

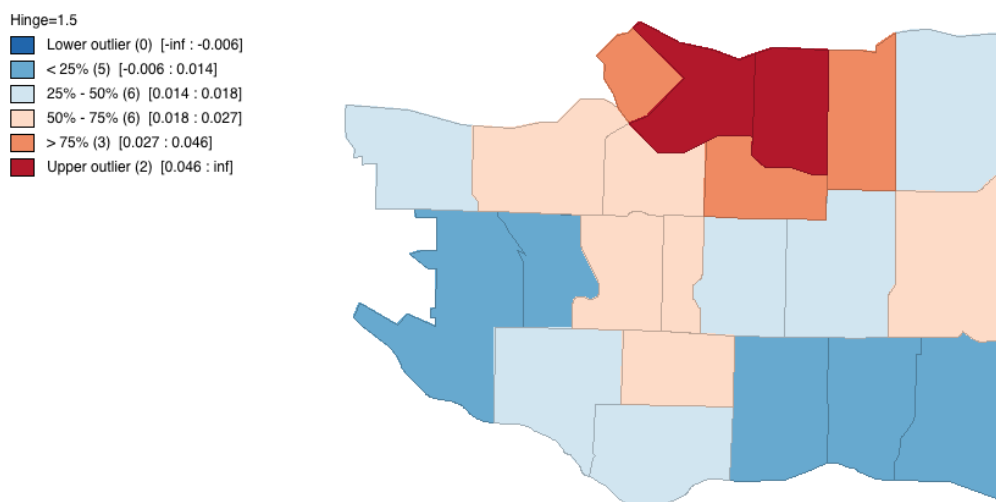
Maps

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The main purpose of this report is to illustrate several features of the geographical distribution of crime rates in the city of Vancouver, Canada. The city of Vancouver is divided into 22 communities, and the data used here includes two variable of interest for each community: the number of crimes in 2017(to date) and the community population. We want to explore different geographical visualization of the crime rates for interpreting the spatial distribution of the rates.

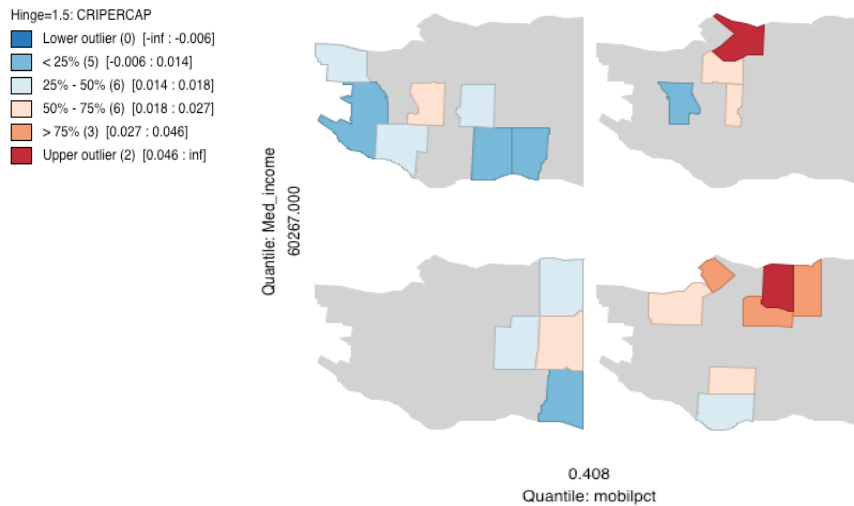
1. Raw rate map

The raw rate is the simple ratio of the number of crimes over the community population. Here we choose Box Map(Hinge=1.5) to detect the spatial distribution of the raw rate. As the map below shows, Downtown and Strathcona are the two communities identified as upper outliers with extremely high raw crime rates. We can see these two neighboring communities are located on the north boundary of the city, and among all 22 communities, Downtown has the highest mobility level while Strathcona has the lowest median income. In other words, these two communities are filled by large number of new immigrants with low income, which may explain the highest level of crime rates there. A further look at the map, we can find an interesting pattern: the farther one community is from Downtown and Strathcona, the lower the crime rates this community has, which is one typical feature of spatial distribution of event rates.

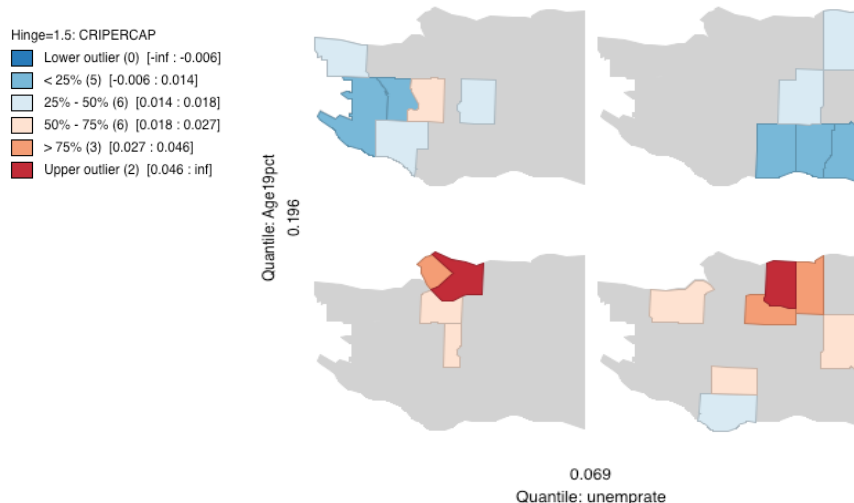


2. Conditional map

Next we want to examine other variables that may be correlated with crime rates in Vancouver. One way is to plot conditional maps. The first conditional map here uses the median income and mobility level as the conditioning variables. As we can see from the map below, the difference in crime rates conditioning on mobility level is much larger than that conditioning on the median income, which indicates the mobility level is highly correlated with the crime rates.

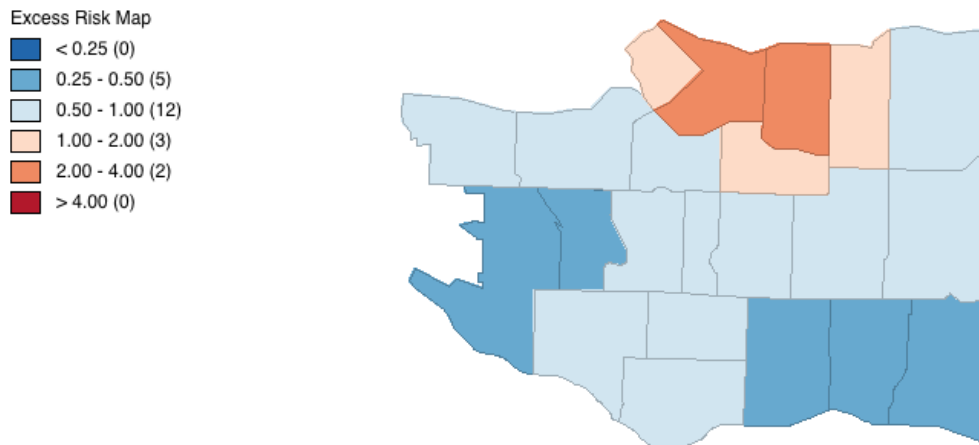


The second conditional map here uses the percentage of children(below 19) and unemployment rate as the two conditioning variables. The map belows shows that the percentage of children are highly correlated with the crime rates while the unemployment rate has barely any correlation with crime rates, which may be a little unexpected.



3. Excess risk map

Now we turn to the excess risk map to measure the crime rate using the overall average crime rate in Vancouver as the unit base. We can see from the excess risk map below that the two outliers Downtown and Strathcona have crime rates more than 2 times higher than the average crime rate of the whole city. No community has crime rate above 4 times the average level and no community has crime rate below a quarter of the average level either.



4. Empirical Bayes smoothed rate map

Lastly, we take a look at the EB smoothed rate map to adjust the possible variance instability of raw crime rates. As the graph below shows, after the EB smoothing, the resulting map is exactly the same as the raw rate map, which indicates the variance instability of raw crime rates is relatively small so the EB smoothing does not make any difference here.

