

# Introduction to Hotspot Analysis

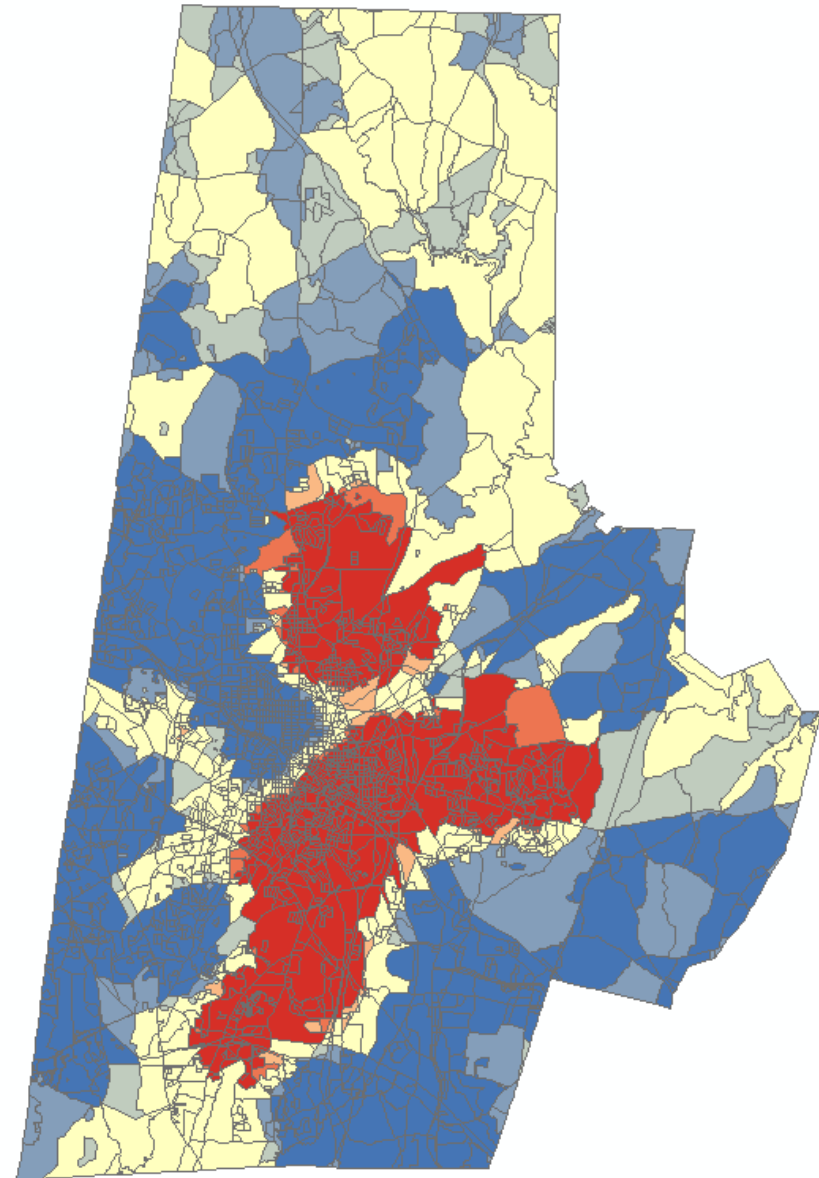
GIS III: GIS Analysis



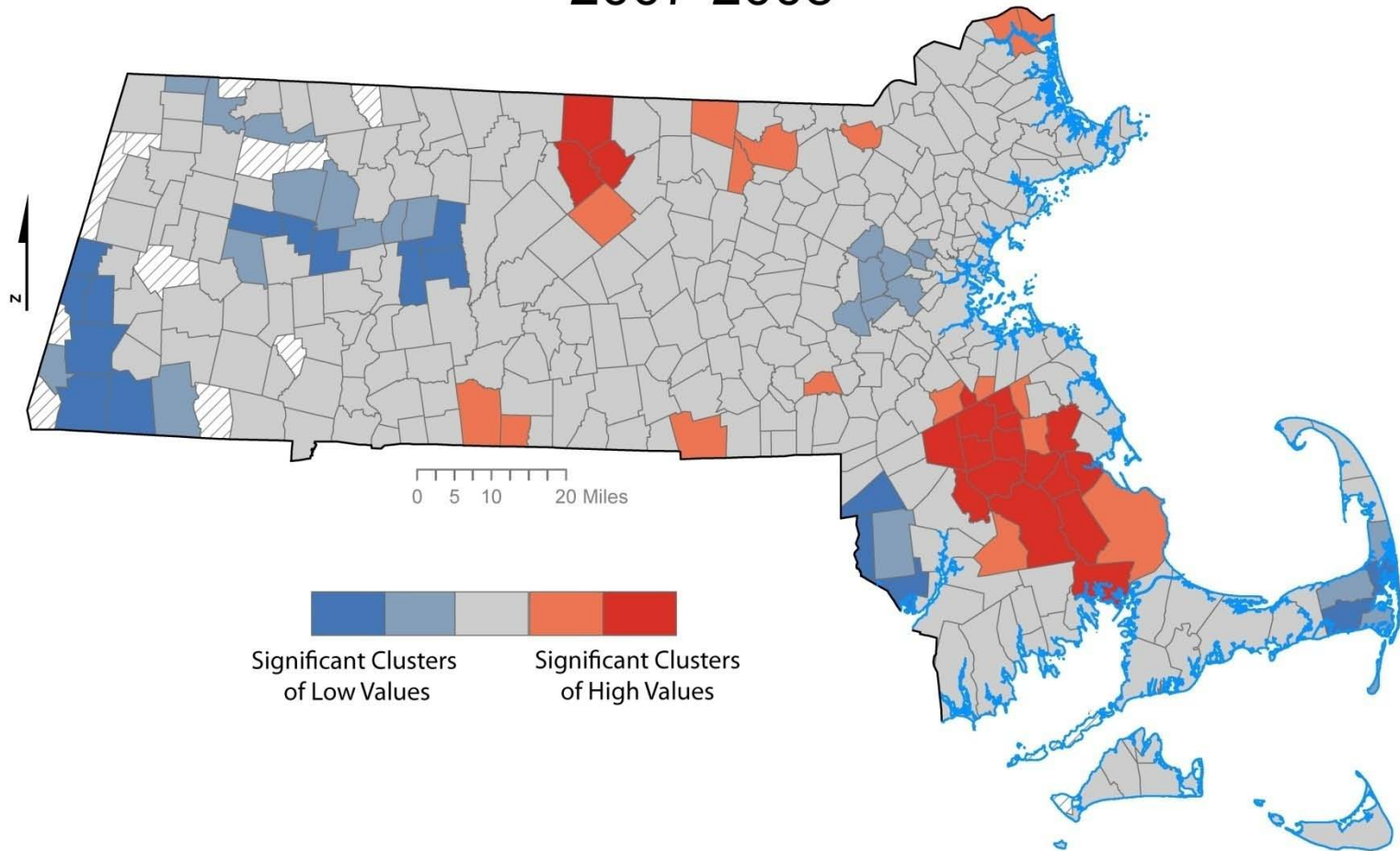
- **Why use hotspot analysis?**
- **Gettis-Ord  $G_i^*$**
- **Interpreting results**

# What is Hotspot Analysis?

- **Density can tell you where clusters in your data exist, but not if your clusters are statistically significant**
- **Hotspot analysis uses vectors (not rasters) to identify the locations of statistically significant hot spots and cold spots in data**
- **Points should be aggregated to polygons for this analysis**



## Cardiovascular Disease Hotspots 2007-2008



- Produces Z scores and P values
- A high Z score and small P value for a feature indicates a significant hot spot. A low negative Z score and small P value indicates a significant cold spot. The higher (or lower) the Z score, the more intense the clustering. A Z score near zero means no spatial clustering.

The Getis-Ord local statistic is given as:

$$G_i^* = \frac{\sum_{j=1}^n w_{i,j} x_j - \bar{X} \sum_{j=1}^n w_{i,j}}{S \sqrt{\frac{\left[ n \sum_{j=1}^n w_{i,j}^2 - \left( \sum_{j=1}^n w_{i,j} \right)^2 \right]}{n-1}}} \quad (1)$$

where  $x_j$  is the attribute value for feature  $j$ ,  $w_{i,j}$  is the spatial weight between feature  $i$  and  $j$ ,  $n$  is equal to the total number of features and:

$$\bar{X} = \frac{\sum_{j=1}^n x_j}{n} \quad (2)$$

$$S = \sqrt{\frac{\sum_{j=1}^n x_j^2}{n} - (\bar{X})^2} \quad (3)$$

The  $G_i^*$  statistic is a z-score so no further calculations are required.

# The Hotspot Tool

Hot Spot Analysis (Getis-Ord Gi\*)

Input Feature Class

Input Field

Output Feature Class

Conceptualization of Spatial Relationships  
FIXED\_DISTANCE\_BAND

Distance Method  
EUCLIDEAN\_DISTANCE

Standardization  
NONE

Distance Band or Threshold Distance (optional)

Self Potential Field (optional)

Weights Matrix File (optional)

OK Cancel Environments... Show Help >>

- **Data must be projected!**
- **Inverse Distance** – Closer features are weighed more heavily than features that are further away
- **Inverse Distance Squared** – Same as above, but weight decreases more dramatically over distance
- **Fixed Distance Band** – Every feature within a fixed distance is included, every feature outside that distance is excluded
- **Zone of Indifference** – Combination of Inverse Distance and Fixed Distance Band
- **Polygon Contiguity** – Only features that share a border are included
- **Get Spatial Weights From File**



# Interpreting Results

Table

blks\_grps\_census\_sf1andsf3\_8

OBJECTID *	Shape *	Shape_Length	Shape_Area	GiZScore	GiPValue
145	Polygon	3047.721597	320287.561199	2.047982	0.040562
146	Polygon	7601.826202	2757137.969364	1.657916	0.097334
147	Polygon	7142.483114	1838223.847433	1.224895	0.220615
148	Polygon	4051.692094	666955.702184	-0.116761	0.907049
149	Polygon	1042.016339	76439.46991	-0.235055	0.814166
150	Polygon	2841.881829	497940.705635	0.324372	0.745656
151	Polygon	2805.890184	425268.701417	-0.406061	0.684698
152	Polygon	6092.684583	1073604.18397	0.887018	0.375069
153	Polygon	2110.596433	157189.531117	0.613816	0.539337
154	Polygon	2951.318114	346680.525364	0.921531	0.356773
155	Polygon	1741.233014	148577.617631	1.156202	0.247599
156	Polygon	1210.984899	45219.896733	1.351640	0.176491
157	Polygon	6875.40866	1171559.46344	4.115511	0.000039
158	Polygon	1469.464534	125755.573878	1.676274	0.093684
159	Polygon	2443.805606	350398.083628	3.187734	0.001434
160	Polygon	2274.077196	264859.240998	3.646794	0.000266
161	Polygon	1784.836534	106595.67408	5.477315	0
162	Polygon	12294.911686	5555122.036071	3.314965	0.000917
163	Polygon	3182.142591	312767.025203	3.578400	0.000346
164	Polygon	4352.567917	1089819.58492	3.928491	0.000085
165	Polygon	3101.771826	525425.530764	4.883850	0.000001
166	Polygon	1368.537161	95289.878063	5.314156	0
167	Polygon	4167.012377	571021.627747	2.946494	0.003214
168	Polygon	5135.069771	943223.061121	0.476375	0.633807
169	Polygon	1249.594096	91518.671722	-0.562512	0.573767
170	Polygon	1109.102034	73215.777608	-0.751443	0.452386