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Chapter 1
The 2011 Census in the United Kingdom

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Abstract

In this introductory chapter, some context is established for the 2011 Census and for the chapters which follow in the remainder of the book by reviewing the way in which populations in different countries are counted and the demise of traditional census-taking that is evident across Europe. The future of the census in the United Kingdom has been debated widely over the current decade and the arguments for and against its continuation are summarised. Efficient census data dissemination to the academic user community is critical for high quality and timely research; the role of the UK Data Service-Census Support in this process is explained and the content and structure of the book are outlined.

1.1 Introduction

Most countries around the world recognise that, in order to provide services, administer effectively and guide development, it is essential to collect reliable and comprehensive data on the magnitude, composition and distribution of their populations. The primary source of basic demographic statistics is a population census which involves "the total process of collecting, compiling, evaluating, analysing and publishing or otherwise disseminating demographic, economic and social data pertaining, at a specified time, to all persons in a country or in a well-delimited part of *the country"* (United Nations Statistics Division, 1997, p.3). The socio-demographic data that are collected by this process not only support needs assessment, policy formulation and strategic planning, but they also underpin a wide range of research studies and are often used in combination with data from other sources or as a benchmark, a gold standard, against which data from elsewhere may be compared.

On 27 March 2011, censuses were taken by each of the national statistical offices (NSOs) in the United Kingdom (UK) – the Office for National Statistics (ONS) in England and Wales, National Record of Scotland (NRS) and the Northern Ireland Statistics and Research Agency (NISRA) – continuing a tradition that began in 1801 in England, Wales and Scotland and in 1821 in Northern Ireland. In a 'traditional' census, questionnaire forms are delivered to and collected from every household by

designated enumerators, but the UK is one of a number of countries whose census forms in 2011 were posted out to 25 million addresses with the option of respondents being able to complete and submit their answers to the census questionnaire online or by post and with the additional phase of identification and follow-up of non-respondents.

This introductory chapter of the handbook has three aims. First, in Section 1.2, it provides some global context for the UK Census held in 2011 by reviewing the ways in which populations have been counted in countries across the world in what the United Nations Statistics Division (2013) refer to as the 2010 Census Round. Second, given the evidence that many countries, particularly in Europe, have decided to replace traditional census collection methods with approaches that collect demographic data from administrative registers and sample surveys (Valente, 2010), Section 1.3 considers the arguments for and against the continuation of the census in the UK in its current form. This debate, leading to the National Statistician's recommendation in 2014 for a census in 2021, has underpinned ONS' Beyond 2011 programme[1] and the subsequent Census Transformation Programme[2].

Due to the volume and detail of the data collected for processing, various statistical products have been released by the NSOs in stages commencing in July 2012, with ONS producing all statistics for the UK. In Section 1.4, the different channels of access to these statistics are summarised and the role and structure of the UK Data Service-Census Support in providing a 'one stop shop' for users to access and download aggregate statistics, origin-destination flows, boundary data and cross-sectional microdata from the 2011 Census, is explained. In the final section of the chapter, the rationale for the structure and content of the chapters that follow is outlined.

1.2 Counting populations around the world

[1] http://www.ons.gov.uk/ons/about-ons/who-ons-are/programmes-and-projects/beyond-2011/reports-and-publications/index.html

[2] http://www.ons.gov.uk/ons/guide-method/census/2021-census/about-the-census-transformation-programme/index.html

The 2010 World Population and Housing Census Programme[3] of the United Nations Statistical Division (UNSD) reports that 214 out of 235 countries (or areas) conducted some form of population and housing census at least once during the 2010 Census Round (between 2005 and 2014) where the term 'census' is used in its broadest sense to include traditional censuses, population registers, the use of administrative records, sample surveys and data from other surveys. The UK is one of 60 countries whose census was taken in 2011, in close temporal proximity to population censuses carried out in Portugal (21 March), the Czech Republic (25 March), Curacao (26 March), Croatia and Poland (31 March). Subsequently, the UNSD (2013) reported the results of two surveys, the first based on a sample of 138 responding countries on how they have implemented their censuses, and a second of 126 countries on what lessons can be learned to inform the formulation of the Third Revision of The Principles and Recommendations for Population and Housing Censuses (UNSD, 2014). The results of the first survey (UNSD, 2011), summarised in Table 1.1, suggest that whilst 83% of the 138 countries responding carried out a traditional census with full enumeration as their main methodology, many countries had developed alternative methods when compared to previous rounds.

Table 1.1 Main census methodology for the 2010 census round, by geographical region

World region	Countries responding	Traditional census	Administrative register(s)	Rolling census	Other*
Africa	29	29			
Asia	39	35	2		2
Europe	39	21	12	1	5
North America	4	3	1		
Oceania	5	5			
Latin America and Caribbean	22	22			
Total	138	115	15	1	7

* Combination of data sources including registers with full or partial enumeration and/or sample surveys.
Source: UNSD (2011, Table 2.1, p. 10)

All the countries in Africa, Oceania, Latin America and the Caribbean responding to the survey took a traditional census whilst all but four in Asia did so; Bahrain and Singapore used a register-based census, whilst Turkey and Israel, together with five European countries (Estonia, Italy, Latvia, Lithuania and Poland)

[3] http://unstats.un.org/unsd/demographic/sources/census/census3.htm

used a combination of data sources. France is the only country in the world which counts its population using a rolling census, whereas nearly one third of the responding countries in Europe now use administrative registers. The results of the UNSD survey align with those obtained from other studies. An inventory of internal migration data collections among the 193 UN member states built as part of the IMAGE project (Bell et al., 2015) indicates that 88% of the 179 countries collecting migration data did so using a census, although this study confirms an increasing number of countries, particularly in Europe, are using 'register-based censuses' or 'combined censuses' which link data from registers and surveys. Similarly, the Ethnicity Counts? project (Kukutai et al., 2015), investigating how different countries count their ethnic populations between 1984 and 2014, created a database which provides evidence of an absolute decline in countries undertaking a traditional census between the 1990 and 2010 rounds, the growing use of administrative data, and the wider use of survey data.

In summary, whilst census-taking retains its importance in many countries, particularly in the less developed world, full enumeration using a traditional census is becoming much less popular in more developed countries, particularly in Europe where many countries use population registers as the source of their demographic statistics (Poulain and Herm, 2013) and where opportunities to generate population counts that combine data from different administrative sources using electronic data linkage techniques has gained ground in recent years. In view of these, developments, Coleman (2013) refers to the 'twilight of the census' as many NSOs consider the future of their census-taking methodologies and explore alternative options that are available. In the UK, the debate on the future of the census is captured in the consultation and research activities involved in the ONS' 'Beyond 2011' which, since January 2015, became the 'Census Transformation Programme'.

1.3 Census-taking in the UK: benefits and concerns

The question we address in this section is what are the reasons that are driving the consideration of alternative approaches to a traditional census which has served the country pretty well for over 200 years and which generates a range of products that provide essential data for public administration, governance and research as well as

for strategic planning by private enterprises, community groups and voluntary sector agencies.

In England and Wales, the aggregate data products derived from the 2011 Census and released subsequently by the ONS include: population and household estimates plus headcounts for postcodes; univariate Key Statistics (KS) presented in 35 tables and Quick Statistics (QS) which are more detailed data about a single topic available from 74 tables; Detailed Characteristics (DC) with more detailed multivariate data (218 tables) that are not available for the smallest areas (output areas) and Local Characteristics (LC) which are less detailed (184 tables) but are available for small areas; and populations with a base alternative to usual residence that include those with second addresses and short-term residents as well as workplace and workday populations. Whilst each of these products, after statistical disclosure controls have been applied, provides estimates of single area attributes, Origin-Destination Statistics (ODS), also known as flow data, include the counts of flows of migrants, those commuting to work, students and second home owners between two geographical areas. In addition, there are the cross-sectional samples of microdata derived from the full census and the longitudinal microdata that link a sample of individuals between censuses.

As well as the 100% census aggregate and flow estimates and the various unadjusted sample census data sets, there are also data products that are derived from the primary data which are of value to different user communities. Among the examples of these products are the area classifications that are produced either by the national statistics office or by researchers in collaboration with an NSO or by independent researchers in the public or private sectors. For example, the first 2011 Census geodemographic classification was produced for output areas (2011 OAC) in partnership with University College London (Gale, 2014). This is a three-tiered hierarchical geodemographic classification of the whole of the consisting of eight supergroups, 26 groups and 76 subgroups[4]. Figure 1.1 illustrates the distribution of supergroups in the central and inner suburbs of Leeds, showing the 'Cosmopolitan' demographic of much of City and Hunslet, Hyde Park and Woodhouse and Headingley, all census wards with large student populations. To the east and south

[4] Available from: http://geogale.github.io/2011OAC/

are found suburbs classified as 'Multicultural Metropolitan' (Chapel Allerton, Gipton and Harehills and Beeston and Holbeck, interwoven with areas classified as 'Hard-Pressed Living' (such as Burmantofts and Richmond Hill) and 'Constrained City Dwellers' (Armley) with increasing numbers of 'Suburbanites' and 'Urbanites' (e.g. Weetwood, Moortown, Roundhay) with distance from the city centre. More recently, a Classification Of Workplace Zones (WZs) for England and Wales (COWZ-EW) has been constructed at the University of Southampton in collaboration with ONS using k-means clustering based on 48 census variables selected for their ability to differentiate types of workers and workplaces to produce a two-tier WZ classification of seven supergroups and 29 groups[5] (Cockings et al., 2015).

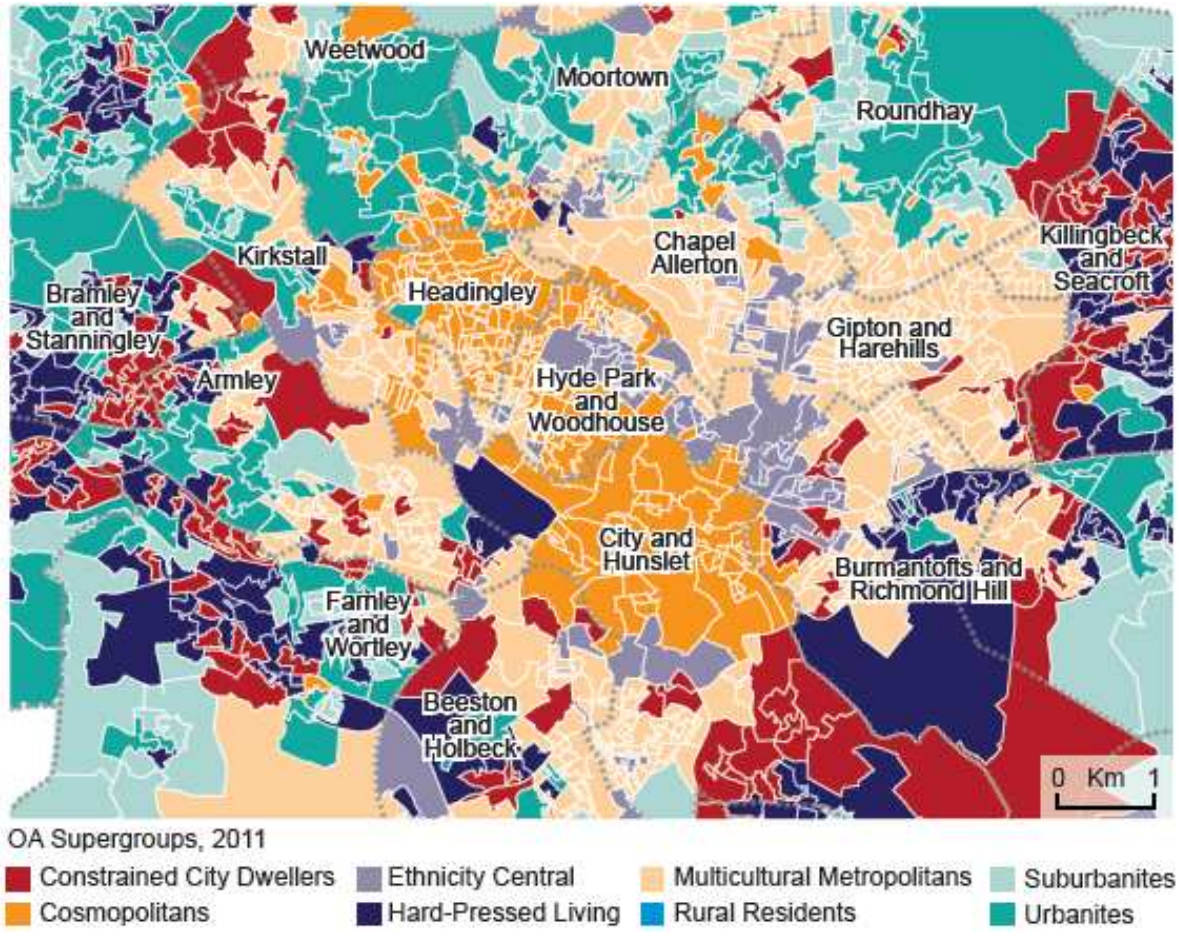


Figure 1.1 Distribution of 2011 geodemographic supergroups in inner city Leeds, by output area, 2011

[5] Details at: http://cowz.geodata.soton.ac.uk/

The 2011 Census is therefore an unrivalled source of data that are exploited by researchers from a wide range of academic backgrounds. Geographers, in particular, benefit from the high level of coverage that makes it possible to analyse and understand the socio-demographic characteristics of populations in very small areas as shown in Figure 1.1. Output areas (OAs) were introduced across the UK in 2001 and are the lowest level of spatial unit for which census estimates are provided. In 2011, there were 171,372 OAs in England, 10,036 in Wales, 46,351 in Scotland and 5,022 in Northern Ireland, although in the case of the latter, the OAs defined initially in 2001 were aggregated into 4,537 small areas (SAs) in 2011. The requirement to maintain consistency between 2001 and 2011 has meant that only 2.6% of OAs in England and Wales, for example, have changed. Since these are the building blocks for higher level geographies, this has facilitated spatial analysis of change between the two censuses. Comparisons of small areas between 2001 and 1991 were problematic because data in 1991 were released for enumeration districts, the census collection areas, with OAs being used for the first time in 2001.

In response to a public consultation organised by the ONS (2013) as part of the 'Beyond 2011' Programme, the Royal Geographical Society with the Institute of British Geographers (2014) provided a submission consisting of a number of case studies that highlighted the value of small area census estimates and the importance of their flexibility in answering important societal questions. When detailed geography is less important, the cross-sectional and longitudinal microdata come into their own, providing users with detailed attributes for individuals or households that can be cross-classified according to the researcher's requirements, unconstrained by the limited combination of variables imposed on the aggregate and flow data to preserve confidentiality.

One of the underlying motivations for the ONS 'Beyond 2011' review was a concern over the rising costs of delivery aligned with tighter fiscal constraints, a view aired publicly by Francis Maude, Minister for the Cabinet Office in the Coalition Government, and reported in popular press (Hope, 2010). Maude considered that the decennial census was an expensive and inaccurate method of measuring the population of the UK and revealed that the Government was looking at alternative and less expensive ways to count the population more regularly and make use of existing

registers and administrative data sources. The debate on the future form of the census in the UK has been paralleled by similar debates reported by the press in other countries around the world including, for example, the USA (Singer, 2010), Canada (Underhay, 2011) and Australia (Hutchens and Martin, 2015).

The need to control cost is by no means the only concern of those who consider the days of the traditional census to be numbered. The list of concerns of those commenting on the census debate around the world includes issues of privacy, frequency, accuracy and apathy, as well as the pressure to make better use of information available elsewhere (Valente, 2010; Fienberg and Prewitt, 2010; Coleman, 2013).

In the UK, as in other countries like the USA and Canada, there is tension between the need for the Government, through its NSOs, to collect information on which to formulate policy and to base legislation and the fundamental human rights of individual privacy and freedom from discrimination. Fienberg and Prewitt (2010) indicate that privacy was a major issue in the 2010 Census in the US, with questions relating to age, gender and ethnicity, in particular, considered by some to be too invasive. In preparing for the 2011 Census in UK, approval by Parliament was required for secondary legislation to enable the census to be taken and Parliamentary debates in the run-up reflected the conflict between the collection of information necessary for running the country and the privacy burden it imposes on the public. Despite the fact that the Statistics and Registration Act (SRSA) 2007 gives responsibility to the UK Statistics Authority (UKSA) to maintain confidentiality of census data and prohibit disclosure of personal information, there is increasing distrust of politicians and public servants and increasing uncertainty about what the data collected by the census will be used for (Coleman, 2013). This is partly responsible for lower public co-operation and the growing reluctance of people to participate (Valente, 2010). Mistrust of government and concerns about privacy are by no means confined to census data; these issues are equally if not more relevant in the context of the growing use of data from administrative and register-based sources. Singer et al. (2011) suggest that negative public opinion has been one of the main reasons why the US Census Bureau has been loath to implement the use of administrative data on a large scale.

One of the major longstanding criticisms of the traditional census in the UK has been its relative infrequency and the time taken for the results to be processed and

released. Having only a once-a-decade snapshot of the population is considered insufficient when social and demographic changes are occurring at a relatively rapid rate. The UK population, estimated to be 63.2 million at the time of the 2011 Census, increased by 4.1 million or nearly 7% over the preceding decade, the largest decadal growth since censuses began. Population development in terms of both size and demographic structure in the 2000s has been driven in particular by the process of ageing and by the influx of unprecedented numbers of international immigrants. The significant increase in net migration to the UK during the 2000s coincided with the enlargement of the European Union (EU) and the opening up of opportunities for migrants from the Accession 8 (A8) countries to work in the UK. It is estimated by the Migration Observatory that the average annual net migration gain was nearly a quarter of a million migrants between 2004 and 2014, compared with an annual average of 65,000 between 1991 and 1999 (Vargas-Silva and Markaki, 2015). The perceived inability of local authorities and other agencies to cope with this influx has been reflected in the rising popularity of the UK Independence Party (UKIP), which campaigned successfully for UK withdrawal from the EU.

The mid-year population estimates are rebased on the decennial census and consequently, as each year passes following the year of the census, the margin of error is likely to increase and the need to use existing, up-to-date data from administrative sources becomes more paramount. The value of data from each census in this context therefore deteriorates over time up until the release of data from the next census. This cycle is illustrated in Figure 1.2 which has been adapted from the ONS Consultation document (ONS, 2011, p.6) and indicates how the net benefit from the census over alternative administrative sources will gradually reduce over time as the quality of data collection using the latter matures.

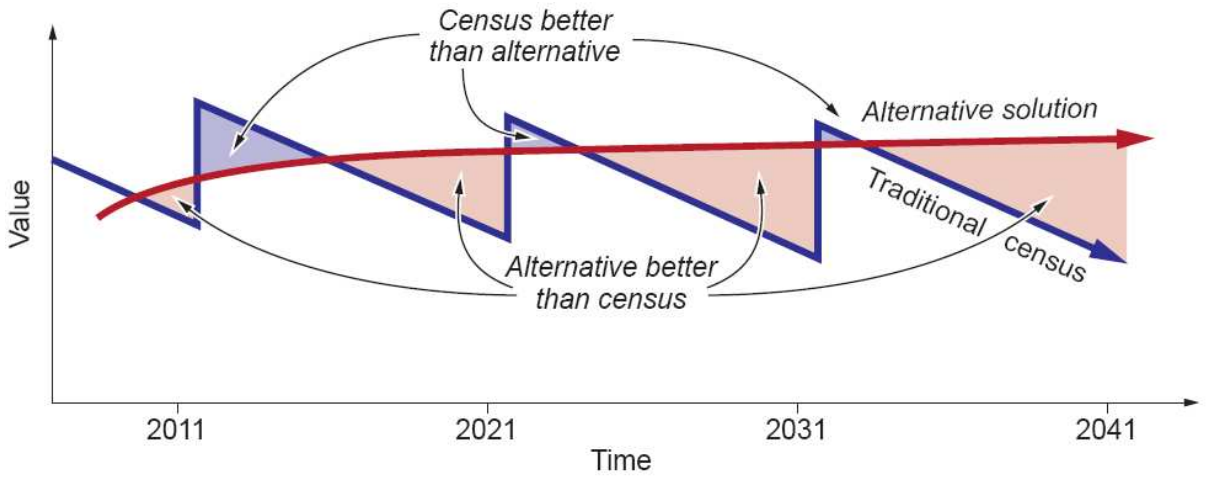


Figure 1.2 A comparison of the value of traditional and alternative (administrative) census-taking over time (adapted from ONS, 2011, p.6)

In response to a proposal in 2015 by the Australian Bureau of Statistics to hold a census every ten years rather than the traditional five years, one senior academic from the Queensland Centre for Population Research stated that "It's the one benchmark we have for population dynamics in Australia, and 10 years is way too long to wait for a benchmark to enable one to put together effective, accurate information" (Martin Bell, quoted in Sydney Morning Herald, February 2015). However, since there is no data source to compare with the census in the UK when it comes to rich socio-demographic data for small areas, its value tends to be preserved from one census to the next, at least as far as researchers are concerned. This is partly because of the time taken to release particular data sets and partly due to the access conditions surrounding their release. Thus, for example, different sets of 2011 origin-destination statistics classified as either open, safeguarded or secure have only become available in 2015 and will only be fully exploited in the second half of the inter-censal period.

Whilst the time delay between census data collection and release is a justifiable concern, especially for the policy community, there is the additional problem that the data are increasingly inappropriate for addressing the problems of contemporary society. Social and economic change makes conventional enumeration through a census more and more difficult because of the complexity of household arrangements and social circumstances in an increasingly mobile world (Sheller and Urry, 2006). The concept of a single place of usual residence is becoming increasingly less meaningful

for a range of different groups including the children of divorced parents, for example, and the classifications used to categorize variables such as ethnicity and occupation are increasingly inappropriate.

Various negative reasons are therefore apparent to suggest that change in the traditional method of population counting is required but there is also the pressure to make much greater use of the information that is already available elsewhere in digital form. Various consultation exercises have been undertaken as part of the 'Beyond 2011' Programme with eight alternative methods proposed initially for investigation and summarized as statistical options in the appendix of the ONS Consultation document (ONS, 2011). ONS had whittled these down to two alternatives by September 2014: (i) an online census supplemented by the use of administrative data to take account of annual population change during the intercensal period; and (ii) the use of administrative data already held by government departments to estimate mid-year populations supplemented by a rolling annual survey to help estimate the socio-demographic characteristics of the population. ONS commissioned an independent report (Skinner et al., 2014) which supported the online census option subject to the inclusion of full follow-up for non-response, but which was less positive about the administrative data option, suggesting that more evidence (and research) was needed to support this alternative.

The National Statistician accepted the findings of the Skinner Review and recommended a modernised census for England and Wales in 2021 and the "increased use of administrative data and surveys in order to enhance the statistics from the 2021 Census and improve annual statistics *between censuses" (*ONS, 2014, p. 2). The value and benefits of the 2011 Census and the options for collecting population data in the future were also considered by a House of Commons Public Administration Select Committee (PASC) whose report and formal minutes endorsed the recommendations of the Skinner Review and stipulated that the ONS "now scope and set out a more ambitious vision for the creative and full use of administrative data to provide rich and valuable population statistics*"* (PASC, 2014, p. 20). A statement of agreement between the National Statistician and the Registrars General in Scotland and Northern Ireland to conduct a census simultaneously across the UK was issued in October 2015. The programme to run the 2021 Census in England and Wales, to increase the use of administrative data and surveys in producing the 2021 Census

results and improve intercensal statistics, and to consider plans beyond 2012 are the three components of ONS' Census Transformation Programme.

1.4 Channels of access to census data: the UK Data Service-Census Support

In order to maximise the use of census data, effective dissemination is critical and the changing information environment presents ongoing challenges for those who collect, process, supply and provide access to census data. The NSOs continuously want to improve the efficiency of their operations and gain better value from their data production and dissemination mechanisms. Compared to previous censuses, 2011 Census outputs include data generated in new multi-dimensional forms and supplied using new transfer methods to devices such as mobile phones or i-pads. On the demand side, census users expect more immediate access through delivery mechanisms that are more intuitive and user friendly.

ONS' Web Data Access (WDA) project was established to deliver an enhanced web site capability for organisations and individuals to use and explore census data but also other ONS statistics more effectively. Direct access to bulk census data in a machine-to-machine readable format was implemented through a public Application Programming Interface (API) and the data available from this OpenAPI were also accessible from the Data Explorer (Beta)[6]. This interface offers functionality for users to discover or find datasets by area or topic, view and manipulate datasets online, produce charts and maps as well as refine queries and download data. The other NSOs developed similar websites. In Scotland, the NRS Census Data Explorer[7] also provides access to a Data Warehouse[8] where all the standard tables are downloadable in bulk form as .csv files. The Northern Ireland Neighbourhood Information Service (NINIS) website[9] fulfils an equivalent function and has interactive content that can be filtered by subset, geography or year. The ONS' Neighbourhood Statistics (NeSS) website[10] is a similar online source, containing datasets that describe the characteristics of a neighbourhood, with a particular focus on deprivation and including results from the 2011 Census as well as the 2001 Census and other official

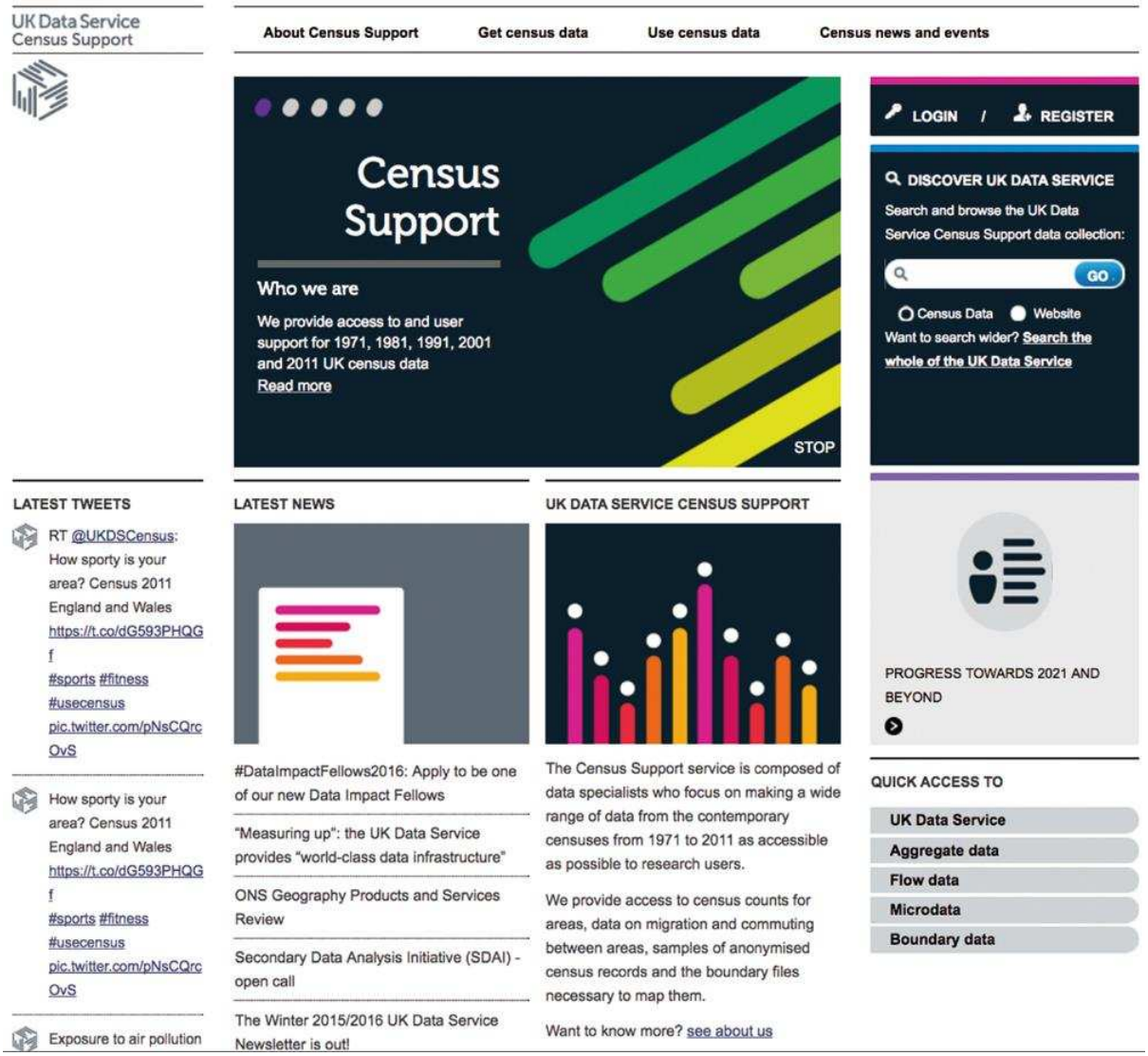
[6] http://www.ons.gov.uk/ons/data/web/explorer
[7] http://www.scotlandscensus.gov.uk/ods-web/home.html
[8] http://www.scotlandscensus.gov.uk/ods-web/data-warehouse.html
[9] http://www.scotlandscensus.gov.uk/ods-web/home.html
[10] https://www.neighbourhood.statistics.gov.uk/dissemination/

government statistics. All the 2011 Census data for England and Wales, including 'open' Origin-Destination Statistics for the UK, are available from the Nomis website[11], the service provided by the ONS that gives users free access to the most detailed and up-to-date UK labour market statistics from official sources. Digital boundaries for 2011 Census areas and look-up tables are available from ONS' 'Open Geography' geoportal and from NRS and NISRA websites.

It is clear from the examples above that each of the NSOs in the UK has taken advantage of the new digital technologies to develop online systems and interfaces that have facilitated access to the results of the 2011 Census as well as other data from official sources. This has been encouraged by much greater recognition of the importance of transparency in government and the belief outlined in the Open Data White Paper that *"opening up data will empower citizens, foster innovation and reform* pubic *services"* (H M Government, 2012, p. 5). Data produced by statistical offices such as the census and key socioeconomic indicators are one type of open data, i.e. data that must be available as a whole and at no more than a reasonable reproduction cost, preferably by downloading over the internet in convenient and modifiable form, that are provided under terms that permit reuse and redistribution, and that anyone must be able to use, reuse and redistribute.

The last two decades have witnessed the development of a set of services designed to provide members of the academic community in the UK with quick and easy access to census data sets, primarily for research purposes but also for teaching. Independent units providing services for academic users to access the census aggregate statistics, boundary data, flow data and microdata from pre-2011 censuses were funded by the Economic and Social Research Council (ESRC) under the Census Programme up until August 2012. Thereafter, is was agreed that these hitherto rather disparate services should become part of a more integrated Census Support (CS) service which itself would become part of the ESRC-funded UK Data Service, aiming to allow researchers access to a wider range of data from census, administrative and survey sources through a single point of entry. Figure 1.3 shows the Census Support homepage of the UK Data Service website.

[11] https://www.nomisweb.co.uk/census/2011



Source: https://census.ukdataservice.ac.uk/

Figure 1.3 UK Data Service-Census Support homepage

The UK Data Service-Census Support (UKDS-CS) is essentially comprised of the four 'data support units' operating under the Census Programme that provided expert support and online access to different datasets (Stillwell et al., 2014). The first of these, providing support for the aggregate outputs, was the Census Dissemination Unit (CDU) based within Mimas at the University of Manchester until July 2014, at which point Mimas became part of Jisc, and moved to Churchgate House in central Manchester. The second unit is the former UKBORDERS service within EDINA at the University of Edinburgh which provides access to census-related digital boundary data. The third unit is based at University College London (formerly the Centre for

Interaction Data Estimation and Research, CIDER, at the University of Leeds) and provides access to census and related interaction data sets, whilst the fourth unit providing advice and guidance to users of census microdata sets, which were known Samples of Anonymised Records (SARs) prior to 2011, is based at the Cathie Marsh Institute for Social Research (CMist) at the University of Manchester. The UKDS-CS Director is based at the University of Leeds.

Collectively, the CS units are referred to as 'value-added services' of the UK Data Service, receiving census data supplied by the NSOs (sometimes through a respective API), ingesting them for storage in various databases, and maintaining interfaces through which users can discover, query, retrieve, analyse and download the data they require. In the first 12 months since the census data became 'open' in January 2014, there were 25,600 data downloads from InFuse; the boundary data and postcode directories averaged around 9,500 downloads in the first two quarters after becoming open in 2015; and there were 2,650 downloads of the 2011 flow data during the first three quarters in 2015 after they became available in WICID. One downside of the transition to open data access is that, once the need for authentication is removed, detailed monitoring of service usage becomes impossible. However, Google Analytics data on service providers does provide an indication of which academic institutions are the principal users. By way of example, Figure 1.4 illustrates usage of InFuse in 2015, as measured by the number of user sessions per HE institution.

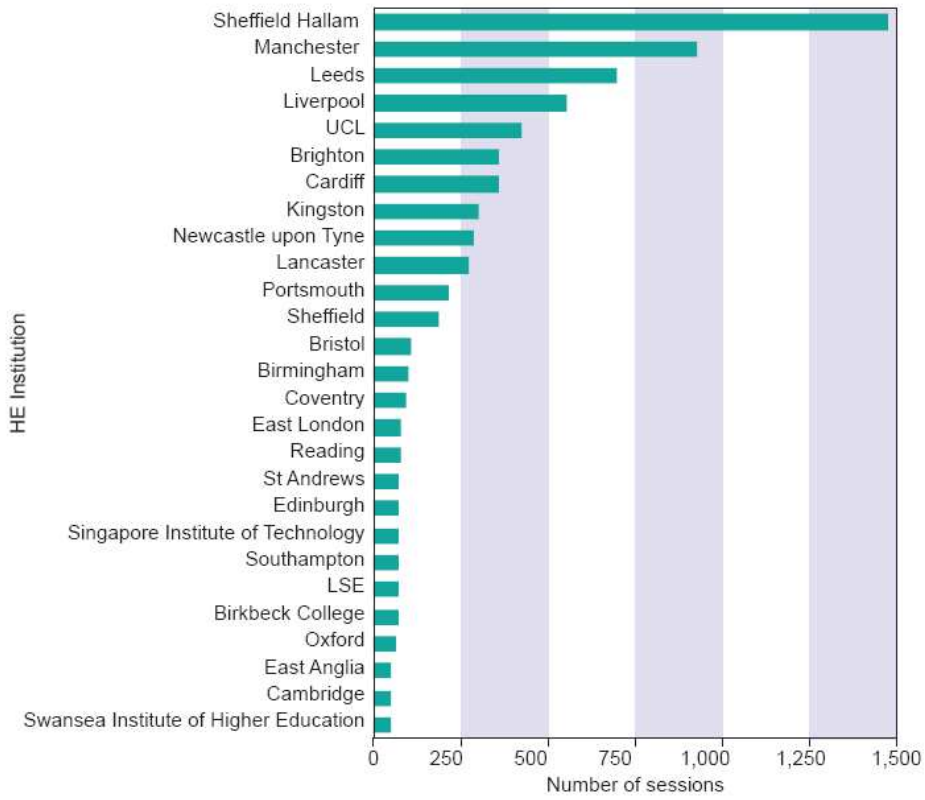


Figure 1.4 Higher education institutions with over 50 InFuse sessions during 2015

The online interfaces and their associated information systems are one of the unique selling points of the UKDS-CS. InFuse, the user interface for aggregate data from the 2011 Census, has been developed to avoid the conventional table structure of census aggregate statistics on which its predecessor, Casweb, was based, to improve the consistency of the labelling of variable categories (such as age groups) in different tables and to provide clear metadata with each data download. The construction of this more flexible interface has required the reformatting of the underlying database into a multi-dimensional structure based on Statistical Data and Metadata eXchange (SDMX), a data model which has been adopted as the standard for data and metadata exchange for aggregate time series data. Users of InFuse are able to locate data more easily and intuitively that with Casweb without hunting through a multitude of tables.

UKDS-CS supports a suite of services available for users to select and download the geography outputs of the last five decennial censuses as well as a range of historical census geographies, associated look-up tables, postcode directories and

non-census geographical boundary data. Easy Download allows users to extract complete sets of the most regularly requested census boundaries available as ready-to-use national datasets in popular formats whilst the Boundary Data Selector allows the selection of boundaries that are required, for the area required, in the format required. Equivalent systems are available for access to current and historical postcode directories and sets of postcode. Geoconvert is a geography matching and conversion tool that allows users to obtain and manipulate census geographical and postcode data in a straightforward way.

Census interaction data, which have been produced from modern censuses from 1981 onwards, tabulate information about flows within and between locations, and take the conceptual form of matrices of origins by destinations for migrants, students commuters or details of those individuals with second homes. Sparsity becomes a problem when the zones are small and the numbers of origins and destinations is high, such as with a ward-to-ward matrix of migrants in England. The main access path to the flow data is via WICID (Web Interface to Census Interaction Data), which allows users to flexibly build and execute a query which extracts the required data either for online analysis or direct download. WICID provides a number of routes into the data that aim to address the practical problems for users of sparse matrices.

Delivery of the microdata is a more collaborative affair. Safeguarded data and the census microdata which can be distributed under licence by the UK Data Service, are archived with the UK Data Archive, a UK Data Service partner organisation. These data can be downloaded or accessed online in a manner similar to the other survey microdata that the UK Data Service provide. Once users have the data they are then able to produce their own outputs in a flexible manner.

One of the long-term goals of the UK Data Service is to work with data owners to identify and remove all unnecessary barriers to accessing data. To this end, a generic access policy of three tiers – open, safeguarded and controlled (or secure) – has been implemented in collaboration with ONS. The large majority of datasets held by UKDS-CS are available without registration or authentication using an ‘open data licence’ for data that are not classified as personal. Data licensed for use in the 'safeguarded' category are not personal, but the data owner has identified a risk of disclosure resulting from linkage to other data, such as private databases.

'Safeguarded data' is the ONS preferred term for data which UKDS-CS provide under an End User Licence (EUL) and which requires user registration and specification of what the purpose for which the data are required. Controlled data are personal data which may be identifiable and thus potentially disclosive and thus require registration and special user training to enable access.

The only means of access to the 'safeguarded' tables of flow data that have been produced from the 2011 Census is through the WICID interface and therefore users must be registered and abide by the stipulations of the EUL. A time series of inter-district migration flow estimates based on NHS patient re-registrations and supplied by ONS are also available from WICID together with estimated migration matrices from certain ESRC-funded research projects. Other non-census data are available from other UKDS-CS systems such as deprivation indicators from GeoConvert and there are a wide range of non-census geographical boundary data sets available from Easy Download or Boundary Data Selector. However, one of the key user attractions of the UKDS-CS resources is the ability to access data from previous censuses. InFuse provides access to 2001 as well as 2011 aggregate data, whereas Casweb holds UK aggregate data for 2001 and 1991 and GB data for 1981 and 1971. Migration and commuting data from censuses back to 1981 are available from WICID and census boundary data are available from 1991. Users of InFuse benefit from the effort that has been spent on integrating aggregate data supplied by each of the NSOs into a single system, and thereby facilitating UK-wide analysis and avoiding the need to extract data for different home nations from different online systems. Boundary data for the UK are available for a range of geographies which match exactly with the geographies used in InFuse.

It is important to recognise that the function of the UKDS-CS is not only to disseminate census data. The technical expertise that has accumulated in handling large and complex data sets and developing online database systems and interfaces has been valuable in collaborative initiatives with the census offices. UKDS-CS staff are involved in many of the census advisory groups and advice has been provided, in particular, to the data suppliers on the structure and content of the 2011 microdata and on the table structure, disclosure thresholding and dissemination of the 2011 flow data. Work is currently ongoing to prepare a trimmed-down version of WICID to support access to the secure flow data held in the ONS virtual microdata laboratory

(VML). However, as well as providing users with seamless and flexible access to a wide range of data resources that facilitate high quality social and economic research and education, it is also the role of the UKDS-CS to support members of the user community with advice and guidance on particular issues, to maintain a helpdesk that provides rapid response to issues as they arise, to provide regular training courses and webinars and to develop a bank of user support materials available online that can be used by researchers and students.

1.5 Rationale and structure of the handbook

UK census handbooks or user guides have been produced for previous censuses in 1981 by Rhind (1983), in 1991 by Dale and Marsh (1993) and Openshaw (1995) and in 2001 by Rees et al. (2002), providing details of the census process and the data sets that are produced. The 2011 Census Handbook is unique in endeavouring to demonstrate, through inclusion of an extensive set of case studies, how different census data sets are hugely important for research in academia in a wide range of different socio-demographic contexts from geodemographic profiling of small areas to understanding the geography of immigration and the changes in the ethnic structure of British cities.

The book is divided into six parts, the first of which is comprised of two chapters that provide context. This introductory chapter has reviewed, census-taking around the world, flagged up the trend apparent in many European countries and in developed countries elsewhere (USA, Canada, Australia) towards using hybrid methods involving data from administrative sources and surveys, and discussed both the benefits and shortcomings of the traditional census. The next chapter provides a synopsis of how the census in the UK has evolved throughout its history. Part 2 also contains two chapters that will provide readers with an understanding of the steps involved in the run-up to the 2011 Census, the actual data collection framework, methods of collection, problems, imputation, adjustment and evaluation. Attention is given to the devolved nature of the census and the different accountabilities. Both chapters have been written by individuals with first-hand involvement in the 2011 Census preparation, collection, adjustment and evaluation procedures. In Part 3 of the book, there are five chapters which spell out the types of data generated by the 2011 Census in detail and illustrate the means of user access and extraction of each type. The chapters provide

guidance on using the web interface services of the UK Data Service-Census Support, in particular.

The chapters in Parts 2 and 3 are essentially focused on the supply side of the census process and the paths through which census data travel to the user while those in Parts 4 and 5 are primarily concerned with the demand side or how the data are being used for visualisation and analysis, in this case almost entirely by members of the research community rather than users from other public or private sector organisations. Part 4 contains seven relatively short chapters that introduce and exemplify some of the ways in which new technologies are being used to create innovative visualisations of census data through web-based infographics and mapping applications. Part 5 of the book, on the other hand, includes a series of chapters that cover the use of census data in a range of thematic areas, beginning with families, household and individuals, and then focusing on identity, ethnicity and religion, health care and deprivation, housing and inequality, migration and commuting and finishing with issues of scale and long-term change. The chapters are all written by members of the academic research community. Finally, Part 6 of the book contains a single chapter that takes a forward look at ONS' activities in planning for the 2021 Census and the future role of the census vis à vis alternative approaches to counting the population. Throughout the volume, we use Census with an upper case C when referring to a particular census (e.g. the 2011 Census) and lower case c otherwise.

In conclusion, this book is important in terms of the information that it provides for those wanting to understand how 2011 Census data were collected, what data products are available and how and where different types of data can be accessed, for those interested in understanding the state-of-the-art in data visualisation, for those wanting to absorb some of the latest findings of contemporary research in social science in the UK, and for those concerned to understand more about the census and its utility at a time when its future existence is under threat. We hope you agree with the overall conclusion that the 2011 Census has been extremely valuable in underpinning a wealth of diverse academic research which has generated some fascinating results as well as some important messages for policy makers. It would be folly to abandon such a vital resource of reliable and comprehensive data without putting in place an infrastructure for a much improved collection of data from other

sources, be they administrative records, sample surveys or big data in its various guises.

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