

# Using R for Geodemographic Analysis

Thursday 10<sup>th</sup> July, 10:45am – 4pm

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Department of Geography and Planning

## Geographic Data Science Lab



UNIVERSITY OF  
LIVERPOOL

E·S·R·C  
ECONOMIC  
& SOCIAL  
RESEARCH  
COUNCIL

# Welcome

- Using R for Geodemographic Analysis
- Who has used R before?
- Who has used another GIS before?
  - (ArcGIS, MapInfo, QGIS, ....)
- Who has used geodemographic data before?

# Outline of the day

- 11am – 11:30am – Talk
- 11:30am – 12:45pm – Practical
- 12:45pm – 1:30pm – Lunch
- 1:30pm – 2:30pm – Practical
- 2:30pm – 3pm – Talk
- 3pm – 4pm – Optional Mapping Clinic

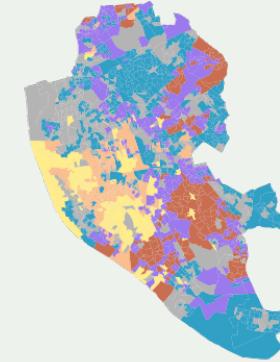
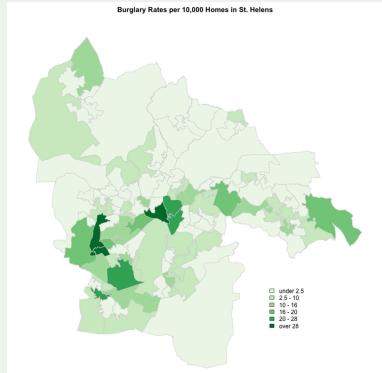
# Outline

- What will you get from the course?
  - What is R & what can you do with it?
  - R as a GIS
  - Geodemographics
  - Notes on R
- 
- Introductions & logon

# What is GIS?

- Turning (spatial) data into information

#	camp	mass	Time	rt_index	chg	\$1	\$2	\$3	\$4
0	1	300.130	13.271	218.720	2	35.200	71.000	100.000	125.700
1	2	300.150	14.875	216.565	1	35.200	71.000	100.000	125.700
2	4	300.150	18.879	369.890	1	26.700	22.600	48.500	69.700
3	5	300.150	14.974	210.627	2	11.400	26.700	48.500	69.700
4	7	300.170	17.375	216.565	2	11.400	26.700	49.500	55.700
5	9	300.170	27.375	459.410	3	27.700	21.400	21.400	16.000
6	10	300.170	18.844	303.145	1	191.000	20.300	21.300	16.000
7	11	300.170	19.380	321.203	2	21.600	23.800	23.800	16.000
8	12	300.170	20.750	350.840	2	123.000	470.000	690.000	353.000
9	13	300.170	18.844	303.145	1	191.000	20.300	21.300	16.000
10	14	300.170	19.380	321.203	2	21.600	23.800	23.800	16.000
11	15	300.170	18.599	309.823	3	18.300	26.000	26.000	26.000
12	16	300.170	14.747	237.073	3	42.000	23.500	23.500	39.000
13	17	300.170	19.380	321.203	2	21.600	23.800	23.800	16.000
14	18	300.170	29.241	490.978	2	82.000	86.800	90.400	100.000
15	19	300.170	17.935	300.048	1	43.500	45.200	26.500	34.100
16	20	300.170	19.380	321.203	2	21.600	23.800	23.800	16.000
17	21	300.170	22.229	377.470	2	140.000	129.000	73.200	95.400
18	22	300.170	18.844	303.145	1	191.000	20.300	21.300	16.000
19	23	300.170	19.380	321.203	2	21.600	23.800	23.800	16.000
20	24	300.170	18.599	309.823	3	18.300	26.000	26.000	26.000
21	25	300.170	18.844	303.145	1	191.000	20.300	21.300	16.000
22	26	300.170	19.380	321.203	2	21.600	23.800	23.800	16.000
23	27	300.170	19.741	319.060	1	23.000	11.500	11.500	11.500
24	28	300.170	16.577	619.438	1	16.800	38.600	49.200	32.000
25	29	300.170	18.844	303.145	1	191.000	20.300	21.300	16.000
26	30	300.170	18.599	309.823	2	73.300	78.600	110.000	110.000
27	31	300.170	16.108	237.775	2	73.300	19.700	52.100	52.100
28	32	300.170	18.844	303.145	1	191.000	20.300	21.300	16.000
29	33	300.170	20.429	344.366	2	56.300	51.600	55.100	80.500
30	34	300.170	18.844	303.145	1	191.000	20.300	21.300	16.000
31	35	300.170	21.619	365.506	2	104.000	90.600	87.100	87.100
32	36	300.170	24.271	412.480	2	127.000	117.100	90.100	84.000
33	37	300.170	24.271	412.480	2	127.000	86.900	103.000	103.000
34	38	300.170	22.727	385.908	2	204.000	283.000	341.000	341.000



- Using this information to answer questions
  - How have housing conditions changed in the past ten years?

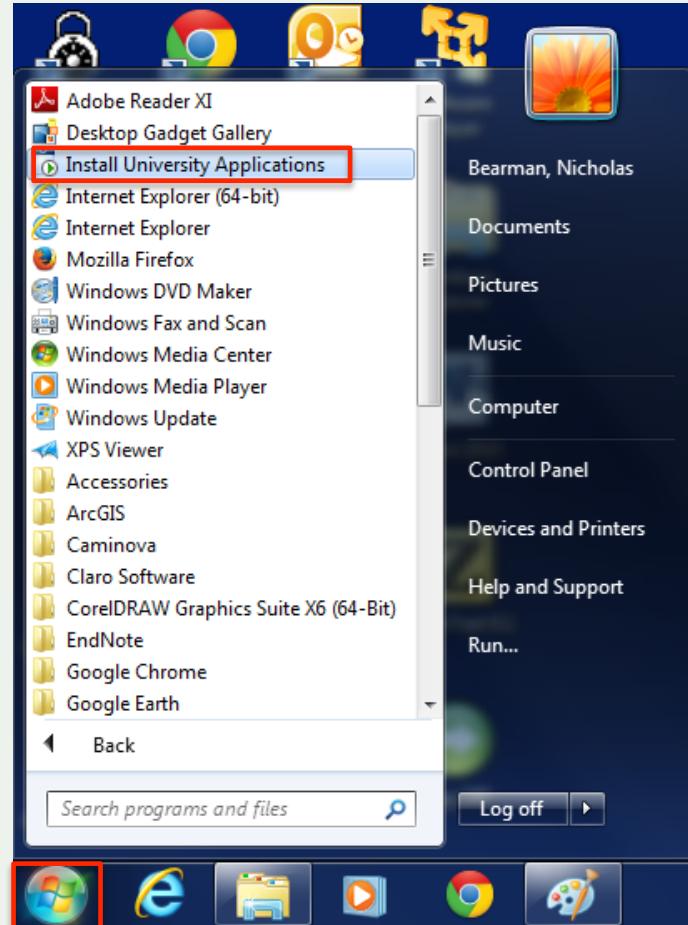
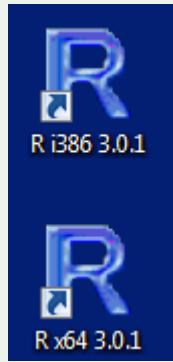
# What is R?



- “a **freely available** language and environment for statistical computing and **graphics**”
- **freely available** = ‘free as in beer’ and ‘free as in speech’
- **graphics** = GIS
- user contributed – GIS
- packages / libraries

# Installing R 3.0.1...

R Installed  
Already?



# Installing R 3.0.1...

Screenshot of the "Install University Applications" window.

The window title is "Install University Applications".

Left sidebar (Category list):

- <All>
- Accessibility
- Architecture
- Audio
- Bibliographic
- Business Systems
- Chemistry
- Earth Sciences
- Engineering
- Fixes
- Graphics
- History
- Internet
- Life Sciences
- Management School
- Mathematics
- Office

Right pane (Application list):

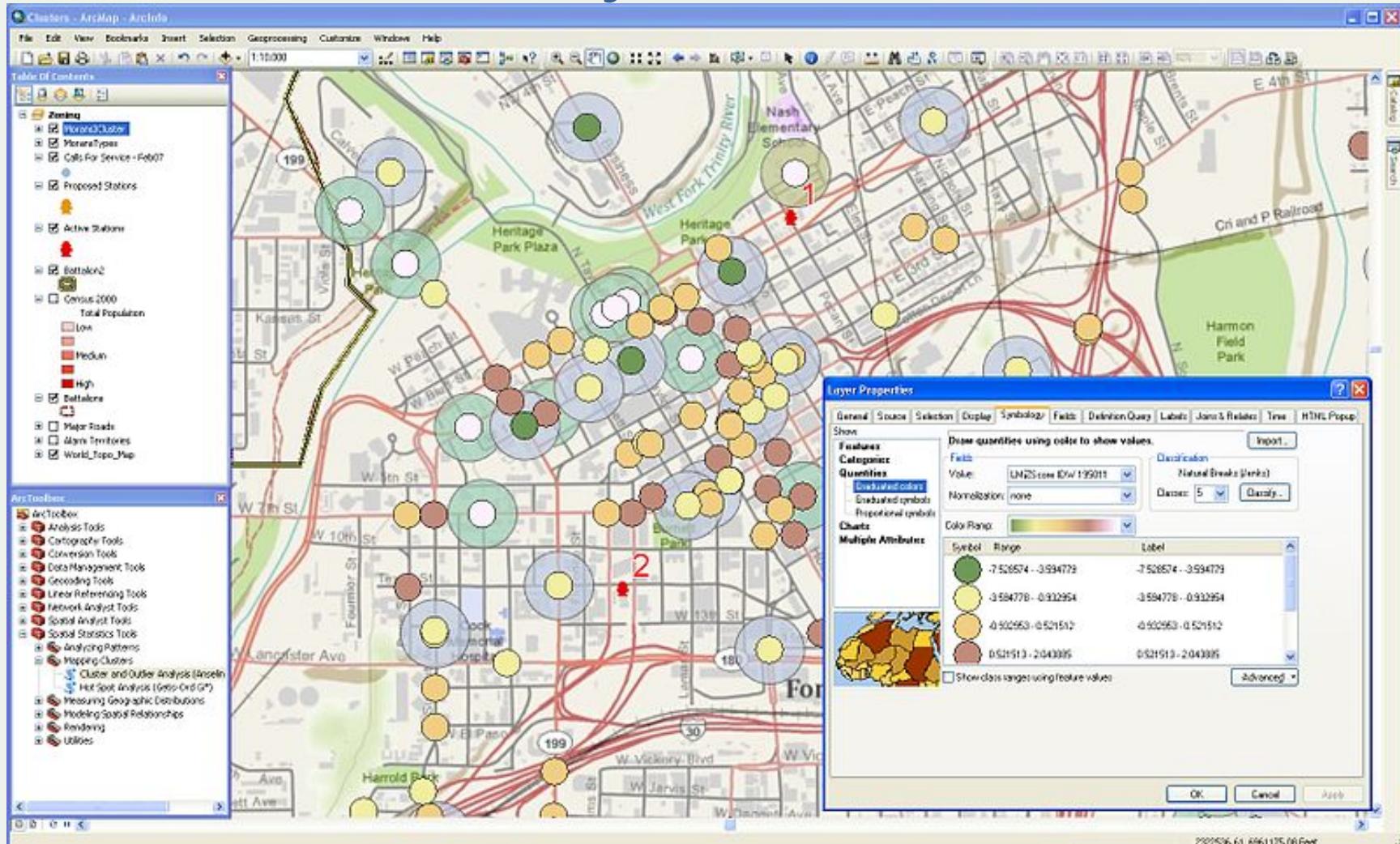
Application	Info
QAS Pro 6.75	Available
QQ International 2.11	Available
QUANTAX 70v1.1.0.370	Available
QUANTAX 70v1.1.0.372	Available
Quantum GIS 2.0.1	Available
QuickTime 7.7.3	Installed
R 3.0.1	Available
R 3.1.0	Available
Raynoise 3.1f	Available
Refresh Group Policy - Computer	Available
Refresh Group Policy - User	Available
Refresh SCCM Policy	Available
Reread Group Memberships - Computer	Available
Reread Group Memberships - User	Available
Response 6.71	Available
Review Manager 5.2.7	Available
Revit 2011 IIR2 64bit	Available

Detailed view for R 3.0.1:

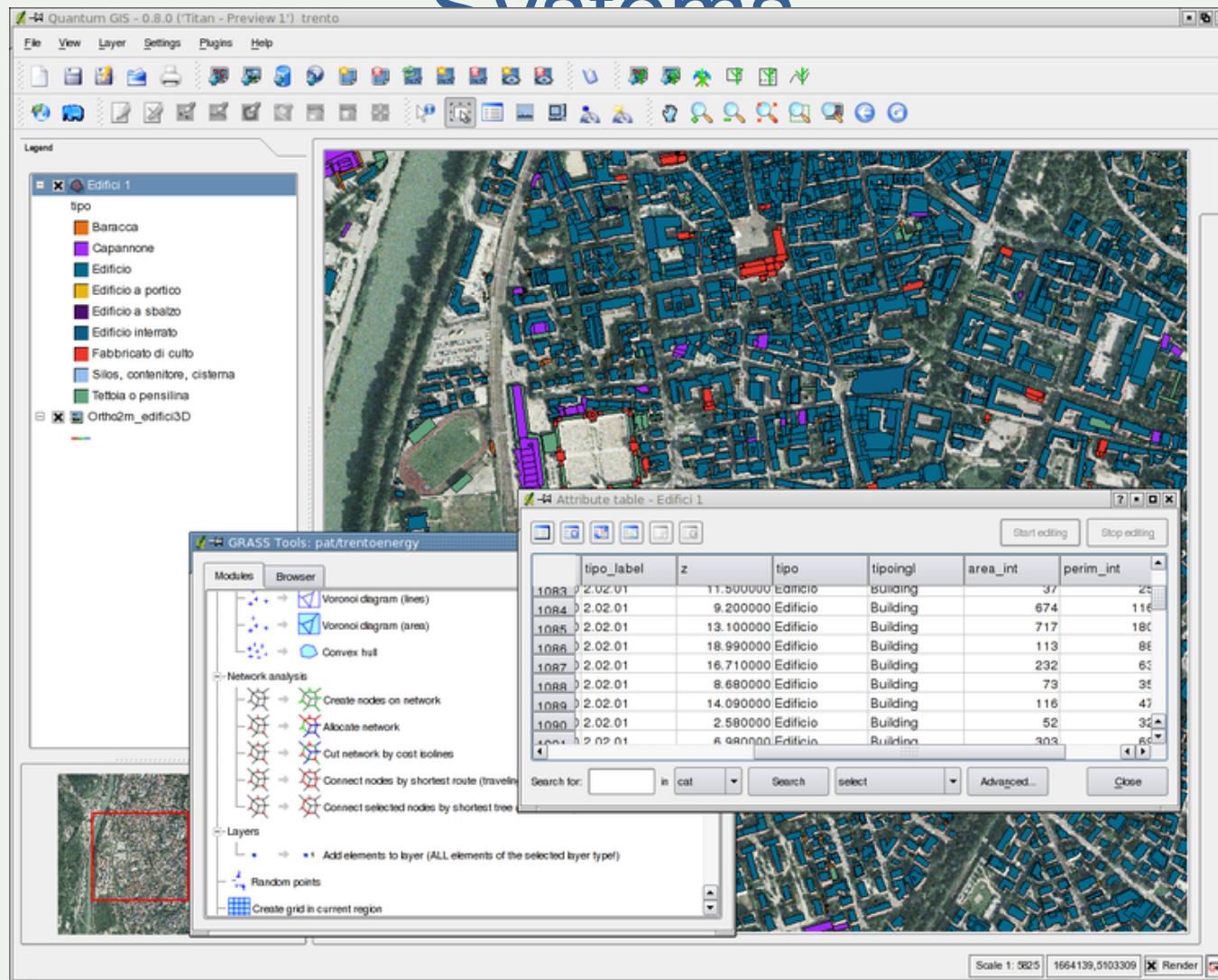
<a href="#">More Info &gt;&gt;&gt;</a>	<a href="#">Run</a>	<a href="#">Remove</a>	<a href="#">Install</a>
Requirements: 700MB Disk	Department: Computing Services Department		
Est. Install Time: 10 minutes	Contact: Helpdesk	<a href="#">Email</a>	
Reboot: Not needed	Test status: Live		

Bottom status bar: Current operation: Idle.

# GIS – Geographic Information Systems

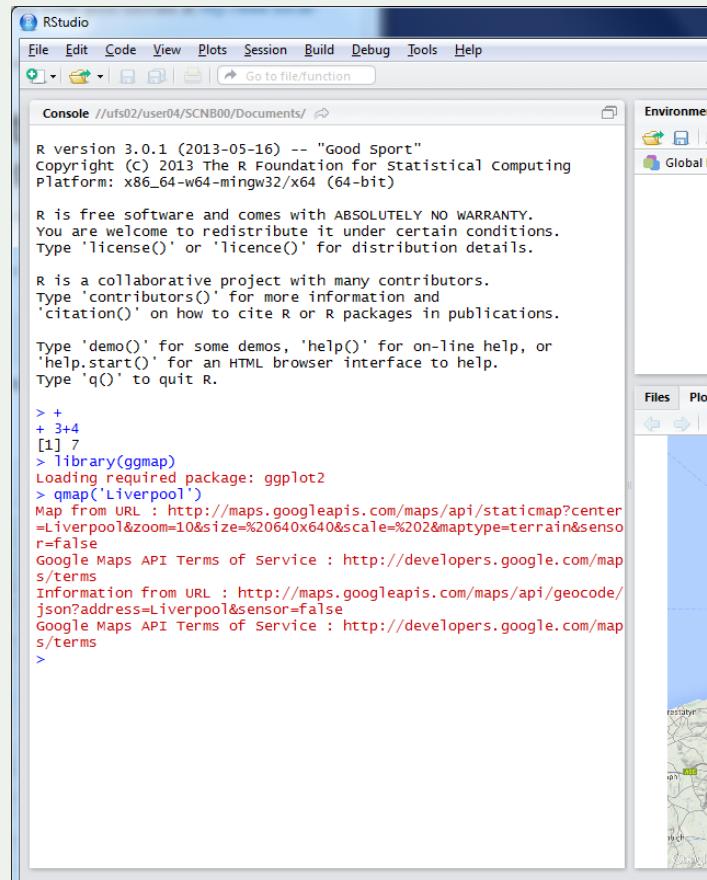


# GIS – Geographic Information Systems



# R as a GIS

- Command line driven, rather than GUI
- Disadvantages
  - Steeper learning curve
  - Remembering commands

A screenshot of the RStudio interface. The console window shows R version 3.0.1 starting up, followed by a series of commands related to ggmap and Google Maps API. A map of Liverpool is visible in the background of the RStudio window.

```
R version 3.0.1 (2013-05-16) -- "Good sport"
copyright (C) 2013 The R Foundation for statistical computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

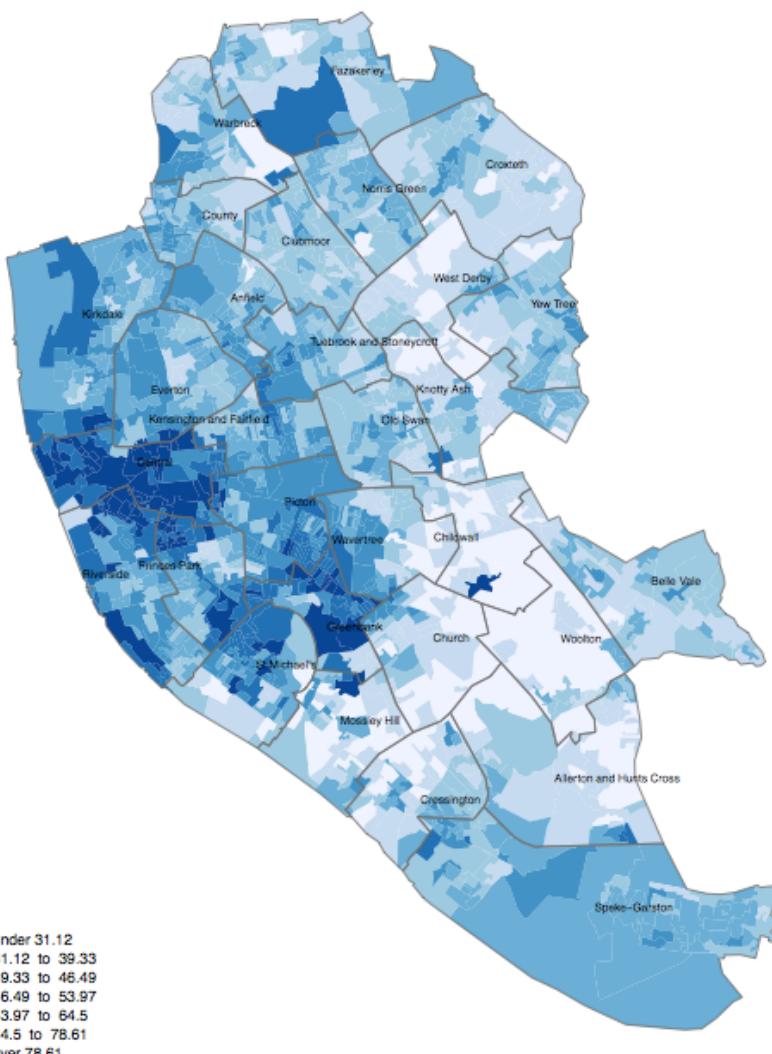
> +
+ 3+4
[1] 7
> library(ggmap)
Loading required package: ggplot2
> qmap('liverpool')
Map from URL : http://maps.googleapis.com/maps/api/staticmap?center
=Liverpool&zoom=10&size=%20640x640&scale=%202&maptype=terrain&senso
r=false
Google Maps API Terms of Service : http://developers.google.com/map
s/terms
Information from URL : http://maps.googleapis.com/maps/api/geocode/
json?address=liverpool&sensor=false
Google Maps API Terms of Service : http://developers.google.com/map
s/terms
>
```

# R as a GIS

- Advantages
  - Easy to record what you did and repeat specific pieces of work
  - Lots of reproducible examples on the web
  - Easily scriptable. 134,567 maps? easy!
  - 2011 Census Open Atlas
  - <http://www.alex-singleton.com/r/2014/02/05/2011-census-open-atlas-project-version-two/>

## Liverpool

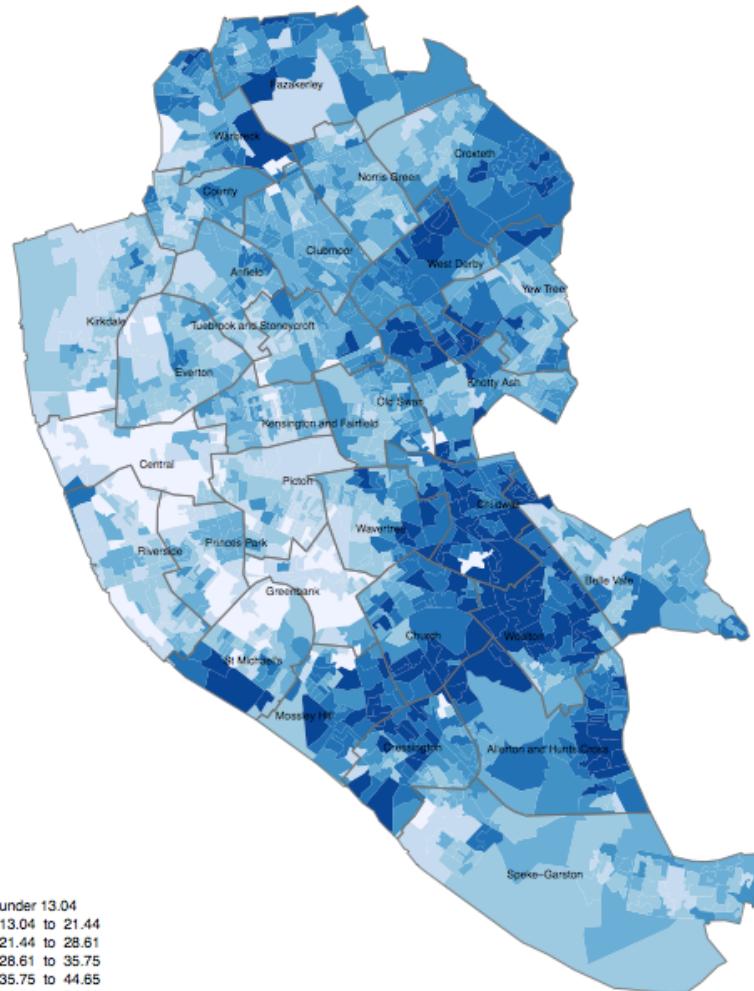
Table: Marital and civil partnership status  
KS103EW0008 (Single (never married or never registered a same-sex civil partnership))



Single

## Liverpool

Table: Marital and civil partnership status  
KS103EW0009 (Married)



Married

Map created by Alex Singleton (<http://www.alex-singleton.com>)

Contains National Statistics data © Crown copyright and database right 2013; Contains Ordnance Survey data © Crown copyright and database right 2013

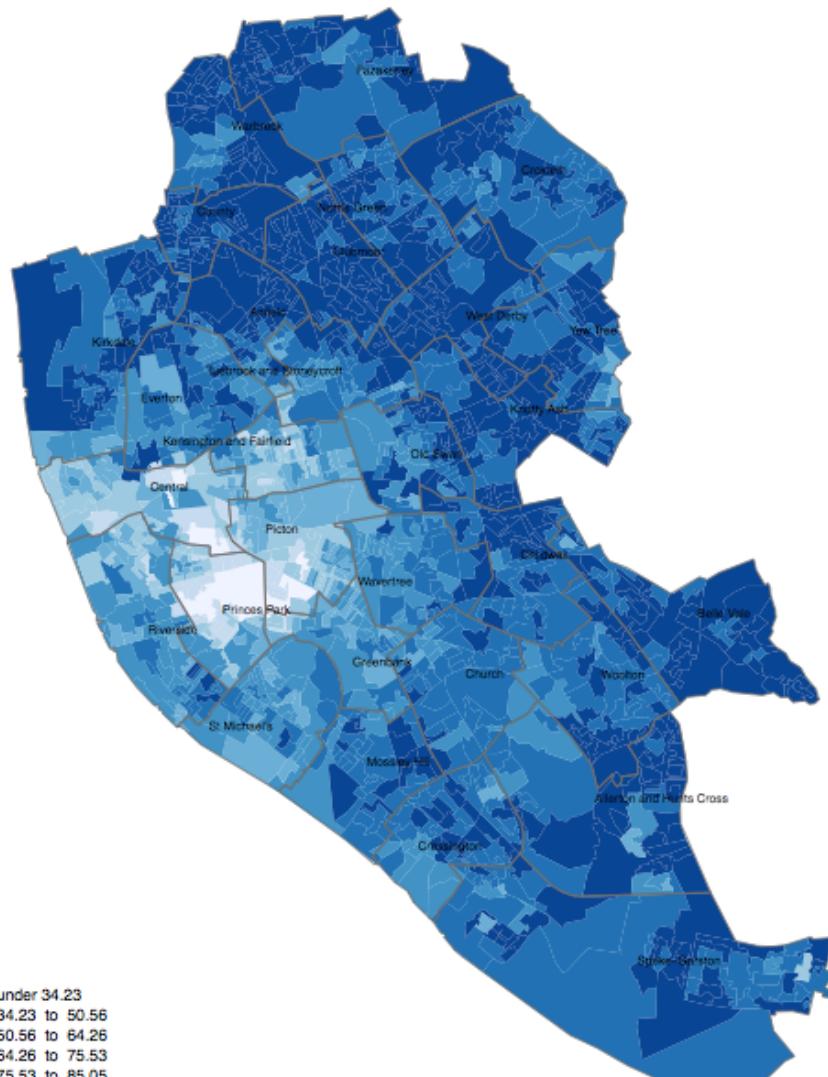
Map created by Alex Singleton (<http://www.alex-singleton.com>)

Contains National Statistics data © Crown copyright and database right 2013; Contains Ordnance Survey data © Crown copyright and database right 2013

## Liverpool

Table: Ethnic group

KS201EW0020 (White: English/Welsh/Scottish/Northern Irish/British)



Map created by Alex Singleton (<http://www.alex-singleton.com>)

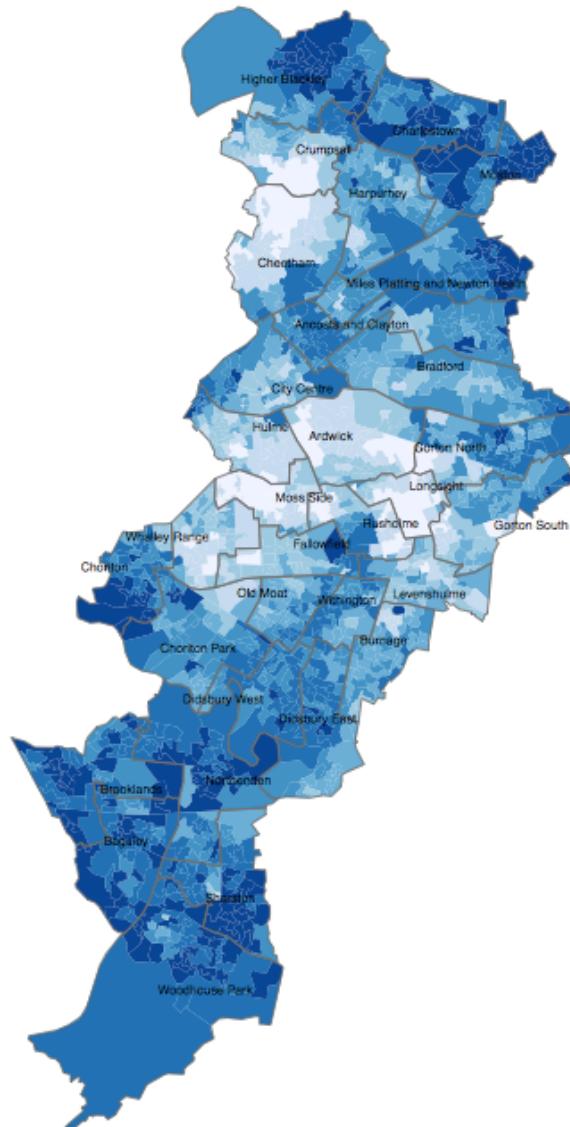
Contains National Statistics data © Crown copyright and database right 2013; Contains Ordnance Survey data © Crown copyright and database right 2013

Ethnic group: white

## Manchester

Table: Ethnic group

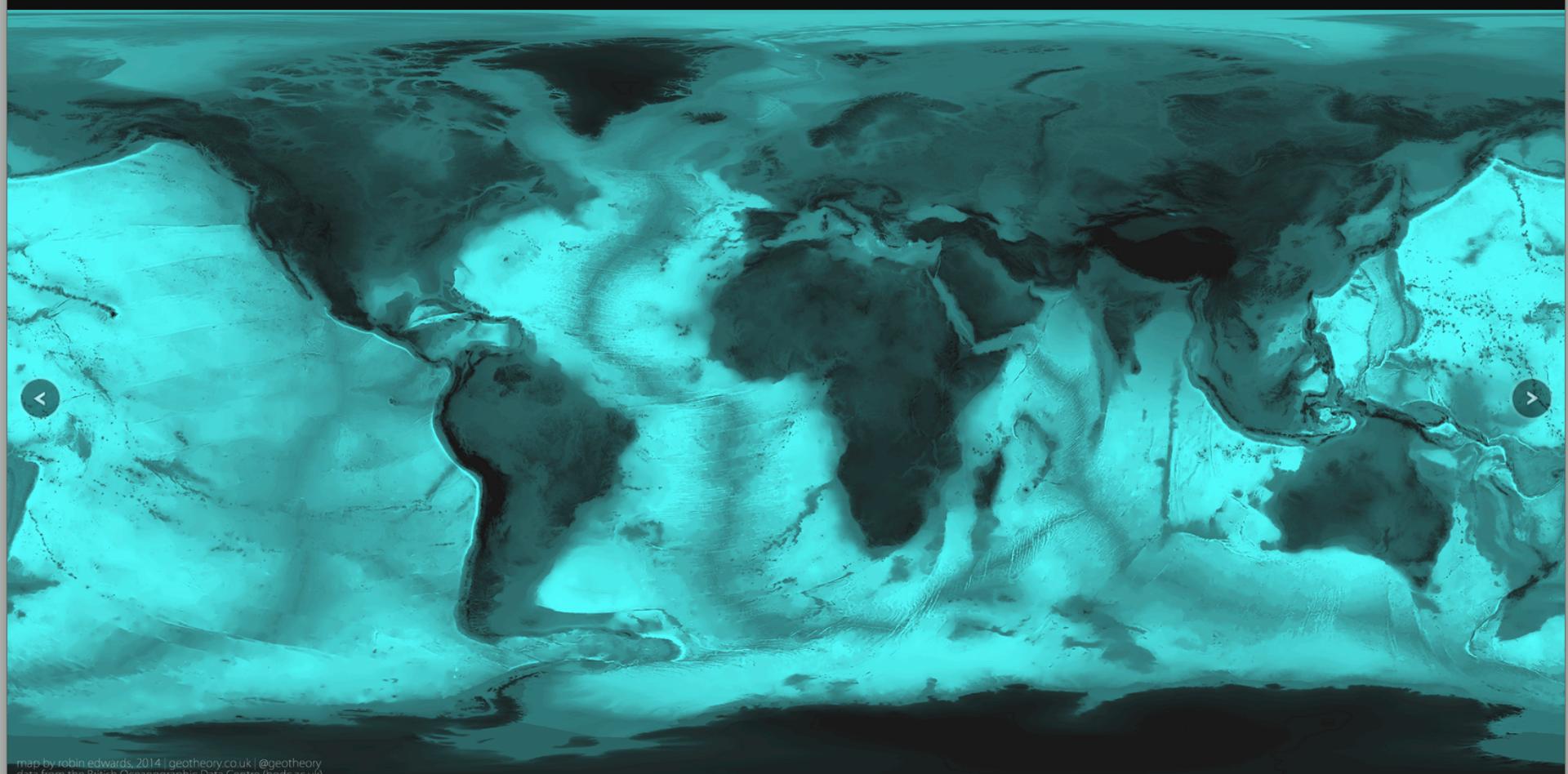
KS201EW0020 (White: English/Welsh/Scottish/Northern Irish/British)



Map created by Alex Singleton (<http://www.alex-singleton.com>)

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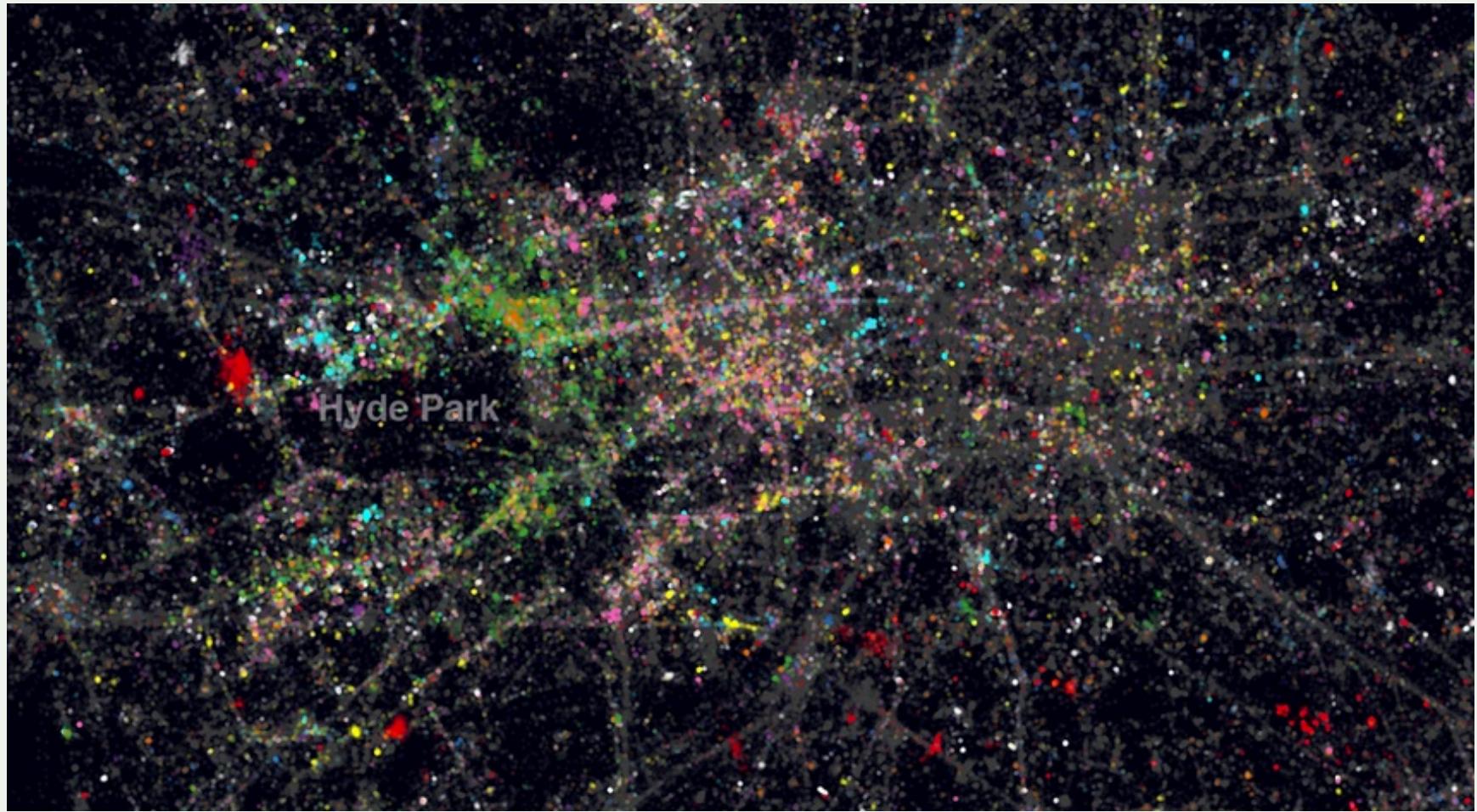
# Topography



map by robin edwards, 2014 | geotheory.co.uk | @geotheory  
data from the British Oceanographic Data Centre (bodc.ac.uk)

<http://topography.geotheory.co.uk/>

# Twitter Languages in London



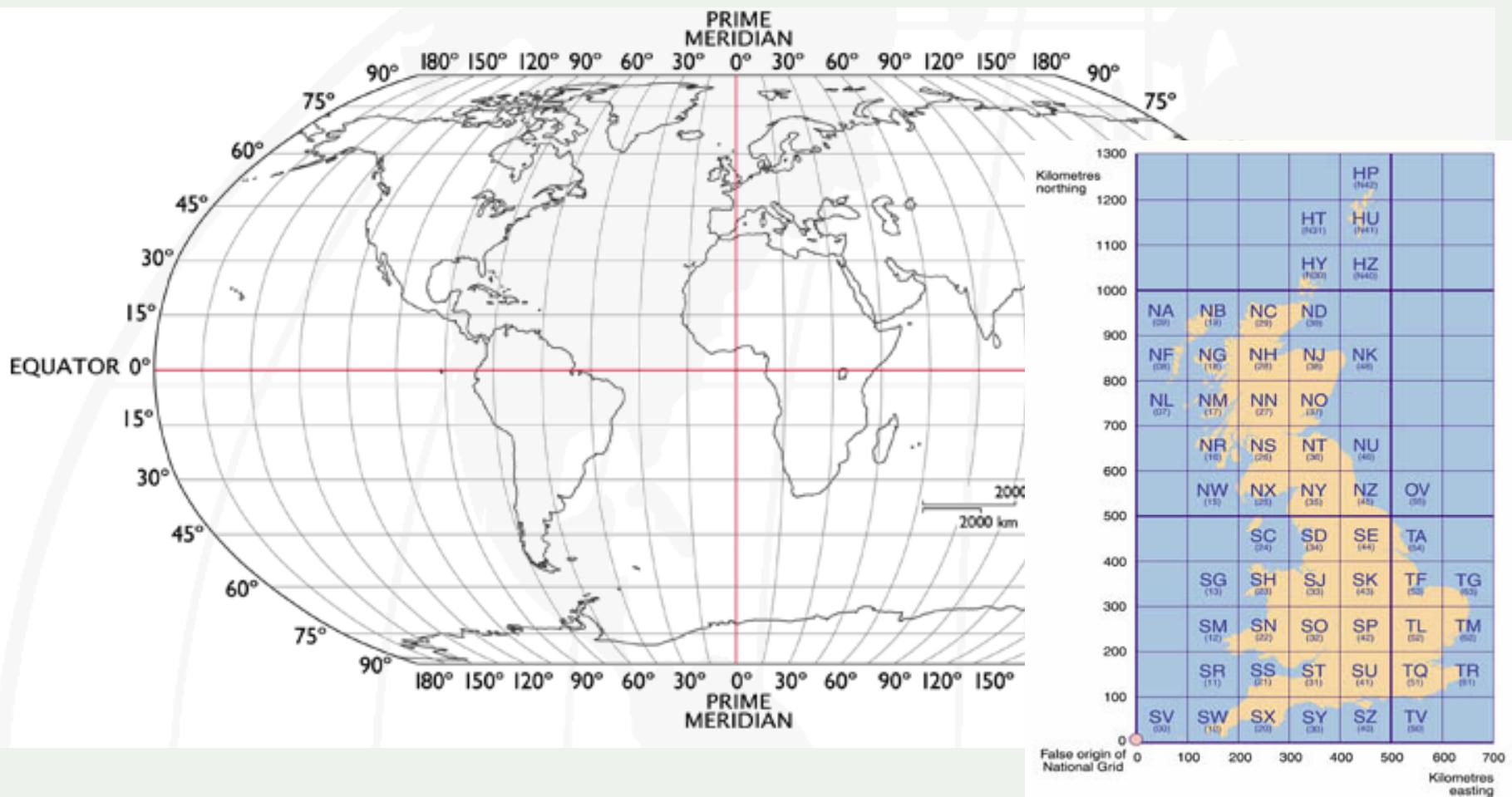
<http://spatial.ly/2012/10/londons-twitter-languages/>

# R as a GIS

- R is just another tool in the toolbox
- I use it alongside ArcGIS, QGIS, etc.

# Coordinate Systems

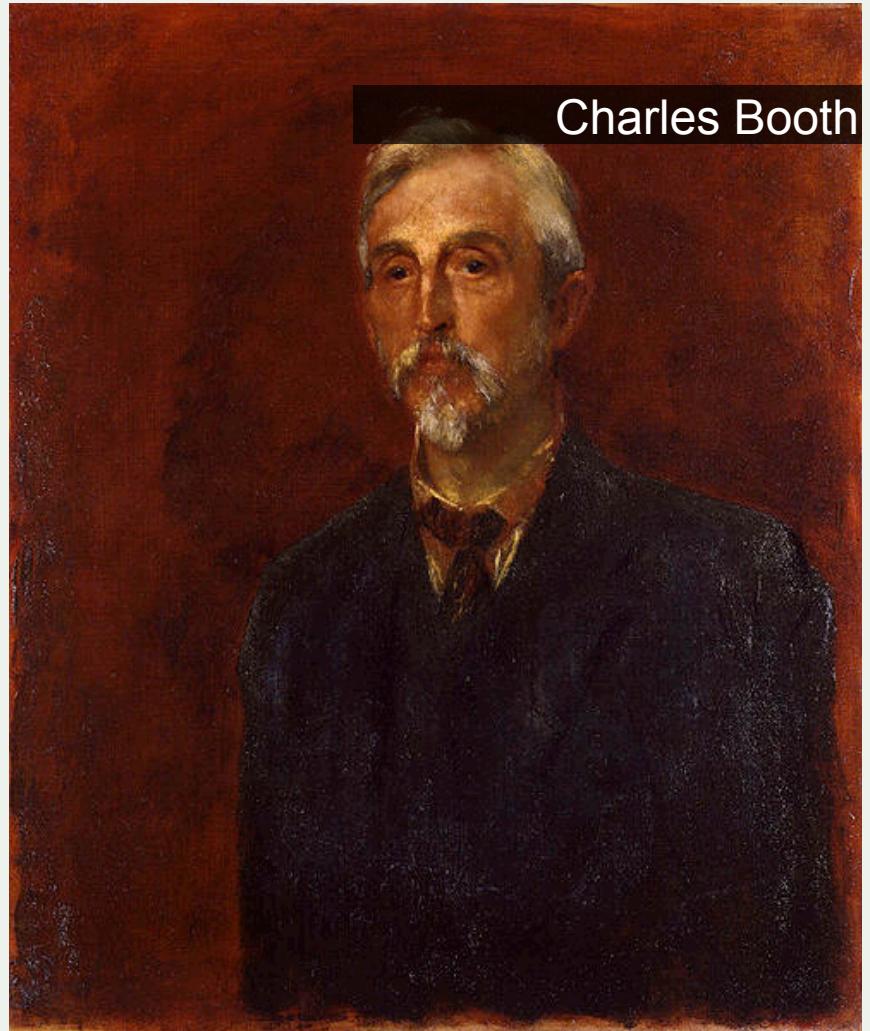
- Latitude and Longitude (WGS 1984)    EPSG = 4326
    - 52°N 37' 30.32" (52.6250)    1°E 14' 2.05" (1.2339)



# Geodemographics

- Brief overview
- What it is and why it's used
- MSc Applied Geographical Information Science

- 30 March 1840 – 23 November 1916
- Shipping business owner & Philanthropist
- Survey:
- **“Life and Labour of the People in London”**
  - First Edition
    - Life and Labour of the People, Vol. I (1889)
    - Labour and Life of the People, Vol II (1891)
  - Second Edition
    - Life and Labour of the People in London; 9 volumes 1892-97
  - Third Edition
    - Life and Labour of the People in London; 17 volumes (1902-03)
- Quantitative and Qualitative



[http://en.wikipedia.org/wiki/File:Charles\\_Booth\\_by\\_George\\_Frederic\\_Watts.jpg](http://en.wikipedia.org/wiki/File:Charles_Booth_by_George_Frederic_Watts.jpg)



### Description

BLACK: Lowest class. Vicious, semi-criminal.

DARK BLUE: Very poor, casual. Chronic want.

LIGHT BLUE: Poor. 18s. to 21s. a week for a moderate family

PURPLE: Mixed. Some comfortable others poor

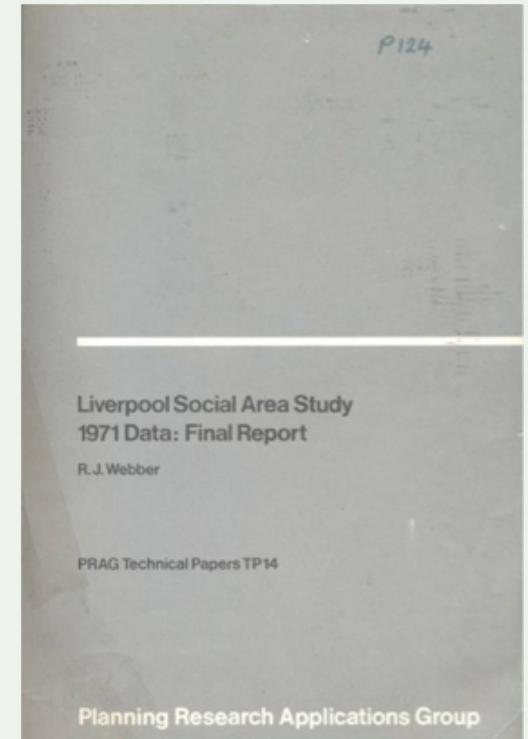
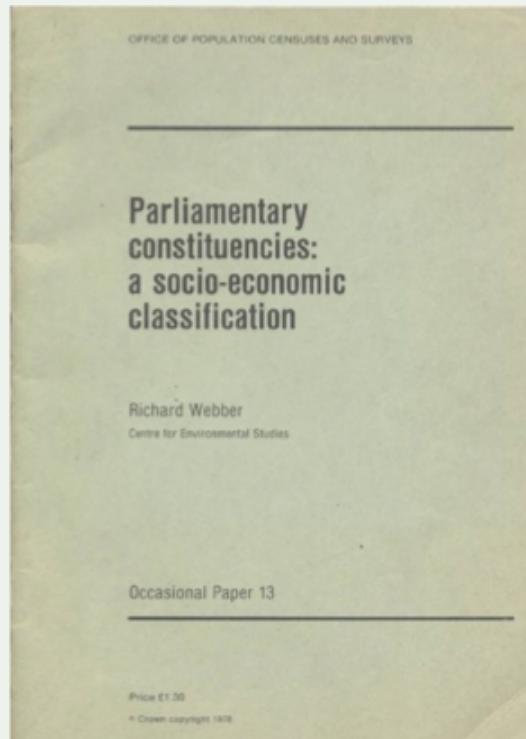
PINK: Fairly comfortable. Good ordinary earnings.

RED: Middle class. Well-to-do.

YELLOW: Upper-middle and Upper classes. Wealthy.

# Origins of Geodemographics

- Technique developed in 1970's attributed to Richard Webber
- Identify similar neighborhoods
- Target urban deprivation Funding
  - Public Sector – Government
  - Enumeration District Level



# Geodemographic Classification

- Experian: Mosaic
- Acorn: CACI
- People2Places
- OAC 2001 and 2011

# OAC

- 41 Variables
  - 100% 2001 Census
- Open Methodology
  - Peer Reviewed
  - ONS and UCL
- 7 SuperGroups
- 21 Groups
- 52 SubGroups

## Introducing the Area Classification of Output Areas

Daniel Vickers Department of Geography, University of Sheffield  
Phil Rees School of Geography, University of Leeds

This article provides a brief introduction to the Area Classification of Output Areas. The classification uses data from the 2001 Census to group the 223,060 output areas into groups of similarity based on their census attributes. The classification is freely available as a 'National Statistic' via the National Statistics website.

### Introduction

Social Area Classification is the classifying of areas into groups of similar based on the socio-economic characteristics of their residents. Gooddemographics is a term that has grown in prevalence over the last 20 years, with the development an industry that produces small scale area classifications (usually at postcode level) for commercial purposes such as target marketing and business or service site selection.

Gooddemographics is not just a set of off the shelf consumer targeting products it is "the analysis of people by where they live". Sleigh's definition of gooddemographics needs little elaboration as it is simple and to the point. Another definition that is worth noting is "Demography is the study of population types and their dynamics therefore gooddemographics may be labelled as the study of population types and their dynamics as they vary by geographical area". This definition identifies the blend of geography and demography that underpins gooddemographics.

Area classifications provide a unique way of bringing together area patterns from a range of variables, and identify similarities and dissimilarities between areas.<sup>1</sup> However, the idea of sorting things into categories based on similarities is not a new one; the basic premise of classification is fairly primitive. The nouns of the English language are little more than labels to describe classes into which objects can be placed.<sup>2</sup> In its widest sense, a scheme of classification represents a convenient technique for the organisation of a large dataset to enhance the efficiency of information recovery. Class labels describing arrangements of differences and similarities between objects provide a convenient summary of data.<sup>3</sup>

- 7 Supergroups, 21 Groups and 52 Subgroups:
  - 1 – Blue Collar Communities
  - 2 – City Living
  - 3 – Countryside
  - 4 – Prospering Suburbs
  - 5 – Constrained by Circumstances
  - 6 – Typical Traits
    - 6a – Settled Households
      - 6b2 - Suburban Families
  - 7 – Multicultural

“Pen Portraits:”

## 2 – City Living

- Densely populated urban areas with a young multi-ethnic population, primarily in and around London.
- High debt
- Low home ownership
- Poor health



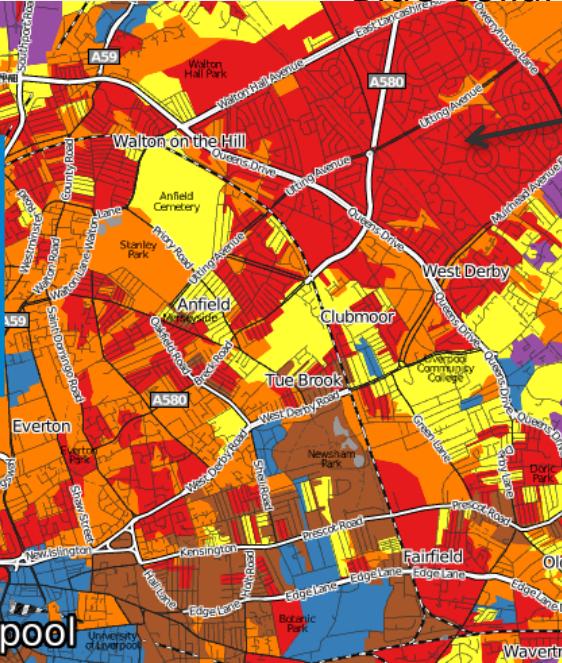
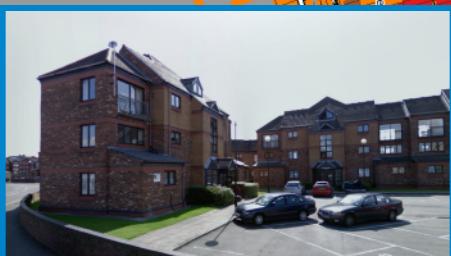
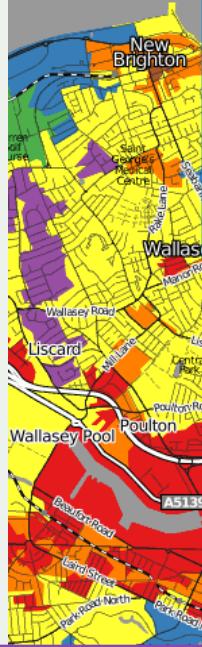
# 7 - Multicultural

These are poor urban areas where poorly paid young people and a relatively high ethnic mix are key characteristics. These young families live in the terraced streets of many major cities, including Birmingham, Bradford and London.



# Blue Collar

City Living



## Legend

Showing classification areas.

# Classification

- 1 Blue Collar Com
- 2 City Living
- 3 Countryside
- 4 Prospering Sub
- 5 Constrained by
- 6 Typical Traits
- 7 Multicultural

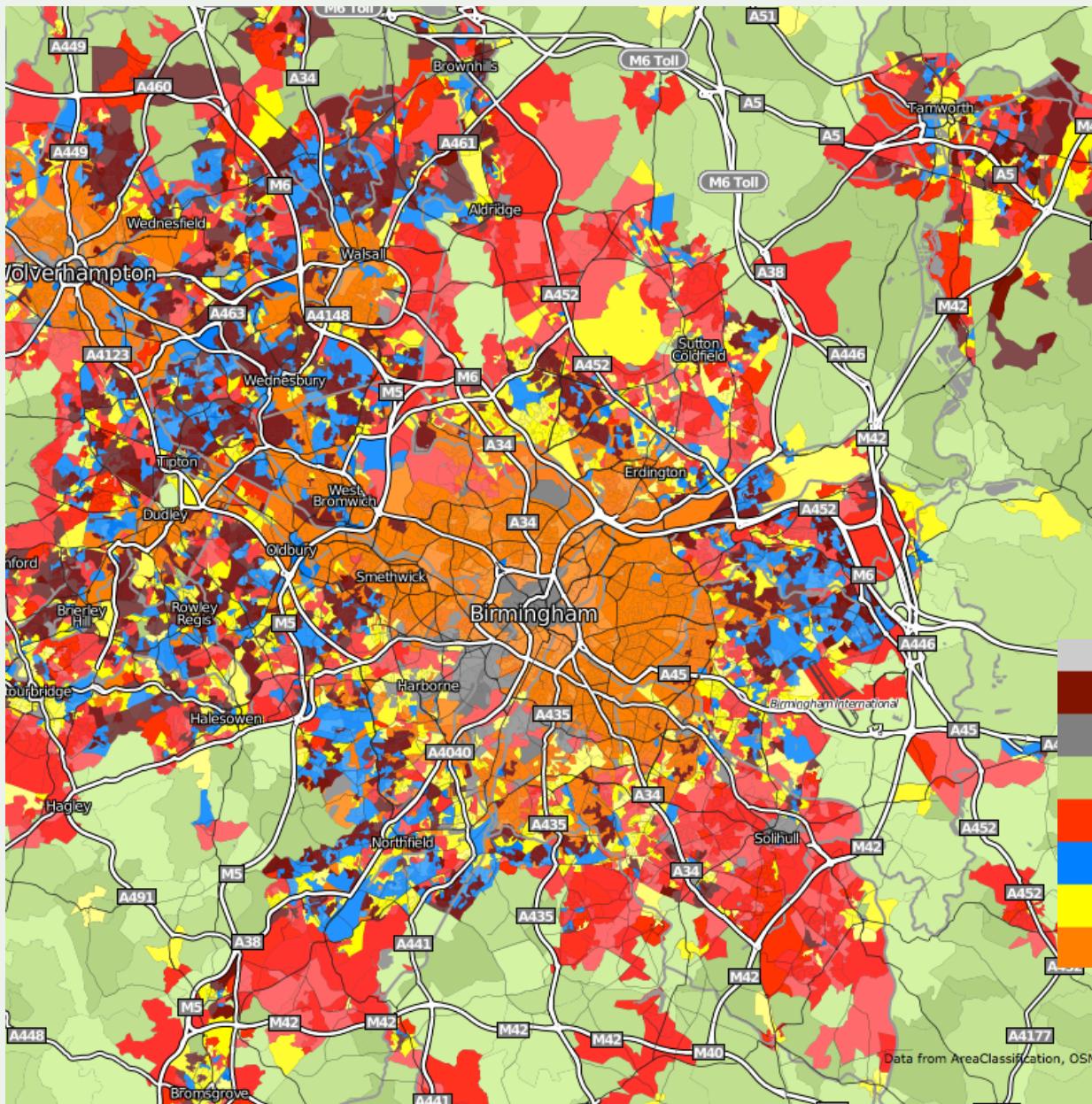
Hover for classification description.



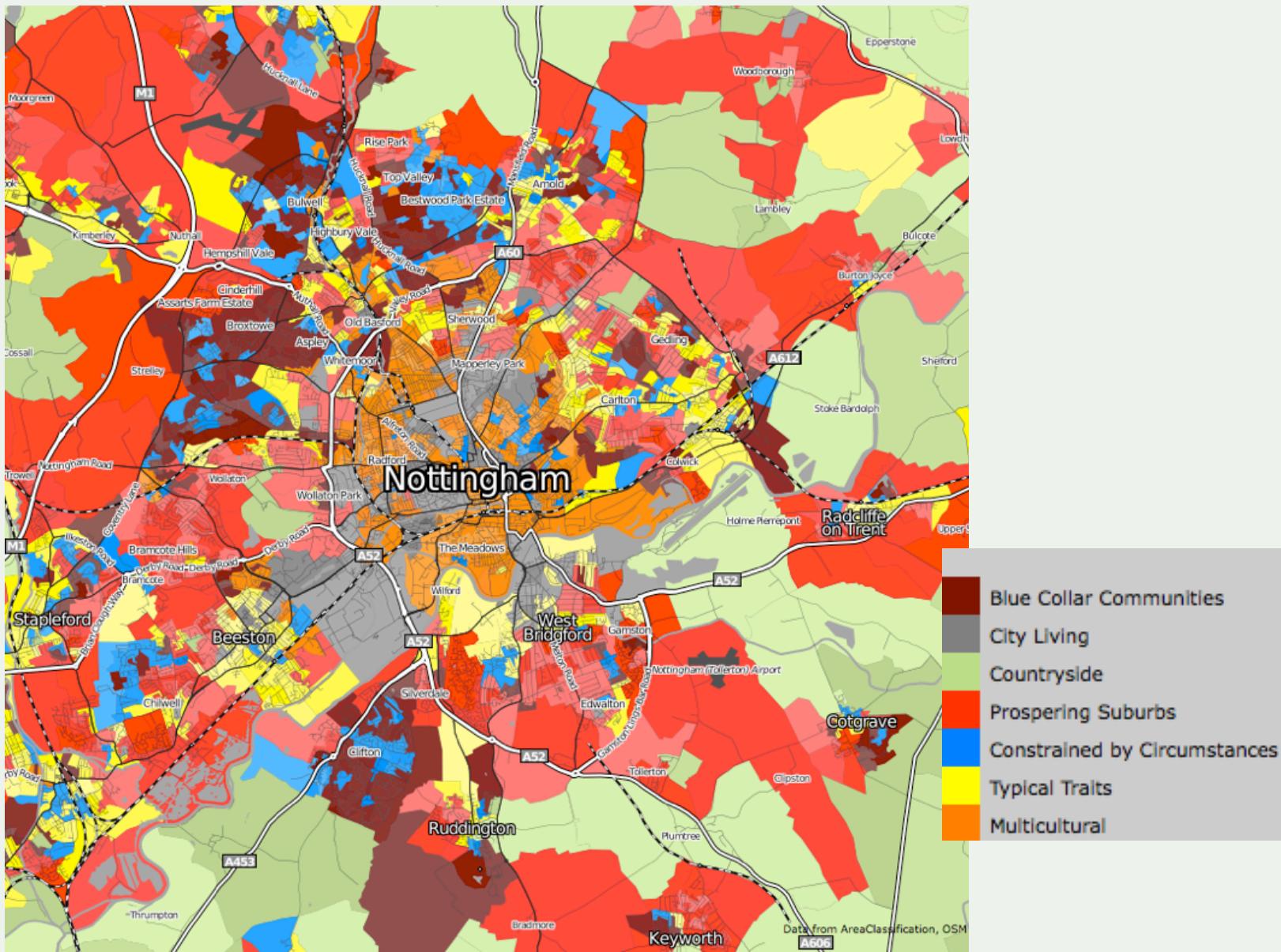
Prospering Suburbs

Multicultural

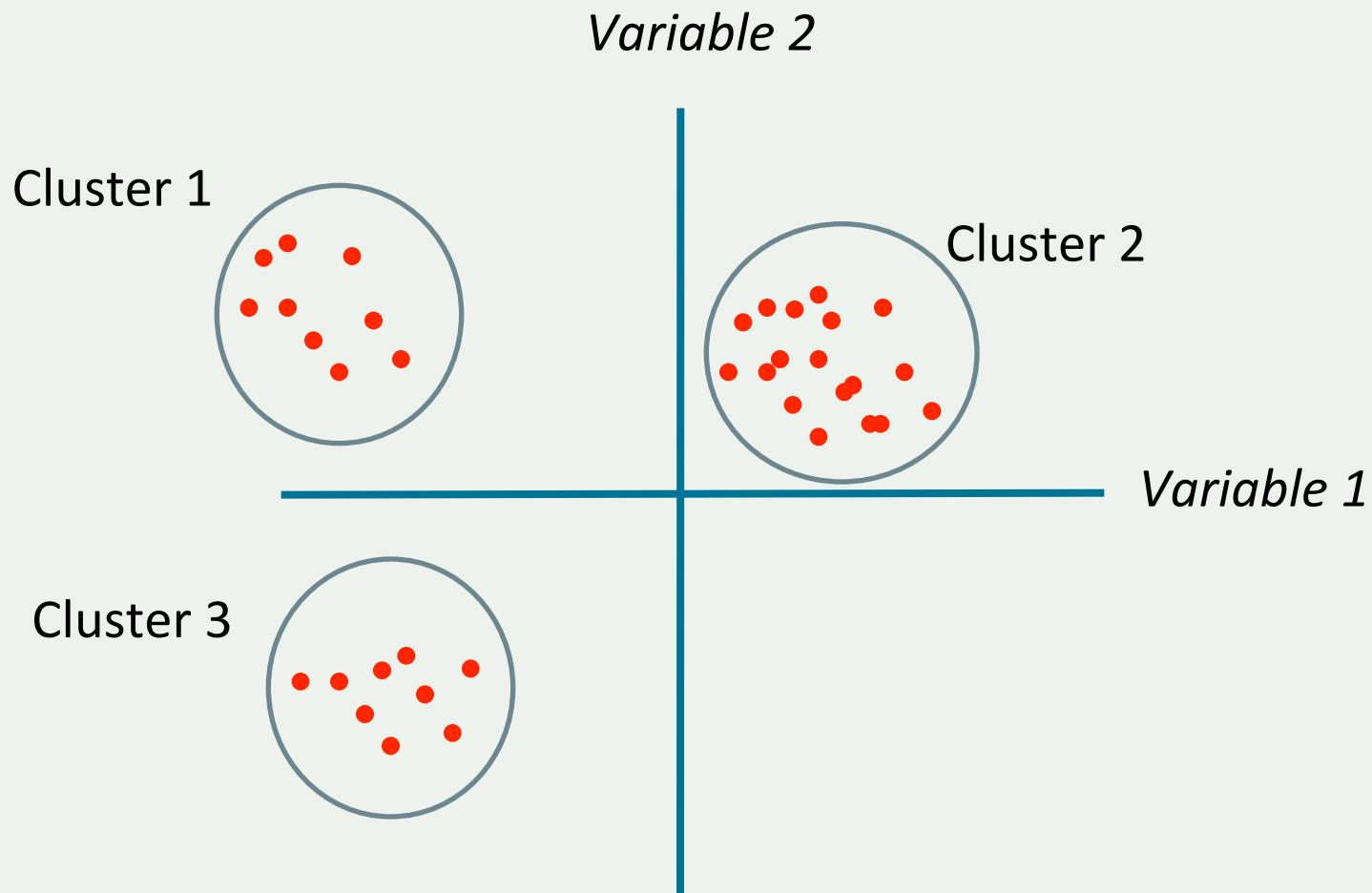
OAC



Data from AreaClassification, OSM



# Cluster Analysis



# Output Area Classifications (2011)

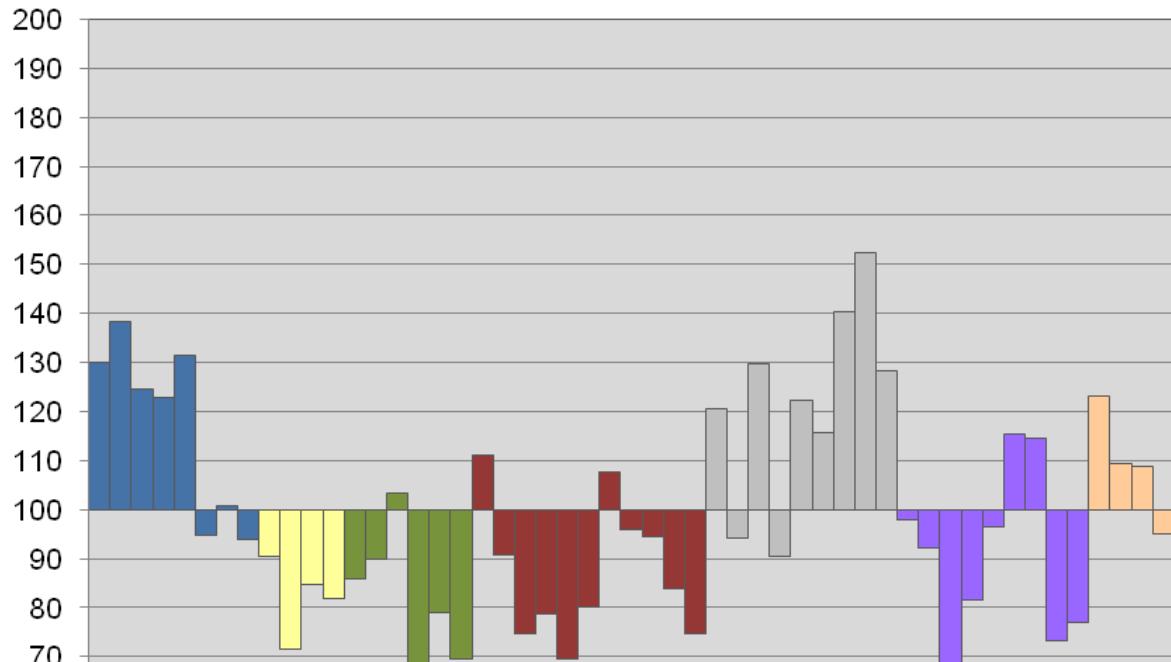
- Collaboration between ONS and UCL
- Preliminary
- Three-tiered hierarchical classification
- 8 Supergroups, 24 Groups and 67 Subgroups

# Index Scores

- Compares groups characteristics to the wider population
- 100 = group same as national average
- 200 = twice national average
- 50 = half national average

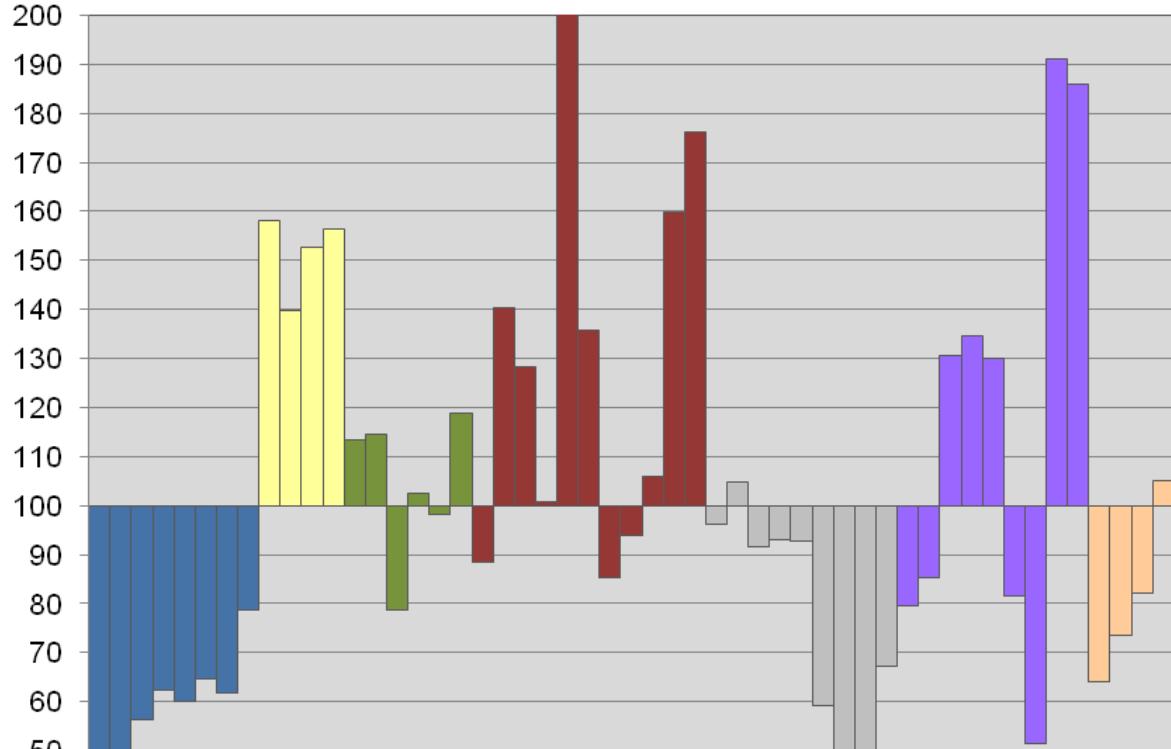
## Asda

- 1: Blue Collar Communities
- 2: City Living
- 3: Countryside
- 4: Prospering Suburbs
- 5: Constrained by Circumstances
- 6: Typical Traits
- 7: Multicultural

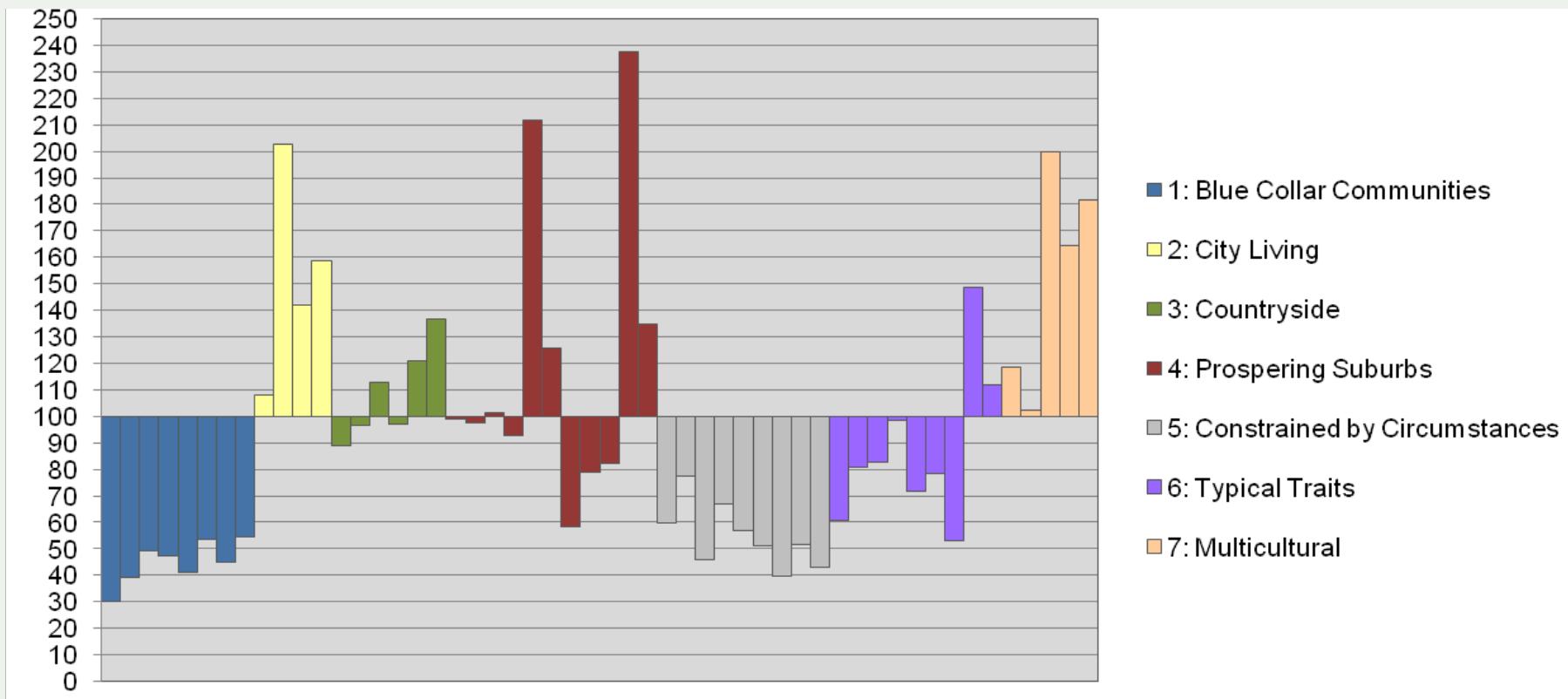


## Waitrose

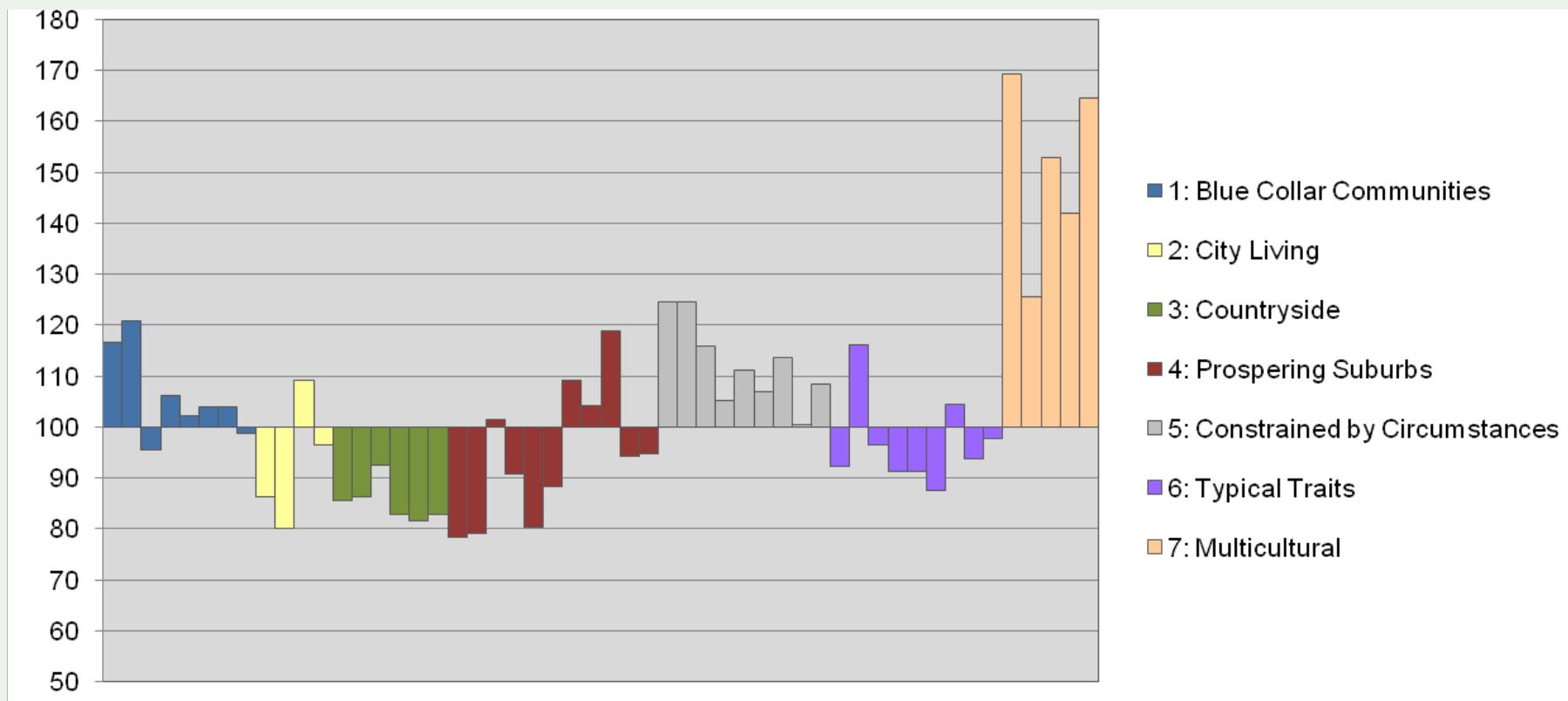
- 1: Blue Collar Communities
- 2: City Living
- 3: Countryside
- 4: Prospering Suburbs
- 5: Constrained by Circumstances
- 6: Typical Traits
- 7: Multicultural



# Who owns a Mercedes?



# Who owns a Nissan?



# Uses

- Targeting mail shots
- Shop site selection
- Credit scoring
- Car insurance

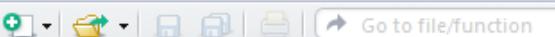
# R Notes - Working Directory

- R uses a ‘working directory’ to store your files in
- You might have a different one for each project / piece of work
- e.g. M:\\Documents\\GIS
- `setwd ("M:/Documents/GIS")`

# Variables

- R uses variables to store information – listed in your ‘workspace’ (top-right)
- When you close R Studio, save workspace

```
liverpool <-
  readShapeSpatial('liverpool_OA/
liverpool', proj4string =
CRS ("+init=epsg:27700"))
```



## Console //ufs02/user04/SCNB00/Documents/

```
R version 3.0.1 (2013-05-16) -- "Good sport"
Copyright (C) 2013 The R Foundation for statistical computing
Platform: x86_64-w64-mingw32/x64 (64-bit)
```

```
R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.
```

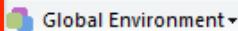
```
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.
```

```
Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.
```

&gt;

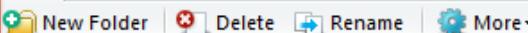
This is the console where you can type in commands

## Environment History



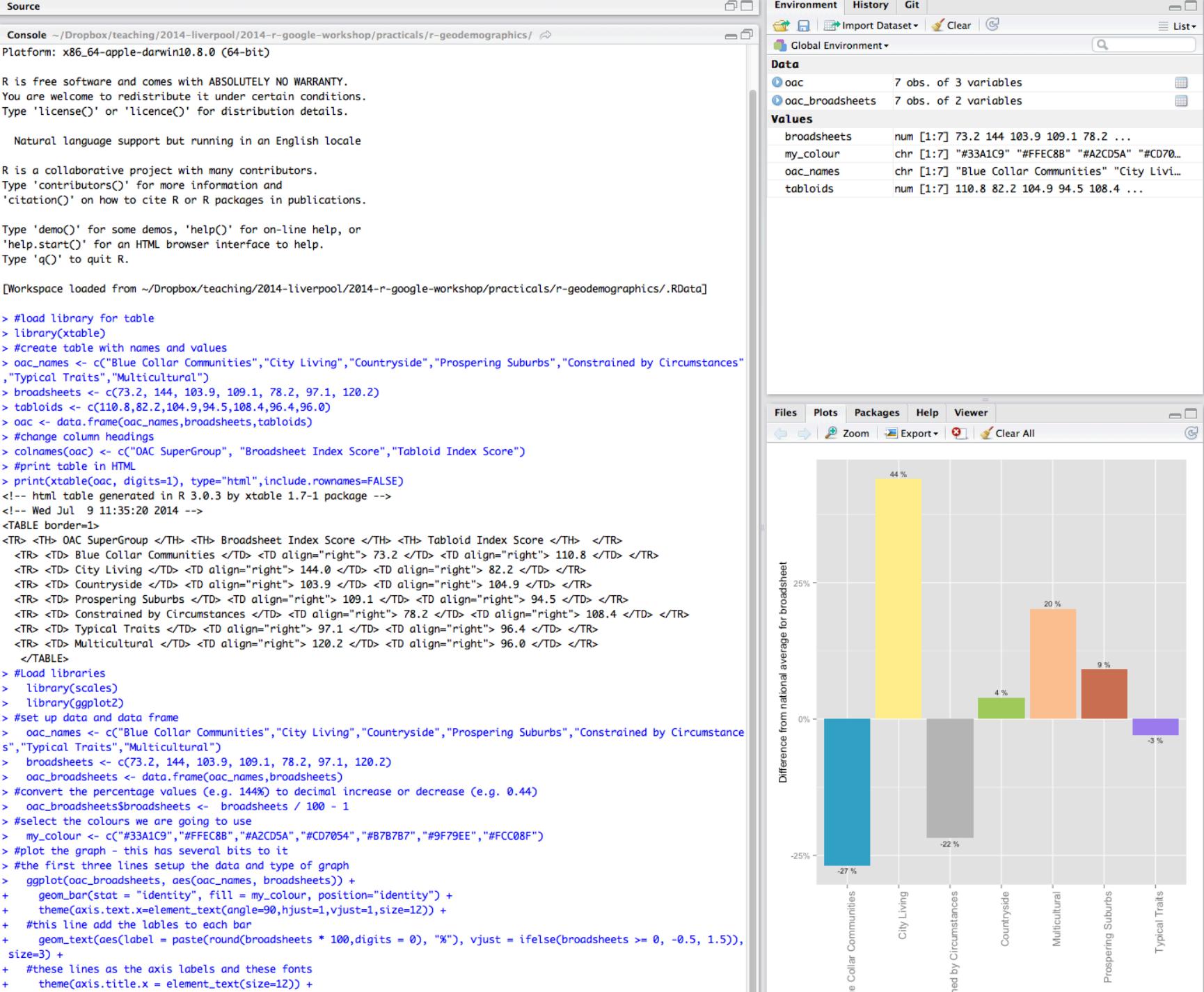
This lists the variables you have

## Files Plots Packages Help Viewer



Name	Size	Modified
My Music		
My Pictures		
My Video		

Here will show either your files  
(the files tab) or your plots (the  
plots tab)



File Edit Code View Plots Session Build Debug Tools Help

+ Go to file/function

Project: (None)

Untitled1 \*

Source on Save | Run | Source |

This is where you can write scripts

1 |

1:1 (Top Level) R Script

Console //ufs02/user04/SCNB00/Documents/

```
R version 3.0.1 (2013-05-16) -- "Good Sport"
Copyright © 2013 The R Foundation for Statistical Computing
Plat This is the console where you can type in commands

R is free software and comes with ABSOLUTELY NO WARRANTY.
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R is a collaborative project with many contributors.
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'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.
```

> |

Environment History

Import Dataset Clear List

Global Environment

This lists the variables you have

Files Plots Packages Help Viewer

New Folder Delete Rename More

Home

Name	Size	Modified
My Music		
My Pictures		
My Video		

Here will show either your files  
(the files tab) or your plots (the  
plots tab)

# Using R for Geodemographic Analysis

## R Basics

R began as a statistics program, and is still used as one my many users. At a simple level you can type in "3 + 4", press return, and R will respond "7". The code you type in in this tutorial is shown like this:

```
3 + 4
```

And R's output is shown like this:

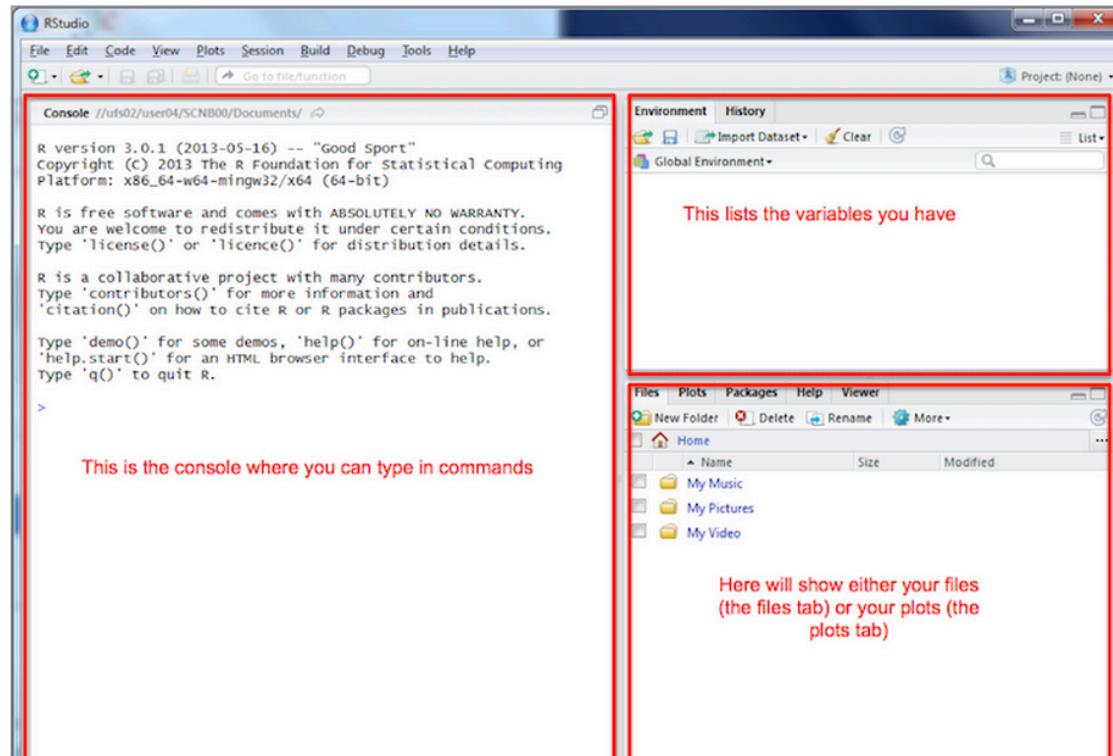
```
[1] 7
```

R has developed into a GIS as a result of user contributed packages, or libraries, as R refers to them. We will be using several libraries in this practical, and will load them as necessary.

*If you are using this worksheet outside of the course, you may need to install the R libraries as well as loading them. To do this, run `install.package("package_name")`.*

We won't spend too much time on the basics of using R - if you want to find out more, there are some good tutorials at <http://www.social-statistics.org/?p=764> or <http://rpubs.com/nickbearman/gettingstartedwithr>.

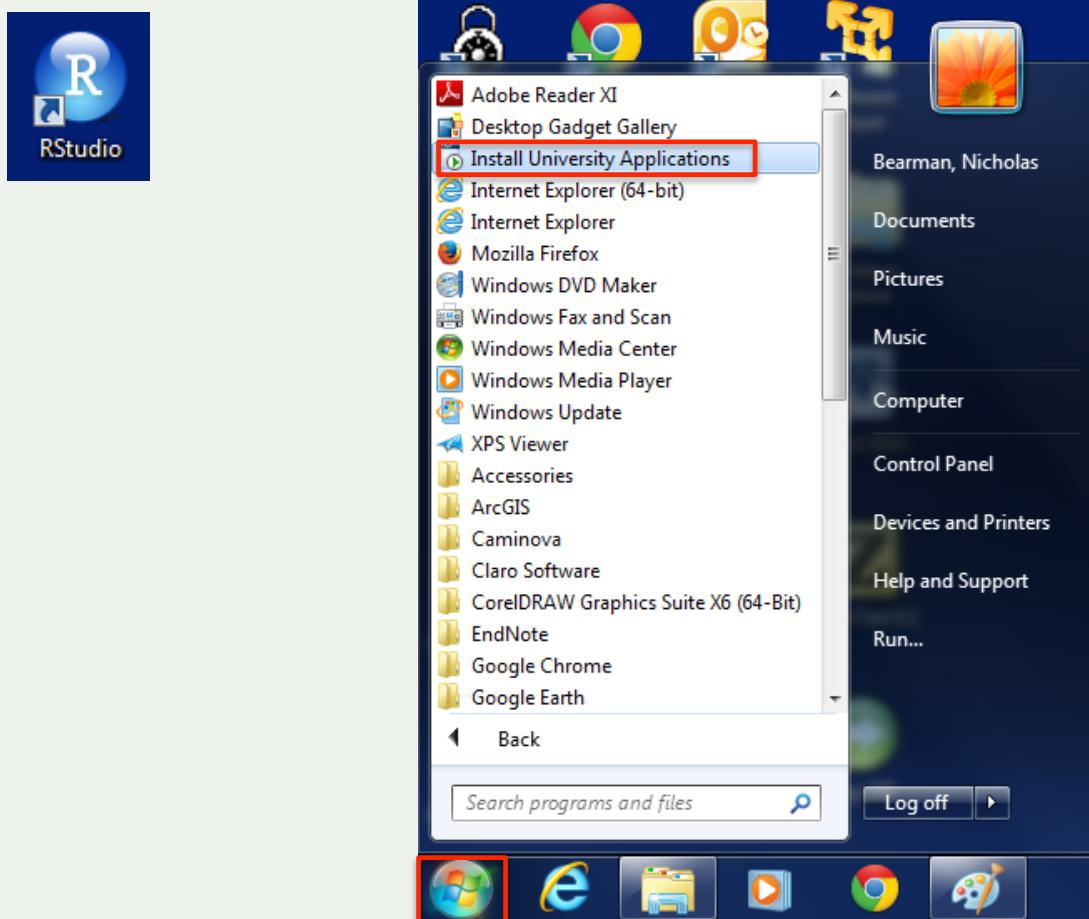
We are going to use a program called [R Studio](#), which works on top of R and provides a good user interface. I'll talk a little bit about it in the presentation, but the key areas of the window are these:



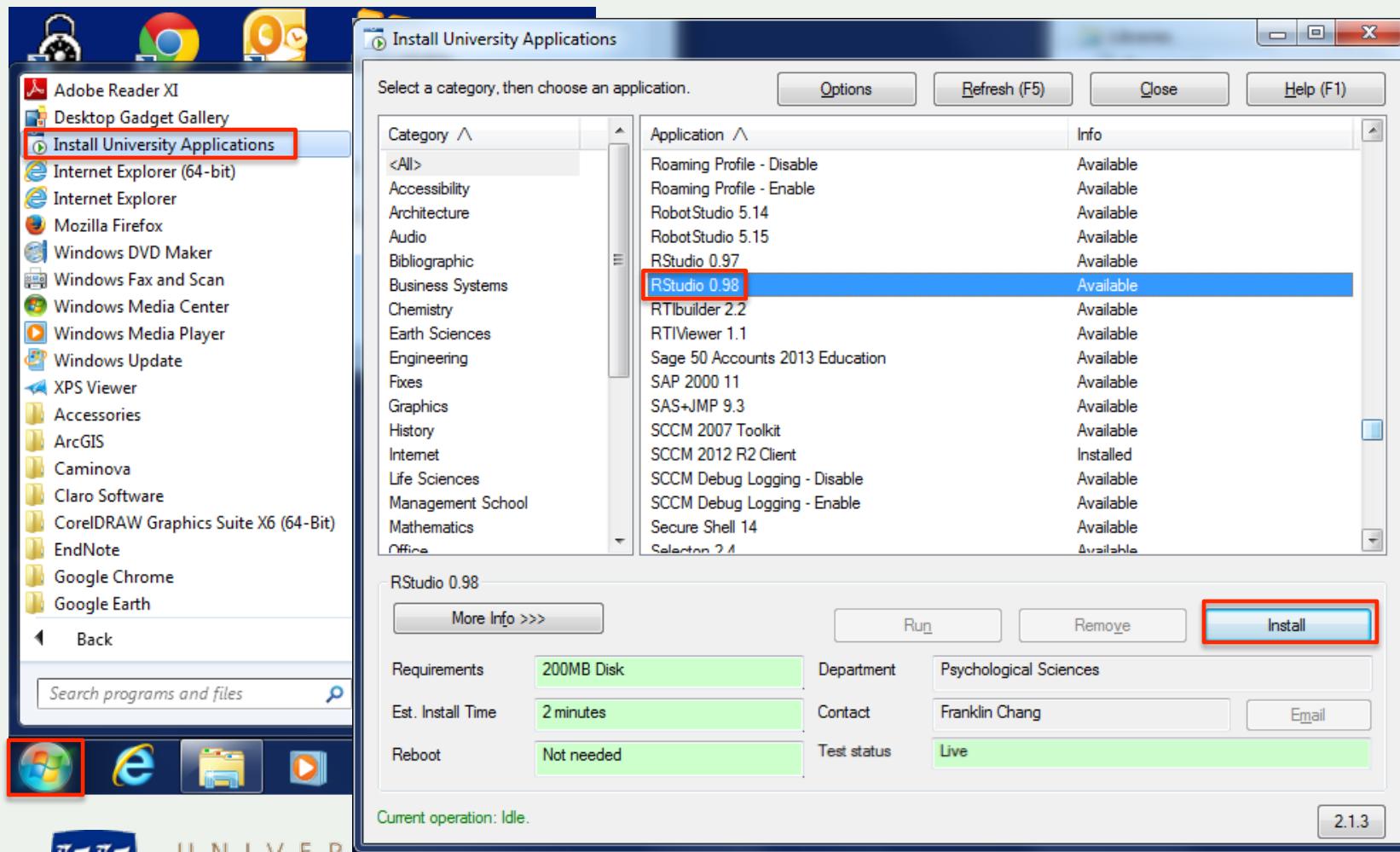
# Survey Questions

- Part of my research is GIS teaching
- Very quick (7 ques) survey of your GIS experience
- Follow up in 6 months / 1 year
- Optional

# Installing R Studio 0.98...



# Installing R Studio 0.98...



[bit.ly/1jpapm7](http://bit.ly/1jpapm7)



Survey:  
[bit.ly/1jpapm7](http://bit.ly/1jpapm7)

Practical:  
[bit.ly/1pZ8G9H](http://bit.ly/1pZ8G9H)

- Go!



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COUNCIL

Practical:

[bit.ly/1pZ8G9H](http://bit.ly/1pZ8G9H)

Libraries:

library(maptools)

Extra:

<http://rpubs.com/nickbearman/geodemographics>

# Recap

- Recap of the practical
- Geodemographics – the future
- Where now?
- Feedback

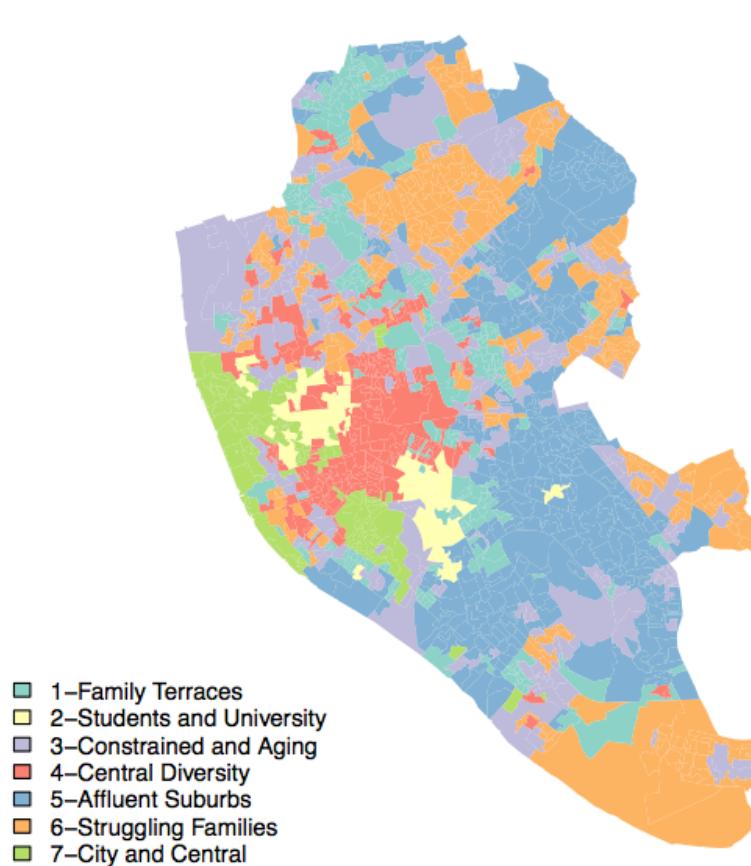
# The Practical

- Using R & R Studio
- Creating R scripts (& saving them!)
- Importing data (OAC, OAs)
- Joining Data
- Making Maps
- Available online
  - Tuesday on Google Maps

# Geodemographics – The Future

- Continually developing area
- Big data and public participation a big future contribution
- Current work from Geographic Data Science Lab

# Local Classification

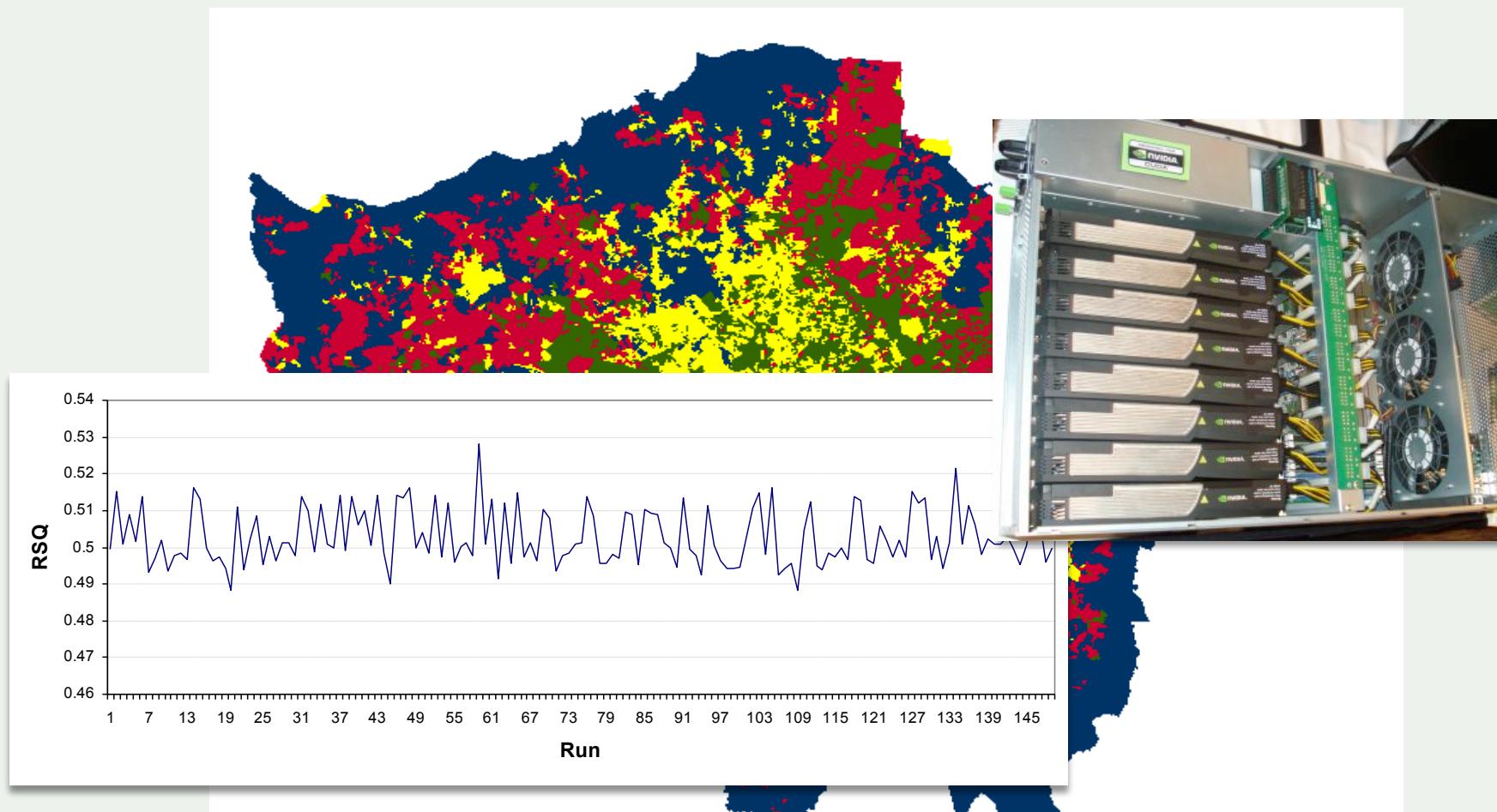


- 
- A choropleth map of the OAC 2011 area, color-coded into eight distinct categories. The categories and their corresponding colors are:
- 1 – Rural Residents (Dark Green)
  - 2 – Cosmopolitans (Red)
  - 3 – Ethnicity Central (Pink)
  - 4 – Multicultural Metropolitans (Orange)
  - 5 – Urbanites (Brown)
  - 6 – Suburbanites (Purple)
  - 7 – Constrained City Dwellers (Dark Blue)
  - 8 – Hard-Pressed Living (Yellow)

a classification for Liverpool versus OAC 2011 (right)

One size fits all?

## K-means (100 runs of k-means on OAC data set for k=4)



Big data and real time geodemographics – how can you optimize classifications quickly and from large temporally dynamic data sources

Singleton, A., Longley, P.A. (2009) Creating Open Source Geodemographics: Refining a National Classification of Census Output Areas for Applications in Higher Education. *Papers in Regional Science*, 88(3), 643–666.

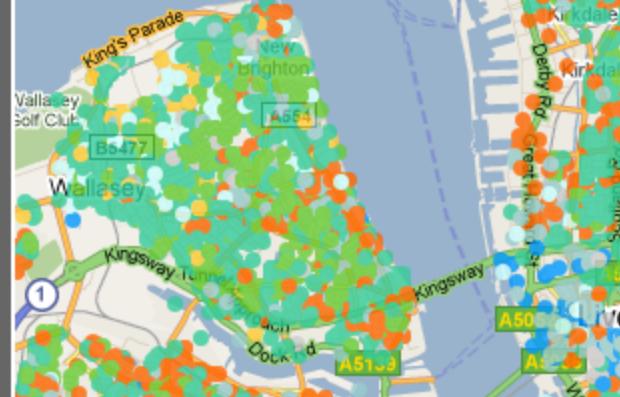
Adnan, M., Longley, P.A., Singleton, A.D., Brunsdon, C. (2010) Towards Real-Time Geodemographics: Clustering Algorithm Performance for Large Multidimensional Spatial Databases. *Transactions in GIS*, 14(3), 283 – 297 .



## eSociety Postcode Points

- Group A: E-unengaged
- Group B: E-marginalised
- Group C: Becoming engaged
- Group D: E for entertainment and shopping
- Group E: E-independents
- Group F: Instrumental E-users
- Group G: E-business users
- Group H: E-exposed

# How can greater social responsibility be incorporated into geodemographics – public feedback mechanisms



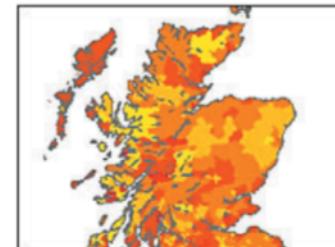
### Britain's digital tribes revealed

By Jonathan Fildes  
Science and technology reporter, BBC News

**Households in Britain can be classified into 23 "e-types" depending on their access to technology, say researchers.**

E-types include mobile explorers, the e-committed and rational utilitarians.

The researchers, from University College London (UCL), say the profiles could be used to inform future policies on access to digital technology.



[OPEN](#) [Enlarge Map](#)

79,051 hits over the 13 day period  
3,952 feedback responses

## SPATIAL-LITERACY.ORG

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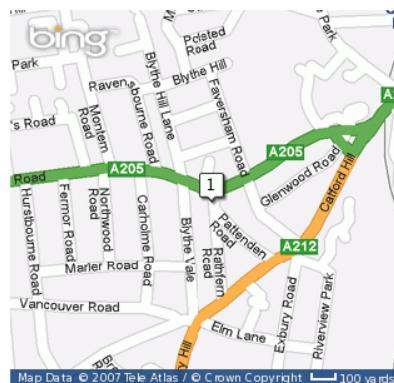
[Home](#) [Contacts](#) [People](#) [Projects](#) [Resources](#)

### Who else is like us?

The following table shows the top 10 most similar postcode districts to "London (SE6)" in terms of their technology use. Clicking the links will display a map of their location.

Rank	District	Town
1	PO1	Portsmouth
2	PR1	Preston
3	TW4	Hounslow
4	M19	Manchester
5	SE7	London
6	B55	Bristol
7	OL1	Oldham
8	E16	London
9	BD7	Bradford
10	LS5	Leeds

If you would like to know more about how these ranks were created please see our help page by clicking [\[here\]](#).



Map Data © 2007 Tele Atlas / © Crown Copyright

100 yards

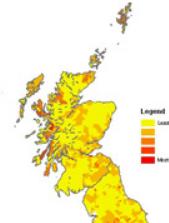
Terms of Use

Search Again:

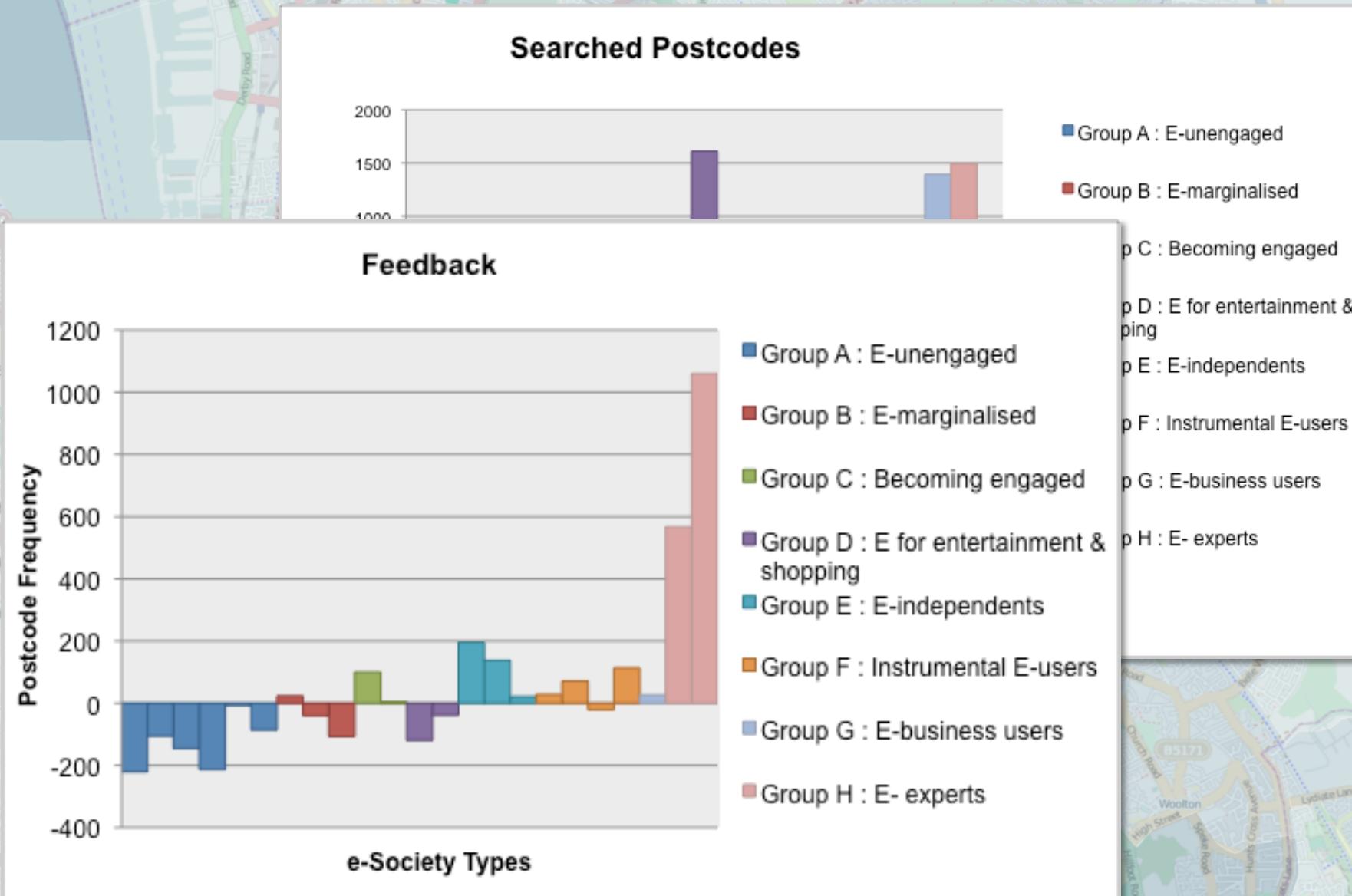
e.g. NW6 1CN

[GO](#)

Group C : Becoming engaged



**Do you agree with the E-Society classification for your postcode?** If not, then please let us know what you think it should be by clicking this [\[link\]](#).



# Geodemographics – The Future

- Much to be done – watch this space!

# Where now?

- R resources on the web
  - [www.rpubs.com/nickbearman](http://www.rpubs.com/nickbearman)
  - [www.youtube.com/user/marininstatlectures/playlists](http://www.youtube.com/user/marininstatlectures/playlists)
  - <http://cran.r-project.org/doc/contrib/intro-spatial-rl.pdf>
- R problems
  - [www.alex-singleton.com/R-Tutorial-Materials/](http://www.alex-singleton.com/R-Tutorial-Materials/)
  - “Why doesn’t my code work? - Common things to check”

# Feedback

- Feedback is really important for me
- Post-its
  - One thing you found fun
  - One thing you found challenging and useful
  - One thing you would improve
- Or email / phone / in person

# Thank you!



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