Lab 8 Spatial Autocorrelation and Spatial Regression
Due on December 4, 2014

1. **Start GeoDa and load data**
   The crime dataset "Columbus" in Lab 6 will be used for the exercise of modeling spatial autocorrelation in Geodata.
   (a) Launch GeoDa
   (b) Open the Columbus.shp file by clicking File →Open Project
   (c) Choosing POLYID as Key Variable

2. **Create spatial weight (or spatial link) file**
   GeoDa provides functions to create spatial weights (W). The spatial weight can be generated in a contiguity method or distance method. We will use a contiguity of polygons to generate spatial weight with the Queen option.

   (a) Lanch the popup window for creating a spatial weight by clicking Tools → weights → Create
   (b) Specify options
      Input file: Columbus.shp
      Save the output as: Columbus.GAL
      ID: POLYID
      Queen contiguity
   (c) Click OK

   In order to get information of the spatial weight,
   (a) Choose Tools → Weights → Open
   (b) Select Columbus. GAL file and click OK

Assignment I

1. *Insert the graphical output for the connectivity of Columbus.shp file*
2. *Briefly interpret the connectivity of Columbus.shp file based on the queen option*

3. **Measure Moran's I for Crime rate in Columbus**
   To evaluate whether the crime rate is spatially autocorrelated or not, let us calculate Moran's I value for the variable
   (a) Choose Space → Univariate Moran
   (b) Select CRIME variable on the popup window
   (c) Select Columbus.GAL file for spatial weight in the next popup window.
   (d) Click OK

Assignment II

1. *Insert the Moran's I scatterplot in your report*
2. *Interpret the Moran's I scatterplot (please include (a) what the data for x and*

y axes (b) what the slope is for the context of bivariate regression, and (3) what is the relationship between the slope and Moran's I value)

3. *Based on the Moran's I value, does the crime rate show spatial autocorrelation?*
4. *Make a choropleth map for the CRIME variable using the quantile option with 6 classes. Include the choropleth map and explain the spatial pattern.*

4 . Test for spatial autocorrelation using permutation methods

GeoDa provide a permutation method to conduct a statistical significant test of spatial autocorrelation. To conduct the permutation test, you need to have Moran's I scatterplot first

(a) If necessary, create Moran's scatterplot for CRIME variable as above

(b) By right click on the Moran's I scatterplot, choose Randomization →999 permutations

Assignment III

1. *Insert the result of the permutation test for Moran's I (to capture the result, you can use <Alt Print Screen> key, which captures an active window).*
2. *Please interpret the result*
3. *At alpha =0.05, are the CRIME rate data spatially autocorrelated?*

5 . Test for spatial autocorrelation in the residuals of OLS regression

Run regression model with CRIME as dependent variable and HOVAL & INC as independent variables. To test if there is spatial autocorrelation in the residuals, please save the residuals. Below are details steps.

(a) To run a regression model, choose Regress
(b) Check on Moran's I z-value on the popup window
(c) Click OK
(d) On the next popup window, specify dependent and independent variables as in Figure 1
(e) Specify Columbus.GAL for spatial weight
(f) Choose Classic regression
(g) Click RUN
(h) After the regression process is completed, click SAVE button to save residuals
(i) On the next popup window, check on residuals and click OK as in Figure 2
(j) Click OK button on Regression window to see the results

Assignment IV

1. *Provide the regression results including regression summary and diagnostics for spatial dependence.*
2. *Provide the equation for the linear regression model*
3. *Based on Moran's I under diagnostics for spatial dependence, does the residuals show spatial autocorrelation?*

4. *For the residuals, conduct a permutation test for spatial autocorrelation. Report the result. Based on the permutation, does there exist a spatial autocorrelation in the residuals*
5. *Make a choropleth map for the residuals using the quantile option with 6 classes. Include the choropleth map and compare it with the choropleth map for the CRIME variable*

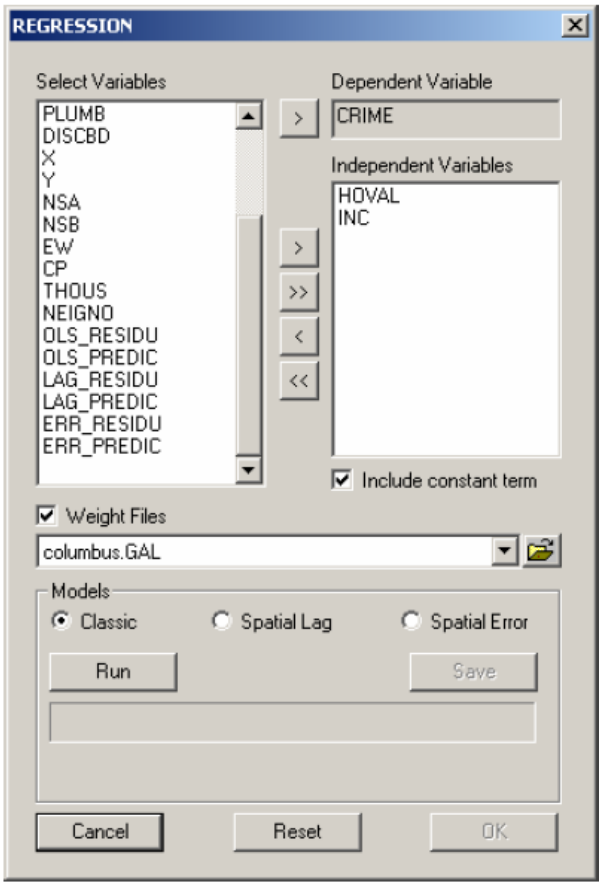

Figure 1. Interface for specifying variables, regression models and spatial weight

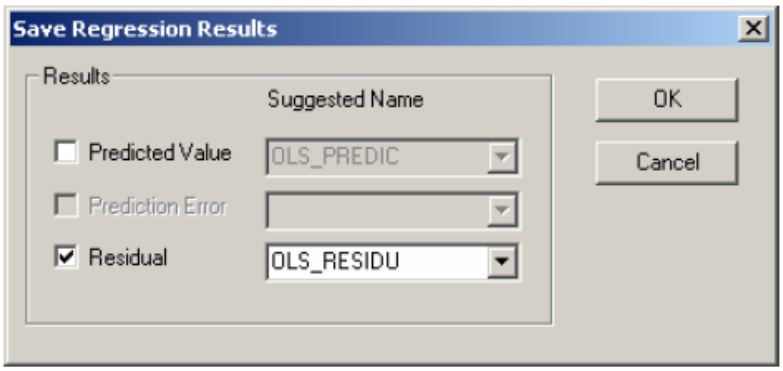

Figure 2. Interface to save regression results as variables in the data table

6 . Run a spatial lag regression model and test for spatial autocorrelation for

its residuals

Run a spatial lag regression model with the same variables as above

(a) Refer to the above steps, run a spatial error regression model. The only difference is to choose **Spatial Lag *instead of Classic***

Assignment V

1. *Provide the spatial lag regression results including regression summary and diagnostics for spatial dependence (note: spatial dependence test is not on the residuals of spatial lag model. It is test compare the classical OLS model to alternative spatial lag model).*
2. *Prove the equation for the spatial lag regression model*
3. *For the residuals of the spatial lag regression, conduct a permutation test for spatial autocorrelation. Report the result. Based on the permutation, is there spatial autocorrelation in the residuals?*
4. *Make a choropleth map for the residuals of spatial lag regression using the quantile option with 6 classes. Include the choropleth map and compare it with the above choropleth maps.*