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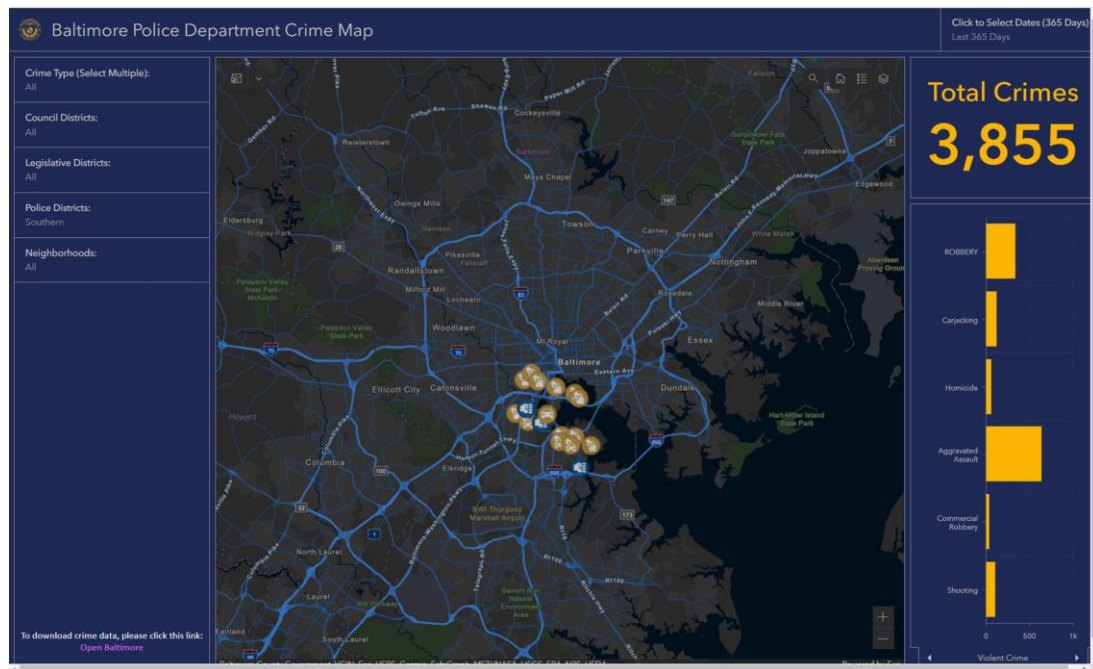
Introduction to Complex Systems, University of Vermont

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Fractal Analysis of Crime Baltimore Police District Crime Reports.

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Introduction. The crime problem in Baltimore has been persistent for decades and has been rated as the number one public problem in the city for at least the last ten years. The city of Baltimore keeps excellent data on crime events over the last 10 years. Critically these cases all have position, location and time values.



The dataset is from the Open Baltimore project. Below is an example of the results from the Geographic Information system. This is where the majority of the data will be obtained for this project.

The ultimate Goal of this project is to see if there are dramatically different Rescaled Range Analysis across districts and then cross check to see if persistence in urban blight causes persistence in crime. This paper is the first step in this effort, which is to get a complex systems view of the districts crime data.

Before we do the Rescaled Range Analysis, it makes sense to do some descriptive statistics to get a lay of the land.

Below is a snapshot of the complete crime reports in Baltimore over the last 10 years.

X	C2	C3	C4-T	C5-T	C6-T	C7-T	C8-T	C9-T	C10	C11-T	C12	C13-T	C14-T	C15-T	C16-T	C17	C18	C19-T	
	Y	RowID	CrimeDate/Time	CrimeCode	Location	Description	Inside/Outside	Weapon	Post	Gender	Age	Race	Ethnicity	District	Neighborhood	Latitude	Longitude	Geolocation	
1	-76.637	39.388	1/2022/1/05 19:45:00-00	4E	4300 PMULCO RD	COMMON ASSAULT	Missing	PERSONAL_WEAPONS	414 F			38 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	NORTHWEST	GREENSPRINGS	39.3388	-76.6637	-76.6637	
2	-76.6796	39.3388	2/2022/1/05 18:40:00-00	3C0	3800 MARRINGTON RD	ROBBERY	Missing	PERSONAL_WEAPONS	423 F			28 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	NORTHWEST	CALLAWAY GARRISON	39.3388	-76.6796	-76.6796	
3	-76.5981	39.2931	3/2022/1/05 20:15:00-00	6F	1400 E FAYETTE ST	LARCENY	Missing	Missing	212 F			43 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	SOUTHEAST	DUNBAR-BROADWAY	39.2931	-76.5981	-76.5981	
4	-76.6251	39.3109	4/2022/1/05 11:00:00-00	4C	1900 Mt Royal Ter	AGG. ASSAULT	Missing	UNKNOWN	133 F			53 BLACK_OR_AFRICAN_AMERICAN	Missing	CENTRAL	RESERVOIR HILL	39.3109	-76.6251	-76.6251	
5	-76.6266	39.2435	5/2022/1/05 11:20:00-00	4E	1000 BETHUNE RD	COMMON ASSAULT	Missing	UNKNOWN	922 M			37 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	SOUTHERN	CHERRY HILL	39.2435	-76.6266	-76.6266	
6	-76.6075	39.3372	6/2022/1/05 23:25:00-00	3F	600 WYANKE AVE	ROBBERY	Missing	HANDGUN	525 M			52 BLACK_OR_AFRICAN_AMERICAN	Missing	NORTHERN	PEN LUCY	39.3372	-76.6075	-76.6075	
7	-76.6377	39.3048	7/2022/1/05 02:38:14-00	95	1300 N FREMONT AVE	SHOOTING	Outside	FIREARM	724 Female			29 BLACK_OR_AFRICAN_AMERICAN	Missing	WESTERN	SANDTOWN-WINCHESTER	39.3048	-76.6377	-76.6377	
8	-76.5819	39.3047	8/2022/1/05 00:00:00-00	1A	2500 E BIDDLE ST	HOMICIDE	Outside	FIREARM	332 Male			33 BLACK_OR_AFRICAN_AMERICAN	Missing	EASTERN	BIDDLE STREET	39.3047	-76.5819	-76.5819	
9	-76.6847	39.3394	9/2022/1/05 02:27:50-00	95	4700 GARRISON BLVD	SHOOTING	Outside	FIREARM	621 Female			27 BLACK_OR_AFRICAN_AMERICAN	Missing	NORTHWEST	WEST ARLINGTON	39.3394	-76.6847	-76.6847	
10	-76.5758	39.3072	10/2022/1/05 14:49:48-00	1A	1400 N POTOMAC ST	HOMICIDE	Outside	FIREARM	332 Male			29 BLACK_OR_AFRICAN_AMERICAN	Missing	EASTERN	BEREA	39.3072	-76.5758	-76.5758	
11	-76.5684	39.2935	11/2022/1/05 06:24:24-00	95	3400 E FAIRMOUNT AVE	SHOOTING	Inside	FIREARM	222 Male			53 BLACK_OR_AFRICAN_AMERICAN	Missing	SOUTHEAST	BALTIMORE HIGHLANDS	39.2935	-76.5684	-76.5684	
12	-76.5800	39.2306	12/2022/1/05 13:34:46-00	95	3800 PENNINGTON AVE	SHOOTING	Outside	FIREARM	911 Male			36 ASIAN	Missing	SOUTHERN	CURTIS BAY	39.2306	-76.5800	-76.5800	
13	-76.6847	39.3394	13/2022/1/05 02:27:50-00	1A	4700 GARRISON BLVD	HOMICIDE	Outside	FIREARM	621 Male			31 BLACK_OR_AFRICAN_AMERICAN	Missing	NORTHWEST	WEST ARLINGTON	39.3394	-76.6847	-76.6847	
14	-76.6351	39.3312	14/2022/1/05 12:30:00-00	4E	3600 FALLS RD	COMMON ASSAULT	Missing	PERSONAL_WEAPONS	531 M			21 WHITE	Missing	NORTHERN	HAMPDEN	39.3312	-76.6351	-76.6351	
15	-76.5803	39.2921	15/2022/1/05 12:20:00-00	6F	2600 E BALTIMORE ST	LARCENY	Missing	Missing	222 F			45 WHITE	Missing	SOUTHEAST	PATTERSON PARK NEIGHBORHOOD	39.2921	-76.5803	-76.5803	
16	-76.6014	39.2316	16/2022/1/05 20:40:00-00	4D	4000 8TH ST	AGG. ASSAULT	Missing	Missing	913 F			27 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	SOUTHERN	BROOKLYN	39.2316	-76.6014	-76.6014	
17	-76.5703	39.2925	17/2022/1/05 20:20:00-00	3A0	3300 E BALTIMORE ST	ROBBERY	Missing	BLUNT OBJECT	222 M			35 WHITE	Missing	HISPANIC_OR_LATINO	SOUTHEAST	PATTERSON PARK NEIGHBORHOOD	39.2925	-76.5703	-76.5703
18	-76.6527	39.2646	18/2022/1/05 20:00:00-00	4E	2600 CARROLL ST	COMMON ASSAULT	Missing	Missing	831 M			25	Missing	HISPANIC_OR_LATINO	SOUTHWEST	MORRELL PARK	39.2646	-76.6527	-76.6527
19	-76.6072	39.2880	19/2022/1/05 22:30:00-00	4A	800 E Lombard ST	AGG. ASSAULT	Missing	HANDGUN	111 M			16 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	CENTRAL	DOWNTOWN	39.2880	-76.6072	-76.6072	
20	-76.6077	39.2887	20/2022/1/05 15:26:00-00	4E	800 E PRATT ST	COMMON ASSAULT	Inside	PERSONAL_WEAPONS	112 M			34 WHITE	Missing	CENTRAL	INNER HARBOR	39.2887	-76.6077	-76.6077	
21	-76.5927	39.2226	21/2022/1/05 02:00:00-00	5A	1300 CHURCH ST	BURGLARY	Missing	Missing	911 M			52 BLACK_OR_AFRICAN_AMERICAN	Missing	SOUTHERN	CURTIS BAY	39.2226	-76.5927	-76.5927	
22	-76.6250	39.2488	22/2022/1/05 09:00:00-00	4B	2900 CHERRYLAND RD	AGG. ASSAULT	Inside	KNIFE CUTTING INSTRUMENT	922 M			19 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	SOUTHERN	CHERRY HILL	39.2488	-76.6250	-76.6250	
23	-76.5995	39.2279	23/2022/1/05 00:00:00-00	4E	4200 THAYER CT	COMMON ASSAULT	Outside	Missing	913 F			29 BLACK_OR_AFRICAN_AMERICAN	UNKNOWN	SOUTHERN	BROOKLYN	39.2279	-76.5995	-76.5995	
24	-76.5995	39.2279	24/2022/1/05 00:00:00-00	4E	4200 THAYER CT	COMMON ASSAULT	Outside	Missing	913 M			31 BLACK_OR_AFRICAN_AMERICAN	UNKNOWN	SOUTHERN	BROOKLYN	39.2279	-76.5995	-76.5995	
25	-76.5315	39.2791	25/2022/1/05 02:00:00-00	7A	6700 DULUTH AVE	AUTO THEFT	Outside	Missing	234 M			21 WHITE	NOT_HISPANIC_OR_LATINO	SOUTHEAST	GRACELAND PARK	39.2791	-76.5315	-76.5315	
26	-76.6396	39.3614	26/2022/1/05 13:00:00-00	4E	2100 CATHEDRAL RD	COMMON ASSAULT	Outside	PERSONAL_WEAPONS	533 M			15 NATIVE_HAWAIIAN_OR_OTHER_PACIFIC_ISLANDER	HISPANIC_OR_LATINO	NORTHERN	MOUNT WASHINGTON	39.3614	-76.6396	-76.6396	
27	-76.6086	39.3383	27/2022/1/05 19:00:00-00	4E	3300 HOWARD PARK AVE	COMMON ASSAULT	Outside	PERSONAL_WEAPONS	622 F			28 WHITE	NOT_HISPANIC_OR_LATINO	NORTHWEST	HOWARD PARK	39.3383	-76.6086	-76.6086	
28	-76.5739	39.3094	28/2022/1/05 20:47:00-00	4E	3100 E FEDERAL ST	COMMON ASSAULT	Outside	Missing	232 F			66 BLACK_OR_AFRICAN_AMERICAN	Missing	EASTERN	BEREA	39.3094	-76.5739	-76.5739	
29	-76.5869	39.2849	29/2022/1/05 18:30:00-00	6F	2100 FLEET ST	LARCENY	Inside	Missing	313 M			35 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	SOUTHEAST	CANTON	39.2849	-76.5869	-76.5869	
30	-76.5497	39.3563	30/2022/1/05 18:20:00-00	3C0	6100 GLENDALE AVE	ROBBERY	Outside	PERSONAL_WEAPONS	424 F			37 BLACK_OR_AFRICAN_AMERICAN	UNKNOWN	NORTHEAST	WESTFIELD	39.3563	-76.5497	-76.5497	
31	-76.6084	39.3533	31/2022/1/05 18:00:00-00	6J	6100 REISTERSTOWN RD	LARCENY	Missing	Missing	631	Missing			Missing	Missing	NORTHWEST	REISTERSTOWN STATION	39.3533	-76.6084	-76.6084
32	-76.6084	39.3533	32/2022/1/05 18:00:00-00	6J	6100 REISTERSTOWN RD	LARCENY	Missing	Missing	631	Missing			Missing	Missing	NORTHWEST	REISTERSTOWN STATION	39.3533	-76.6084	-76.6084
33	-76.6084	39.3533	33/2022/1/05 18:00:00-00	6J	6100 REISTERSTOWN RD	LARCENY	Missing	Missing	631	Missing			Missing	Missing	NORTHWEST	REISTERSTOWN STATION	39.3533	-76.6084	-76.6084
34	-76.5601	39.3140	34/2022/1/05 20:15:00-00	4E	3800 Strawberry Field Ln	COMMON ASSAULT	Inside	PERSONAL_WEAPONS	433 F			35 BLACK_OR_AFRICAN_AMERICAN	Missing	NORTHWEST	ORCHARD RIDGE	39.3140	-76.5601	-76.5601	
35	-76.6411	39.3010	35/2022/1/05 20:46:00-00	7A	1400 BIGGS AVE	AUTO THEFT	Inside	Missing	724 F			35 BLACK_OR_AFRICAN_AMERICAN	Missing	WESTERN	SANDTOWN-WINCHESTER	39.3010	-76.6411	-76.6411	
36	-76.5974	39.2313	36/2022/1/05 22:00:00-00	3A0	3900 10TH ST	ROBBERY	Inside	PERSONAL_WEAPONS	913 M			17	Missing	HISPANIC_OR_LATINO	SOUTHERN	BROOKLYN	39.2313	-76.5974	-76.5974
37	-76.5857	39.3069	37/2022/1/05 20:00:00-00	4D	2300 E FEDERAL ST	LARCENY FROM AUTO	Inside	Missing	331 F			62 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	EASTERN	BROADWAY EAST	39.3069	-76.5857	-76.5857	
38	-76.5675	39.3533	38/2022/1/05 18:00:00-00	6J	5300 HAMLET AVE	LARCENY	Missing	Missing	423 F			37 WHITE	Missing	NORTHEAST	HAMILTON HILLS	39.3533	-76.5675	-76.5675	
39	-76.5991	39.3162	39/2022/1/05 16:15:00-00	4E	1200 DARLEY AVE	COMMON ASSAULT	Inside	PERSONAL_WEAPONS	312 F			38 BLACK_OR_AFRICAN_AMERICAN	NOT_HISPANIC_OR_LATINO	EASTERN	EAST BALTIMORE MIDWAY	39.3162	-76.5991	-76.5991	

Figure 1 - Baltimore Crime Dataset

Below is a chart breaking down the aggregate crime counts in Baltimore varied by the nine police districts. Note that the Northeast and Southeast Districts dominate the aggregate numbers of crime. This was an unexpected finding.

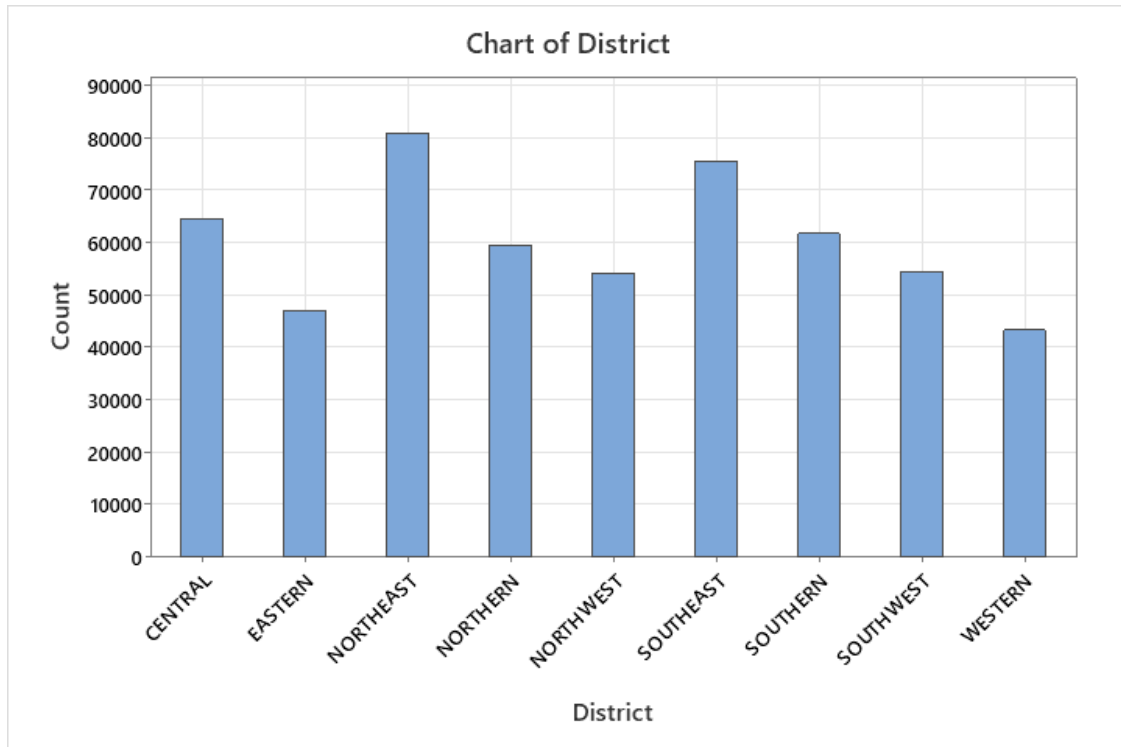
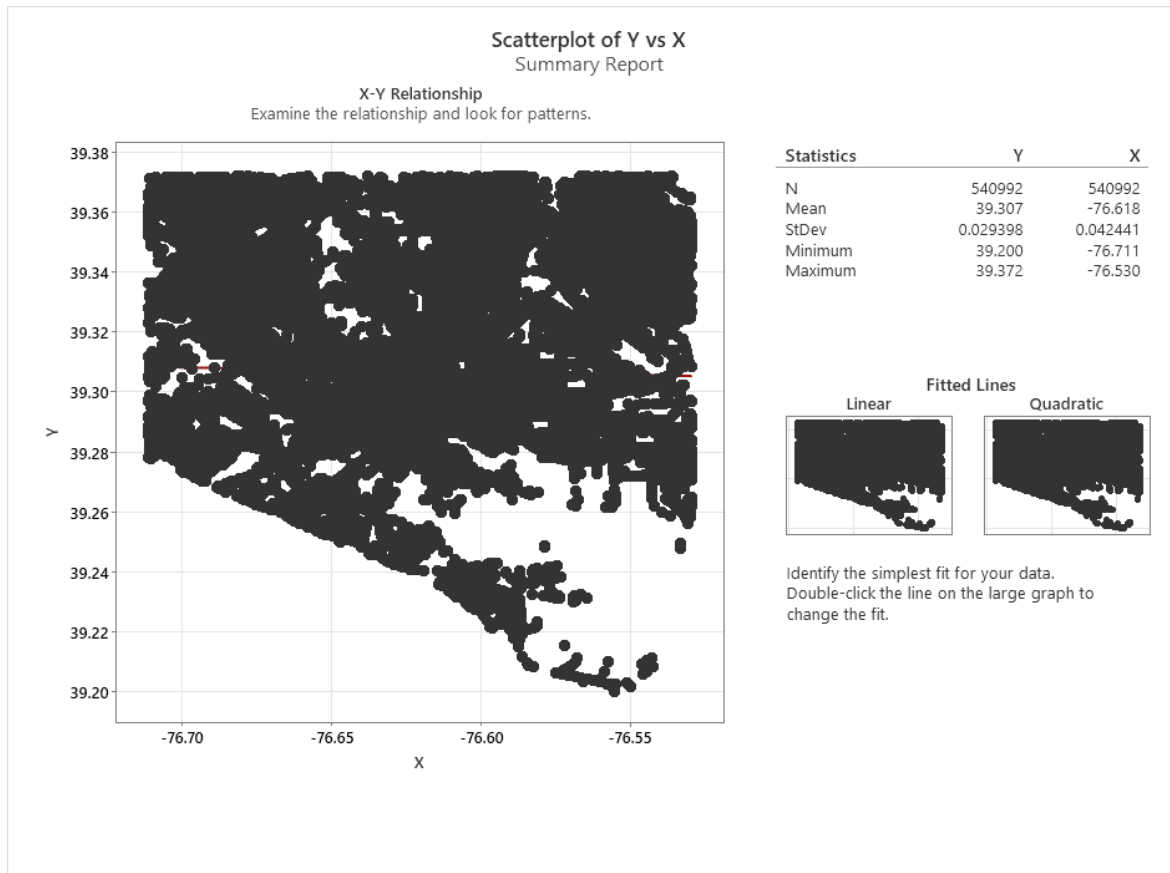


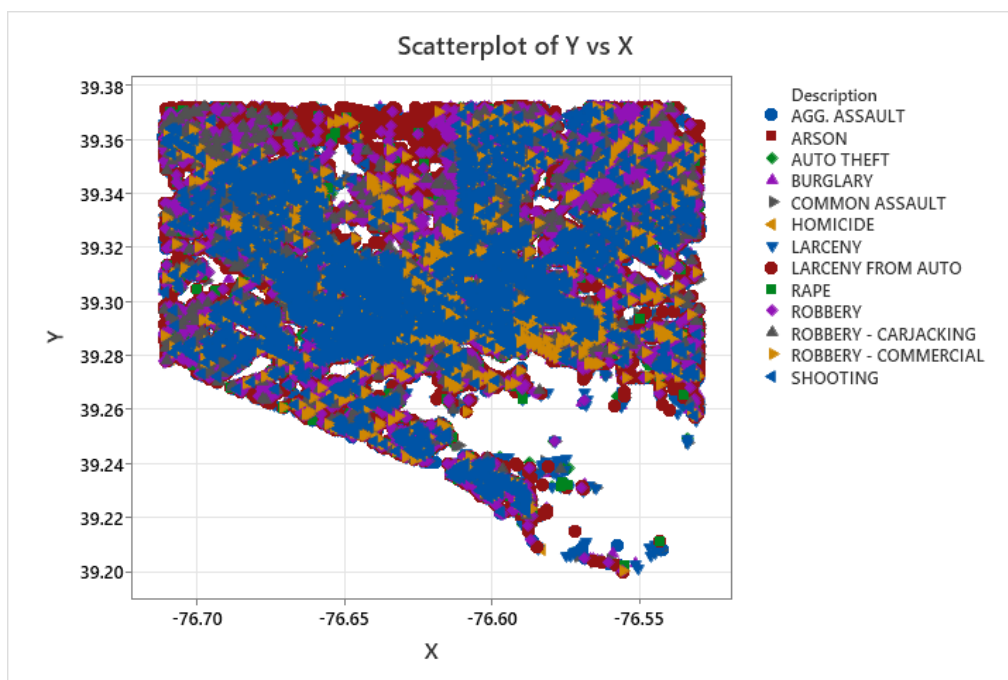
Figure 2 - Crime by Baltimore District 2012-2022

The next chart shows the type of crime in the aggregate over the last ten years.

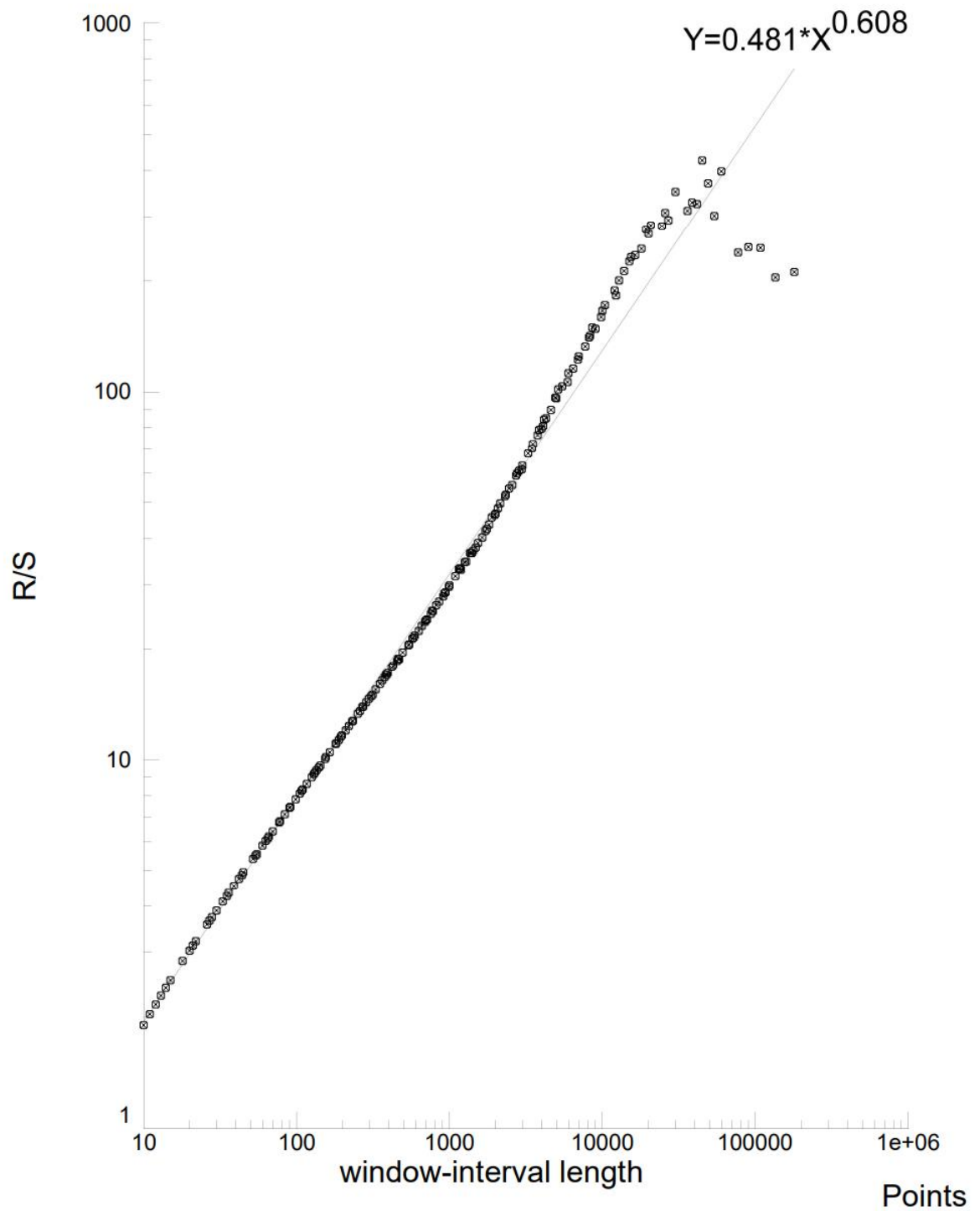
The next chart shows the lat-long of crime in Baltimore. Note how it outlines the city.



The next chart shows the lat-long of crime by type



Next Chart Shows a Rescaled Range analysis and Hurst Exponent of 0.608.



This Rescaled Range analysis and Hurst Exponent of 0.608 which is very close to a H of 0.625 in Varma's analysis of Vancouver Crime Data.

Notes

<\$--ENDNOTES-->

Works Cited

Multifractal Approach to the Analysis of Crime Dynamics: Results for Burglary in San Francisco

– Melgarejo and Obergon

Fractal Dimension of Policing - Verma