

# 13 – Spatial Temporal Analysis

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# Outline

- Methodological Challenges
- Data Sources for Normalized Data
- Descriptive Space-Time Analysis
- Differential Moran's I

# Methodological Challenges

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# Methodological Challenges


- Space can't change
  - Migration
  - Population growth/decline
- Measurement is the same of time
- Measurement of space is always changing
  - Census Tracts are difficult to use because they change
  - MSA and Place boundaries are changing
- Constant Space
  - Counties
  - Spatial Interpolation - Grids –
  - Spatial Interpolation to latest polygon boundaries

# Data Sources for Normalized Data

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# Social Explorer

2010 boundaries are normalized to 2000 boundaries. Therefore we can use ACS data from 2010 through 2019.

 Social Explorer<sup>®</sup>


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▼ U.S. Decennial Census	
Census 2010	Begin report   Data Dictionary
Census 2010 (Redistricting Data - PL94)	Begin report   Data Dictionary

# GeoLytics



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Geocoding, Site Reports, Zip+4

Census 2010 / ACS

Bundled Packages - Big Savings

Normalized Data

Time Series Research Package

Neighborhood Change Database (1970-2010)

2000 Long Form in 2010 Boundaries

Census 1990 in 2010 Boundaries

Census 1980 in 2010 Boundaries

1990 Long Form in 2000 Boundaries

1980 in 2000 Boundaries

Census 1960, '70, '80, '90, 2000

Mailing Lists


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Special Data Sets

Online Data & Maps



Thursday, April 20, 2017

 Empty

Neighborhood Change Database [NCDB] Tract Data from 1970-2010

Features | Geography | Variables | History | Order

Neighborhood Change Database (NCDB) gives users instant access to US Census data from 1970, 1980, 1990, 2000, and 2010 at the census tract level. This easy-to-use product was developed in association with The Urban Institute and partially funded by The Rockefeller Foundation. It is an invaluable resource for policy makers, community organizations, and researchers who want to analyze changes that have occurred in US neighborhoods over five decades. The NCDB contains 1970, 1980, 1990, and 2000 Long Form data and the 2010 Summary File 1 and 2010 American Community Survey (ACS) data with details such as: population, household, and housing characteristics, income, poverty status, education level, employment, housing costs, immigration, and other variables.

**Selecting Data Format - Regular vs. Normalized**

You can access the data for 1970, 1980, 1990, 2000 or 2010 in their census year tract boundaries. In this way, the data will appear as it did for that census year and the maps will be drawn according to that year's boundaries. For example, you can view the 1980 data in the 1980 tracts. With Neighborhood Change Database, however, you can also access data for all five decades normalized to 2010 tract boundaries. This lets you view and display data as if the 2010 tracts existed and all the data is weighted to these areas. Thus you can compare 1980 data with 1970, 1990, or 2000 all compared to the 2010 data since they are all in the same 2010 tract boundaries.

The **All years normalized to 2010** selection allows you to compare data for various years. The data for years 1970, 1980, 1990, and 2000 are recalculated and normalized, and the report uses the 2010 tract ID (FIPS code). This allows you to compare data for various years within the exact same boundary definitions. By selecting "All years normalized to 2010" you can do actual apples-to-apples comparisons of historic data in 2010 tract definitions.


Please Note: Not all of the US was tracted in 1970 and 1980, so there are some rural areas that will not have data for 1970 and 1980 in this product. Contact GeoLytics if you are concerned about coverage in 1970 and 1980 in your area of research interest. See example below of Atlanta, GA.

**Example: Visualizing Atlanta's Population Density, 1970 to 2000**

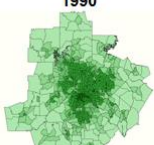
The example below of Atlanta Population Density from 1970 to 2000 is a case in point. With the NCDB, users can produce maps of populations and landmass for 1970, 1980, and 1990 census data already weighted to the 2000 boundaries. In one pass, the computer will be able to generate the data and boundaries and map these trends. With another minute, you can calculate a variable for population density. Quickly, you are printing, saving, and producing impressive thematic maps that visually illustrate Atlanta population growth through time. All in only a matter of minutes!

Changing Population Density 1970 to 2000 - Atlanta, Georgia


1970



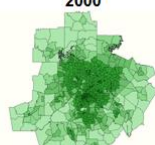
1990



1980



2000



Legend

0	To 50000
1	to 5000
2	to 1000
3	to 500
4	to 200
5	to 1

Maps created using  
GeoLytics Neighborhood  
Change Database

What are the differences between the Neighborhood Change Database and the individual census products for 1970, 1980, 1990, and 2000?

The Neighborhood Change Database has two main advantages: normalized data and cost. If you want to do time series analysis (looking at the changes of a given location across time), then the Neighborhood Change Database is the ideal product. Because the NCDB data is normalized, you can evaluate population trends without having to control for changes in boundary definitions. The year specific boundaries are also included and if you only need tract level geographies, this is a much more cost-effective way of purchasing 5 decades of Census data for the price of two.


# Brown University – Bridging Tract Data


Diversity and Disparities

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America in the first decades of the **new century**

The Diversity and Disparities Project provides independent and peer-reviewed research examining changes in American society in the recent past.






**DIVERSITY AND DISPARITIES**

AMERICA ENTERS A NEW CENTURY

JOHN LOGAN, EDITOR



Obama/Biden  
Assessed Wrong  
the Stimulus  
a Country "Guess  
Wrong" on Obama

FORECLOSURE

2008-2009

**See DATA**  
Find census data for your metropolitan region and see time trends over several decades.

**See REPORTS**  
Find reports by US2010 researchers on their latest findings.

**Map USA**  
Create maps of census data for counties and neighborhoods anywhere in the U.S. and as far back as 1940.

**Bridging Tract Data 1970-2010**  
An introduction to the Longitudinal Tract Data Base.

**For Researchers**  
Find detailed information about how changes in collection of census data affect your work.

**Download Diversity and Disparities as a FREE eBook.**  
(Russell Sage Foundation, 2014)

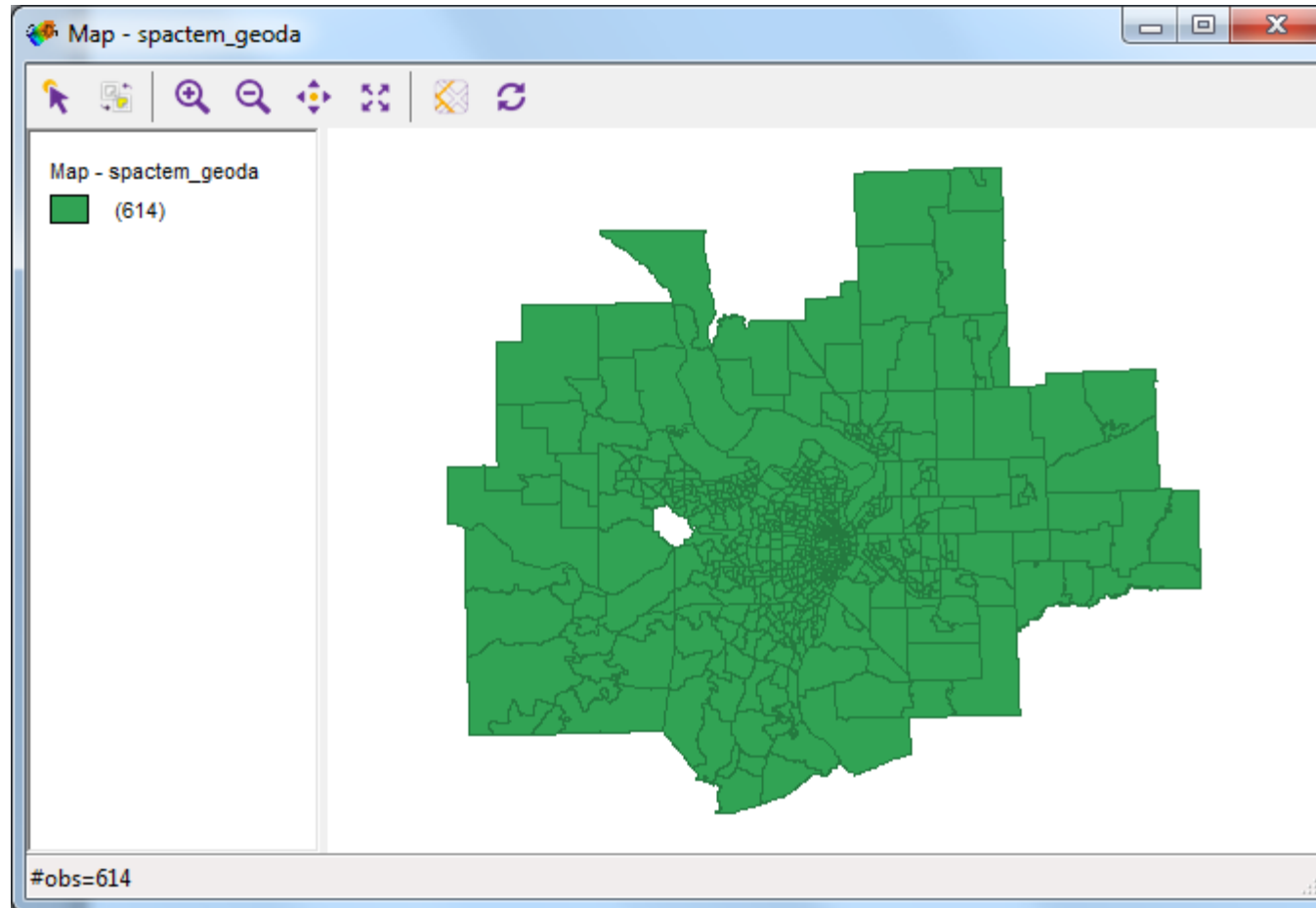
<https://s4.ad.brown.edu/Projects/Diversity/Researcher/Bridging.htm>



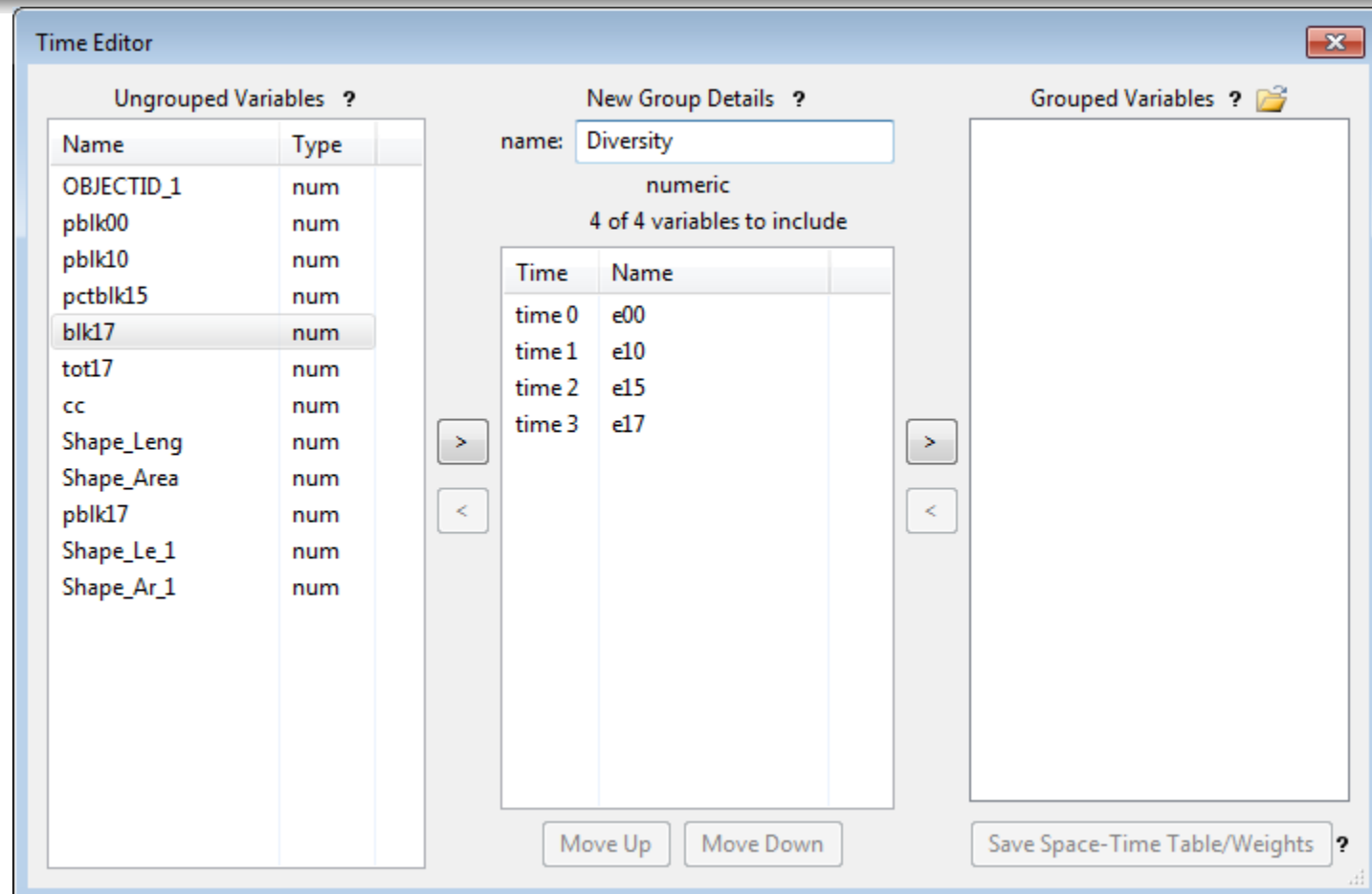
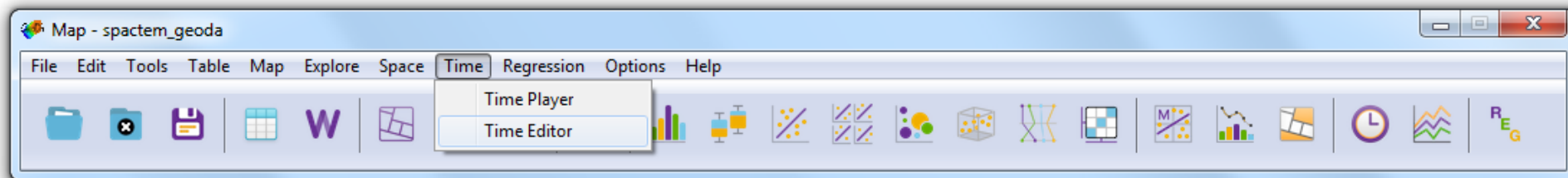
# Descriptive Space-Time Analysis

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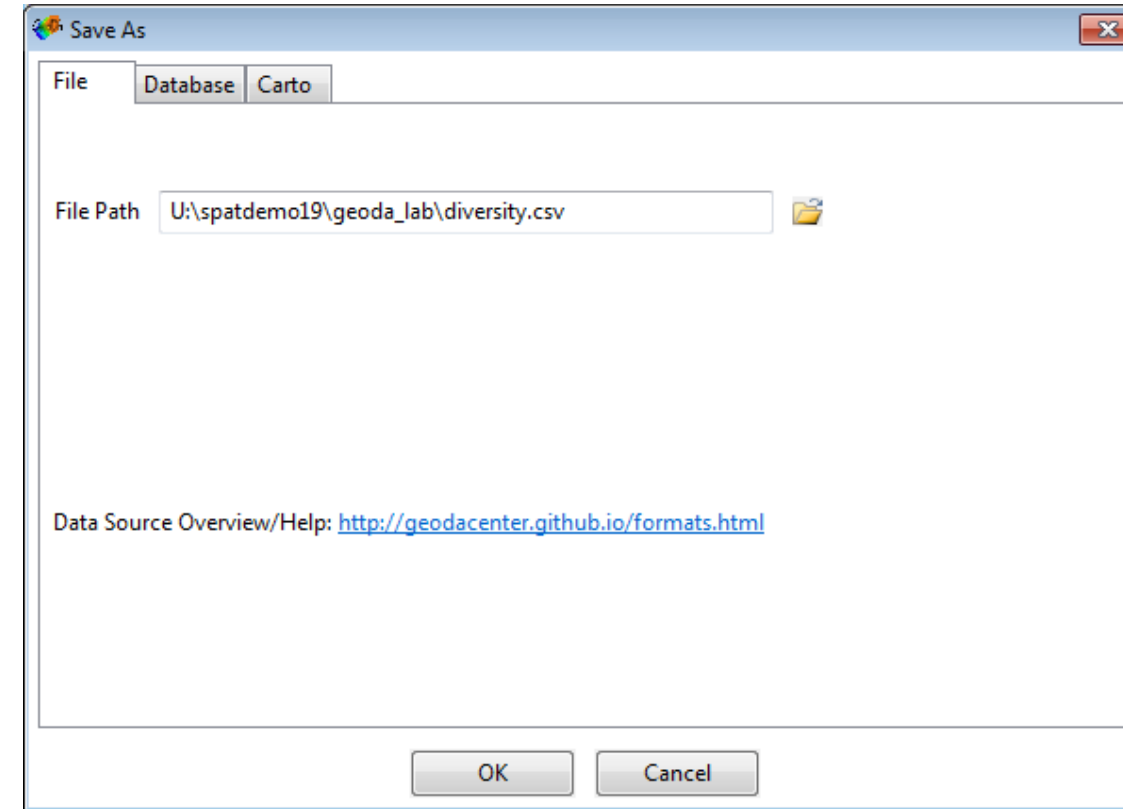
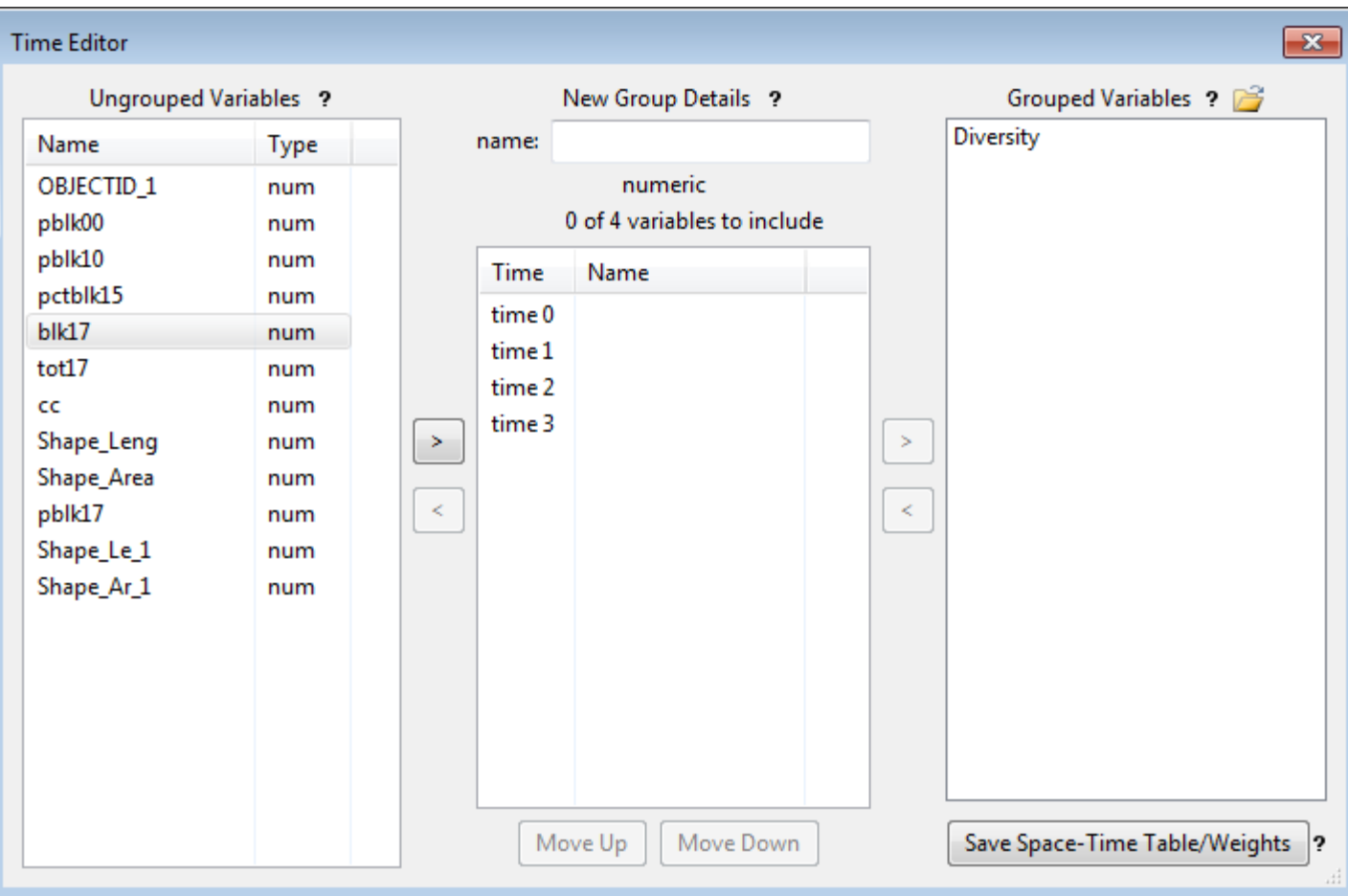
1. Open the shapefile that has data for several time points  
Example: 2000, 2010, 2015, 2017
2. Create your weight file



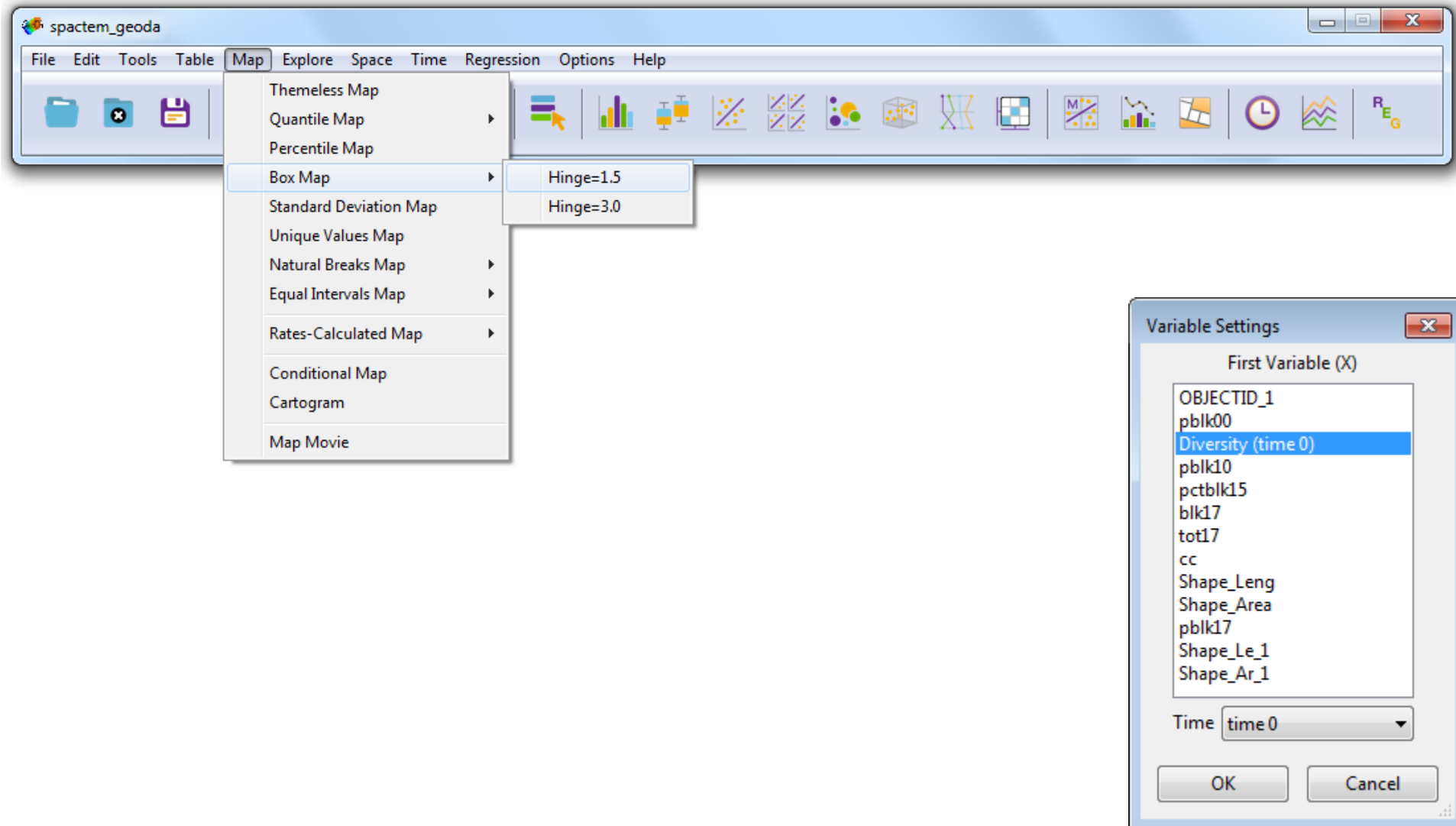
3. Open the Time Editor -> Add your time series variables ->  
Edit Group name and Time name



4. Group Variable by moving “Diversity” to the Grouped Variables
5. Create Space-Time weights – you need to create a csv file.

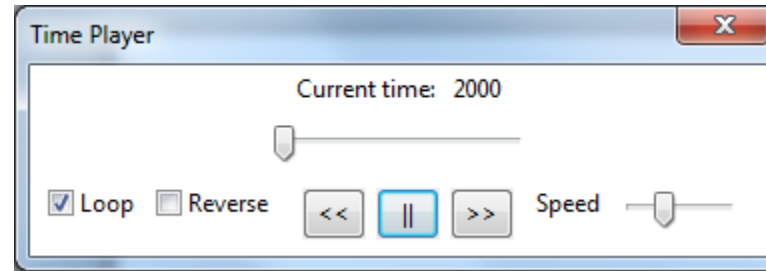


## 6. Let's create a Box Map.

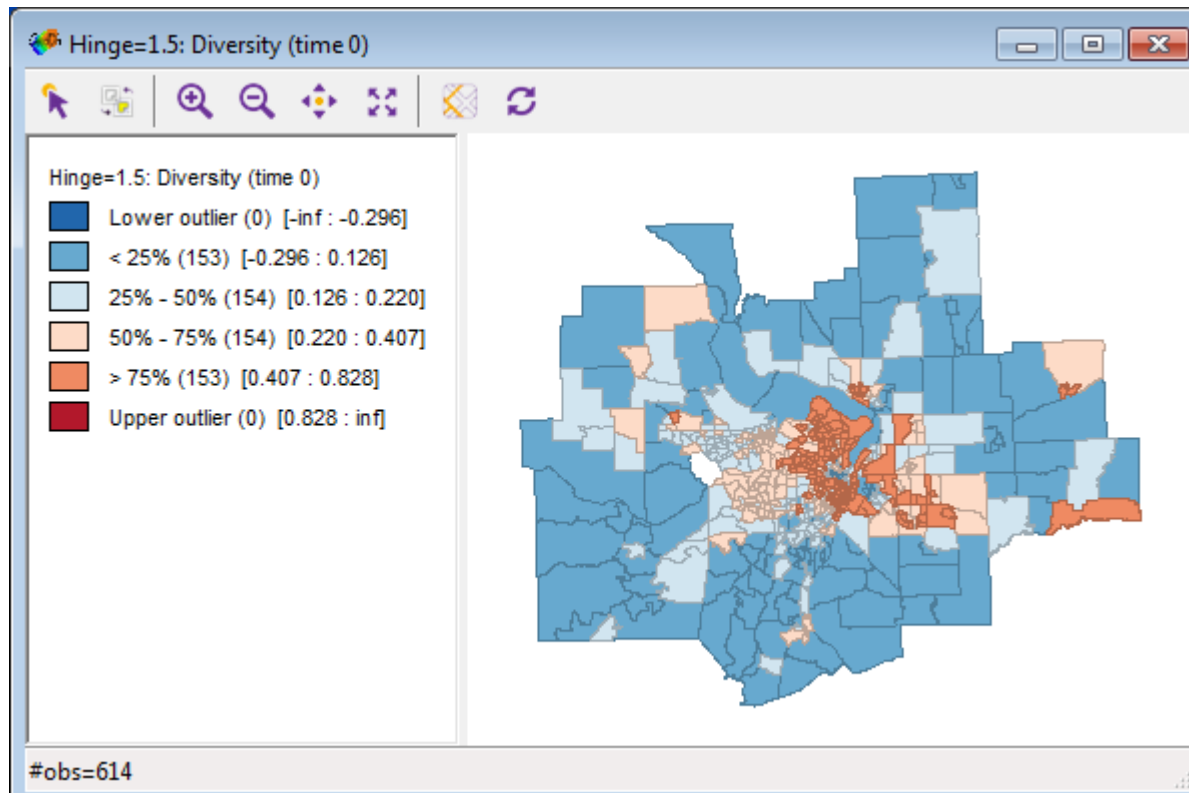


7. Now if we use the Time Player, we can visualize the changes of racial diversity over the same space and over three time period.

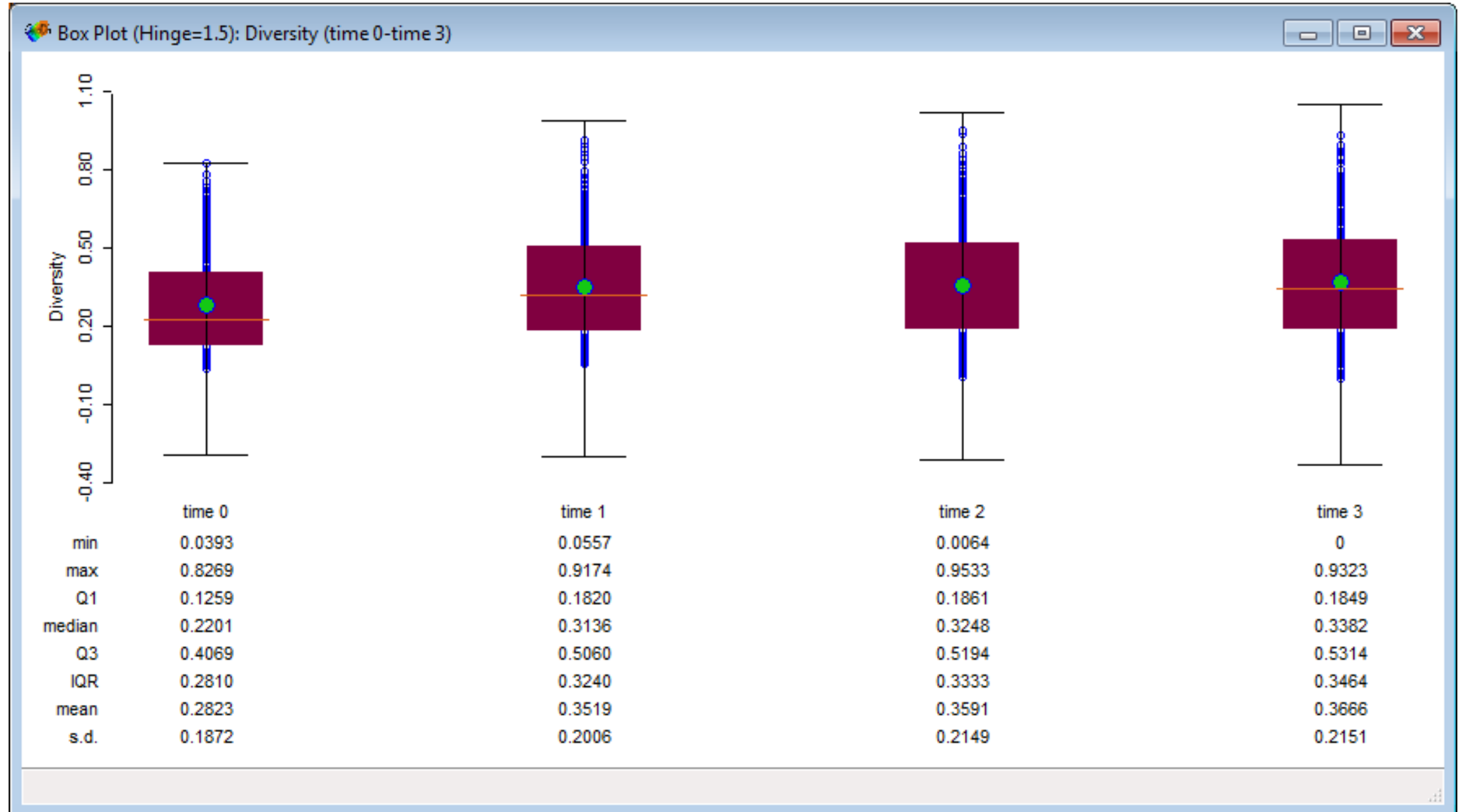
Note : Hinge 1.5 is 1.5 times the Interquartile Range. The hinge criterion determines how Extreme observations need to be before they are classified as outliers.



This box will change automatically for each Time period



8. Let's exam Box Plot. It will automatically create a figure that includes the time points



# Differential Moran's I

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# Differential Moran's I – Part 1

- Let's assume we have data on racial diversity for 2000, 2010, 2015, 2017.
- We want to compare diversity at a given location  $i$  in 2000 ( $X_i$ ) to the average of its neighbors in 2010 ( $X_j$ ) or  $Y$  or spatial lag).
- One way to study this problem, is change in diversity from two time periods.

# Differential Moran's I – Part 2

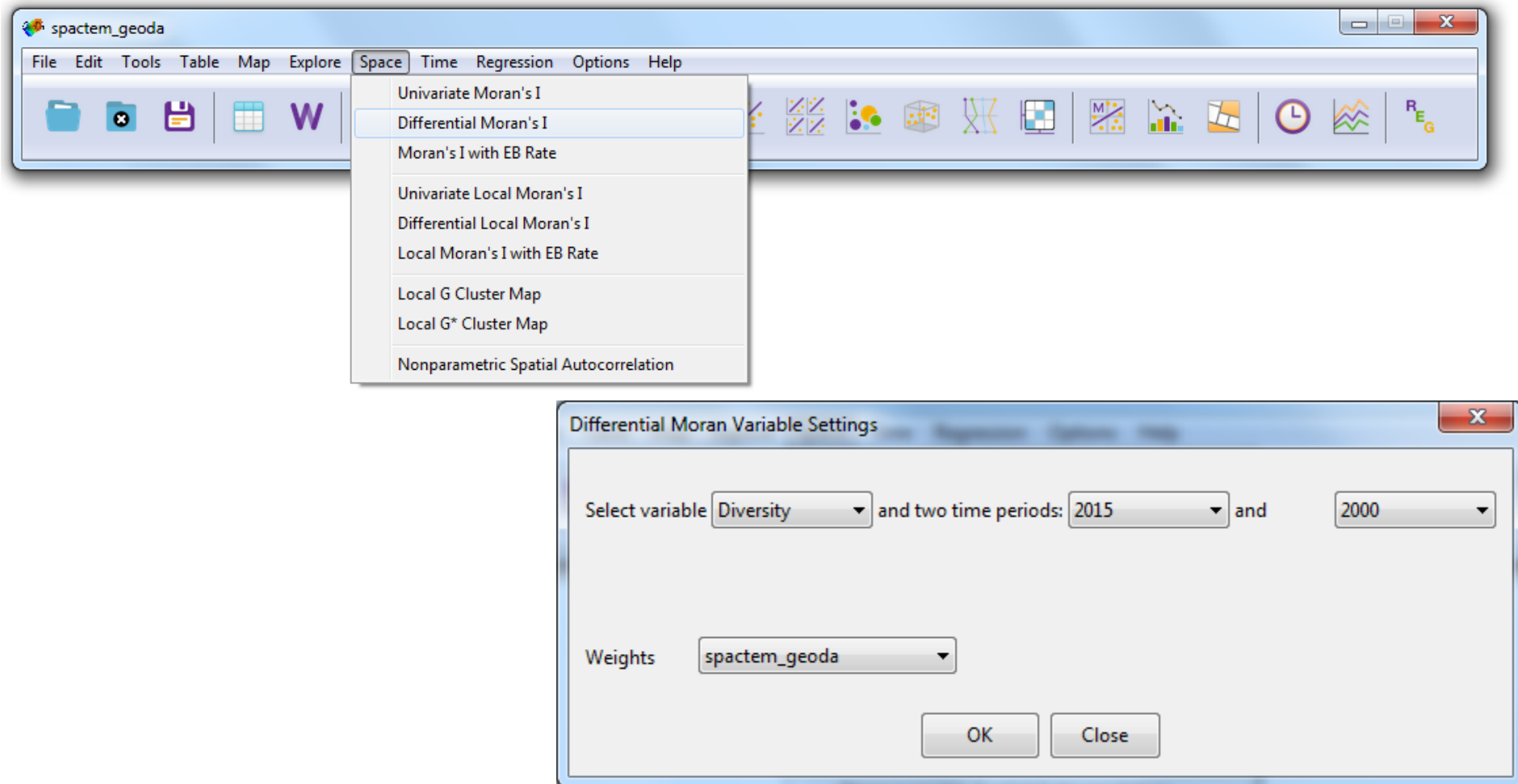
- We can use Differential Moran's I to study change over two time periods.
- For example, Differential Moran's I deducts diversity in 2015 from diversity in 2000 (so we have a new variable, let's say *diff\_e*)
- GeoDa then runs the Moran's I test on this new variable (same result as first computing *diff\_e* in GeoDa and then running the univariate Moran's I on *diff\_e*)

# Differential Moran's I – Part 3

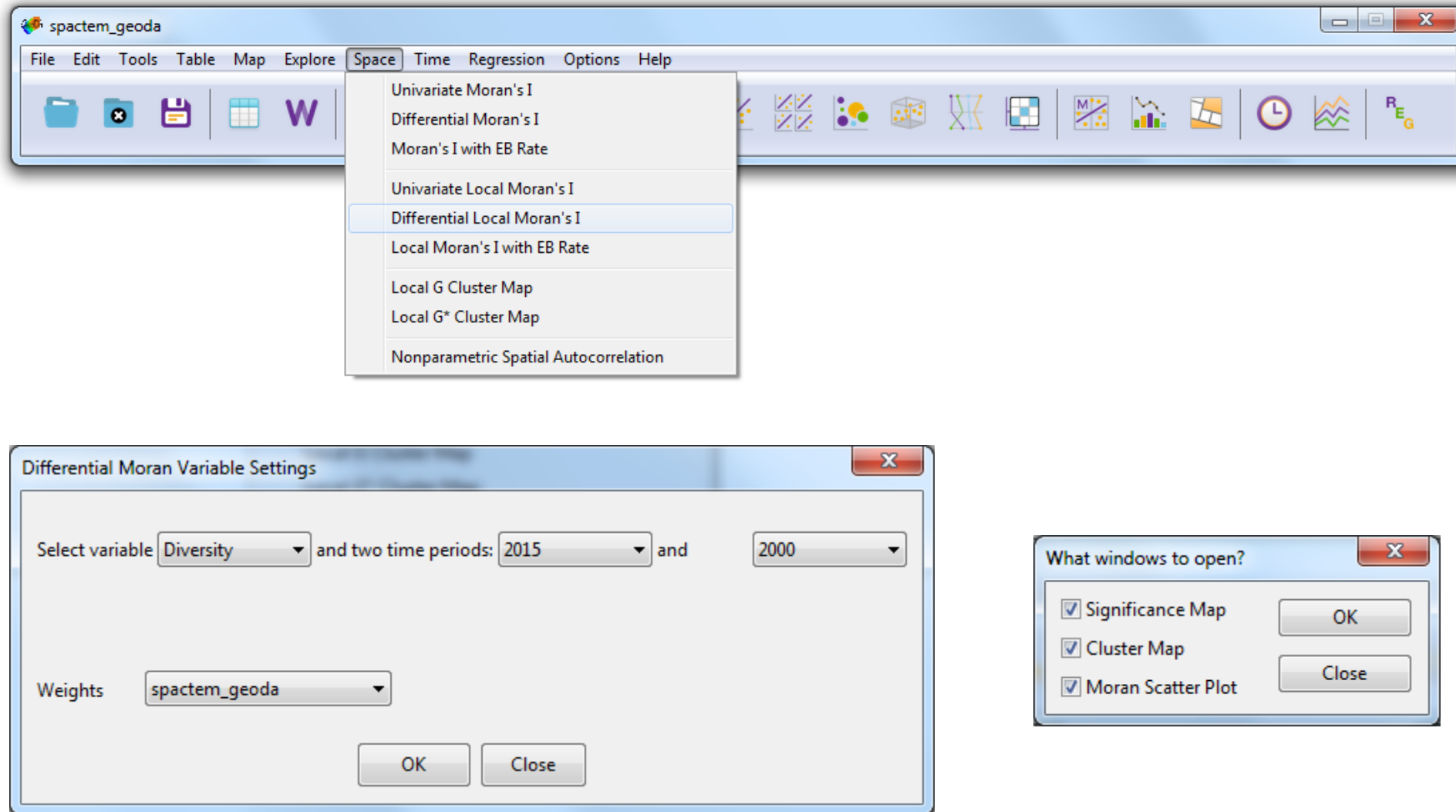
- We can use the global or local Differential Moran's I test to find out if a variable's change over time in a given location is statistically related to that of its neighbors.
- In other words, it addresses the question whether there are clusters of changes in diversity between 2015-2000.
- A high-high cluster would be one with above-average 2015-2000 changes in an area and its neighbors.
- A low-low cluster would be one with below-average 2015-200 changes in an area and its neighbors.
- A low-high and high-low cluster would be small changes in the core vs. high changes in the neighbors and vice versa.

1. Go to the Space Menu -> Select Differential Moran's I
2. Select two time periods

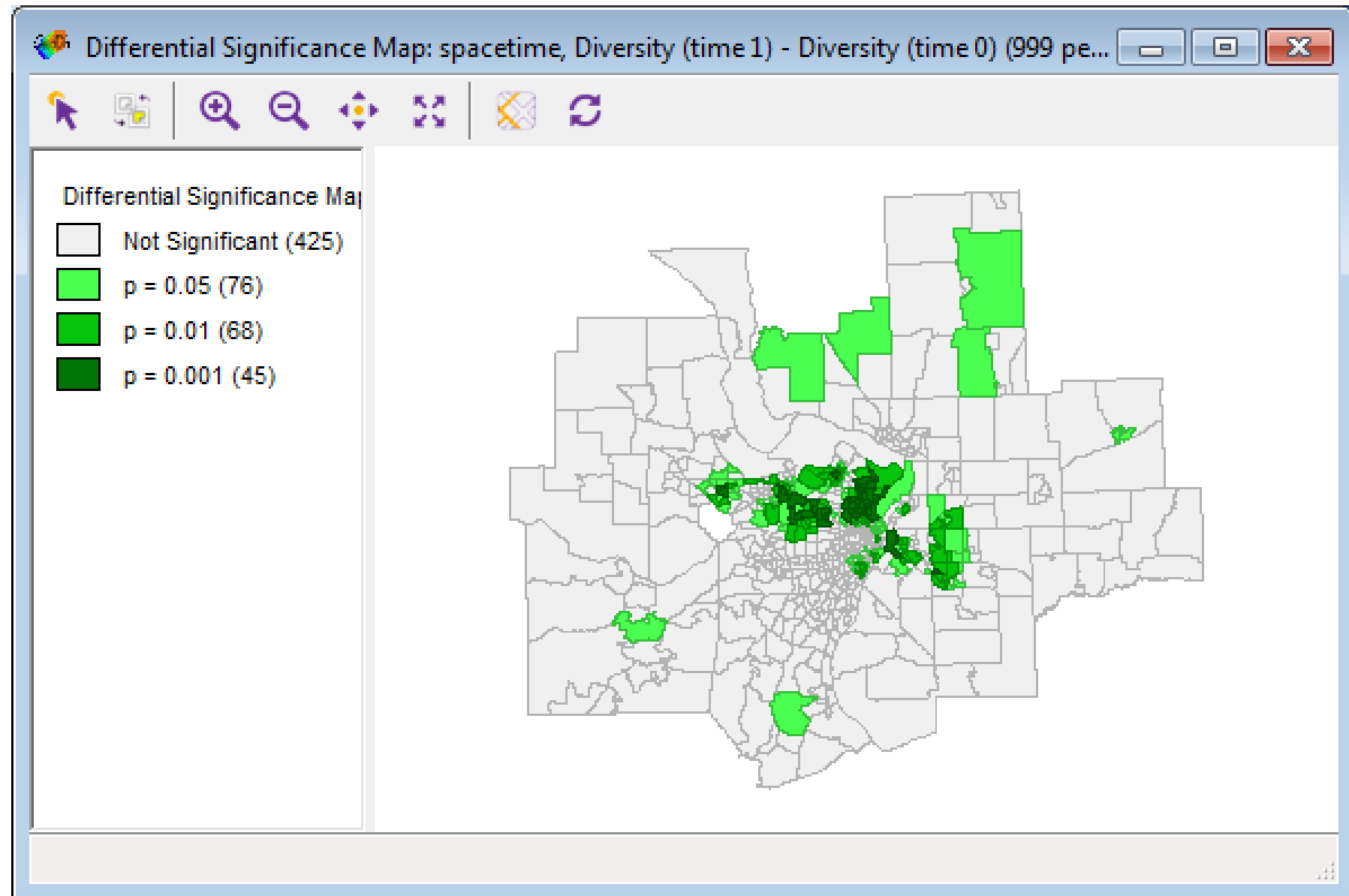
Note: You must group your time variables first.



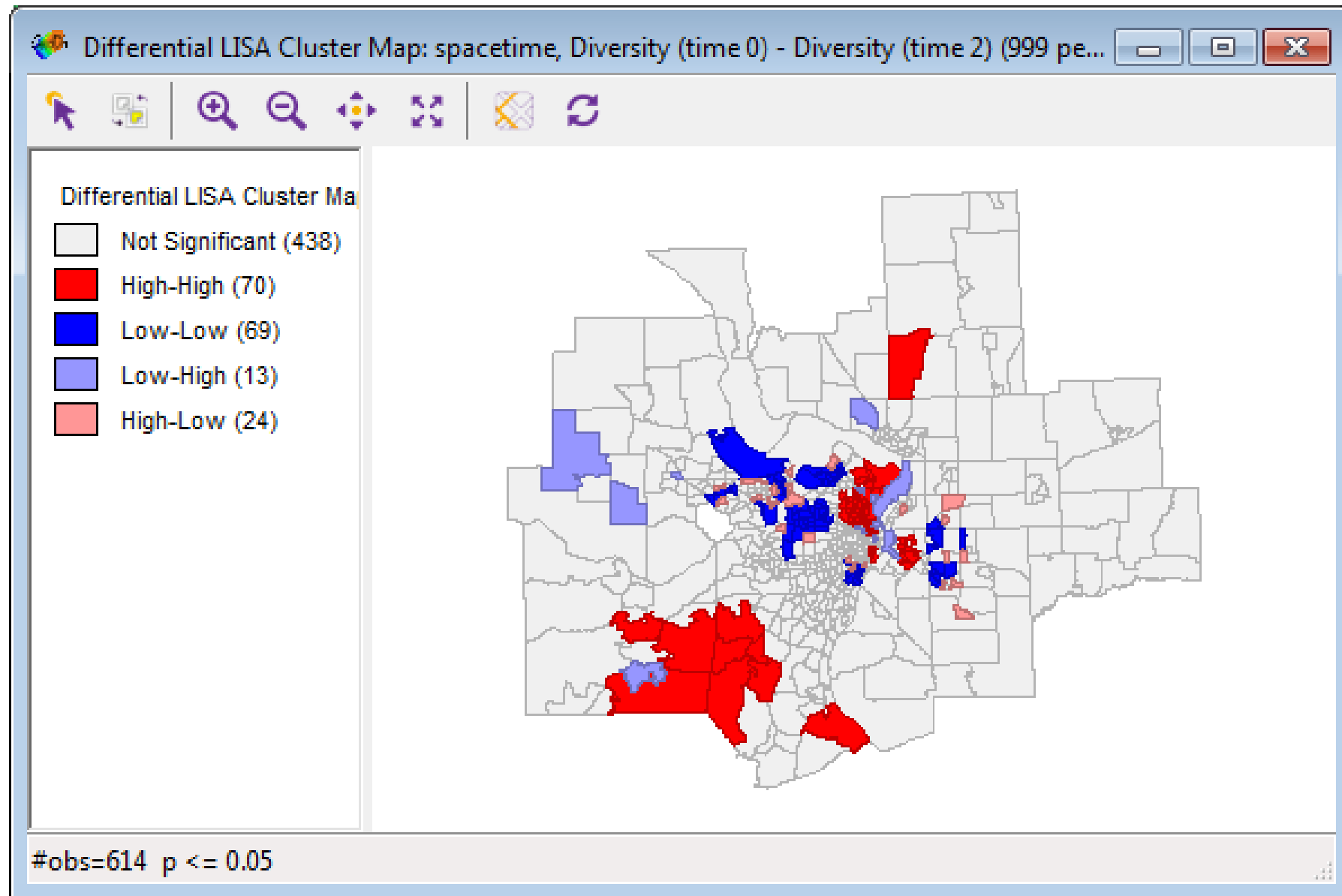
#### 4. Calculate a Differential Local Moran's I -> Select Time Periods -> Select Options



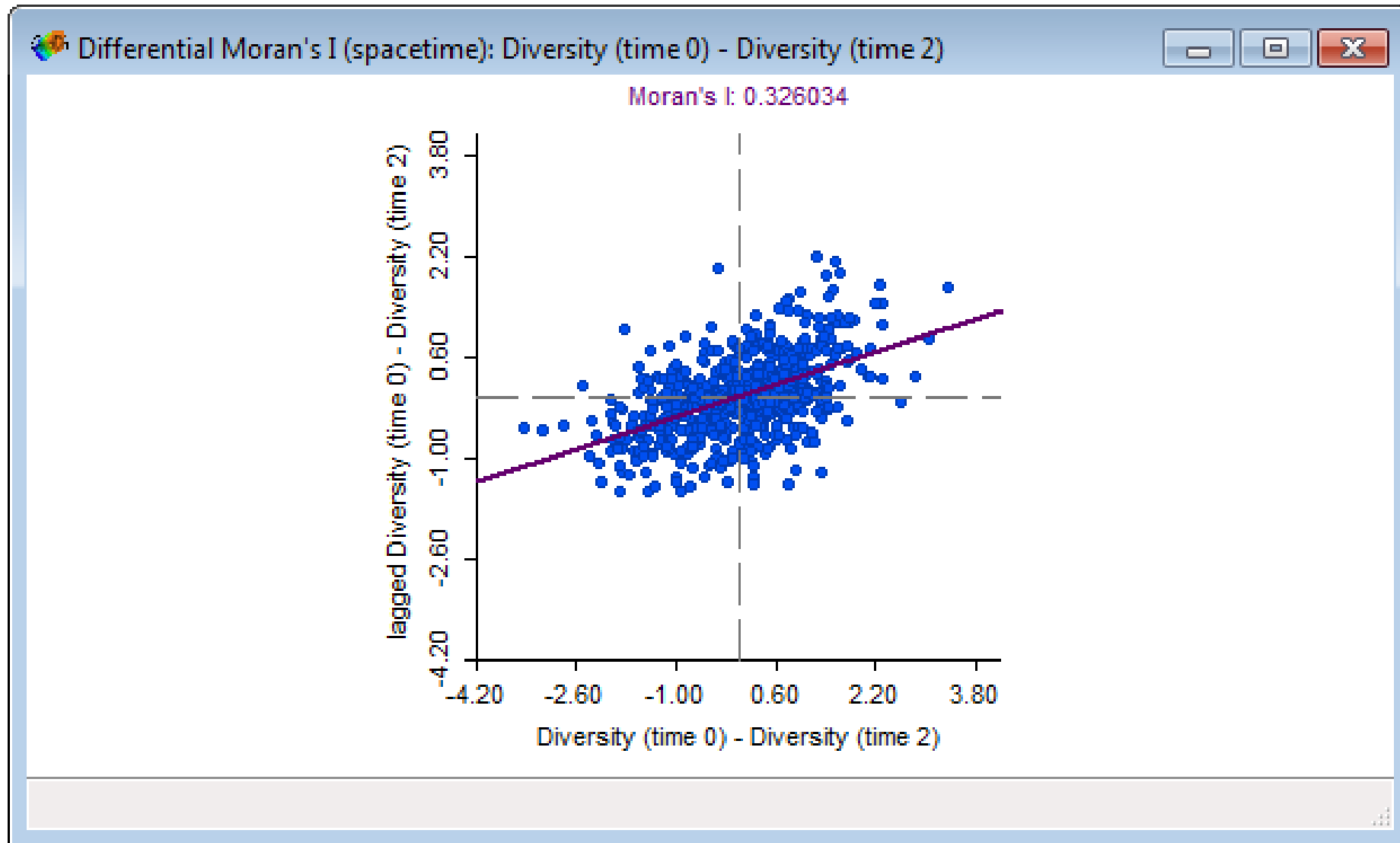
5. Here is your Differential Moran's I with significant values



## 6. Here is your Differential Moran's I LISA map



7. We can compute it ourselves -> create a new variable `diff_e`  
(2015-2000 diversity values)-> Run a Moran's I test and compare values





# Final Thoughts

- Your dependent variable is the change in the dependent variable.
- Most difference of means analyses assumes that the data is random distributed. However, like most data, change of time for most social economic has problems with spatial autocorrelation.
- If you pursue time-space analysis you need to move to GeoDa Space. Simply computing a fix-effect models will not solve your problems.