Chapter 3.7

Area Cartograms: Their Use and Creation

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Editors' overview

Dorling re-energised the deployment of the cartogram as a design following his PhD research in the early 1990s, and in an ongoing series of atlases and publications in the twenty years since. In this excerpt from a short booklet he situates cartogram techniques, contrasting and explaining physical, mechanical and algorithmic methods used in their construction. He also explores the popularity of the technique in political cartography, epidemiological mapping, the mapping of mortality and the mapping of commuting and migration flows, before considering the explanatory power of the cartogram as a device for presenting complex socio-economic and political data.

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Introduction

Maps are called cartograms when distortions of size, and occasionally of shape or distance, are made explicit and are seen as desirable. Typically places on a cartogram are drawn so that their size is in proportion to their human populations. However, their size could be made proportional to any measurable feature. Conventional maps can be seen as land area cartograms – as places on them are usually drawn in proportion to their land areas – although this is often not the case for features on these maps. [. . .] Cartograms are produced for a variety of purposes. They can be used, like the London Underground map, to help people find their way. In atlases they are often used for their ability to shock; cartograms where area is drawn in proportion to the wealth of people living in each place show a dramatic picture. A major argument for the use of equal population cartograms in human geography is that they produce a more socially just form of mapping by giving people more equitable representation in an image of the world. In research, cartograms are increasingly used to provide alternative base maps upon which other distributions can be drawn to see, for example, whether the incidence of a particular disease is spread evenly over the population. Cartograms can also be used like conventional maps where different areas are shaded with different colours to show variation over space. For instance, to be able to map both the absolute and relative concentration of elderly people across the population a cartogram is required. [. . .]

It may be helpful to begin with a simple example. Figure 3.7.1 gives population statistics and a map for a fictional island. Its area is 20 square kilometres and 100 people live on the island, which is divided into three districts: the Farm, Town and City. The figure shows that the mean population density of the island is five people per square kilometre, although most of its population live in the City at a density of 15 people per square kilometre. The equal area map of the island has been simplified to fit on a grid. The cartogram of the island was drawn by hand, starting with the City and trying to alter the shape of the island as little as possible while making the area of each district proportional to its population. Note that the Town still separates the Farm and City. The impact of this transformation is illustrated by using two pictograms in which icons are placed on both the map and cartogram to show the distribution of the population. The icons differentiate people depending on whether they are in work, but even on the cartogram it is difficult to

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Vital Statistics	Farm	Town	City	Total
Area	10	6	5	2060
People	10	30	60	100
Density	1	5	15	5
Working	5	10	15	30
Dependency	50%	33%	25%	30%

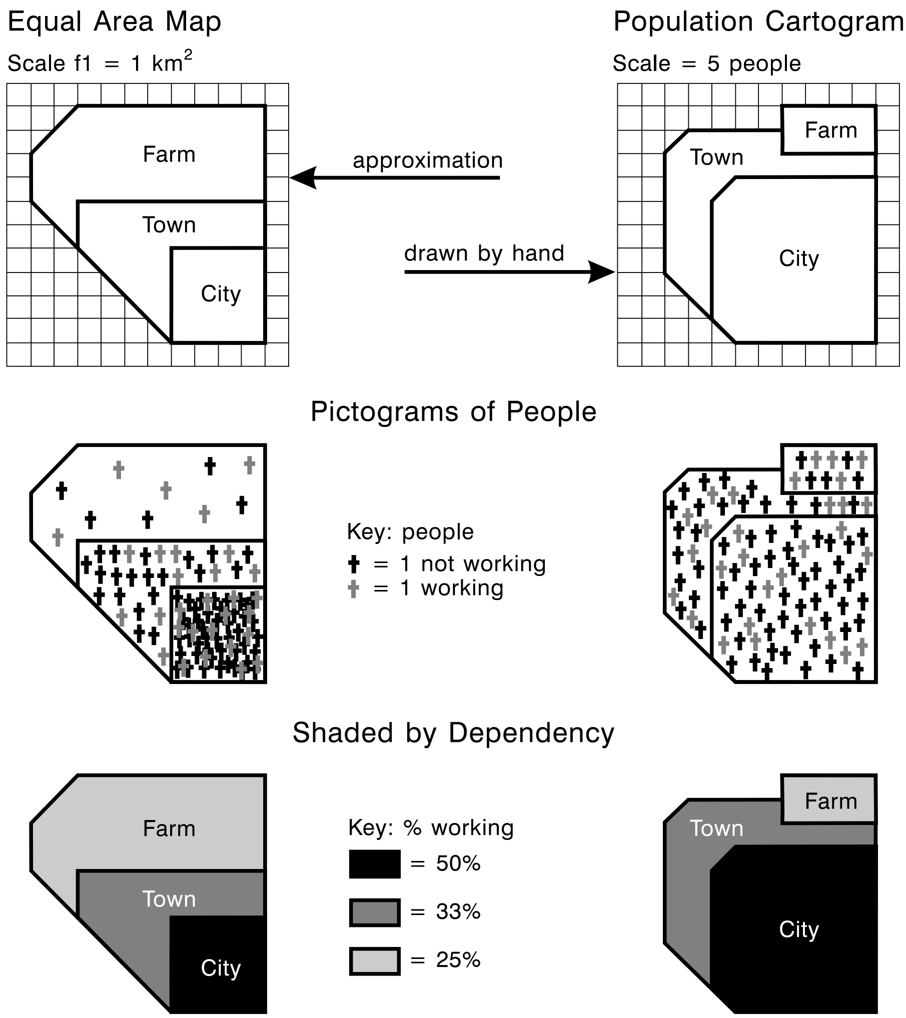

Figure 3.7.1 Example of a cartogram created and shaded by hand for a fictional island.

tell where workers are more numerous from these icons. The final pair of equal area map and population cartogram in the figure has each district shaded by the proportion of the population who are working (the dependency rate). Clearly the map and cartogram give very different impressions. One shows that on most land many people are working while the other shows that many people live in areas where most people do not work. [. . .]

People are unevenly distributed over the surface of the earth. This has always been so and is true no matter how closely these geographical patterns are studied. It appears that the ways in which people organise their lives require them to be spread unevenly over space. This presents a problem for looking at how their lives are organised spatially as, if conventional maps are used at any level of detail, the maps will always highlight the uneven distribution of people over the land rather than the differences between groups of people, which are of more interest. [. . .] Most cartograms are designed to make visualising the detailed human geography of people possible and sometimes even to make it easy.

Ever since the first maps were drawn, cartographers have had to decide how they will distort the shape of the earth to best show what they wish others to study. A frequent criticism of cartograms is that even cartograms based upon the same variable for the same areas of a country can look very different. There is nothing new about that in cartography. [. . .] Mapping involves making compromises between conflicting goals which result in the variety of views that we have of the world. Inevitably, they alter how we see different parts of this world. [. . .] With cartograms, distortion is not seen as unfortunate, but is deliberately used to convey information.

Methods

There are numerous methods of creating cartograms. [. . .] Each method produces useful maps which could not have been created by the alternative techniques. In general, manual methods are useful when only a few areas are being represented, while computer algorithms have to be used to produce area cartograms of many places. Mechanical methods provided a compromise between these two options in the past. [. . .]

Physical accretion models

The term 'physical accretion models' was first introduced by John Hunter and Johnathan Young. [. . .] They attempted to formalise the approach taken to produce the cartograms of British general election results drawn in *The Times* newspaper in both 1964 and 1966 (Hunter and Young 1968). The term physical accretion model describes the technique of constructing cartograms by using wooden tiles and rearranging them by hand. In the case of the old counties of England and Wales, 9214 wooden tiles were painted 62 different colours and were then manipulated to create a cartogram which was 2.4 square metres in size before being copied onto paper. The manipulation alone took 16 hours and involved attempting to maintain the shape of prominent features, such as estuaries, and preserving contiguity, as well as making area almost exactly proportional to population. In constructing that cartogram Hunter and Young began with London and proceeded northwards. [. . .]

Hunter and Meade (1971) discuss three-dimensional population models and how these cartograms can be constructed in the classroom. Many thousands of school children may have used this method and hundreds of undocumented cartograms could thus have been produced!

Mechanical methods

Only a year after John Hunter and Melinda Meade produced their series of cartograms created by combining wooden blocks, a paper was published [. . .] which illustrated a mechanical method of making population cartograms. The [. . .] remit was to create a map of Canada in which the divisions of the 1966 Census were drawn with their areas in proportion to their populations (Skoda and Robertson 1972). Furthermore, this map had to attempt to approximate the actual shape of places, maintain contiguity, include lines of longitude and latitude and the census tract boundaries of the twelve urban areas with populations in excess of 200 000 people. There were 266 census divisions to be included for the map of all of Canada and a further 1408 census tracts for the large cities. [. . .]

To create the isodemographic map of Canada, Skoda and Robertson developed a mechanical model in which 265 000 steel ball bearings, each with a diameter of one eighth of an inch, and each representing 140 people on the main map (and 70 people on the separate city maps) were poured into an equal land area map of Canada constructed from brass hinged aluminium strips. The ball bearings were weighed rather than counted and the whole model was assembled on several five metre two-plywood boards surfaced with Formica, which allowed the balls to move easily within the hinged metal district boundaries. [. . .] As the ball bearings were pressed down to form a continuous layer, correct contiguity was maintained – while a population cartogram was created. Transparent perspex sheets were used to apply an even pressure to all the ball bearings across the map and to prevent spillage. The authors had some licence in the design process and used this to attempt to keep the final result as conformal (shape preserving) as possible, [. . .] and the model resulted in a very accurate isodemographic map of Canada and particularly detailed population cartograms being produced of the major cities. [. . .]

The rising interest in urban geography in the 1960s and early 1970s was cited as one reason why this cartogram might be used by other researchers (Skoda and Robertson 1972: 25). [. . .] The way in which cartograms can radically change people's views of the world was being explored in some detail. In practice, however, there is little evidence that this cartogram was ever used to map social or economic variables. Just five years after the isodemographic map was printed, Canadian cartographers were publishing maps of general elections by using conventional equal land area projections (Coulson 1977). The one factor which advocates of cartograms have consistently underestimated has been the hostility to changing from conventional projections, and the more a cartogram is needed, such as in mapping aspects of the unevenly distributed human geography of Canada, the more unconventional that cartogram will look.

Competing cartogram algorithms

A year after Skoda and Robertson released the details of their mechanical model for constructing cartograms, a method which used a computer program was published (Tobler 1973). [. . .] To summarise Tobler's method, an estimate was made of the population living in each cell of a grid which had been laid over the United States of America. [. . .] The position of each vertex in the grid was then repeatedly altered according to the populations in, and the areas of, the four cells which surrounded it, until there was little improvement in the accuracy of the cartogram to be achieved by further iterations. [. . .]

Although the cartogram [. . .] was one of the first which had been created by computer to be published, Tobler had been working on algorithms to produce cartograms for several years before publishing his results (Tobler 1961) and has produced numerous examples since 1973. [. . .] Slight alterations to one algorithm can result in very different cartograms being drawn of the same places, even when the same statistics are used. All other computer algorithms for producing cartograms suffer from the same problem. All computer algorithms appear to produce differently shaped cartograms of the same distribution, often because of differences in the type of data being input, as well as due to differences between the algorithms themselves.

The propensity of slight alterations to a basic algorithm to produce very different end maps has resulted in many researchers claiming to have produced better algorithms since Tobler's first suggestions were published. [. . .] For example Guseyn-Zade and Tikunov (1993, 1994) published details of a 'new technique for constructing continuous cartograms'. Although there is a vast improvement in the speed of convergence of this method over others and the results may be more pleasing visually, this algorithm can be viewed as an improved version of the first implementation of a computer algorithm made by Tobler over thirty years ago. This is because all the methods described here have two common features. Firstly, they attempt to produce a numerical approximation to a pair of equations which cannot be solved by analytical means, and they attempt to do this through many small adjustments to the vertices of a digitised map (Tobler 1973: 216). Secondly, they cannot yet be used to produce cartograms as detailed as those produced by manual or mechanical methods.

Cellular automata cartograms

In 1968, John Conway, a mathematician at the University of Cambridge, invented the 'Game of Life', which was later credited with popularising the study of Cellular Automata (Toffoli and Margolus 1987). [. . .] A variant of the game can be developed to grow cartograms. The method would formally be called a cellular automata machine. [. . .] A grid of cells is set up in which each cell is assigned to one of the regions to be represented on the map, which is to have its area, eventually, in proportion to its population. To achieve this, regions represented by too few cells have to gain cells from regions represented by too many. [. . .] The checkerboard method of updating the cell values referred to in the algorithm is a standard technique (Toffoli and Margolus 1987: 118) and the stipulation that cells should be most prone to change state if they have few neighbours of their own kind, and less likely to change if they have many neighbours, causes the algorithm to simulate a process called 'annealing'. Cells on the corners of regions are most prone to be replaced by the cells of other regions and so the regions as a whole tend to form simpler shapes as the lengths of the boundaries drawn between them are minimised. However, under this implementation that advantage is partly offset by not altering cells if they are originally assigned to the sea (region '0'). Thus the shape of the coastline is maintained while contiguity is assured and a correct cartogram is produced. [. . .]

A major problem with preserving the coastline is that the complexity of boundaries within the cartogram is increased. [. . .] To overcome this problem the algorithm could be altered to allow cells in the sea to change state, but that might result in the loss of any coastline features, which are useful for identifying areas on the cartogram. A simpler solution is to transform the original base map to form a pseudo-cartogram, Here lines of latitude and longitude have been squeezed together or pulled apart to approximate an equal population cartogram, while those lines remain straight and parallel. When the algorithm is applied to this base a more visually acceptable solution is reached. Because this cartogram is continuous, every region is still connected to its original neighbours and no others and so this cartogram can be used to re-project a grid of equal population sized 'squares' onto the map of Britain. [. . .] This method of projection [. . .] does not result in a conformal map, nor does it necessarily produce a simple solution, but the final result always maintains contiguity.

Circular cartograms

Cartograms which can be shown to have good mathematical properties, such as approximating a conformal projection, are not necessarily the best options for cartographic purposes. If, for instance, it is desirable that areas on a map have boundaries which are as simple as possible, why not draw the areas as simple shapes in the first place? [. . .] The antecedents of this approach for making cartograms can be seen in work by Härö (1968: 456) [. . .] Johnston *et al.* (1988: 340) and Howe (1970) also show examples of cartograms which define areas as simple shapes for use as a base map. There is a long tradition of mapping with circles as symbols in cartography and the advantages of using this simple shape are well known (Dent 1972). [. . .] The metaphor for this algorithm is [. . .] a development of the programs which simulate the orbits of stars and planets.

Each region is drawn as a circle with its area in proportion to its population and is then treated as an object in a gravity model which is repelled by other circles with which it overlaps, but is attracted to circles which were neighbouring regions on the original map. Forces akin to forces of gravity are calculated, including velocity and acceleration, and the whole process is acted out as if it were occurring in treacle, to avoid any circles moving too quickly. [. . .] If this algorithm is left to run on a normal map for a few hundred iterations it eventually produces a solution in which no circles overlap and as many as possible are still in close contact with their original geographic neighbours. Some of the original coastline features are even retained [. . .] but a true continuous cartogram is not produced, as this is not possible where each place is drawn as a regular shape. [. . .] This cartogram has the advantage over more sophisticated forms of showing quite clearly how the populations of areas vary, without having to compare very complex shapes in more rural areas. The dominance of the major cities in the population structure of Britain is emphasised [. . .] which uses a functional rather than an administrative definition of cities. As the number of areas is increased the proportion of contacts which break topology decreases. This is one of the major advantages of this method of making cartograms – the picture becomes more accurate as more detail is added. [. . .]

A major problem with manual, mechanical and computer-based methods of producing continuous area cartograms is that the time this takes often escalates exponentially as the total number of individual areas to be represented rises. Computer algorithms are also prone to producing bottlenecks, which prevent the program progressing to an accurate solution when there are many area to be mapped. The time taken by the circular algorithm described here to converge to a sufficiently accurate result is in almost direct proportion to the number of areas being mapped [. . .] The maximum number of areas it has been used to map so far exceeds one hundred thousand (Dorling 1993).

Applications

Political cartography

[. . .]

There are distinct subject areas where the use of cartograms is particularly common. The most obvious, perhaps, is in mapping the results of elections (Upton 1994). To map the outcome of political elections on a traditional map may appear foolhardy, although this has not prevented entire atlases of election results being produced using equal land area maps (see Waller 1985, and, for a defence of the method, Kinnear 1968: 12). [. . .]

Use of cartograms often, of course, dramatically alters the impression of which party has won an election [. . .] but one aspect of political cartography which makes the use of cartograms difficult is that of frequent boundary changes. In Britain the boundaries of constituencies were altered many times before 1955 and there were large-scale redistributions of seats after the 1970, 1979 and 1992 general elections. When cartograms are drawn by computer this need not present a problem, but political cartograms drawn by hand can quickly become obsolete (Dorling 1994). A popular method for designing cartograms to study British general election results is to have each constituency drawn as a square. [. . .] Although there are cartographic advantages to raising simple symbols [. . .] their use in cartograms of Britain has often meant that the constituencies of London had to be shown as an inset (Johnston *et al.* 1988). [. . .] Interest in cartograms, in at least both Britain and America, tends to surge around the time of national elections (particularly when urban-based parties win and also just after population censuses have been taken). [. . .]

Early epidemiology

[. . .] Many doctors have been struck by the idea that they could learn more about disease through mapping. The earliest example often quoted is of a map of the incidence of cholera in London (Snow 1854), from which map a pump in Broad Street was identified as being at the centre of the clusters of cases of cholera in the 1848–1849 epidemic. The pump handle was removed. A cartogram of the area has yet to be constructed from the 1851 census of population data, so whether that pump was actually at the centre of a real cluster is still unknown. The first cartogram of London known to this writer is an 'epidemiological map' which was produced by a doctor working for the then London County Council Department of Public Health (Taylor 1955). The cartogram contained crosses, drawn in the borough rectangles, to show the incidence of polio during the 1947 epidemic. Because the rectangles were each drawn with the same height, their widths, as well as their areas, are proportional to population. The borough with the highest rate of polio and, hence, the tallest column of crosses in the figure was Shoreditch. Almost exactly one hundred years separates the two London epidemics, which were first drawn on a map and cartogram, respectively. Cartograms showing distributions within countries came later.

A claim was made to have produced the first cartograms showing national disease distributions only a decade after the crude cartogram of London was first drawn. The nation was Scotland and a separate cartogram was constructed by hand for each of eight age–sex groups (Forster 1966: 165). The author of these cartograms concluded that a national series of cartograms should be produced for each age–sex group for use in epidemiological studies in Britain. This was never done.

Mapping mortality

A National Atlas of Disease Mortality in the United Kingdom was published in 1963 under the auspices of the Royal Geographical Society; the atlas contained no cartograms. [...] Fortunately, a revised edition was published a few years later which made copious use of a 'demographic base map' (Howe 1970: 95). It is interesting to note that when the revised edition was being prepared, the president of the Society was Dudley Stamp who believed that 'The fundamental tool for the *(sic)* geographical analysis is undoubtedly the map or, perhaps more correctly, the cartogram' (Stamp 1962: 135). In the cartogram, which was used in the revised national atlas, squares were used to represent urban areas while diamonds were used to show statistics for rural districts. No attempt was made to maintain contiguity, but a stylised coastline was placed around the symbols, which were all drawn with their areas in proportion to the populations at risk from the disease being shown on each particular cartogram.

[...] What differentiates medical uses of cartograms most from political cartography is the mapping of clusters – individual cases of a disease or death which together might possibly be connected. [...] This process has been used to illustrate how cases of Salmonella food poisoning occurring in Arkansas in 1974 were not unduly clustered in Pulaski county (Dean 1976). Cartograms have been shown to be useful in determining that certain types of disease which appear clustered are in fact quite evenly distributed across the population. In more recent years researchers have turned their attention to trying to develop cartograms upon which actual, rather than illusory, clusters of disease can be identified.

The major problem with using population cartograms to identify clusters of disease is that the choice of which areas are closest to which on a cartogram can be quite arbitrary. For instance, if the same set of incidences of one particular disease were plotted on three different cartograms of America, then different parts of the country may appear to have dense clusters of cases depending on which cartogram was chosen. This would be true regardless of whether the clusters were to be identified by eye or by statistical procedures. [...] The proposition that there is no single 'true answer' as to whether a disease is clustered does not go down too well in some circles. Because of this problem a group of researchers at Berkeley developed a computer algorithm for identifying incidences of disease (Selvin *et al.* 1984). The algorithm they developed was not very different from other 'continuous transformation' cartogram algorithms and was still slow enough to warrant testing on a Cray supercomputer! (Selvin *et al.* 1988: 217). However, the authors of the algorithm do claim that their program would result in a unique transformation given an infinite amount of input data. [...] The algorithm was used to [...] create a cartogram of San Francisco county, upon which apparent clusters of disease were shown to be false (Selvin *et al.* 1988: 217). However, application of the method to another Californian County did provide evidence of some clustering of high cancer rates near oil refineries (Selvin *et al.* 1987).

Transformed flows

The term 'flows' covers a wide range of subjects. For instance, workers can be seen to 'flow' between different states of employment and votes are said to 'flow' between political parties. There are flows in medical mapping, such as were used to plot the movement of the influenza epidemic which spread across England and Wales in 1957 (Hunter and Young 1971). [...]

Commuting flows are amongst the most simple to map because people usually do not commute very far to work in a day so the flows tend to be short. [...] Which flows are shown depends on how a flow is defined to be significant and on the nature of the areas which are used to count the flows. In the centre of London there are many very small wards and hence fewer strong patterns can emerge. The final results of flow mapping depend both on the nature of the flows being mapped and on the way in which those flows are mapped.

[...] Although researchers have considered creating cartograms in which distance is proportional to time, few travel-time cartograms have been created (Angel and Hyman 1972). Almost all travel-time cartograms which do exist show travel time only from a single point using the fastest method of travel. [...]

A cartogram could be created in which travel-time distances between all points was shown; this would result in a complex surface being drawn but it should not be impossible to achieve. On this surface cities would appear as mountains, as commuters fight their way through the rush hour to enter them. The deep gorges of inter-city railway lines would cut through them, or perhaps appear as tunnels coming out of the mountains. The surface could be drawn upon the two-dimensional base of an equal population cartogram and so both time and population could be measured from its geometry. And, if a different surface were drawn for different times of the day or for different days of the year, those surfaces could be combined as a space-time volume in which distance is proportional to hours and volume is proportional to human lives. [. . .]

Conclusions

[. . .] I have attempted to illustrate how the use of cartograms is widespread in academic and popular writing and how cartograms are not as difficult to create as many readers might think. No commercial geographical information system exists which will create cartograms from scratch, but that is largely due to a perceived lack of demand and, perhaps, due to an inflated view of how difficult it is to implement computer programs to create cartograms. [. . .] In this final section some of the more complex uses to which cartograms can be put are illustrated [. . .] to show how the use of cartograms can shed light on complex spatial processes.

The evolving structure of British social geography, looking in detail at unemployment, voting and social segregation, [can be] visualised using cartograms. [. . .] Between 1955 and 1970 there were 630 constituencies in the country. [. . .] At this time seats where Labour came second were almost all won by the Conservative party and *vice versa.* However, the following six general elections saw a very different pattern emerge. For the general election of February 1974 the number of parliamentary constituencies was increased to 635. It increased again to 650 in 1983 and to 651 in 1992. [. . .] The rise and geographical spread of both the Liberals and the Nationalists in this period are quite striking (the Social Democrat Party are included with the Liberals here). Cartograms show that although the last four general elections were all won by the Conservative party, their share of seats in which they came second was falling over time. Most importantly, the way in which the main opposition parties had established clear geographical territories by the aftermath of the last general election is also made evident (Dorling 1994). The geographical evolution of political preferences over eleven general elections can be shown on a single A5 page if seats are drawn in proportion to the number of people who can vote.

[. . .] The longest series of unemployment rates for small areas extends back to 1978 for places known as 'amalgamated office areas' (which are groups of unemployment benefit offices). There are just over 850 of these areas and the number of people claiming unemployment benefit in each of them was recorded by the Department of Employment in almost every month over the sixteen years. [. . .] In this illustration the changing spatial distribution of unemployment in Britain is depicted using these statistics. The shading of each place at each time reflects its unemployment rate then, compared to its average unemployment rate over the whole period (for more details see Dorling 1995b). [. . .] The worst period for Devon, Cornwall and Wales was 1978–1979, for Scotland 1978–1979 and 1988–1989, but for the south east 1991–1993. For the latter region, the maps clearly show how the blight of unemployment took hold in central London in 1987 and spread out across south-east England in subsequent years. Compare this pattern to the rise in Conservative party losses in London at the last general election and the return of the Labour party as the main political contender between the capital and the midlands. The use of cartograms allows possibly unexpected connections to be seen between different spatial processes where the importance of events is weighted by how many people are involved. [. . .]

It would be misleading to think of the north of the country as economically prosperous in static terms at the start of the 1990s. Although the south did experience particularly high rates of unemployment then, unemployment is not the only way in which loss of employment is expressed. Increasingly, levels of permanent sickness and early retirement rose in Britain during the last decade and, in places, these factors resulted in more people of working age being out of employment than did unemployment alone.

A cartogram of over ten thousand wards in Britain (part-postcode sectors in Scotland) allocates [wards] to one of sixteen categories depending on the proportion of people of working age who were either unemployed or were retired or permanently sick in that ward. Thus over twenty thousand statistics are used [. . .], two for each ward resulting in a bivariate shading scheme. [. . .] Almost twice as many statistics are being used as in the last [example]. [. . .] In some wards over 10% of the working population was unemployed and over 10% was prematurely retired or permanently sick. [. . .] A very clear north/south and urban/rural divide still separates the people of Britain when shown at this level, despite the equalizing effects of the last recession. The pattern for each of the other fifteen categories of ward [. . .] also tells a story about the spatial social structure of this country [. . .] (Dorling 1995a; Dorling and Woodward 1996).

The relative levels of four groups of people within each ward [can also be shown in cartograms]. [. . .] The four groups are: people who were working in managerial or professional jobs, [. . .] people in supervisory or artisan type jobs, [. . .] people in semiskilled or strictly supervised jobs [. . .] and people looking for work who had not been employed in the last ten years [. . .]. Wards where a disproportionate share of the workforce belongs to a single one of these groups are given its 'primary' colour. Wards where two groups are disproportionately represented are shaded by the mix of those colours so that a ward with many managers and artisans would be shaded light green, and so on. An excess of workers with no occupation in an area (the long-term unemployed and people in the armed forces) changes the shade from light to dark. This mixing results in fourteen possible categories of ward [. . .]

If different levels of each group were distinguished, rather than just over- or under-average levels being used, then many hundreds of shades would be needed; but already with this minimal number the pattern which is revealed is complex. Around almost every city in Britain are localities containing disproportionate numbers of single groups. A majority (61%) of the population live in areas where either one or two of the three groups in employment are over-represented and the other two or three groups are under-represented. [. . .] This cartogram contains a detailed picture of the way in which people in Britain are spread over the country according to the kind of work they do or have done. On a conventional map the red, purple and black would appear to occupy very little space. What is unusual here is the level of detail which is included in this series of colour cartograms. However, these show detail which is still nowhere near the limit possible with high quality colour printing and computer animation.

Population cartograms are, almost by definition, economical with space, but it is still surprising to see how much land area in a country like Britain is sparsely populated, and hence how much detail can be afforded to the cities when the countryside is shrunk. Whatever you choose to use cartograms for, from studying participation in elections, to the spread of a disease, or the social structure of a country, the very different perspectives they show are likely to alter the way you imagine the processes behind these patterns to be operating. In human geography, mapping with population cartograms changes the perspective from concentrating on the populations of the countryside to the inhabitants of towns and cities where most of the people live. The last cartogram to appear in *The Times* newspaper was drawn on 4 April 1966 following the Labour victory, which was orchestrated from the cities. When the Conservative party regained power at the following general election the newspaper reverted back to a conventional projection, which made the result appear like a landslide for the party of the right (*The Times*, 22 June 1970). Claiming space on maps is as much a political process as a technical one. People who are seen not to matter are often neither counted nor shown in studying society.

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Further reading

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See also

- Chapter 2.5: Automation and Cartography
- Chapter 2.9: Emergence of Map Projections
- Chapter 3.4: Generalisation in Statistical Mapping
- Chapter 3.8: ColorBrewer.org: An Online Tool for Selecting Colour Schemes for Maps
- Chapter 3.12: The Geographic Beauty of a Photographic Archive