Lab 3: Crime Analysis Using CrimeStat

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In-text questions

Q1.

1st order crimes are less spatially aggregated then expected. The index does change as a function of neighbours, with BeR continually having high index values, BeC and Car having similar index values, and Rob having continually low index values. This tells us about the spatial distribution of the crimes because lower index values indicate clustering. Ex. because rob has consistent lower index values it potentially indicates that areas where robberies occur are often close together and not random – perhaps always in residential areas. See Appendix B – Map 2 and Map 3, Appendix C – Figure 1.

Q2.

The correlograms tell us that for all intensity variables as distance increases, spatial autocorrelation decreases. This analysis differs from the nearest neighbour analysis because the nearest neighbour index accounts for clustering, not spatial autocorrelation. However, the two analyses do tell sort of similar stories as they are in a way both accounting for randomness/dispersion to be at further distances. Additionally, the Moran values for different crimes do differ from the population values because it's indicating almost no spatial autocorrelation at any distance beyond its immediate proximity.

Moran's Results

The Moran's results strongly indicate that as distance increases, spatial autocorrelation strongly decreases. It is also apparent that Rob, Car, and BeC yielded very low Moran's I values even at close distances indicating that these types of crimes are not spatially autocorrelated. Another interesting result was that BeR proved to yield significantly higher Moran's I values at all distances than the other crimes. The break and enter residential crimes do follow the same pattern of increased distance creating decreased spatial autocorrelation, but clearly Ottawa is seeing a high clustering of BeR's. See Appendix C – Figure 2.

Fuzzy Mode, NNH Spatial Clustering, and Risk-Adjusted Results

The fuzzy mode results show high frequencies of residential B&E's occurring tightly in Ottawa's downtown core, and as you branch out from this downtown core this type of crime seems to slowly disperse and decrease in frequency. The fuzzy mode results are essentially depicting "hot spots" showing the frequency of crimes that have occurred within 750 meters of one another. Also, it is no surprise that in an area that is likely densely populated that the frequency of this type of crime is high. See Appendix B – Map 2.

The nearest neighbour hierarchical spatial clustering results depict areas, instead of "hot spots" where crimes are happening. In this case the ellipses show areas where 10 or more crimes have occurred within 750 meters of another crime. This distance was chosen as it is relative to how the fuzzy more results were calculated and as such they can be compared. These ellipses are referred to as "1st order clusters" and simply identify where crimes are clustering together. It can be noted that higher volumes of these ellipses are found in the same places as "hot spots", and that these ellipses do not account for population density.

As a further step, risk-adjusted ellipses were calculated, and can be referred to as "2nd order clusters". These second order clusters take into account the population density of those over 15 years old. These clusters are essentially "clusters of clusters". See Appendix B – Map 2, Map 3.

Knox index

The Knox Index is a way to compare how crimes relate in time and space. In the context of this lab we have investigated this index for car thefts. The output of this test will tell us whether there is a cluster that is statistically significant, this output will be in the form of a P-value. A low P-value would tell us that there is high time-space clustering, and alternatively a high P-value would tell us that there is low time-space clustering. These calculations are based off of the imputed space-time intervals, which in this case are 12 hours, and 5 kilometers. The P-value yielded was 0.00010, which is very low. As a result, it can be concluded that there is high-time space clustering of car thefts. See Appendix A.

Kernel Density Estimation

The kernel density tool was used to find out where in the city there was a density of residential break and enter crimes. Using points of residential B&E's and using triangular interpolation with a minimum sample size of 75, a vector grid kernel density surface was outputted. This surface proved to indicate that high densities of residential B&E's are found dispersed around the city. However, upon conducting a dual surface kernel density estimation, where the secondary surface relates to the intensity of the population over 15 years old it is clear that more densely populated areas are seeing higher residential B&E intensities. The results of the dual surface kernel density estimation prove to yield similar results to the fuzzy mode and clustering results as areas of high residential B&E intensity are dominantly in and around the downtown core. See Appendix B – Map 1, Map 2, Map 3.

Appendix A

Knox Index: Interaction of Space and Time

Sample size ....: 2152

Measurement type ......: Direct

Input units ....: Meters

Time units ....: Hours

Simulation runs ....: 99

Start time ....: 12:03:48 PM, 03/10/2020

"Close" time ....: 12.00000 hours

"Close" distance ....: 5000.00000 m

	Close in space(1)	Not close in space(0)	
Close in time(1)	502829	1535276	2038105
Not close in time(0)	65608	210763	276371
	568437	1746039	2314476

Expected:

	Close in space(1)	Not close in space(0)	
Close in time(1)	500560.08007	1537544.91993	2038105.00000
Not close in time(0)	67876.91993	208494.08007	276371.00000

| 568437.00000 | 1746039.00000 | 2314476.00000

Chi-square ....: 114.16713

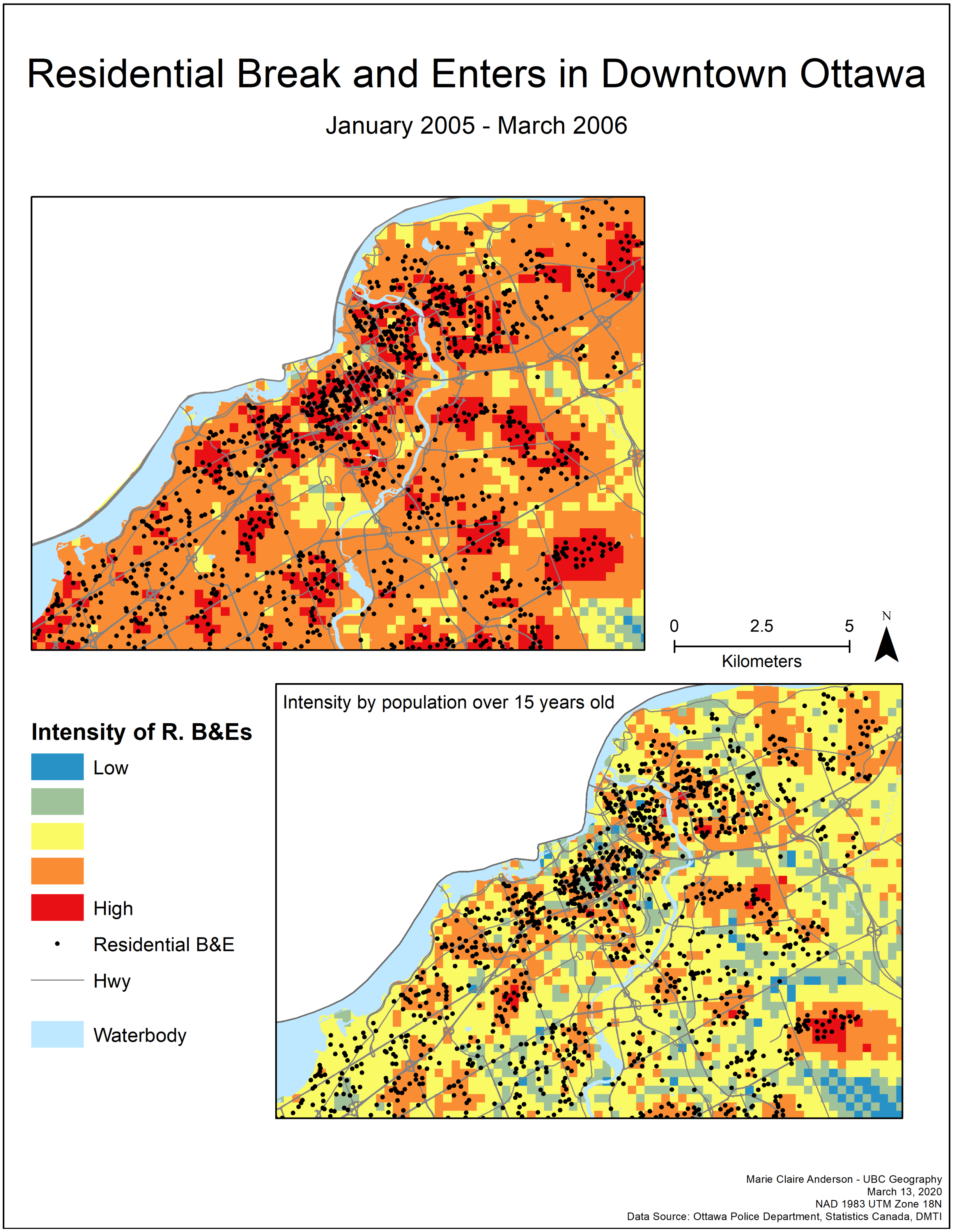
P value of Chi-square: 0.00010

End time ....: 12:03:49 PM, 03/10/2020

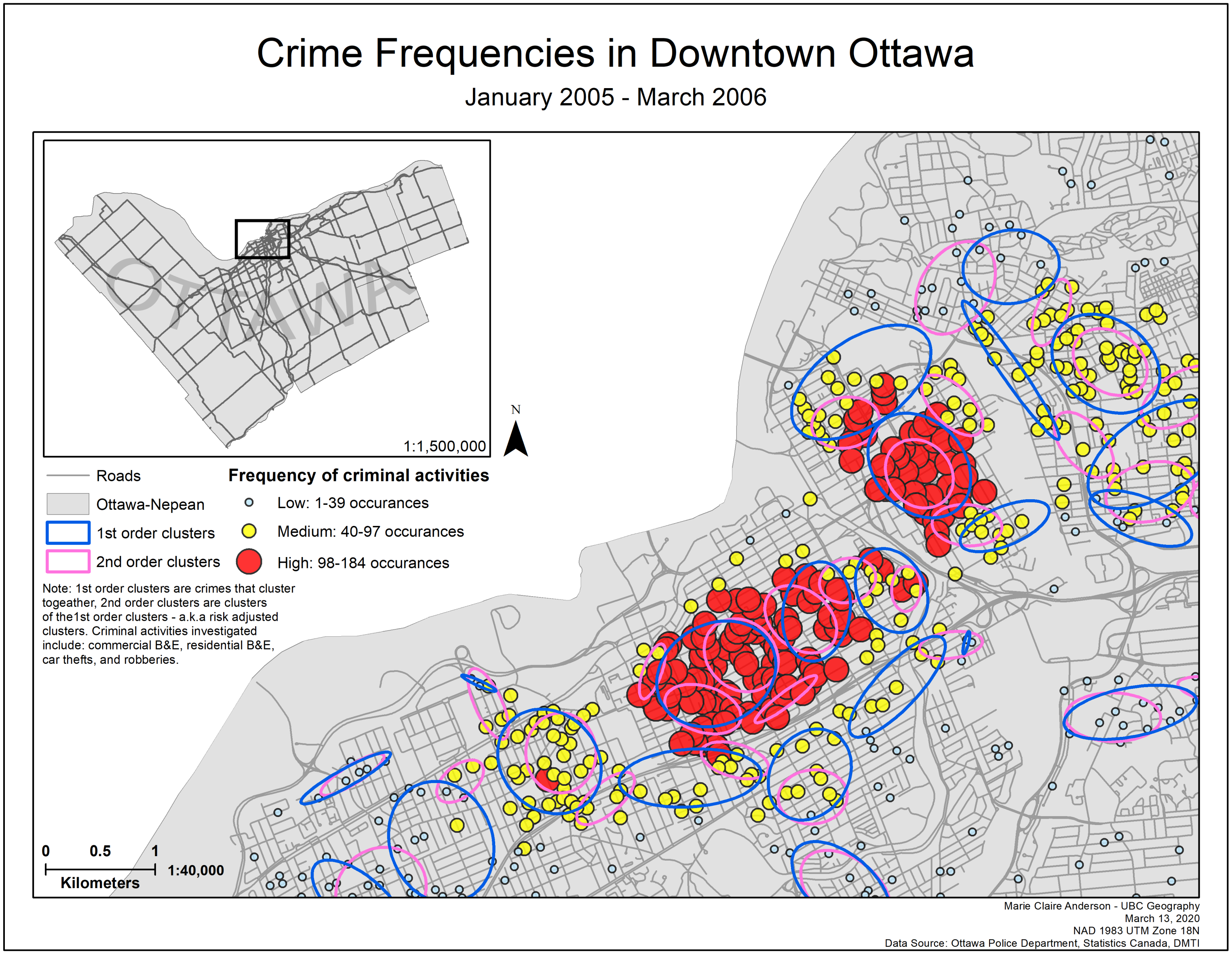
Distribution of simulated index (percentile):

Percentile	Chi-square
min	0.00071
0.5	0.00071
1.0	0.00071
2.5	0.00546
5.0	0.00626
10.0	0.03866
90.0	3.38179
95.0	6.08605
97.5	7.07216
99.0	13.62212
99.5	13.62212
max	13.62212

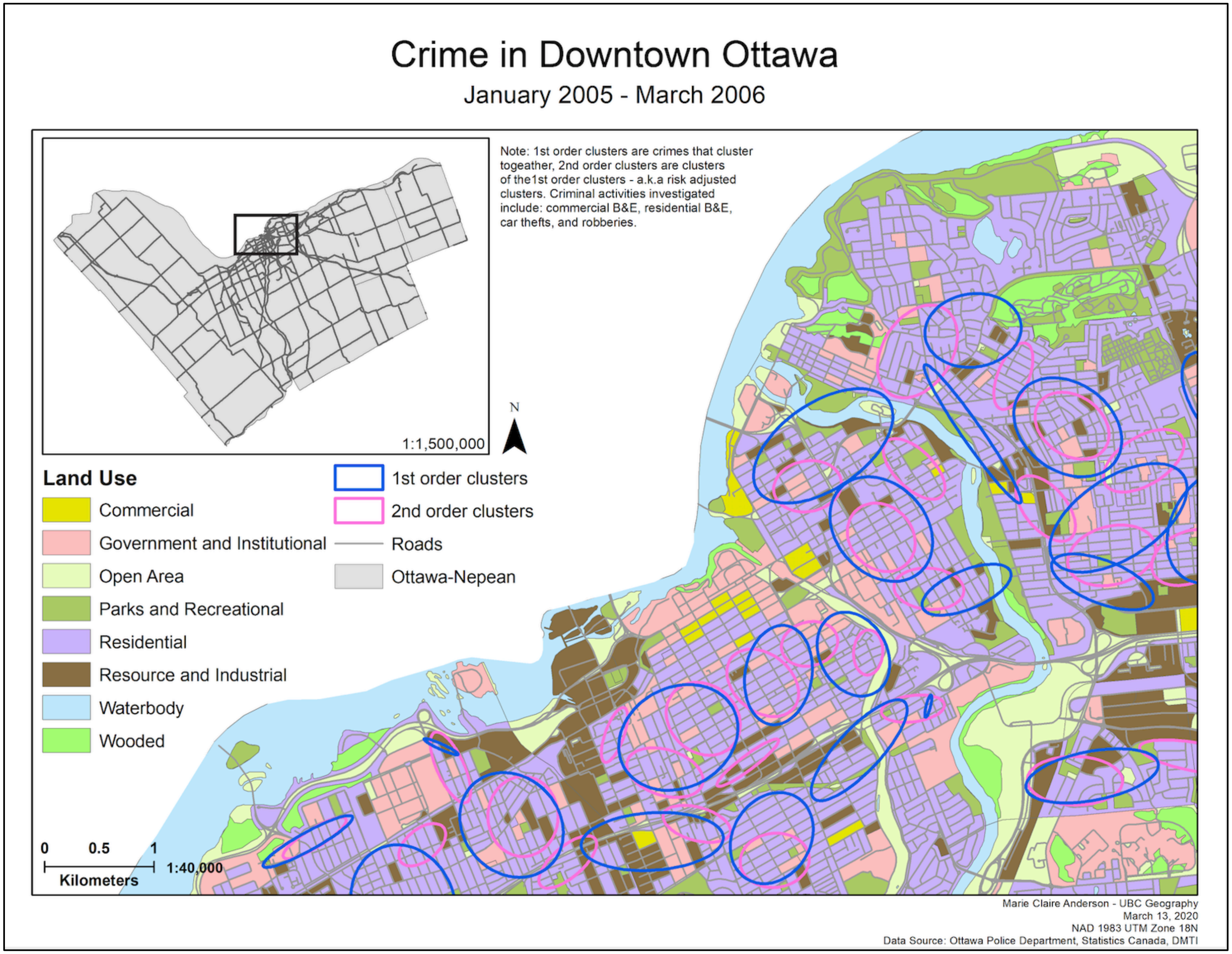
Appendix B



Map 1 – Intensity of Residential B&E's (Kernel Density Analysis Output)



Map 2 – Crime Frequencies in Downtown Ottawa. Nearest neighbour ellipses with fuzzy mode results.



Map 3 – Crime in Downtown Ottawa. Nearest neighbour ellipses with land use.

Appendix C

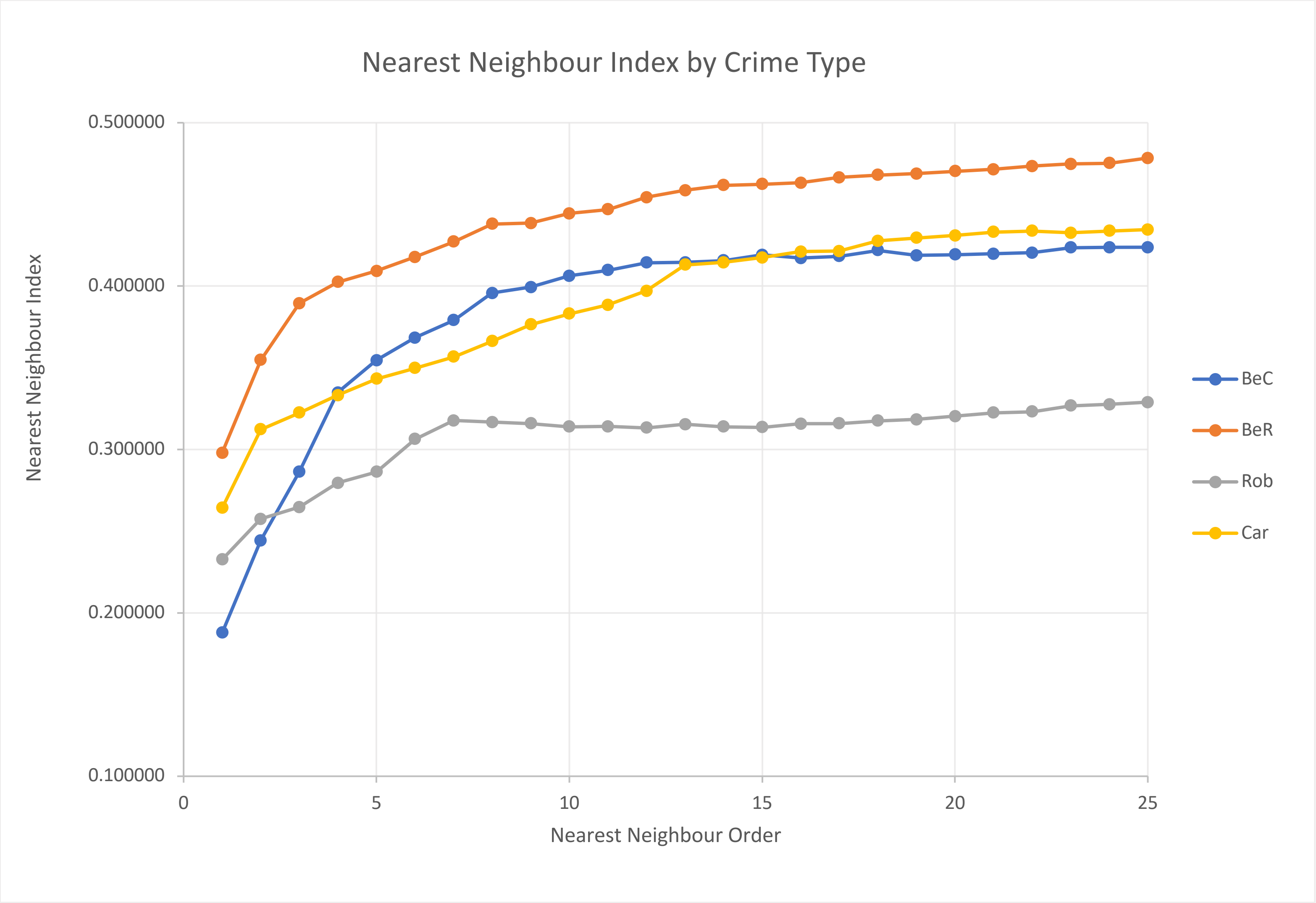


Figure 1 – Nearest Neighbour Index by Crime Type

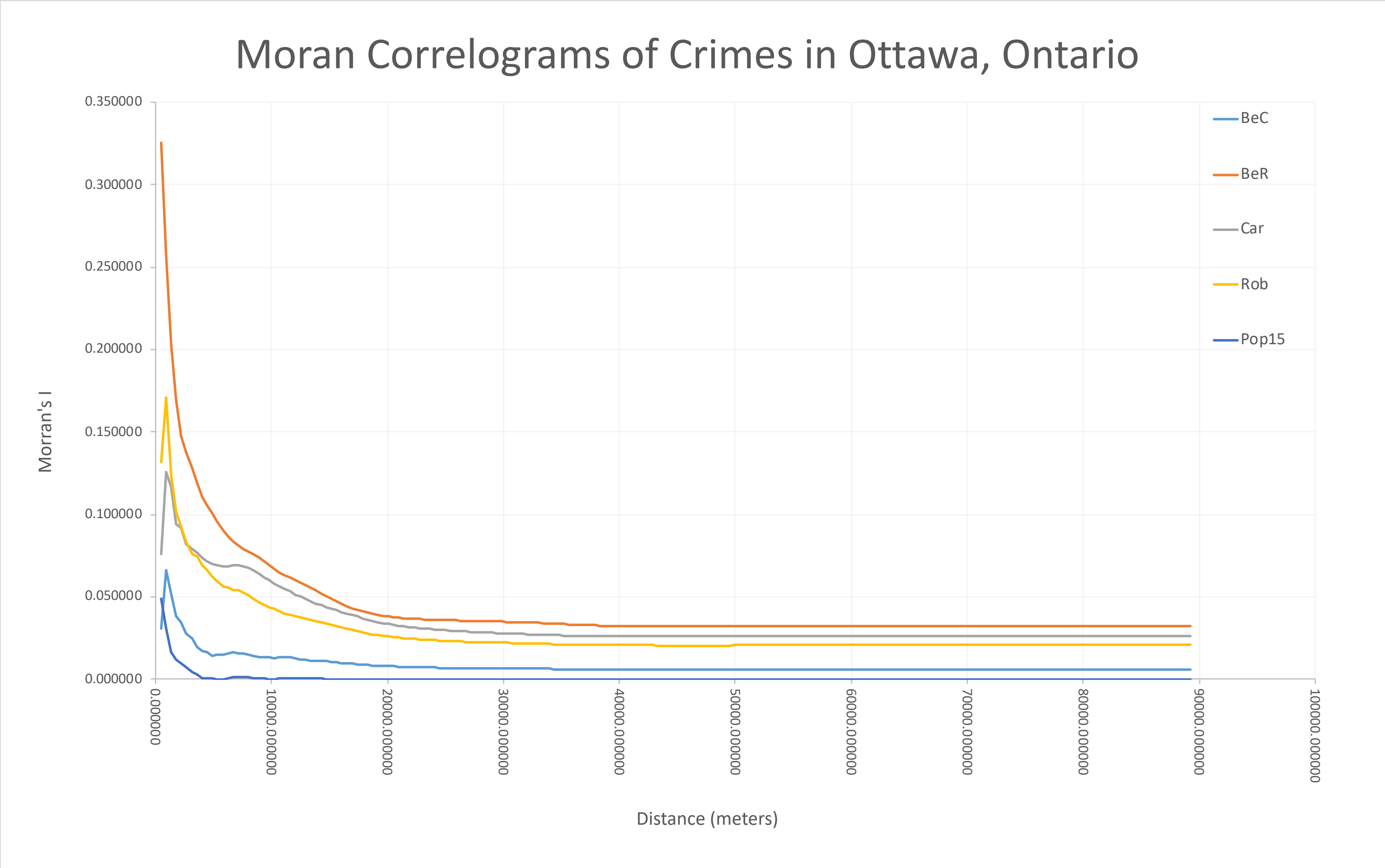


Figure 2 – Moran Correlograms of Crimes in Ottawa, Ontario