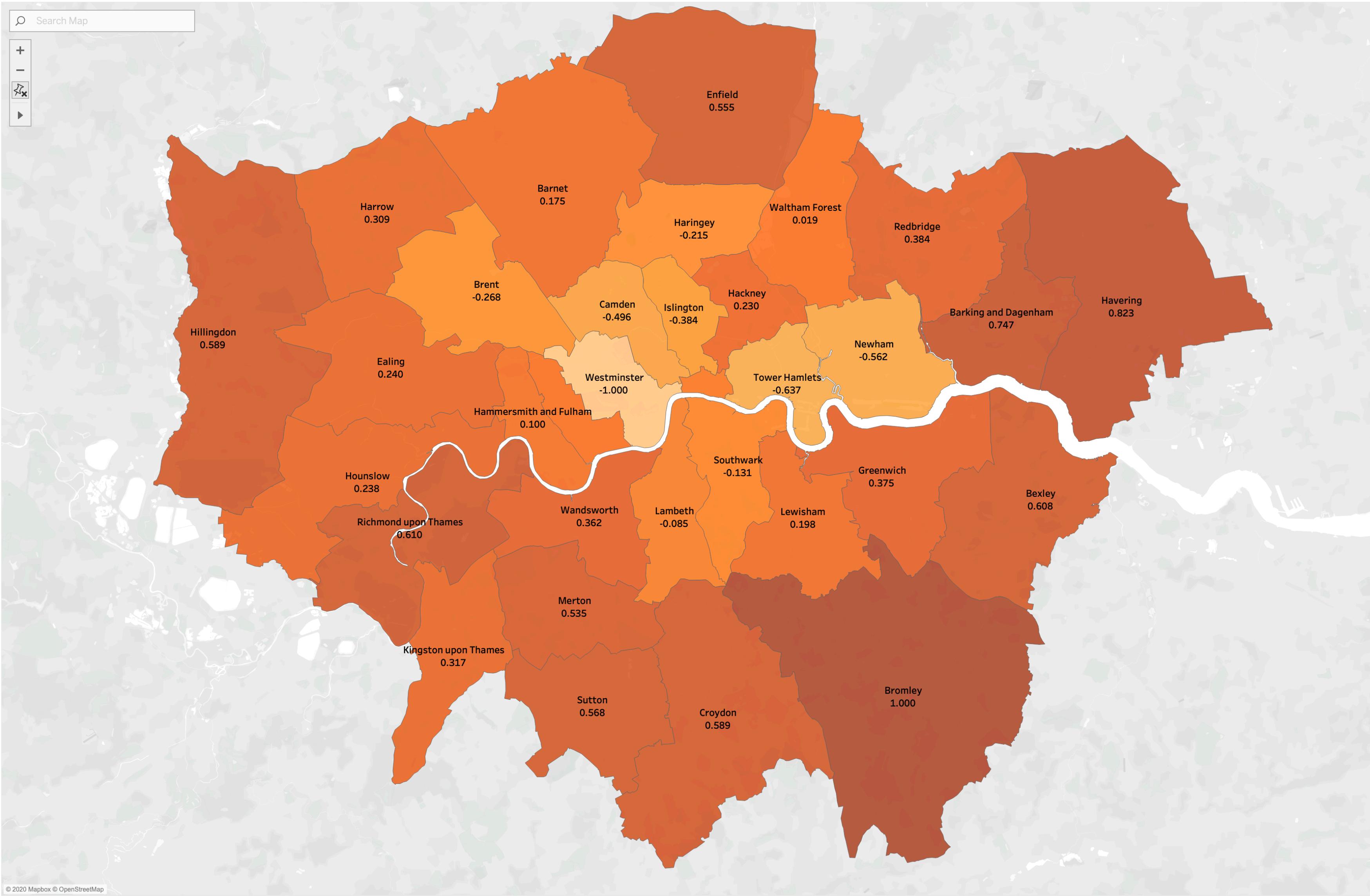
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Visualisation- Thematic Map for Demography Criteria



Diversity

Borough	DI.Ind_BornAbroad	DI.Ind_LarMigPop	DI.Ind_MaiLanNotEng	DI.Ind_NewMigr	DI_Total
Havering	1.00	1.00	1.00	0.95	1.00
Bromley	0.66	1.00	0.93	1.00	0.97
Bexley	0.76	0.79	0.92	1.00	0.86
Sutton	0.44	0.90	0.71	0.96	0.84
Richmond upon Thames	0.41	0.90	0.68	0.87	0.80
Kingston upon Thames	0.13	0.85	0.36	0.72	0.63
Croydon	0.14	0.65	0.46	0.62	0.51
Wandsworth	-0.01	0.85	0.30	0.39	0.49
Lewisham	-0.11	0.66	0.35	0.50	0.43
Lambeth	0.01	0.70	0.15	0.33	0.36

Labour Market

Borough	LM.Ind_EmpRat	LM.Ind_HouMedInc	LM.Ind_AdlVol	LM.Ind_NumJob	LM.Ind_NumBus	LM_Total
Westminster	-1.00	0.40	-0.23	1.00	1.00	1.00
Camden	-0.49	0.12	-0.33	-0.05	0.02	0.02
Barnet	-0.59	-0.12	0.23	-0.68	-0.20	-0.20
Islington	0.00	-0.18	0.13	-0.49	-0.36	-0.36
Ealing	0.01	-0.46	0.18	-0.70	-0.50	-0.50
Wandsworth	0.89	0.39	0.30	-0.78	-0.50	-0.50
Hackney	-0.51	-0.53	0.05	-0.78	-0.51	-0.51
Tower Hamlets	-0.31	-0.54	-0.39	-0.34	-0.52	-0.52
Lambeth	0.84	-0.28	0.16	-0.63	-0.56	-0.56
Southwark	0.23	-0.38	-0.11	-0.32	-0.57	-0.57

Safety

Borough	SA.Ind_CriRat	SA.Ind_Fires	SA.Ind_AmbInc	SA_Total
Harrow	1.00	1.00	0.98	1.00
Richmond upon Thames	0.93	0.85	1.00	0.94
Merton	0.89	0.63	0.86	0.86
Bexley	0.98	0.26	0.59	0.85
Sutton	0.93	0.48	0.69	0.85
Kingston upon Thames	0.90	0.63	0.73	0.85
Barnet	0.85	0.78	0.73	0.82
Bromley	0.83	0.26	0.71	0.76
Wandsworth	0.73	0.63	0.92	0.76
Redbridge	0.76	0.56	0.69	0.73

Housing

Borough	HA.Ind_HouPri	HA.Ind_CouTax	HA.Ind_NewHom	HA_Total
Croydon	0.88	-0.63	0.51	1.00
Newham	0.87	-0.13	0.09	0.94
Barking and Dagenham	1.00	-0.35	-0.40	0.92
Greenwich	0.80	-0.24	0.29	0.91
Tower Hamlets	0.64	-0.04	0.76	0.89
Harving	0.91	-0.72	-0.21	0.84
Lewisham	0.77	-0.40	0.16	0.83
Wandsworth	0.34	0.98	1.00	0.78
Enfield	0.84	-0.48	-0.44	0.74
Hillingdon	0.78	-0.42	-0.41	0.69

Environment

	EN.Ind_AreGre	EN.Ind_CarEmi	EN.Ind_WasRec	EN_Total
Borough				
Bromley	0.94	0.42	0.67	1.00
Havering	1.00	0.58	-0.17	0.99
Richmond upon Thames	0.64	0.84	0.31	0.83
Enfield	0.42	0.35	0.16	0.43
Hillingdon	0.57	-0.15	0.45	0.43
Kingston upon Thames	0.02	0.96	0.55	0.36
Redbridge	0.20	0.75	-0.37	0.30
Harrow	-0.05	0.89	0.52	0.26
Merton	-0.05	0.95	0.11	0.22
Barnet	0.23	0.17	0.13	0.19

Transport

	TR.Ind_NumCar	TR.Ind_AduCycle	TR.Ind_TraAcc	TR_Total
Borough				
Westminster	0.82	-0.26	1.00	1.00
Islington	1.00	0.15	0.61	0.79
Kensington and Chelsea	0.90	-0.18	0.66	0.74
Camden	0.86	-0.04	0.61	0.72
Hackney	0.94	0.43	0.22	0.51
Tower Hamlets	0.91	0.22	0.27	0.50
Southwark	0.62	0.05	0.22	0.37
Hammersmith and Fulham	0.91	0.05	0.12	0.33
Lambeth	0.51	-0.24	0.27	0.33
Wandsworth	0.12	0.83	-0.07	0.22

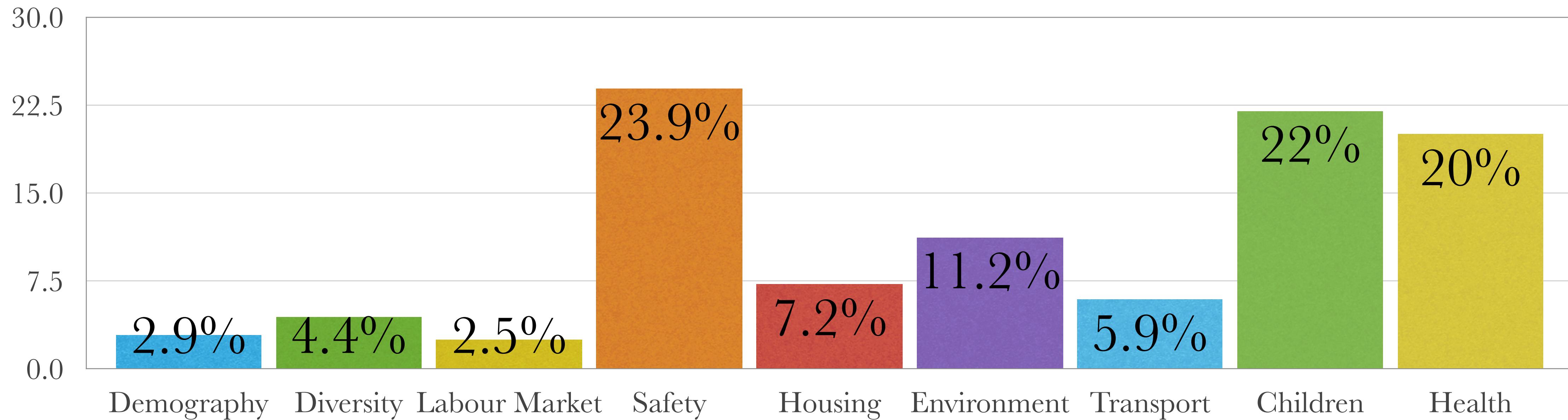
Children

	CH.Ind_AchGCSE	CH.Ind_ChLooAft	CH.Ind_PupFLNotEng	CH.Ind_LivOOHou	CH_Total
Borough					
Richmond upon Thames	1.00	1.00	-0.37	1.00	1.00
Kingston upon Thames	0.74	0.87	0.32	0.77	0.83
Merton	0.64	0.71	0.56	0.47	0.67
Redbridge	0.76	0.94	-1.00	0.54	0.65
Kensington and Chelsea	0.76	0.65	0.00	0.40	0.65
Bromley	0.66	0.55	0.34	0.49	0.62
Barnet	0.57	0.71	-0.01	0.59	0.59
Sutton	0.58	0.23	0.56	0.56	0.51
Harrow	0.45	0.81	-0.57	0.62	0.48
Westminster	0.35	0.58	-0.33	-0.14	0.21

Health

	HE.Ind_MaleLE	HE.Ind_FemaleLE	HE.Ind_LifSat	HE.Ind_WorWhi	HE.Ind_Happ	HE.Ind_Anx	HE.Ind_MorRat	HE_Total
Borough								
Barnet	0.58	0.30	0.67	0.67	0.33	0.67	1.00	1.00
Harrow	0.79	0.74	0.00	-0.67	0.00	0.83	1.00	1.00
Kensington and Chelsea	1.00	0.87	1.00	0.67	1.00	0.17	0.96	0.96
Richmond upon Thames	0.68	0.70	0.67	0.67	0.00	-0.00	0.94	0.94
Kingston upon Thames	0.54	0.09	0.00	0.33	0.33	-0.17	0.87	0.87
Redbridge	0.16	0.09	0.00	0.00	0.00	-0.00	0.85	0.85
Bromley	0.33	0.22	0.67	1.00	0.33	-0.17	0.73	0.73
Enfield	0.09	-0.13	0.00	0.00	0.00	1.00	0.66	0.66
Havering	-0.09	-0.22	0.33	0.33	-0.33	-0.17	0.52	0.52
Westminster	0.65	0.83	0.00	-0.33	-0.67	-0.33	0.47	0.47

Criteria Weights



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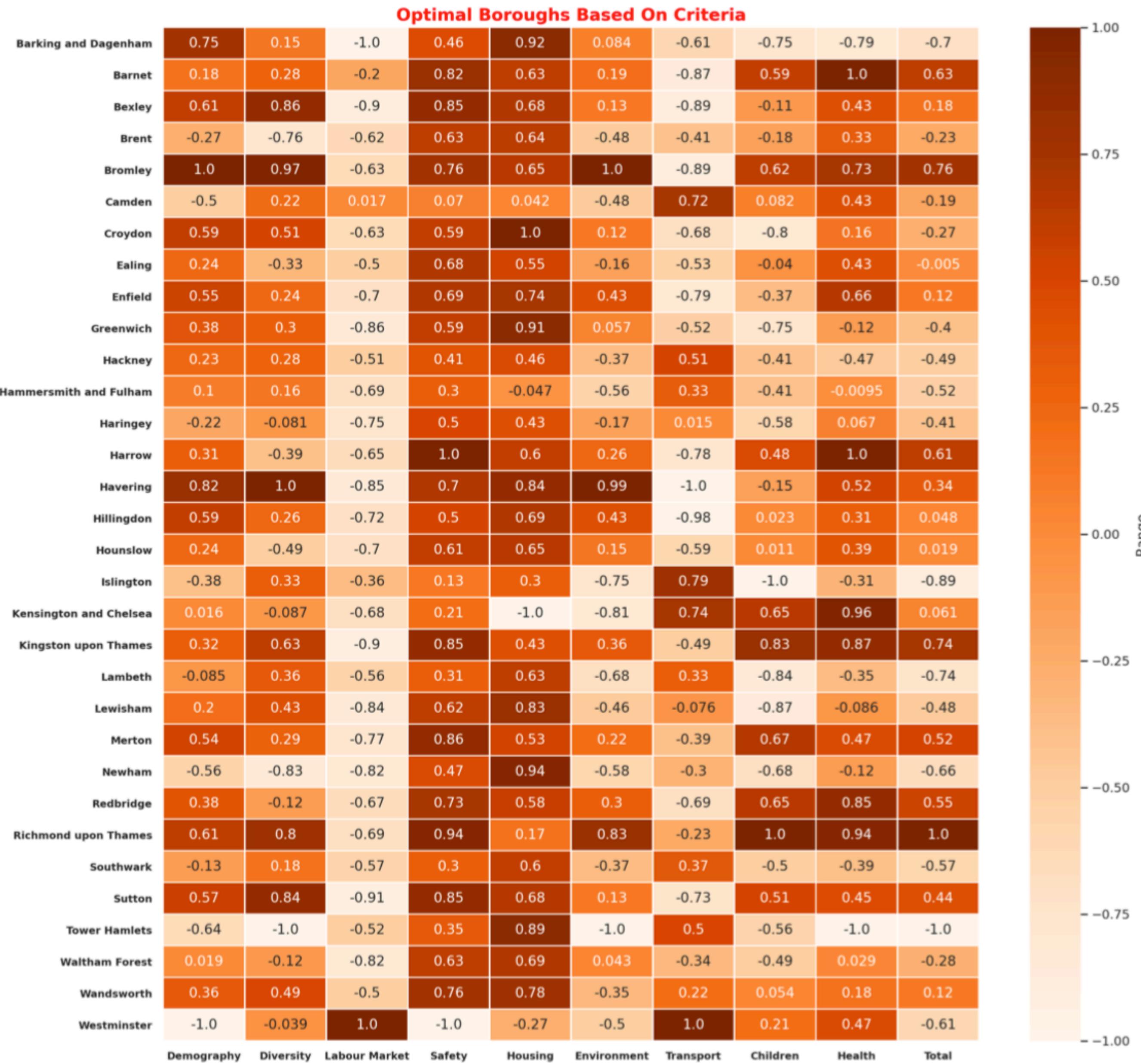
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- Richmond upon Thames, Bromley and Kingston upon Thames** are most suitable boroughs for moving in Outer London. Because of metrics that shown below:
 - Safety**
 - Children**
 - Health**
- Wandsworth** is most suitable borough for moving in inner London. Because of
 - Safety** (0.76)
 - Housing** (0.78) metrics
- Kensington and Chelsea** is the second suitable borough for moving in inner London Because of
 - Transport** (0.74),
 - Health** (0.96)
 - Children** (0.65)



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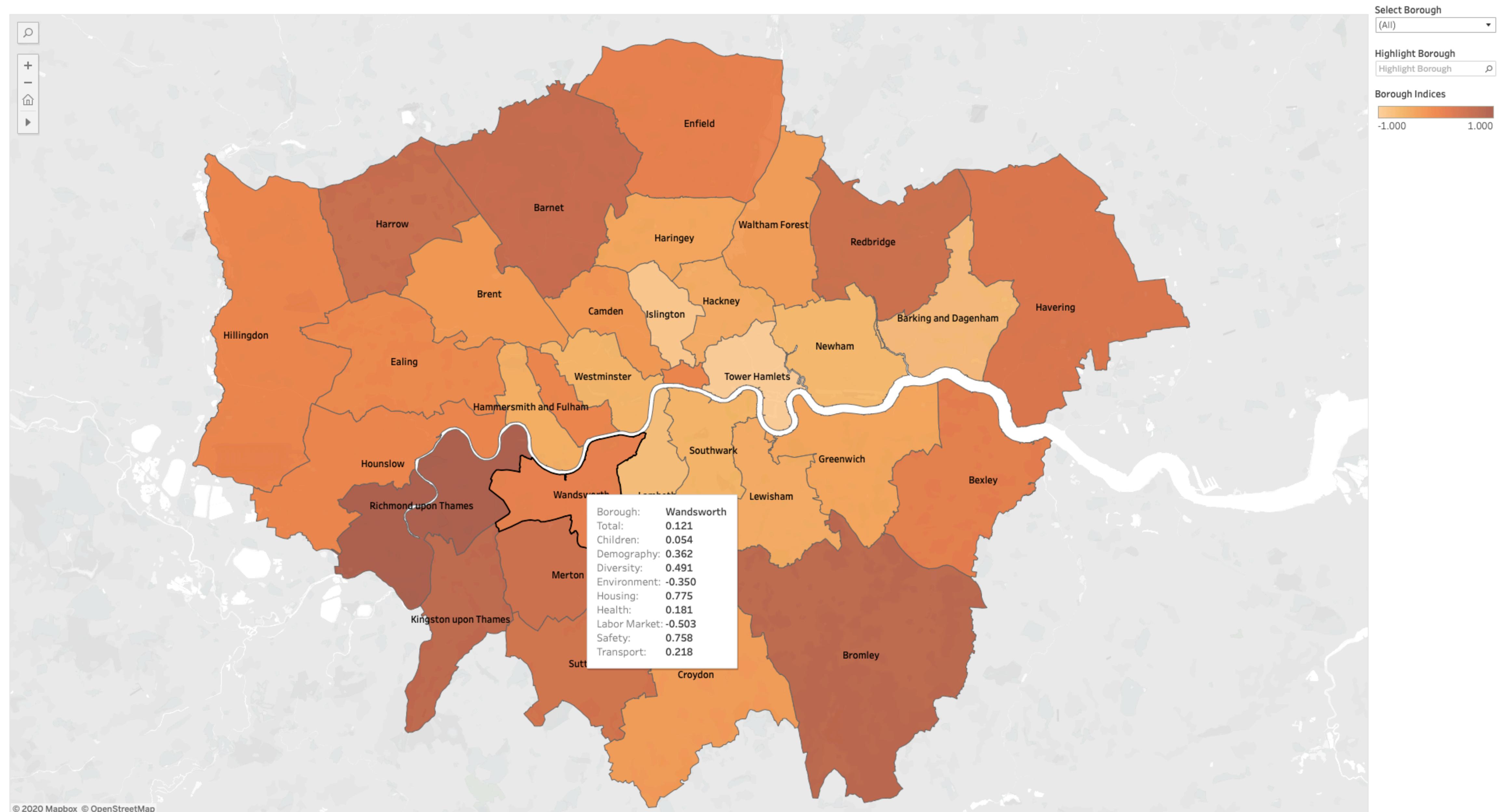
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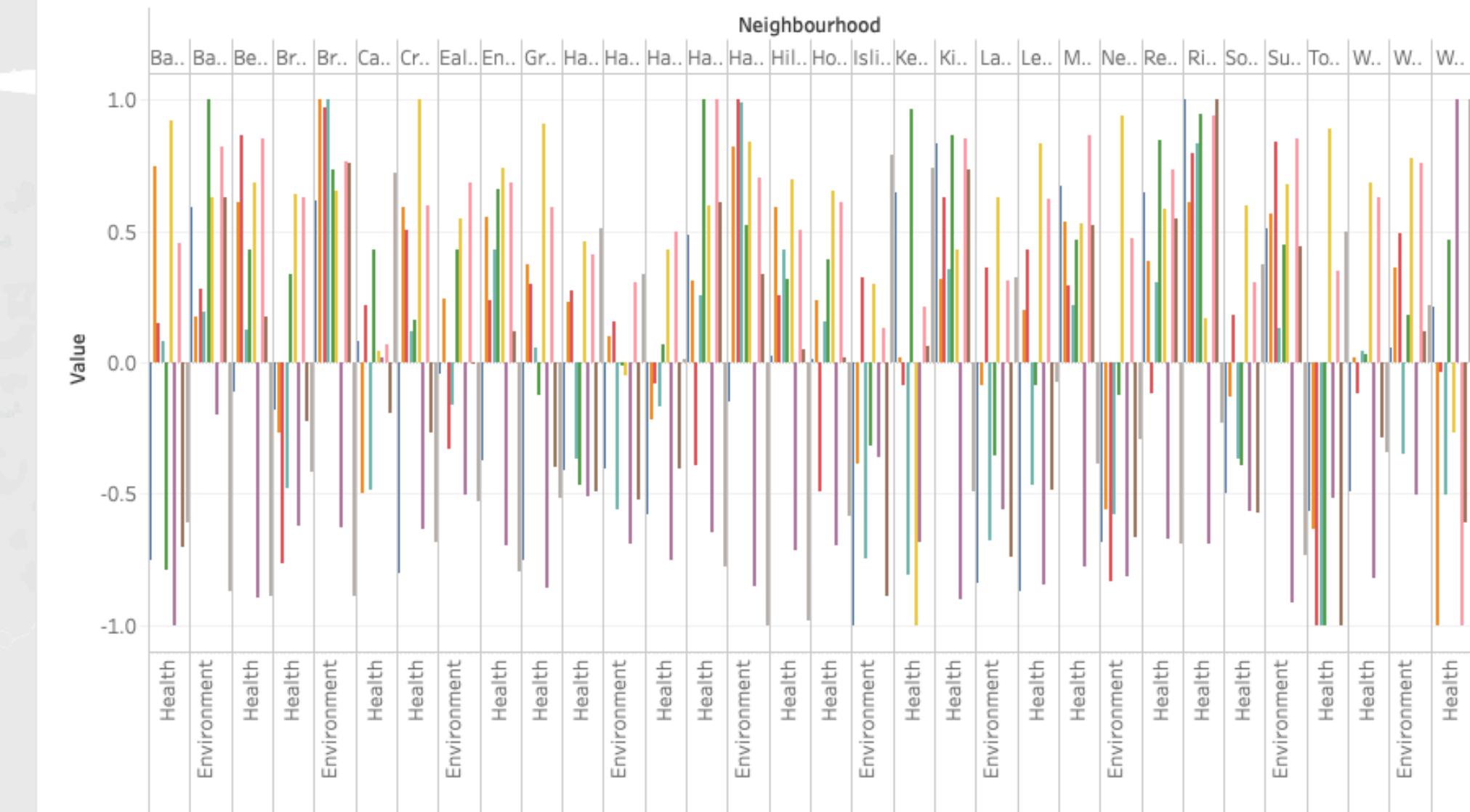
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Neighbourhood	Children	Demogr..	Diversity	Environ..	Health	Housing	Labor M..	Safety	Total	Transp..
Barking and Dagenham	-0.752	0.747	0.152	0.084	-0.790	0.917	-1.000	0.455	-0.702	-0.607
Barnet	0.591	0.175	0.277	0.194	1.000	0.630	-0.196	0.823	0.625	-0.872
Bexley	-0.114	0.608	0.862	0.127	0.429	0.682	-0.897	0.853	0.176	-0.886
Brent	-0.178	-0.268	-0.765	-0.479	0.333	0.639	-0.624	0.628	-0.226	-0.414
Bromley	0.617	1.000	0.971	1.000	0.733	0.650	-0.626	0.764	0.759	-0.886
Camden	0.082	-0.496	0.220	-0.483	0.429	0.042	0.017	0.070	-0.192	0.722
Croydon	-0.804	0.589	0.506	0.118	0.162	1.000	-0.632	0.595	-0.268	-0.684
Ealing	-0.040	0.240	-0.329	-0.159	0.429	0.545	-0.503	0.682	-0.005	-0.530
Enfield	-0.373	0.555	0.238	0.430	0.657	0.740	-0.698	0.685	0.118	-0.794
Greenwich	-0.750	0.375	0.299	0.057	-0.124	0.906	-0.857	0.588	-0.398	-0.516
Hackney	-0.410	0.230	0.276	-0.366	-0.467	0.463	-0.510	0.408	-0.494	0.508
Hammersmith and Fulham	-0.405	0.100	0.155	-0.559	-0.010	-0.047	-0.691	0.301	-0.522	0.333
Haringey	-0.580	-0.215	-0.081	-0.166	0.067	0.427	-0.750	0.500	-0.407	0.015
Harrow	0.484	0.309	-0.390	0.256	1.000	0.599	-0.648	1.000	0.611	-0.776
Havering	-0.152	0.823	1.000	0.990	0.524	0.838	-0.854	0.700	0.338	-1.000
Hillingdon	0.023	0.589	0.257	0.427	0.314	0.693	-0.716	0.504	0.048	-0.979
Hounslow	0.011	0.238	-0.489	0.155	0.390	0.650	-0.699	0.607	0.019	-0.587
Islington	-1.000	-0.384	0.325	-0.746	-0.314	0.300	-0.363	0.130	-0.887	0.788
Kensington and Chelsea	0.646	0.016	-0.087	-0.811	0.962	-1.000	-0.681	0.213	0.061	0.737
Kingston upon Thames	0.832	0.317	0.625	0.357	0.867	0.430	-0.901	0.849	0.736	-0.489
Lambeth	-0.838	-0.085	0.363	-0.678	-0.352	0.630	-0.561	0.309	-0.741	0.326
Lewisham	-0.869	0.198	0.426	-0.464	-0.086	0.834	-0.842	0.624	-0.484	-0.076
Merton	0.674	0.535	0.293	0.217	0.467	0.530	-0.774	0.864	0.519	-0.388
Newham	-0.684	-0.562	-0.833	-0.580	-0.124	0.940	-0.816	0.474	-0.662	-0.295



Select Criteria

Select Borough

Measure Values



-1.000 1.000

Highlight Borough

Highlight Criteria

Measure Names

- Children
- Demography
- Diversity
- Environment
- Health
- Housing
- Labor Market
- Safety
- Total
- Transport

Introduction

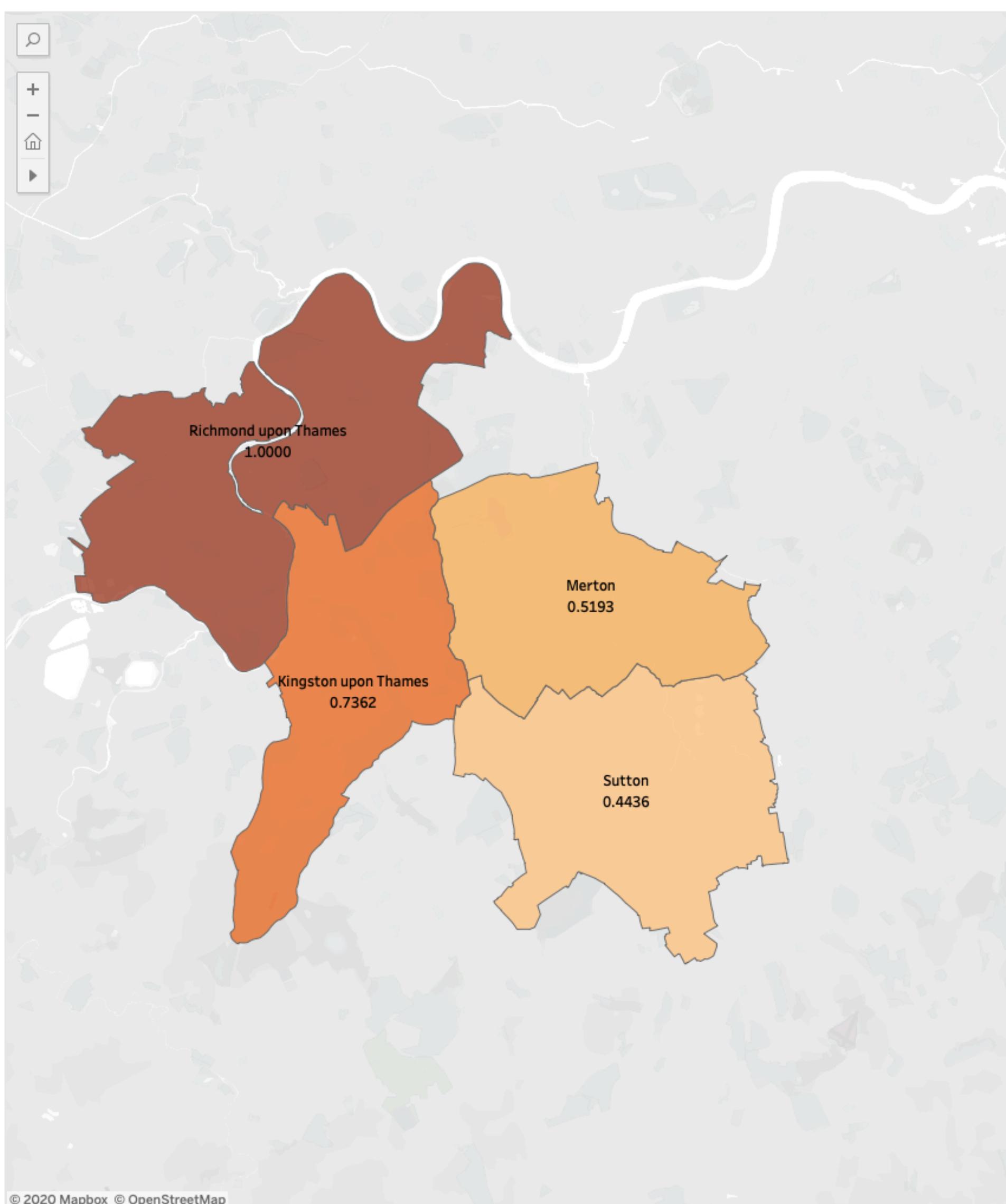
Methodology

Results

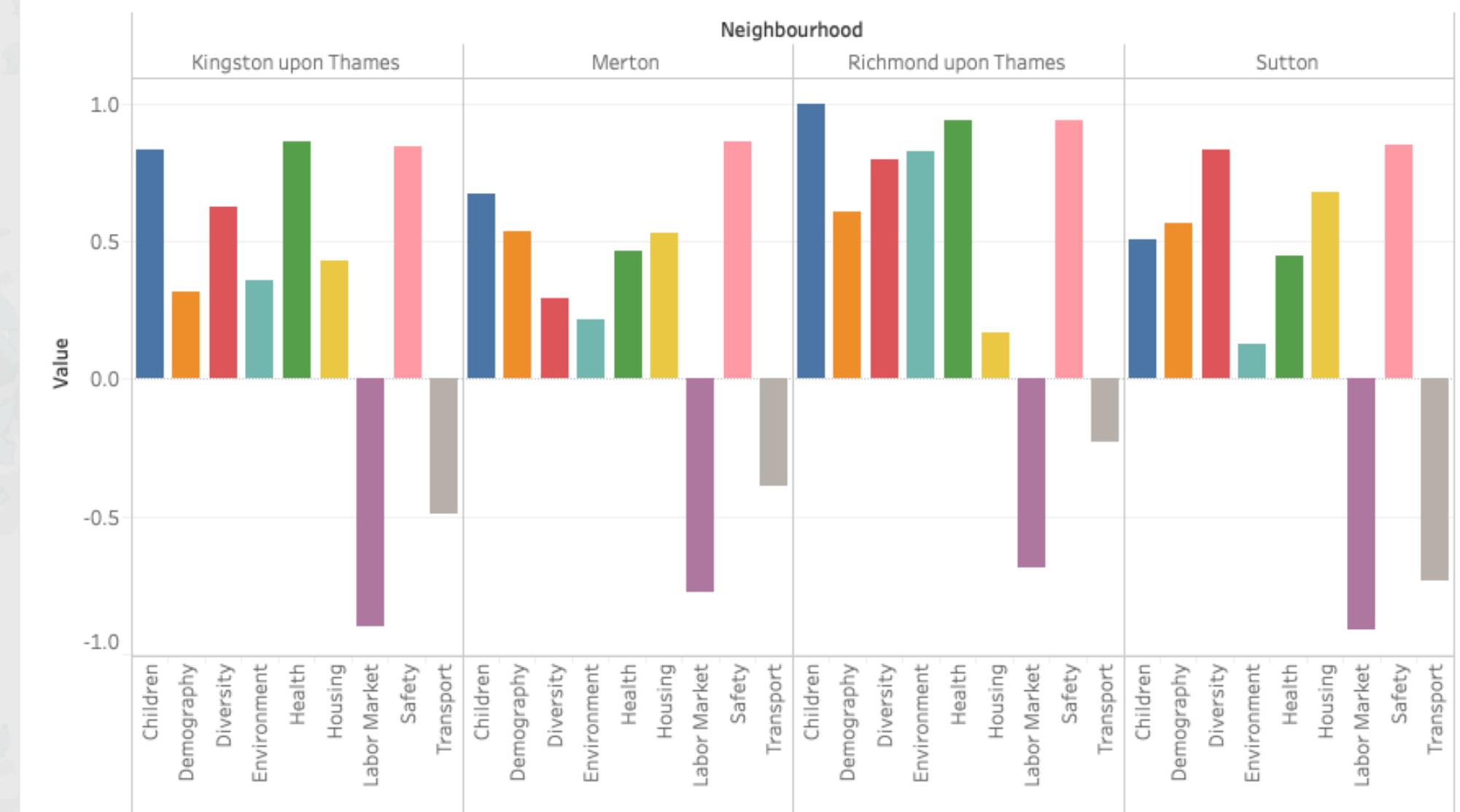
Conclusions

Future Work

Appendix



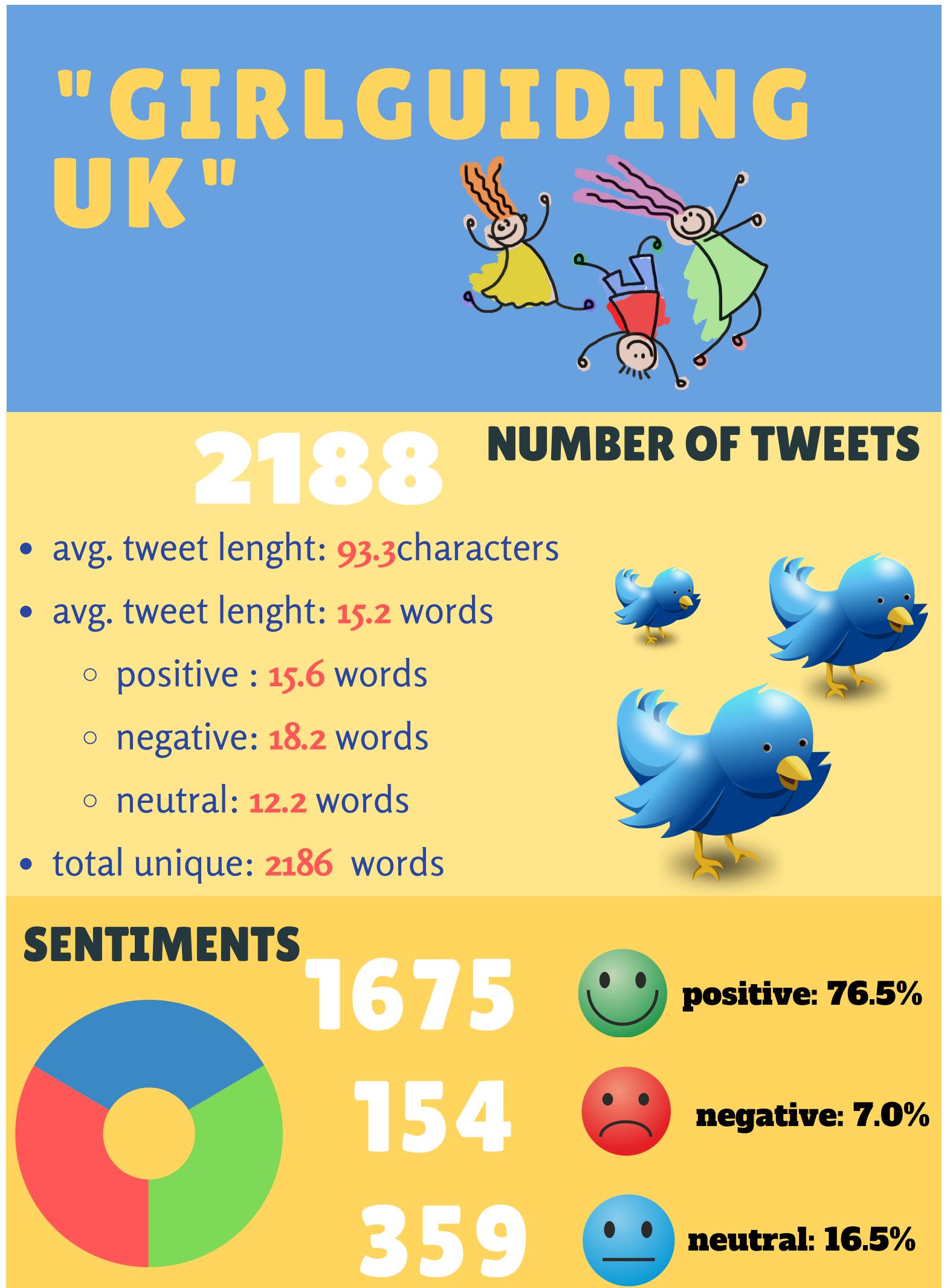
Neighbourhood	Children	Demogra..	Diversity	Environm..	Health	Housing	Labor Mar..	Safety	Transport	Total
Enfield	-0.373	0.555	0.238	0.430	0.657	0.740	-0.698	0.685	-0.794	0.118
Greenwich	-0.750	0.375	0.299	0.057	-0.124	0.906	-0.857	0.588	-0.516	-0.398
Hackney	-0.410	0.230	0.276	-0.366	-0.467	0.463	-0.510	0.408	0.508	-0.494
Hammersmith and Ful..	-0.405	0.100	0.155	-0.559	-0.010	-0.047	-0.691	0.301	0.333	-0.522
Haringey	-0.580	-0.215	-0.081	-0.166	0.067	0.427	-0.750	0.500	0.015	-0.407
Harrow	0.484	0.309	-0.390	0.256	1.000	0.599	-0.648	1.000	-0.776	0.611
Havering	-0.152	0.823	1.000	0.990	0.524	0.838	-0.854	0.700	-1.000	0.338
Hillingdon	0.023	0.589	0.257	0.427	0.314	0.693	-0.716	0.504	-0.979	0.048
Hounslow	0.011	0.238	-0.489	0.155	0.390	0.650	-0.699	0.607	-0.587	0.019
Islington	-1.000	-0.384	0.325	-0.746	-0.314	0.300	-0.363	0.130	0.788	-0.887
Kensington and Chelsea	0.646	0.016	-0.087	-0.811	0.962	-1.000	-0.681	0.213	0.737	0.061
Kingston upon Thames	0.832	0.317	0.625	0.357	0.867	0.430	-0.901	0.849	-0.489	0.736
Lambeth	-0.838	-0.085	0.363	-0.678	-0.352	0.630	-0.561	0.309	0.326	-0.741
Lewisham	-0.869	0.198	0.426	-0.464	-0.086	0.834	-0.842	0.624	-0.076	-0.484
Merton	0.674	0.535	0.293	0.217	0.467	0.530	-0.774	0.864	-0.388	0.519
Newham	-0.684	-0.562	-0.833	-0.580	-0.124	0.940	-0.816	0.474	-0.295	-0.662
Redbridge	0.648	0.384	-0.121	0.305	0.848	0.584	-0.671	0.734	-0.692	0.547
Richmond upon Thames	1.000	0.610	0.798	0.830	0.943	0.167	-0.688	0.938	-0.231	1.000
Southwark	-0.496	-0.131	0.178	-0.366	-0.390	0.596	-0.567	0.304	0.371	-0.573
Sutton	0.507	0.568	0.836	0.128	0.448	0.678	-0.912	0.853	-0.733	0.444
Tower Hamlets	-0.563	-0.637	-1.000	-1.000	-1.000	0.892	-0.515	0.346	0.498	-1.000
Waltham Forest	-0.489	0.019	-0.117	0.043	0.029	0.687	-0.817	0.626	-0.339	-0.284
Wandsworth	0.054	0.362	0.491	-0.350	0.181	0.775	-0.503	0.758	0.218	0.121
Westminster	0.212	-1.000	-0.039	-0.503	0.467	-0.265	1.000	-1.000	1.000	-0.610



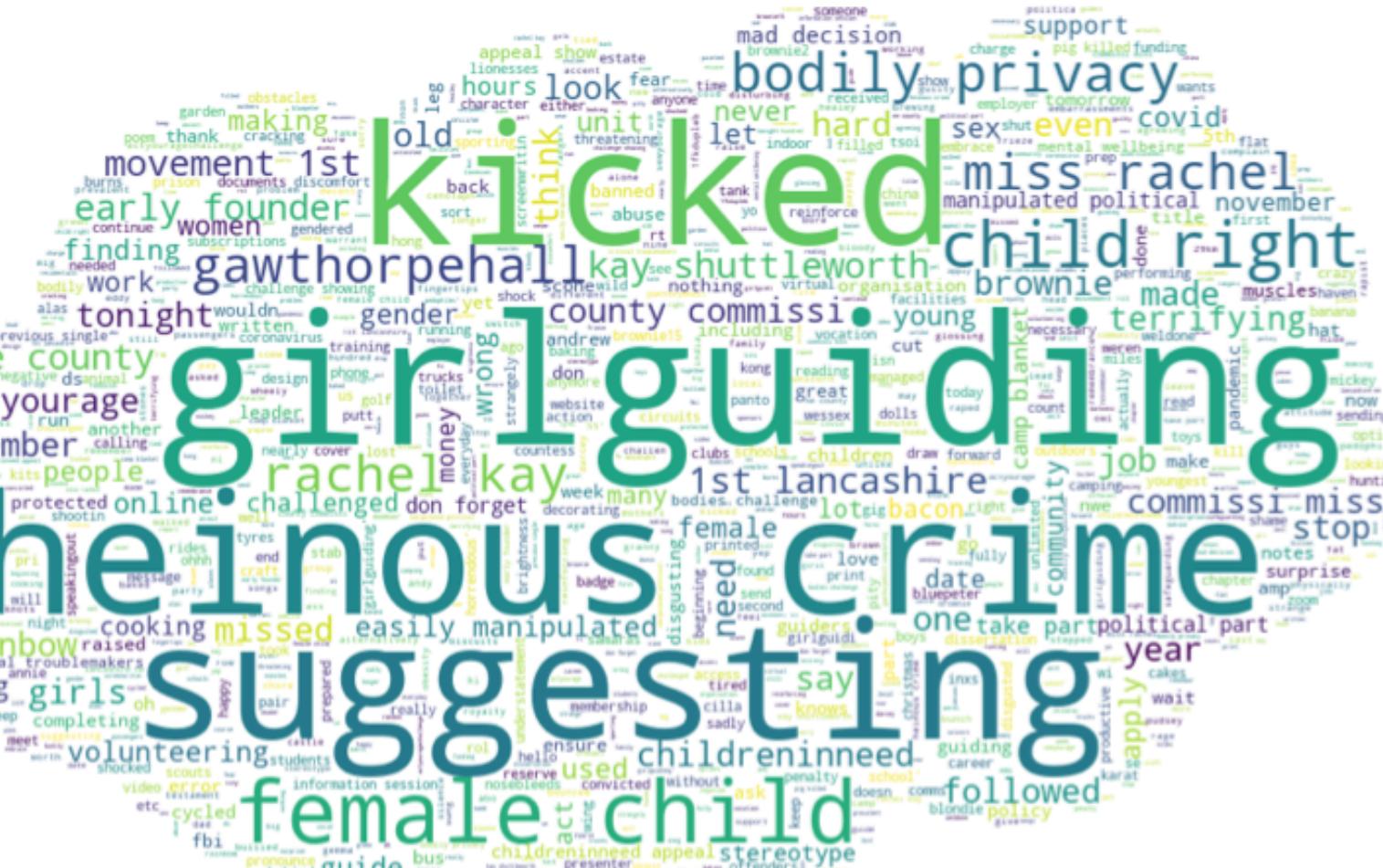
This project can be extended further by;

- Developing GUI and Performing AHP
- Analysing based on **zip code** on highest points boroughs.
- Obtain **additional data** for most weighted criteria such as
 - Number of schools based on ofsted report
 - Number of crime types details
 - etc.

Negative Tweets



2



Positive Tweets



WORDS	COUNT
challange	581
actyourage	563
complete	410
countess	379
wessex	367
support	365
hrh	346
shown	294
guide	248
brownie	303

WORDS (BIGRAM)	COUNT
actyourage challenge	404
countess wessex	366
completed actyourage	347
wessex shown	294
support completed	293
shown support	291
challange hrh	291
actyourage challenges	65
guides rangers	63
rainbows brownies	61

TOP WORD(S)

THANK YOU

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