Open GEODA

GIS Seminar Series
2012
Division of Spatial Information Science
University of Tsukuba
H.Malinda Siriwardana

Introduction

ASU Arizona State University | ASU GeoDa Center for Geospatial Analysis and Computation

- The GeoDa Center for Geospatial Analysis and Computation
  - **develops state-of-the-art methods for geospatial analysis**,
  - geovisualization,
  - geosimulation
  - spatial process modeling
  - **implements them through open source software tools**
  - **applies them to policy-relevant research** in the social and environmental sciences
  - **disseminates them through training and support** to a growing worldwide community
- The GeoDa Center succeeds the Spatial Analysis Laboratory (SAL) which was founded by the School of Geographical Sciences and Urban Planning Director Luc Anselin
- https://geodacenter.asu.edu https://geodacenter.asu.edu/software/documentation

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Product List

Name	Functionality	Images	Platform & Code	Language
OpenGeoDa	*Introduction to Spatial Data Analysis*: EDA, ESDA & ML Spatial Regression (List of features)		Cross-platform and open source	C++
PySAL	*Open Source Library for Spatial Analysis*: Weights, computational geometry, ESDA, spatial econometrics, clustering and spatial dynamics		Cross-platform, open source	Python
GeoDaSpace (Alpha)	Spatial econometrics (lag and error, endogenous variables, HAC, robust standard errors)		Cross-platform, code in PySAL 1.3	Python
GeoDaNet (Alpha)	Spatial point pattern analysis on networks		Cross-platform, code in PySAL 1.4	Python
R-Geo	Spatial weights, spatial econometrics, geostatistics, point pattern analysis		Cross-platform, open source	R

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Design and Functionality

In broad terms, the functionality can be classified into six categories:

- Spatial data manipulation and utilities:
  - data input, output, and conversion
- Data transformation:
  - variable transformations and creation of new variables
- Mapping:
  - choropleth maps, cartogram and map animation
- EDA: statistical graphics
- Spatial autocorrelation:
  - global and local spatial autocorrelation statistics, with inference and visualization
- Spatial regression:
  - diagnostics and maximum likelihood estimation of linear spatial regression models

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GeoDa Functionality Overview

Spatial Data

- Data input from shape file (point, polygon)
- Data input from text (to point or polygon shape)
- Data output to text (data or shape file)
- Create grid polygon shape file from text input
- Centroid computation
- Thiessen polygons

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GeoDa Functionality Overview

Data Transformation

- Variable transformation (log, exp, etc.)
- Queries, dummy variables (regime variables)
- Variable algebra (addition, multiplication, etc.)
- Spatial lag variable construction
- Rate calculation and rate smoothing
- Data table join

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GeoDa Functionality Overview

Mapping

- Generic quantile choropleth map
- Standard deviational map
- Percentile map
- Outlier map (box map)
- Circular cartogram
- Map movie
- Conditional maps
- Smoothed rate map (EB, spatial smoother)
- Excess rate map (standardized mortality rate, SMR)

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GeoDa Functionality Overview

EDA histogram

- Box plot
- Scatter plot
- Parallel coordinate plot
- Three-dimensional scatter plot
- Conditional plot (histogram, box plot, scatter plot)

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GeoDa Functionality Overview

Spatial Autocorrelation spatial weights creation (rook, queen, distance, k-nearest)

- Higher order spatial weights
- Spatial weights characteristics (connectedness histogram)
- Moran scatterplot with inference
- Bivariate Moran scatterplot with inference
- Moran scatterplot for rates (EB standardization)
- Local Moran significance map
- Local Moran cluster map
- Bivariate Local Moran
- Local Moran for rates (EB standardization)

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GeoDa Functionality Overview

Spatial Regression

- OLS with diagnostics (e.g., LM test, Moran's I)
- Maximum Likelihood spatial lag model
- Maximum Likelihood spatial error model
- Predicted value map
- Residual map

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Getting Started with GeoDa

- Objectives
- Starting a Project
- User Interface
- Practice

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Getting Started with GeoDa

Objectives

- This illustrates how to get started with GeoDa, and the basic structure of its user interface
  - Open and Close a project
  - Load a shape file with the proper indicator (Key)

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User Interface

- 9 Menu Items

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Getting Started with GeoDa

- In GeoDa, only shape files can be read into a project at this point
- However, even if you don't have your data in the form of a shape file, you may be able to use the included spatial data manipulation tools to create one

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Starting a Project

- Start GeoDa by
  - Double-clicking on its icon on the desktop
  - or run the GeoDa from the file manager
- A welcome screen will appear
- In the File Menu,
  - select Open Project
  - or click on the Open Project toolbar button
- After opening the project, the familiar Windows dialog requests the file name of a shape file and the Key variable
- The Key variable uniquely identifies each observation
- It is typically an integer value like a FIPS (Federal Information Processing Standard) code for counties, or a census tract number

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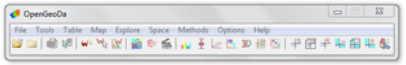
Starting a Project

- Open / Close GeoDa
- Load a shape file with the proper indicator (Key)



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Creating a Point Shape File

- Format a text file for input into GeoDa
- Create a point shape file from a text input file or dbf data file

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Creating a Point Shape File

- Point Input File Format
  - The format for the input file to create a point shape file is very straightforward
  - The minimum contents of the input file are three variables: a unique identifier (integer value), the x-coordinate and the y-coordinate In a dbf format file, there are no further requirements
    - Note that when latitude and longitude are included, the x-coordinate is the longitude and the y-coordinate the latitude

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Creating a Point Shape File

- Point Input File Format
  - When the input is a text file, the three required variables must be entered in a separate row for each observation, and separated by a comma
  - In addition to the identifier and coordinates, the input file can also contain other variables
    - (The input file must also contain two header lines
    - The first includes the number of observations and the number of variables
    - The second a list of the variable names, Again, all items are separated by a comma)

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Creating a Point Shape File

- Point Input File Format
  - Lets use - OZ9799 sample data set in the text file "oz9799.txt" (-> renamed as oz9799.csv)
  - This file includes monthly measures on ozone pollution taken at 30 monitoring stations in the Los Angeles basin

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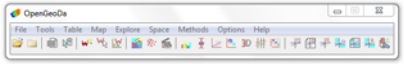
Creating a Point Shape File

- Point Input File Format



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Creating a Polygon Shape File

- Create a polygon shape file from a text input file with the boundary coordinates
- Create a polygon shape file for a regular grid layout
- Join a data table to a shape file base map

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Creating a Polygon Shape File

- Create a polygon shape file from a text input file with the boundary coordinates
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Creating a Polygon Shape File

- Boundary File Input Format
  - GeoDa currently supports one input file format for polygon boundary coordinates
  - While this is a limitation, in practice it is typically fairly straightforward to convert one format to another
  - The supported format consists of a header line containing the number of polygons and a unique polygon identifier, separated by a comma
  - For each polygon, its identifier and the number of points is listed, followed by the x and y coordinate pairs for each point (comma separated)

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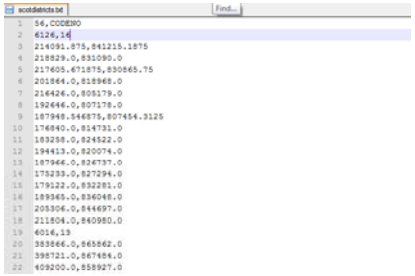
Creating a Polygon Shape File

- Boundary File Input Format - scotdistricts.txt

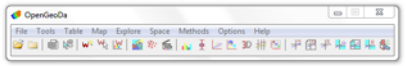


Creating a Polygon Shape File

- In contrast to the procedure followed for point shape files
  - a two-step approach is taken here
  - First, a base map shape file is created
  - This file does not contain any data other than polygon identifiers, area and perimeter
  - In the second step, a data table must be joined to this shape file to add the variables of interest

Creating a Polygon Shape File

- Creating a Polygon Shape File for the Base Map



Creating a Polygon Shape File

- Joining a Data Table to the Base Map
  - In order to create a shape file for the Scottish districts that also contains the lip cancer data, a data table (dbf format) must be joined to the table for the base map
  - This is invoked using the Table menu with the Join Tables command

Creating a Polygon Shape File

- Joining a Data Table to the Base Map

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Creating a Choropleth Map

- Make a simple choropleth map
- Select items in the map
- Change the selection tool

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Creating a Choropleth Map

- Quantile Map
  - The SIDS data set in the sample collection is taken from Noel Cressie's (1993) Statistics for Spatial Data (Cressie 1993, pp. 386–389)
  - It contains variables for the count of SIDS deaths for 100 North Carolina counties in two time periods, here labeled SID74 and SID79
  - In addition, there are the count of births in each county (BIR74, BIR79) and a subset of this, the count of non-white births (NWBIR74, NWBIR79)

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Creating a Choropleth Map

- Quantile Map
  - Consider constructing two quantile maps to compare the spatial distribution of non-white births and SIDS deaths in 74 (NWBIR74 and SID74)
  - Click on the base map to make it active
  - In the Map Menu, select Quantile
  - A dialog will appear, allowing the selection of the variable to be mapped

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Creating a Choropleth Map

- Quantile Map – NWBIR74 and SID74
  - In the Variables Settings dialog, select NWBIR74 and click OK
  - After you choose the variable, a second dialog will ask for the number of categories in the quantile map: for now, keep the default value of 4 (quartile map) and click OK
  - A quartile map (four categories) will appear
  - Next, create a quartile map (4 categories) for the variable SID74

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Creating a Choropleth Map

- Quantile Map
  - NWBIR74 and SID74

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Creating a Choropleth Map

- Selecting and Linking Observations in the Map
  - The concept of dynamic maps implies that there are ways to select specific locations and to link the selection between maps
  - GeoDa includes several selection shapes, such as point, rectangle, polygon, circle and line

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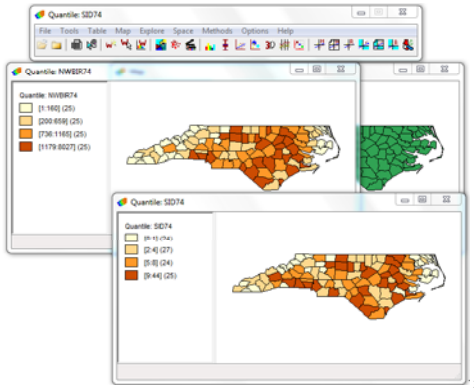
Creating a Choropleth Map

- Selecting and Linking Observations in the Map



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- Source
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Thank You!!!

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