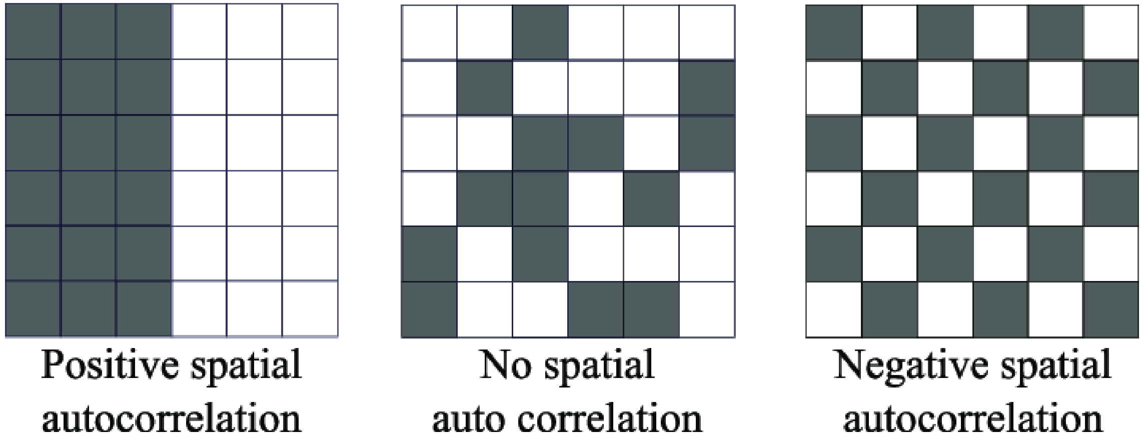
QGIS Cartography Part 3

Introduction to Spatial Autocorrelation

- **Definition**: Spatial autocorrelation refers to the degree to which one object is similar to other nearby objects in a spatial distribution.
- **Importance**: It helps in understanding the spatial patterns and the clustering of data points in geography.

Moran’s I

- **Definition**: A measure of global spatial autocorrelation. It evaluates whether the pattern expressed is clustered, dispersed, or random.
- **Interpretation**:
  - Values range from -1 (perfect dispersion, right image, no spatial autocorrelation) to +1 (perfect clustering, left image, perfect spatial autocorrelation)
  - A value of 0 indicates random distribution

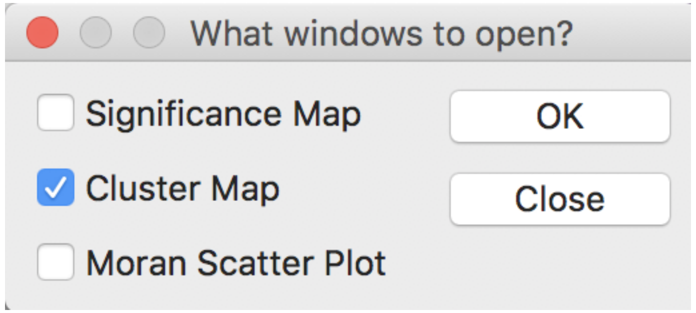


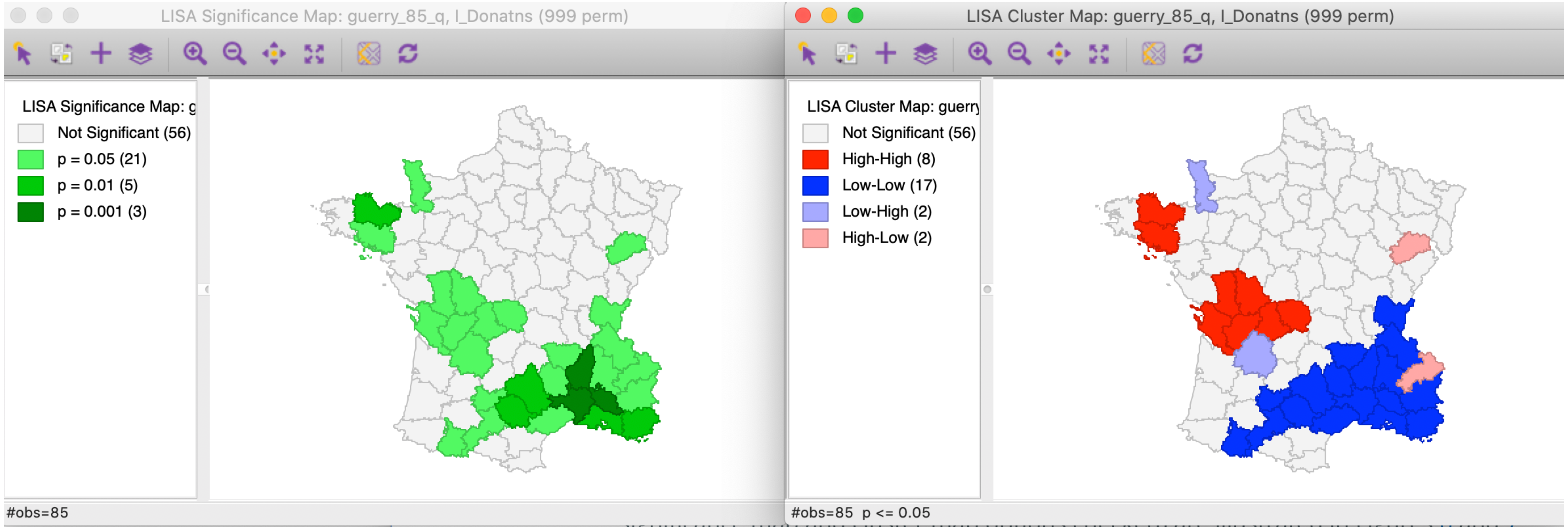
Global vs Local: Moran’s I

- **Global vs. Local**: Moran's I provides a single global value indicating overall autocorrelation, while Local Moran's I gives multiple local values indicating spatial patterns or anomalies at the local level.
- **Use Cases**:
  - Moran's I: Used when interested in the overall spatial dependency of the dataset.
  - Local Moran's I: Useful for identifying hot spots, cold spots, and spatial outliers.

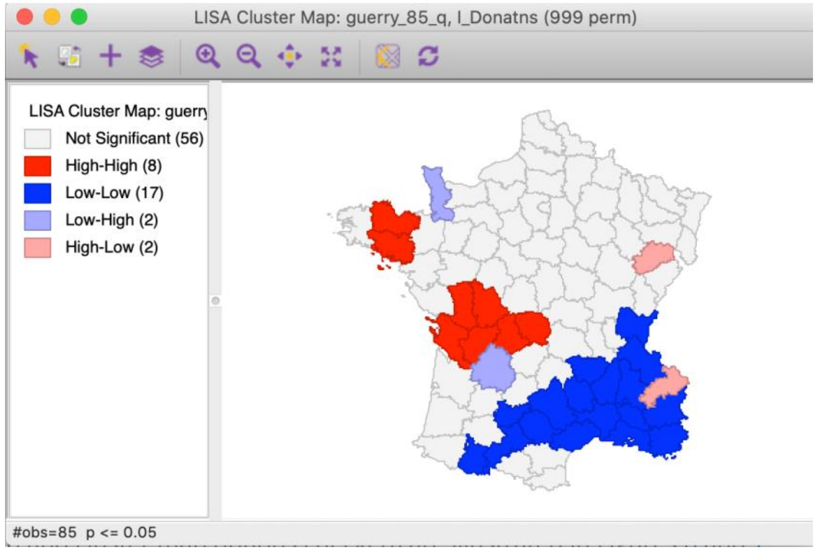
Local Moran's I

- Must first generate Spatial Weights
- Generate all 3 windows



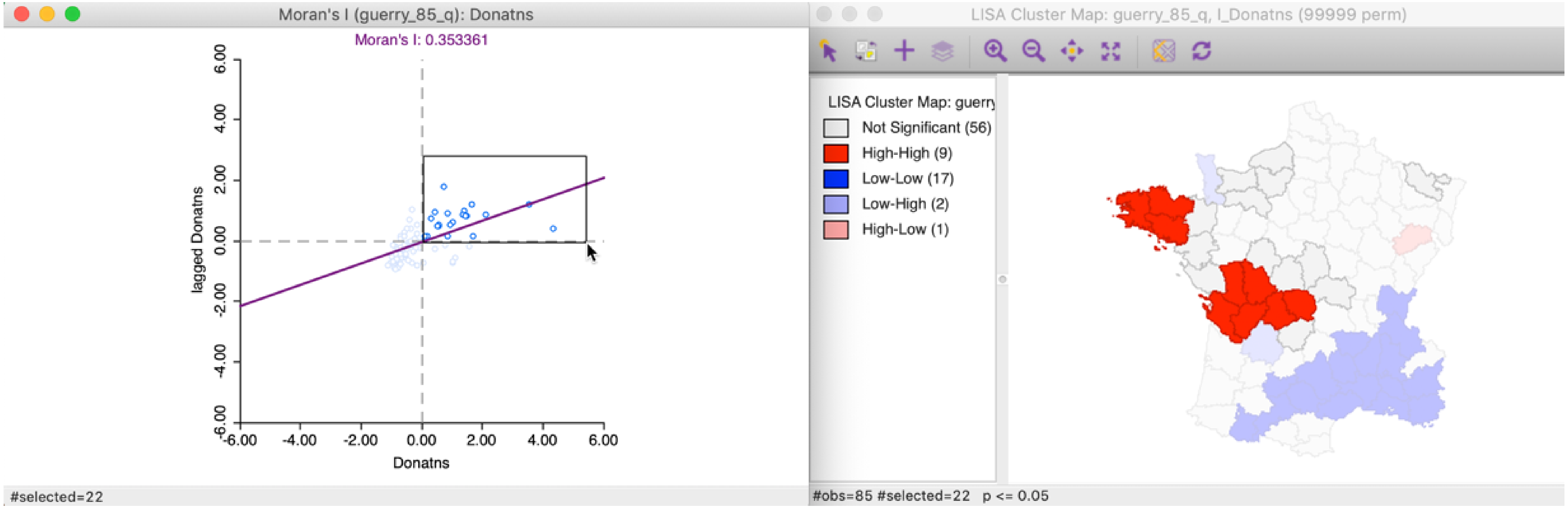


Interpreting Local Moran's I



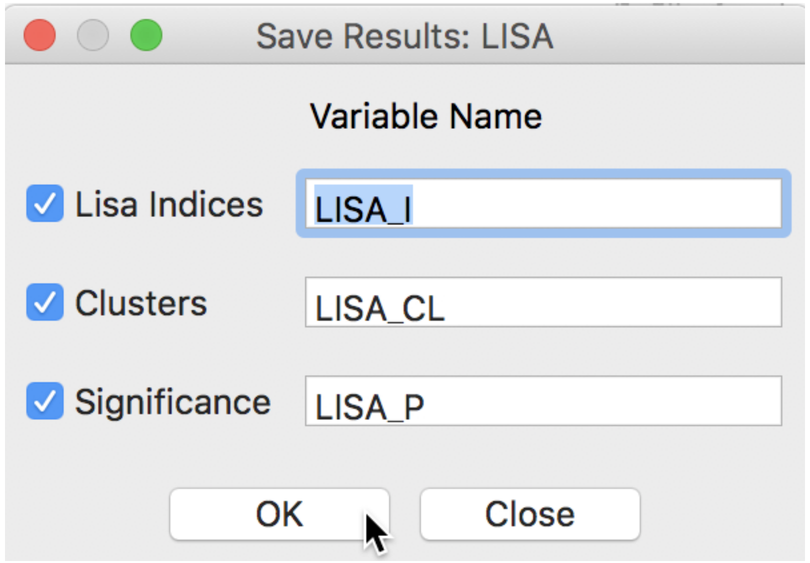
category	scatter plot quadrant	autocorrelation	interpretation
high-high	upper right (red)	positive	**Cluster** - "*I'm high and my neighbors are high.*"
high-low	lower right (pink)	negative	Outlier - "*I'm a high outlier among low neighbors.*"
low-low	lower left (blue)	positive	**Cluster** - "*I'm low and my neighbors are low.*"
low-high	upper left (light blue)	negative	Outlier - "*I'm a low outlier among high neighbors.*"

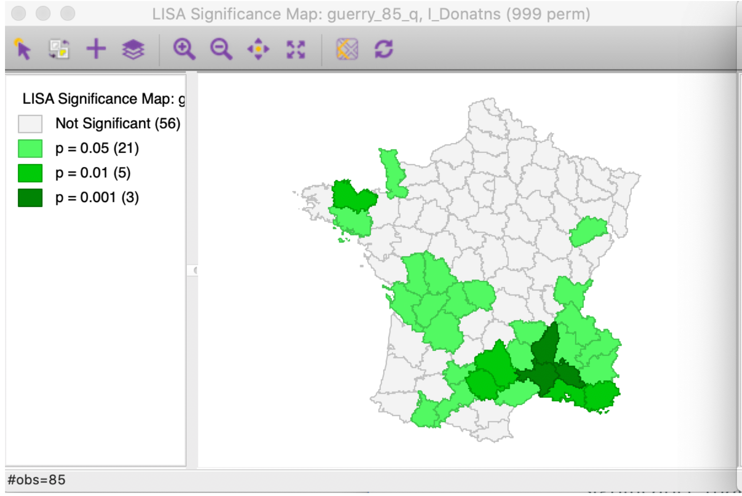
Investigating Quadrants

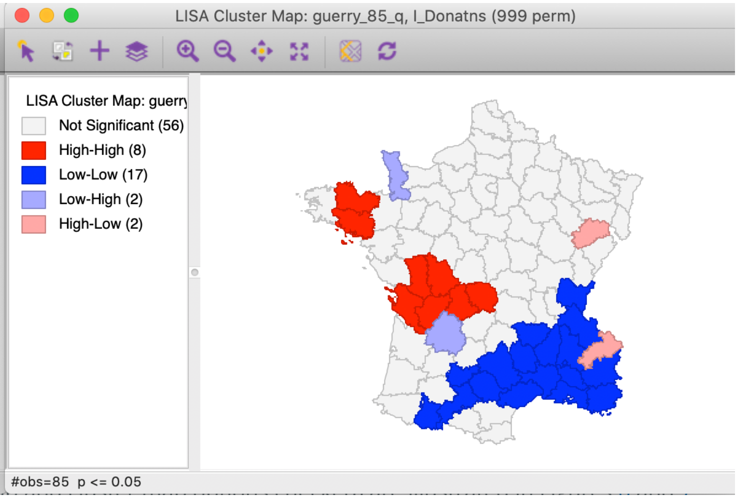


Save Local Moran's I

- Right click in the main map to save the results, then click save in GeoDA
- To make maps in QGIS, use the LISA_CL and LISA_P columns … what do those represent?







Introduction to Spatial Dependence in Regression Models

- **Definition**: Spatial dependence refers to the relationship between a variable of interest and its spatial context or location.
- **Importance**: Understanding spatial dependence is crucial for accurate modeling and analysis in geography, as ignoring it can lead to biased and inefficient results.

Spatial Lag vs Spatial Error

- **Spatial Lag**: The spatial lag model incorporates the spatial dependence of the dependent variable directly into the regression model.
- **Spatial Error**: The spatial error model addresses spatial autocorrelation in the error terms of the regression model.

Spatial Lag vs Spatial Error

Key Differences:

- Spatial Lag Model: Focuses on the spatial dependence of the response variable itself.
- Spatial Error Model: Concentrates on accounting for spatial autocorrelation in the error terms of the model.

Selection Criteria:

- Use Spatial Lag Model when the influence of neighboring regions is a substantive part of the research question.
- Use Spatial Error Model when residuals from a traditional regression model show spatial autocorrelation.

Diagnostic Tests and Implementation

Diagnostic Tests:

- Moran's I (on residuals): To detect spatial autocorrelation in residuals, indicating the need for a spatial model.
- Lagrange Multiplier tests for both lag and error: To decide between spatial lag and spatial error models.

Deciding Between Lag and Error Models

The general advice is first to look for a theoretical basis to inform your choice. If there are strong substantive grounds for one model instead of the other, you should adopt it.

When it is not so clear theoretically, you can compare the model performance parameters: the **R-squared and Log likelihood (also check the LL is significant by looking at the p-value)**.

Remember to produce visuals in QGIS.

Bivariate Mapping

- **Definition**: Bivariate mapping is a cartographic technique that visualizes two variables simultaneously on a single map, allowing for the exploration of relationships between them.
- **Purpose**: To reveal patterns and correlations that may not be apparent when mapping variables separately.
- **Key Elements**:
  - Color: Often utilizes a two-dimensional color scheme to represent different combinations of the two variables.
  - Symbolization: May also use varying symbols or sizes to represent data layers effectively.

Bivariate Mapping

- **Color Blending Techniques**:
  - Use of complementary colors for each variable that blend to create distinct hues representative of variable interactions.
  - Example: One variable in shades of blue (low to high), another in shades of red (low to high), with overlaps creating purples.
- **Legend Design**:
  - Crucial for interpretation; typically a grid or matrix that explains what each color or symbol combination represents.
  - Example: A matrix showing different shades of colors corresponding to variable ranges.
- **Considerations**:
  - Clarity: Ensure the map remains interpretable and not overly complex.
  - Audience: Consider the map's audience and their ability to understand and extract meaningful insights.

Bivariate Mapping

- **Different than cluster map!**
- **Excellent tutorial:** https://bnhr.xyz/2019/09/15/bivariate-choropleths-in-qgis.html