Information Theory and the Sociological Study of Social and Spatial Inequality

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Residential Segregation

Segregation is a key mechanism that perpetuates racial stratification

https://www.flickr.com/photos/themorganburke/5580012469

"…a complex urban ecology in which race and class interact powerfully to determine individual and family well-being"

(Massey 2016:6)

Social and Spatial Context

The Relevance of Scale

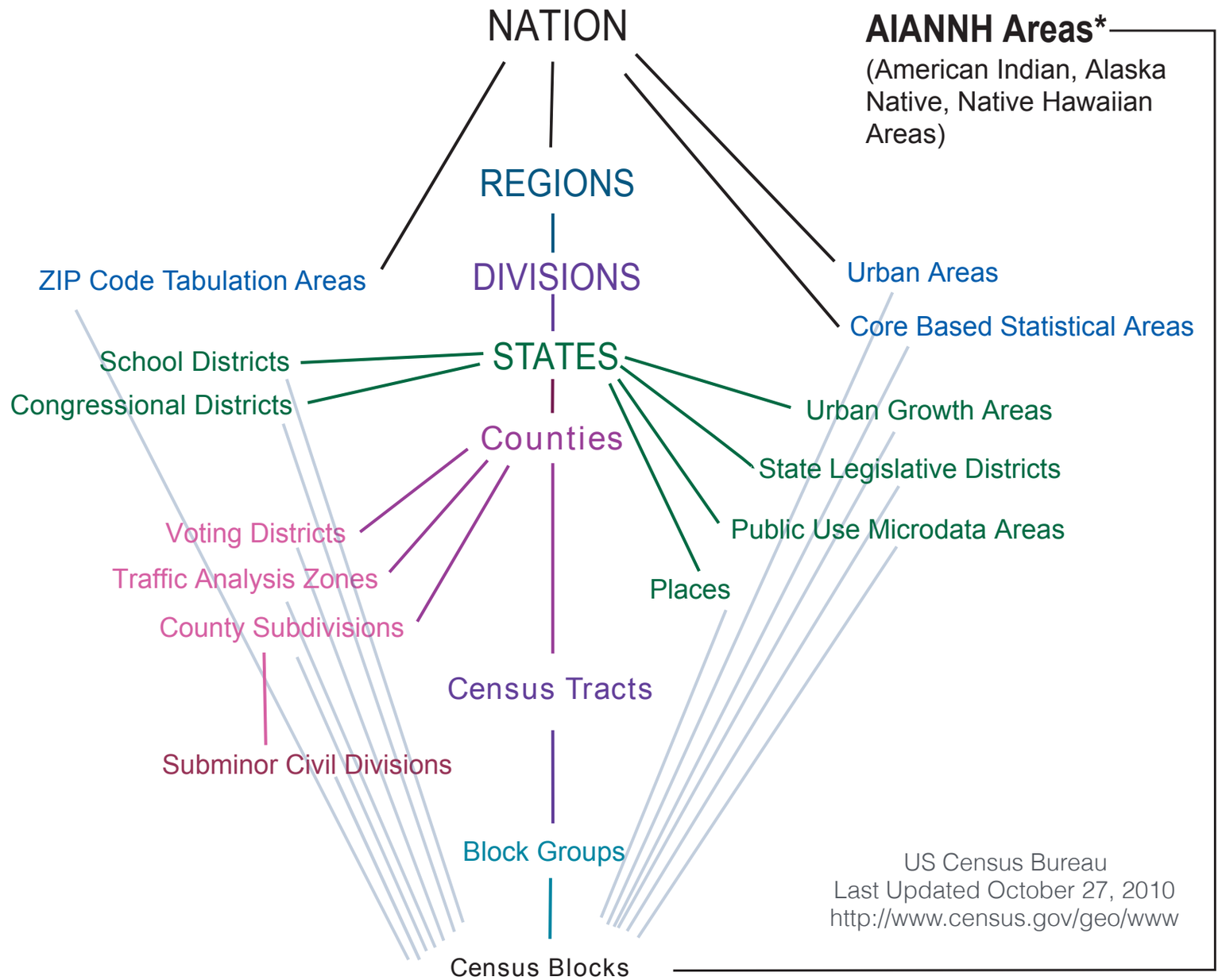
Issues:

- lack of spatial correspondence
- lack of complete spatial coverage

Approaches:

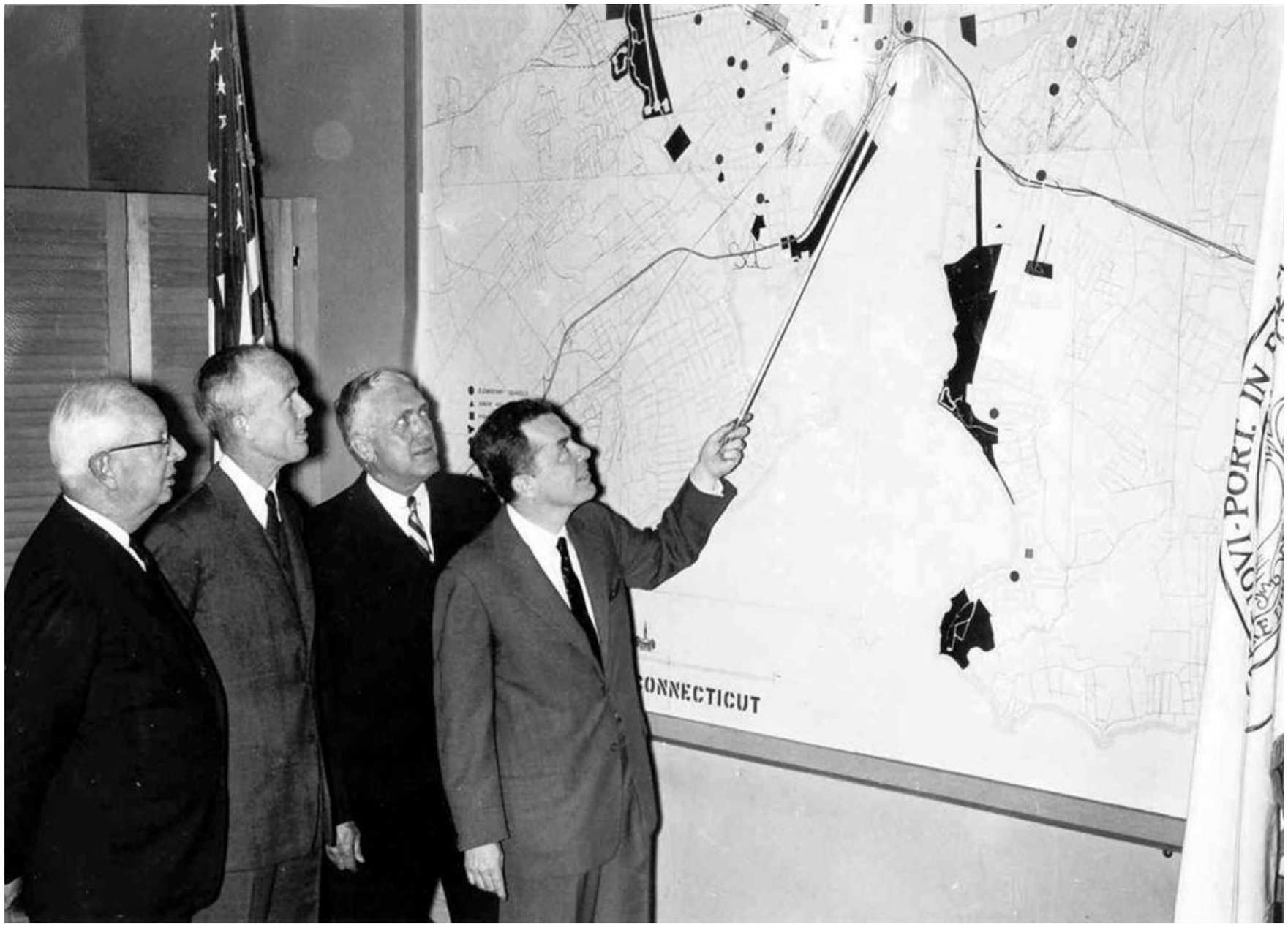
- single unit of analysis
- multiple nested units
- decomposition with nested units
- overlapping local environments (“ego-hoods”)

Standard Hierarchy of Census Geographic Entities



The Divergence Index (Roberto 2016)

A Decomposable Measure of Segregation and Inequality



http://hdl.handle.net/10079/digcoll/2253864

Highway and Urban Renewal Plans in New Haven, CT

The Divergence Index (Roberto 2016)

A Decomposable Measure of Segregation and Inequality

Based on relative entropy / Kullback– Leibler (KL) divergence
(Cover and Thomas 2006; Kullback 1987)

Residential Segregation

Measures the difference between the population composition of local areas (e.g., neighborhoods) and the overall region (e.g., a city)

- How surprising is the local population given the overall population?

Divergence Index for location i:

$$D_i = \sum_m \pi_{im} \log \frac{\pi_{im}}{\pi_m}$$

m groups
i locations

π_m group m's proportion of the overall population in the region
π_{im} group m's proportion of the population in location i

Divergence Index for the region:

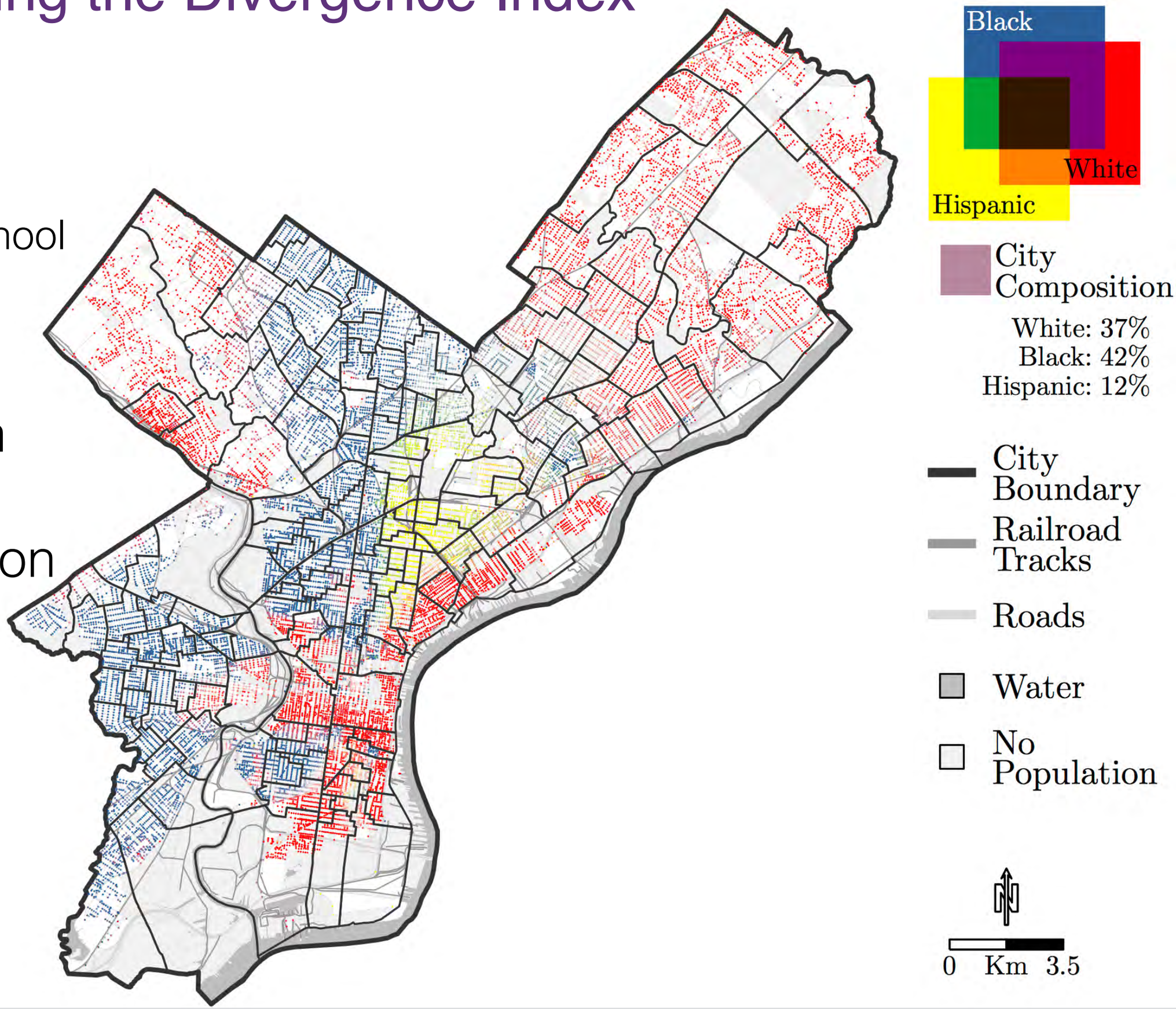
$$D = \sum_i \frac{\tau_i}{T} D_i$$

τ_i population count in location i
T population count in the region

Decomposing the Divergence Index

Segregation Within and Between School Catchment Zones

More than 2/3 of the Segregation in Philly Occurs Between School Zones



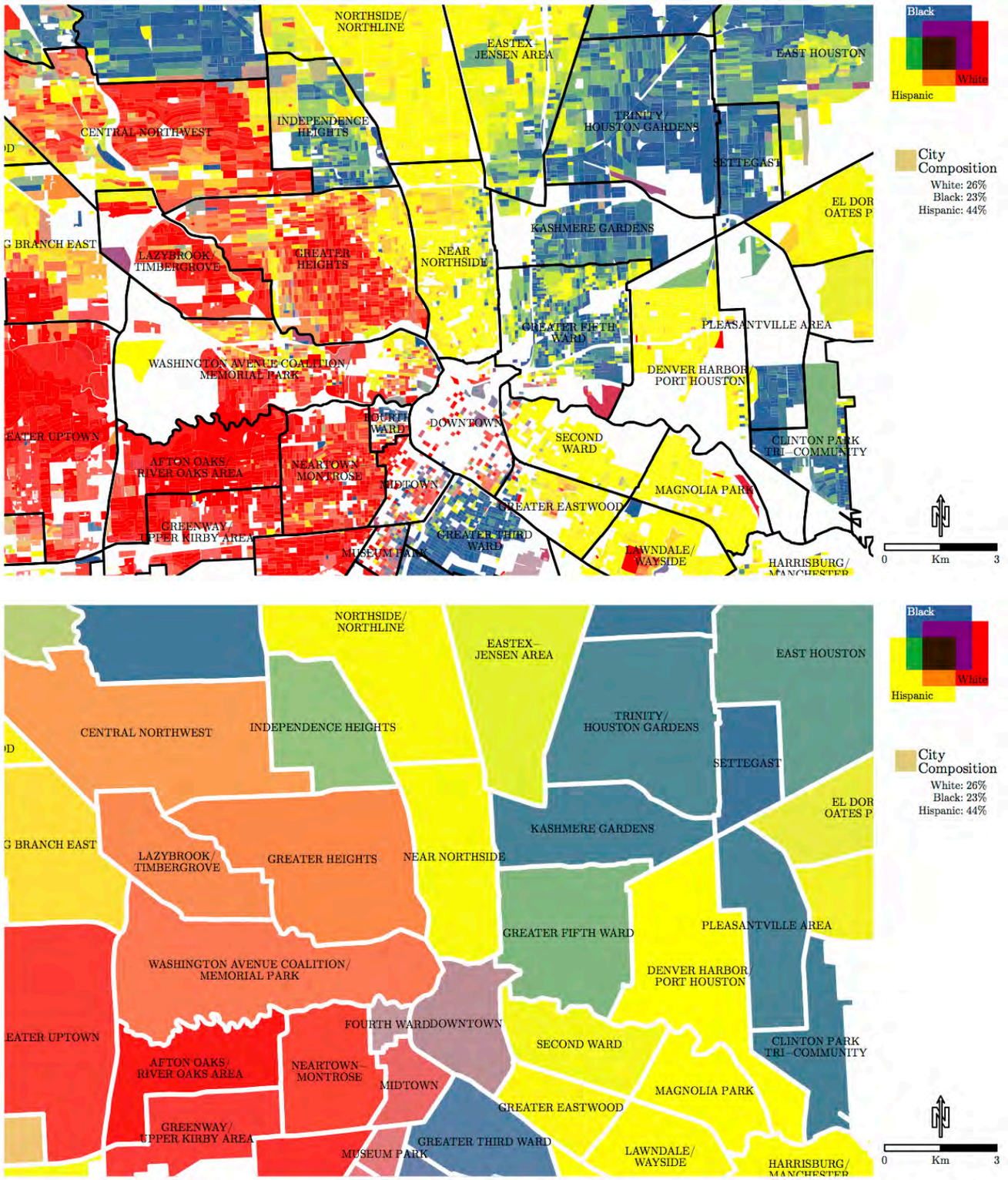
Decomposing the Divergence Index

The Spatial Structure and Local Experience of Segregation in Houston, TX

with Elizabeth Korver-Glenn

Decomposition of White-Black-Hispanic Segregation Within and Between Neighborhoods in Houston

Nearly 2/3 of the Segregation in Houston Occurs Between Neighborhoods



The Spatial Structure of Segregation

Why Does Racial Residential Segregation Persist at High Levels?

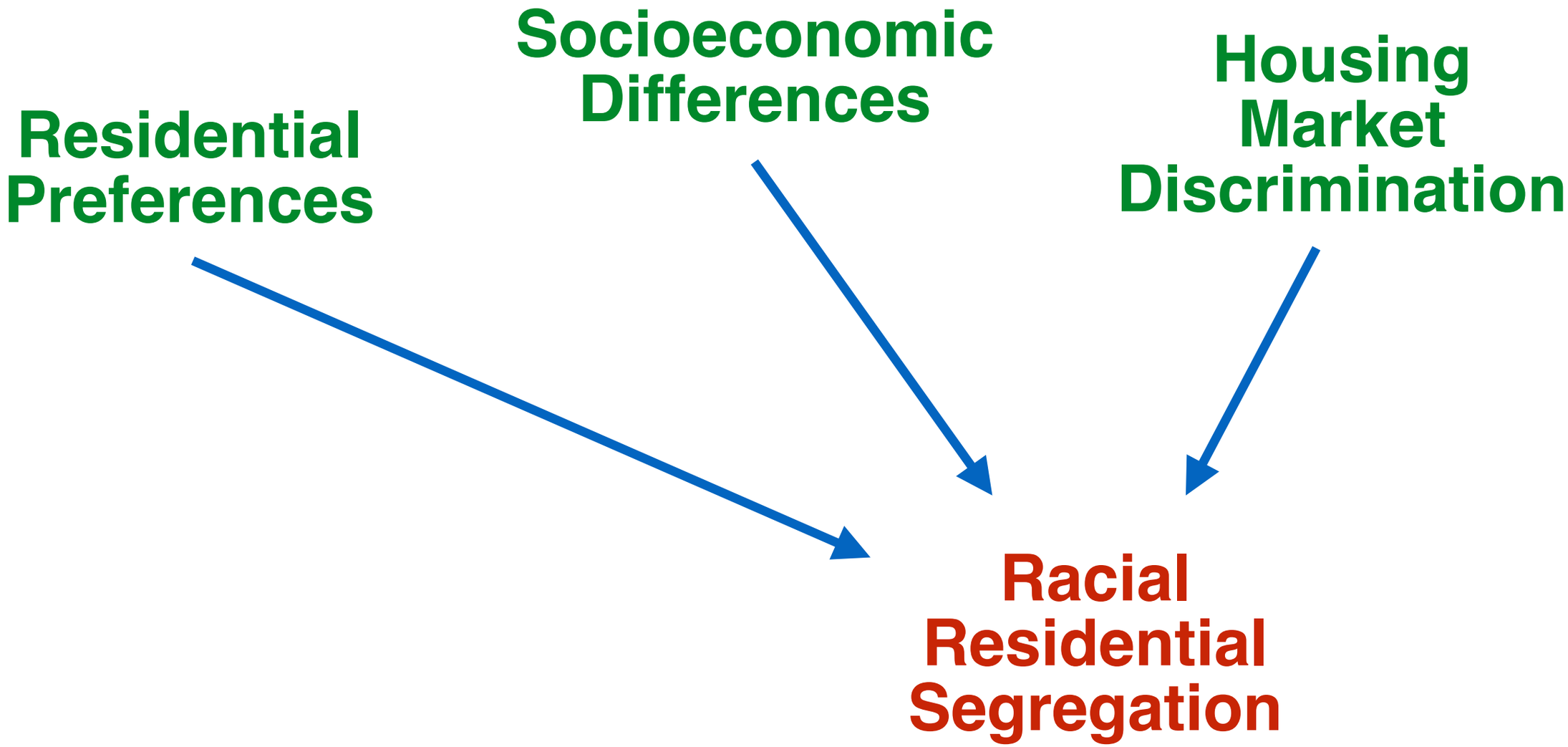
http://affordablehousinginstitute.org/blogs/us/2012/09/nobodys-on-the-fence-part-1-past.html

https://www.flickr.com/photos/thecourtyard/3979147442

http://www.streano-havens.com/data/photos/43_1Dan_Ryan_Expressway_Chicago.jpg

Why Does Racial Residential Segregation Persist?

Explanations for the persistence of segregation



Why Does Racial Residential Segregation Persist?

Explanations for the persistence of segregation

Residential Preferences

Socioeconomic Differences

Housing Market Discrimination

Racial Residential Segregation

The Spatial Structure of Segregation

"The Other Side of the Tracks"

https://medeapyralis.deviantart.com/art/The-Other-Side-Of-The-Tracks-133111804

Spatial **P**roximity and **C**onnectivity Method (Roberto 2018)

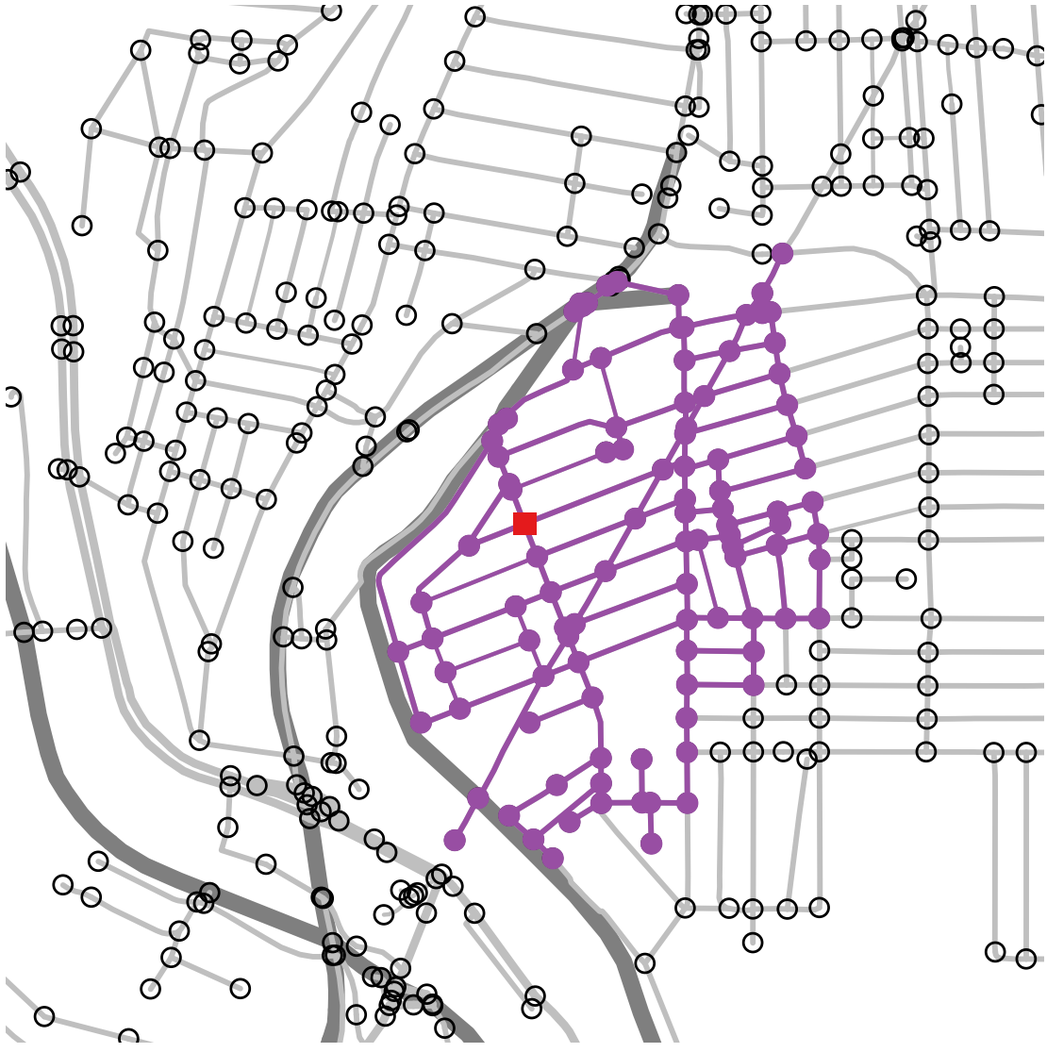
Six Steps:

1) Link the geographic data for blocks and roads
2) Estimate the population count and composition at locations on the road network
3) Calculate the distance between all pairs of locations
4) Construct local environments around each location
5) Apply proximity weights
6) Measure segregation

Spatial Proximity and Connectivity Method (Roberto 2018)

Comparing Distance Measures used to Construct Local Environments

Road Network Distance



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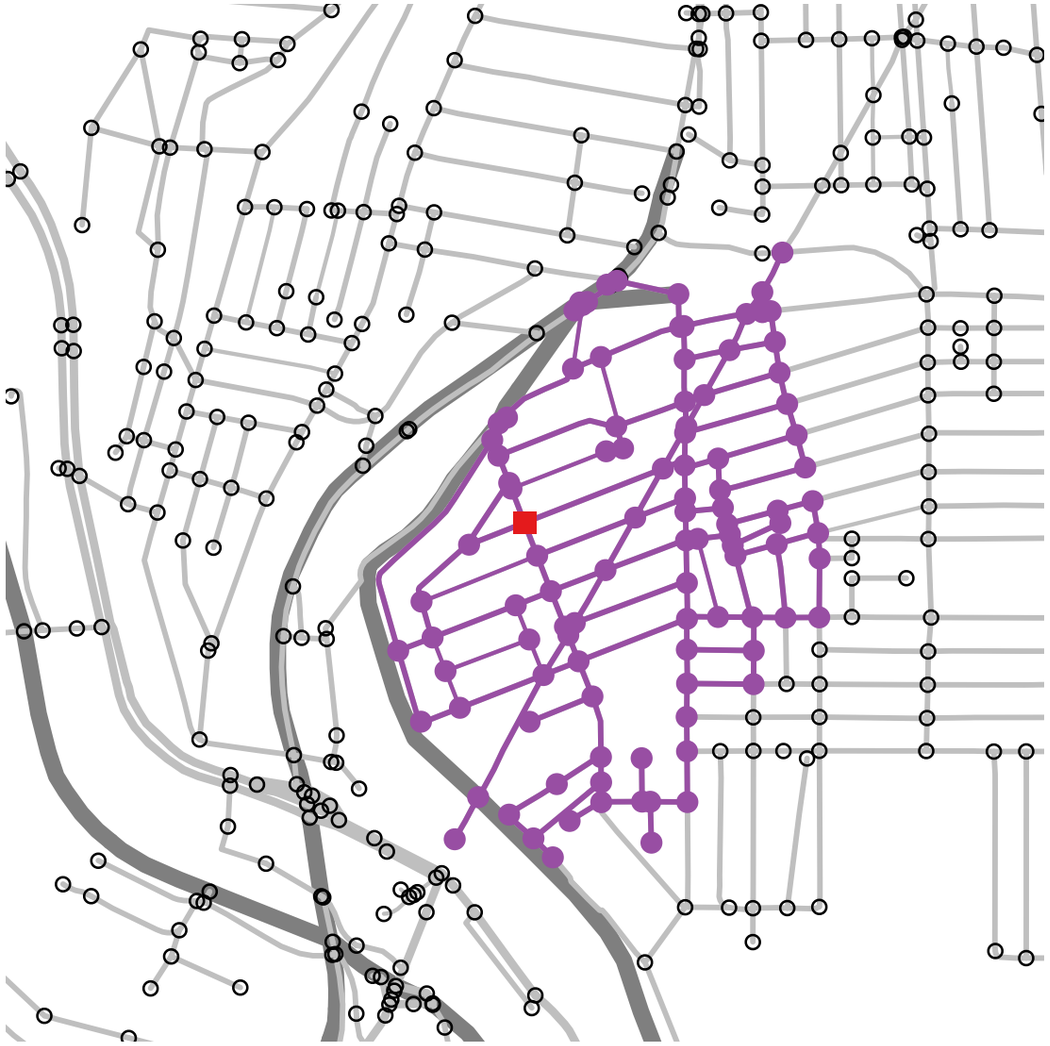
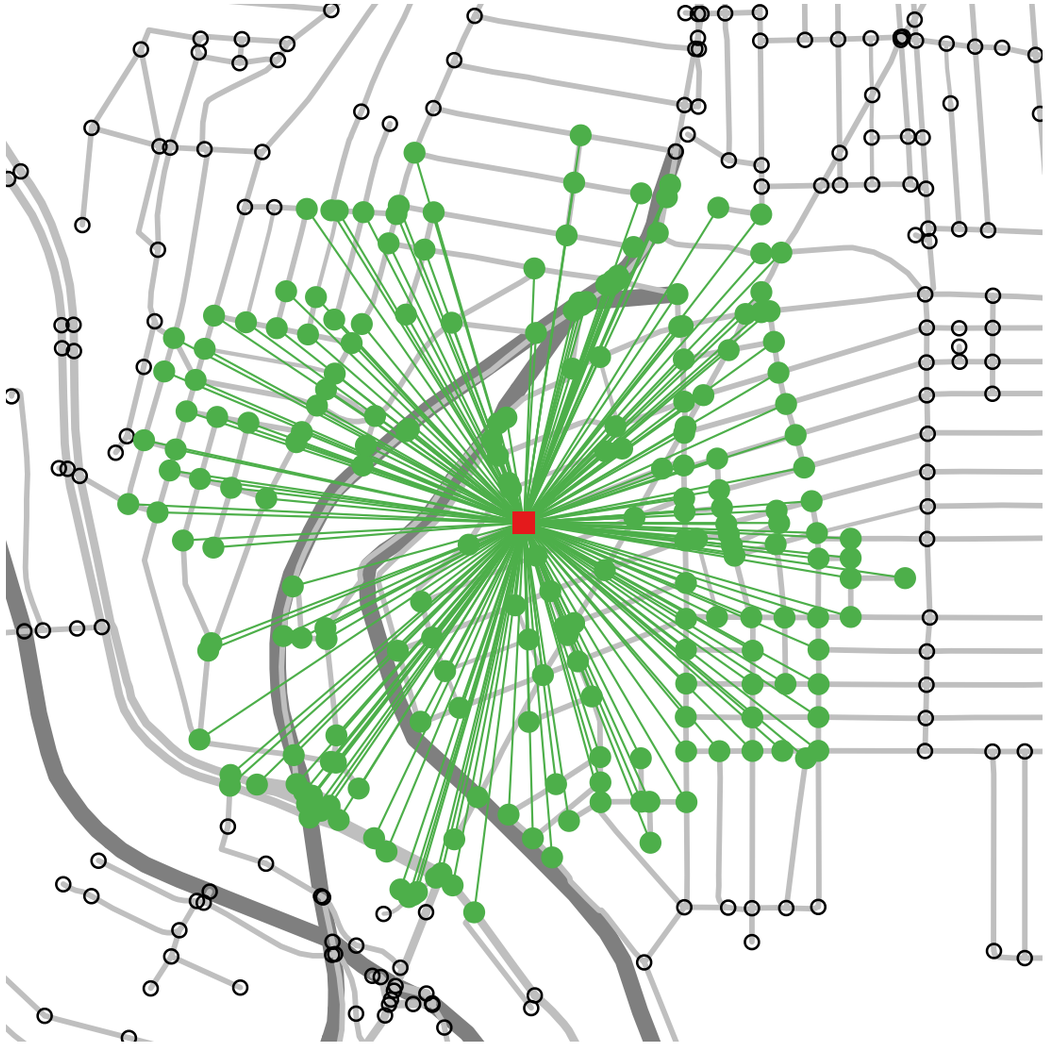


Straight Line Distance



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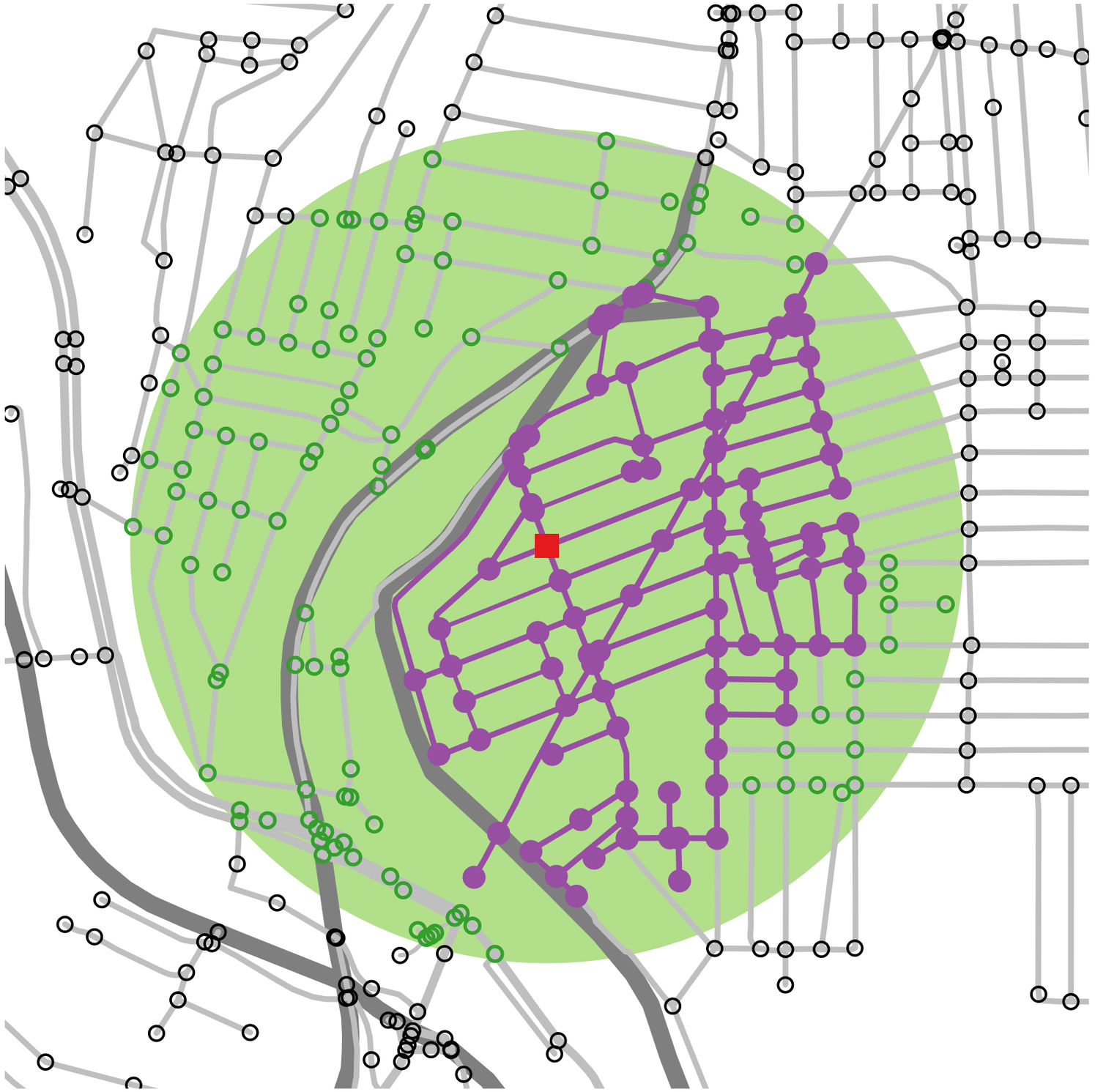


Spatial Proximity and Connectivity Method (Roberto 2018)

Measure Segregation with the Divergence Index

Divergence Index for location i's local environment with a reach of r km:

$$\tilde{D}_{ri} = \sum_m \tilde{\pi}_{rim} \log \frac{\tilde{\pi}_{rim}}{\pi_m}$$

m	groups
i	locations
r	reach of local environments

π_{rm}	group m's proportion of the overall population in the region
$\tilde{\pi}_{rim}$	group m's proportion of the proximity weighted population in location i's local environment

Divergence Index for the region:

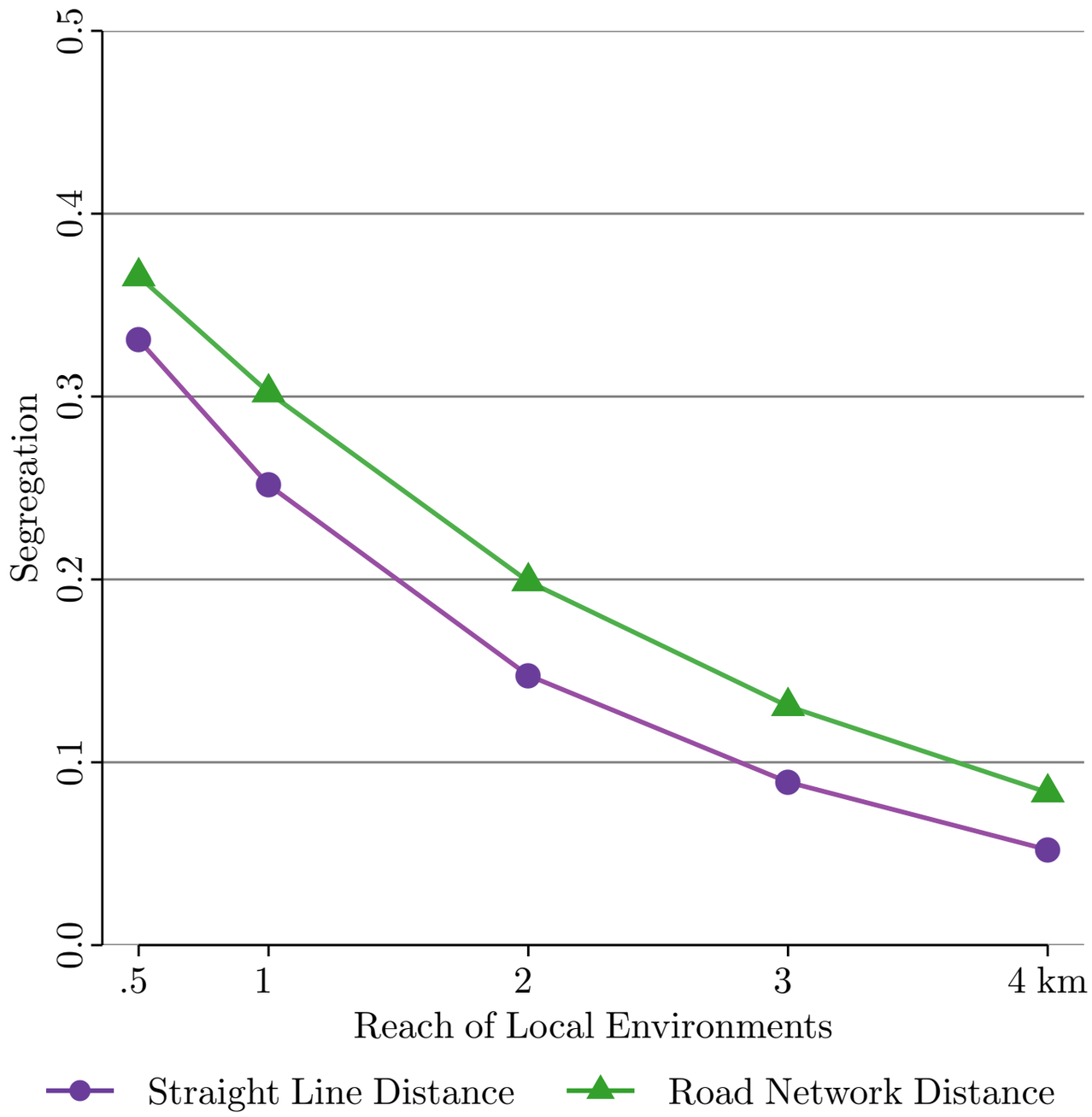
$$\tilde{D}_r = \sum_i \frac{\tau_i}{T} \tilde{D}_{ri}$$

τ_i	population count in location i
T	population count in the region

Physical Barriers and Segregation in Pittsburgh (Roberto 2018)

White-Black-Hispanic-Asian Segregation

Comparison of Road Distance and
Straight Line Distance Segregation Measures



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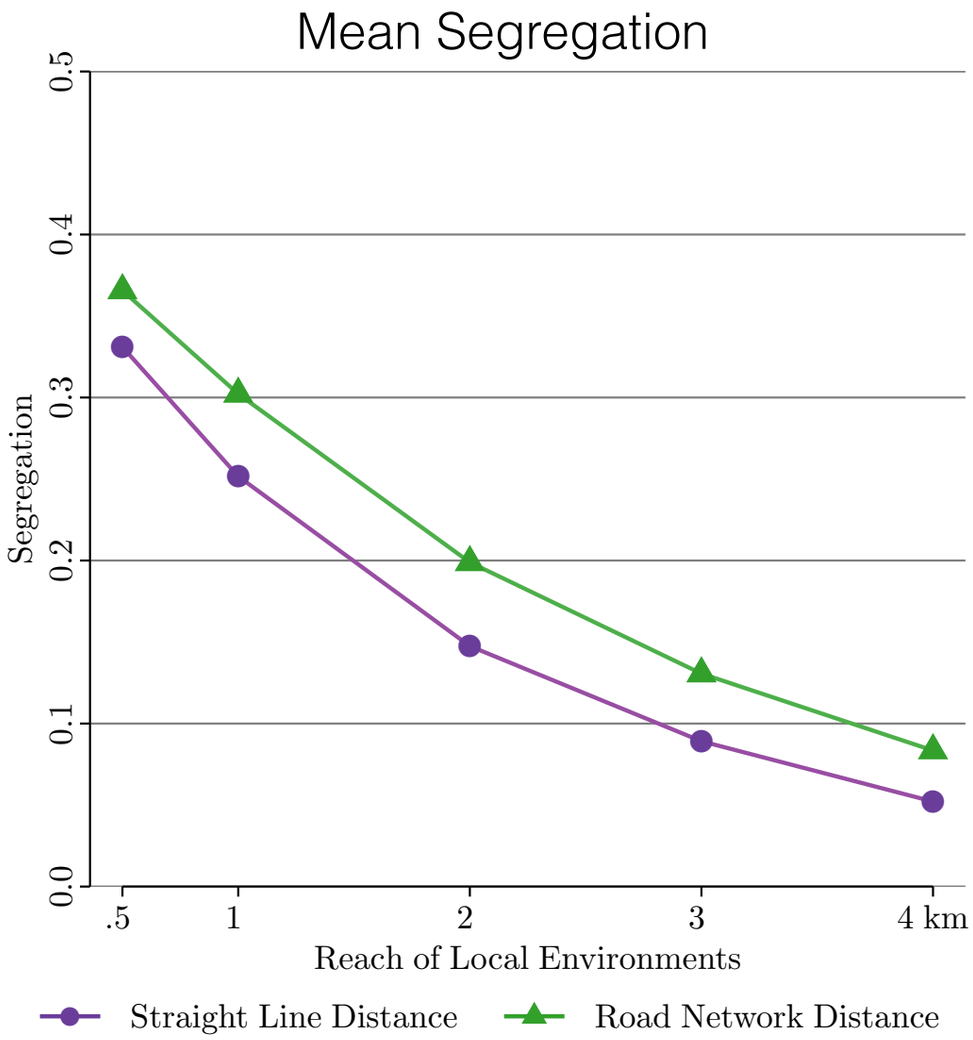
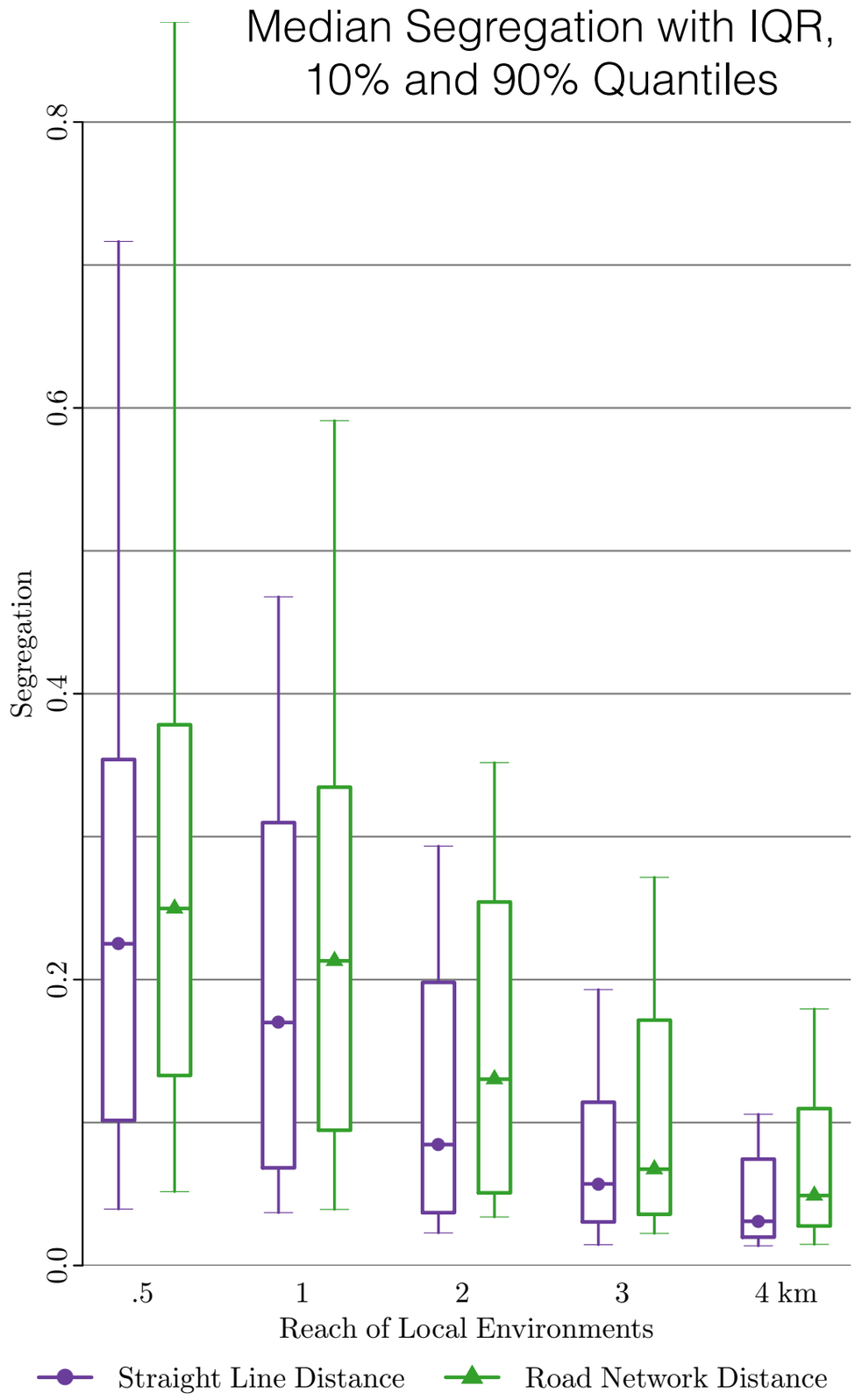
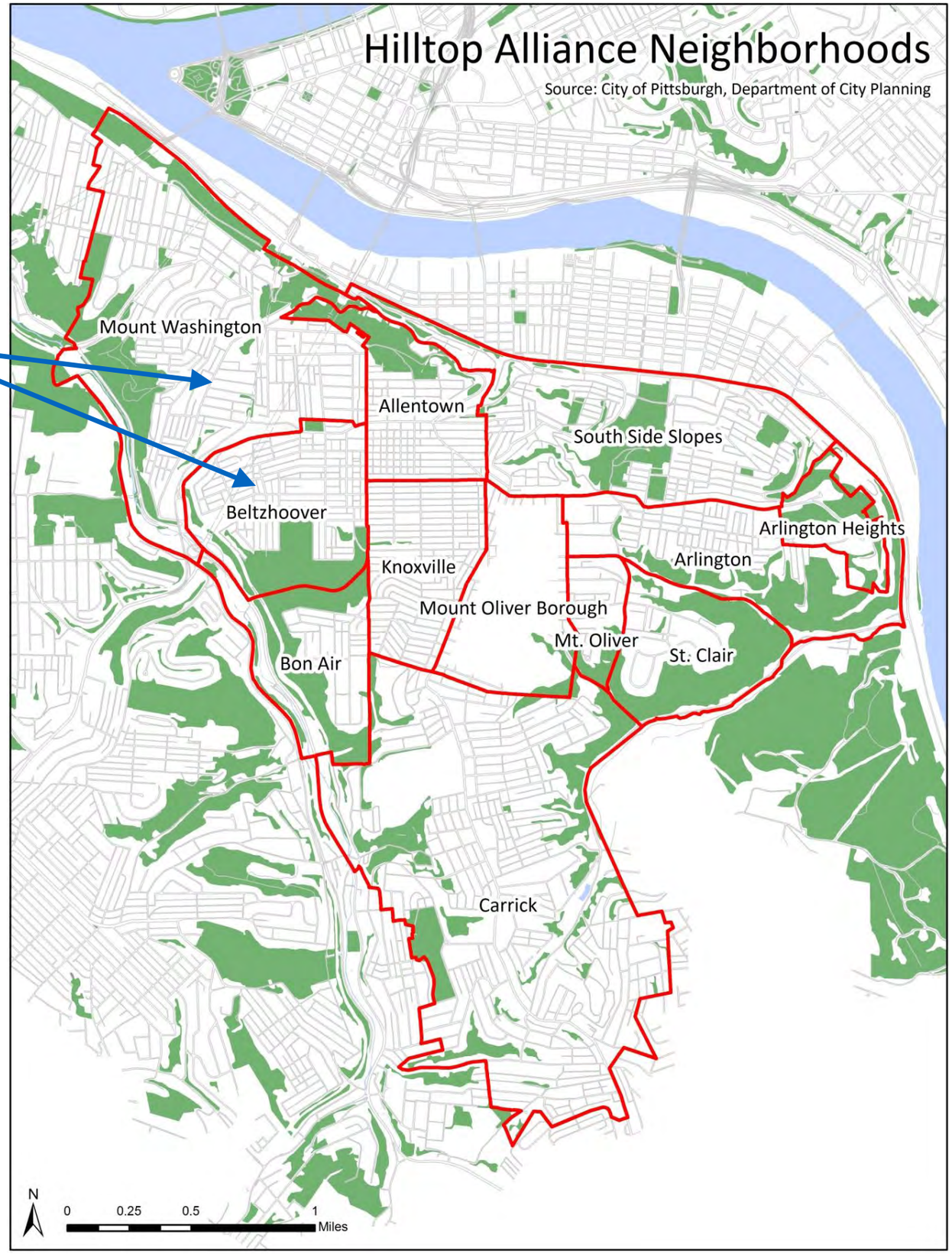




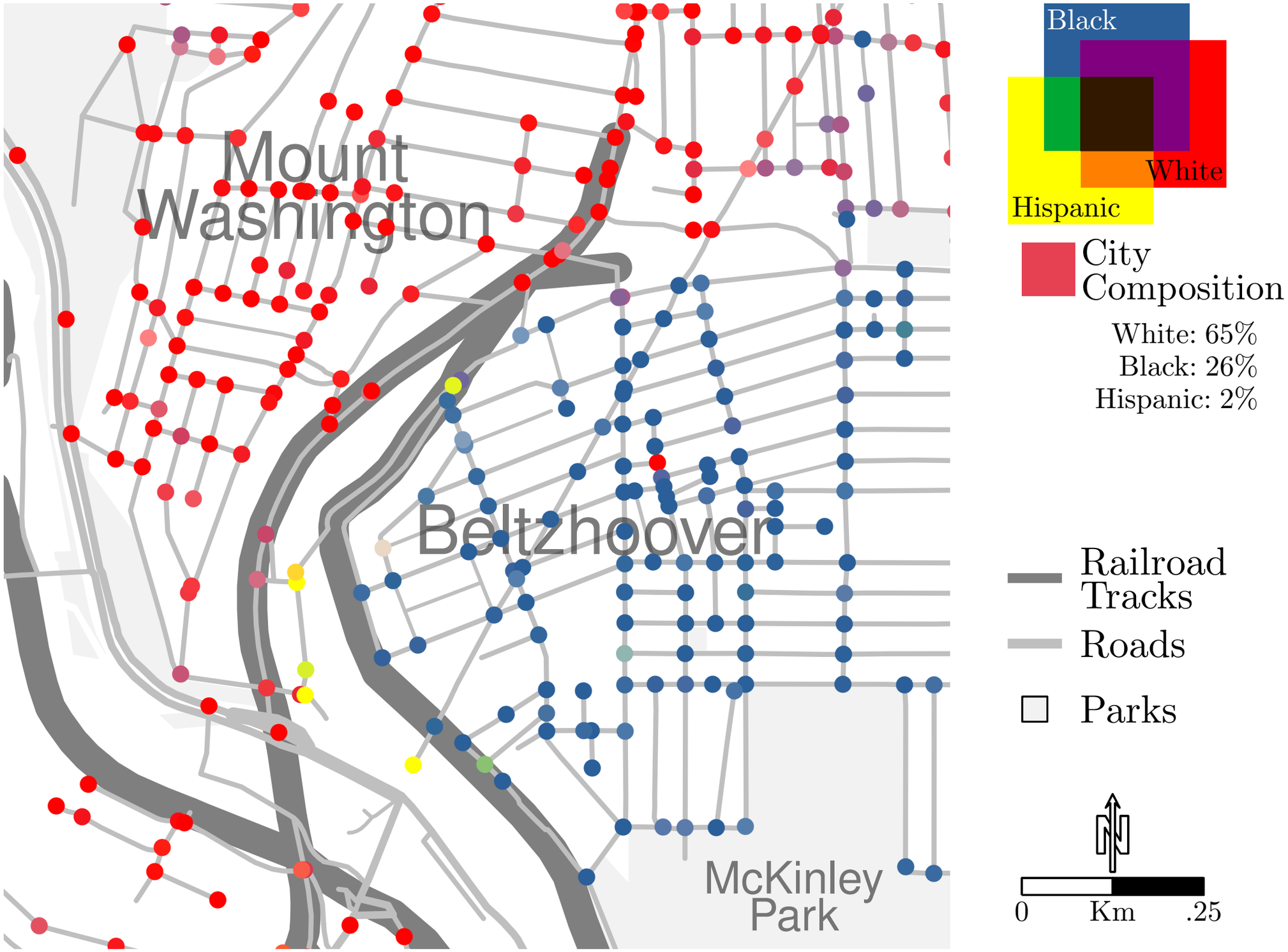
“The Other Side of the Tracks” in Pittsburgh (Roberto 2018)

The Beltzhoover and Mount Washington Neighborhoods of Pittsburgh, PA



“The Other Side of the Tracks” in Pittsburgh (Roberto 2018)

White, Black, and Hispanic Population in 2010



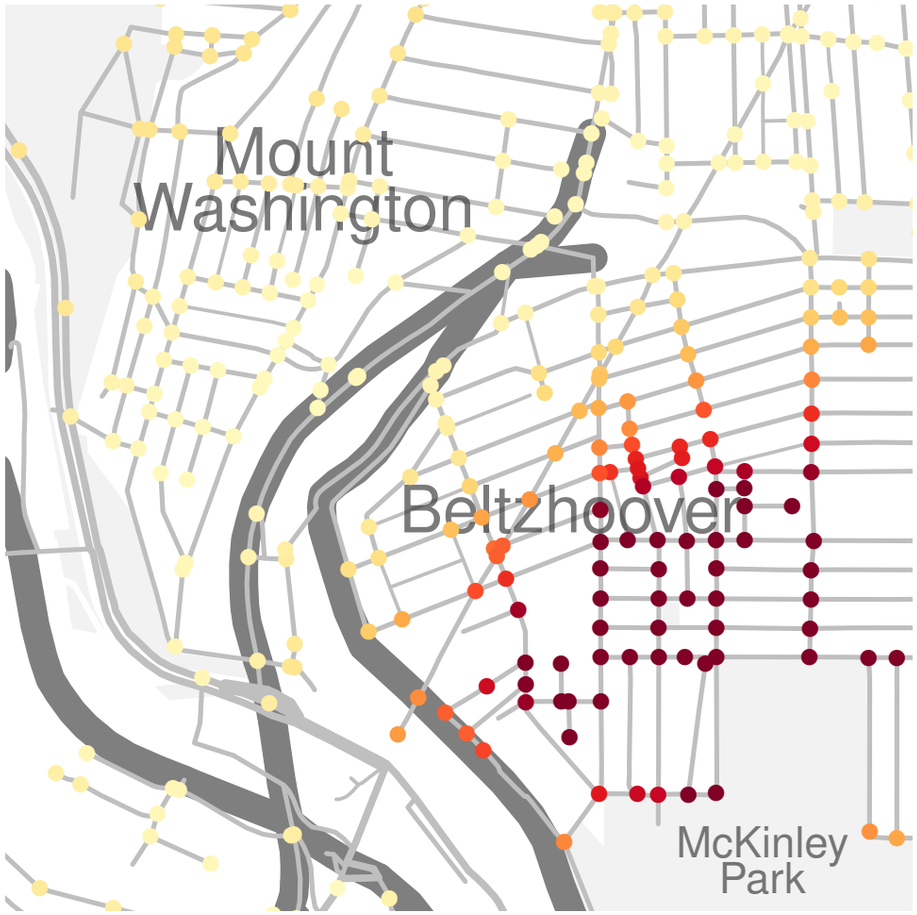
“The Other Side of the Tracks” in Pittsburgh (Roberto 2018)

White-Black-Hispanic-Asian Segregation

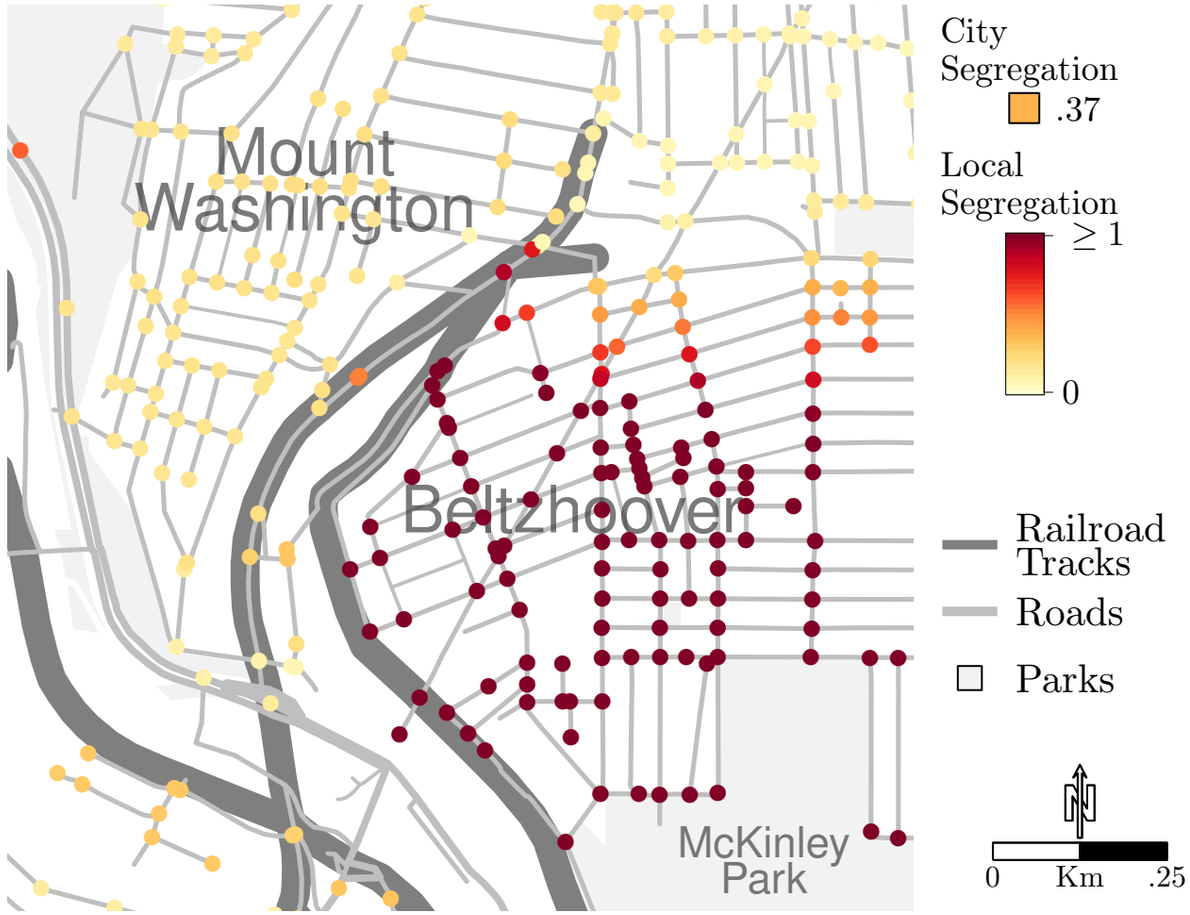
Comparison of Local Segregation Levels

(Reach of Local Environments = .5 km)

Straight Line Distance Segregation Measure



Road Distance Segregation Measure



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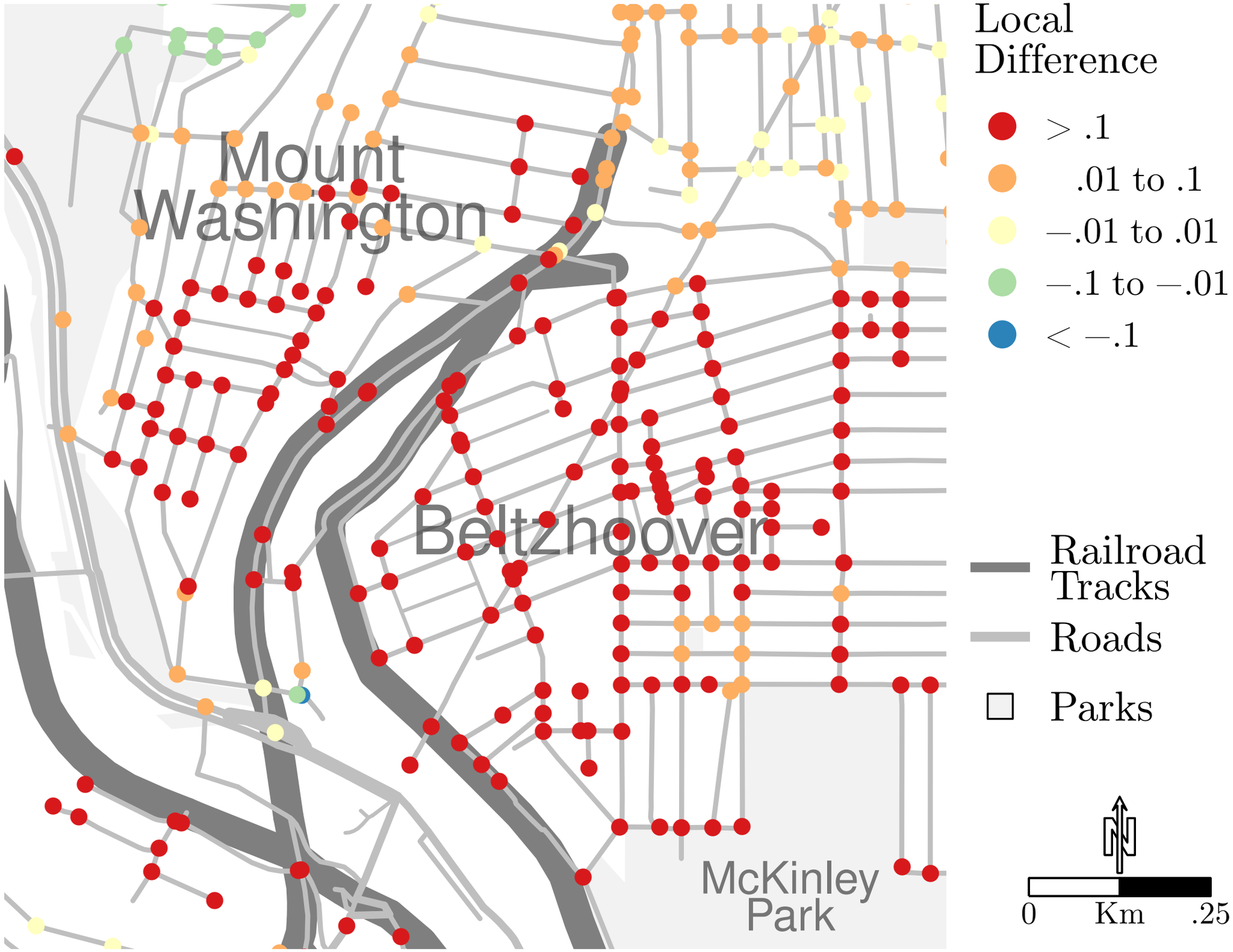

Contributions

Theoretical

Incorporates the **materiality** of the built environment into theories about the persistence of segregation

Methodological

Introduces a new method to systematically examine the relationship between the presence of **physical barriers** and **segregation** levels

Empirical

Reveals that physical barriers divide urban space in ways that **increase** segregation levels

Uncovers a new source of **variation** in the segregation experienced by city residents

Next Phase of the Research

Examine the interdependent relationship between residential segregation and the built environment of cities:

Historical Co-Evolution

How have spatial patterns of segregation and the built environment **changed** over time?

Border between Grosse Pointe Park and Detroit

http://motorcitymuckraker.com/2014/06/20/grosse-pointe-park-blocks-off-main-road-at-detroit-border-to-build-farmers-market/

Persistence of Segregation

What would happen if a physical barrier were **removed**?

How can changes to the built environment lead to **entrenched** patterns of segregation or generate a shift toward residential **integration**?

New Haven-Hamden “Berlin Wall” (1951 - 2015)

Paul Bass / New Haven Independent

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by CILIP Photos

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