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Dr. Mark L. Burkey co-editor, *The Review of Regional Studies*

Introduction to Spatial Econometrics: (You should already understand Econometrics!)

The "Big Name" Players You Should Know About

Luc Anselin GeoDa
Jim LeSage and Kelly Pace
Harry Kelejian and Ingmar Prucha
Charles Manski
Paul Elhorst

Using free tools where possible **(On a Windows Platform)**

MapWindow (GIS)
GeoDa (Spatial Statistics, Easy Creation of Neighbor RelationShip Files)
R with spdep and other add-ins (Data Analysis, Spatial Econometrics)
Matlab (not Free!) with Spatial Econometric Toolbox (Free), Possibly Octave
Other tools: Edit .DBF files (OpenOffice), work with .ZIP fuiles (7-zip)

We will Cover:

The main ideas of Spatial Econometrics, types of models (Lag, Error, Durbin, etc.)
How to create a spatial dataset and contiguity files
Basic Spatial Statistics (Spatial Correlations)
How to specify, estimate and interpret spatial econometric models

- Diagnostics (LR tests, LM tests)
- Maximum Likelihood
- Bayesian and Panel Models (Don Lacombe)
- Others…

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Handouts: Spatial Econometrics (SE)

Video 1: Overview of Spatial Econometrics/Statistics

MapWindow (free), download maps (free) .shp .shx .dbf
Contiguity (Measuring Neighbors)
The Various Models

Consider an unemployment rate study in the 48 contiguous US States plus Washington DC, n=49 observations.

(1) $y = X\beta + \varepsilon$ (OLS) Anselin

Same as $Y_i=B_o+B_1x_i+\varepsilon_i$, but written in more compact Matrix/Vector notation.

We will measure who "Neighbors" are with a Spatial Weights Matrix, **W**

Regions might be correlated with their neighbors in three different ways:

A) The value of y in a region might impact (or be related to) the value of y in a neighboring region
B) The values of X's in a region might affect (or be related to) the value of y in a neighboring region
C) The residuals ε might affect (or be related to) the residuals in a neighboring region (spatial heteroskedasticity)

(2) $y = \rho Wy + X\beta + WX\theta + u,\ \ u = \lambda Wu + \varepsilon \quad (Manski\ Model)$

*If $\theta = 0$ then Manski becomes the Kelejian-Prucha model

(3) $y = \rho Wy + X\beta + u,\ \ u = \lambda Wu + \varepsilon$

*Or if $\lambda = 0$, we get the Spatial Durbin Model (SDM) Lesage & Pace

(4) $y = \rho Wy + X\beta + WX\theta + \varepsilon$ Spatial Durbin

* If $\rho = 0$, then this becomes the Spatially Lagged X (SLX) Model

(5) $y = X\beta + WX\theta + \varepsilon$

*If θ=0, then (4) degenerates into the spatial lag model

(6) $y = \rho Wy + X + \varepsilon$ Spatial Lag, Spatial Autoregressive (SAR)

*If θ= -ρβ, then (8) simplifies into the spatial error model (because λ=ρ in this case).

The math below is probably not technically correct… but it gives you the intuition:

$y = \rho Wy + X\beta + WX[\theta = -\rho\beta] + \varepsilon$

$y = \rho W[X\beta + \varepsilon] + X\beta + WX[-\rho\beta] + \varepsilon$

$y = \rho WX\beta + \rho W\varepsilon + X\beta + WX[-\rho\beta] + \varepsilon$

(7) $y = X\beta + u, \quad u = \lambda Wu + \varepsilon,\ \ where\ \ \varepsilon \sim i.i.d.$ Spatial Error (SEM)