Local Spatial Autocorrelation

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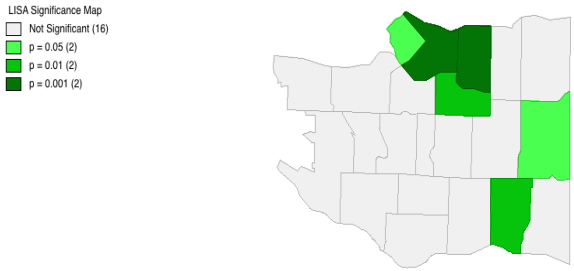
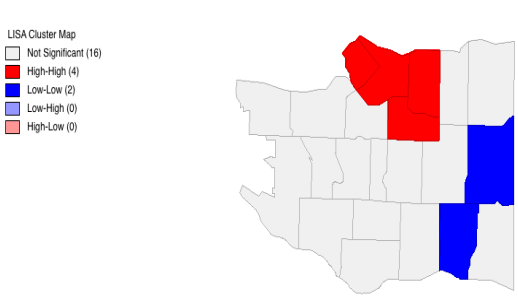
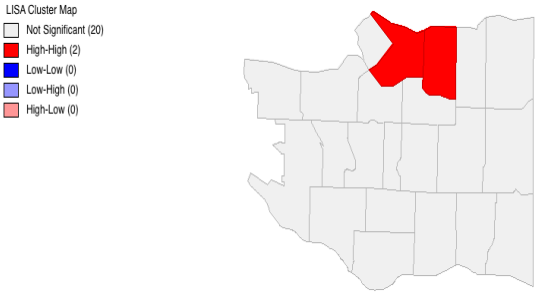
The main purpose of this report is to illustrate and compare local spatial autocorrelations using different spatial weights for the crude crime rates and mobility level in the city of Vancouver, Canada. The city of Vancouver is divided into 22 communities with different numbers of neighboring communities. Here we want to analyze the local clusters and spatial outliers in terms of Moran's I using both the contiguity-based and the distance-based spatial weights.

1. Local spatial autocorrelation for the crime rate

First we use the queen contiguity weight to detect local clusters and spatial outliers for the crude crime rates in Vancouver. As the LISA significant graph shows below, when we choose to use as the p-value cut-off we choose decreases from 0.05 to 0.01 to 0.001, the number of significant communities decreases from 6 to 4 to 2 accordingly. From the cluster maps below, we can see that when choosing 0.05 as the cut-off p-value, one high-high cluster and one low-low cluster emerge but with no spatial outliers. The high crime rate cluster consists of 4 communities locating to the north of Vancouver and the low crime rate cluster consists of 2 communities locating in the southeast part of Vancouver. When we choose 0.001 as the cut-off p-value, however, the low crime rate cluster disappears and the high crime rate cluster shrinks to be a two-cluster community as expected from the LISA significant map.

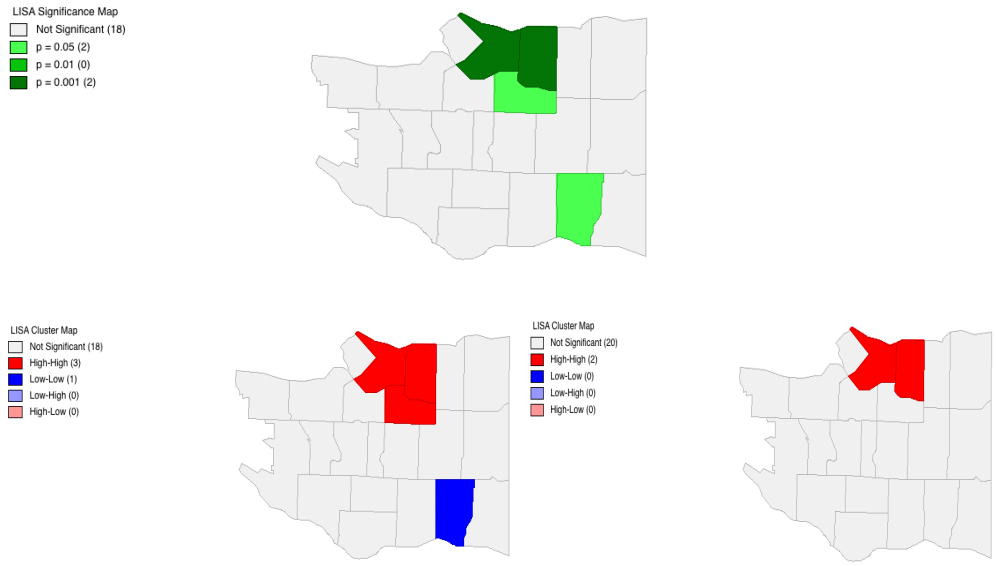






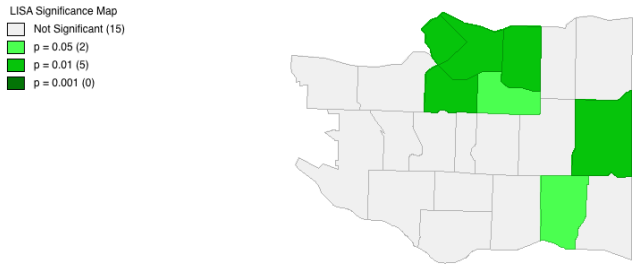
Next we examine the local clusters and spatial outliers for the crude crime rates in Vancouver using distance contiguity weight with default distance threshold. As we can see

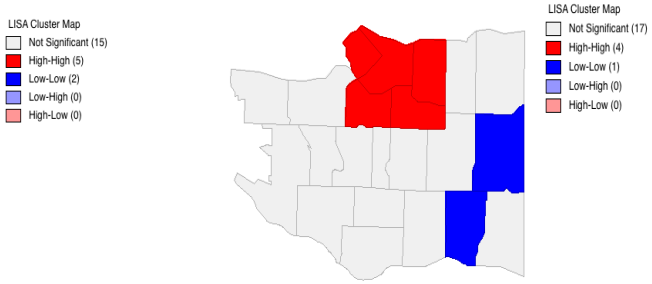
from the LISA significant map and the cluster map below, when choosing 0.05 as the cut-off p-value, both the high crime rate cluster size and the low crime rate cluster size decrease compared with those using the queen contiguity weight. Now the high crime rate cluster and the low crime rate cluster consists of 3 communities and 1 community respectively. This is due to a different definition of neighboring communities as we choose a different contiguity weight. When we choose 0.001 as the cut-off p-value, the crime rate cluster map is exactly the same as the one using the queen contiguity weight with only one high crime rate cluster consisting of 2 communities on the north side in Vancouver, which indicates that these 2 communities are significantly involved with high-rate crimes under various local spatial autocorrelation tests.

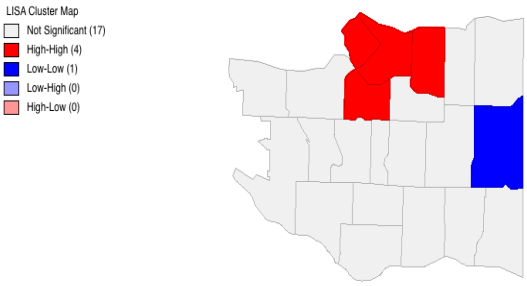


2. Local spatial autocorrelation for the mobility level

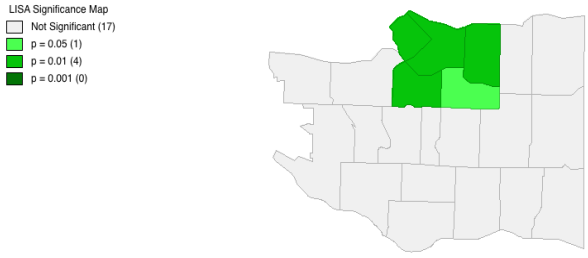
Now we take a look at the local clusters and spatial outliers for the mobility level in Vancouver. First we use the queen contiguity weight, and from the LISA significant map and the cluster map below, we can see that as the cut-off p-value we choose decreases from 0.05 to 0.01 to 0.001, the number of significant communities decreases from 7 to 5 to 0 accordingly. From the cluster maps below, we can see that when choosing 0.05 as the cut-off p-value, one high-high cluster and one low-low cluster emerge but with no spatial outliers. The high mobility level cluster consists of 5 communities locating to the north of Vancouver and the low mobility level cluster consists of 2 communities locating in the south part of Vancouver. When we choose 0.01 as the cut-off p-value, the low mobility level cluster shrinks to contain only 1 community and the high mobility level cluster shrinks to contain 4 communities as expected from the LISA significant map.

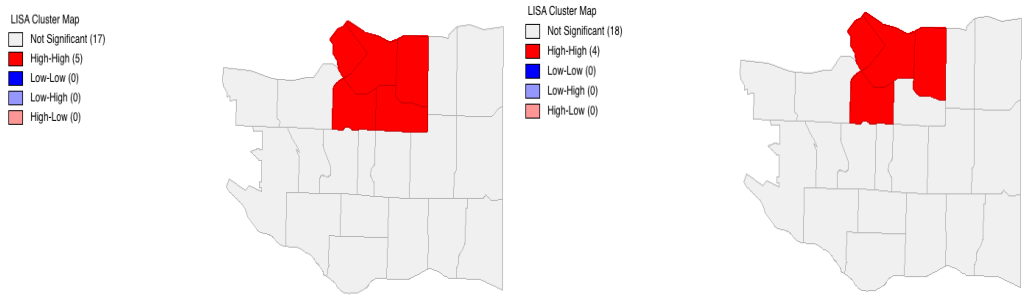






Now we use the distance contiguity weight with default distance threshold to detect the local clusters and spatial outliers for the mobility level in Vancouver. As we can see from the LISA significant map and the cluster map below, while the high mobility level cluster remains the same compared with those using the queen contiguity weight, the low mobility cluster disappears. Again, this is due to a different definition of neighboring communities as we choose a different contiguity weight. Therefore, the two cluster maps indicate that the 4 communities in the north part of Vancouver are significantly related to high mobility level under various local spatial autocorrelation tests. Compared with the crime rate spatial patterns, the mobility level patterns are quite similar in terms of the location of high-high and low-low clusters, so we take a look at the bivariate local autocorrelation test between these two variables next.





3. Bivariate local autocorrelation test between the crime rate and the mobility level

By choosing the mobility level as the explanatory variable and the crime rate as the dependent variable and using the queen contiguity weight, we can observe the spatial correlation between the two variables in terms of the local clusters from the LISA significant map and the cluster map using 0.05 as the cut-off p-value below. As the cluster map shows, the observed patterns are very similar to the one from the univariate analysis for the crime rate and mobility level respectively, with a high crime-rate/mobility level cluster of 4 communities located on the north side and a low crime-rate/mobility level cluster of 2 communities in the south. The reason for this similarity is due to the high correlation between the crime rate and mobility level both within the same community and among the neighboring communities as the bivariate Moran's I scatter plot below shows, which reveals the spatial distribution of local autocorrelation between the mobility level and the crime rate in the city of Vancouver.