

# A Short Introduction to Quantitative Geography

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## Summary

This short report provides a short introduction to quantitative geography (or, why geography without quantitative methods just does not add up), its history and why it is of on-going importance within the discipline. It argues that quantitative geography is sometimes confused with traditional statistical tests that, although often useful, do not do justice to its wider scope. A better understanding of quantitative geography is as a creative act of applied data analysis – geographical ‘story telling’ with data – for which new sources of information, better access to data and new technologies for mapping and presentation provide fresh insights into geographical processes and outcomes. The report stresses the importance of numeracy and of experience in using data for geographical enquiry and knowledge as key skills for geographers to obtain.

## Introduction

“Well-rounded graduates, equipped with core quantitative skills, are vital if the UK is to retain its status as a world leader in research and higher education, rebuild its economy, and provide citizens with the means to understand analyse and criticise data. Quantitative methods facilitate ‘blue skies’ research and effective, evidence-based policy. Yet, the UK currently displays weak quantitative ability in particular, but not exclusively in the humanities and social sciences.” (The British Academy: Society Counts)<sup>1</sup>

“Geographers require skills in the presentation, interpretation, analysis and communication of quantitative data. They are familiar with a range of statistical techniques including simple descriptive statistics, inferential tests and relational statistics such as correlation and regression; principles of research design and ways to collect data; the retrieval and manipulation of secondary datasets; and geospatial technologies such as digital cartography, Geographic Information Systems (GIS) and remote sensing. Attention is given to spatial statistics, to issues of spatial

<sup>1</sup> [http://www.britac.ac.uk/policy/Society\\_Counts.cfm](http://www.britac.ac.uk/policy/Society_Counts.cfm)

dependency, to spatial difference and to the effects of scale.” (QAA University Subject Benchmark for Geography)

This section was originally written on Monday December 7<sup>th</sup>, 2015. The preceding weekend saw what might have been the highest amount of rain ever to fall in a single day in the UK, when Storm Desmond hit Cumbria and surrounding regions. Thousands of properties were without power and people had been evacuated from their homes. The word Cumbria was trending at sixth place amongst Twitter users in Greater Manchester, and also was sixth north of the Scottish-English border in Strathclyde. Further south, in Bristol, it was eighth. Cumbria didn't appear anywhere in the top fifty trends for Greater London, although the river Kent (which is in Cumbria) made an entry at tenth.

What has any of this to do with quantitative geography? Easy! It's to do with data and measurement, and especially data that can be linked to particular places to reveal geographical differences. When some people think of quantitative geography they do so with a sinking feeling that they associate with maths and equations or traditional statistical techniques like chi-square, the Mann Whitney test and Spearman's rank correlation. The statistician, Professor Michael Crawley, has quipped that chi-square is a statistical test that is “taught to geographers at school and misunderstood thereafter.” It is a cheeky jibe but one that makes a useful point: sometimes statistical tests are taught in isolation from the main themes and topics in geography, which is not a good way of learning and results in a poor understanding of what quantitative geography is really about.

Of course, maths is a part of the language of statistics and statistical methods are often used in the analysis of data. However, it is a mistake to see these as defining quantitative geography or even to make them the focus of attention. Figure 1 takes a wider view. It is not exhaustive but identifies seven different components of quantitative geography. Key amongst them is using methods of data analysis and of presentation, often in conjunction with geospatial technologies such as GIS, to explore and to explain the differences between places, and to study the outcomes of geographical processes at a range of scales. What Figure 1 emphasises is that the focus on quantitative geography is on geography not simply statistics.



Figure 1. Seven components of quantitative geography.  
 It's about geography more than it is about maths or statistics  
 (Source: adapted from Harris, 2016)

**Quantitative narratives: telling stories with data**

Another way to think of quantitative geography is about telling geographical stories with data. Those data may be collected by the researcher themselves, they may be secondary data provided by national or international data agencies – survey data, Census data or administrative data, for example – or they may be new sources of less conventional data such as those generated by social media. In any of these cases, the data are used to help tell a story, whether it be in the form of a scientific paper, a policy briefing, a business analysis or a media story (data journalism).

To speak of telling stories with data is neither to belittle the scientific value of data analysis nor to suggest the outcomes are a work of fiction. Instead it is to recognise the creative processes that are used to take data in their raw form and turn them into statistical, graphical and cartographic outputs that are used to communicate a point of view, to illuminate an area of knowledge, to test ideas and to help make sense of the world around us. Good analysis has a narrative, a plot that

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the author wants the reader to engage with – a message to take away, to consider and to debate. Watch some of the videos and presentations on the Gapminder website, for example (<http://www.gapminder.org/>) and see how the data and visualisations are used to craft a story, challenging existing perceptions and making people think afresh about some of the ‘hot topics’ in the world such as the potential challenges of growing populations.<sup>2</sup> Alternatively, have a look at the website <http://theinformationcapital.com/> and admire the artistry behind the maps that use often unconventional sources of data to generate information and knowledge about London and the lives of the people who live there. In both these examples, meaning is drawn from the data in fresh ways without a classic statistical test anywhere in sight.

Figures 2 and 3 can be used to tell stories about the ethnic geographies of London. London is a major world city that is becoming increasingly diverse in terms of the ethnic backgrounds of its inhabitants. In 2011, 45 per cent of the Census resident population of Greater London self-identified as White British, compared to 86 per cent across the rest of England. In 2001 the corresponding values were 60 per cent (for London) and 92 per cent (the rest of England). London is a ‘melting pot’ of different cultures and traditions and although there remains a geographical patterning to where in the city particular groups are most likely to live (Figure 3), its neighbourhoods are becoming more ethnically mixed. In terms of residential choices, ethnic segregation is decreasing in the city, especially amongst groups other than the White British.

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<sup>2</sup> They are hot topics in geography too. Indeed, Hans Rosling, who created Gapminder, was recognised for his contribution to geography with the award of the RGS-IBG’s Patrons Medal in 2014.

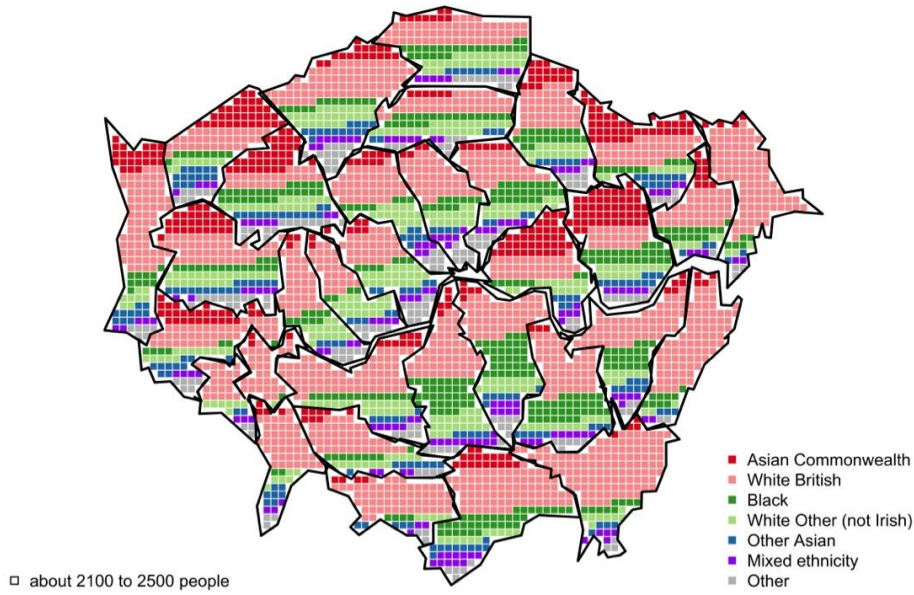


Figure 2. A map showing the ethnic composition of London's Boroughs in 2011 (Source: Harris, 2016)



Figure 3. 'Hot spot analysis' showing the spatial clustering of school children from the various ethnic groups in London (Source: Harris, 2016) (Darker shading shows a greater local concentration of the ethnic group concerned)

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## Convincing Stories?

It's a cliché to say that there are three types of lie – lies, damn lies and statistics – but it is true that it can be easy to deceive or to misinform with data. There are plenty of examples of terrible and misleading graphs (do a web search on bad or misleading graphs – you'll find many), of spurious statistics (try <http://tylervigen.com/spurious-correlations>) and of misunderstandings, mischief or blatant misuse of data (for examples of these see <http://www.badscience.net/>). An understanding of quantitative methods is important to engage in what the author Joel Best describes as Stat-Spotting, in his book subtitled a field guide to identifying dubious data.

Take as an example Figure 4, which appeared on the website of a national UK website and was also circulated amongst sceptics of human-made climate change. There is an obvious bias that is clear from the title. What is less obvious is that the “spectacular miscalculation” claim is untrue and, what is more, the graph actually shows it is untrue. A 95 per cent estimate will not, by definition, be correct 100 per cent of time so even if the world average temperatures did “crash out” of the predicted range that would not necessarily invalidate the predictions. However, as it happens, the temperatures don't fall outside the predictions so a more accurate headline would be ‘graph reveals how 95 per cent certain estimates of the earth heating up are correct.’ Admittedly the graph was circulated in 2013 when there was some suggestion of a pause in global warming but by 2015 the change in temperature had risen by 1 degree, as predicted by the forecasts but now at their upper end.

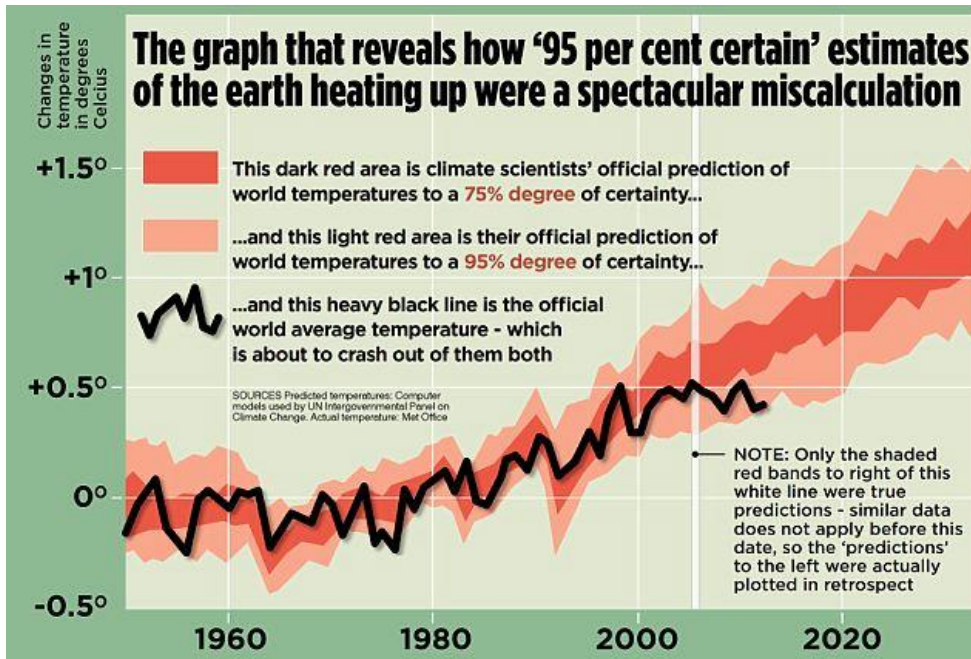


Figure 4. An example of a misleading graph (Source: Harris, 2016)

Stories can be retold in different ways and the same is true of those based on data. The choropleth maps in Figure 5 all use exactly the same data – the percentage of the 2011 Census population not White British by English local authority – but they don't all look the same. The higher percentages of 'minority' groups in London are evident in all the maps but changing the way the map is shaded changes how geographically clustered or spread-out the not White British groups appear to be. This in turn affects our understanding of the ethnic geography of the UK. Mapping software (GIS) will have a default setting but it won't necessarily be suitable for the data presented. In this case there is an uneven distribution: there are many places with low percentages of the not White British and fewer with high percentages. Maps (a) and (c) best capture the spatial unevenness.

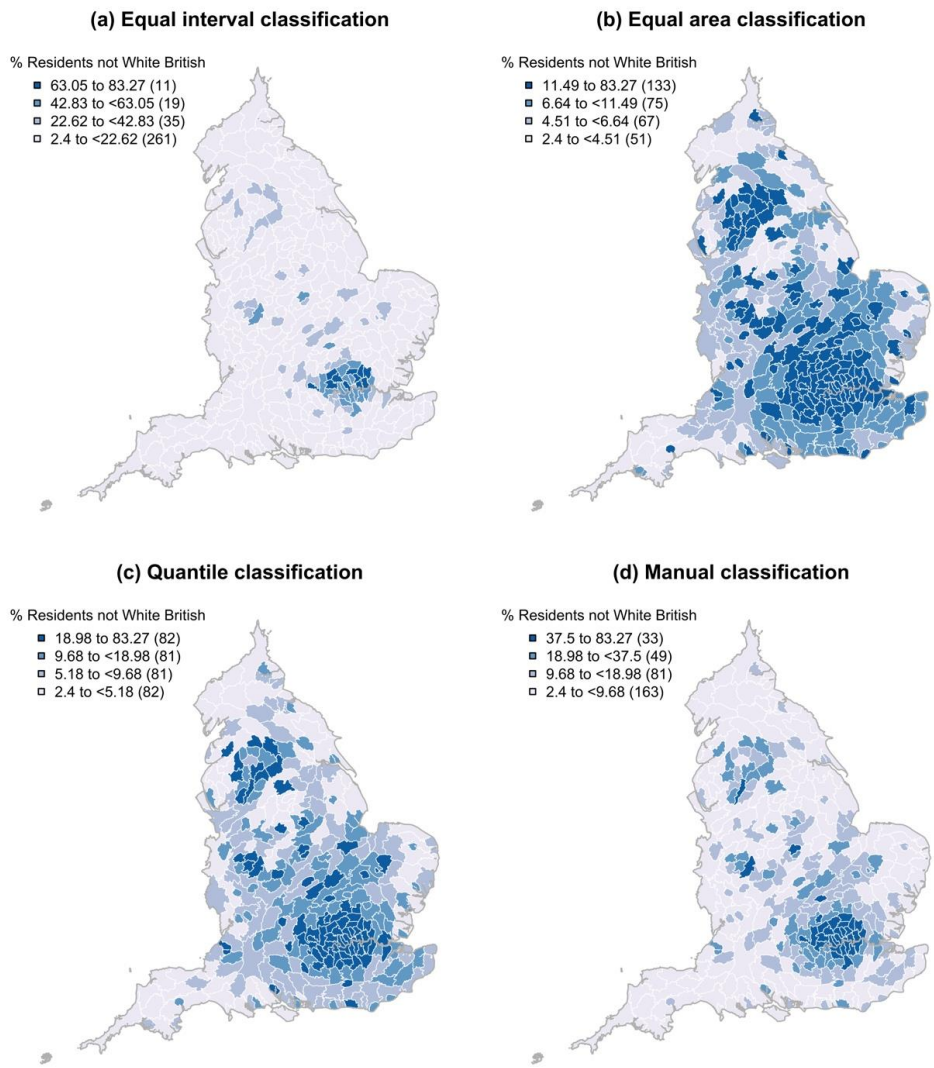


Figure 5. Same data, different maps: varying representations of where non-White British ethnic groups live in England (Source: Harris, 2016)

In a way, all we are seeing in Figure 5 is that the outcomes of analysis are affected by how the analysis is undertaken. That is hardly surprising but it is not always appreciated. In fact, it is hard to appreciate if we have little understanding of the processes involved in collecting, analysing and presenting data. In a data-driven society it is important for students to be able to engage in debates around data and, without being overly cynical, to be suitably questioning about the claims that are made in the media or in public policy for which numbers and data are presented as evidence. On April 1<sup>st</sup>, 2015, the Daily Telegraph reported that “British pupils are suffering because teachers are struggling to cope with an influx of foreign students speaking a total of 300 different languages, a union has said,” which might be regarded as an adverse effect of migration. However, as a report by



the fact-checking charity Full Fact discussed, although there are rising proportions of pupils in England’s state-funded schools with English as an additional language there is no evidence that this has affected other pupils’ learning.<sup>3</sup> In a similar but more extreme vein, the Daily Express had a complaint upheld against it for an article that claimed English “is starting to die out” and that English was “hardly heard at all” in some schools – claims that were misleading and completely unsupported by the data the newspaper had cited.<sup>4</sup>

In his classic book, *How to Lie with Statistics*, Darrell Huff encourages people to ‘talk-back’ to statistics, to not take them at face value but to lean to question and to scrutinise them. His goal is not to promote cynicism but understanding and good practice. He shows how graphics can be used to mislead. A particular *bête noire* amongst those who advocate good visual design is the pie chart, which, although widely taught, is an ineffective method of data presentation because angles are very hard to interpret – see Figure 6. The persuasive power of maps has also come under scrutiny. In a series of books that includes *How to Lie with Maps*; *Air Apparent: How Meteorologists Learned to Map, Predict, and Dramatize Weather*; *Bushmanders and Bullwinkles: How Politicians Manipulate Electronic Maps and Census Data to Win Elections*; and *No Dig, No Fly, No Go: How Maps Restrict and Control*, Mark Monmonier, explores the use and misuse of maps for political and other purposes. Full Fact’s website, <https://fullfact.org/>, is a rich resource for exploring the validity or otherwise of what politicians, the media and pressure groups are claiming. They expose both the misuse of data and claims for which there is no evidence base or for which the evidence is unreliable.

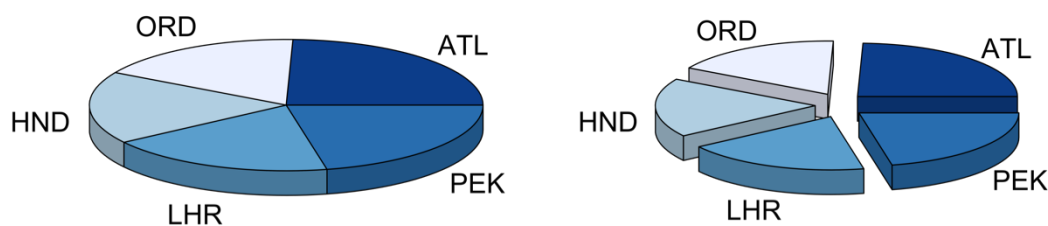


Figure 6. Examples of how not to present data. It may look nice but pie charts are rarely a good way to show information because angles are hard to interpret – use a bar chart instead. Adding superfluous ‘3D’ and other visual trickery makes things worse. (The data are passenger traffic in

<sup>3</sup> [https://fullfact.org/factcheck/education/effect\\_immigration\\_performance\\_native\\_speakers\\_schools-50166](https://fullfact.org/factcheck/education/effect_immigration_performance_native_speakers_schools-50166)

<sup>4</sup> <http://www.express.co.uk/news/clarifications-corrections/627051/IPSO-complaint-upheld-English-in-schools>

the world's busiest airports in 2013)

(Source: Harris, 2016)

### **Quantitative geography: geographical context, geographical processes and geographical differences**

Sometimes quantitative geography is about revealing the geographical diversity concealed by what have been described as stylised truths. In 2010, two economists, Carmen Reinhart and Kenneth Rogoff, published a paper that provided a rationale for the policies of austerity adopted by many governments following the banking crises and global recession of the late 2000s. Their paper suggested that increasing government debt stifles economic growth but only once debt exceeds 90 per cent of a nation's Gross Domestic Product (GDP, a measure of the monetary value of a country's economic output). In 2014, three geographers looked at the same data, this time approaching it from a geographical angle. What they found was the relationship between debt and growth varies across countries in ways that allude simple policy prescriptions: "these findings clearly indicate that, with regards to the effect of debt on growth, an argument and implied policy prescription based on a 'stylised fact' alone is much too simplistic and general to be particularly relevant from a policy perspective [...] as such, the importance of debt for budgetary policies should not be exaggerated; much depends on time and place."<sup>5</sup> Geography matters!

Sometimes quantitative geography is about modelling physical processes and their interactions with human environments. In 2013 there was extensive flooding of the Somerset Levels, with the lack of dredging of water channels considered to be a cause. However, as one Professor of Hydrology has argued, dredging is a simplistic response to a complex problem. In fact, it may owe more to politics than to science: "there was completely disproportionate attention on the Somerset Levels. About 150 homes were flooded compared with 6-10,000 nationwide. Local farmers lobbied very effectively, seized the agenda and got the Environment Agency to overturn its policy of not dredging. But the agency's policy was the right one. This is a massive seasonally-flooded wetland and dredging would have made only a marginal difference. It could even make matters worse if it shunts the water somewhere else."<sup>6</sup>

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<sup>5</sup> Stylised fact or situated messiness? The diverse effects of increasing debt on national economic growth: Bell A, Johnston R & Jones K, 2015. In: Journal of Economic Geography, 15(2), 449-472.

<sup>6</sup> <http://www.bbc.co.uk/news/science-environment-30209764> and <http://www.theguardian.com/environment/2014/feb/12/flood-crisis-dredging-climate-change>

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Sometimes quantitative geography is about solving geographical conundrums. For example, if ethnic minority groups tend to be in lower paid jobs (which they currently are), if London house prices are expensive and rising (which they are) and if those same ethnic minority groups are spatially concentrated in London (which the 2011 Census data suggests they are) then how can those groups afford to be there? The answer is by residing in more densely occupied and sometimes overcrowded living spaces – the ‘densification’ of the capital.<sup>7</sup>

### **Quantitative geography, spatial science, GIS and beyond**

Quantitative geography spans physical, human and environmental geography, and also the sciences, social sciences and the humanities. However, the term often is associated with the ‘quantitative revolution’ that took place within the discipline during the 1960s and early 1970s. Sometimes known as spatial science, its practitioners found inspiration in adapting scientific laws to socio-economic systems, drawing especially on economic theories to model urban systems, for example. Critiques of spatial science find it too tied to economics and, by implication, to the processes of power and wealth reproduction that sustain inequalities and social injustices. Others find it narrowly focused on the measured and measurable, and on overly formalised methods of representation. It has been criticised for taking a too narrow and depersonalised view of what it means to be human, eschewing sensitivity to individual experience in favour of more abstract ‘laws’ of human behaviour.<sup>8</sup>

There is truth in these criticisms but quantitative geography is a diverse field. There is no single philosophical perspective that binds its practitioners together. What there is, is a sense that geography matters, and that geographical differences matter. Much geographical analysis is about exploring differences between people and places, looking for geographical variations.

Consider issues of economic inequality. How can it be claimed that inequality between the rich and poor is growing in countries such as the UK unless there is data to measure it? (For some of the evidence, see <https://www.equalitytrust.org.uk/scale-economic-inequality-uk>). Furthermore, a geographer would not be content with just knowing that it is growing but would ask *where* is it growing, which people and places does it most effect? Is there, for instance, evidence of a north-

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<sup>7</sup> Densification in London, 2001 – 2011: the non-white housing market experience: Johnston R, Owen D, Manley D & Harris R, 2016. In: International Journal of Housing Policy, in press.

<sup>8</sup> See Chapter 4 of Geography & Geographers (7<sup>th</sup> edition) by Ron Johnson and James Sidaway – the book is also an excellent introduction to University geography for students making the transition from school.

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south divide or is such language overly simplistic? The Guardian newspaper has gathered together a number of articles and commentaries about the perceived differences between southern England and the rest of Great Britain (<http://www.theguardian.com/society/north-south-divide>) but 'divisions' exist at multiple scales – read, for example, the geographer Daniel Dorling's book, *The 32 Stops: The Central Line*, to learn more about the diversity of the lived experience within London, or see 'The Cattle Report' which was written in 2001 in the aftermath of riots Bradford, Burnley and Oldham. The first of its findings is sobering.

Whilst the physical segregation of housing estates and inner city areas came as no surprise, the team was particularly struck by the depth of polarisation of our towns and cities. The extent to which these physical divisions were compounded by so many other aspects of our daily lives, was very evident. Separate educational arrangements, community and voluntary bodies, employment, places of worship, language, social and cultural networks, means that many communities operate on the basis of a series of parallel lives. These lives often do not seem to touch at any point, let alone overlap and promote any meaningful interchanges.<sup>9</sup>

It also raises questions about how explicitly geographical concepts such as segregation can be measured.<sup>10</sup>

Spatial science contributed to some of the theoretical foundations of geographical information science and to geospatial technologies such as GIS. When GIS were first developed they were expensive, standalone systems. However, these days spatial data handling is firmly embedded into our lives and the technologies we use: consider, for example, Google Maps, Google Earth or the sorts of location based services available on a mobile phone. We are all active in creating, recreating and participating in digital worlds. A particularly interesting strand of application is participatory GIS that aims to empower those traditionally excluded from spatial decision-making processes, also used in response to natural disasters. See, for example, <http://www.participatorymethods.org/method/participatory-geographical-information-systems-pgis>, <http://www.ppgis.net> and the videos at <https://vimeo.com/channels/pgis>.

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<sup>9</sup> <http://resources.cohesioninstitute.org.uk/Publications/Documents/Document/Default.aspx?recordId=96>

<sup>10</sup> See [https://www.census.gov/hhes/www/housing/resseg/pdf/app\\_b.pdf](https://www.census.gov/hhes/www/housing/resseg/pdf/app_b.pdf) if you are interested - the range of measures it describes and their various formulae make a useful point: there are different ways of conceiving what it meant by segregation, and different ways of taking the concept and translating it into a formula (i.e. something that can be measured).

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## Teaching quantitative methods

Although a student in geography can expect to use quantitative methods at school and at university – and typically these methods include some GIS, descriptive statistics and some statistical tests – a 2013 report for the Royal Geographical Society (with IBG) found that quantitative methods were not well integrated in the geography curricula. It is for this reason that the 2014 recommendations of the A-level Content Advisory Board (ALCAB) included greater embedding of quantitative methods within the substantive themes of geography (in themes such as economic and social inequalities) rather than teaching methods in isolation and as an end in themselves.

Quantitative methods are sometimes taught ‘in the field’, collecting data and undertaking statistical tests to compare, for example, the size of pebbles moving away from the shoreline of a beach. Knowing how to collect and to analyse data is important but is limited to small samples and what can be achieved with limited resources and time. More extensive data, especially for studies of human geography, are available on line – for example at Eurostats (<http://ec.europa.eu/eurostat>), the United Nations (<http://data.un.org/>), the World Bank (<http://data.worldbank.org/>), the UK Data Service (<https://census.ukdataservice.ac.uk/>), the UK Data Archive (<http://www.data-archive.ac.uk/>) or Neighbourhood Statistics (<http://www.neighbourhood.statistics.gov.uk/>, <http://www.sns.gov.uk/>, <http://www.ninis2.nisra.gov.uk/>).

The US Open Data Centre is another useful source of openly available data <http://us-city.census.okfn.org>. Similar initiatives to make data more open and accessible exist in the UK and can form part of smart city technologies – see, for example, <http://www.bristolisopen.com> or <http://data.london.gov.uk>.

Making use of these data can be daunting because it may require a process of identifying what you are looking for, registering, downloading and tidying-up the data before they are ready to use. Fortunately, there are ways to ease the process. For example, The Guardian provides a whole range of interesting analyses of data that are of relevance to geographical studies (see <http://www.theguardian.com/data>). The website <http://datashine.org.uk> provides interactive visualisation of Census data. The website <http://www.uklocalarea.com> has information including census statistics, house prices, school results, council tax, energy prices and street-level crime in England, Wales and Scotland; <http://www.checkmyarea.com> provides a commercial classification of neighbourhoods by ‘neighbourhood type’ which would make for an interesting discussion about

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how commercial companies portray neighbourhoods and some of the potential social implications of doing so; <https://www.police.uk> provides crime maps; <https://www.gov.uk/check-local-environmental-data> allows you to see what is in your environmental backyard – including landfill sites, risk of flooding and air pollution. The think-tank Demos has an ‘Integration Hub’ at which the ethnic geography of England and Wales can be explored (<http://www.integrationhub.net/map/residential-patterns-map/>). GapMinder World (<http://www.gapminder.org/world/>) contains a lot of interesting data and interactive tools to visualise it, such as CO<sub>2</sub> emissions since 1820, dental health, HIV numbers and about whether it matters for development if a country is landlocked or has a coastline.

These data are geographically relevant and ready to use. They complement the recommendations of ALCAB, which aim to bring data into the classroom and into the heart of the geography curricula. Data complement teaching by providing information and evidence to discuss.

## **Conclusion**

New data and new technologies are helping to invigorate what we can do with quantitative information, enhancing geographical understandings of the world in creative and imaginative ways. Caricatures of quantitative geography that see it as limited to nineteenth and twentieth century statistical techniques are anachronistic and incomplete. It is about using data to enhance our geographical understanding of the world in fresh and often challenging ways. The hope is that geography students will be ‘hands on’ in their use of data and data handling tools not just to enhance their numeracy employability and research skills but because the use and critical evaluation of quantitative data is central to geographical debate and enquiry – it is an important part of what geographers do.

## **Acknowledgements**

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## Additional resources

The reports *Quantitative Methods in Geography: Making the Connections between Schools, Universities and Employers*, and *Skills in Mathematics and Statistics in Geography and tackling transition* are available on the RGS-IBG, which also includes short videos of how quantitative methods are used in the workplace.<sup>11</sup>

The British Academy's Society Counts website has various reports about the quantitative skills crisis in UK social science, the importance of quantitative skills for student employability and academic learning, as well as a booklet aimed at students with testimonials from other students about how they have benefitted from learning quantitative skills.<sup>12</sup>

The Nuffield Foundation website has details about the Q-Step initiative, a £19.5 million programme designed to promote a step-change in quantitative social science training in the UK, and about the 15 Q-Step Centres offering degree programmes with enhanced quantitative training (geography is included at Bristol, Leeds, Sheffield and UCL).<sup>13</sup>

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<sup>11</sup> <http://www.rgs.org/OurWork/Research+and+Higher+Education/Learning+teaching+and+research+in+higher+education/Quantitative+Teaching+and+Learning+in+Geography/Quantitative+Teaching+and+Learning+in+Geography.htm>

<sup>12</sup> [http://www.britac.ac.uk/policy/QS\\_Publications.cfm](http://www.britac.ac.uk/policy/QS_Publications.cfm)

<sup>13</sup> <http://www.nuffieldfoundation.org/q-step>