

Introduction to Geographic Information Analysis

SERGIO REY

Geographic Information Analysis

School of Geographical Sciences and Urban Planning
Arizona State University

1 GIS and Spatial Analysis

- Big Picture
- What is Spatial Analysis?

2 EDA and ESDA

- Exploratory Data Analysis (EDA)
- Exploratory Spatial Data Analysis (ESDA)

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GIS Then



GIS Then





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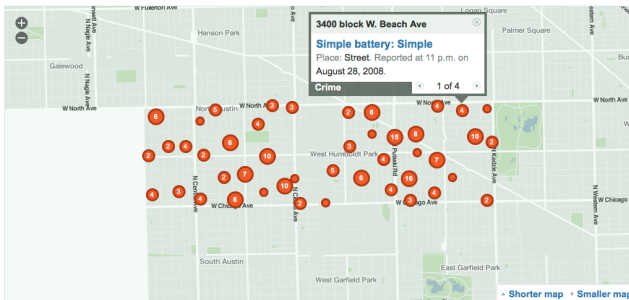
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Anselin-Getis (1992) Taxonomy

- Input
- Storage
- **Analysis**
- Output

Many other taxonomies

Goodchild (1992)

- cross-disciplinary
- **central** role for spatial analysis
- scientific **glue**

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What is Spatial Analysis?

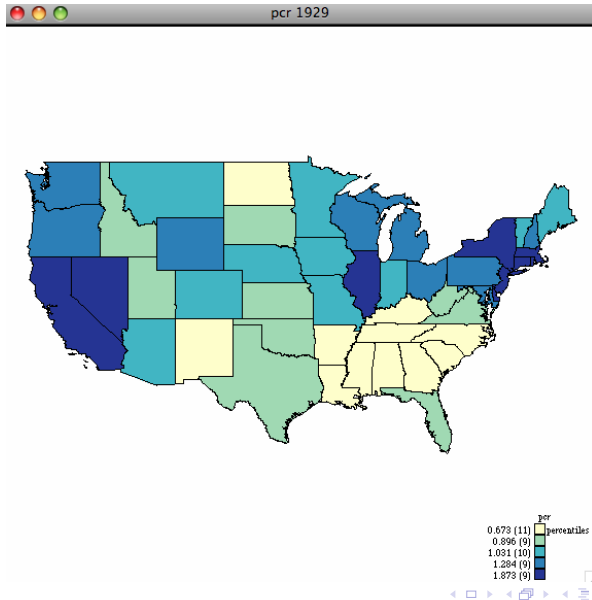
From Data to Information

- **Beyond** mapping
- **added value**
- transformations, manipulations and application of analytical methods to spatial (geographic data)

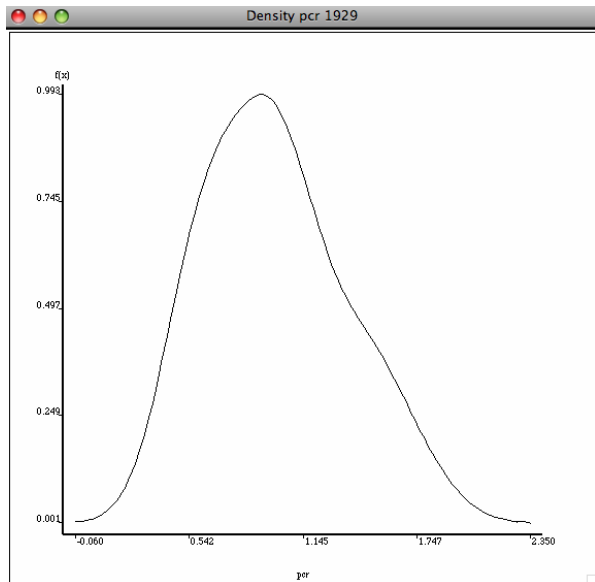
How Insights Change with location

- spatial analysis is **not** locationally invariant
- the results change when the locations of the study objects change
- **where** matters

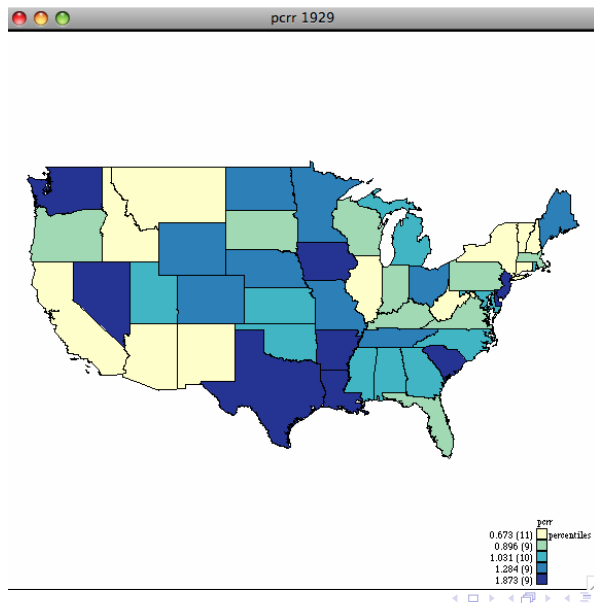
State Income Distributions 1929



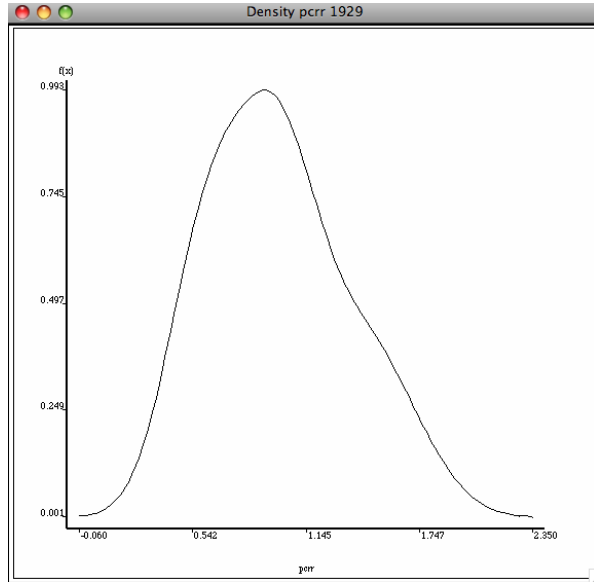
State Income Distributions 1929



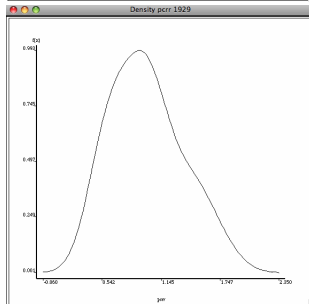
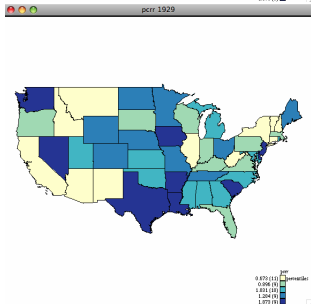
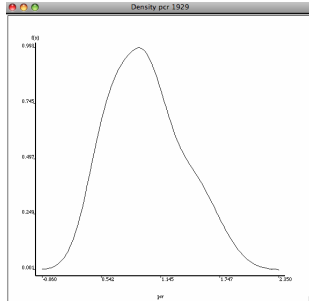
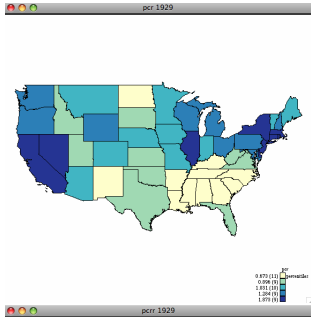
Randomized Income Distribution 1929



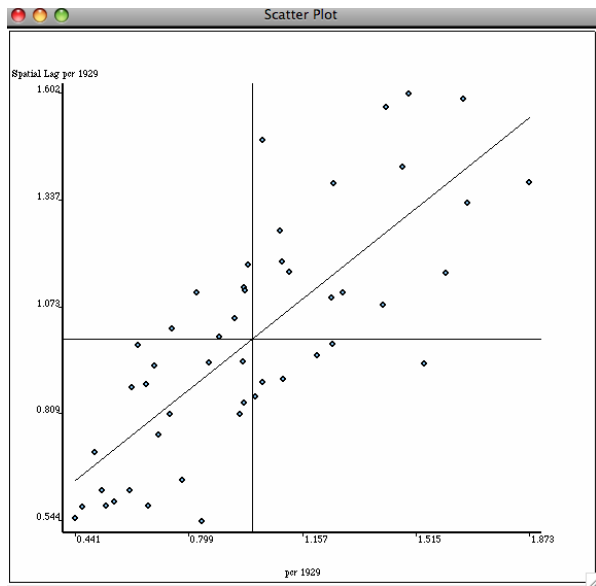
Randomized Income Density 1929



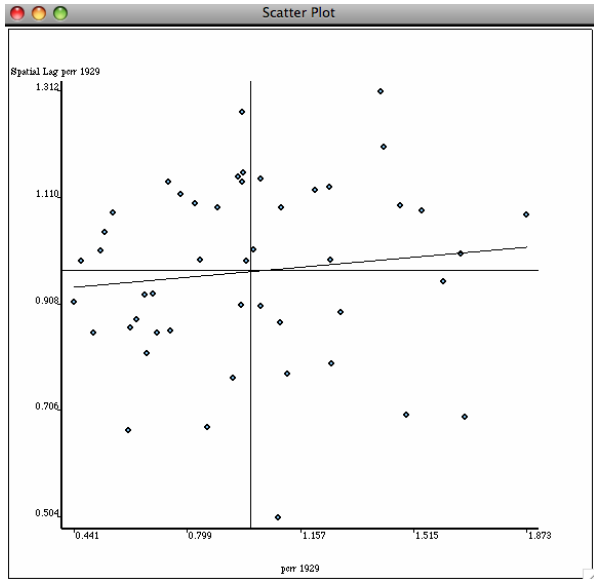
Locational Invariance



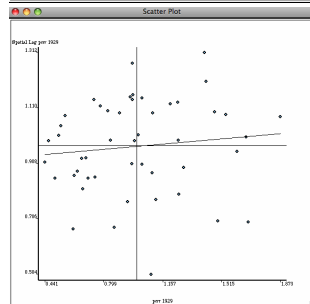
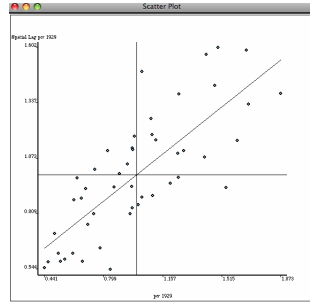
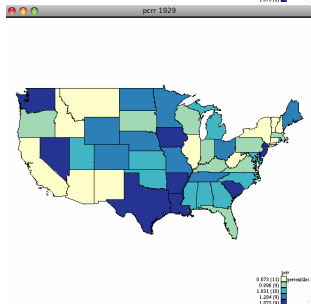
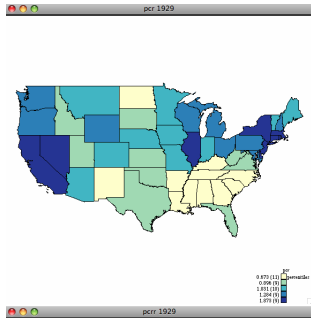
Spatial Autocorrelation Income 1929



Spatial Autocorrelation Randomized Income 1929



Locational Variance



Components of Spatial Analysis

Mapping and Geovisualization

showing interesting patterns

Exploratory Spatial Data Analysis

discovering interesting patterns

Spatial Modeling

explaining interesting patterns

Summary: Spatial Analysis

Beyond Mapping

Central role for **analysis**

Distinguished by Locational Variance

Location matters

Components

Showing, discovering, explaining

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What is EDA?

Philosophy

EDA is an approach, not simply a set of techniques, but an attitude/philosophy about how a data analysis should be carried out. Postpones the usual assumptions about what kind of model the data follow

Origins

Tukey, J. (1977) *Exploratory Data Analysis*. Addison, Wesley

Set of techniques to

- maximize insight into a data set
- uncover underlying structures
- extract important variables
- detect outliers and anomalies
- test underlying assumptions
- suggest hypotheses
- develop parsimonious models

Statistical Graphics

- EDA relies heavily on statistical graphics
- EDA is not identical to statistical graphics
- Graphics support pattern recognition and open-minded exploration
- Interactive graphics push this even further

Quantitative Methods

Although heavily graphic in orientation, there are also a number of numerical techniques in EDA.

EDA Versus Confirmatory Analysis

Confirmatory Analysis (e.g. regression)

Problem → Theory → Model → Data → Conclusion

Exploratory Analysis

Problem → Data → Analysis → Model

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What is ESDA?

Definitions

- Type of EDA
- Extended to include spatial attributes of the data

Crossfertilization

- Applying classic EDA to spatial data
- Developing new EDA methods for spatial data
- Interactions between EDA and ESDA

How does ESDA fit in spatial analysis?

Spatial Modeling?

- Modeling based on assumptionss
- ESDA largely model free
- Matter of degree (e.g., clustering)

Mapping?

- Maps play a critical role in ESDA
- Does a map = ESDA?
- No. ESDA = map, manipulation + visualization