Special Talk

Dr. A. Stewart Fotheringham

A. Stewart Fotheringham is Science Foundation Ireland Research Professor and Director of the National Centre for Geocomputation (NCG) at the National University of Ireland in Maynooth. He previously held positions at the University of Newcastle in the UK, the State University of New York at Buffalo, the University of Florida and Indiana University. He obtained his PhD and MA at McMaster University in Canada and his BSc at Aberdeen University in Scotland. He has been actively involved with large GIS-based initiatives in the US, Canada, the UK and Ireland.Professor Fotheringham's research interests include: the integration of spatial analysis and GIS; spatial statistics; exploratory spatial data analysis; and spatial modeling. His expertise is in the analysis of spatial data and in particular the local modeling of spatial relationships with geographically weighted regression, for which he has co-authored software that has been distributed to a wide variety of agencies and individuals concerned with spatial modeling. He is a founding editor of Transactions in GIS and is on a number of editorial boards. He has co-authored eight books, including Quantitative Geography: Perspectives on Spatial Data Analysis and Geographically Weighted Regression: An Analysis of Spatially Varying Relationships. He has also published over 20 book chapters and over 100 journal articles. He is a co-editor of the recently published 600+ page Handbook of Geographical Information Science published by Blackwell.Professor Fotheringham has presented many keynote addresses at International Conferences and he has organized workshops on Geographically Weighted Regression in many countries.

Abstract

Spatial Variations in Population Dynamics: A GIScience and GWR Perspective using a Case Study of Ireland 1841-1851

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Population dynamics within Ireland are both highly unusual and highly complex – for instance, the 2006 population is still over 2 million below the 1841 population.

Population change though has not been constant over space or over time. There were dramatic reductions in population during the decade of the 1840s due to the Great Irish Famine but the effects of the Famine were not experienced equally in all parts of the country. Some areas suffered massive population decline whilst other areas experienced population gain. This paper examines spatial variations in population change from a GIScience perspective. It does so in three parts.

The first part of the paper draws on a research project with is concerned with mapping population change in Ireland from 1841 to 1851 at Electoral Division (ED) level. Using EDs, of which there were 3,439 in Ireland in 1851, as the unit of analysis, reveals the spatially uneven impacts of the famine in greater detail than has been seen before. While it is well established that poorer regions in the west and south west of the country suffered more intensive population decline than the more prosperous east and north, mapping population change at ED level reveals that patterns of population change were far more complex than this interpretation suggests. Parts of the west and south experienced low levels of population decrease and some parts experienced population increase while some parts of the north and east experienced significant decrease. We describe the GIS operations that allow population change to be examined at ED level for the first time; previous mappings of the Famine have used relatively crude spatial units such as Baronies, Parishes or even Counties (of which there are only 32).

The second part of this paper displays the spatial variations in population change in a series of cartograms against the backdrop of national population change. Displaying spatial variations in population through time via continuous cartograms can provide an effective visual display of the complexity of population dynamics and the dramatic nature of the change through time although some caveats are discussed in the use of cartograms in this manner.

The third part of this paper, examines the extent to which features of the social and natural landscape, can be identified and statistically analysed as determinants of population change at ED level. Local variables that may have had an impact on the vulnerability or resilience of particular EDs during the famine include distance to urban settlements, relief schemes and workhouses, topography, agricultural practices and industrial development, and distances to the coast, lakes and waterways. Very little work has been carried out using statistical analyses that link population change to features of the social and natural landscape primarily because of the difficulty to gathering data at the national level and because the territorial units used to gather

information in Ireland during the nineteenth century varied from survey to survey. Here we employ three sets of techniques to obtain data on a wide array of explanatory variables. We are fortunate in having access to 1841 census records which include (with some manipulation) information on agricultural practices and land values in each ED, so giving very useful information on land quality and farming practices. The census also contains some limited demographic information. Further demographic and locational information will be obtained from detailed archival research to obtain information on relief schemes and the location of workhouses. Finally, standard GIS operations are employed in conjunction with other spatial databases to obtain data on topography, distance to the coast and lakes and population density.

Having gathered data on a range of explanatory variables an 1841-1851 population change index will be regressed globally on these explanatory variables to identify general patterns in the determinants of population change during the Irish Famine. This will then be followed by a Geographically Weighted Regression to examine if these determinants of population change had spatially varying effects and whether a single model of population growth and decline is too simplistic. For this we will utilise the latest version of the GWR software soon to be released (GWR 4.0) which allows the construction and calibration of semi-parametric GWR models. In this case, the use of GWR 4.0 will provide a novel example of model selection from a set of fixed and spatially varying determinants. Issues examined here include which of the determinants of population change had a constant impact across the county and which factors had a more important role in certain parts of the country than in others. Interpretation of the results in the context of Irish demographics will be given.

This paper will thus contain one of the first applications of the new GWR software and an example of the automatic construction of semi-parametric GWR models which is a novel feature of this version of the software. Hence, although the empirical focus is on an historical database, the geocomputational aspects of this paper will be of general interest.

Given the extent to which GISscience can contribute to a spatially sensitive statistical analysis of the factors that impacted on population change in Ireland during the period 1841 to 1851, the final part of his paper of discusses the relevance of GIscience for historical research in Ireland. On the basis of this we outline how the establishment of a more longitudinal GIscience approach to the study of population dynamics in Ireland from 1841 to the present can contribute to understandings of more contemporary population dynamics in Ireland. Such an analysis can provide us with a

perspective on the geography and rates of post-famine recovery and help to explain how the current population patterns have evolved. While Ireland is fortunate in having a constant unit of census reporting from 1851, the ED, there are approximately over 500 more Electoral Divisions in Ireland now than in 1851. These changing Electoral Division boundaries will need to be incorporated into this project - as will the changing range of variables that impacted upon population change over the past century.

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