

Geographically Weighted Regression

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This document provides a brief overview of geographically weighted regression (GWR).

Basics

Material presented here is mostly from the GWR website <http://www.ncl.ac.uk/geography/GWR>.

Geographical Weighted Regression (GWR) is a *new* modelling technique for local spatial analysis. This technique allows *local*, as opposed to *global* spatial models to be calibrated and interesting variations in relationships to be measured and mapped. Stewart Fotheringham, Martin Charlton and Chris Brunsdon of the Spatial Analysis Research Group and Department of Geography at the University of Newcastle, UK are the pioneers in this field. They are the developers of the package GWR (current release is Version 2.x). Their website (listed above) provides a brief primer on GWR, some recent references and details about acquiring the software.

GWR is based on the premise that relationships between variables measured at different locations might not be constant over space. The prevailing assumption is that such relationships are constant, an assumption that would appear to be the result of convenience rather than of any serious examination of the issues. If relationships do vary significantly over space, then serious questions are raised about the reliability of traditional, global-level analyses.

Geographically Weighted Regression, as part of a broader research area in local modelling, provides a new analytical tool and a different perspective on spatial analysis. Instead of being restricted to simple global analyses in which interesting local variations in relationships are 'averaged away' and unobservable, GWR allows local relationships to be measured and mapped. In many ways the output from GWR is similar to that presented by a microscope: previously unimagined detail suddenly comes into focus. This modeling approach challenges many of the global statements of spatial relationships that have been made in the academic literature.

Software

GWR is a Windows-based program with a Visual Basic interface. It is available for approx \$30 (academic) and \$300 (commercial). A UNIX version is also available and the code for GWR is available in *R*. See website <http://www.ncl.ac.uk/geography/GWR> for more complete details.

Classic Citations

A.S. Fotheringham, C. Brunsdon and M.E. Charlton. 2002. Geographically Weighted Regression: The Analysis of Spatially Varying Relationships Chichester: Wiley, UK. (Price = \$95.00).

A.S. Fotheringham, M.E. Charlton and C. Brunson. 1997. Measuring spatial variations in relationships with geographically weighted regression. Pp 60-82 (Chapter 4) in Recent developments in Spatial Analysis M.M. Fischer and A. Getis [Eds.] London, UK: Springer-Verlag.

C. Brunson, A.S. Fotheringham and M.E. Charlton. 1996. Geographically weighted regression: a method for exploring spatial non-stationarity. Geographical Analysis 28(4), 281-298.

Recent publications

C. Brunson, A.S. Fotheringham, M. Charlton. 2002. Geographically weighted summary statistics: a framework for localized exploratory data analysis. Computers, Environment and Urban Systems 26, 501-524.

Y. Huang and Y. Leung. 2002. Analysing regional industrialization in Jiangsu province using geographically weighted regression. Journal of Geographical Systems 4, 233-249.

A, Paez, T. Uchida and K. Miyamoto. 2002. A general framework for estimation and inference of geographically weighted regression models: 1. Location-specific kernel bandwidth and a test for locational heterogeneity. Environment and Planning A 34, 733-754.

A, Paez, T. Uchida and K. Miyamoto. 2002. A general framework for estimation and inference of geographically weighted regression models: 2. Spatial association and model specification tests. Environment and Planning A 34, 883-904.

Penn State Resources

One or two individuals on campus may have personal copies of GWR (e.g., Stephen Matthews). Stephen's copy of the manual is available in the GIS Lab (802 Oswald).

Copies of all articles listed above and many others are available in a folder also located in the GIS Lab.

Related GIS Resource Documents

GIS_RD_02-03 (GIS and Spatial Analysis)

GIS_RD_02-06 (Spatial Regression Models)

GIS_RD_02-09 (Exploratory Spatial Data Analysis)