# Modeling Tuberculosis Dissemination in Harris County, Texas, 1995-1998, with Spatial Analysis and Geographic Information Systems (GIS)

Matthew L. Stone, MPH
The Center for Health Policy Studies
The University of Texas School of Public Health
Houston, Texas; Email: mstone@sph.uth.tmc.edu

Edward A. Graviss, Ph.D., MPH
Houston Tuberculosis Initiative
Email: egraviss@bcm.tmc.edu

UT★HOUSTON SCHOOL of PUBLIC HEALTH

BAYLOR COLLEGE OF MEDICINE • RESEARCH • EDUCATION • SERVICE

2002 International Conference on Emerging Infectious Diseases

# TB Incidence in Texas and Harris County

- Steady decrease in incidence rates during 1995-1998 in Texas.
  - From 12.7 cases/100,000 to 9.2 cases/100,000
    - High compared to the national rate
  - Majority of prevalence among 25-44 age group
    - Hispanics (47.5%)
    - African-Americans (24.3%)
    - Whites (18.5%)
- In Harris County, Texas incidence decreased from 25.6/100,000 in 1995 to 14.4 cases/100,000 in 1998.

# Factors associated with TB clustering in Harris County, Texas

- **Increased Risk**
  - Birth in U.S.
  - Homelessness
  - Pulmonary disease
  - HIV+
  - 5+ persons in household
  - Use of public transportation
- **Decreased Risk**
  - Asian ethnicity
  - As age increases, odds decrease

Data from Final Multivariate Model (de Bruyn et al., 2001)

# Purpose of GIS and Spatial Analysis

- Visualization
- Exploratory analysis
- Hypothesis generation
- Model-building
- Promote active case finding among high-risk populations
- Database management to incorporate attribute data
- Capability to link together health information from a variety of data sources
- Suggest where cost-effective public health interventions should take place

# Overall Research Objectives

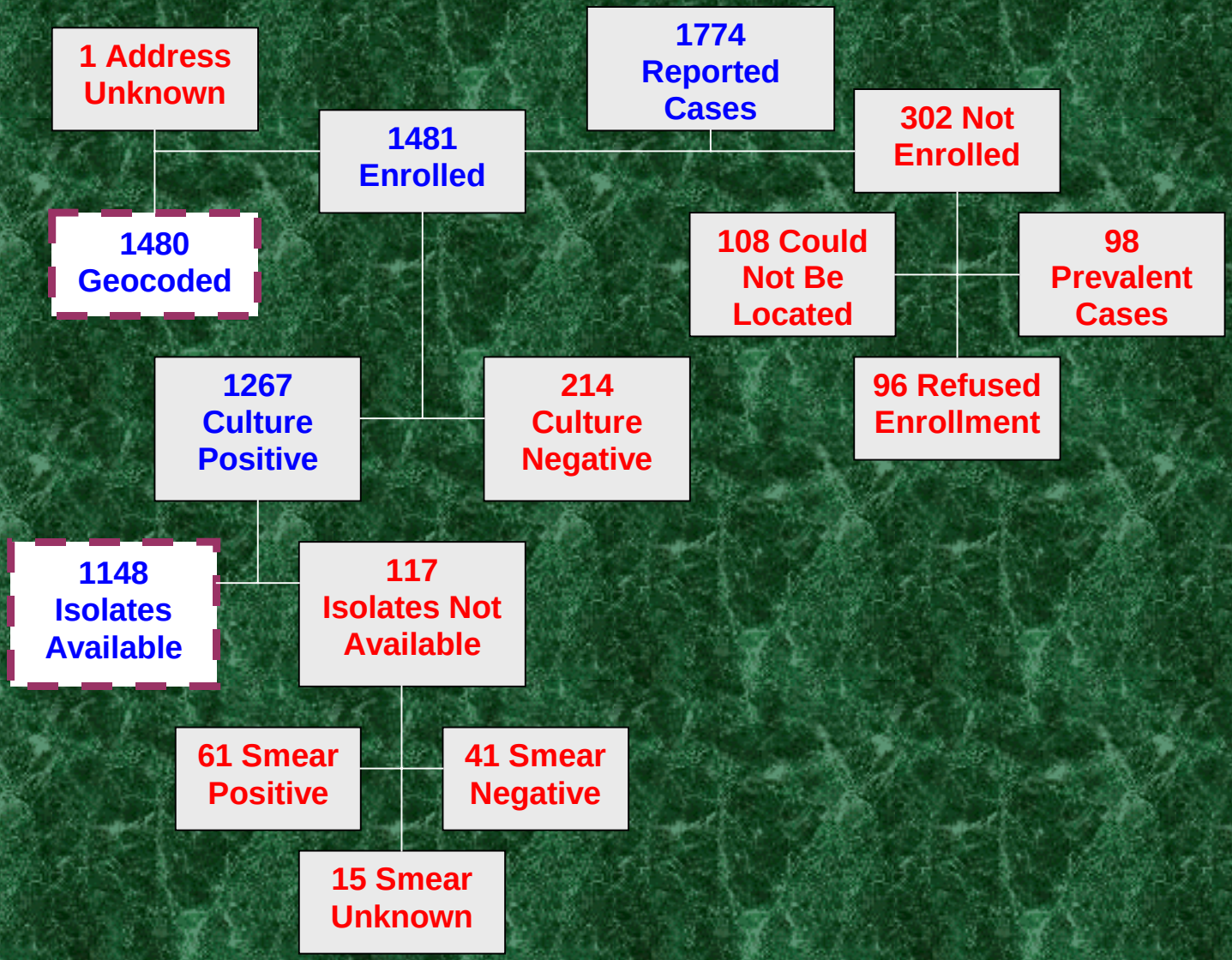
- Describe the spatial distribution of TB cases in Harris County, Texas from October 1995 through September 1998.
- Describe and assess the statistical significance of the spatial intensity patterns of TB cases in Harris County, Texas from October 1995 through September 1998.
- Show and determine the statistical significance of the areas where low or high incidence rate areas occur based on 2000 U.S. Census data.
- Describe and determine the spatial distribution and apparent clustering of TB cases of the same genetic type in reference to a specific mode of public transportation.

# Methodology

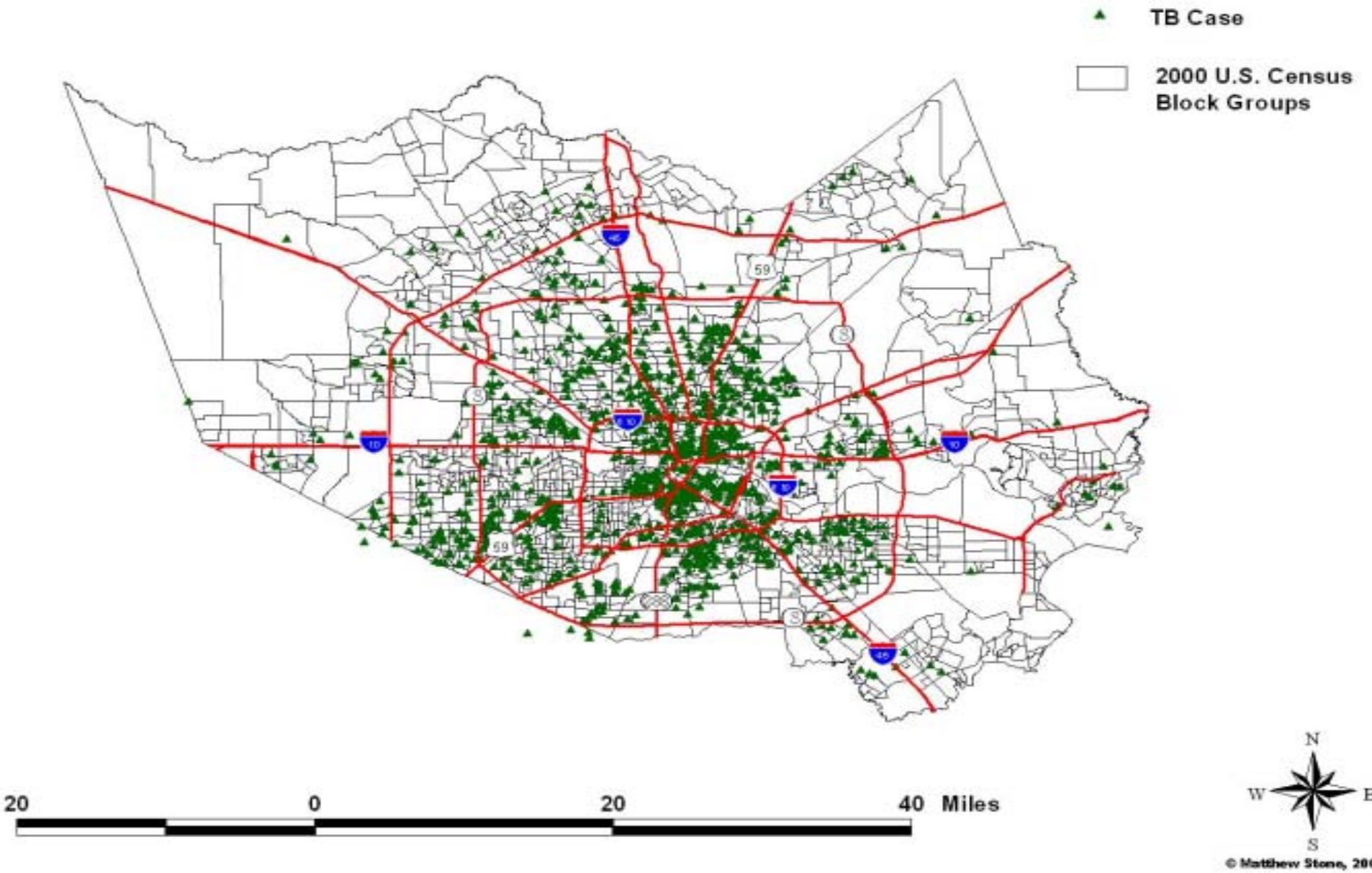
## Spatial Analytical Methods

- Kernel Estimation
- Nearest Neighbor Distances
- Spatial Filtering Method
- Space-Time Scan Statistic

# Distribution of TB Cases in Harris County, 1995-1998

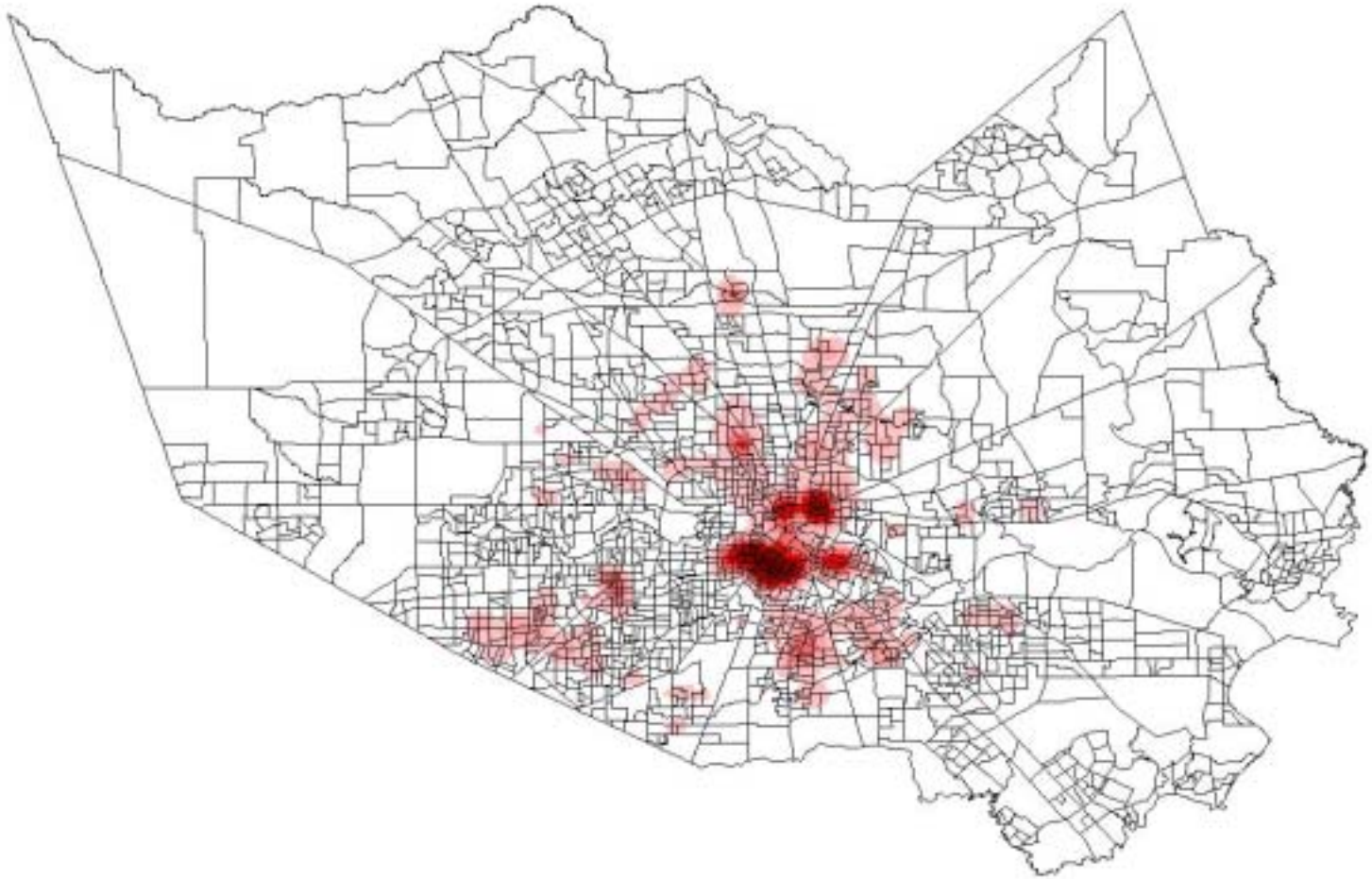


# All TB Cases in Harris County, Texas
# 1995-1998 (N=1480)




© Matthew Stone, 20

# Density of All TB Cases, Harris County Texas, 1995-1998

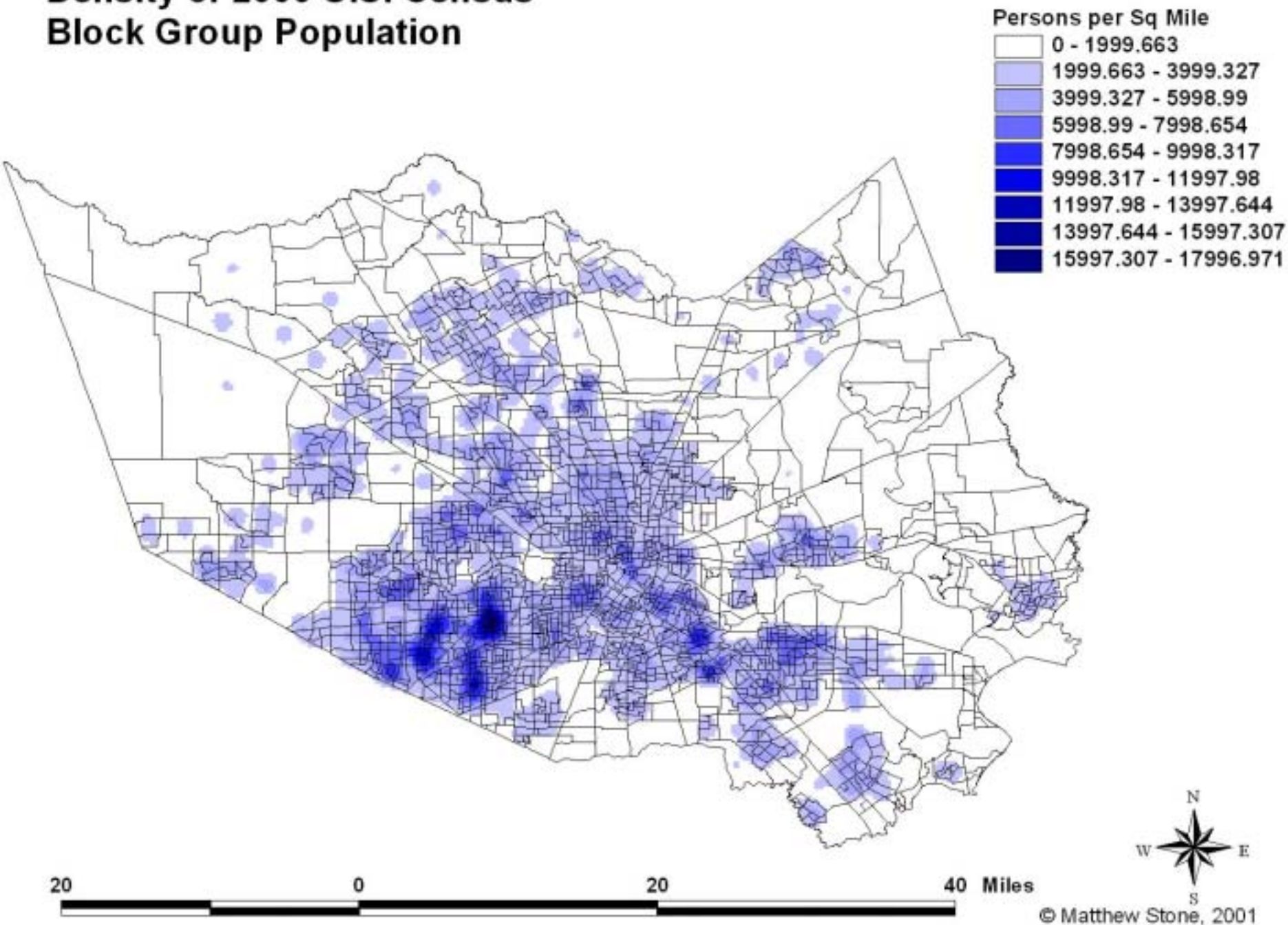


Cases per Sq Mile
- 0 - 2.728
- 2.728 - 5.455
- 5.455 - 8.183
- 8.183 - 10.91
- 10.91 - 13.638
- 13.638 - 16.366
- 16.366 - 19.093
- 19.093 - 21.821
- 21.821 - 24.548

20 0 20 40 Miles

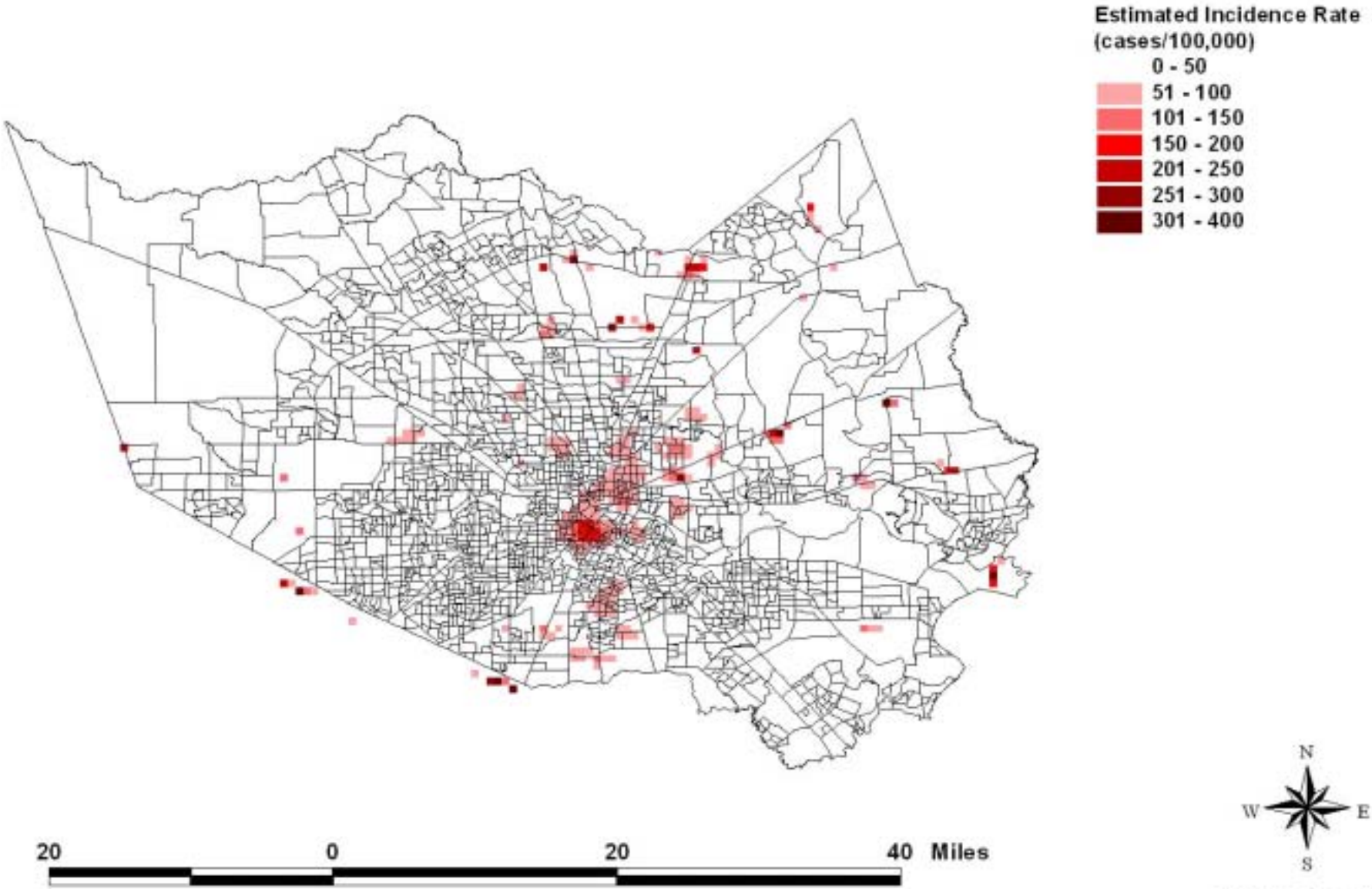
© Matthew Stone, 2001

# Density of 2000 U.S. Census Block Group Population



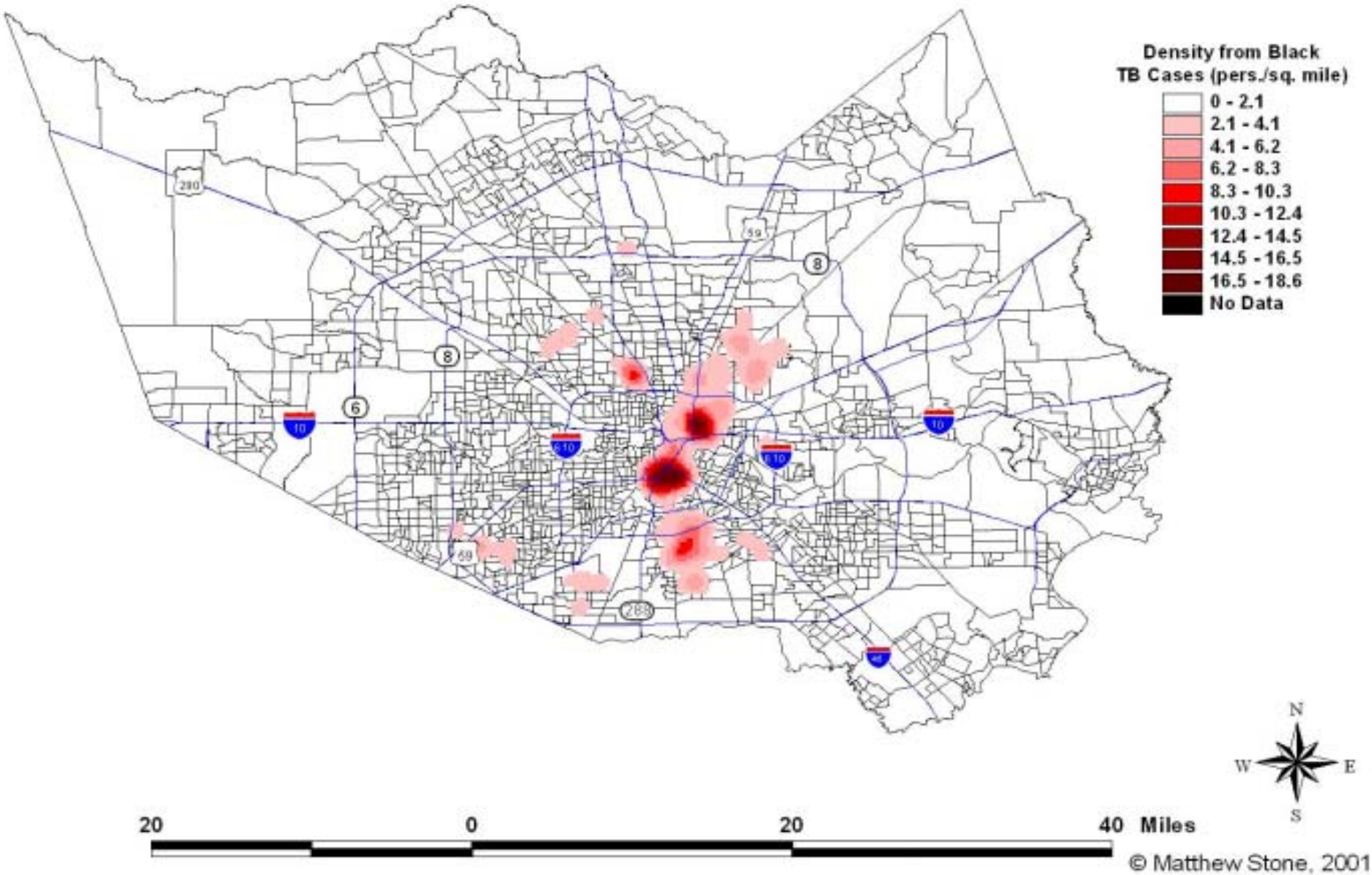

© Matthew Stone, 2001

# Kernel Density Ratio of TB Cases to Underlying 2000 U.S. Census Population Harris County, Texas, 1995-1998

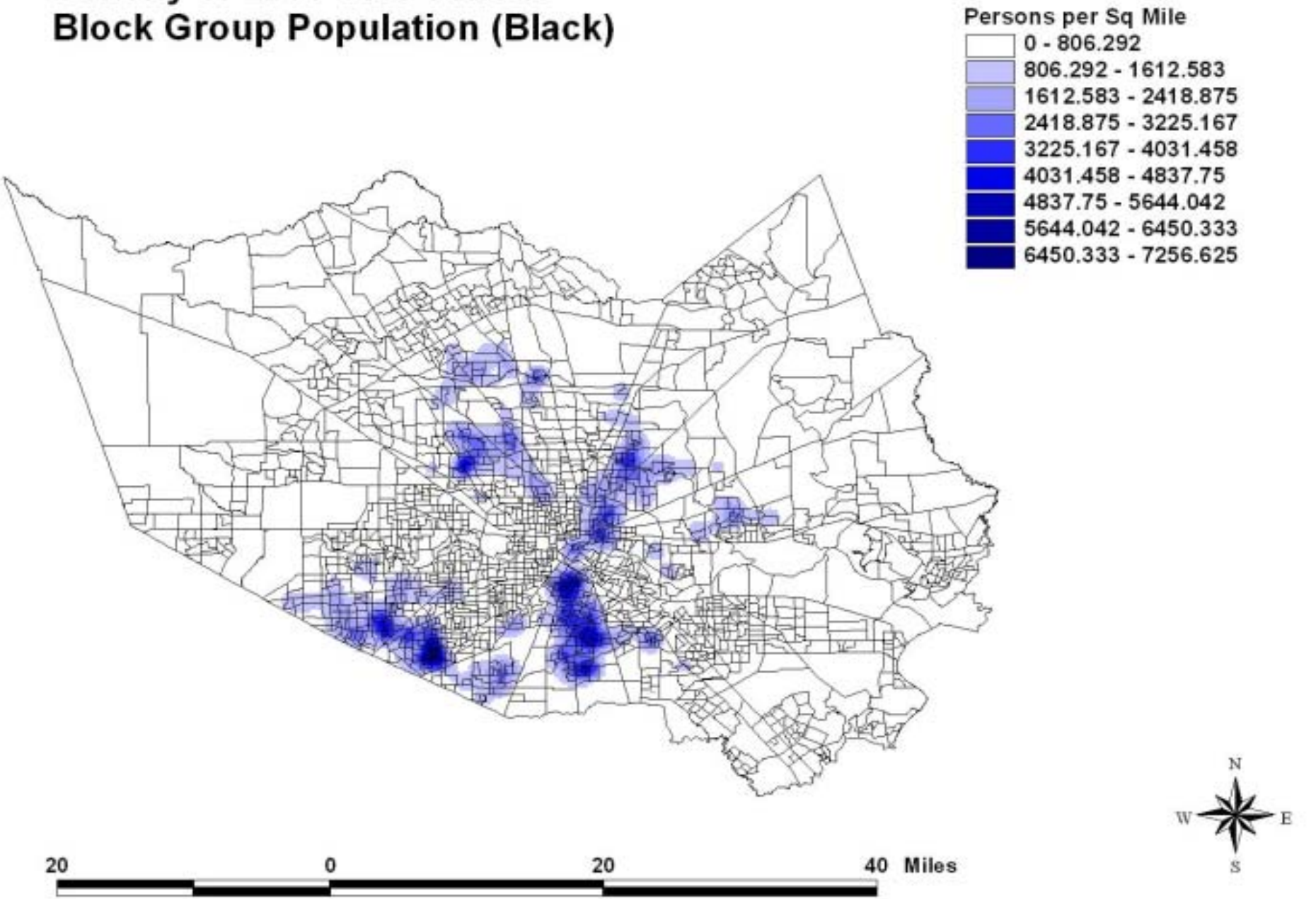



© Matthew Stone, 2001

# Density of Black TB Cases, Harris County, Texas, 1995-1998

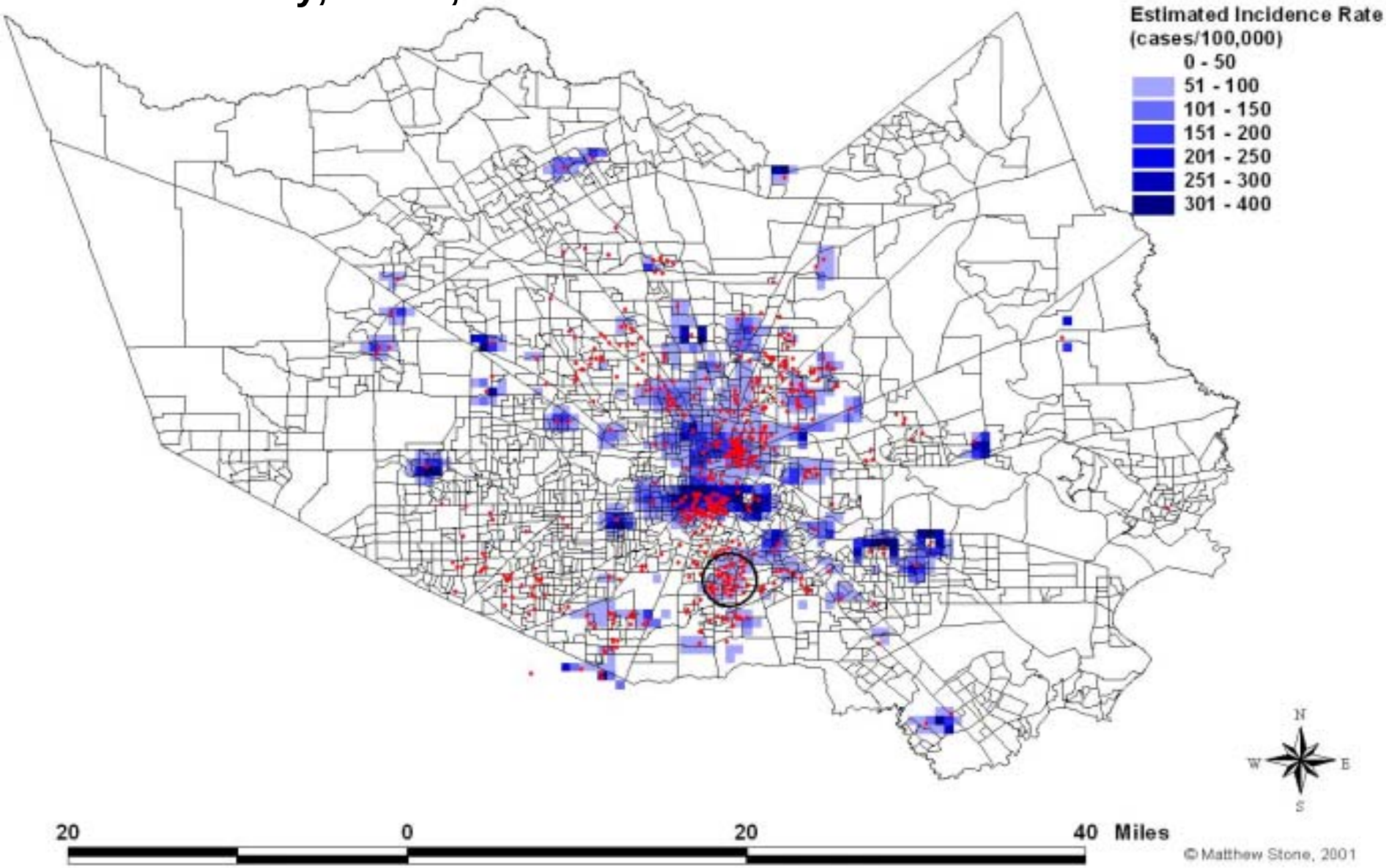


# Density of 2000 U.S. Census Block Group Population (Black)

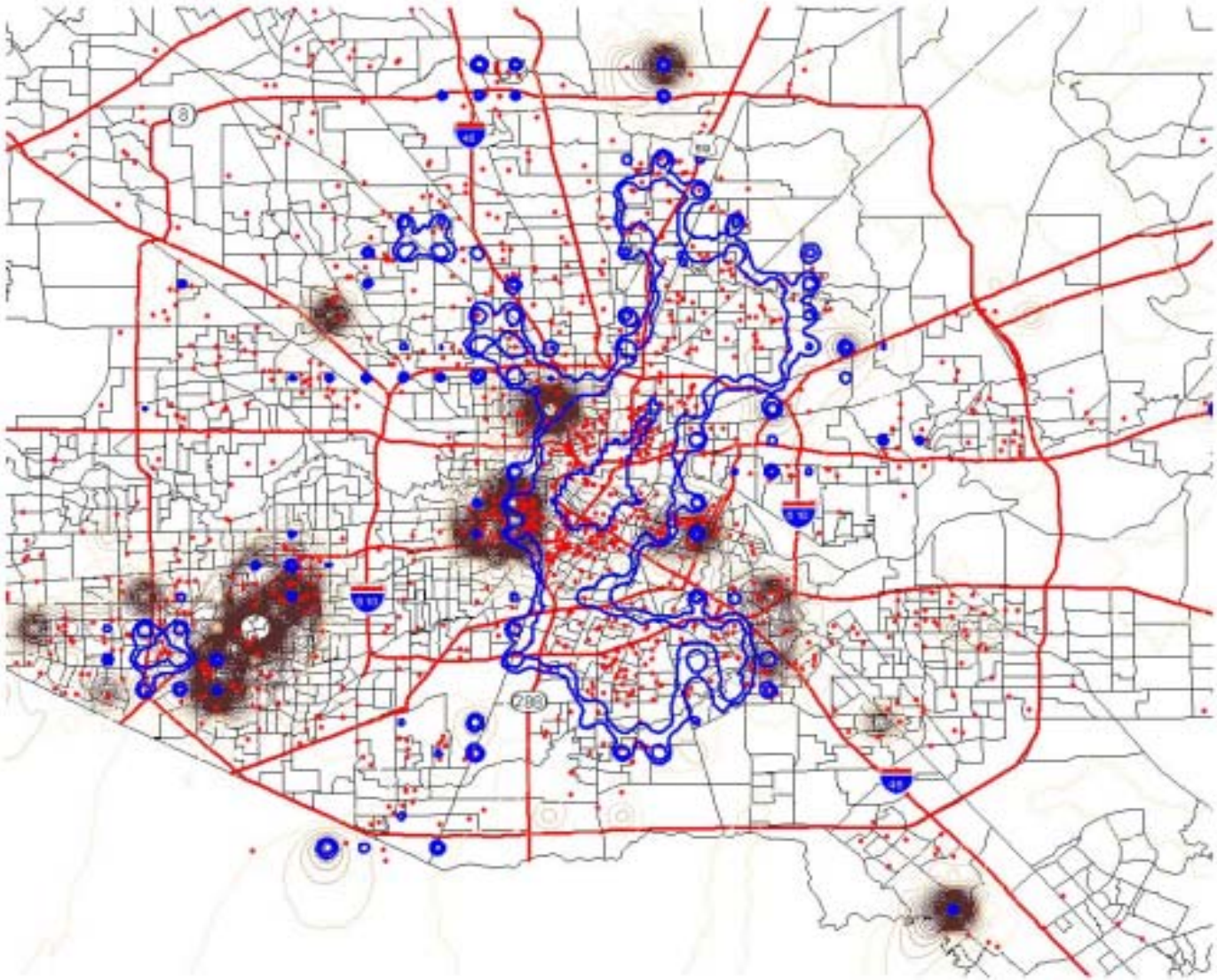



© Matthew Stone, 2001

# Kernel Density Ratio of TB Cases (Black) to Underlying 2000 U.S. Census Population (Black) Harris County, Texas, 1995-1998



# Spatial Filtering Method, All TB Cases
# Harris County, Texas, 1995-1998



Significance Contours
Simulated Rate<Observed Rate
95% - 100% of the time

Cases

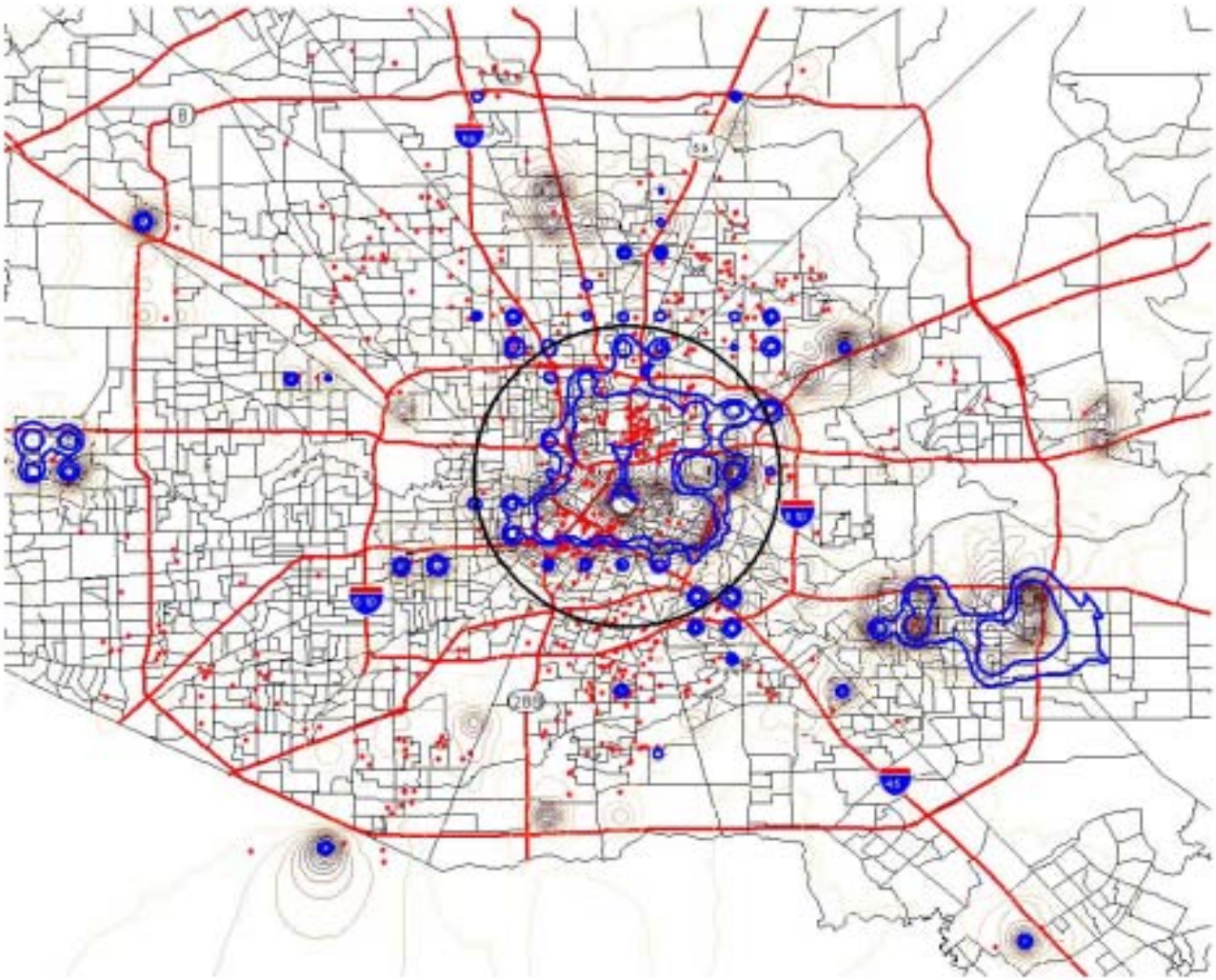
Contours of Rates(per 100,000)
- 0-20/100,000
- 21-40/100,000
- 41-60/100,000
- 61-80/100,000
- 81-100/100,000
- 101-120/100,000
- GT 120/100,000

10 0 10 20 Miles

N W E S

© Matthew Stone, 2001

# Spatial Filtering Method, Black TB Cases
# Harris County, Texas, 1995-1998



Significance Contours
Simulated Rate<Observed Rate
95% - 100% of the time

Cases

Contours of Rates(per 100,000)
- 0-20/100,000
- 21-40/100,000
- 41-60/100,000
- 61-80/100,000
- 81-100/100,000
- 101-120/100,000
- GT 120/100,000

10 0 10 20 Miles

N W E S

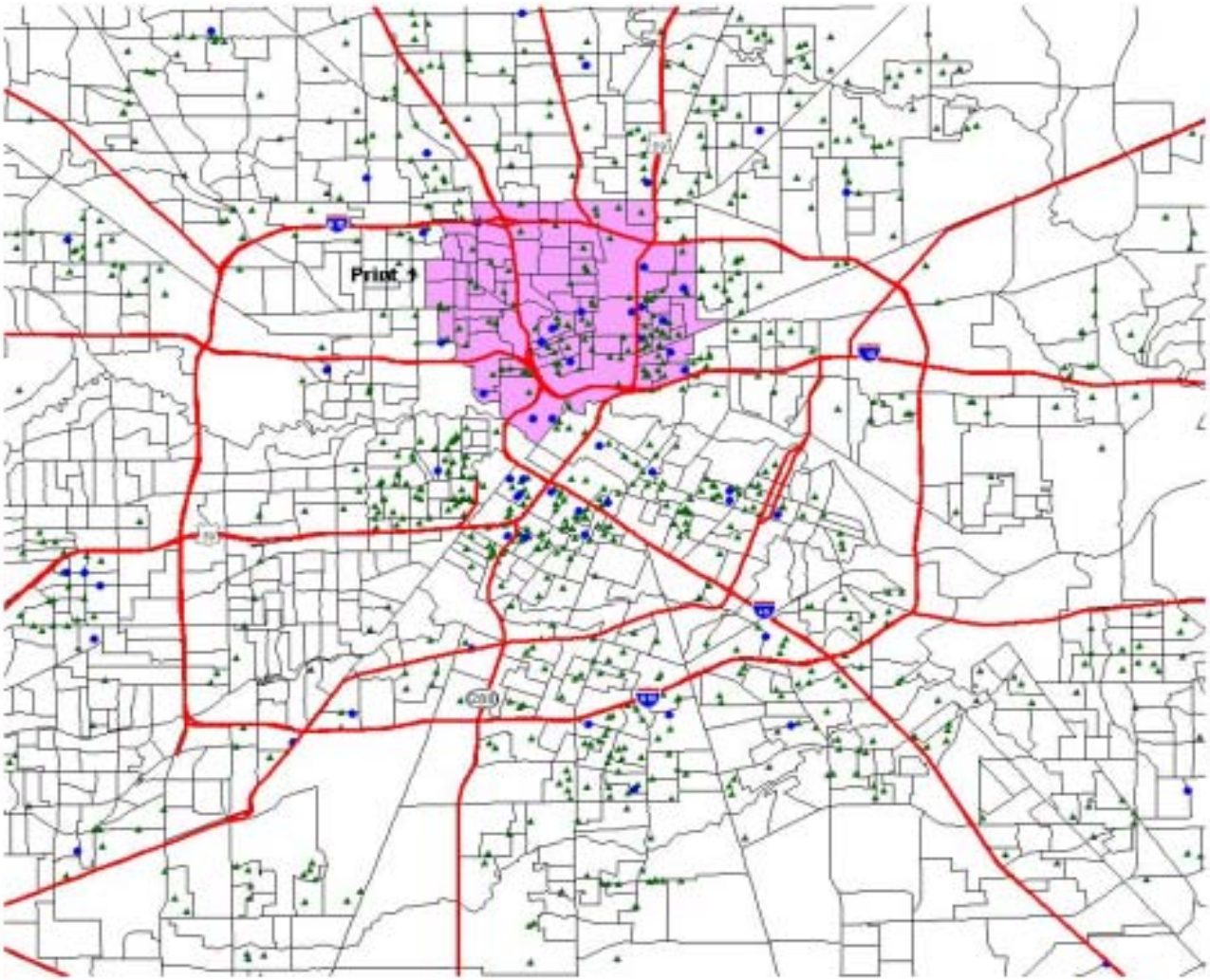
© Matthew Stone, 2001

# Print 1 Cluster
# (Print 1 Cases compared to Non-Print 1 Cases)

Print 1 Cluster
RR=2.98 (p=.01)

Print 1 Cases

Non-Print 1 Cases

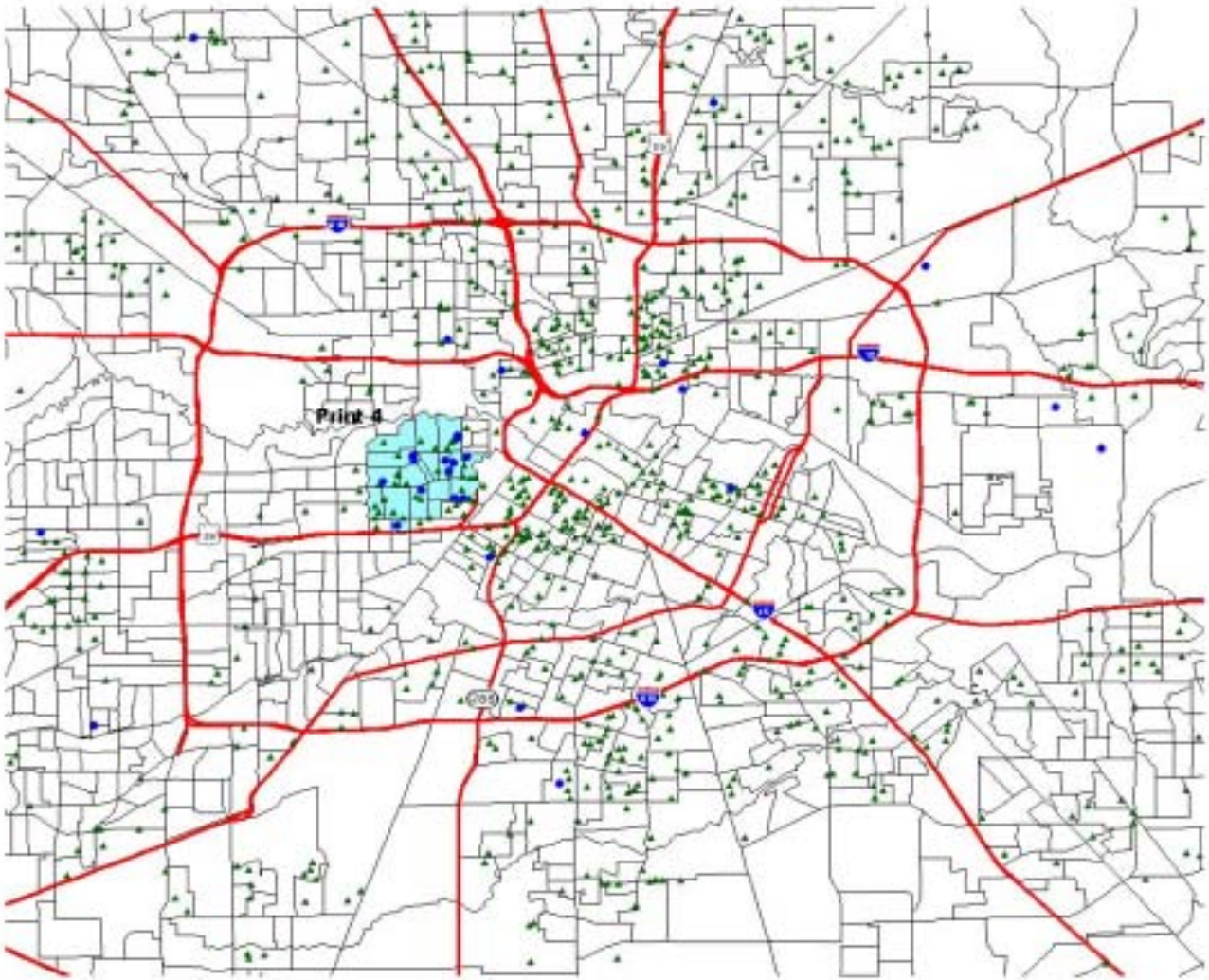



7 0 7 14 Miles

N
W E
S

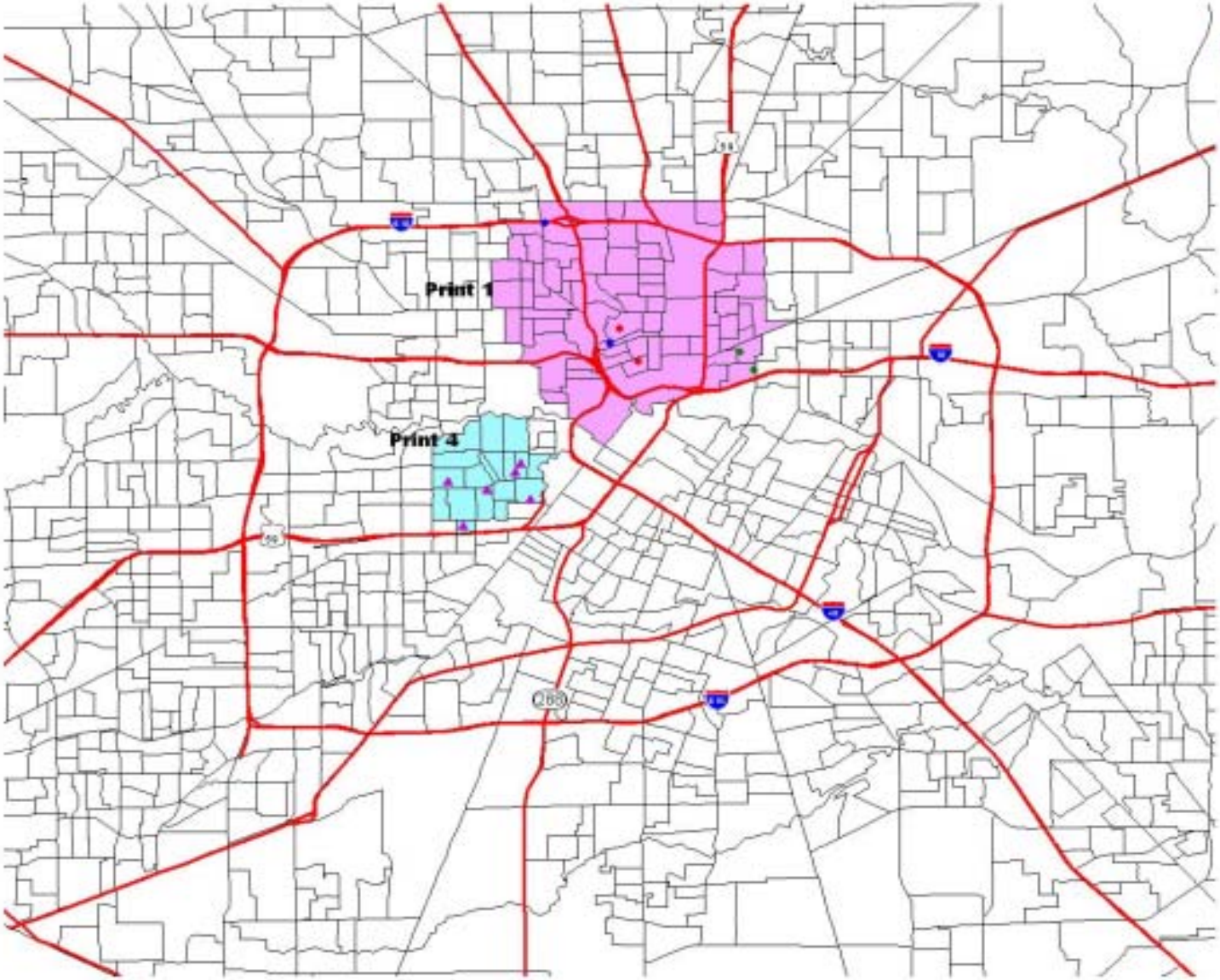
© Matthew Stone, 2001

# Print 4 Cluster
# (Print 4 Cases compared to Non-Print 4 Cases)




© Matthew Stone, 2001

# Print 1 and Print 4 Significant Clusters Showing Shared Bus Routes within Cluster




Print 4 Cluster
RR=9.03 (p<.01)

Shared Bus Route 82

Print1 Cluster
RR=2.98 (p=.01)

Print1 Shared Bus Routes
- 15
- 25
- 80

7 0 7 14 Miles

© Matthew Stone, 2001

# Conclusions

- There were specific neighborhood areas where the intensity of Black TB cases during the three-year period was high, even in reference to the underlying Black population.
- There appear to be definite areas where specific genetic print types tend to cluster.
- Within the print type clusters, there is evidence that shared public transportation occurs that may warrant further inspection

# Acknowledgements


- Houston Tuberculosis Initiative and Edward Graviss, Ph.D, M.P.H.
- The designers of the software utilized in this project
  - Ned Levine, Ph.D (CrimeStat®)
  - Martin Kulldoorf, Ph.D (SatScan™)
  - Gerard Rushton, Ph.D (Dmap™)