**Chakraborty, J. and Armstrong, M.P. (2001). Assessing the impact of airborne toxic release on populations with special needs. Professional Geographer, 53(1):119-131.**

# Background

- USEPA Risk Management Program: offsite consequences of accidental release of regulated substances need to be analyzed.
- Environmental justice movement: studies the disproportionate distribution of risk on people and places.

# Objectives

- Assess the potential exposure of people with special needs to accidental release of hazardous chemicals.
- Target population groups: people with physical disabilities and health concerns
- Study area: Cedar Rapid metropolitan, Iowa

# Methods Overview

Potential exposure model
- Spatial unit of vulnerable area
  - Administrative units
  - Circular buffer
  - Dispersion model output

Population model
- Spatial unit of population distribution
  - Census units
  - Individual locations

Overlay analysis
- Mismatch of spatial units – areal interpolation

Spatial pattern analysis
- Spatial randomization

# Methods

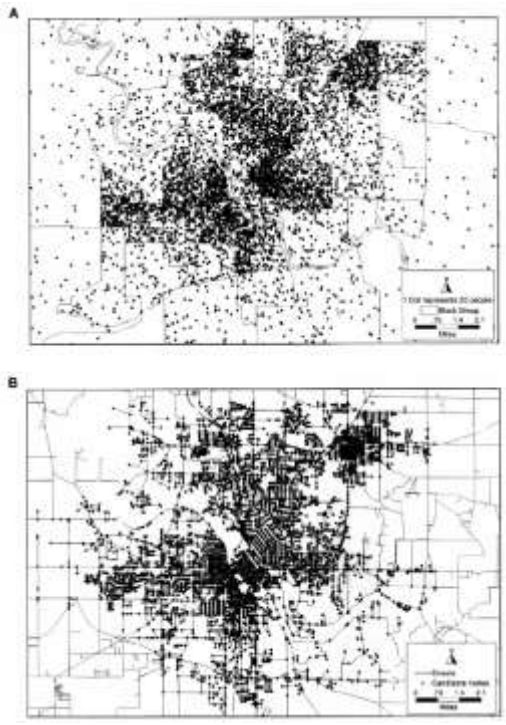
- Geocoding
  - EHS facilities
  - Self-identified individuals with special needs
- Geographic masking
  - Affine transformation
  - Random perturbation
  - Aggregation

# Methods (cont.)

- Chemical Dispersion Model (ALOHA)
  - Worst-case release
  - Specified weather condition
  - Buffer distance (IDLH)
- Exposure risk analysis
  - Summarizing using point-in-polygon (554)
- Spatial distribution of SNP

# Measurement of Disproportion

- Observed pattern
  - Locations of 903 individuals
- Candidate locations for neutral pattern
  - Based on street nodes (6260 points)
  - Node densities are strongly positively correlated to census block group population density
  - Randomly selected 1000 sets of 903 nodes
  - Summarizing using point-in-polygon



# Results

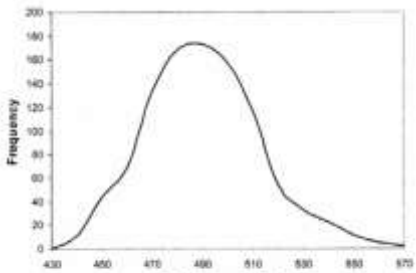
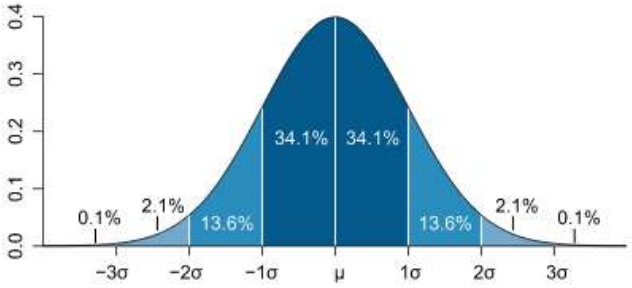



***Table 2*** *Analysis of Disproportionate Impacts Based on 1,000 Randomly Simulated Location Patterns of the Special Needs Population.*

| Number of Vulnerable Zones | Population at Risk* ($P_{obs}$) | Population at Risk in Simulated Location Patterns ($P_{exp}$) | | | | |
|---|---|---|---|---|---|---|
| | | Max | Min | Mean | Patterns with $P_{exp} < P_{obs}$ | Significance Level |
| At least 1 | 554 | 567 | 436 | 493 | 996 | 99.6% |
| 2 or more | 341 | 368 | 259 | 311 | 982 | 98.2% |
| 3 or more | 257 | 284 | 182 | 228 | 971 | 97.1% |
| 4 or more | 140 | 161 | 89 | 120 | 963 | 96.3% |

** Based on assignment to nearest TIGER/Line file node.*

# Normal Distribution

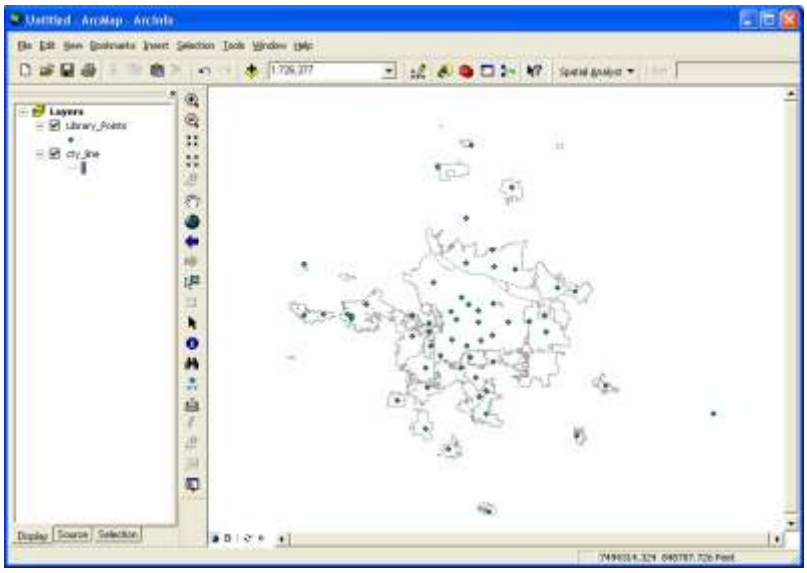


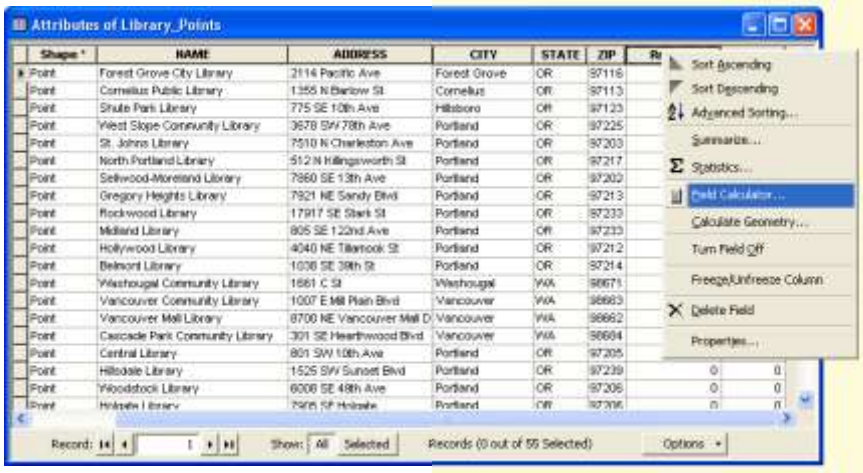

- PDF: Probability Distribution Function of a random variable.
- 68.2% within +/- one standard deviation of the mean
- 95.4% within +/- two StDev of the mean
- 99.6% within +/- three StDev of the mean

# Comments/Critiques

- Historical weather data not used
- Buffer Distance (IDLH) not adjusted for people with physical conditions.
- Possibility vs. probability

# Randomization




Attributes of Library_Points
Shape * | NAME | ADDRESS | CITY | STATE | ZIP
Point | Forest Grove City Library | 2114 Pacific Ave | Forest Grove | OR | 97116
Point | Cornelius Public Library | 1355 N Barlow St | Cornelius | OR | 97113
Point | Shute Park Library | 775 SE 10th Ave | Hillsboro | OR | 97123
Point | West Slope Community Library | 3678 SW 78th Ave | Portland | OR | 97225
Point | St. Johns Library | 7510 N Charleston Ave | Portland | OR | 97203
Point | North Portland Library | 512 N Killingsworth St | Portland | OR | 97217
Point | Sellwood-Moreland Library | 7860 SE 13th Ave | Portland | OR | 97202
Point | Gregory Heights Library | 7921 NE Sandy Blvd | Portland | OR | 97213
Point | Rockwood Library | 17917 SE Stark St | Portland | OR | 97233
Point | Midland Library | 805 SE 122nd Ave | Portland | OR | 97233
Point | Hollywood Library | 4040 NE Tillamook St | Portland | OR | 97212
Point | Belmont Library | 1038 SE 39th St | Portland | OR | 97214
Point | Washougal Community Library | 1661 C St | Washougal | WA | 98671
Point | Vancouver Community Library | 1007 E Mill Plain Blvd | Vancouver | WA | 98663
Point | Vancouver Mall Library | 8700 NE Vancouver Mall D | Vancouver | WA | 98662
Point | Cascade Park Community Library | 301 SE Heartherwood Blvd | Vancouver | WA | 98684
Point | Central Library | 801 SW 10th Ave | Portland | OR | 97205
Point | Hillsdale Library | 1525 SW Sunset Blvd | Portland | OR | 97239
Point | Woodstock Library | 6008 SE 48th Ave | Portland | OR | 97206
Sort Ascending
Sort Descending
Advanced Sorting...
Summarize...
Statistics...
Field Calculator...
Calculate Geometry...
Turn Field Off
Freeze/Unfreeze Column
Delete Field
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Record:
Show:
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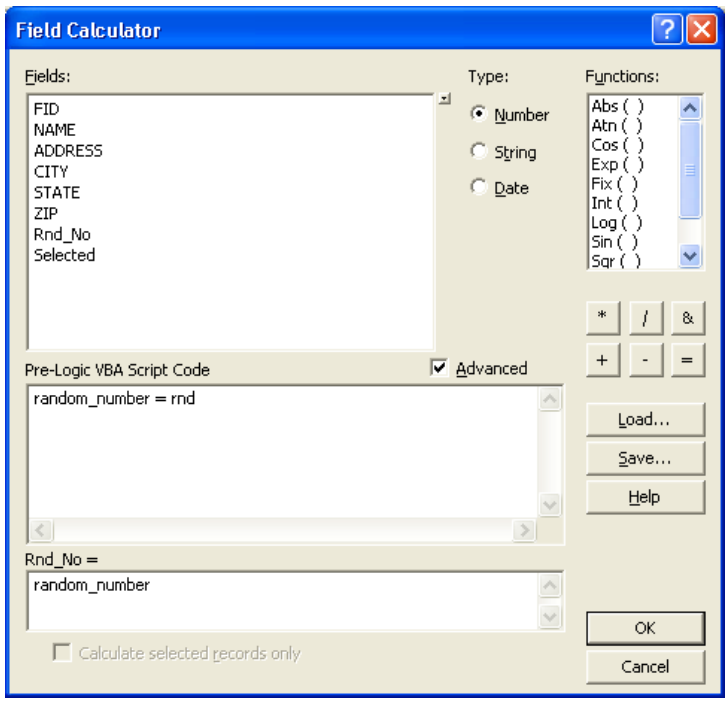
Records (0 out of 55 Selected)
Options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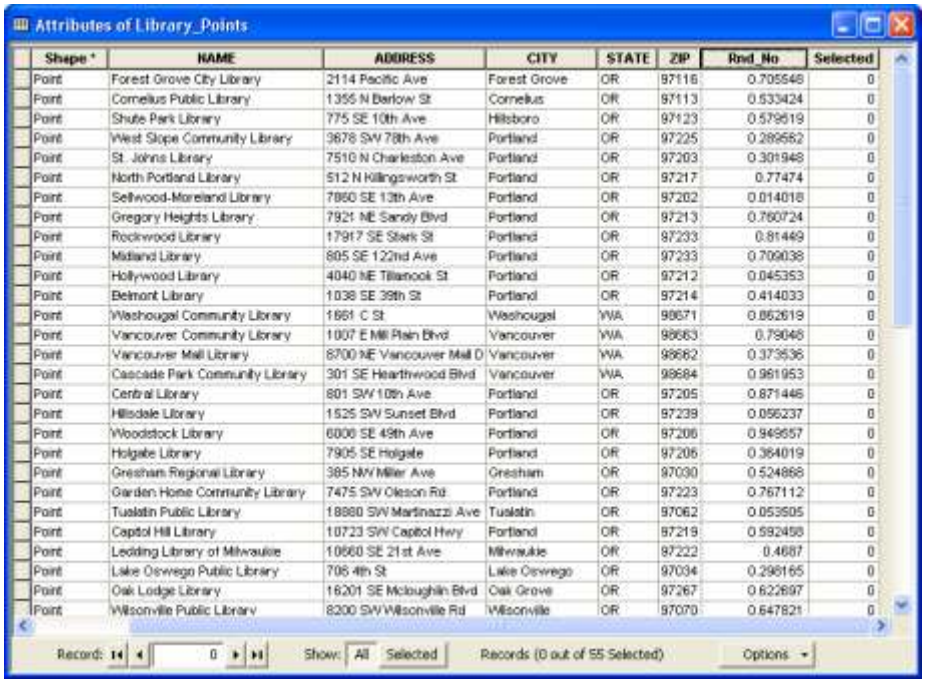

Attributes of Library_Points

| Shape * | NAME | ADDRESS | CITY | STATE | ZIP | Rnd_No | Selected |
|---|---|---|---|---|---|---|---|
| Point | Forest Grove City Library | 2114 Pacific Ave | Forest Grove | OR | 97116 | 0.705548 | 0 |
| Point | Cornelius Public Library | 1355 N Barlow St | Cornelius | OR | 97113 | 0.533424 | 0 |
| Point | Shute Park Library | 775 SE 10th Ave | Hillsboro | OR | 97123 | 0.579519 | 0 |
| Point | West Slope Community Library | 3678 SW 78th Ave | Portland | OR | 97225 | 0.289562 | 0 |
| Point | St. Johns Library | 7510 N Charleston Ave | Portland | OR | 97203 | 0.301948 | 0 |
| Point | North Portland Library | 512 N Killingsworth St | Portland | OR | 97217 | 0.77474 | 0 |
| Point | Sellwood-Moreland Library | 7860 SE 13th Ave | Portland | OR | 97202 | 0.014018 | 0 |
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| Point | Midland Library | 805 SE 122nd Ave | Portland | OR | 97233 | 0.709038 | 0 |
| Point | Hollywood Library | 4040 NE Tillamook St | Portland | OR | 97212 | 0.045353 | 0 |
| Point | Belmont Library | 1038 SE 39th St | Portland | OR | 97214 | 0.414033 | 0 |
| Point | Washougal Community Library | 1661 C St | Washougal | WA | 98671 | 0.862619 | 0 |
| Point | Vancouver Community Library | 1007 E Mill Plain Blvd | Vancouver | WA | 98663 | 0.79048 | 0 |
| Point | Vancouver Mall Library | 8700 NE Vancouver Mall D | Vancouver | WA | 98662 | 0.373536 | 0 |
| Point | Cascade Park Community Library | 301 SE Hearthwood Blvd | Vancouver | WA | 98684 | 0.961953 | 0 |
| Point | Central Library | 801 SW 10th Ave | Portland | OR | 97205 | 0.871446 | 0 |
| Point | Hillsdale Library | 1525 SW Sunset Blvd | Portland | OR | 97239 | 0.056237 | 0 |
| Point | Woodstock Library | 6008 SE 49th Ave | Portland | OR | 97206 | 0.949557 | 0 |
| Point | Holgate Library | 7905 SE Holgate | Portland | OR | 97206 | 0.364019 | 0 |
| Point | Gresham Regional Library | 385 NW Miller Ave | Gresham | OR | 97030 | 0.524868 | 0 |
| Point | Garden Home Community Library | 7475 SW Oleson Rd | Portland | OR | 97223 | 0.767112 | 0 |
| Point | Tualatin Public Library | 18880 SW Martinazzi Ave | Tualatin | OR | 97062 | 0.053505 | 0 |
| Point | Capitol Hill Library | 10723 SW Capitol Hwy | Portland | OR | 97219 | 0.592458 | 0 |
| Point | Ledding Library of Milwaukie | 10660 SE 21st Ave | Milwaukie | OR | 97222 | 0.4687 | 0 |
| Point | Lake Oswego Public Library | 706 4th St | Lake Oswego | OR | 97034 | 0.298165 | 0 |
| Point | Oak Lodge Library | 16201 SE Mcloughlin Blvd | Oak Grove | OR | 97267 | 0.622897 | 0 |
| Point | Wilsonville Public Library | 8200 SW Wilsonville Rd | Wilsonville | OR | 97070 | 0.647821 | 0 |

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Attributes of Library_Points

| Shape * | NAME | ADDRESS | CITY | STATE | ZIP | Rnd_No | Selected |
|---|---|---|---|---|---|---|---|
| Point | Sellwood-Moreland Library | 7860 SE 13th Ave | Portland | OR | 97202 | 0.014018 | 1 |
| Point | Cedar Mill Community Library | 12505 NW Cornell Rd | Portland | OR | 97229 | 0.015704 | 1 |
| Point | Hollywood Library | 4040 NE Tillamook St | Portland | OR | 97212 | 0.045353 | 1 |
| Point | Ridgefield Community Library | 210 N Main Ave | Ridgefield | WA | 98642 | 0.045649 | 1 |
| Point | Tualatin Public Library | 18880 SW Martinazzi Ave | Tualatin | OR | 97062 | 0.053505 | 1 |
| Point | Hillsdale Library | 1525 SW Sunset Blvd | Portland | OR | 97239 | 0.056237 | 1 |
| Point | Tuality Health Resource Center | 334 SE 8th Ave | Hillsboro | OR | 97123 | 0.100052 | 1 |
| Point | Oregon College of Art & Craft | 8245 SW Barnes Rd | Portland | OR | 97225 | 0.103023 | 1 |
| Point | Beaverton City Library | 12375 SW 5th | Beaverton | OR | 97005 | 0.10637 | 1 |
| Point | Sherwood Public Library | 22560 SW Pine St | Sherwood | OR | 97140 | 0.226866 | 1 |
| Point | Fairview-Columbia Library | 1520 NE Village St | Fairview | OR | 97024 | 0.243931 | 1 |
| Point | Canby Public Library | 292 N Holly St | Canby | OR | 97013 | 0.263793 | 1 |
| Point | Clackamas Corner Branch | 11750 SE 82nd Ave | Portland | OR | 97266 | 0.279342 | 1 |
| Point | La Center Community Library | 1402 E Lockwood Creek R | La Center | WA | 98629 | 0.28448 | 1 |
| Point | West Slope Community Library | 3678 SW 78th Ave | Portland | OR | 97225 | 0.289562 | 1 |
| Point | Three Creeks Community Library | 800-C NE Tenney Rd | Vancouver | WA | 98685 | 0.295773 | 1 |
| Point | Lake Oswego Public Library | 706 4th St | Lake Oswego | OR | 97034 | 0.298165 | 1 |
| Point | SW Washington Medical Center | 400 NE Mother Joseph Pl | Vancouver | WA | 98664 | 0.30097 | 1 |
| Point | St. Johns Library | 7510 N Charleston Ave | Portland | OR | 97203 | 0.301948 | 1 |
| Point | Holgate Library | 7905 SE Holgate | Portland | OR | 97206 | 0.364019 | 1 |
| Point | Vancouver Mall Library | 8700 NE Vancouver Mall D | Vancouver | WA | 98662 | 0.373536 | 1 |
| Point | Camas Public Library | 625 NE 4th Ave | Camas | WA | 98607 | 0.382011 | 1 |
| Point | Belmont Library | 1038 SE 39th St | Portland | OR | 97214 | 0.414033 | 1 |
| Point | Ledding Library of Milwaukie | 10660 SE 21st Ave | Milwaukie | OR | 97222 | 0.4687 | 1 |
| Point | Gresham Regional Library | 385 NW Miller Ave | Gresham | OR | 97030 | 0.524868 | 1 |
| Point | Cornelius Public Library | 1355 N Barlow St | Cornelius | OR | 97113 | 0.533424 | 0 |
| Point | Northwest Library | 2300 NW Thurman St | Portland | OR | 97210 | 0.533873 | 0 |
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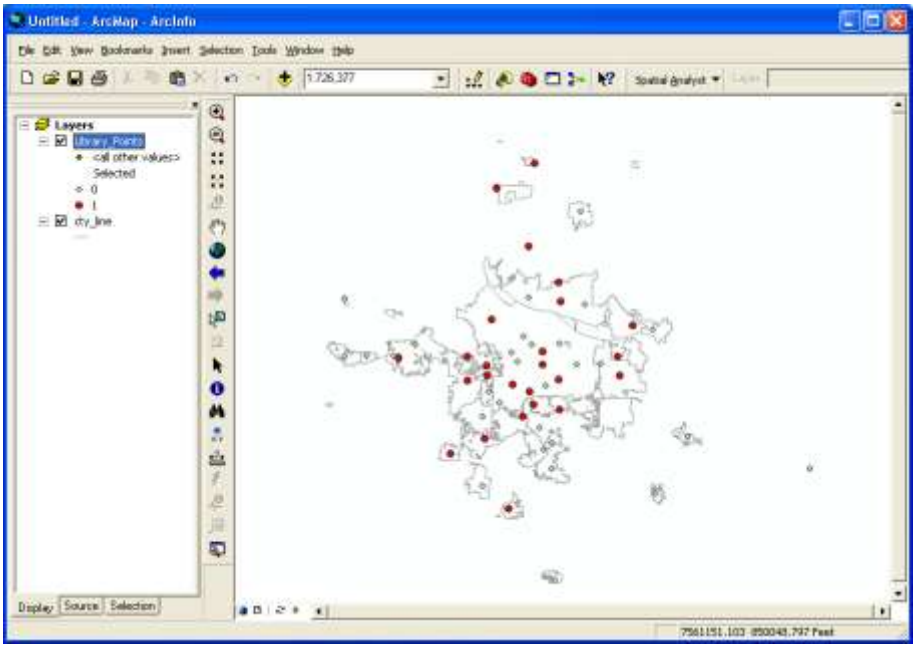
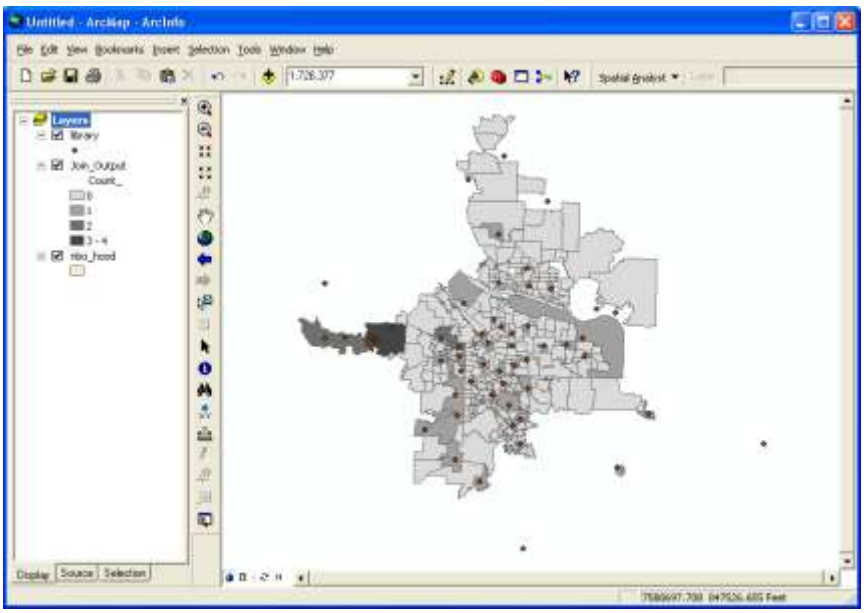
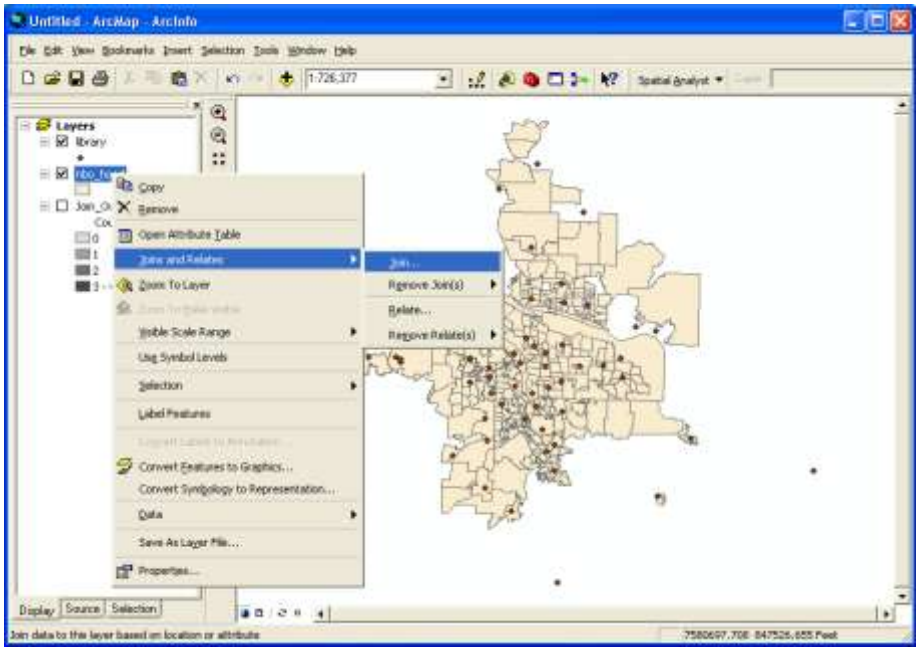



# Count Points in Polygons






# Join by Location