Moving Beyond Maps:
Using Spatial Analysis Methods to Understand Violence and Reentry Issues

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Overview

- The challenge at hand is translating spatial data into useful information for policymakers and service providers

- *CrimeStat III* technology has made complex modeling a realistic option

- The goal is to apply various *CrimeStat* III routines to available data to address important policy questions

Spatial Analysis Techniques

- **Spatial Descriptions:** identifies the pattern of the overall distribution

- **Distance Analysis:** identifies evidence of clustering or 'local' patterns within the overall distribution

- **Hot Spot Analysis:** identifies clusters of incidents

For a detailed description of these methodologies see: http://www.icpsr.umich.edu/CRIMESTAT/

Using Spatial Analysis Techniques to Address Policy Questions

Sample Policy Questions

Where should employment services for returning prisoners be located?

How can we understand of the location of returning prisoners in relation to their employers?

Where should street outreach workers focus their efforts in a community?

Is violence randomly distributed across a community?

Is there a gap in services for returning prisoners?

Data Sources

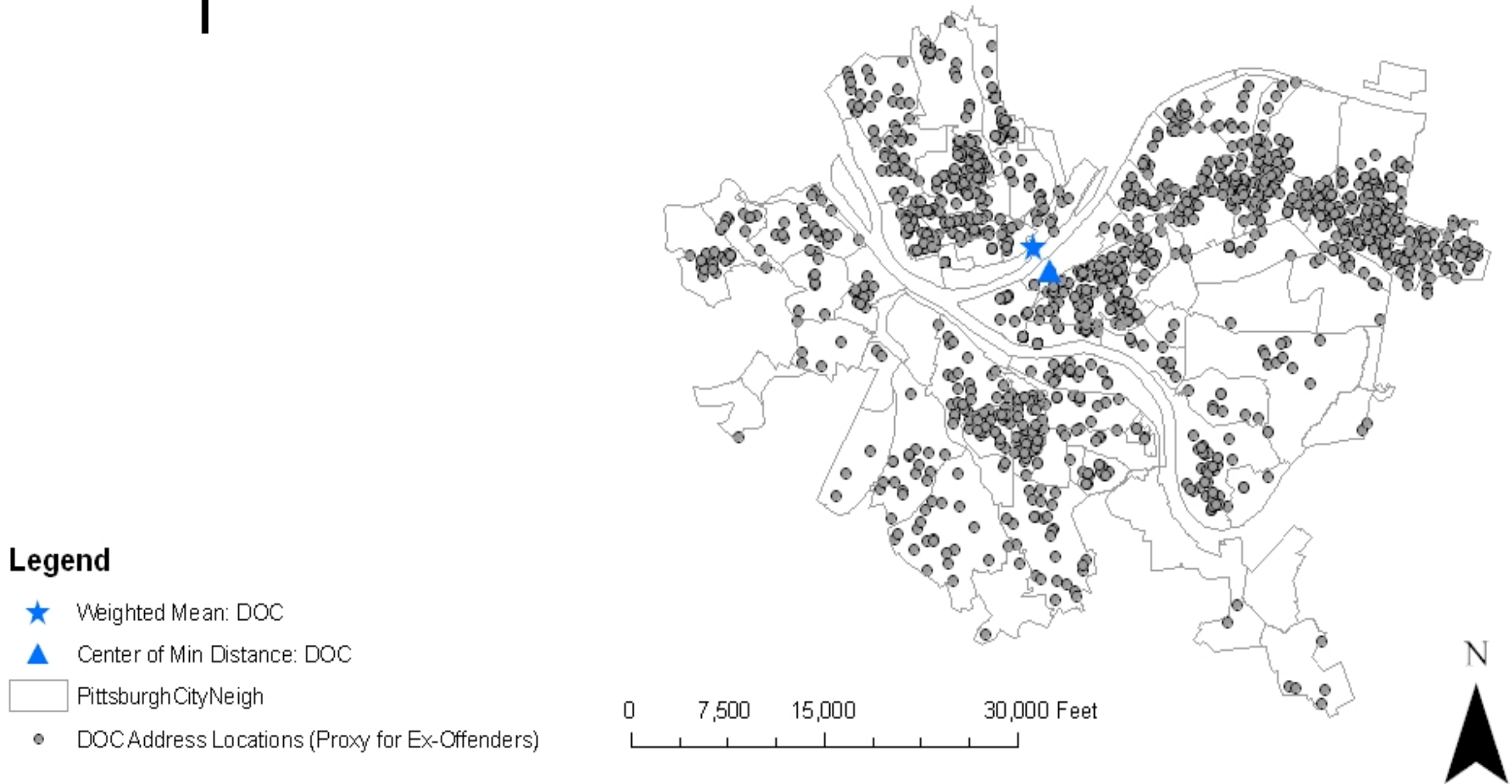| Source	Data Set	Year(s)
Pennsylvania Department of Corrections	Residence data of committed offenders in the Corrections' system at time of admission	2004
Goodwill Industries of Pittsburgh	Residence data of ex-offenders and location of current employers	2004
City of Pittsburgh Police	Incident data on homicides and aggravated assaults with a firearm	2003 to 2006
Allegheny County Bureau of Corrections	Residence data of offenders in the Corrections' system at time of admission	2005
U.S. Census Bureau	Population data	2000

Individual identifying information was removed from the data set before any analysis was conducted.
Erin Dalton geo-coded the data and the *Crime Stat* techniques were applied by Asheley Van Ness.

# Using Spatial Description Techniques to Address Policy Questions

Spatial Description Technique	Sample Policy Questions
weighted mean center and center of minimum distance	Where should employment services for returning prisoners be located?
standard deviation ellipse	How can we understand of the location of returning prisoners in relation to their employers?
weighted mean center, standard deviation distance, standard deviational ellipse	Where should street outreach workers focus their efforts in a community?

Map 1: Center of Minimum Distance; Pittsburgh residences of Department of Corrections inmates (2004)

Legend

★ Weighted Mean: DOC

▲ Center of Min Distance: DOC

▢ Pittsburgh CityNeigh

• DOC Address Locations (Proxy for Ex-Offenders)

0   7,500   15,000   30,000 Feet

N

Sample Policy Question: Where should employment services for returning prisoners be located?

Map 2: Standard Deviation Ellipse; Goodwill Industries' ex-offender clients in Pittsburgh and their respective employers (2005)
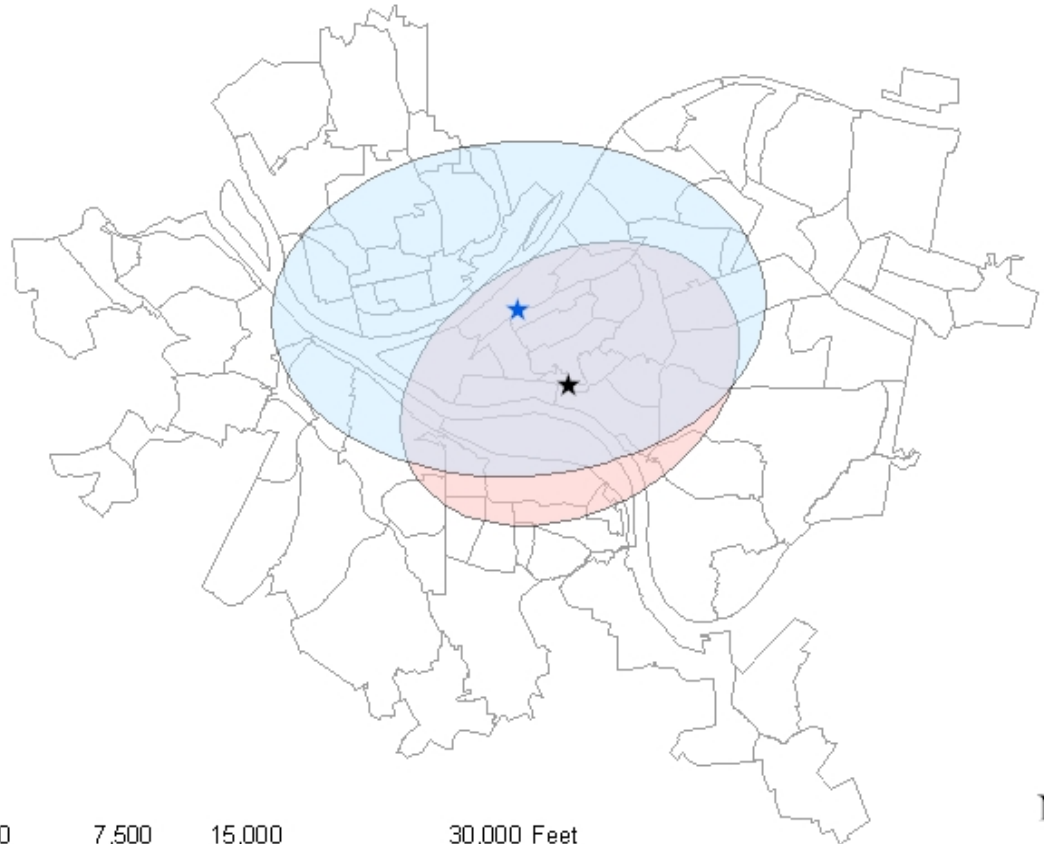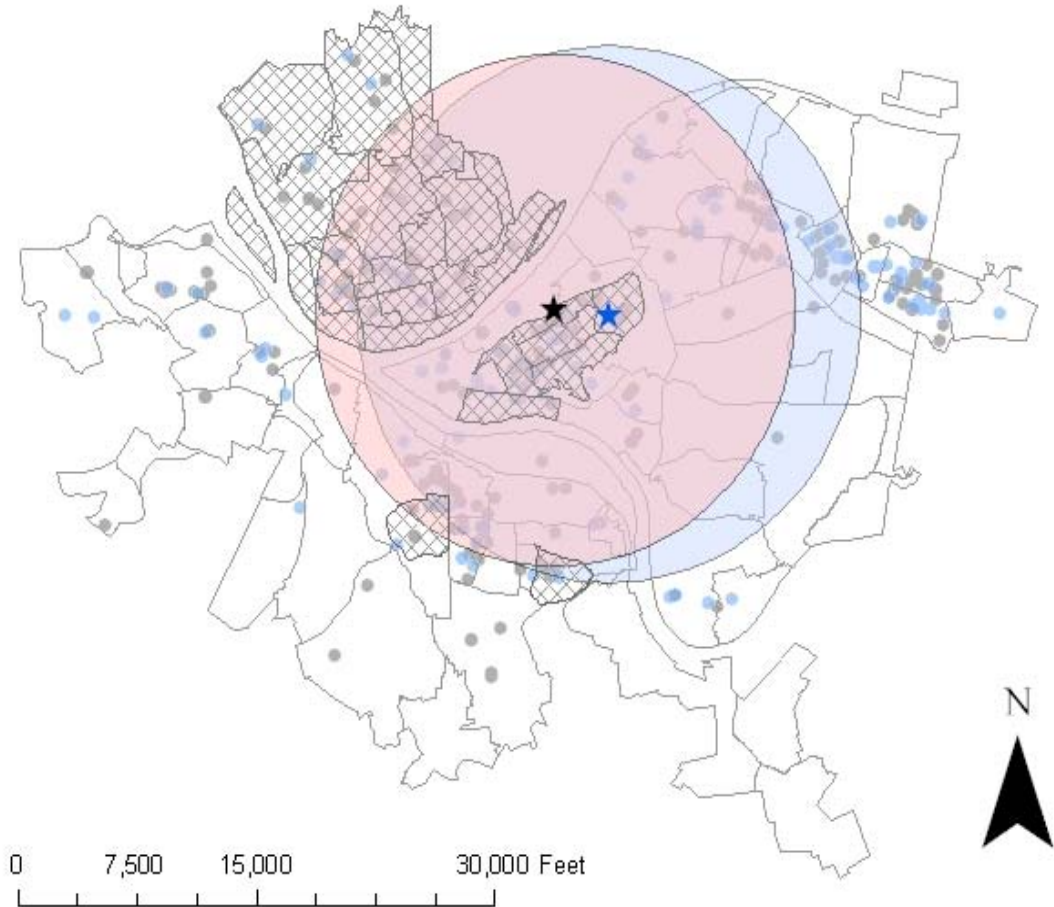

Legend

★ Weighted Mean Center for Ex-Offender Locations

★ Mean Center for Employer Locations

Standard deviation ellipse: Ex-Offenders

Standard deviation ellipse: Employers

Pittsburgh Neighborhoods

0   7,500   15,000   30,000 Feet

N

Sample Policy Question: **How can we understand the location of returning prisoners in relation to their employers?**

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Map 3: Weighted Mean Center; Shootings with and without injury (Day and Night 2006)

Legend

★ Weighted Mean Center: Night
★ Weighted Mean Center: Day
▨ Target Areas 1 - 4
▨ Standard Distance Deviation: Night
▨ Standard Deviation Ellipse: Day
☐ Pittsburgh Neighborhoods
• 2006_Shootings_DAY
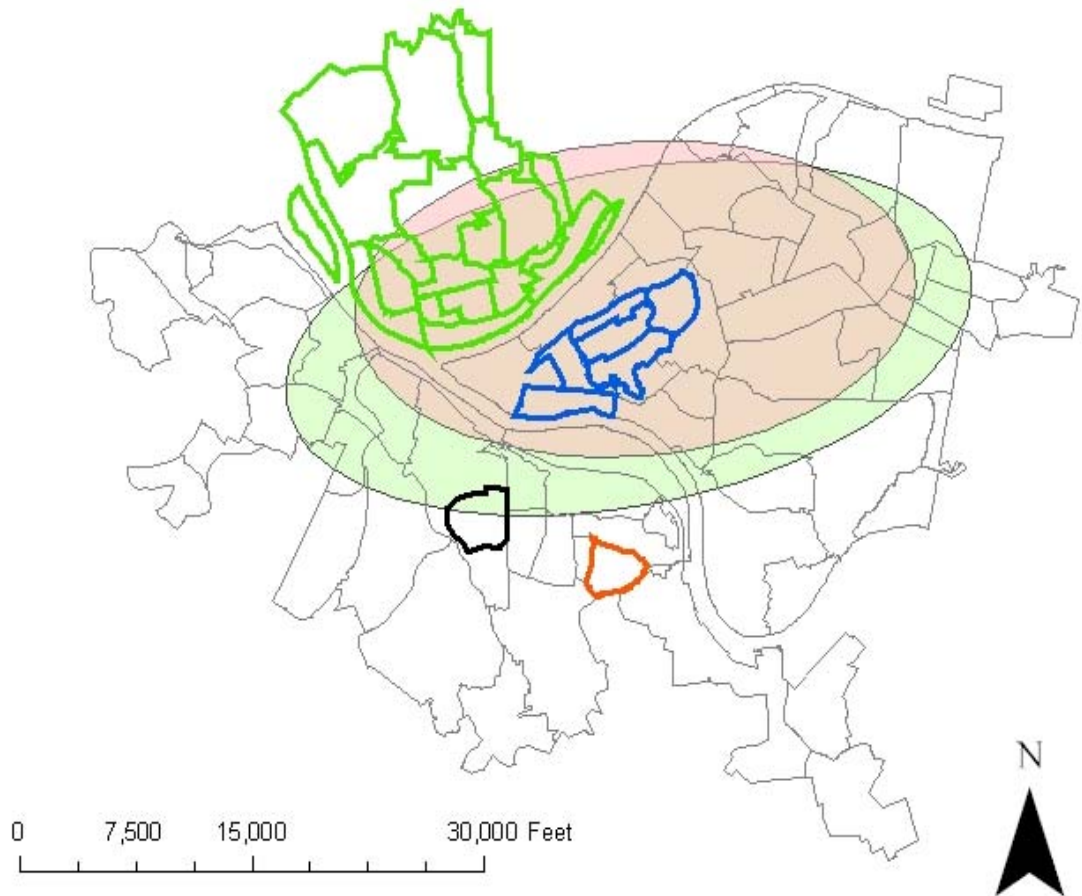• 2006_Shootings_NIGHT

Sample Policy Question: Where should street outreach worker programs focus their efforts?

Map 4: Standard deviation ellipse; Shootings with and without injury (June and July 2004)

Legend

- Target Area 1
- Target Area 2
- Target Area 3
- Target Area 4
- Standard deviation ellipse: June
- Standard deviation ellipse: July
- Pittsburgh Neighborhoods

0   7,500   15,000   30,000 Feet

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Sample Policy Question: **Where should street outreach worker program focus their efforts? (cont'd)**

Using Distance Analysis Techniques to Address Policy Questions

Distance Analysis Technique	Sample Policy Questions
nearest neighbor index and K-order nearest neighbor	Is violence randomly distributed across a community?

Nearest Neighbor Index; Shootings with and without injury (2005 and 2006)

Nearest Neighbor Results

- Nearest Neighbor Index (NNI) = measures degree of dispersion

- Z-score places confidence in the NNI test

Data Set	NNI	Z-Score
Example 1		
Shootings 2005	0.48	-20.65
Shootings 2006	0.37	-25.83

Sample Policy Question: **Is violence randomly distributed across a community?**

K-order Nearest Neighbor; Shootings with and without injury (2005 and 2006)

- NNI is an indicator of 1st order spatial randomness

- Compares nearest neighbor indices for 2005 and 2006 shootings up to the 50th order (i.e. 50th nearest neighbor)


**K-order Nearest Neighbor Indices
2005 and 2006 Shootings**

Legend: NNI Shootings 2005 — NNI Shootings 2006 — K-order Spatial Randomness

X-axis: Order of Nearest Neighbor Index

Y-axis: Nearest Neighbor Index
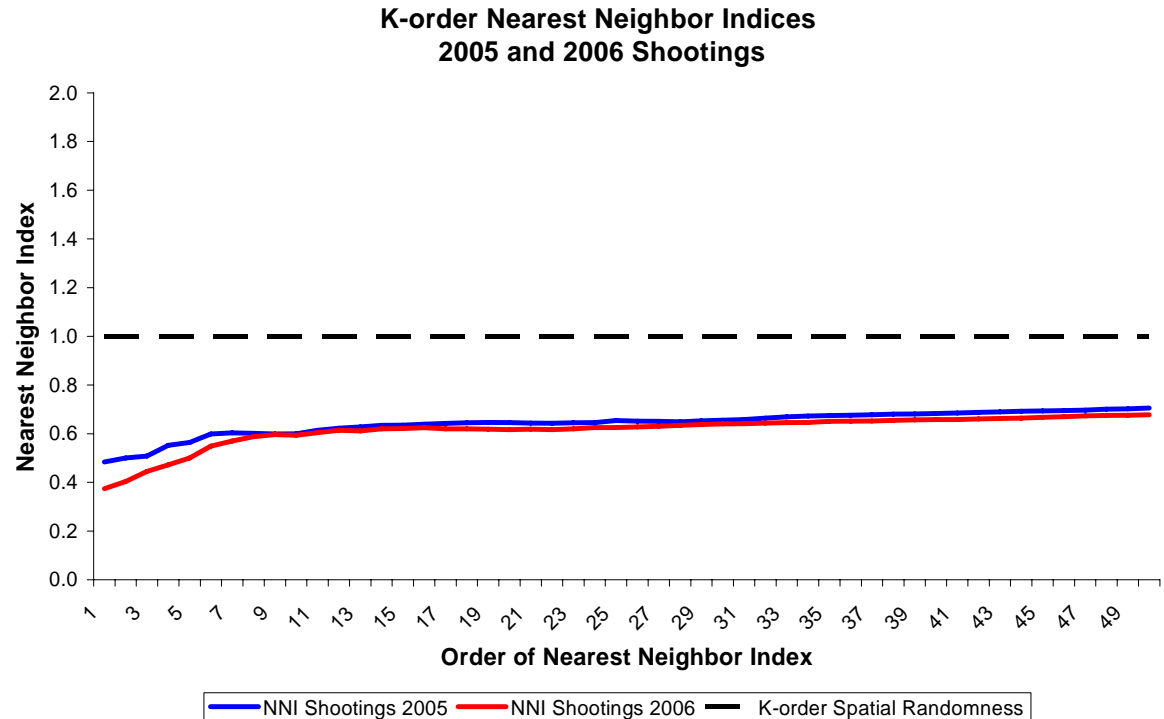
Sample Policy Question: **Is violence randomly distributed across a community? (cont'd)**

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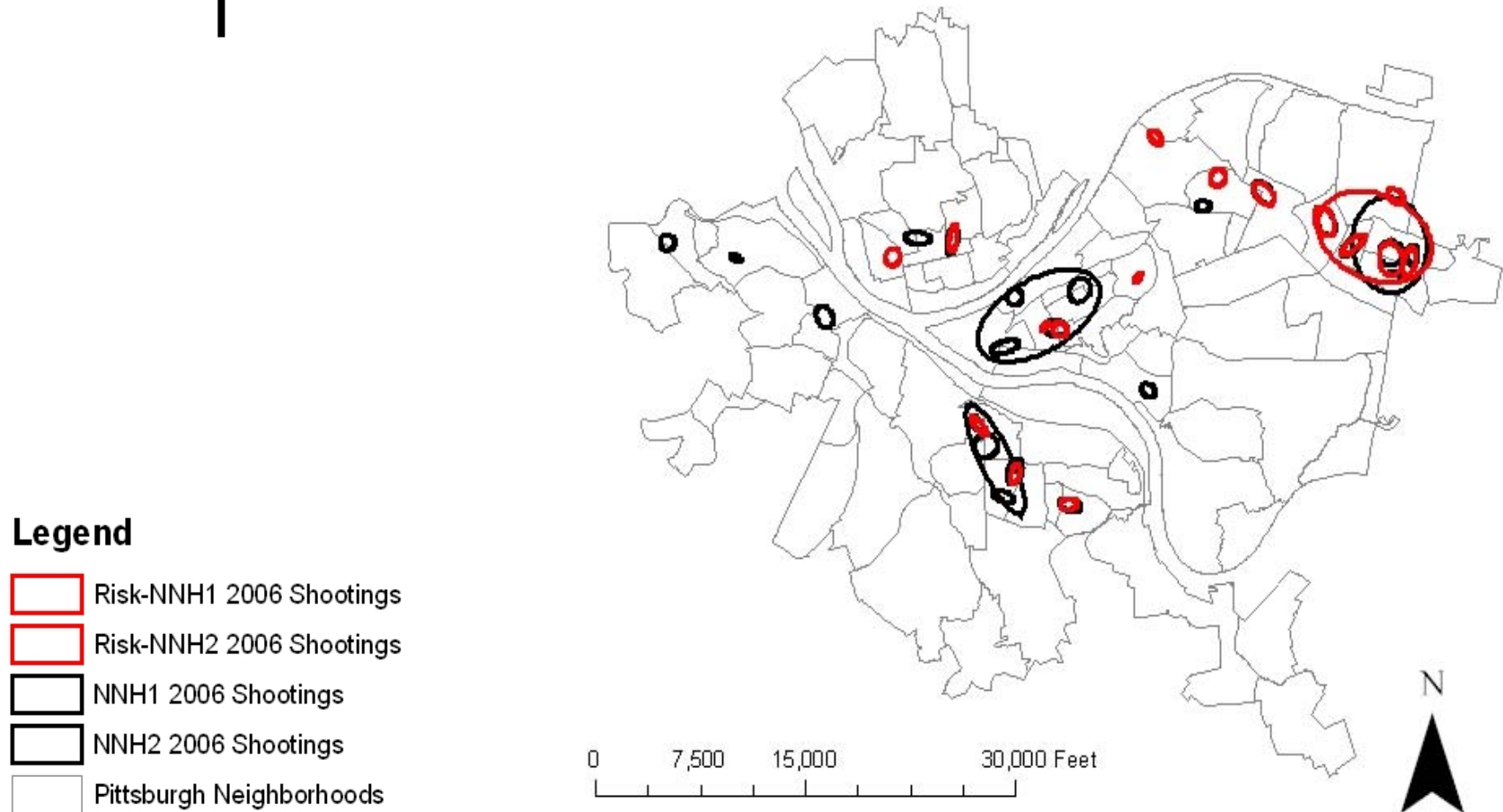# Using Hot Spot Analysis Techniques to Address Policy Questions

Hot Spot Analysis Technique	Sample Policy Questions
nearest neighbor hierarchical clustering and risk-adjusted nearest neighbor hierarchical clustering	Where should street outreach workers focus their efforts in a community?
nearest neighbor hierarchical clustering	Is there a gap in services for returning prisoners?

**Map 5: Nearest Neighbor Hierarchical Clustering; Shootings with and without injury (Summer 2004, 2005, 2006)**
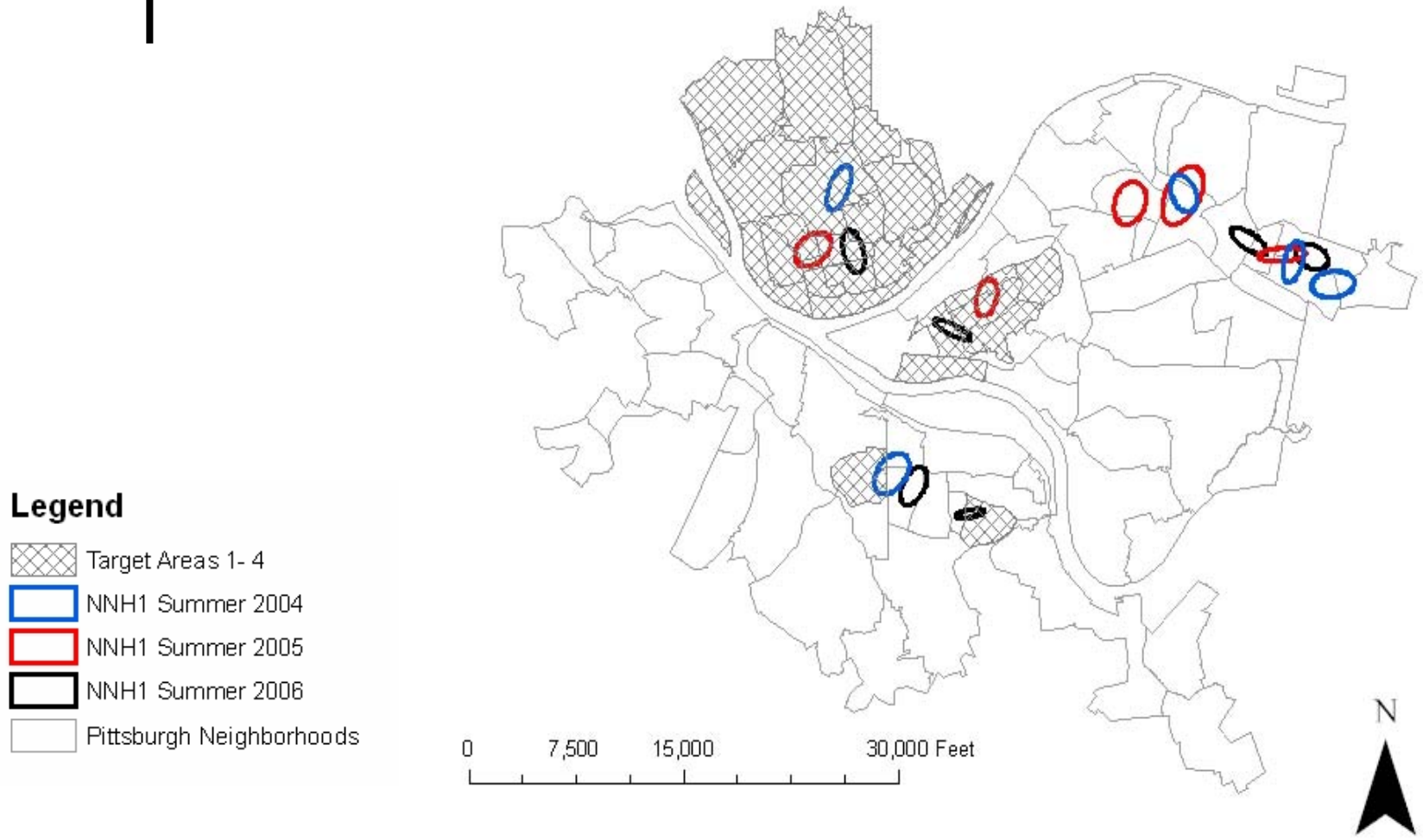
Legend

- Target Areas 1- 4
- NNH1 Summer 2004
- NNH1 Summer 2005
- NNH1 Summer 2006
- Pittsburgh Neighborhoods

0   7,500   15,000   30,000 Feet

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Sample Policy Question: Where should street outreach workers focus their efforts?

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Map 6: Risk-Nearest Neighbor Hierarchical Clustering; Shootings with and without injury (2006)

Legend

Risk-NNH1 2006 Shootings

Risk-NNH2 2006 Shootings

NNH1 2006 Shootings

NNH2 2006 Shootings

Pittsburgh Neighborhoods

0   7,500   15,000   30,000 Feet

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Sample Policy Question: Where should street outreach workers focus their efforts in a community? (cont'd)

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Map 7: Nearest Neighbor Hierarchical Clustering; Jail Services (2005)
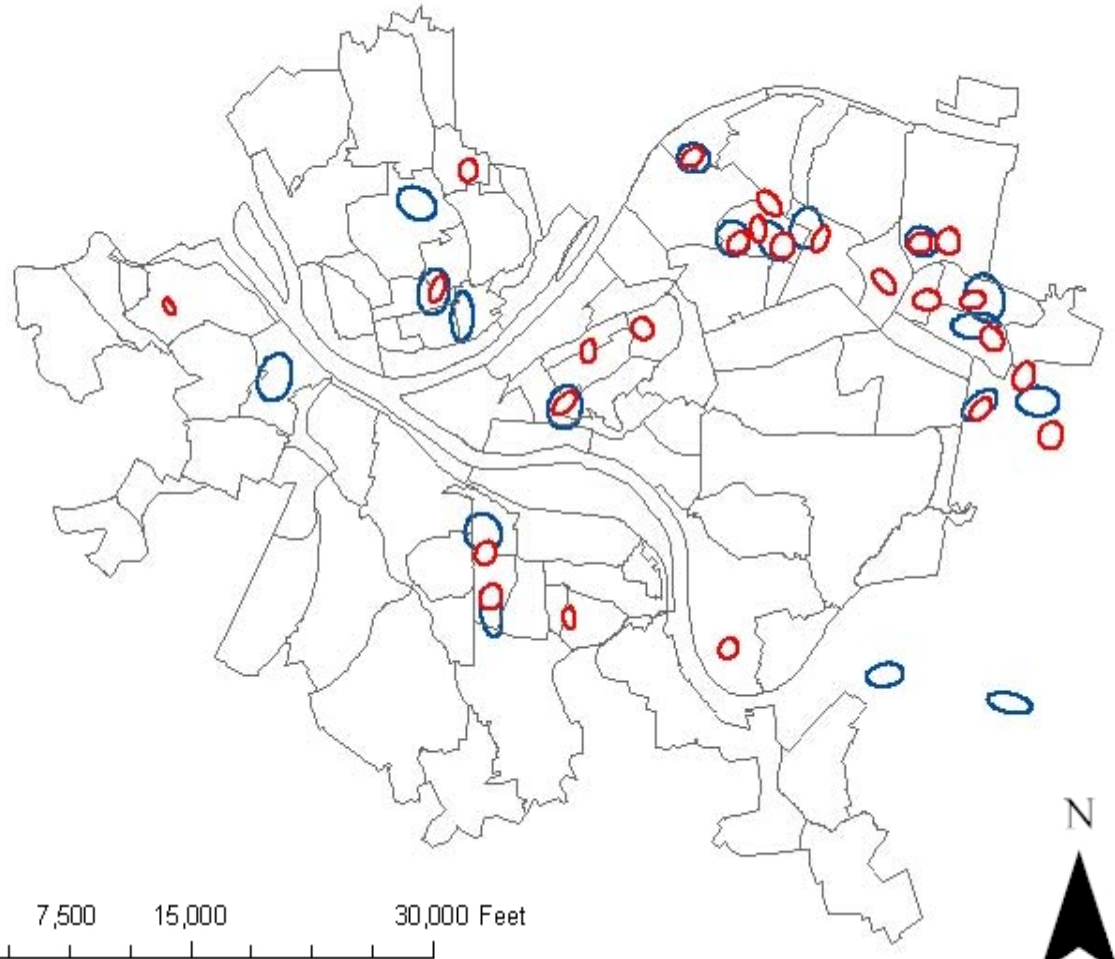
Legend

🟥	NNH1 2005 Jail No Services
🟦	NNH1 2005 Jail Services
⬜	Pittsburgh Neighborhoods

0   7,500   15,000   30,000 Feet

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Sample Policy Question: Is there a gap in services for returning prisoners?

Summary

- *CrimeStat III* technology is a realistic application that can be used to address current policy issues

- Multiple ways to apply spatial techniques to examine policy issues

- Use spatial techniques to initiate a conversation on what is the most strategic way to approach a problem

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- Pennsylvania Board of Probation and Parole
- Pennsylvania Department of Corrections
- University of Pittsburgh School of Social Work

Questions?

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Sources

- Eck, James E., Spencer Chainey, James G. Cameron, Michael Leitner, and Ronald E. Wilson. "Mapping Crime: Understanding Hot Spots." Washington DC: U.S. Department of Justice, National Institute of Justice, 2005.

- La Vigne, Nancy G. and Jake Cowan. "Mapping Prisoner Reentry: An Action Research Guidebook." Washington DC: The Urban Institute. 2005.

- Levine, Ned. "*CrimeStat* III: A Spatial Statistics Program for the Analysis of Crime Incident Locations." Washington DC: U.S. Department of Justice, National Institute of Justice., 2005.

- Visher, Christy and Jill Farrell. "Chicago Communities and Prisoner Reentry." Washington DC: The Urban Institute. 2005.