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The Dissimilarity Index: A Tutorial

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This blog shows how to calculate the index of dissimilarity and provides examples about its possible uses in indicating levels of residential racial segregation

The Index of Dissimilarity (DI)

As noted in the earlier blog, the DI measures the evenness with which two mutually exclusive groups (often racial groups) are distributed across the geographic units that make up a larger geographic entity. Its minimum value is zero, or no dissimilarity, and its maximum value is 1 (or 100%), or complete separation of each race from the other. Here is how to measure it.

Assume:

b_i = the Black population of the i^{th} areal unit, e.g. census tract

B = the total Black population of the large geographic entity for which the ***index of dissimilarity*** is being calculated.

w_i = the White population of the i^{th} area unit, e. g. a census tract

W = the total White population of the large geographic entity for which the ***index of dissimilarity*** is being calculated

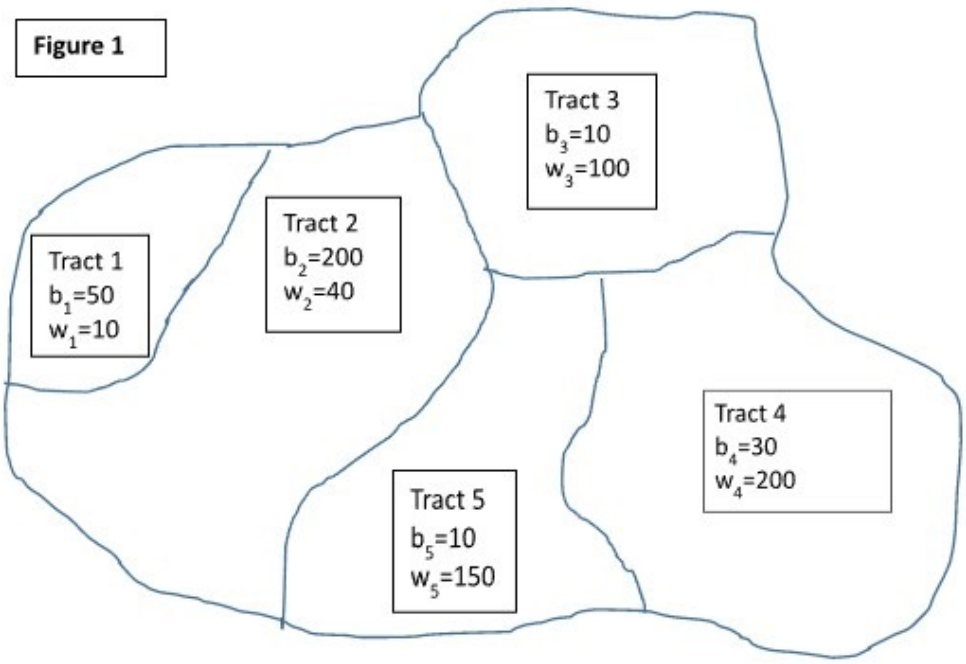
Then the ***index of dissimilarity*** measuring the segregation of Blacks from Whites is

$$(1/2)\ \Sigma\ |b_i/B - w_i/W|$$

The summation is over the component areal units such as census tracts. The value of this index is statistically independent of the relative size of the groups used in its computation. It can be expressed as a 0 to 1 (share) or a 0 to 100 (percentage) number.

An Example

Consider the following hypothetical city with five census tracts and the number of Black and White households in each tract (Figure 1). A cursory glance would show that Blacks are the majority in tracts 1 and 2 and Whites in tracts 3, 4, and 5. How would this distribution appear in a dissimilarity index?



Hypothetical City

Using the formula above for the DI, we make the following calculations:

$B = \Sigma_i b_i = 50+200+10+30+10 = 300$

$W = \Sigma_i w_i = 10+40+100+200+150 = 500$

$b_i /B = 50/300 = .1667$

$w_i /W = 10/500 = .0200$

$|b_1 /B – w_1 /W| = .1467$, for example

We construct Table 1 and calculate the DI.

Table 1: Calculating the Dissimilarity Index for Hypothetical City with Five Census Tracts						
Tract	b_i	w_i	bi/B	wi/W	$b_i/B - w_i/W$	$\lvert b_i/B - w_i/W \rvert$
1	50	10	0.17	0.02	0.15	0.15
2	200	40	0.67	0.08	0.59	0.59
3	10	100	0.03	0.20	-0.17	0.17
4	30	200	0.10	0.40	-0.30	0.30
5	10	150	0.03	0.30	-0.27	0.27
	300	500			sum |bi /B – wi /W|	1.47
					div by 2	**0.73**

The share 0.73 (or 73%) is quite high on the DI range of 0 to 1 (0 to 100), reflecting a high level of racial separation of the races and requiring that 73% of Blacks must move to achieve full integration.

The 100% Racially Integrated City

In this example, 73% of Blacks must move In order for Blacks to be evenly distributed across the five census tracts; 300/800 or 37.5% of the population in each tract would then be Black, matching the Black city-wide share of total city population. We assume the White population remains constant in each tract. The total population in each tract would therefore change as a result of these moves.

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In this example, Blacks would have to move from tracts 1 and 2 to tracts 3, 4, and 5 to achieve an even distribution across the city. If 44 Blacks from census tract 1 and 176 Blacks from census tract 2 move, these tracts will meet the 0.375 Black share requirement. The total number of Blacks needed to be relocated from tracts 1 and 2 to tracts 3, 4 and 5 is 44 + 176 =220, or 73% of the city's Black population, as indicated by the DI. Consider the following algebraic calculation to determine the final location of Blacks by census tract.

1. State the share of the population that is Black

$B/(B+W) = 0.375$

2. Multiply both sides by (B+W)

$B = 0.375(B + W)$

3. Expand the terms in the parentheses

B = 0.375B + 0.375W

4. Subtract .375B from both sides, switch sides, and simplify B

0.375W = B – 0.375B

0.375W = 0.625B

5. Divide both sides by .625 and switch sides

B = (0.375/0.625)W = 0.6W

The Black population in each tract will therefore equal 60% of the white population in each tract, shown in the Table 2.

Table 2: Black Moves to Achieve Even Distribution

Tract	b_i	w_i	t_i	Black Moves[a]	b_{i*}	w_i	t_{i*}
1	50	10	60	-44	6	10	16
2	200	40	240	-176	24	40	64
3	10	100	110	50	60	100	160
4	30	200	230	90	120	200	320
5	10	150	160	80	90	150	240
	300	500	800		300	500	800

[a]Negative values indicate Black moves out of Black census tracts; positive values indicate Black moves into predominantly White census tracts.

The hypothetical city would now be changed as shown in the figure below.