Global Spatial Autocorrelation

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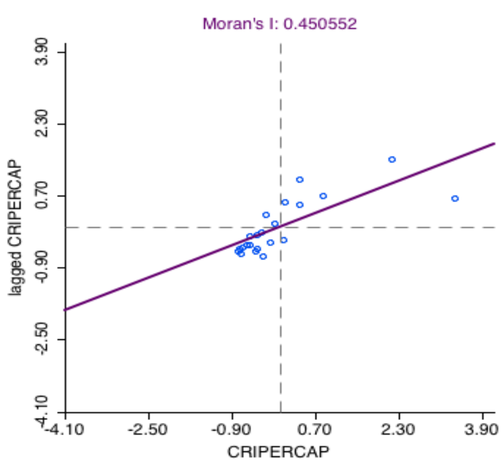
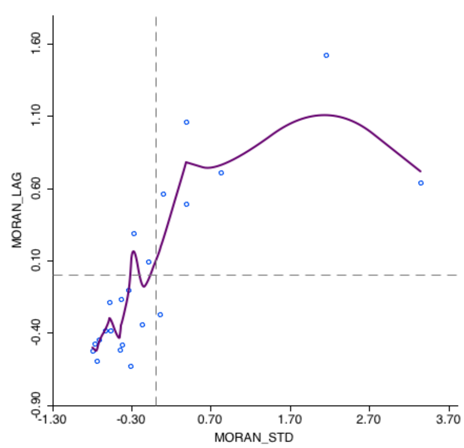
The main purpose of this report is to illustrate and compare global spatial autocorrelations using different spatial weights for the crude crime rates and EB standardized crime rates in the city of Vancouver, Canada. The city of Vancouver is divided into 22 communities with different numbers of neighboring communities. Here we want to explore the difference or similarity in the strength of global spatial autocorrelation in terms of Moran's I using both the contiguity-based and the distance-based spatial weights.

1. Moran's I using queen contiguity weight

First we measure the global spatial autocorrelation using queen contiguity weight for the crude crimes rates in Vancouver. We can see from the left graph below that the global spatial autocorrelation is relatively substantively strong as indicated by a relatively large Moran's I value 0.450552, and the range of lagged crime rates is smaller than the range of the original crime rate in terms of standard deviation from the mean. To check if this is statistically significant, we carry out a permutation inference by selecting 999 permutations and find that the global spatial autocorrelation in terms of the Moran's I is indeed significant as indicated by the large z-value 4.6830.

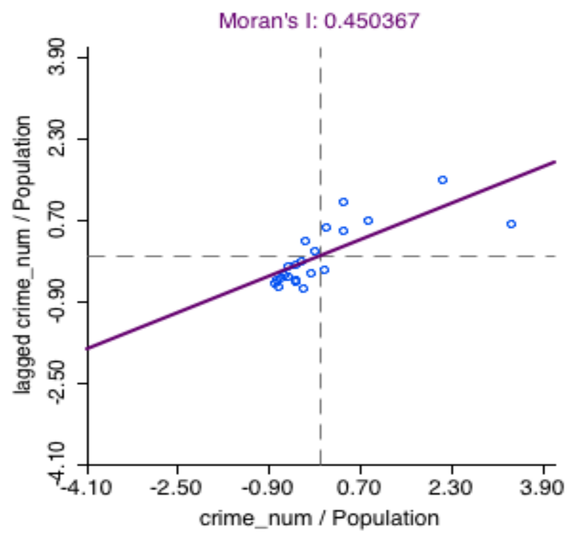




In addition, we want to identify potential structure breaks in the pattern of spatial autocorrelation using the Lowess smoother. We can observe from the right graph above that some areas have very steep curve with positive slope compared with other areas which suggests stronger positive spatial auto correlation.

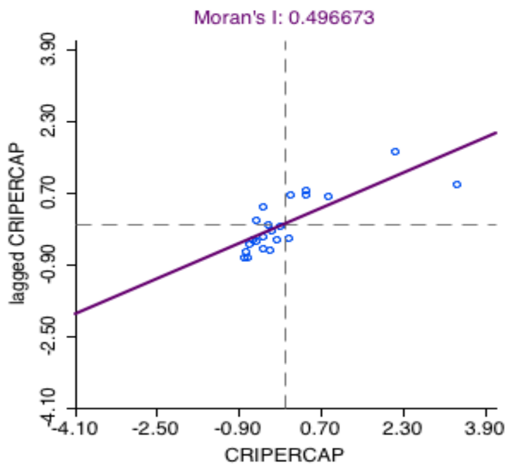
Next we turn to the global spatial autocorrelation for EB standardized crime rates using queen contiguity weight. As we can observe from the graph below, the Moran's I value

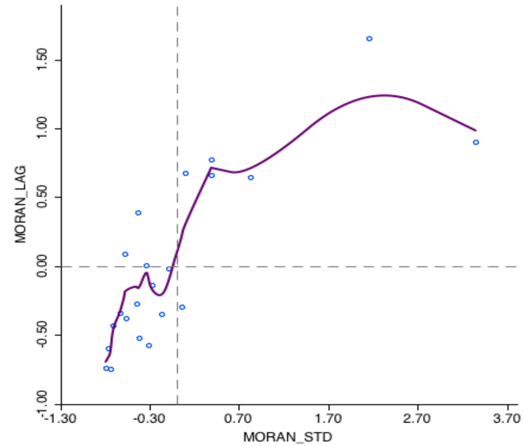
0.450367 is almost the same as the one for the crude crime rate, which indicates small intrinsic instability of the crime rates. Using permutation inference with 999 permutation yields a pseudo p-value of 0.001 with an associated z-value 4.2975.



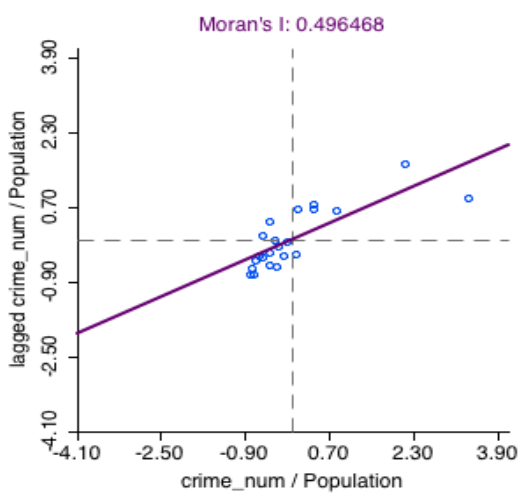
2. Moran's I using distance contiguity weight with default distance threshold

As we can see from the graph below, for the crude crime rate, the range of lagged crime rates is smaller than the range of the original crime rate in terms of standard deviation from the mean, and the Moran's I value 0.496673 is larger compared with the one using the queen contiguity weight, which indicates a stronger global spatial autocorrelation, which may be due to the different definition of neighboring communities using distance contiguity weight, which limits the neighbors to a smaller spatial for each community are and thus increase the global spatial autocorrelation. Using permutation inference with 999 permutation yields a pseudo p-value of 0.012 with an associated z-value 3.5247. We also want to detect any potential structure breaks in the pattern of spatial autocorrelation using the Lowess smoother in this case. As we can see from the graph below, some areas come with very steep curve with positive slope compared with other areas, which are indications of structure breaks.





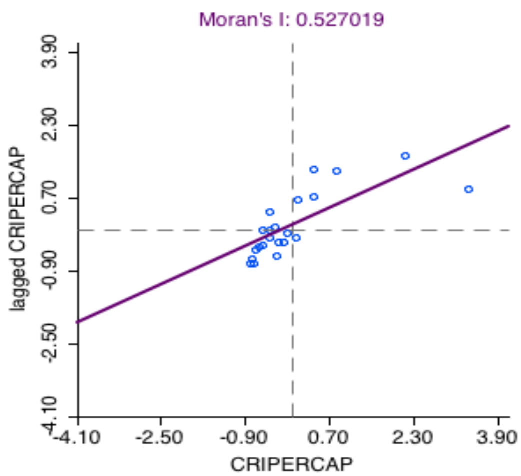
Next, we turn to the global spatial autocorrelation for EB standardized crime rates using distance contiguity weight with default distance threshold. We can see from the graph below that the Moran's I is almost the same as the one for the raw crime rates, which suggests small intrinsic instability of the crime rates. However, due to a different definition of neighboring communities as mentioned above, this number is larger than its counterpart using the queen contiguity weight.

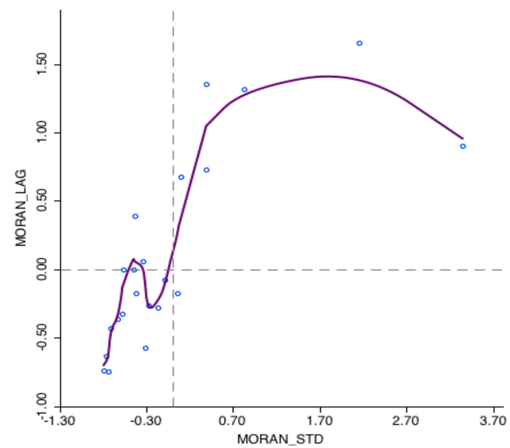


3. Moran's I using distance contiguity weight with smaller distance threshold

This time we choose to use the distance contiguity weight with a smaller distance threshold, which will further decrease the number of neighboring communities.

For the crude crime rates, the range of lagged crime rates is smaller than the range of the original crime rate in terms of standard deviation from the mean, and as we expected, the Moran's I value 0.527019 is larger than the one using default distance threshold because only spatially closer neighboring communities are included to measure the global spatial autocorrelation. Using permutation inference with 999 permutation yields a pseudo p-value of 0.015 with an associated z-value 3.2893. For the potential structure breaks in the pattern of spatial autocorrelation, we use the Lowess smoother in this case and find steep curve with positive slope in some areas which indicates structure breaks in the pattern of spatial autocorrelation using distance contiguity weight with smaller distance threshold.





Finally, we take a look at the global spatial autocorrelation for EB standardized crime rates using distance contiguity weight with a smaller than default distance threshold. As the graph below shows, again, the Moran’s I value 0.526843 is almost the same as the one for the crude crime rate. However, due to a different definition of neighboring communities as mentioned above, this number is larger than its counterpart using distance contiguity weight with default distance threshold.