Lattice Data

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Outline

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Lattice Data

Spatial Domain: D

- Discrete and fixed
- Locations nonrandom
- Locations countable

Examples of lattice data

- Attributes collected by ZIP code
- census tract
- remotely sensed data reported by pixels

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Lattice Data: Indexing

Site

- Each location is now an area or *site*
- One observation on Z for each site
- Need a spatial index: $Z(s_i)$

$Z(s_i)$

- s_i is a representative location within the site
- e.g., centroid, largest city
- Allows for measuring distances between sites

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Lattice Data: Aggregation and Coverage

Sites are areal units

- Attribute is typically aggregated or averaged
- Aggregated: event counts (number of crimes per tract)
- Averaged: per capita income by state

Coverage

- Lattice data is usually exhaustive in coverage
- e.g., U.S. states, census tracts in San Diego
- Prediction or interpolation not meaningful
- Explaining attribute variation across sites is the focus

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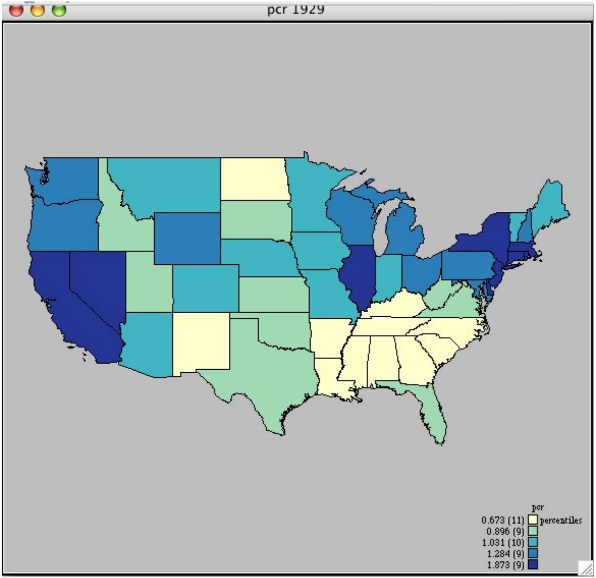
Lattice Data: State Per Capita Incomes



Lattice Data: Spatial Autocorrelation

Outline

Point Data

- focus on geometric pattern
- random vs. nonrandom
- clustered vs. uniform

Geostatistics

- 2-D modeling of spatial covariance (pairs of observations in function of distance)
- kriging, spatial prediction

Lattice Data

- areal units: states, counties, census tracts, watersheds
- points: centroids of areal units
- focus on the spatial nonrandomness of attribute values

Outline

There is no question with respect to emergent geospatial science. The important harbingers were Geary's article on spatial autocorrelation, Dacey's paper about two- and K-color maps, and that of Bachi on geographic series.
– Berry, Griifth, Tiefelsdorf (2008)

Spatial Dependence

Working Concept

- what happens at one place depends on events in nearby places
- all things are related but nearby things are more related than distant things (Tobler)
- central focus in lattice data analysis

Goodchild 1991

- a world without positive spatial dependence would be an impossible world
- impossible to describe
- impossible to live in
- hell is a place with no spatial dependence

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Spatial Dependence

Categorizing

- Type: Substantive versus nuisance
- Direction: Positive versus negative

Issues

- Time versus space
- Inference

Substantive Spatial Dependence

Process Based

- Part of the process under study
- Leaving it out
  - Incomplete understanding
  - Biased inferences

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Nuisance Spatial Dependence

Not Process Based

- Artifact of data collection
- Process boundaries not matching data boundaries
- Scattering across pixels
- GIS induced

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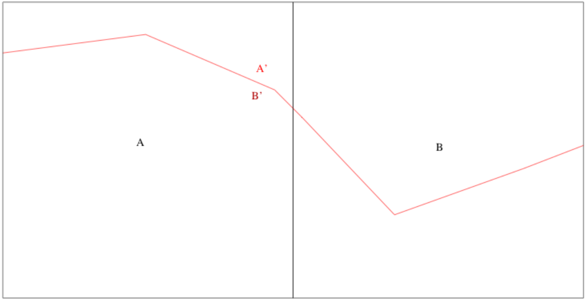
Boundary

Boundary Mismatch



- Even if *A* and *B* are independent
- A' and B' will be dependent

Nuisance vs. Substantive Dependence

Issues

- Not always easy to differentiate from substantive
- Different implications for each type
- Specification strategies (Econometrics)
- Both can be operating jointly

Space versus Time

Temporal Dependence

- Past influences the future
- Recursive
- One dimension

Space versus Time

Spatial Dependence

- Multi-directional
- Simultaneous