GEOG 4/595: Geographic Data Analysis

Spatial neighbors and spatial autocorrelation

Spatial Neighbors

An element required for the calculation of spatial autocorrelation (i.e. the Moran statistic), the fitting of spatial autoregressive models, or simple description of the geometry of a set of locations is the spatial weights/contiguity /neighbor matrix. This matrix is an npts x npts square matrix, the elements of which describe some geometric relationship between pairs of points. Often, the matrix is written as $\boldsymbol{W}$, with elements $w_{i,j}$ that represent the proximity, adjacency, or connectedness of the i-th and j-th point.

The elements can be binary (1 = points are adjacent, 0 = points are not adjacent), distance- or proximity-based values (i.e. points closer to one another have larger weights than points farther apart), or some combination of these. In many cases the matrix is symmetrical (i.e., $w_{i,j = } w_{j,i}$), but in the general case the matrix need not be symmetrical. This case may arise in irregular lattices, where "nearest-neighbor-" weights are used (e.g. point i might be the nearest neighbor of point j, but not the reverse), or where it is desirable to illustrate asymmetric relationships (e.g. the travel time from point j to point i may not be the same as from point i to point j).

- [example of the calculation of spatial neighbors]

The Moran statistic, an overall measure of spatial autocorrelation

The Moran statistic provides a one-number overall measure of spatial autocorrelation. The statistic is broadly analogous to the ordinary correlation coefficient, with a numerator that measures the extent to which adjacent points (as described by the elements of $\boldsymbol{W}$) have similar deviations about the mean of the data, and a denominator that standardizes that quantity to reflect the scale or variability of the variable being examined.

- [Moran statistic examples]

Readings:

Chapter 9 in Bivand, R., et al. (2013) *Applied Spatial Data Analysis with R*, 2nd edition. (Search for the eBook version on the UO Library page [http://library.uoregon.edu])