
Measuring Connectivity for Bicycling and Walking

Pro-Walk Pro-Bike
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Why Connectivity?



Use of Connectivity Measures

- Research
- Policy and Planning

Question: How should we be measuring connectivity?

Three-Step Project

1. Develop measures of network connectivity
2. Compare connectivity measures to performance measures to help select best measure(s)
3. Evaluate implementation issues

Important Note

- Connectivity is just **one** dimension of a set of measures of urban form
- Could be combined with measures of
 - *Terrain (e.g. slope)*
 - *Facilities (e.g. sidewalks, bike lanes)*
 - *Aesthetics/Comfort (e.g. trees)*
 - *Time*
 - *Etc.*

Measures of Connectivity

Measures of Connectivity

- Block length
 - *Average*
 - *Median*
 - *Maximum*
- Block area
- Block density

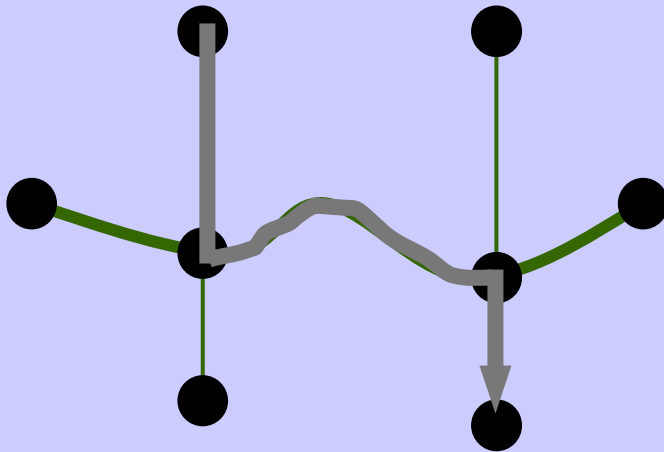
Measures of Connectivity

- Intersection density
- Street network density

Measures of Connectivity

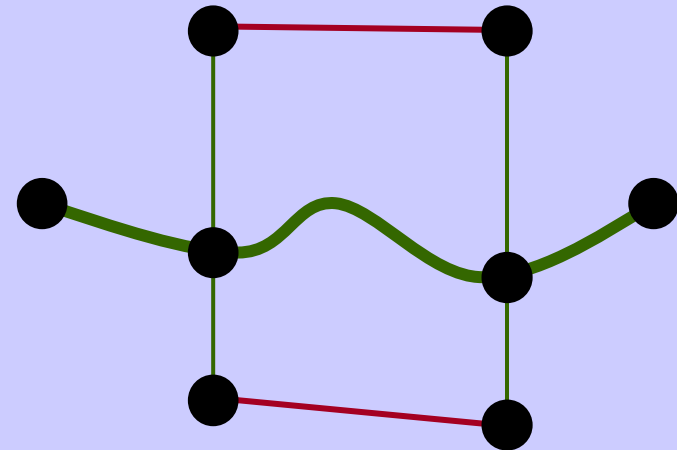
- Link/Node Ratio

Ratio = $7/8 = 0.88$



One
route

Ratio = $9/8 = 1.13$



Three
routes

Measures of Connectivity

- Connected Node Ratio
 - *intersections / intersections + cul-de-sacs*

Measures of Connectivity

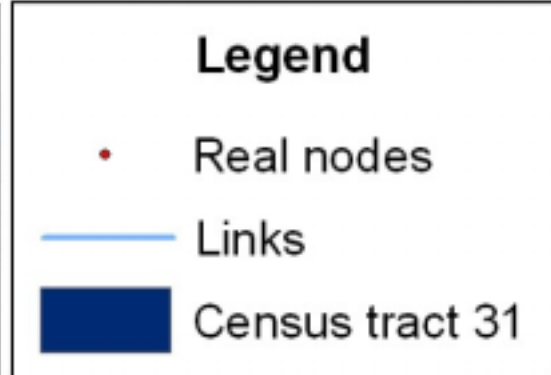
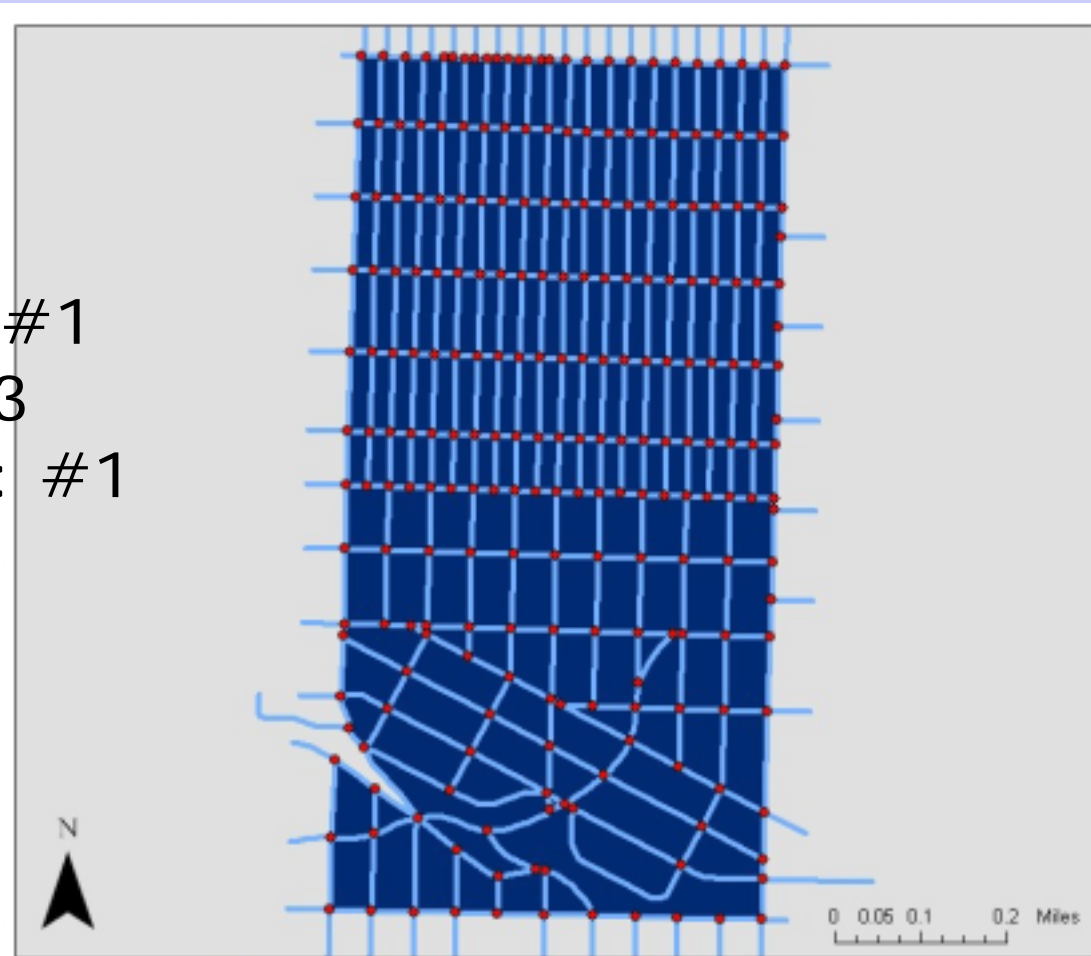
- Alpha Index
 - *Ratio of the number of actual circuits to the maximum number of circuits*
 - *A circuit is a finite, closed path starting and ending at a single node*
- Gamma Index
 - *Ratio of the number of links in the network to the maximum possible number of links between nodes*

Measures of Connectivity

- Effective Walking Area
 - *Ratio of the number of parcels within a one-quarter mile walking distance of a point to the total number of parcels within a one-quarter mile radius of that point*
- Pedestrian Route Directness
 - *Ratio of route distance to straight-line distance for two selected points*

Examples

Connected Node Ratio: #1
Intersection Density: #3
Street Network Density: #1
Link-Node Ratio: #3
Alpha: #4
Gamma: #4

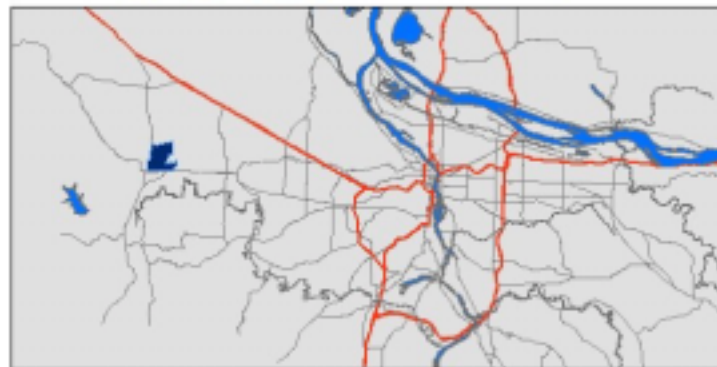
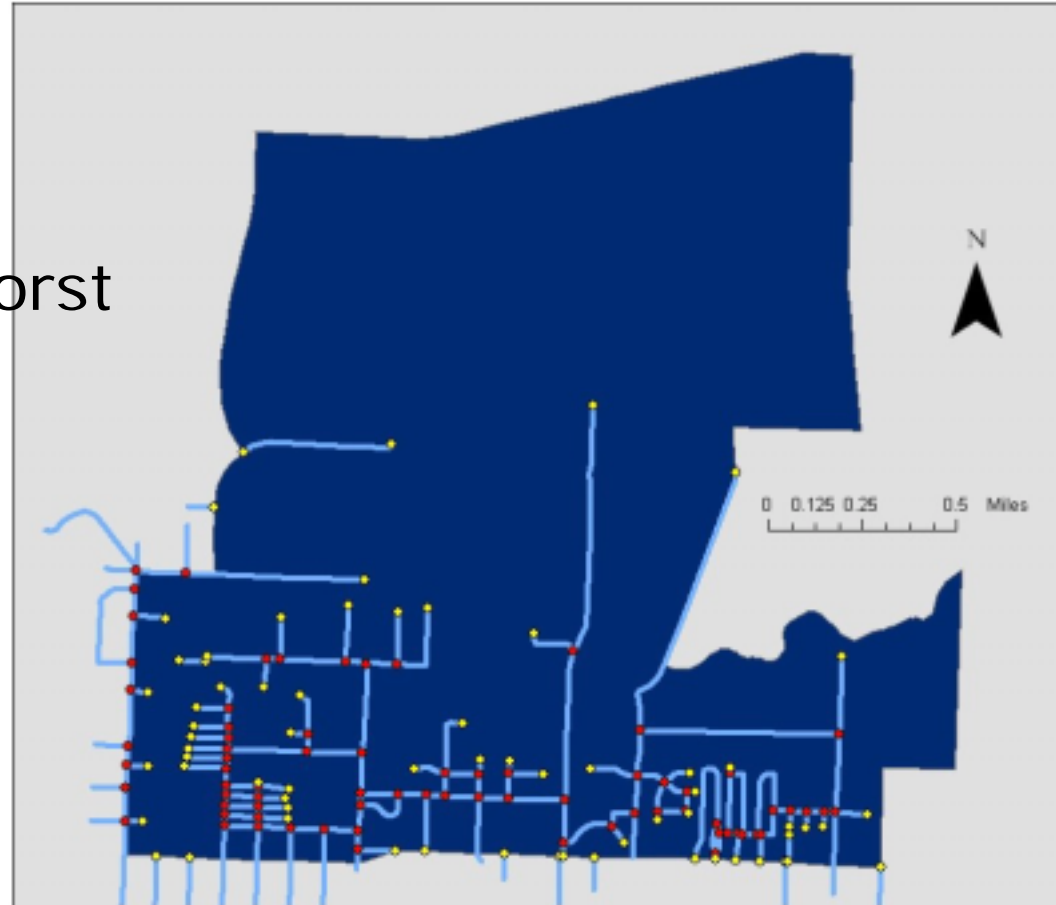


Examples

Link-Node Ratio: 2nd worst

Alpha: 2nd worst

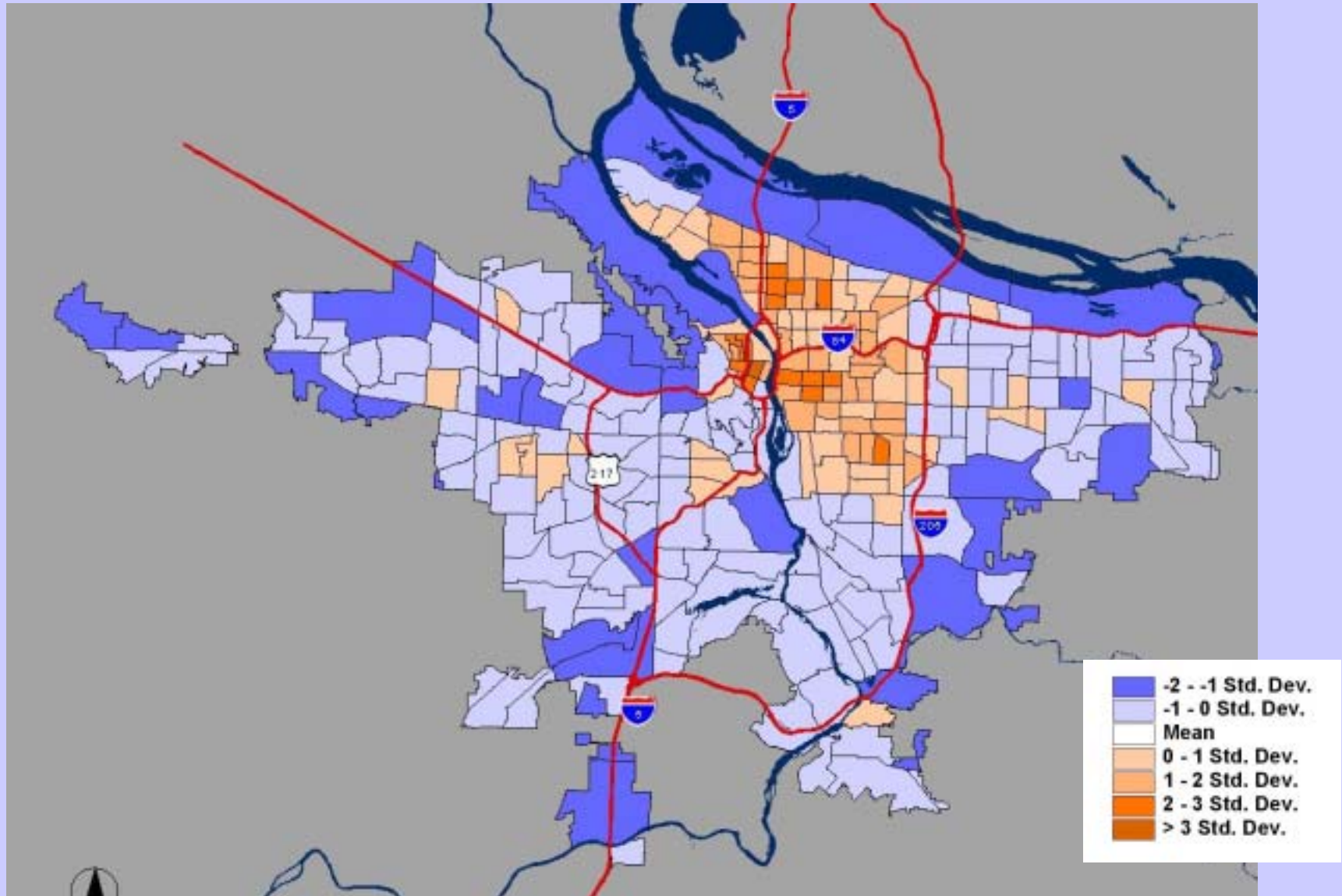
Gamma: 2nd worst



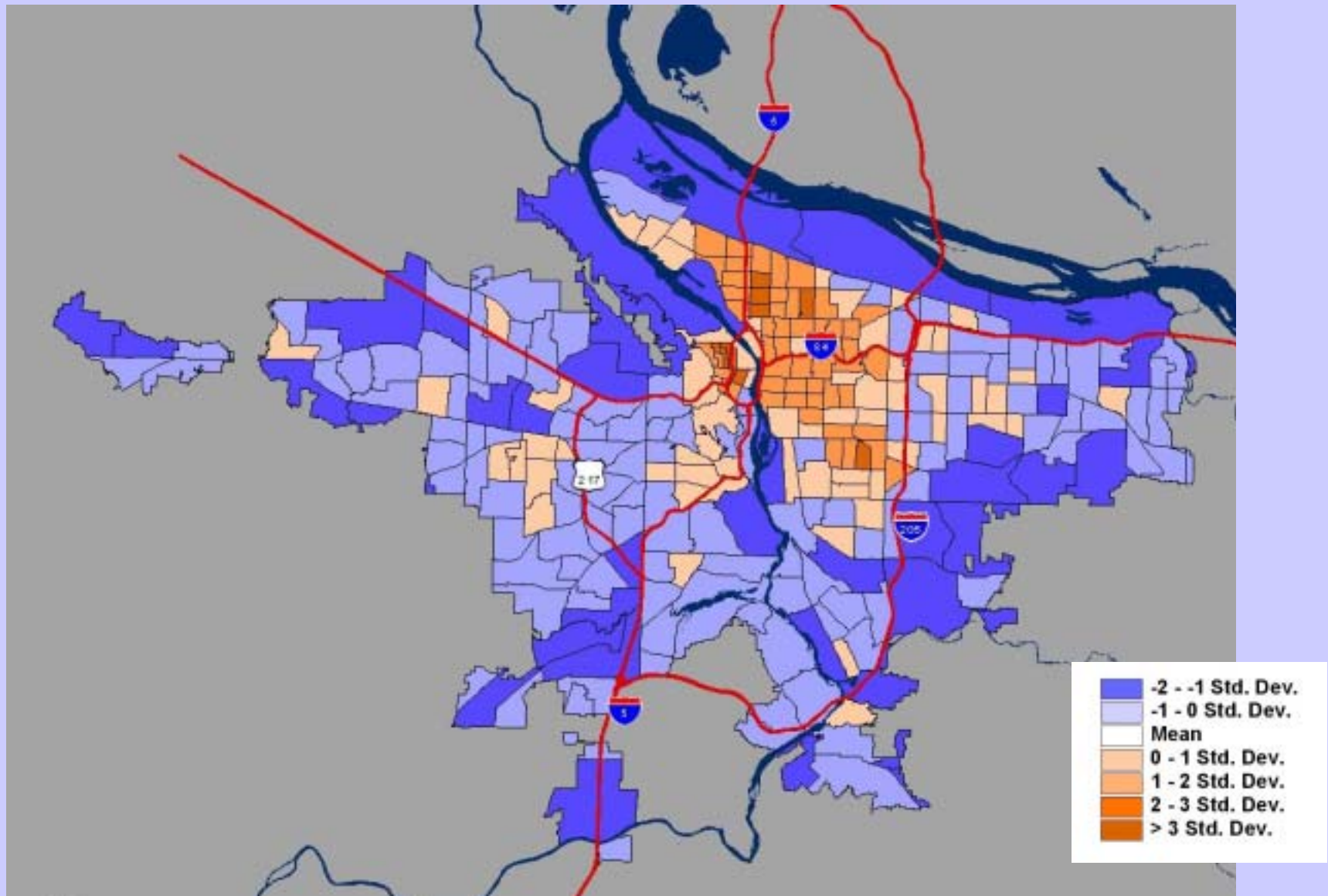
Legend

- Real nodes
- Dangle nodes
- Links nodes
- Census tract 332

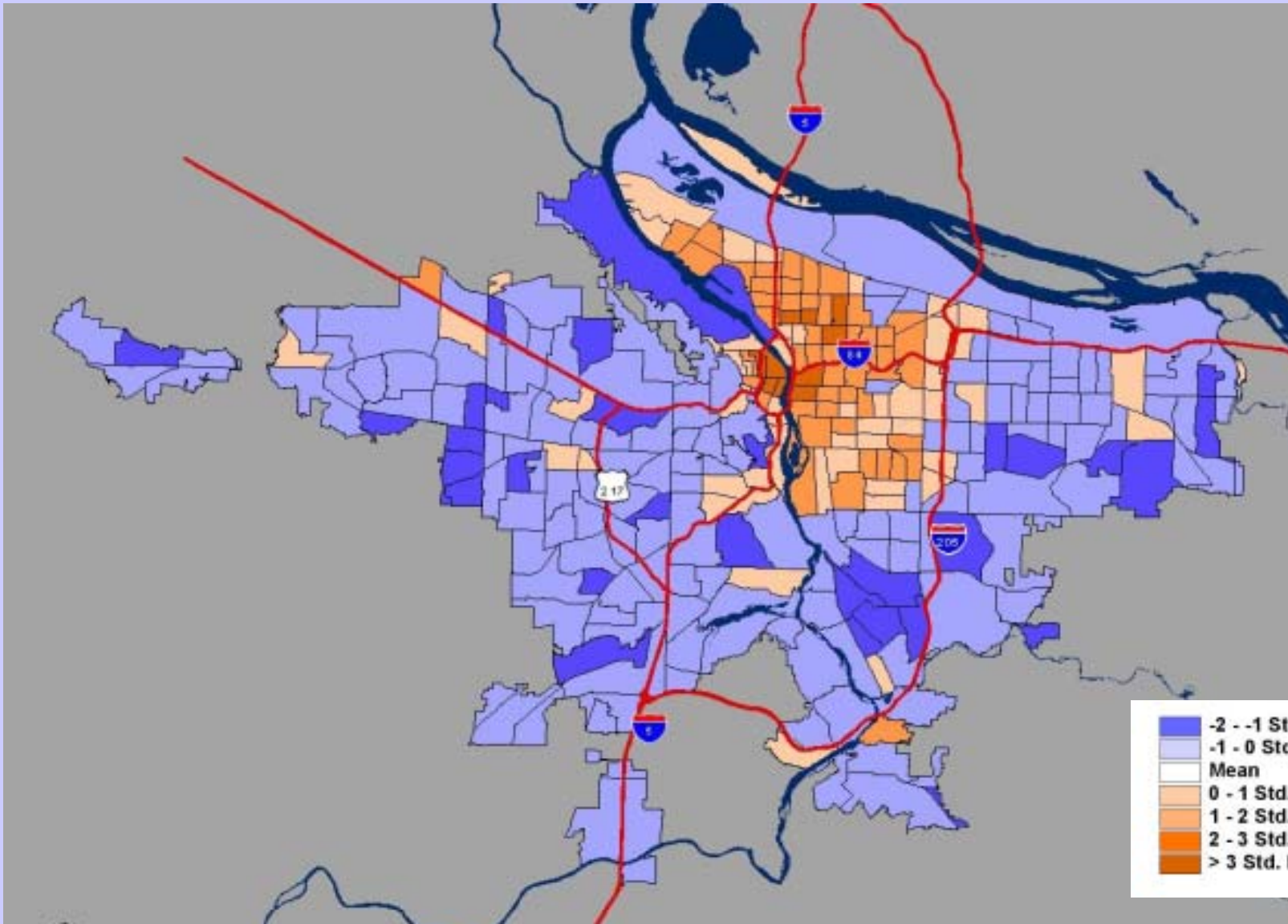
Intersection Density



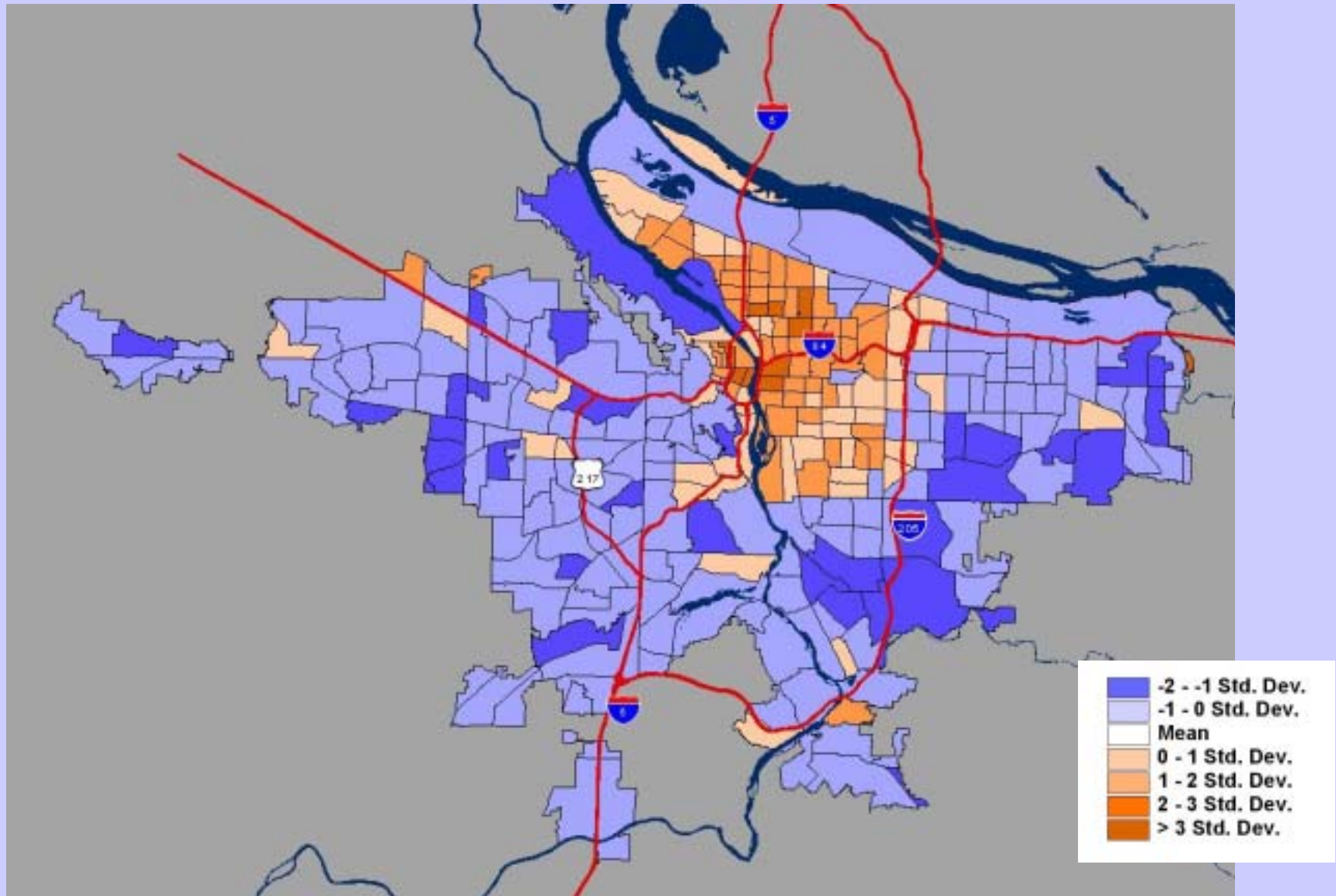
Street Density



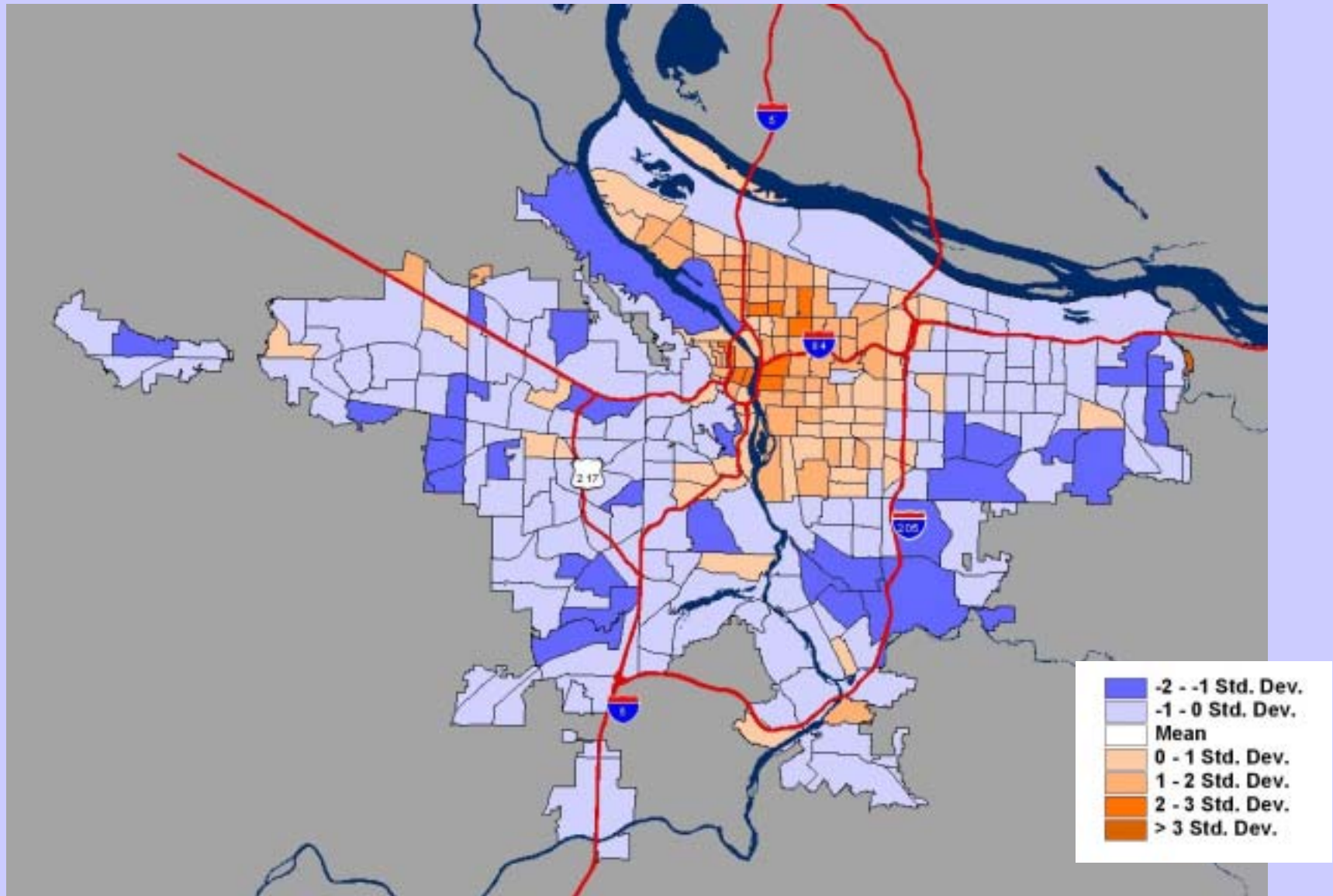
Link-Node Ratio



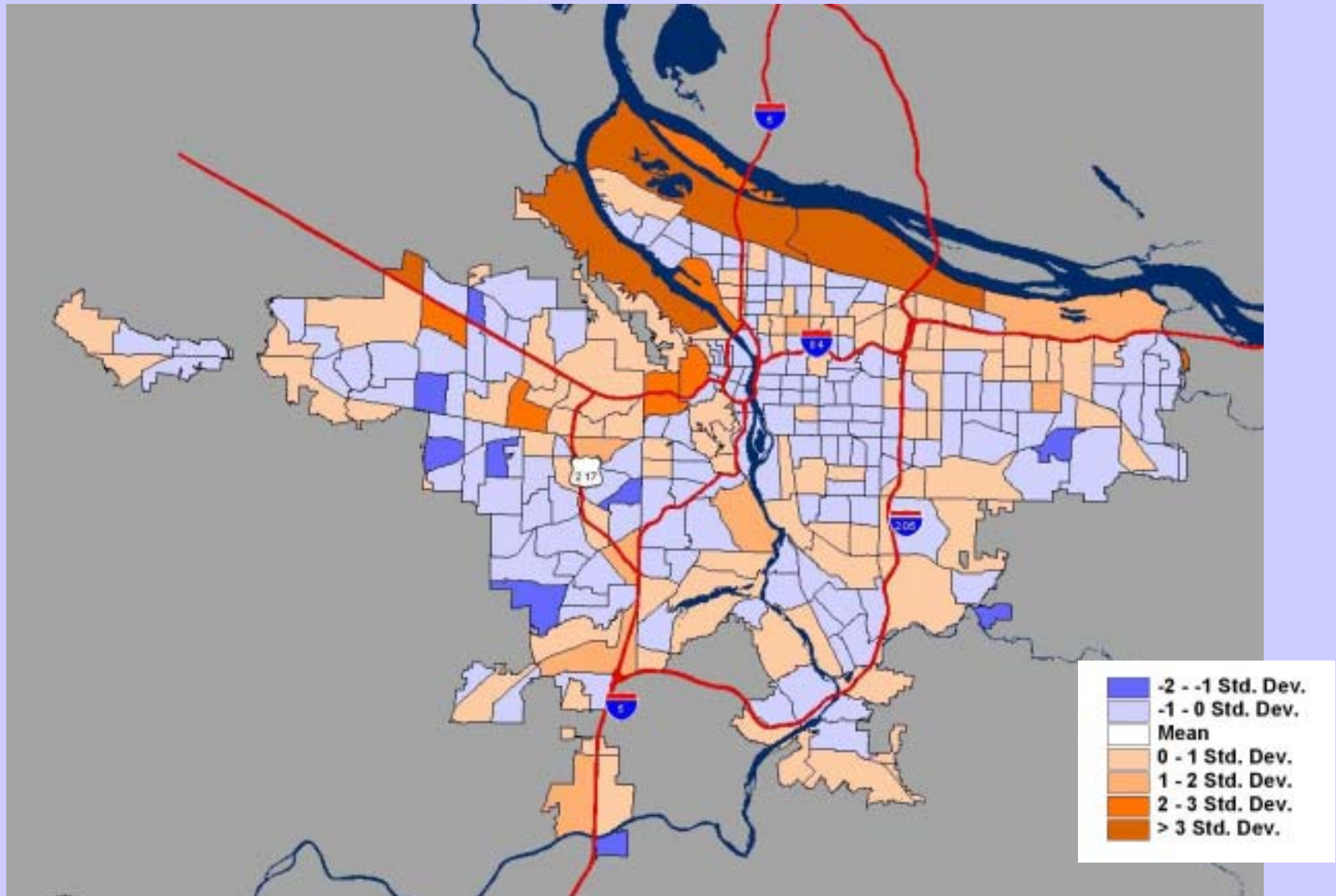
Alpha



Gamma



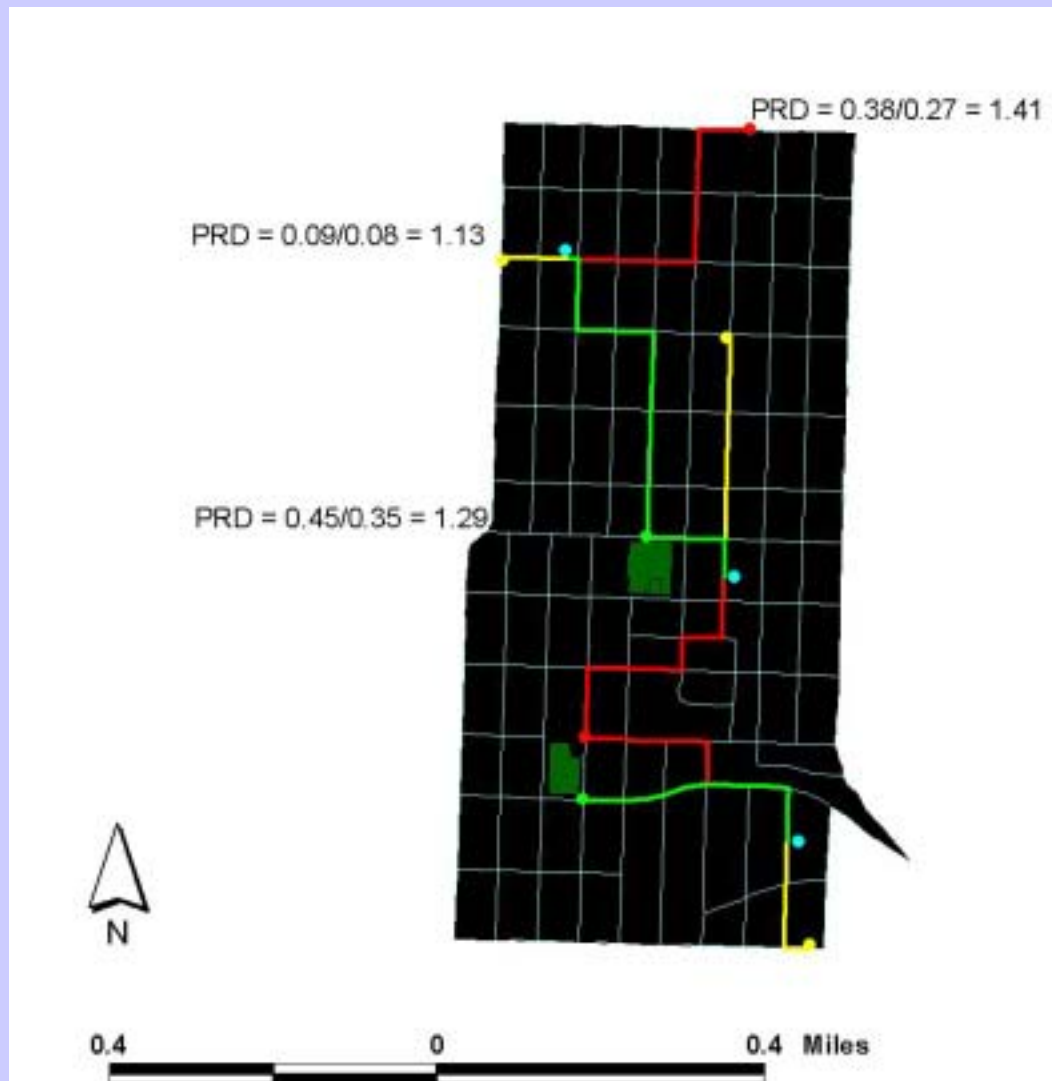
Average Block Length



Evaluating Measures

- Which connectivity measures best reflect minimizing trip distances and route directness?
- Pedestrian Route Directness:
 most direct route/straight-line
- But, difficult to use in research and policy – requires selecting points.

Applying PRD



Applying PRD

- Selected 11 census tracts
- Selected random origins and destinations within a half-mile buffer of the origin
- Calculated an average PRD

Comparing to PRD

	Correlation	significance
Connected Node Ratio	0.772	0.000
Link Node Ratio	0.762	0.000
Alpha	0.751	0.000
Gamma	0.748	0.000
Street Network Density	0.716	0.000
Intersection Density	0.700	0.000
Average Block Length	-0.101	0.577

Implementation Issues

- Alpha and Gamma more difficult to use in buffers
- Size of area matters



Next Steps

- Finish up
- Link to physical activity data

The end

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