Measuring Spatial Urban Segregation

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Urban Segregation

• Simply considered as a measure of spatial separation of population groups in a region.
  • Ethnicity
  • Occupation
  • Income
The Dissimilarity Index

\[ D = \frac{1}{2} \sum_{i,j} |\frac{p_{i,g}}{p_{\downarrow g}} - \frac{p_{\downarrow i,g}}{p_{\downarrow g}}| \]

(Duncan and Duncan, 1955)

\( i, j: \) index of spatial unit;
\( p_g: \) total population of group \( g; \)
\( p_{\downarrow g}: \) total population of group \( g; \)
\( p_{i,g}: \) total population of group \( g \) in spatial unit \( i; \)
\( p_{\downarrow i,g}: \) total population of group \( g \) in spatial unit \( i; \)

0: no segregation and
1: complete segregation
Why Geographic Space matters?

$D=1$

$D=1$

$D=1$

$D=1$
How to incorporate spatial relationship?

• Spatial weight matrix

\[ W = \begin{bmatrix}
0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 \\
1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\
0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\
0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0
\end{bmatrix} \]

• Spatial kernel functions
A Spatial Extension of $D$

$$D(\text{adj}) = D - \sum_{i \uparrow} \sum_{j \uparrow} |w_{ij}(z_{\downarrow i, g} - z_{\downarrow j, g})| / \sum_{i \uparrow} \sum_{j \uparrow} w_{ij}$$

(Morrill, 1991)
An Empirical Example

Greater Glasgow: Ethnicity
Ethnicity Segregation in Great Glasgow -- Global Indices

White/Others

1. Dissimilarity index $D$ (Duncan and Duncan, 1955)
2. Spatial proximity (SP) (White, 1983)
3. Adjusted dissimilarity index, $D$(adj) (Morrill, 1991)
4. $D$(w) (Wong, 1993)
5. $D$(s) (Wong, 1993)

<table>
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<tr>
<th>Year</th>
<th>% of white</th>
<th>Geography</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>2001 data zone</td>
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<td>1.643</td>
<td>0.440</td>
<td>0.444</td>
<td>0.466</td>
</tr>
</tbody>
</table>
Ethnicity Segregation in Great Glasgow -- Local Indices (1)

Location Quotient

$LQ_i > 1.2$: a significant concentration
$LQ_i < 0.85$: significant under-representation
Ethnicity Segregation in Great Glasgow -- Local Indices (2)

Local Indicator of Spatial Autocorrelation

2001

Not Significant
High-High
Low-Low
Low-High
High-Low
An issue with Spatial Measures

- Modifiable Area Unit Problem (MAUP) (Openshaw, 1984)
  - Aggregation
  - Zoning

Patterns are dependent upon the scale of observation!