A critique of the development of quantitative methodologies in human geography

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Introduction

Quantitative methodologies are a powerful research technique in human geography that can provide valuable and accurate insights if used appropriately and with an understanding of the limitations. However, during the 1980s and 90s there was a downturn in the popularity of such methodologies. This essay argues that the criticisms of quantitative methodologies were valid and necessary following geography's quantitative revolution in the 1950s and 60s. However, subsequent developments that have addressed these criticisms, have been ignored by critics. As a result, they run the risk of neglecting a powerful mode of research.

Human geographers have used quantitative methodologies to study a multitude of topics including demographics, migration, housing and settlement patterns and ethnic segregation. Fotheringham *et al* (2000) identifies quantitative geography as consisting of the analysis of numerical spatial data, the development of spatial theory or the construction and testing of mathematical models of spatial processes.

Geography's Quantitative Revolution

Quantitative methodologies were used in the first research as geography emerged as an independent discipline. One of the first practicing geographers, Alexander von Humboldt (1769-1859) mapped quantitative data with the aim of producing in a single work a depiction of the entire material universe (Peet, 1998).

The quantitative revolution of the 1950s was set in motion by the preceding modes of thought. Particularly important in this respect

were environmental determinism and regional geography. Environmental determinism was heavily influenced by scientific developments in biology, notably Darwin's theory of evolution and the political situation of the time (Peet, 1998. Holt-Jensen, 1999). For example, Friedrich Ratzel's ideas that population growth justified the acquisition of new territories was used to serve imperialist needs.

Environmental determinism fell out of favour by the mid 1930s, it was replaced by regional geography, in part as a reaction to the crudities of environmental determinism (Holt-Jensen, 1999. Johnston and Sidaway, 2004). Regional geography involved the study of unique combinations of characteristics in specific areas. No generalisations were possible (Peet 1998), except that all areas were unique.

The movement away from the regional geography approach was stimulated by three factors. Firstly, the practical demands of the war led to geographical research that produced generalisations. Secondly, non-geographers became involved in human geography research, most notably the social physics school of the 1940s applied natural science methodologies to human geography research. The above points exacerbated the final factor, the growing frustration that some geographers felt towards the regional approach which was increasingly considered non scientific and outdated (Peet, 1998. Unwin 1992. Cloke *et al*, 1991).

This led to Fred Schaeffer, a professor at the University of Iowa, attacking regional geography in 1953. He argued that objects in geography were no more unique than in other disciplines and that a science should search for laws (Peet, 1998). He urged geographers to study systematically, using quantitative methodologies (Holt-Jensen, 1999), providing the stimulus for the quantitative revolution.

The initial development of quantitative geography was based in the USA in the 1950s (Johnston and Sidaway, 2004). The assimilation of quantitative methodologies in Britain lagged behind that of the USA by seven or eight years (Robinson, 1998. Holt-Jensen,1999).

The “Quantitative Revolution” saw the first concerted attempt to apply quantitative methodologies within geography. The new approach aimed to make geography more scientific and was guided by the following basic ideals of logical positivism:

- That only one scientific method exists
- That knowledge is neutral
- That the standards of accuracy and precision in the physical sciences offered the only genuinely explanatory framework for the generation of scientific knowledge.

(Robinson 1998: 2)

Criticism of the Quantitative Revolution

In the 1960s and 1970s a number of criticisms were mounted against use of quantitative methodologies in geography (Cloke *et al*, 1991. Johnston and Sidaway, 2004). Most of these were targeted at the positivist underpinnings of the approach (Peet, 1998) and concerned the claim of objective research, the lack of consideration of agency and structure, the imposition of the natural sciences approach, the assumption that social systems could be considered closed and the notion that statistical relation implied causal relation.

The positivist claim that research should be value free was criticised by those who argued that this was not possible in social research. As researchers are part of society, their values, experiences and motives inevitably influence their research. Quantification was claimed to give a false sense of objectivity by artificially separating the observer from the observed (Cloke *et al* 1991).

Another criticism was the failure of quantitative techniques to appreciate the importance of structure and agency. Quantitative researchers treated people as objects without any consideration of the values and meanings that make individuals human and the capabilities that they possess (Cloke *et al,* 1991, Smith, 1998).

Concerns were raised that the complex economic, political and social structures that act on spatial patterns were not sufficiently taken into account by quantitative methodologies. A purely quantitative approach, it was argued, looked at how things seemed to be rather than how they might be under different social conditions (Cloke *et al* 1991). For some geographers the new quantitative approach seemed "socially and politically irrelevant" (Peet 1998: 67).

The idea that a unity of scientific method existed was another positivist assumption that came to be challenged (Bryman, 2004). The imposition of the methods of the natural sciences were rejected by many geographers who felt that each discipline should have its own approach to reflect its unique focus.

The positivist approach is suited to and often assumes a closed system and does not consider the difficulties of quantitative modelling of open systems (Cloke et al 1991). Sayer (1985) argues that there are two conditions that must both be satisfied for a closed system to exist. These are that there must be no change in the object possessing the causal powers and that the relationship between the causal mechanism and those of its external conditions must also be constant. From this definition it is clear that social science research involves open systems because humans have the capacity to change and human actions have the capacity to alter the configuration of systems (Sayer, 1985).

In addition to the criticisms of the positivist underpinnings of quantitative geography other weaknesses emerged. The statistical techniques that were applied after the Quantitative revolution were largely imported from outside the discipline (Harvey, 1969). Some of these techniques were used in a `cookbook' fashion without consideration of the appropriateness of use for spatial data (Fotheringham *et al*, 2004).

The criticisms levelled at the quantitative geography of the mid 20th century can be illustrated with a critique of a study of population and residential segregation at this time. Farley and Taeuber's study (1968) explored the nature of population change for "White" and "Negro" populations in thirteen US cities. Segregation is portrayed as a problem and is measured using a dissimilarity index[1] in 1960 and 1965.

This study is open to many criticisms. Firstly, it shows a lack of understanding of the difference between statistical association and causal association as identified by Sayer (1985). The assumption of causality is shown when Farley and Taueber suggest that the Negro percentage in an area can be used to predict the extent of social problems found in that area.

Secondly, the research makes no attempt to understand the social processes that cause segregation, numerical evidence is used to show that segregation exists but there is no consideration of the cultural, social and historic reasons why it occurs.

The conclusions of the researchers demonstrate the isolation of the research from the society that they study. They produce generalised formulas to calculate the percentage of the population to be moved, in a process where white households are “exchanged” with Negro households in order that segregation is reduced. People are treated as objects whose choice of home can be dictated by formula.

Developments in Quantitative Methodologies

Despite the criticisms, the quantitative revolution in geography was an essential development because it modernised a largely descriptive discipline (Holt-Jensen, 1999. Sayer, 1985). However, the lack of consideration of the philosophical underpinnings of the research of this period, made much of it susceptible to the strong criticisms of positivism (Unwin, 1992). As a result, quantitative methodologies experienced a downturn in popularity in the 80s and 90s, as geography experienced the `cultural turn' and split into various modes of thought (Robinson, 1998).

The major change that resulted from the criticisms of the quantitative revolution was the recognition that the philosophical basis and role of quantitative methodologies had to change. Harvey (1969: 7) recognised the danger of the inappropriate use of quantitative tools: “I believe that these tools have often been misapplied or misunderstood in geography. I certainly plead guilty in this respect. If we are to control the use of these sharp tools in research we must understand the philosophical and methodological assumptions upon which their use necessarily rests.”

The idea that quantification would lead to the generation of universal laws (as in the natural sciences) has been recognised as impossible due to the complexity and ephemeral nature of social systems. Such techniques are now used to provide sufficient evidence that makes acceptance of a line of thought compelling. It has been acknowledged that ontological assumptions applied by those who used quantitative methodologies in the social sciences must differ from the natural sciences (Fotheringham *et al* 2000, Christensen, 1982).

During the 50s and 60s quantitative analysis was used speculatively to develop theory on social processes. A consensus view developed that statistical analysis should not subsume theoretical development and should be accompanied by relational and contextual understanding of the social process (Robinson, 1998, Bennet, 1985). The research strategy has since matured from inductive and deductive approaches to a retroductive approach that recognises the guiding role that social structures and mechanisms should play in social science (Blaikie, 1993).

The speculative nature of much of the quantitative research in human geography led to false identification of causation between variables because researchers had not considered the mechanisms of the social process that they were studying (Blaikie, 2000). Sayer (1984) stresses the importance of qualitative techniques and causal knowledge to distinguish between those variables that are statistically related and those that are causally related.

Whichever methodological approach that is used subjectivity is a difficult issue to address. Quantitative geographers no longer cling to the idea that quantitative techniques allow objective research. They have recognised that knowledge is situated and that there is a need for reflexivity (Rose, 1997. Parker 1999).

The philosophical changes described above led to a number of practical changes to the quantitative approach in human geography. One of these was the increase in use of quantitative and qualitative techniques with the thinking that there is “no fundamental clash between the purposes and capabilities of the

two approaches" (Yeung, 1997: 64). Quantitative geographers have also shifted the focus of their research away from attempts to investigate similarities across space and the production of global, general laws to local analysis that tests for the presence of differences across space rather than assuming such differences do not exist. (Fotheringham *et al*, 2000).

Simpson and Dorling's research (2004) on segregation by race can be compared to Farley and Taeuber's 1968 study, to show the changing use of quantitative methodologies in human geography research. This study uses data from the 1991 and 2001 census as well as detailed data collected by Bradford council to assess claims of self segregation of South Asian populations in Bradford in the wake of the 2001 disturbances (Cantel, 2001).

The paper begins by situating the research in the context of the 2001 "race riots" and the resulting social and political climate. The historical, cultural and economic reasons for segregation are considered and form the substantive theory that the use of quantitative techniques fits around. Statistics involving race are given detailed consideration: racial classifications are recognised as being products of society and as having the power to influence how people see themselves. The danger of misinterpreting statistical relations between ethnic groups and other characteristics as causational relationships is acknowledged.

The study uses the same index of dissimilarity as in Farley and Taeuber's 1968 research. However, there is more evaluation of the use of this technique. Alternative measures are evaluated and the final choice of approach is justified. The limitations of the index of dissimilarity, such as the inability to distinguish between enforced and voluntary segregation, are stated.

Finally, Simpson and Dorling's research recognises the increased understanding that can be gained through the use of non-quantitative techniques. The findings of research using semi-structured interviews with estate agents are used to explore the motivation and role of estate agents in steering vendors to less mixed areas.

Conclusion

The rush to quantitative methodologies in human geography in the 1950s and 1960s did not include sufficient consideration of the philosophical underpinnings of such approaches (Harvey, 1969). The positivist assumptions upon which the approach was based were rightly attacked in the 1970s and 80s as geography experienced its `cultural turn' and split into a range of modes of thought (Peet, 1998). However, the criticisms that were directed at the quantitative methodologies should not be used to claim that such approaches have no role in human geography today. Rather, it should be learnt from these criticisms that the approach must be used with care, guided by substantive social theory and with an understanding of the weaknesses. Researchers who use quantitative techniques today have acknowledged this and have adapted their use of these techniques (Robinson 1998, Poon, 2004). However this does not seem to have been recognised in geography more widely. Indeed, the debate on quantitative methodologies in human geography continues to be polarised between the supporters and opponents of such techniques (Fotheringham *et al,* 2000). This dualism is not helpful; a focus solely on one approach is likely to result in weaker research (Christensen, 1982). Human geographers should be more open to breaching the quantitative-qualitative divide and appreciate that the changes in quantitative methodologies give them great potential for producing more fruitful research.

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Appendix

1. The dissimilarity index.

For any group g the proportion of its population that lives in area i is written g_i and the proportion of the rest of the population in area i is written h_i. The index of dissimilarity (ID) is the summation over all areas of the difference in these two proportions.

$ID = \frac{1}{2} (\sum |g_i - h_i|)$

The dissimilarity index ranges between 0 and 1. A value of 1 indicates complete segregation and a value of 0 indicates no segregation.

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