Researching long-run trends in South East England 1931-2011 for the European Union and Greater London Authority

Paula Aucott[*1] and Humphrey Southall[†1]

[1]Department of Geography, University of Portsmouth

June 7, 2015

Summary

This paper describes the sources, methods and preliminary results of two related projects on historical census data funded by government bodies for policy purposes. Both required data for diverse historical reporting areas to be redistricted to a single set of modern units. All redistricting is done by a simple vector overlap method, but this requires boundary data for both the modern and the historical units; and, as far as possible, that the historical units be more detailed than the modern ones. Even for recent periods, locating boundary maps is often much harder than locating statistics.

KEYWORDS: historical GIS, policy relevance, redistricting, census

1. Introduction

Predicting long-term trends decades ahead requires data stretching back decades. Through its censuses since 1801, the UK has been gathering just such data, but the analytic potential is poorly exploited: "modern" census research generally looks just one or two censuses back, while "historical" census research focuses on the period 1851-1911 when reporting geographies were consistent.

This paper presents two highly applied census projects. The first, funded by the European Union, has created time series 1951 to 2011 for the total populations of the 8,941 Wards of Great Britain as used by the 2011 census. The second, funded by the Greater London Authority (GLA), is redistricting a diverse data from censuses 1801-1961, creating consistent data for the current London Boroughs, for London's Central Activity Zone (CAZ) as defined by the GLA, and for the overall GLA area; but we focus here on constructing consistent data on London's industrial structure, converting diverse historical classifications to Standard Industrial Classification 2007 (SIC).

Note that the statistical results presented here are preliminary and subject to revision.

2. Estimating historical populations of 2011 Wards

Earlier work for *Vision of Britain* (www.VisionofBritain.org.uk) included redistricting to modern units, but only to Britain's 408 districts. Redistricting to a geography twenty times more detailed requires more detailed input data, and different sources are used for each census year.

2011 and 2001 are not our concern, data being available from the Office of National Statistics. For 1991 and 1981 population counts and vector boundaries are available for 103,419 (1991) and 105,598 (1981) English Enumeration Districts, plus Welsh and Scottish EDs, so redistricting to 8,941 British

---

Wards is unproblematic. The historical statistics are associated with the boundaries of their contemporary administrative units and converted to the required output projection (where necessary). The historical polygons are spatially joined to the boundaries of the modern polygons, the population figures are interpolated and finally the boundaries are dissolved to give modern units with weighted statistics.

1971 is somewhat more complex. After significant investigation no digital mapping of real ward or enumeration district boundaries for this year has been found to exist. Instead we use the closest alternative, Thiessen polygons for Wards which were created by aggregating Census Enumeration Districts which themselves were generated from a centroid point dataset. The same processing method as above was employed, although the artificial boundaries meant some mismatching had to be manually corrected.

1961 was the first census year that many urban areas were "unparished", meaning that unless we map Ward boundaries, cities as large as Birmingham, with over a million people, are single polygons. We addressed this issue by seeking ward maps from the modern councils, archives and local studies libraries. The GLA provided a paper map covering all London Boroughs and Figure 1 shows the much higher density of polygons for wards in central London in comparison to the larger civil parish polygons in adjacent counties.

For towns where we could not obtain boundary maps, we located Wards as points then built Thiessen polygons. Overall, this is the most detailed mapping of the 1961 census ever done, as 1960s analyses either mapped Wards as points (Ministry of Housing and Local Government, 1966) or dealt only with parishes (e.g. Osborne, 1966). Although the current analysis covers only total populations, this GIS could map the 1961 census microdata being restored by a project at Essex University.
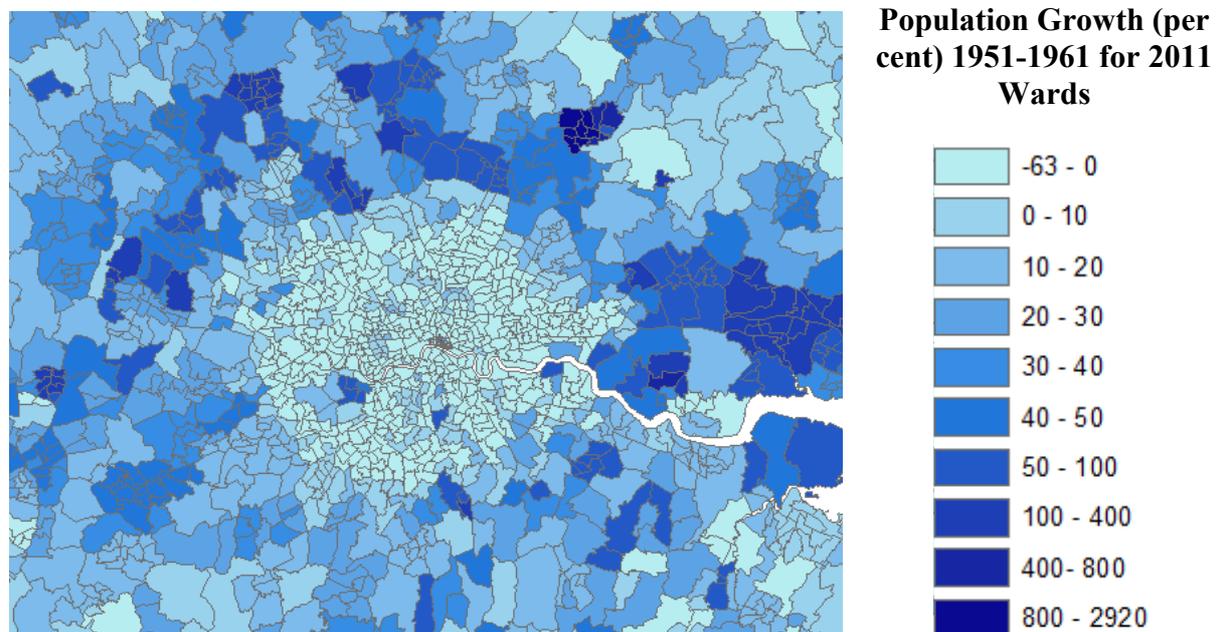

Population Growth (per cent) 1951-1961 for 2011 Wards

	-63 - 0
	0 - 10
	10 - 20
	20 - 30
	30 - 40
	40 - 50
	50 - 100
	100 - 400
	400 - 800
	800 - 2920

Figure 1 The Wards of Greater London in 1961, plus Civil Parishes in adjacent areas.

Table 1 provides a very simple summary of our calculations of population densities for constant geographical areas over sixty years, grouping wards by their distance from Nelson's Column; we were able to include 1951 because the 1961 Census listed 1951 populations of 1961 wards and parishes. The distance zone of most rapid growth is highlighted in bold, and the zone of least growth, or contraction, is italicized. During the first four decades the zone of highest growth is clearly moving outwards through and beyond the Green Belt. The innermost zone experienced the most rapid decline up to 1991, but then very strikingly became the zone of maximum growth.

Table 1 Mean Decennial Population Growth within a 50 mile radius of central London

Distance (Miles)	Growth 1951-61	Growth 1961-71	Growth 1971-81	Growth 1981-91	Growth 1991-2001	Growth 2001-11
5	*-5.22*	*-16.50*	*-17.61*	*-9.61*	**22.75**	**16.54**
10	-4.07	-4.96	-6.45	-4.95	12.42	14.16
15	12.23	5.67	-2.69	-4.48	7.28	8.67
20	33.88	8.20	-1.50	-3.71	9.09	9.42
25	**41.21**	19.98	4.95	-1.14	*7.02*	6.32
30	32.43	**31.73**	9.44	-0.01	8.67	8.41
35	17.46	23.66	10.14	3.64	8.08	*5.64*
40	10.03	21.95	12.16	3.61	11.33	8.88
45	10.76	4.75	**13.61**	**5.43**	12.72	11.20
50	12.89	27.29	7.82	5.32	11.57	9.84

3. Longer-run trends in industrial structure

A wide range of census variables are available via the Small Area Statistics from 1971 onwards, and similar data are becoming available from transcriptions of individual level census returns via Essex's Integrated Census Microdata system (http://icem.data-archive.ac.uk). However the latter is legally limited to data over a hundred years old, so long run overall perspectives must draw on the published census reports.

The Greater London Authority need data on industrial structure, so our work is drawing on four pre-digital censuses: 1841, 1881, 1931 and 1951. However, work on the first two is incomplete while we can include comparable data for 1971 and 2011. For 1931 and 1951 the historical geography is simpler than in the population analysis, data being reported for the pre-1974 system of local government districts, but instead of simple population counts we have to work with a different industrial classification for each date, and re-classify each to the Standard Industrial Classification (2007) used by the 2011 Census.

Despite working with 438 detailed categories in 1931 and 160 in 1951, they describe manufacturing in much greater detail than services and some SIC "Sections", such as "Information and Communication", cannot be identified at all. Once data are re-classified, they are redistricted using a Geography Conversion Table derived from the parish-level table from the relevant census, our equivalent Civil Parish GIS coverage, and the available 2011 Local Authority District boundaries.

Table 2 Changes in Industrial Structure (SIC 2007) 1931-2011

Area	Year	Total	C: Manuf-acturing	G: W'sale +Retail Trade	H: Transport + Storage	K: Finance +Insur.	O: Public Admin-istration
Greater London	1931	3,688,129	1,141,278	649,325	372,833	112,622	188,862
	1951	4,145,021	1,443,653	633,725	418,131	185,295	311,408
	1971	3,921,180	1,010,450	612,620	422,210	251,670	332,270
	2011	4,500,481	142,654	550,529	242,411	409,904	265,069
City of London	1931	9,534	2,354	1,716	573	473	548
	1951	322,052	66,130	57,767	51,957	90,940	7,822
	1971	336,490	45,350	27,380	51,050	134,640	11,520
	2011	356,706	2,864	14,242	4,832	163,425	7,105

Table 2 shows preliminary results for five selected SIC 2007 Sections, which have in fact been calculated for all the individual boroughs. Note that the 1931 data are unavoidably based on place of residence rather than work, with large consequences for the City of London data.

4. Conclusion

The Great Britain Historical GIS project has been working for over twenty years with historical census data. Our experience shows it is quite possible for historical GIS research to achieve significant non-academic "impact", and to draw on a wider range of funding, but significant adaptations in approach are necessary. Firstly, research must come up to the present, and achieving long runs of data requires new skills: disinterring obscure statistical datasets; locating even more obscure boundary maps; even negotiating copyright.

Secondly, both policy makers and the general public have more need for local time series than for maps. Further, policy makers almost always require time series for modern units, even though it is generally easier to redistrict modern small area data to less detailed historical units. This means that once the above ingredients are assembled GIS techniques must be used to redistrict these diverse data sets to a single constant geography.

Despite the extensive research into complex redistricting algorithms, we use simple vector overlay – "cookie cutter" – methods for two reasons (Simpson, 2002). Firstly, the improvement in accuracy from more complex methods is limited, and finding more detailed historical datasets uses our time better. Secondly, these simpler techniques are more easily explained to non-technical audiences. Our focus is on real world use, both the public bodies funding the work described here and the general public accessing our web site: *Vision of Britain* had 1.65m. "unique visitors" in 2014 and the most accessible statistical content is redistricted data for modern districts.

5. Acknowledgements

6. Biography

Paula Aucott is a Senior Research Associate and doctoral candidate in the Department of Geography, University of Portsmouth; she has Masters degrees in English Local History and in GIS, and is the project manager for the Great Britain Historical GIS. Humphrey Southall is Professor of Historical Geography at the University of Portsmouth and director of the Great Britain Historical GIS.

References

Ministry of Housing and Local Government (1966) *Population change 1951-1961 by wards and civil parishes: compiled from the 1961 census. Scale 1:625,000.* Ordnance Survey, Southampton.

Osborne R H (1966) *Atlas of Population Change in the East Midland Counties 1951-1961.* Department of Geography, University of Nottingham.

Simpson L (2002). Geography conversion tables: a framework for conversion of data between geographical units. *International Journal of Population Geography,* 8(1), 69-82.