

**Geographic  
Information  
Systems/Science**

GIS is a collection of computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

ESRI

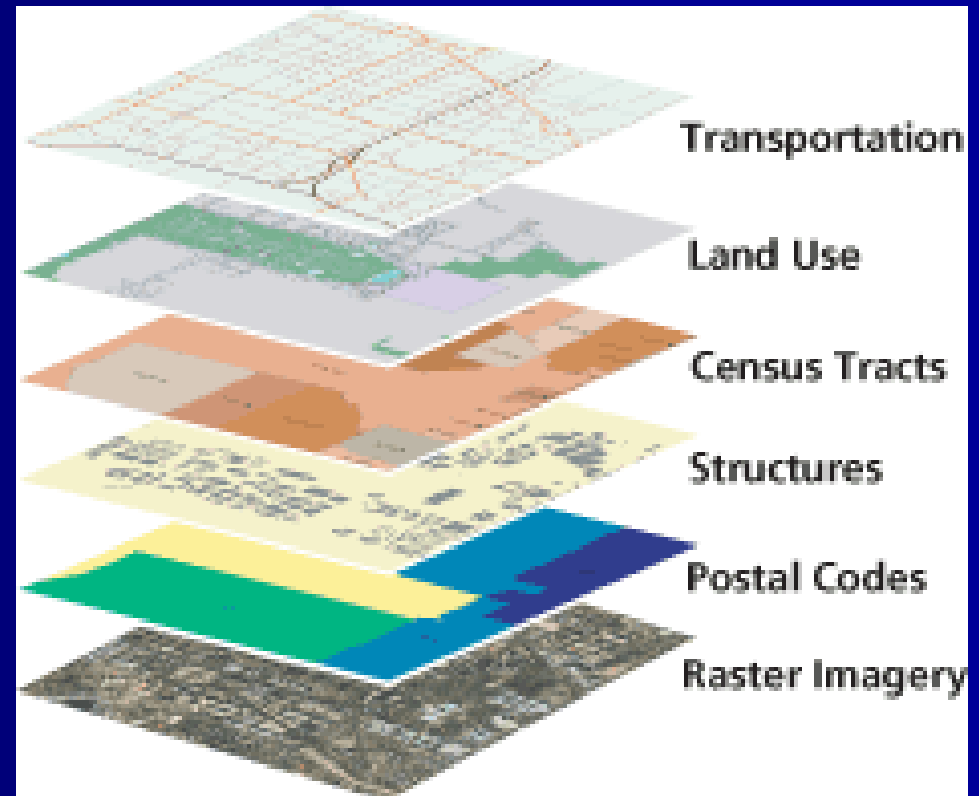
# GIS involves

- I. Data compilation and management
- II. Analysis, and
- III. Mapping for visualization and presentation

# I. Data Compilation and Management

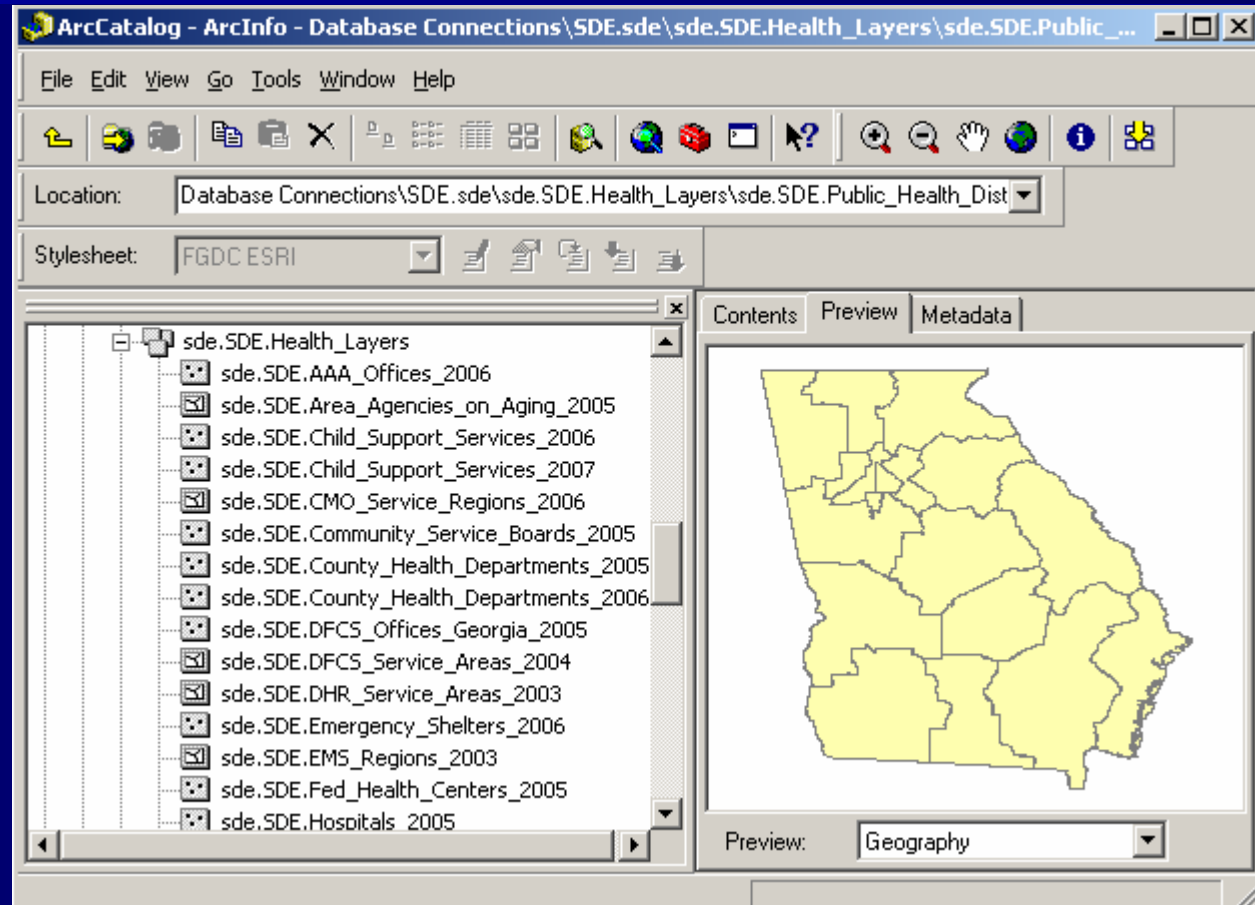
These layers might be part of a city's geographic dataset.

The layers contain spatial data for the city, each layer representing a distinct "theme."



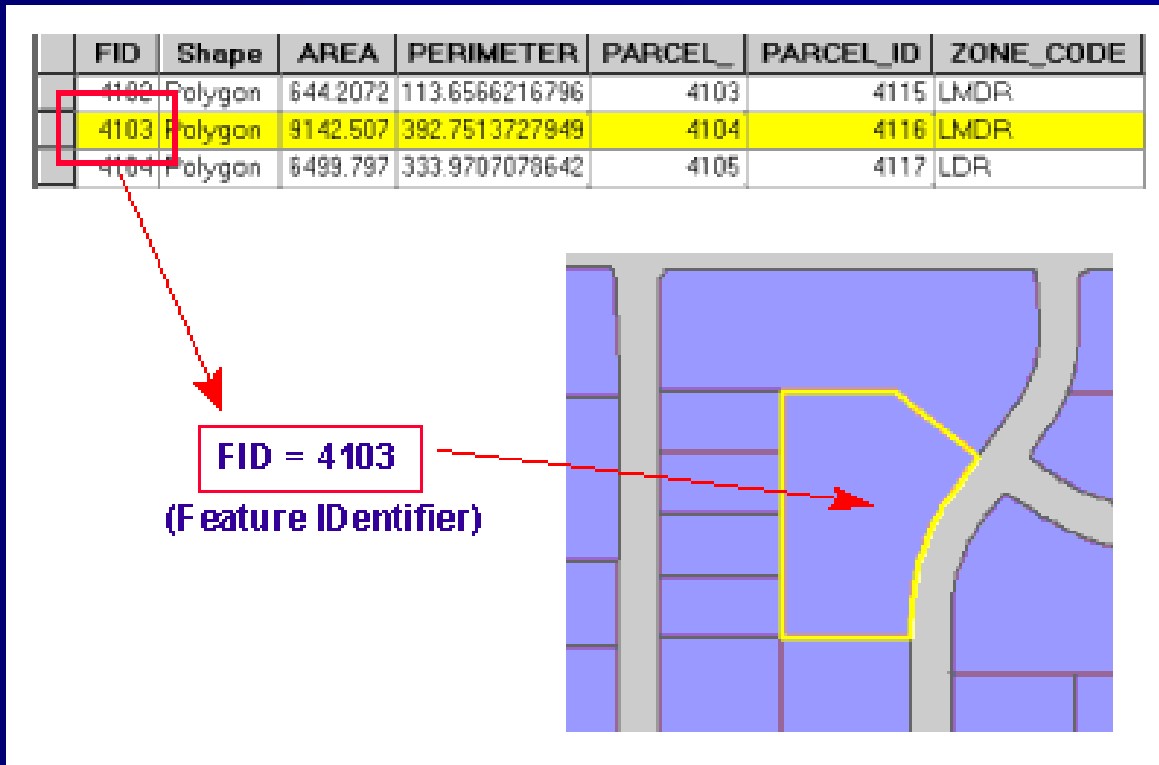
At DHR/DPH we use ESRI's ArcSDE software to store our geographic layers.

From many sources, the layers are processed and updated as needed. Each layer includes federally compliant metadata, or documentation. Map layers can be linked to tabular data, such as demographics.



GIS data models use points, lines, and polygons, or grid cells, that have associated attributes.

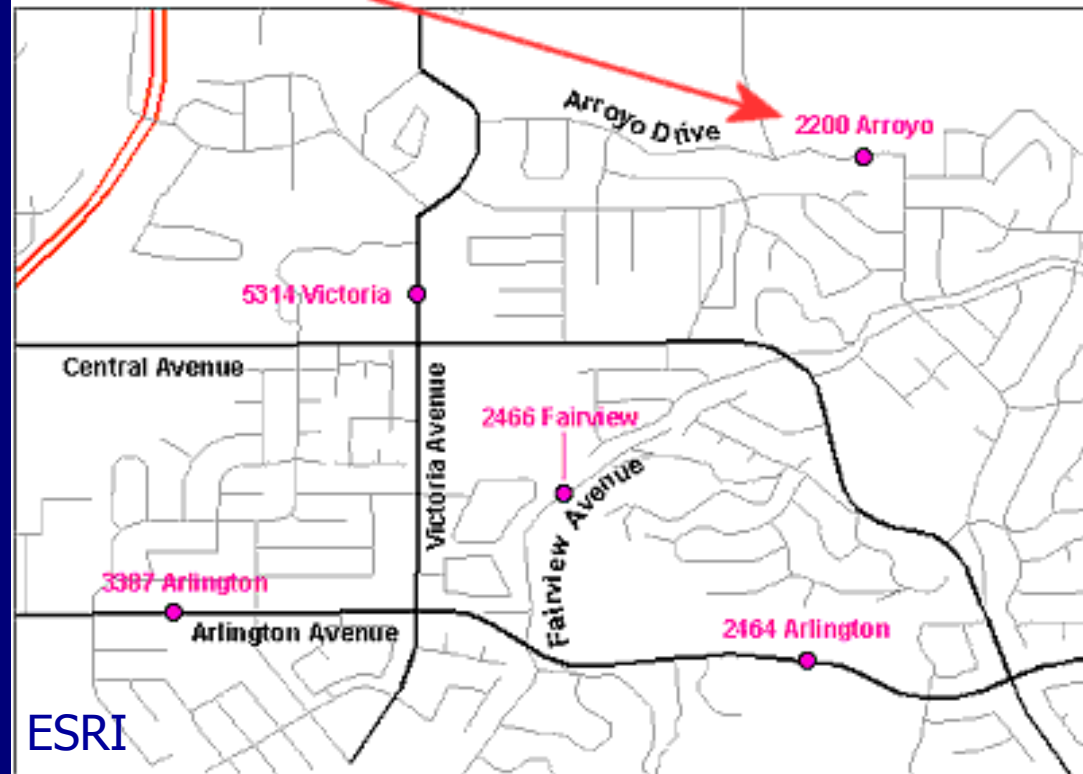
The example here shows polygon features in a parcel theme. Attributes associated with each polygon, such as **PARCEL\_ID**, are stored in a spreadsheet linked to the map.



# Address geocoding: Assigning x and y coordinates to records for mapping

DHR/DPH routinely geocodes vital records, hospital discharge data, and other data sets. In this non-confidential example, a table of addresses is geocoded using a street reference layer.

Address	City	State	Zip
3387 Arlington Avenue	Riverside	California	92506
5314 Victoria Avenue	Riverside	California	92506
2466 Fairview Avenue	Riverside	California	92506
2464 Arlington Avenue	Riverside	California	92506
2200 Arroyo Drive	Riverside	California	92506



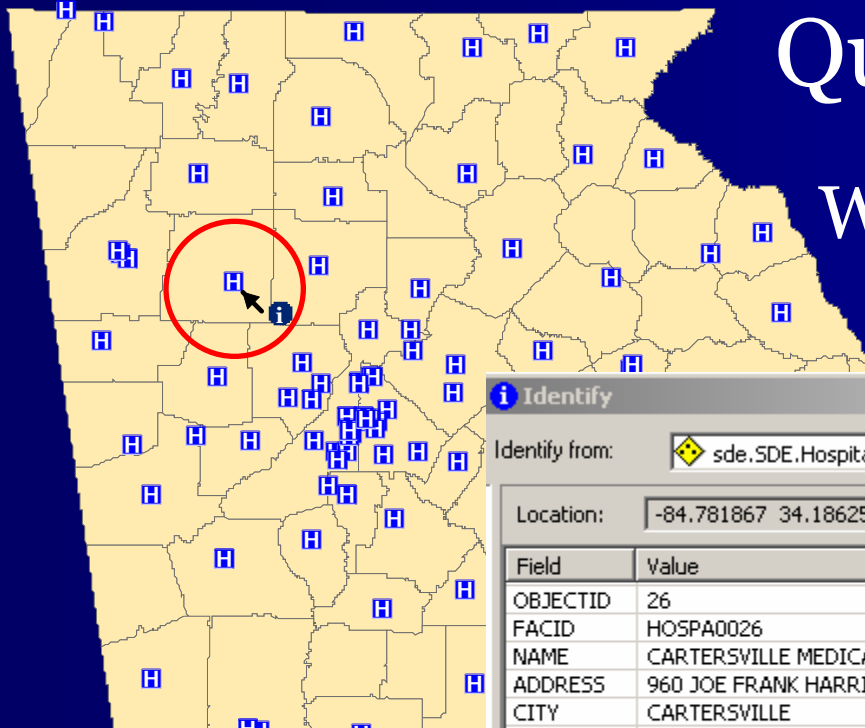
## II. Analysis

GIS offers the ability to analyze data based on geographic, or spatial, characteristics. Analysis can be performed on one map layer or on multiple map layers from diverse sources. The analysis can be visual/qualitative, statistical/quantitative, or a combination of both.

# Examples of Analysis

## Query by Location

What is this hospital?



Identify

Identify from: sde.SDE.Hospitals\_03\_2007

Location: -84.781867 34.186250 Decimal Degrees

Field	Value
OBJECTID	26
FACID	HOSPA0026
NAME	CARTERSVILLE MEDICAL CENTER
ADDRESS	960 JOE FRANK HARRIS PARKWAY
CITY	CARTERSVILLE
STATE	GA
ZIPCODE	30120
TELEPHONE	770387818
FACTYPE	011
COUNTY	BARTOW

Identified 1 feature

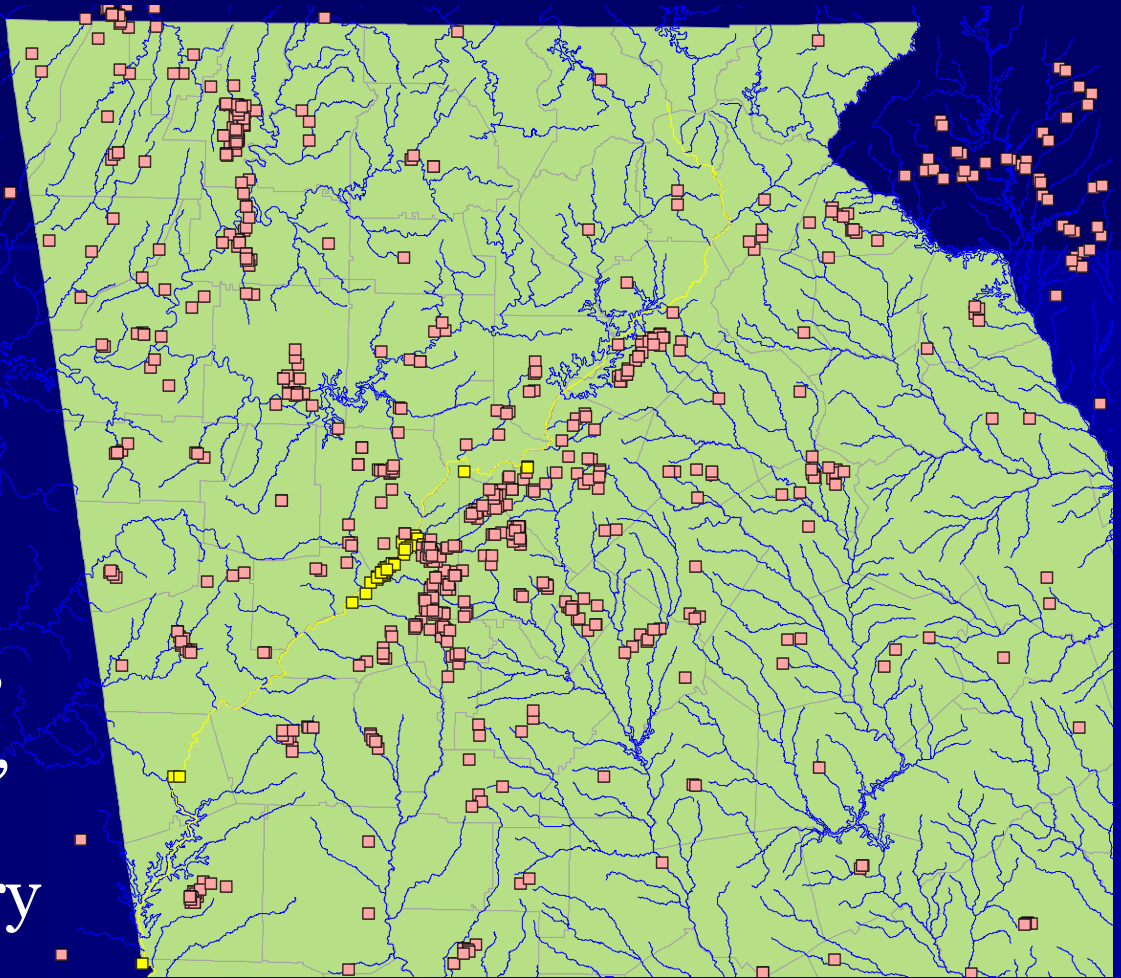
Attributes of  
queried hospital



# Examples of Analysis

## Spatial Query

This example shows three themes, counties of north Georgia, rivers, and Toxic Release Inventory sites defined by the EPA. The Chattahoochee River is displayed in yellow as are those TRI sites located within one mile of the Chattahoochee.



# Examples of Analysis



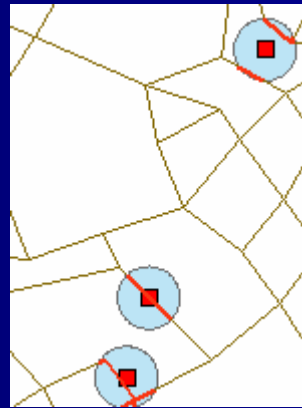
How many nursing homes are within each county?

Spatial Join (aka Point-in-Polygon) to determine county within which each nursing home is located, then Table Summary to get count.

COUNTY	COUNT
Fulton	23
DeKalb	17
Chatham	14
Cobb	13
Bibb	11
Gwinnett	11
Richmond	11
Baldwin	8
Floyd	7
Muscogee	7

# Examples of Analysis

Estimate motor vehicle-generated benzene emissions within 300 meters of the homes of children diagnosed with a specific illness



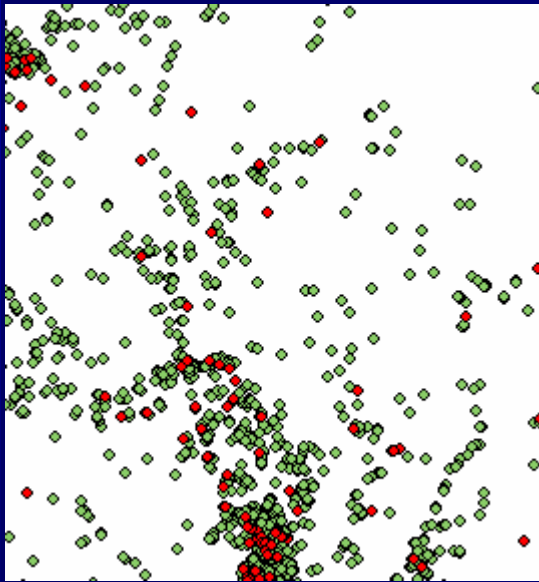
Buffer, Overlay (Intersect), and Table Calculations

Benzene	Total Length	Buffer Length	Proportion	Proportion Benzene
40776.379	653.800858	79.498812	0.121595	4958.197344
41063.535	653.800858	79.498812	0.121595	4993.114033
81839.914	825.325868	62.643049	0.075901	6211.730319

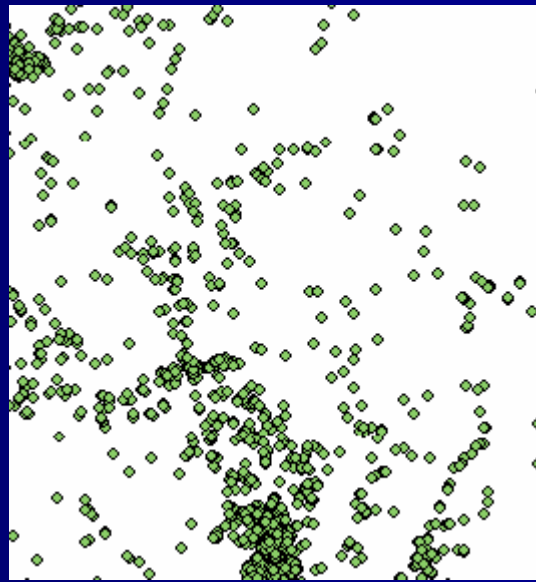
# Examples of Analysis

How do the distributions of births and fetal deaths compare?

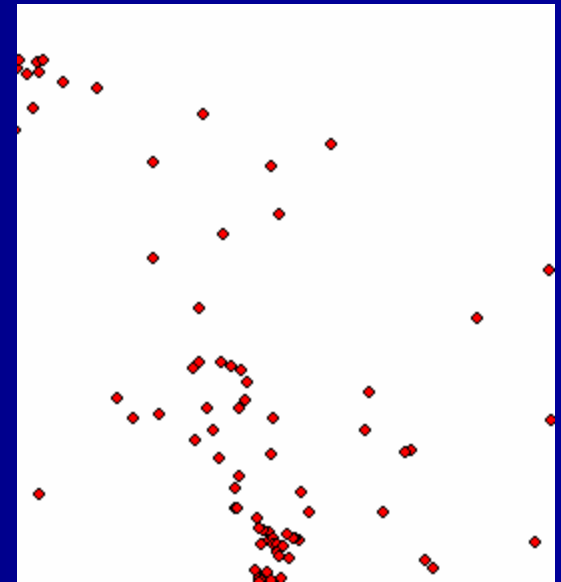
## Visual Analysis



Births and Fetal Deaths  
by Mother's Residence



Births



Fetal Deaths

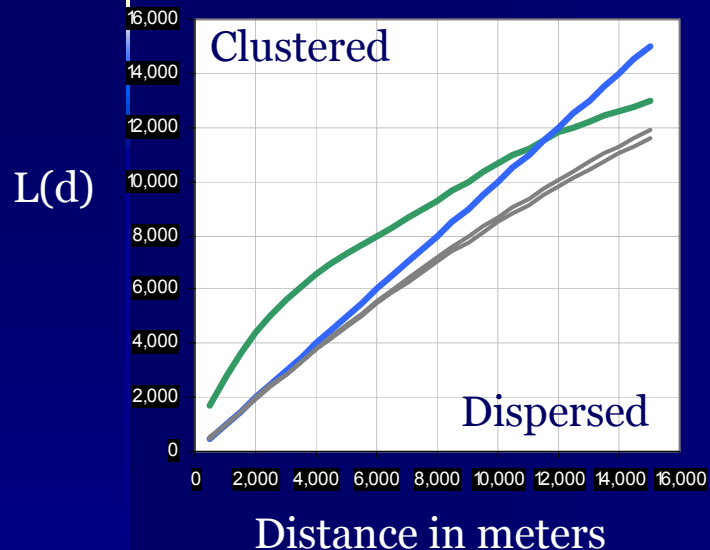
How do the distributions of births and fetal deaths compare?

Spatial Statistical Analysis  
using Multi-Distance Spatial Cluster Analysis  
(Ripleys K-Function)

The K-function measures clustering of points at multiple distances around each point.

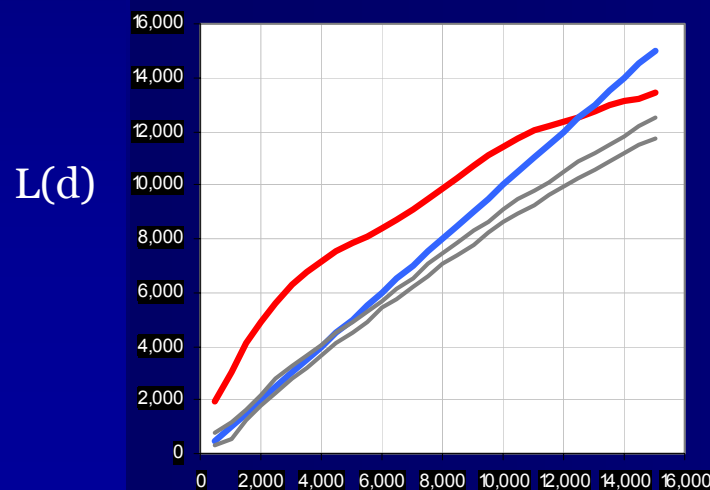
K values are transformed to  $L(d)$  so that for any distance, the expected value is the distance itself. This transformation enables comparison of different distributions within the same study area.

# How do the distributions of births and fetal deaths compare?



Births

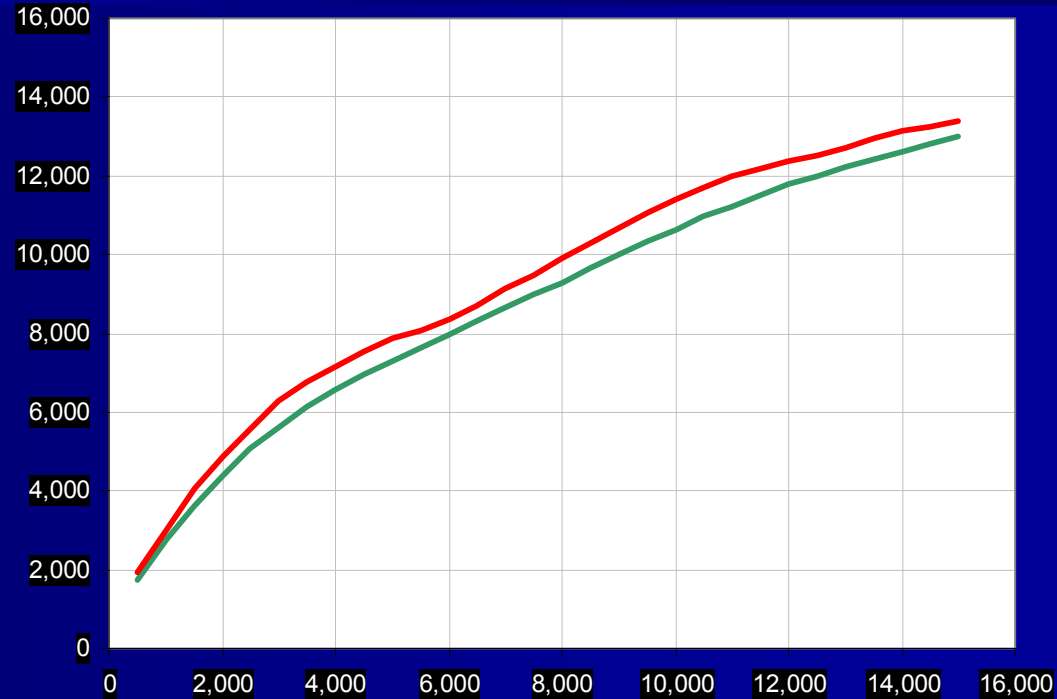
Births and fetal deaths are significantly clustered to about 12,000 meters as demonstrated in the graphs. The observed  $L(d)$ s are greater than expected and they exceed their respective upper confidence limits.



Fetal Deaths

# How do the distributions of births and fetal deaths compare?

Fetal deaths (red) are slightly more clustered than births (green). This probably indicates that some factor other than birth density is causing the pattern.



*ESRI Guide to GIS to GIS Analysis  
Volume 2: Spatial Measurements  
and Statistics*

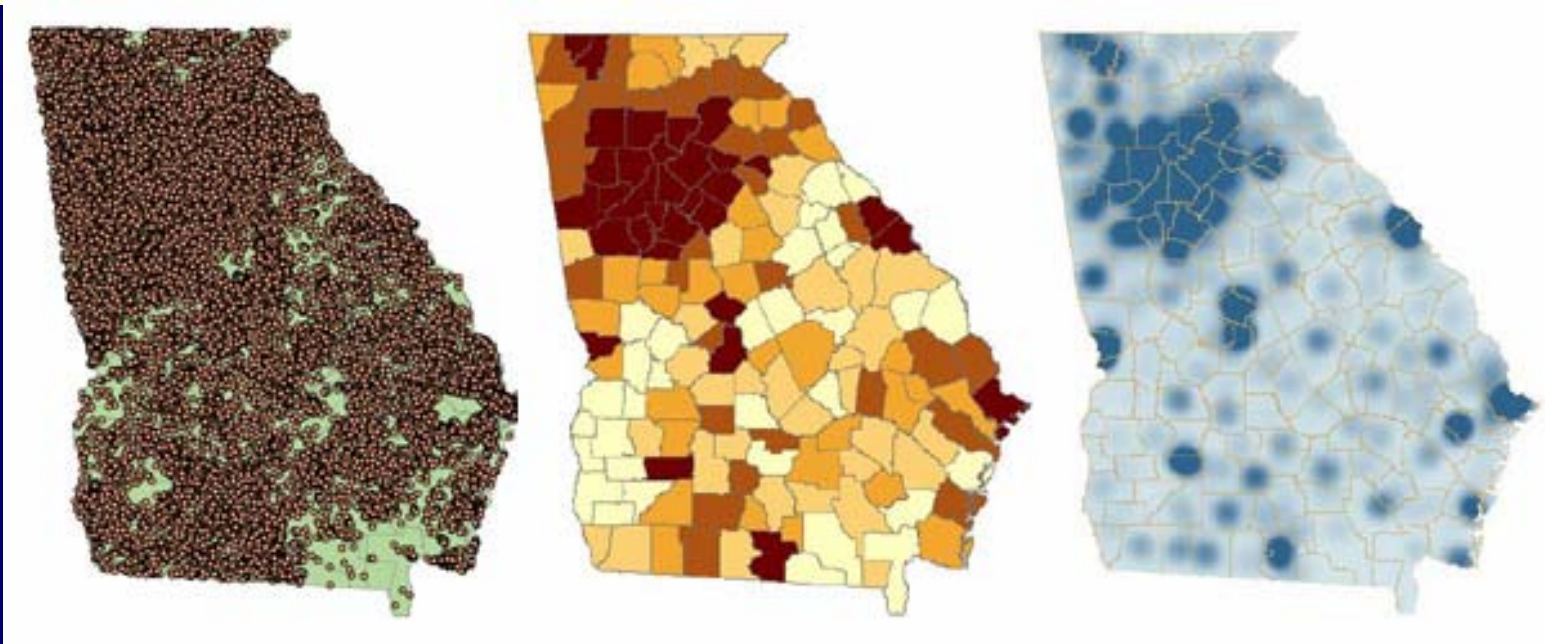
### III. Mapping for Presentation

- Presentation maps are not required for some GIS analysis, such as E-911 operations. Often, however, display maps are necessary.

The following pages show some map examples. Additional DHR/DPH examples are linked from: <http://health.state.ga.us/programs/ohip/gis.asp>.

# Mapping Examples

## Three ways to map the same data

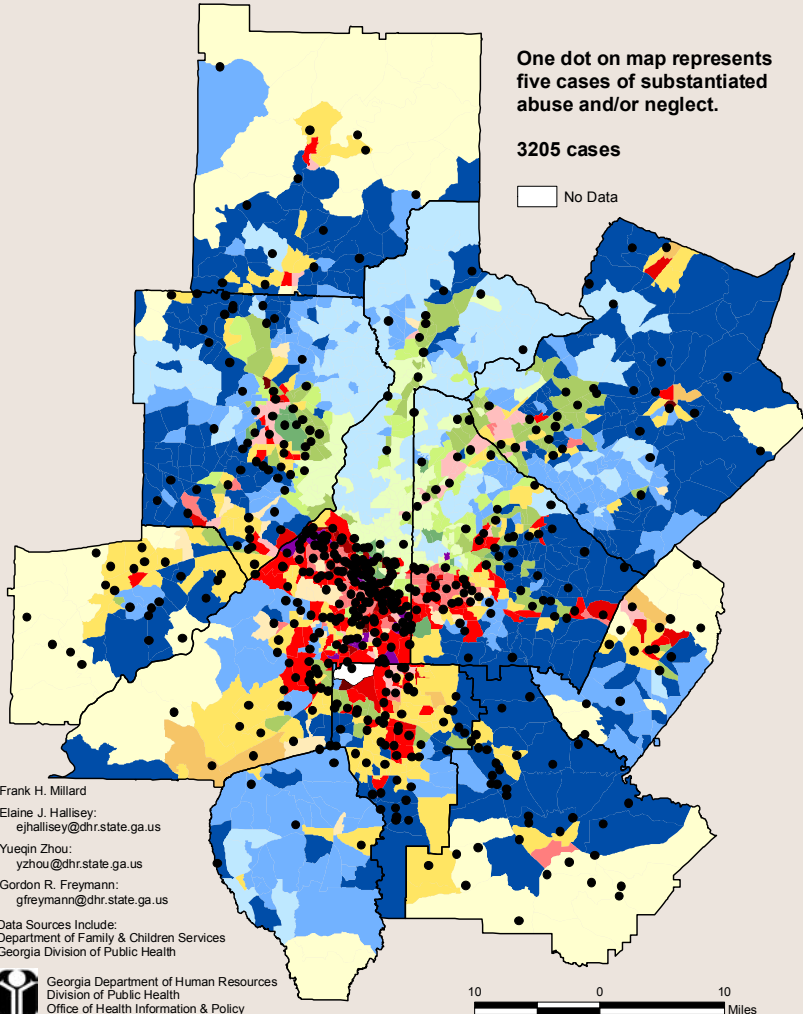


Individual points

Enumeration units, such as census tracts, counties, or public health districts, with aggregated point totals or calculated rates, percentages, densities, etc. (e.g. births per square mile by county)

“Surfaces” with point densities calculated (e.g. births per square mile as calculated directly from points)

# Demographic Clusters and Substantiated Infant Abuse and Neglect Atlanta, 2000-2002

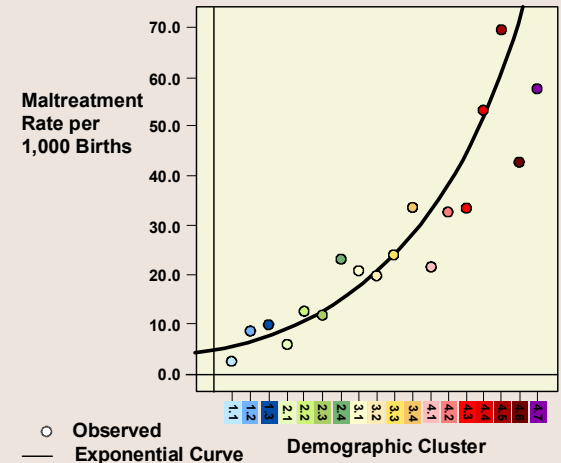


## Demographic Clusters from Highest to Lowest Socioeconomic Status

- 1.1 Georgia's wealthiest cluster is primarily populated by "new money" executives and professionals living in tract mansions of metropolitan suburbs and exurbs. Predominantly white with a high index for Asians, this highly educated cluster is composed of married couples in their 40s and early 50s with adolescent children.
- 1.2 This well-educated, suburban cluster, dominated by professionals and managers, has the second highest level of affluence in the state. Mostly white with a high index for Asians, they are older than cluster 1.1 and include married couples with adolescent and grown children.
- 1.3 Found in the metro suburbs, this mixed-ethnicity, more youthful cluster is populated by married couples in their 30s and early 40s with young children. The majority has some college or are college graduates. Most are employed in managerial and other white collar jobs, while some are high-earning blue collar families. This cluster enjoys a median income well above the state average.
- 2.1 This cluster is characterized by its high concentration of highly educated young people in their late 20s and 30s renting in upscale urban neighborhoods. Dominated by white and Asian married couples without children, this cluster is positioned to join prosperous families in the next decade.
- 2.2 This cluster is primarily populated by people in their late 30s and early 40s and older people over 65. A mixed-ethnicity group, they live in rented apartments and condos in urban areas, and although many are college educated, their median incomes are well below cluster 1.3 and 2.1. Children are not highly represented in this cluster.
- 2.3 This is a very young cluster of mixed ethnicity living in middle-range value apartments in urban/suburban areas. Many are college educated or have some college, and their income is exactly the state average. They have an elevated index for single parent families with children, although the population under 18 is small.
- 2.4 This mixed-ethnicity cluster represents the college, military and prison populations in Georgia (those populations living in group quarters). They are mostly under 24 years of age and have lower incomes than the state average.
- 3.1 This cluster is a white, middle class rural cluster dominated by married families with children. They are mainly home owners, but the value of their housing is much lower than in urban areas. Many in this cluster are high school graduates; but they are higher than the state average in population that failed to graduate from high school. The cluster is highly represented in farming and construction and is widespread across the state.
- 3.2 Although this cluster includes younger populations, it is dominated by the 35+ age group. Found predominantly in N/NE rural counties of Georgia, the cluster is white with some African-American population. As would be expected of a population with many persons living on fixed incomes, this cluster has lower income than families currently working; but their incomes are still average compared to the state.
- 3.3 This mixed-ethnicity cluster is average in its age profile, but has a higher percentage of single parent families than the state as a whole. A large percent did not finish high school and they are much less likely to have a 4-year college degree. Approaching the state average in income, these families work in lower paying service, sales and managerial jobs to maintain a lower middle class lifestyle.
- 3.4 Composed of rural married and single parent families, this cluster is older than cluster 3.1 and less affluent. Predominantly white with some African-American population, this group is much more likely to own low value housing, not to have finished high school, and to work in farming.

- 4.1 This cluster is composed of newly arrived immigrants to the United States. Primarily Hispanic, the cluster is young and not well educated. Dominated by single households, but with a substantial percentage of married families with children, this urban population lives in rental housing, is below average in income, and works in service, construction and processing industries.
- 4.2 An urban cluster, this African-American group has a high representation of elderly people and single parent families with children. Not well educated and with lower than average incomes, this group lives in areas with high vacant housing and low housing values. Although poor, this cluster also demonstrates social stability with almost 60% showing home ownership and 30% being married family households.
- 4.3 This is a young cluster with a high proportion under 24 years of age. Primarily African-American and with a high index for Hispanics, this cluster is characterized by singles and single parent families with children living in urban/suburban rental units. They work in service jobs and their income is more than 30% below the state average.
- 4.4 Found in old mill towns in suburban and rural areas, this cluster is composed predominantly of African-American married families and single parents with children. The population is skewed to the very old and very young. They are primarily renters, have high school or less than high school educations and work in service industries—making half the state average in income.
- 4.5 This African-American cluster is much like cluster 4.4, but is more urban, older, less educated, and lower in income. They are more likely than 4.4 to live in rental units.
- 4.6 This is a very small and unusual urban cluster. It is dominated by an African-American population with a high percentage of whites. The cluster is more than twice the state average in population over 65 and has very few children. Oddly, this cluster has more males than females for the ages 18-54. The group lives in rental units, is very poorly educated and experiences very low income.
- 4.7 This is a very young African-American cluster composed of single parent families with children. The population less than 18 is very high, and there is almost no elderly population. The cluster is poorly educated, lives in rental units and has the lowest median income in the state.

## Relationship between Demographic Clusters and Child Maltreatment



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