

A review of Crime Analysis and Visualization. Case study: Maryland State, USA

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About the Paper

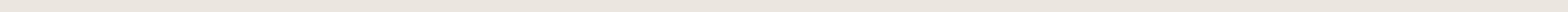
This paper introduced works related to the crime field, created interactive visualization of 2016 crime cases in Maryland, USA, to provide deep insight. This paper focused on 3 types of crime: against a person, against society, and against property.





Goal

Provide interactive visualization of crimes data that would help the police department becomes more efficient in decision-making and carrying out its mission: to prevent and suppress crime.



Contribution

The contributions of this paper are to find the most occurrence types of crimes and where, when and why the crimes occur and provide suggestions for Maryland cities' police department.



Case Study

👤 Data Collection

- Data of all founded crimes in Maryland State (actual data is of Montgomery County) reported after July 1st, 2016 from data.gov.
- Original data has 30 attributes and over 250 000 records.
- Final attributes for this paper: the name of the crime (crime1) with the crime category/type, additional crime names (crime2 & crime3), cities where crimes occurred, time and date, and number of victims.

👤 Data Filtering

Focus on 3 crime categories instead of 5 (crime against property, crime against society, crime against person) with a sample of 1000 records for each.

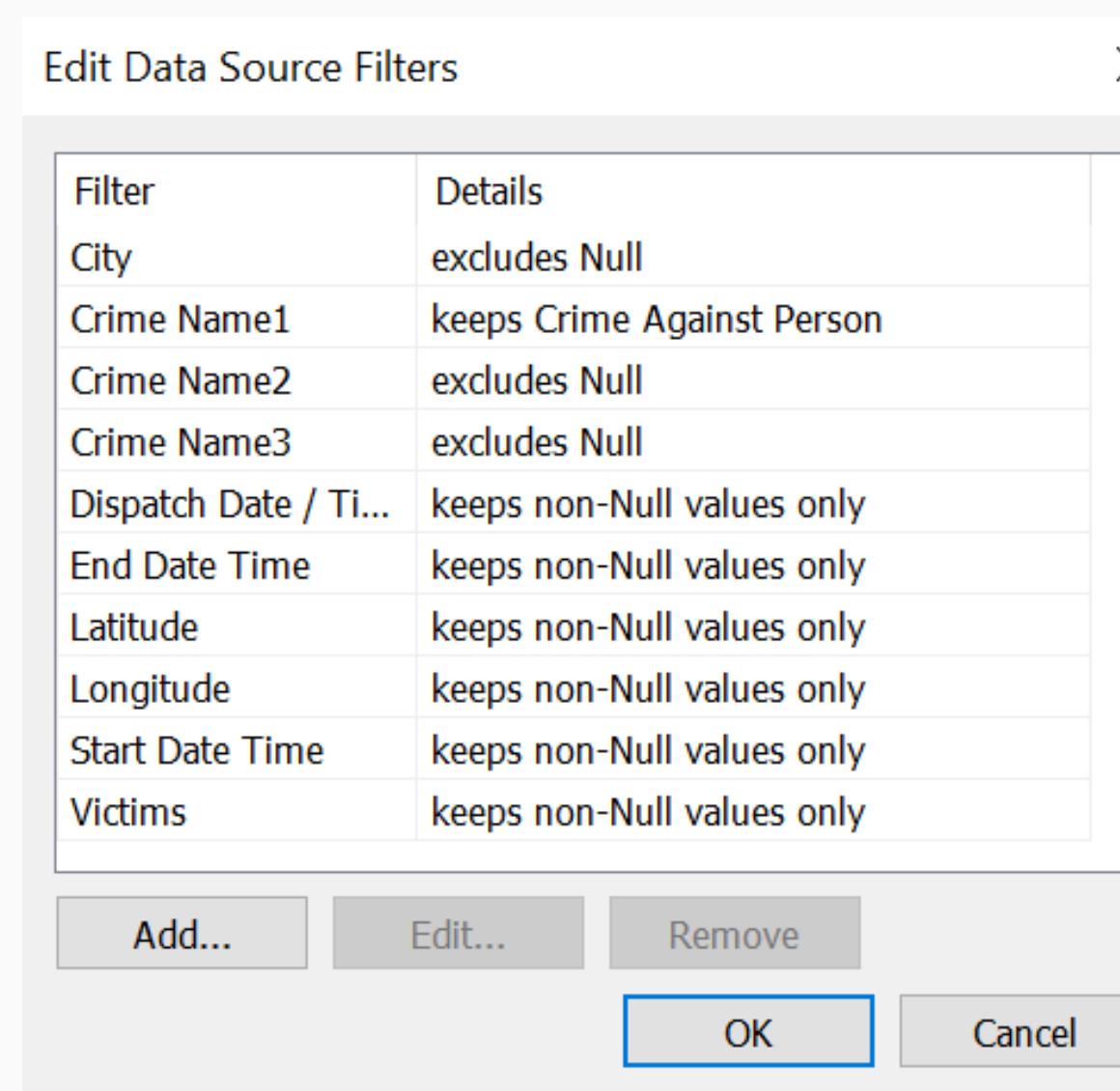
Screenshots of dataset from data.gov

A	B	C	D	E	F	G	H	I	J
1	Incident ID	Offence Code	CR Number	Dispatch Date / Time	NIBRS Code	Victims	Crime Name1	Crime Name2	Crime Name3
2	201202980	3550	180042096	8/23/2018 21:52	35B		1 Crime Against Society	Drug Equipment Violations	DRUGS - NARCOTIC EQUIP - POSSESS
3	201181293	3522	180015424	3/30/2018 1:00	35A		1 Crime Against Society	Drug/Narcotic Violations	DRUGS - OPIUM OR DERIVATIVE - POSSESS
4	201181293	3562	180015424	3/30/2018 1:00	35A		1 Crime Against Society	Drug/Narcotic Violations	DRUGS - MARIJUANA - POSSESS
5	201193163	3520	180029476	6/14/2018 22:26	35A		1 Crime Against Society	Drug/Narcotic Violations	DRUGS - OPIUM OR DERIVATIVE - SELL
6	201204355	2204	180043926	9/3/2018 12:06		220	1 Crime Against Property	Burglary/Breaking and Entering	BURGLARY - NO FORCED ENTRY-RESIDENTIAL
7	201204355	2404	180043926	9/3/2018 12:06		240	1 Crime Against Property	Motor Vehicle Theft	AUTO THEFT - VEHICLE THEFT
8	201122422	1399	17009733			13B	1 Crime Against Person	Simple Assault	ASSAULT - 2ND DEGREE
9	201138627	1212	170513167	6/12/2017 8:02		120	1 Crime Against Property	Robbery	ROBBERY - CARJACKING - ARMED
10	201342249	5404	210032233	8/19/2021 3:13	90D		1 Crime Against Society	Driving Under the Influence	DRIVING UNDER THE INFLUENCE LIQUOR
11	201160052	3550	170539875	10/30/2017 20:21	35B		1 Crime Against Society	Drug Equipment Violations	DRUGS - NARCOTIC EQUIP - POSSESS
12	201160052	3562	170539875	10/30/2017 20:21	35A		1 Crime Against Society	Drug/Narcotic Violations	DRUGS - MARIJUANA - POSSESS
13	201090616	4802	16037412		90Z		1 Crime Against Society	All Other Offenses	OBSTRUCT POLICE - OBSTRUCT CRIMINAL INVESTIGATION
14	201346054	9113	210037206	9/20/2021 19:49	90Z		1 Other	All Other Offenses	MENTAL ILLNESS - EMERGENCY PETITION
15	201346128	2308	210037063	9/20/2021 9:29	23D		1 Crime Against Property	Theft from Building	LARCENY - FROM BLDG
16	201346229	2305	210037331	9/21/2021 17:13	23F		1 Crime Against Property	Theft From Motor Vehicle	LARCENY - FROM AUTO
17	201346229	3562	210037331	9/21/2021 17:13	35A		1 Crime Against Society	Drug/Narcotic Violations	DRUGS - MARIJUANA - POSSESS
18	201103518	2804	16053715			280	1 Crime Against Property	Stolen Property Offenses	STOLEN PROPERTY - POSSESS

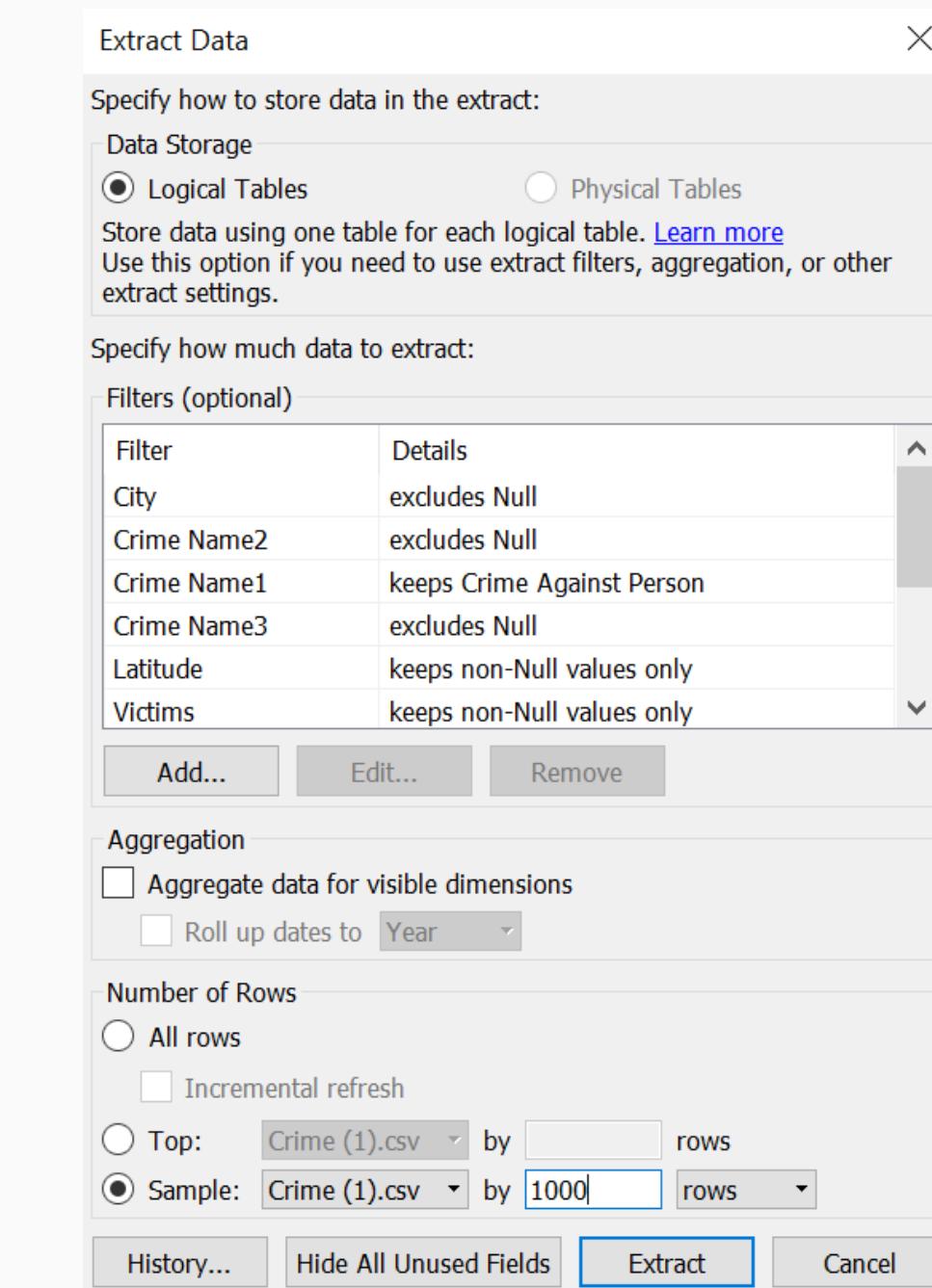
K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	
1	Block Address	City	State	Zip Code	Agency	Place	Sector	Beat	PRA	Address	N Street	Pre Street	Na Street	Suf Street	Start Date	End Date	Latitude	Longitude	Police Dis	Location
2	12800 BLK MIDDLEBROOK	GERMANTOWN MD		20874	MCPD	Street - In vehicle	N	5N1	447	12800		MIDDLEBROOK	RD	#####	#####	39.17774	-77.26565D	(39.1777,		
3	8300 BLK WOODMONT	BETHESDA MD		20814	MCPD	Street - In vehicle	E	2.00E+02	54	8300		WOODMONT	AVE	#####	#####	38.99269	-77.09712D	(38.9927,		
4	8300 BLK WOODMONT	BETHESDA MD		20814	MCPD	Street - In vehicle	E	2.00E+02	54	8300		WOODMONT	AVE	#####	#####	38.99269	-77.09712D	(38.9927,		
5	400 BLK QUINCE ORCHARD	GAITHERSBURG MD		20878	GPD	Hotel/Motel/Etc.	P	6P2	445	400		QUINCE ORCHARD	RD	#####	#####	39.14795	-77.21826D	(39.148,-		
6	4800 BLK FALSTONE	CHEVY CHASE MD		20815	MCPD	Residence - Single Family	E	2.00E+01	17	4800		FALSTONE	AVE	#####	#####	38.96617	-77.09662D	(38.9662,		
7	4800 BLK FALSTONE	CHEVY CHASE MD		20815	MCPD	Residence - Single Family	E	2.00E+01	17	4800		FALSTONE	AVE	#####	#####	38.96617	-77.09662D	(38.9662,		
8	9800 BLK BRISTOL SQUARE	BETHESDA MD		20814	MCPD	Residence - Apartment	E	2.00E+02	71	9800		BRISTOL SQUARE	LA	#####	#####	39.01433	-77.10122D	(39.0143,		
9	300 BLK TULIP AVE	TAKOMA PARK MD		20912	TPPD	Street - Residential	T	8T1	801	300		TULIP	AVE	#####	#####	38.97685	-77.01348D	(38.9768,		
10		SILVER SPRING MD		20906	MCPD	Street - In vehicle	K	4K1	351			GEORGIA	AVE	#####	#####	0	0 4D	(0.0, 0.0)		
11		GERMANTOWN MD		20874	MCPD	Street - In vehicle	N	5N1	465			WATERS LANDING	DR	#####	#####	39.19171	-77.2725D	(39.1917,		
12		GERMANTOWN MD		20874	MCPD	Street - In vehicle	N	5N1	465			WATERS LANDING	DR	#####	#####	39.19171	-77.2725D	(39.1917,		
13	7200 BLK NEW HAMPSHIRE	TAKOMA PARK MD			TPPD	Street - In vehicle	T	8T3	806	7200		NEW HAMPSHIRE	AVE	#####	#####	38.98033	-76.98988D	(38.9803,		
14	5400 BLK MARINELLI	ROCKVILLE MD		20852	MCPD	Residence - Apartment	D	2D4	187	5400		MARINELLI	RD	#####	#####	39.04675	-77.10872D	(39.0468,		
15	20100 BLK ROTHBURY	MONTGOMERY MD		20886	MCPD	Residence - Apartment	R	6R2	504	20100		ROTHBURY	LA	#####	#####	0	0 6D	(0.0, 0.0)		
16	20000 BLK AIRCRAFT	GERMANTOWN MD		20874	MCPD	Parking Lot - Commercial	N	5N1	702	20000		AIRCRAFT	DR	#####	#####	39.18453	-77.26355D	(39.1845,		
17	20000 BLK AIRCRAFT	GERMANTOWN MD		20874	MCPD	Parking Lot - Commercial	N	5N1	702	20000		AIRCRAFT	DR	#####	#####	39.18453	-77.26355D	(39.1845,		
18	11500 BLK LOCKWOOD	SILVER SPRING MD		20904	MCPD	Residence - Apartment	I	3I1	145	11500		LOCKWOOD	DR	#####	#####	39.04121	-76.98623D	(39.0412,		

Data for this Project

1. Open Crime.csv with Tableau
2. Edit Data Source Filter (Main attributes can be found below)



3. Extract Data



Sample Data

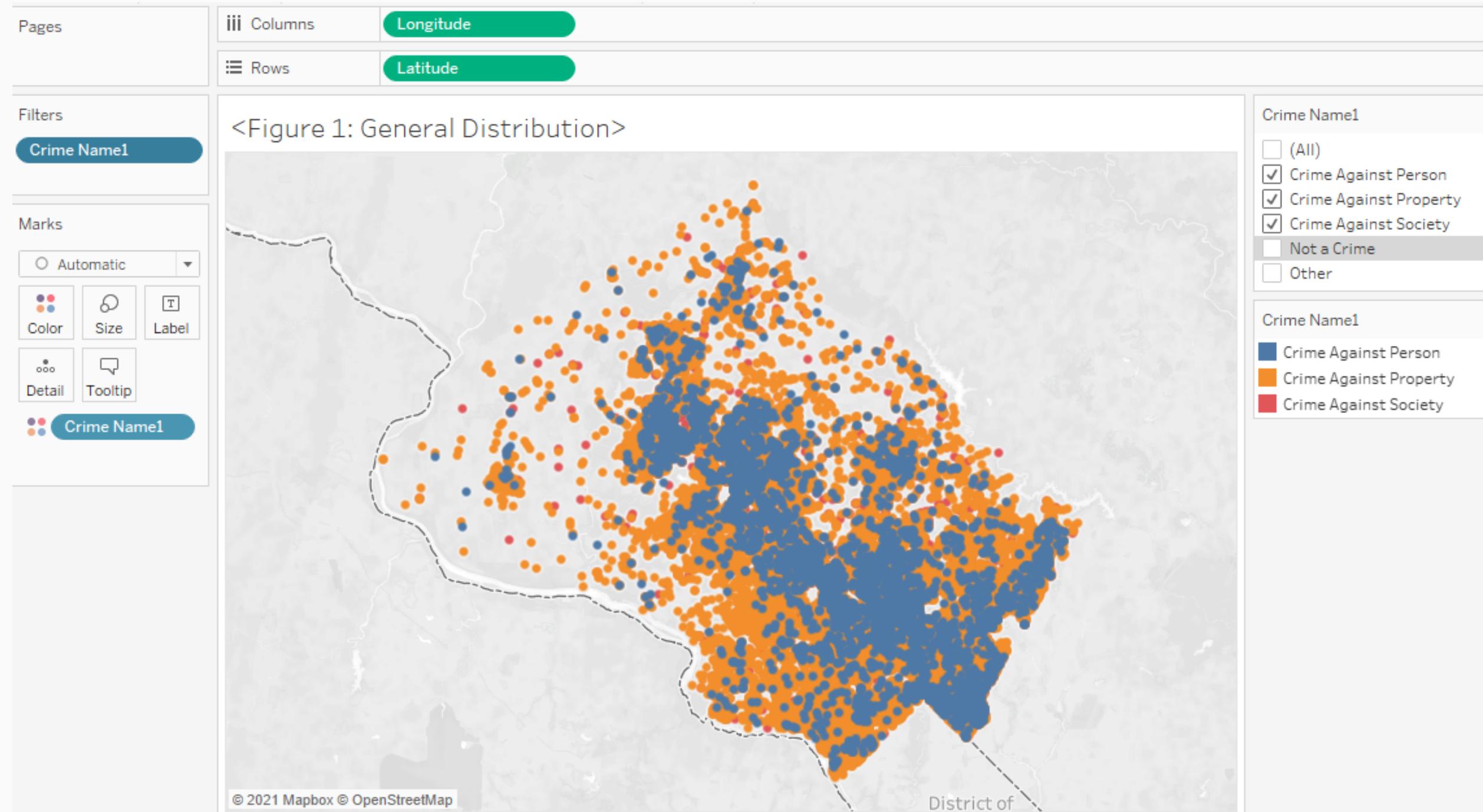
Extract ▾ 30 fields 1000 rows 1000 → rows

Table Details >	# Crime (1).csv	# Crime (1).csv	# Crime (1).csv	📅 Crime (1).csv	Abc Crime (1).csv	# Crime (1).csv	Abc Crime (1).csv
	Incident ID	Offence Code	CR Number	Dispatch Date / Time	NIBRS Code	Victims	Crime Name1
	201235274	1117	190008095	2/19/2019 8:20:24 PM	11D	1	Crime Against Person
	201290461	1399	200022407	6/7/2020 12:45:24 PM	13B	1	Crime Against Person
	201216904	1313	180060012	12/1/2018 12:13:31 AM	13B	3	Crime Against Person
	201172338	1399	180004370	1/26/2018 12:03:04 AM	13B	1	Crime Against Person
	201170988	1399	180002724	1/17/2018 4:33:37 PM	13B	1	Crime Against Person
	201180605	1399	180014638	3/25/2018 3:03:39 AM	13B	1	Crime Against Person
	201319015	1399	210004823	2/7/2021 1:24:50 AM	13B	1	Crime Against Person
	201207872	1399	180048391	9/27/2018 11:10:44 PM	13B	2	Crime Against Person
	201144546	9003	170520635	7/22/2017 8:20:48 PM	11C	1	Crime Against Person

4. Repeat the process for the other categories

Results and Discussion

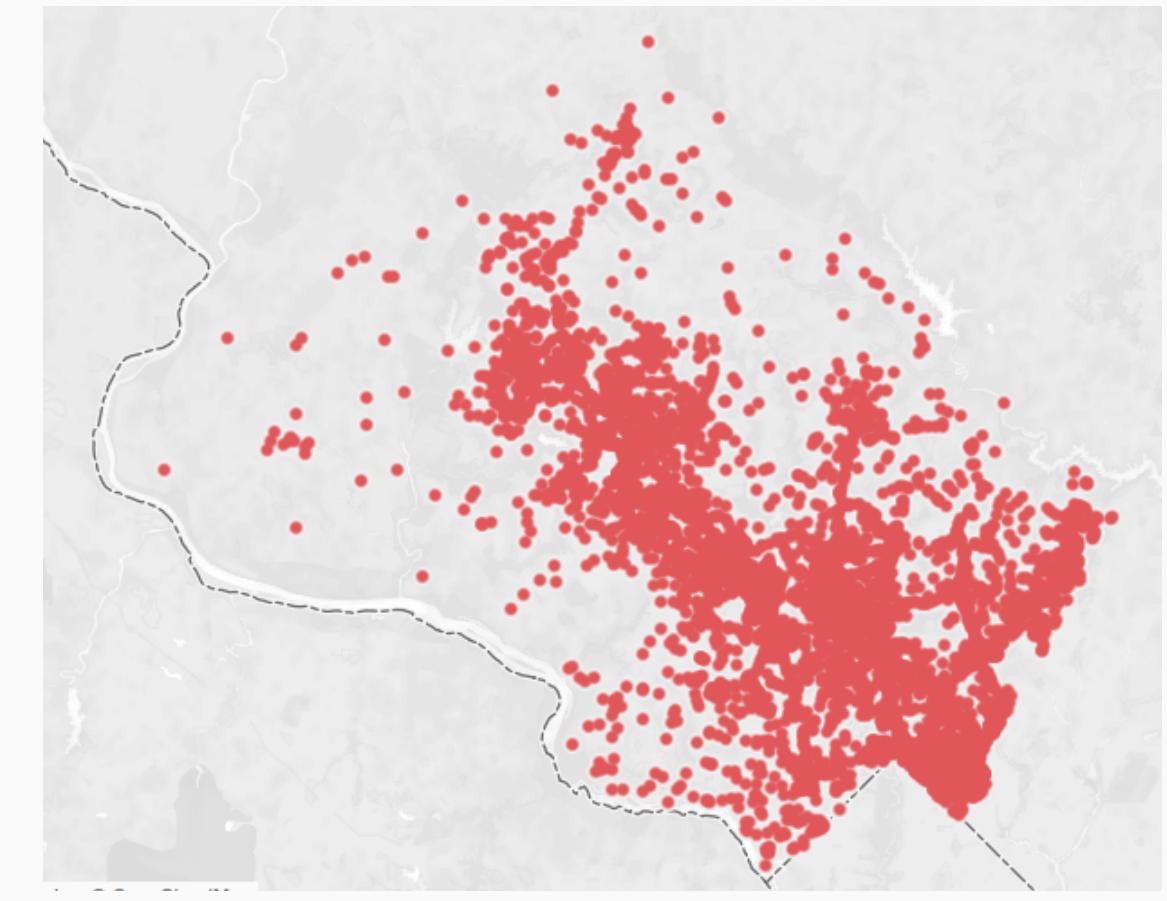
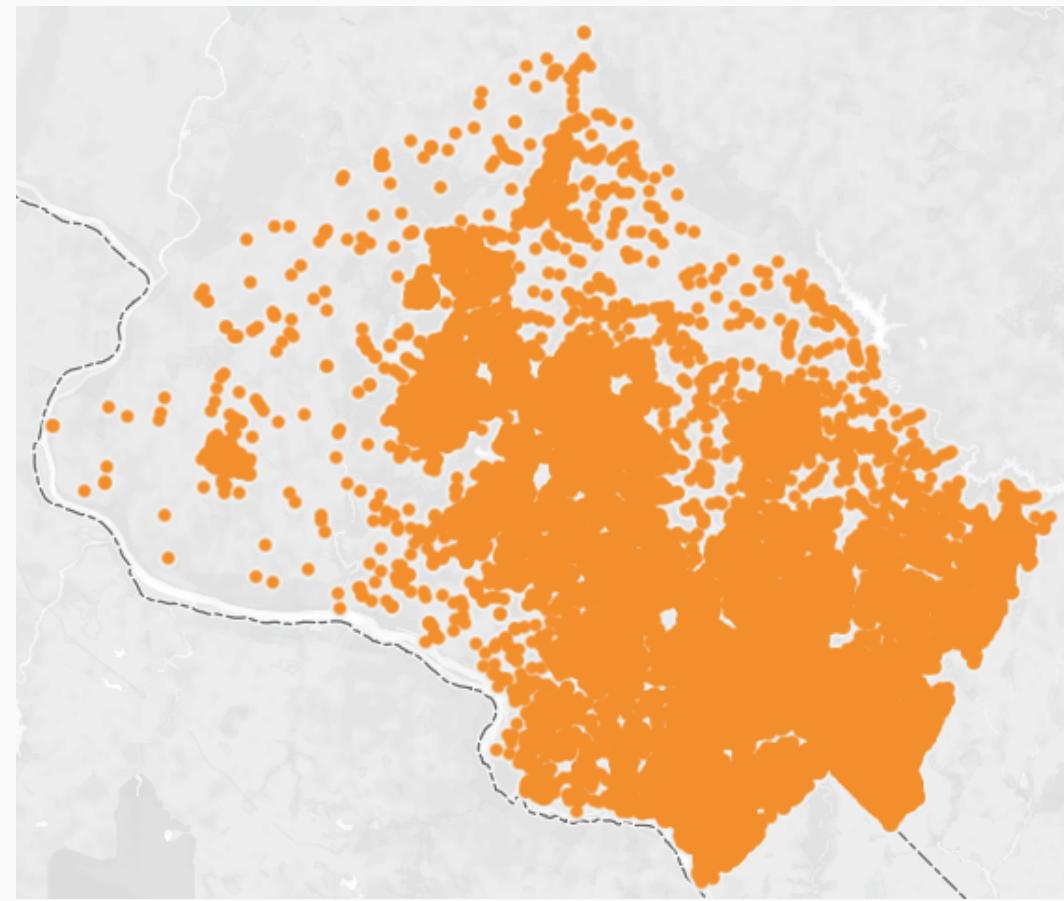
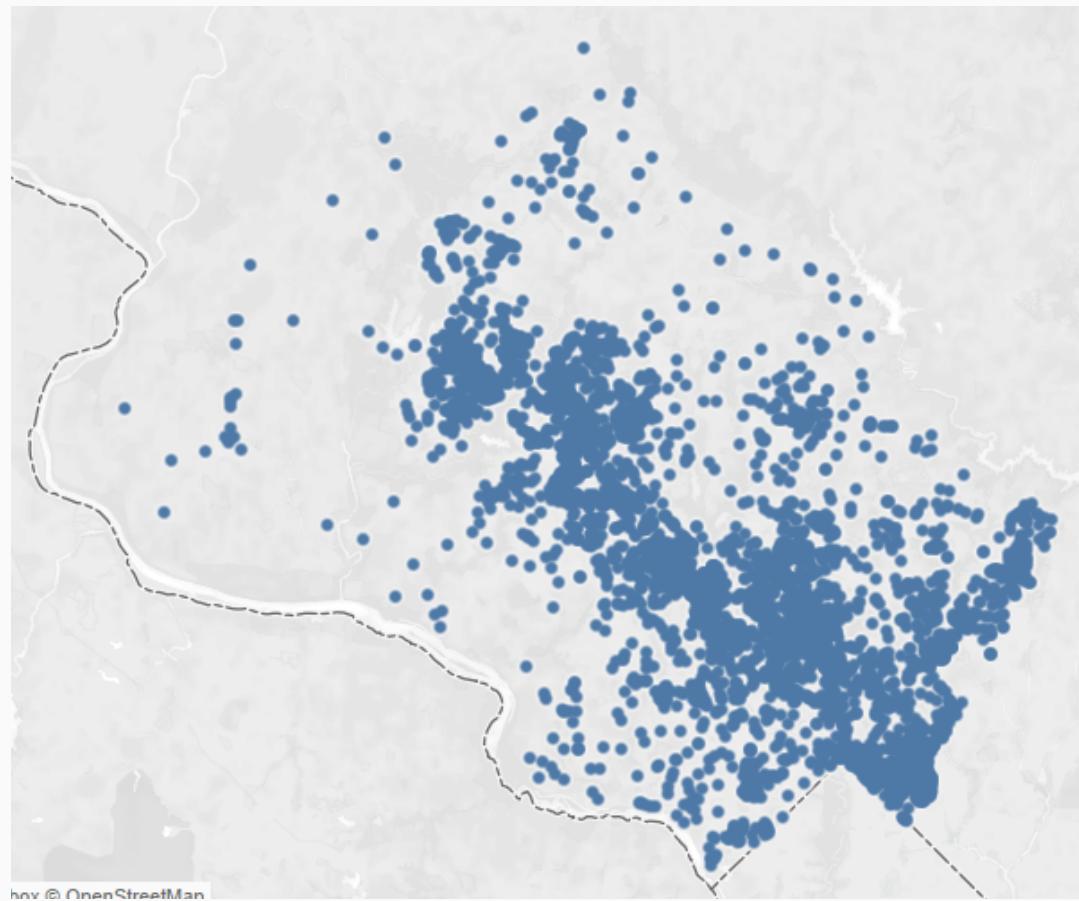
Figure 1: General Distribution of crimes in Montgomery County



Separate Distribution for Each Crime Category from Figure 2.

Crime Name1

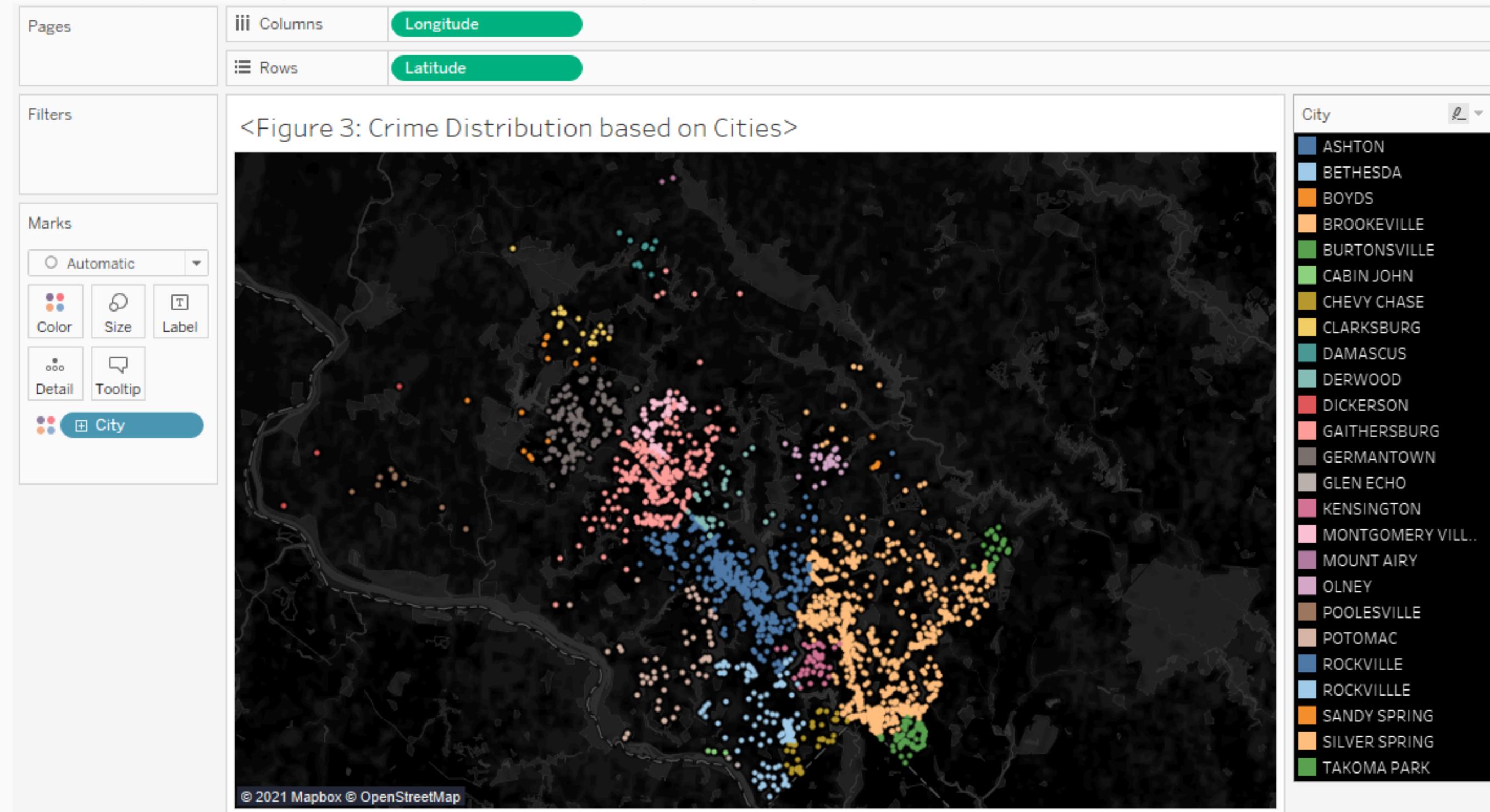
- Crime Against Person
- Crime Against Property
- Crime Against Society



Highest category: Crime Against Property.

	C.A.Society	C.A.Property	C.A.Person	Other Categories	Total
This Project	15.50%	60.08%	7.27%	17.15%	100.00%
The Paper	28%	45%	8%	19%	100%

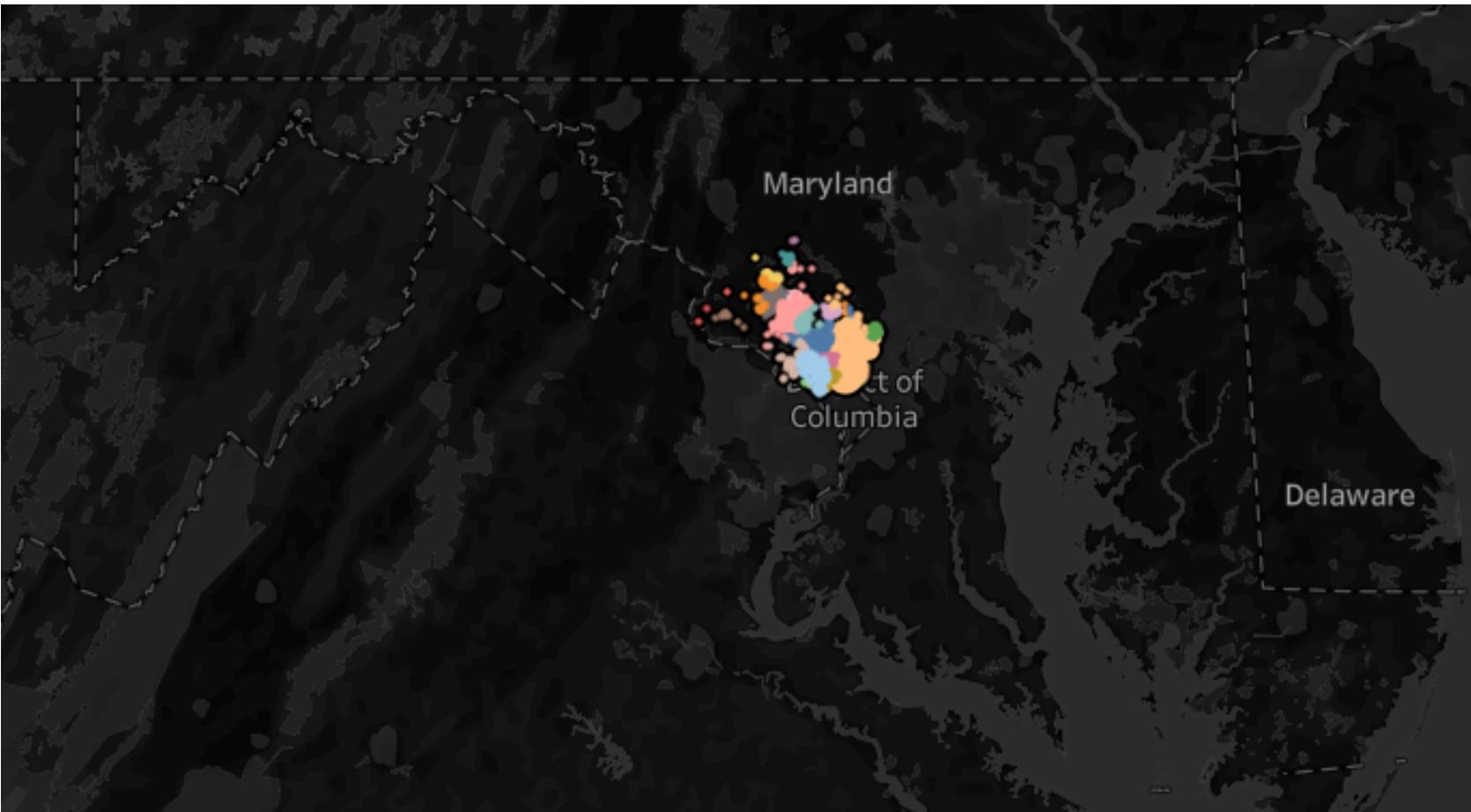
Figure 3: Visualization based on distribution among cities (using 3000 sample data)



Major colors:

SILVER SPRING
ROCKVILLE
GAITHERSBURG

Figure 3: Visualization based on distribution among cities



<https://gisgeography.com/maryland-county-map/>

Result : Centralization at west Maryland (only because the data used is of Montgomery County)

Figure 4: Distribution of Victims

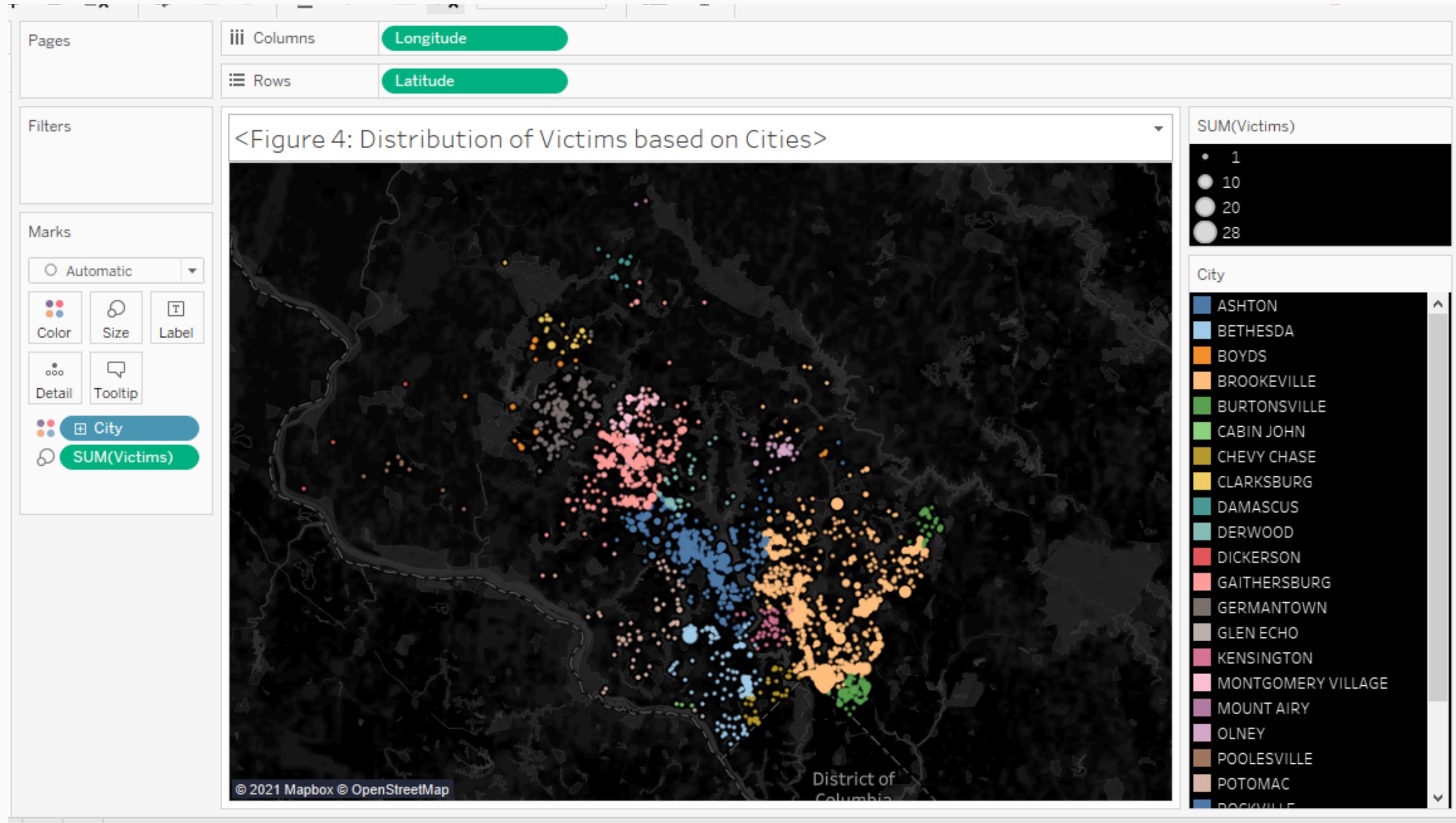
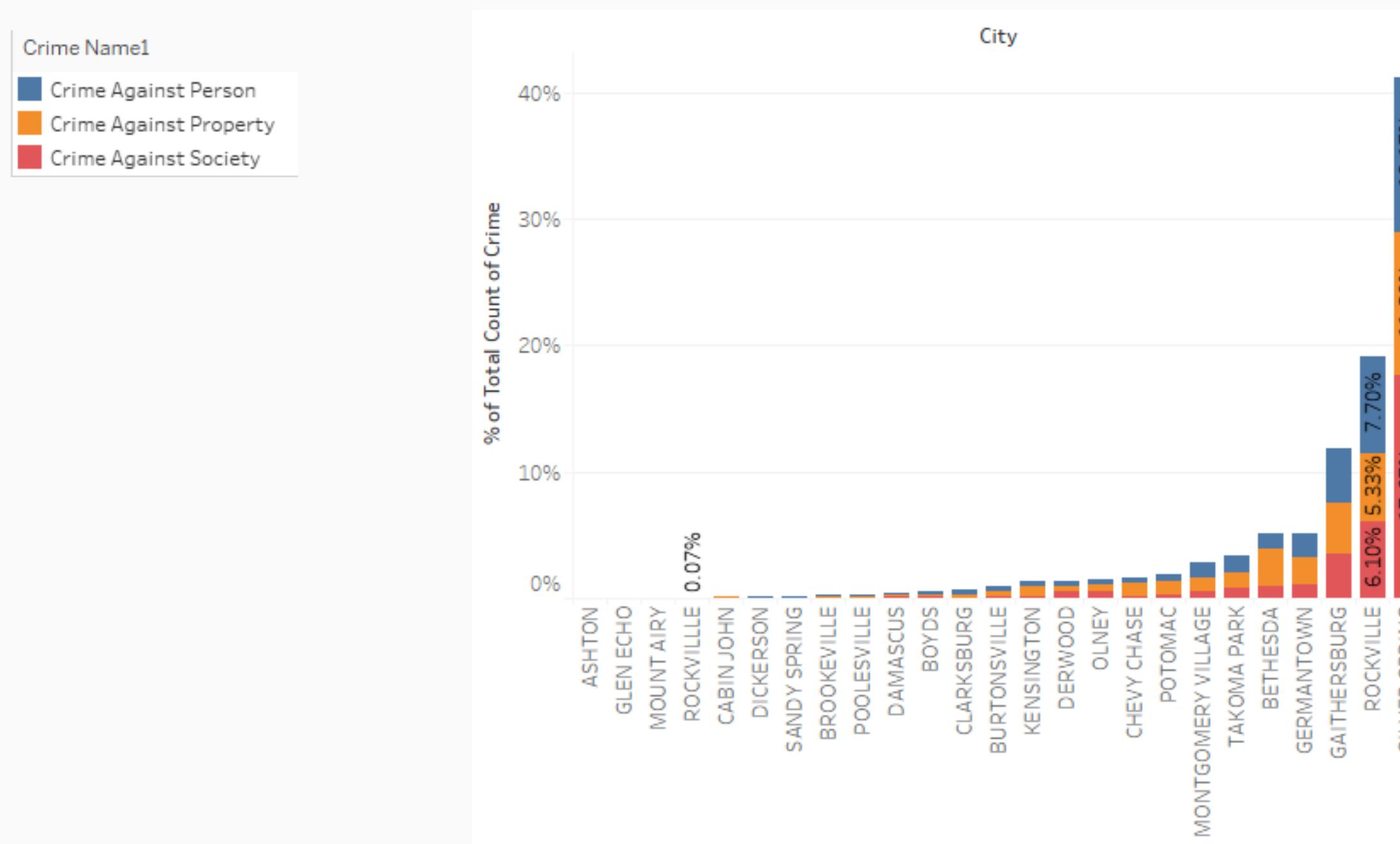
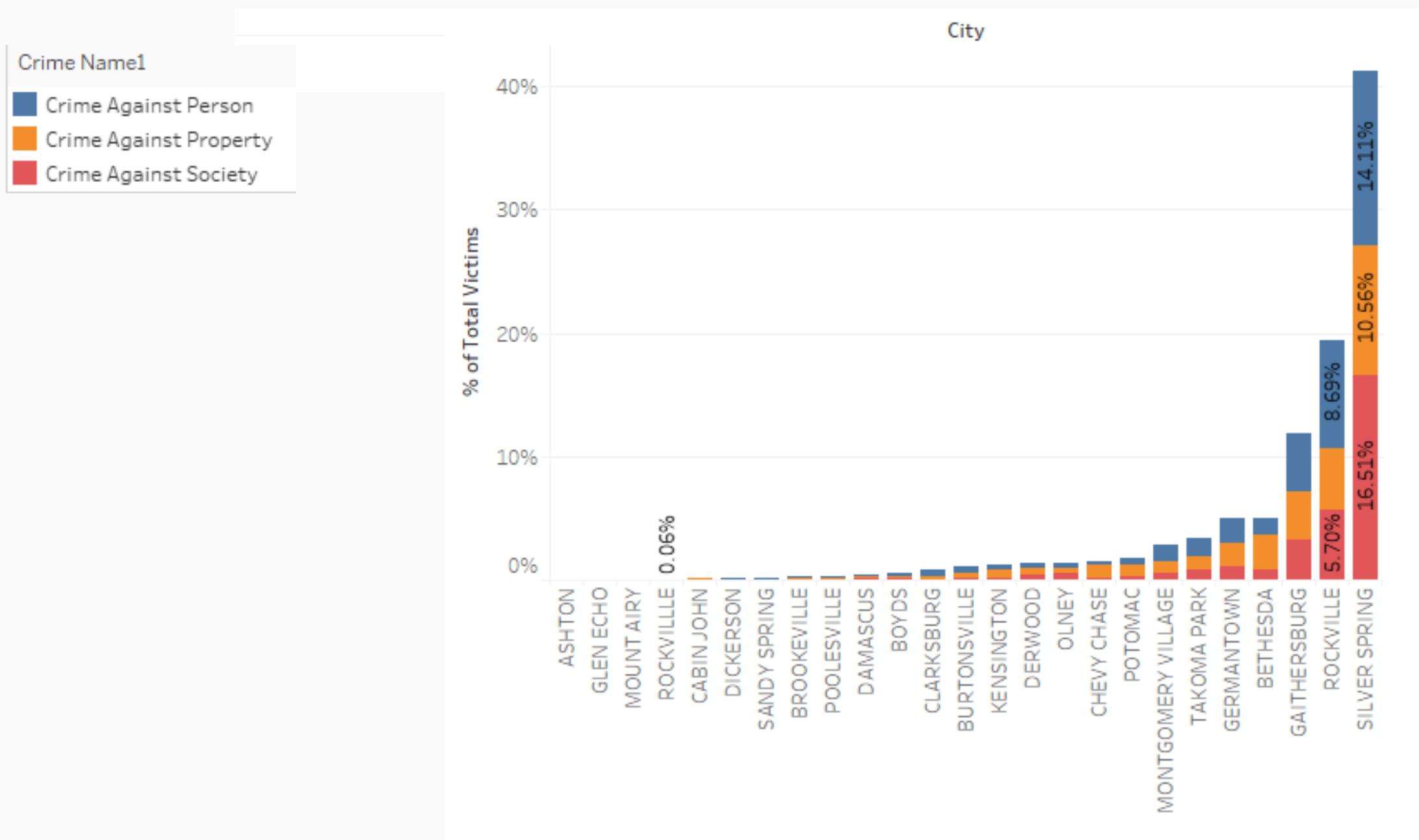


Figure 5: Crime Rates in Montgomery County



Highest: Silver Spring with 41.13% (Paper: 45.63%) in which the highest crime type is Crime Against Society (17.67%).

Figure 6: Victims Rates in Montgomery County



	C.A.Society	C.A.Property	C.A.Person	Total
This Project	16.51%	10.56%	14.11%	41.18%
The Paper	18.03%	11.00%	16.60%	45.63%

Time Distribution for Crime

Time Breakdowns

```
IF (DATEPART('hour', [Start Date Time]) >= 5  
AND DATEPART('hour', [Start Date Time]) <= 8)  
THEN "Early Morning"  
  
ELSEIF (DATEPART('hour', [Start Date Time]) >= 9  
AND DATEPART('hour', [Start Date Time]) <= 11)  
THEN "Late Morning"  
  
ELSEIF (DATEPART('hour', [Start Date Time]) >= 12  
AND DATEPART('hour', [Start Date Time]) <= 15)  
THEN "Early Afternoon"  
  
ELSEIF (DATEPART('hour', [Start Date Time]) >= 16  
AND DATEPART('hour', [Start Date Time]) <= 17)  
THEN "Late Afternoon"  
  
ELSEIF (DATEPART('hour', [Start Date Time]) >= 18  
AND DATEPART('hour', [Start Date Time]) <= 20)  
THEN "Evening"  
  
ELSE "Night"  
END
```

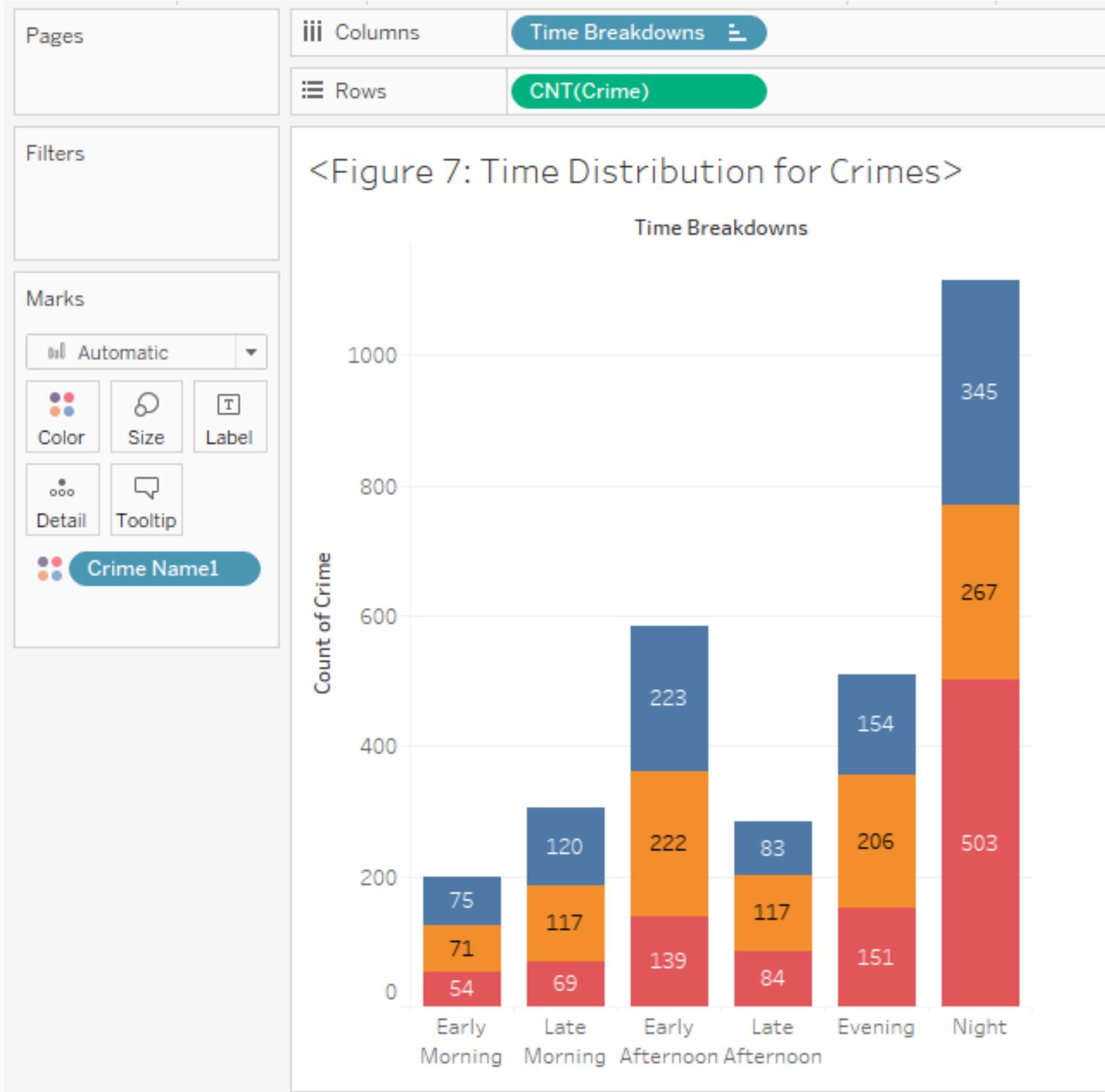
The calculation is valid.

Apply OK

Times of occurrence categories:

- (1) early morning [5:00-8:59]
- (2) late morning [9:00-11:59]
- (3) early afternoon [12:00-15:59]
- (4) late afternoon [16:00-17:59]
- (5) evening [18:00-20:59]
- (6) night [21:00-4:59]

This categorization is based on Learner's Dictionary's [2] and WGNTV [3] time period breakdowns.



<Figure 7: Time Distribution for Crimes>

Crime Name1

- Crime Against Person
- Crime Against Property
- Crime Against Society

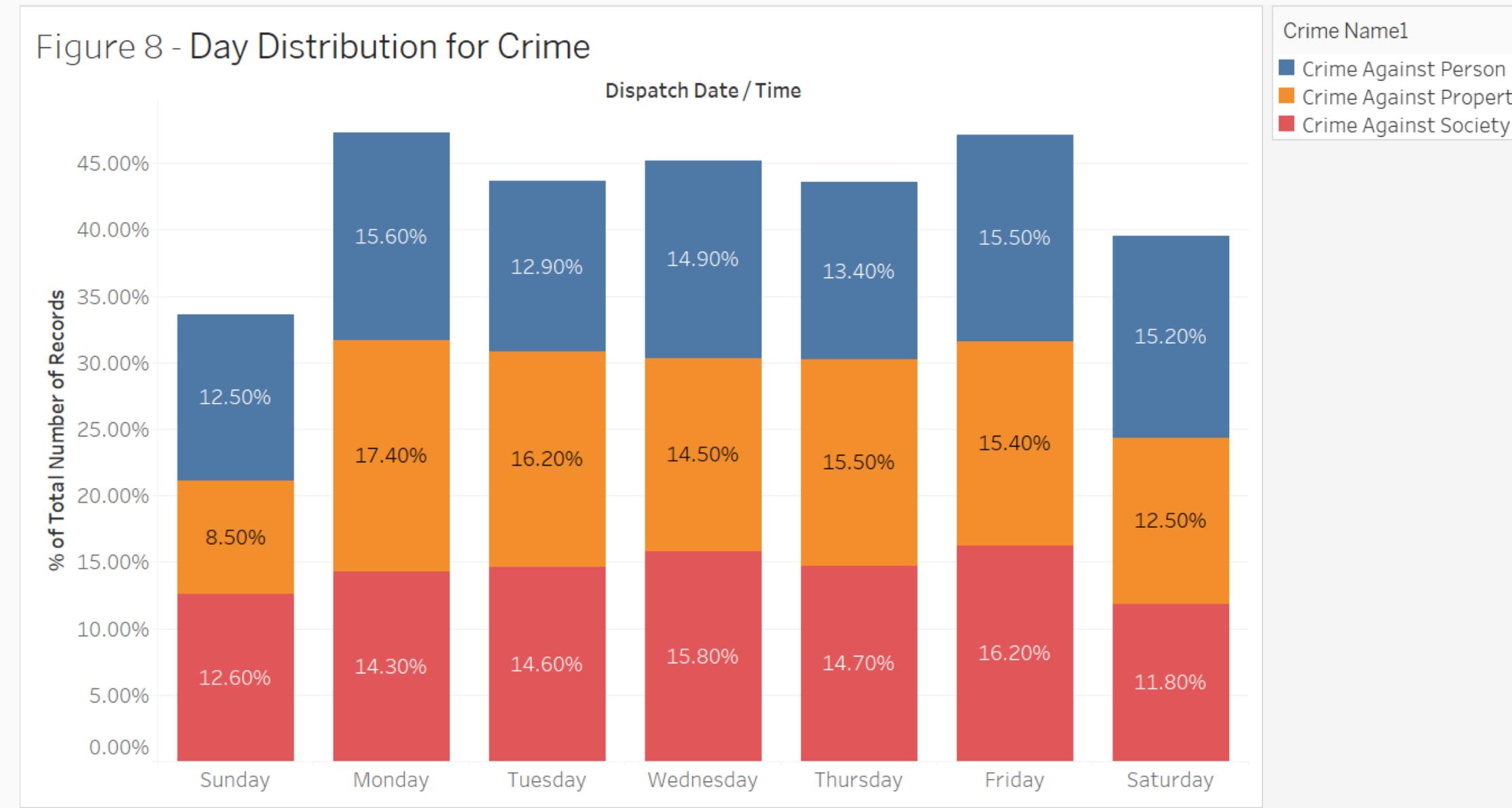
Frequent time of crime occurrence (per 1000 cases):

	C.A.Society	C.A.Property	C.A.Person
This Project	Night	503	Night
The Paper	Night	522	Late Morning, Early Afternoon

The difference between the paper and project result is quite significant. It may be due to the different breakdowns for the time period categories.

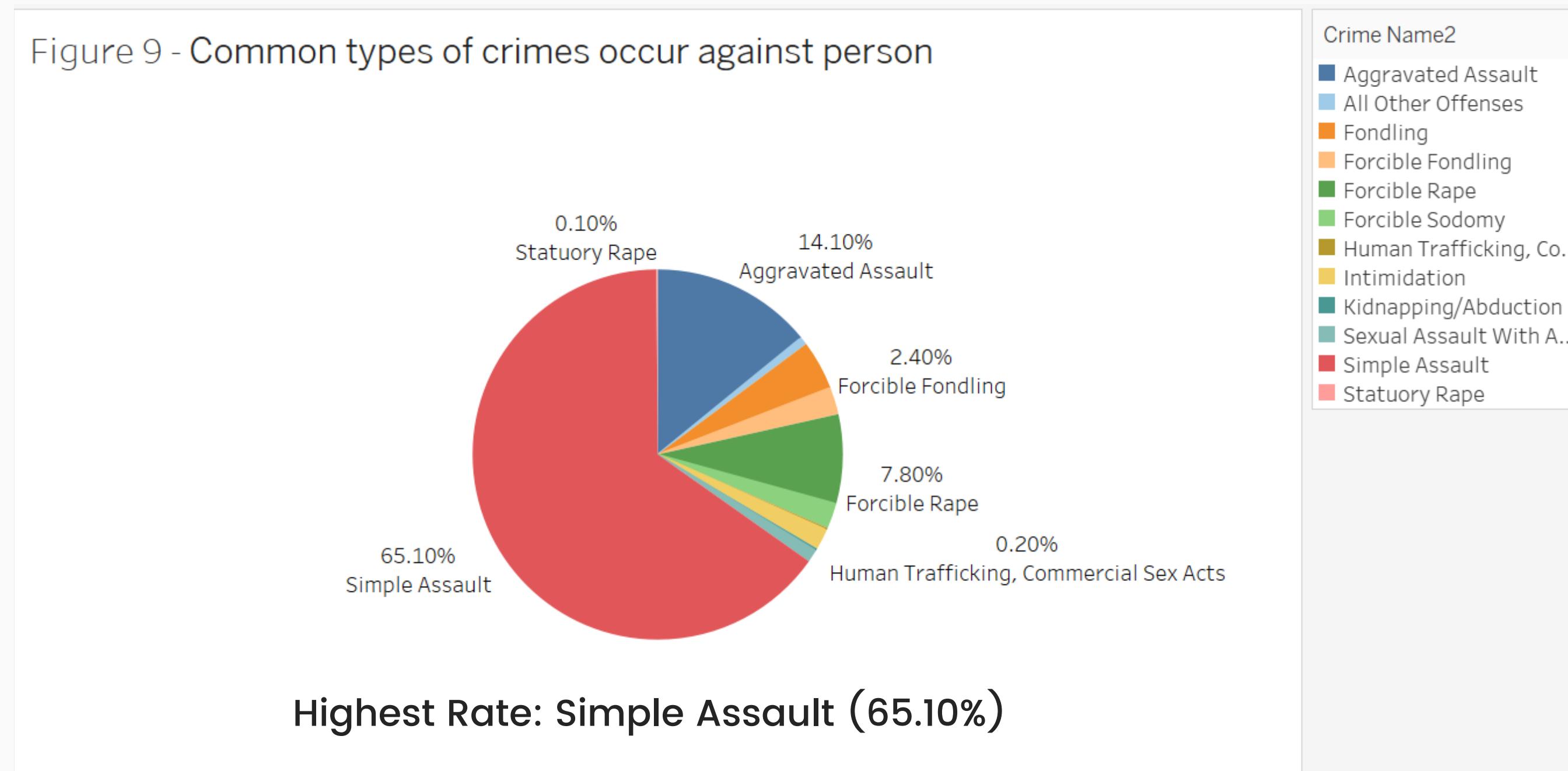
Figure 7: Time Distribution for Crime

Figure 8: Day Distribution for Crime



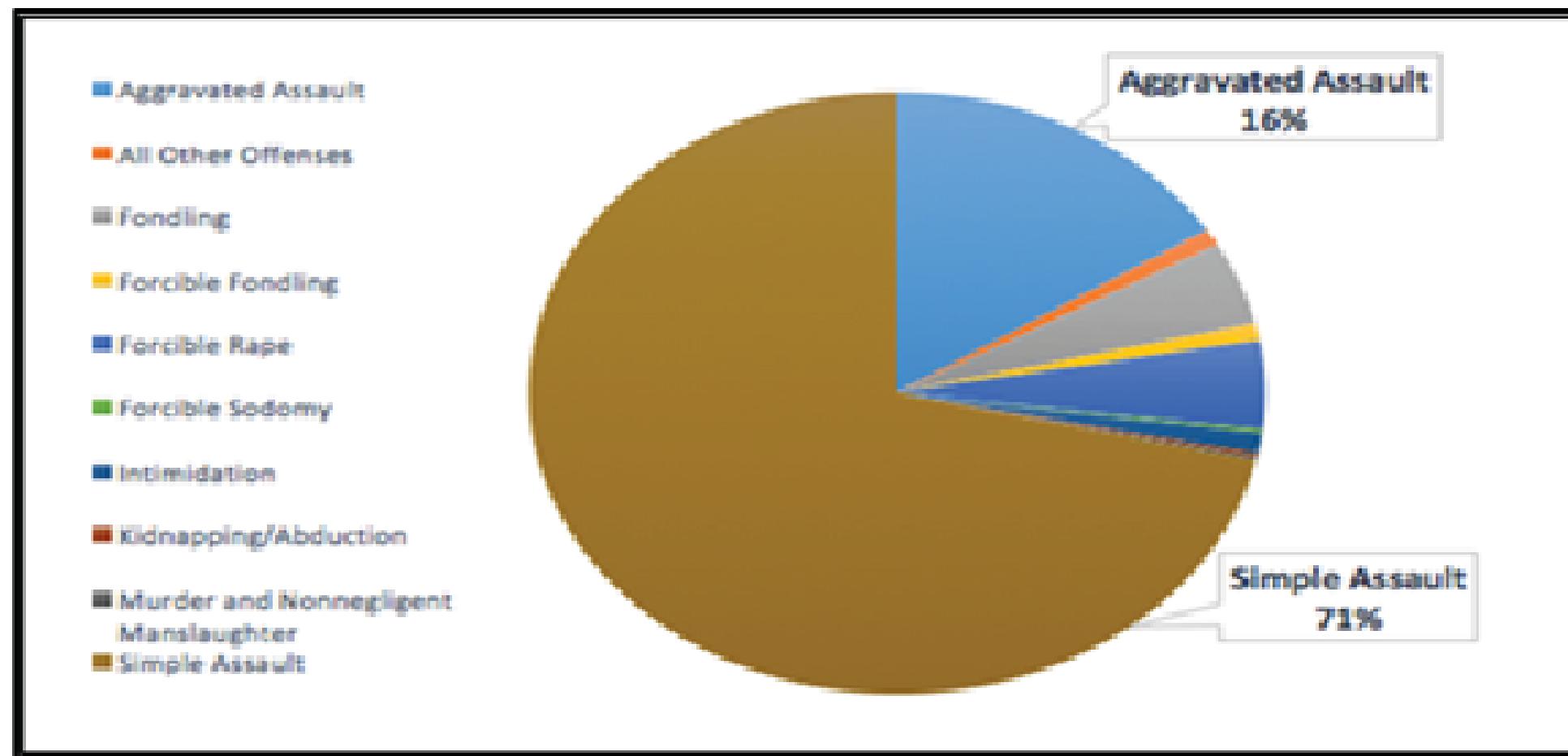
	C.A.Society		C.A.Property		C.A.Person	
This Project	Friday	16.20%	Monday	17.40%	Monday	15.60%
					Friday	15.50%
The Paper	Saturday	5.50%	Wednesday	-	Wednesday	-
	Friday	5.276%		Tuesday	-	Tuesday

Figure 9: Common types of crimes occur against person



- Simple Assault: Unwanted physical contacts, threats or attempts on hurting somebody
- Aggravated Assault: Attacks with the intention to hurt somebody, usually with a weapon

Figure 9 Paper: Common types of crimes occur against person



Results Comparison: Common types of crimes occur against person

	This Project	The Paper
1	Simple Assault (65.10%)	Simple Assault (71%)
2	Aggravated Assault (14.10%)	Aggravated Assault (16%)
3	Forcible Rape (7.80%)	Forcible Rape

Figure 10: Common types of crimes occur against society

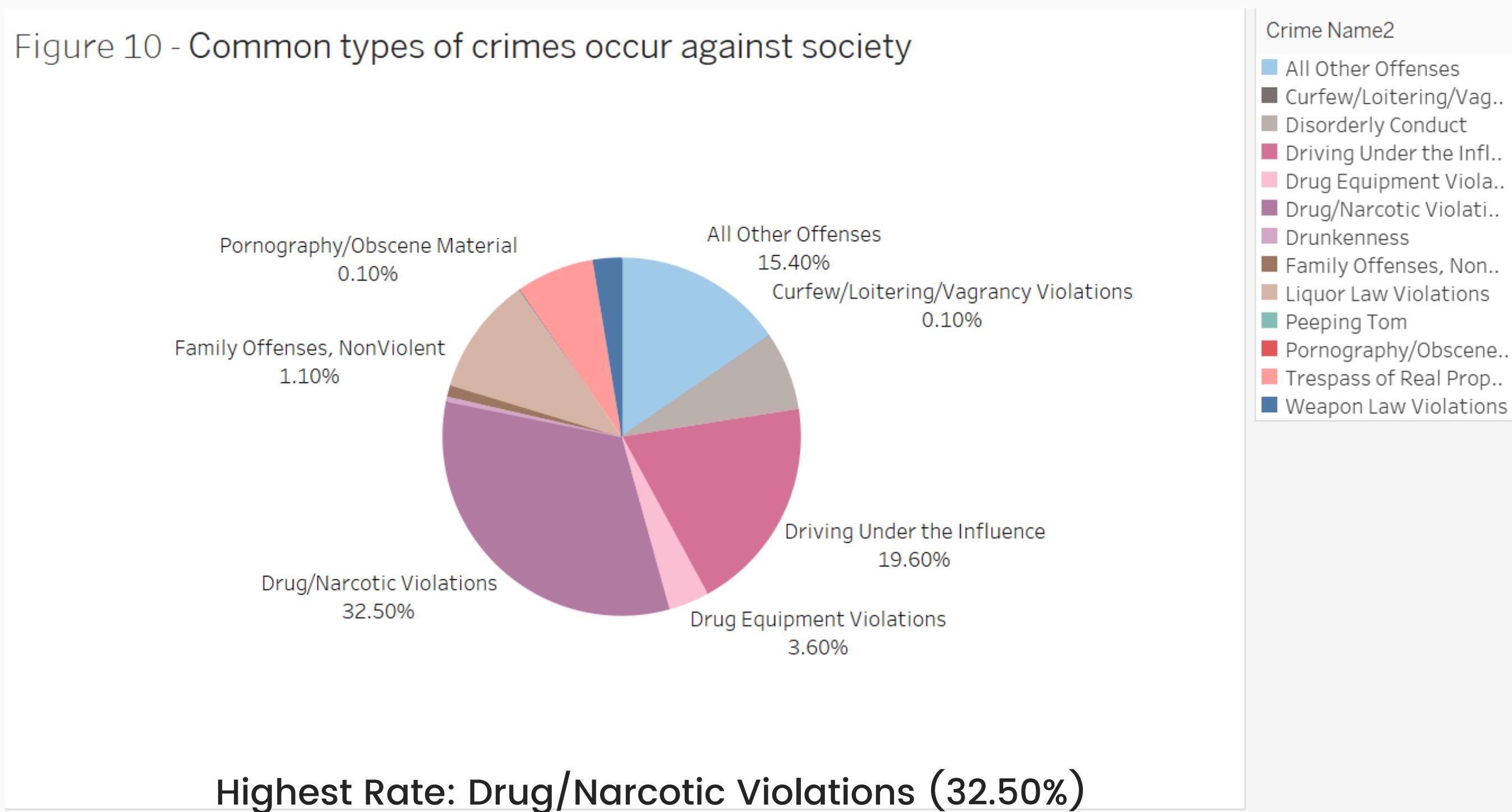
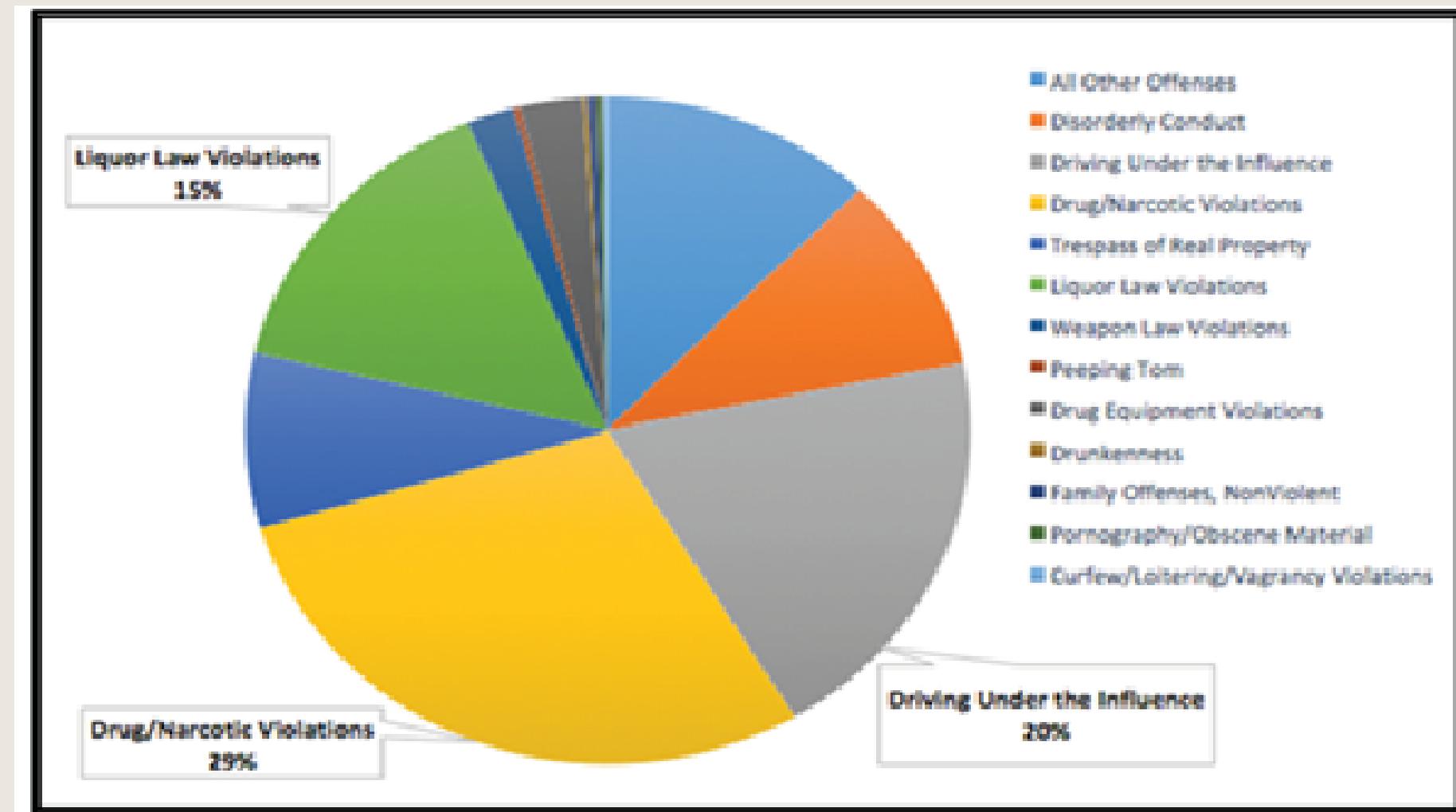


Figure 10 Paper: Common types of crimes occur against society



Results Comparison:
Common types of crimes occur against society

	This Project	The Paper
1	Drug/Narcotic Violations (32.50%)	Drug/Narcotic Violations (29%)
2	Driving Under the Influence (19.60%)	Driving Under the Influence (20%)
3	All Other Offenses (15.40%)	Liquor Law Violations (15%)

Figure 11: Common types of crimes occur against property

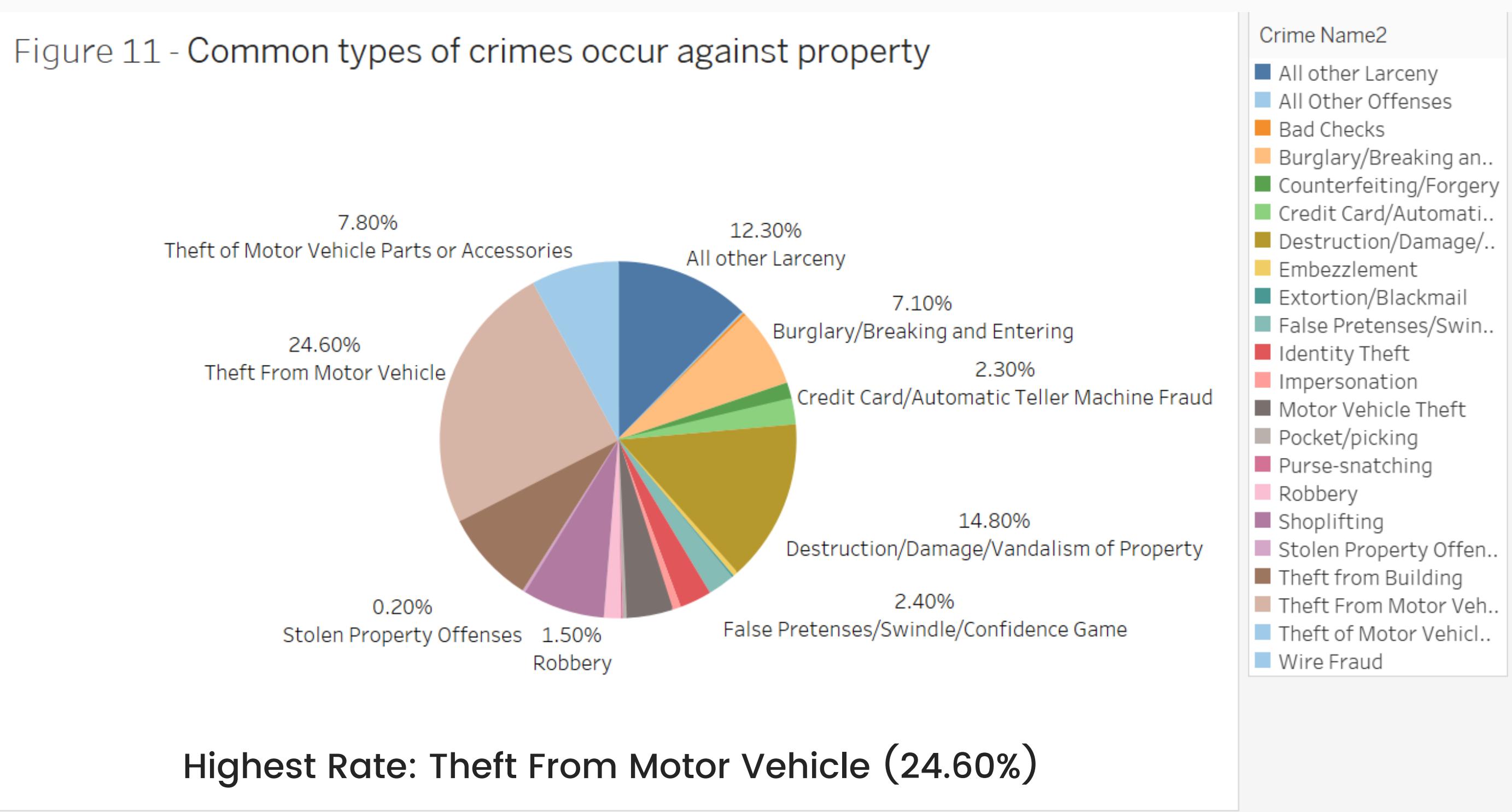
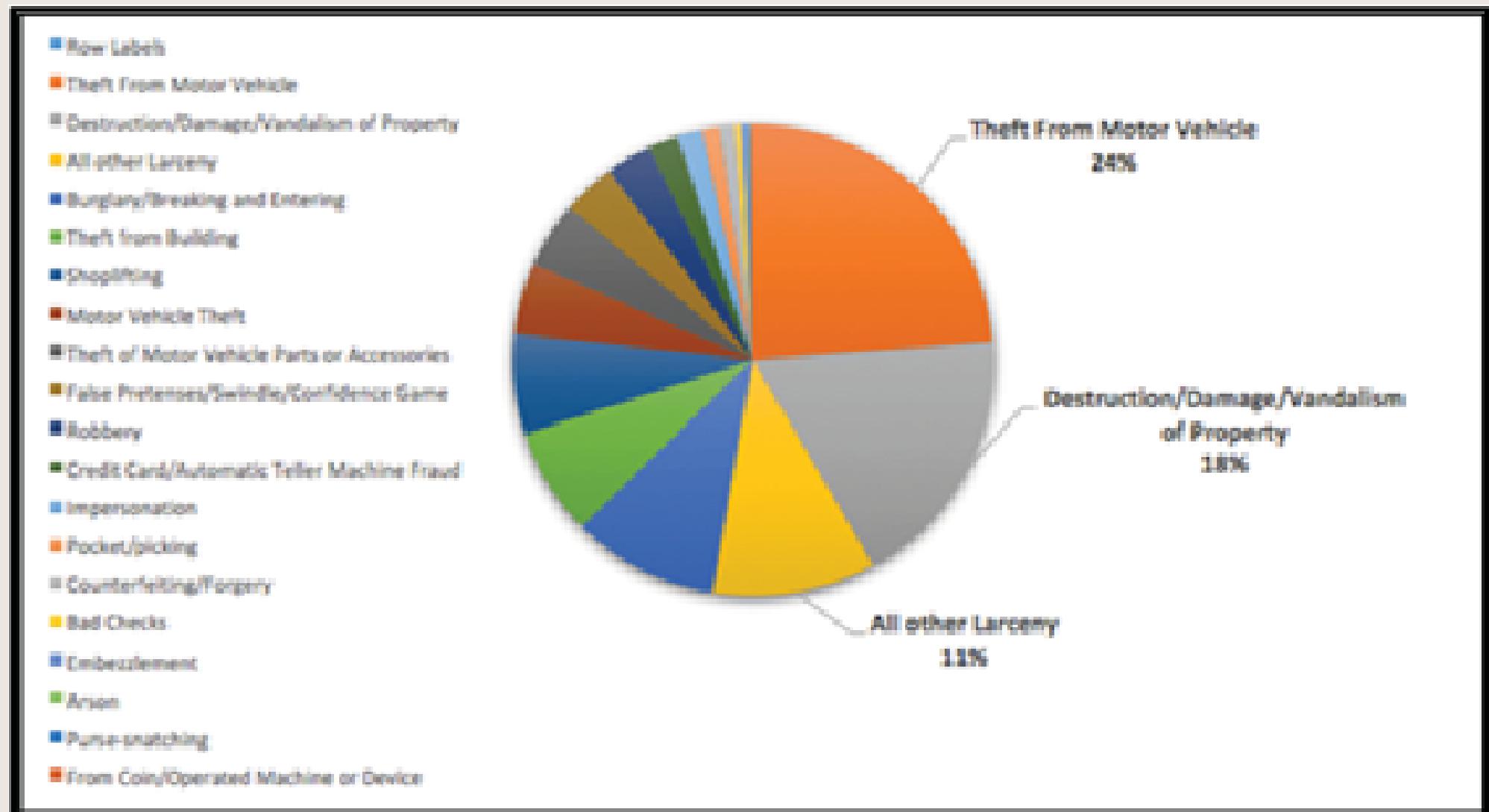


Figure 11 Paper: Common types of crimes occur against property



Results Comparison: Common types of crimes occur against property

	This Project	The Paper
1	Theft From Motor Vehicle (24.60%)	Theft From Motor Vehicle (24%)
2	Destruction/Damage/Vandalism of Property (14.80%)	Destruction/Damage/Vandalism of Property (18%)
3	All Other Larceny (12.30%)	All Other Larceny (11%)

Recommendation from Paper

- Priority in staffing and combat training for Silver Spring police department
- Increase patrol frequency
- Create awareness campaign about driving under influence and the danger of substance abuse
- Learn some self-defense knowledge for each individuals and learn to handle heated situations calmly
- Add security system to prevent theft

Discussion

It is written that the factors that makes Silver Spring the city with the highest crime rate in Maryland are: (1) It has the highest population (76,000), (2) unemployment rate and proximity to the District of Columbia that has high unemployment rate and the highest crime rate, (3) high rate of substance abuse.

MAIN PROBLEM:

The paper is written as though the dataset encompassed all crime cases in Maryland while it was limited to Montgomery County.

Point A – Population Number

Because of the difficulty to find past data, we evaluate factor (1) with the most recent data and assumed that without the growth from 2016 until 2020, the rank would not have changed significantly. Below are the top 3 cities with the highest crime rates (according to both the paper and this project), ranked by population based on 2020 Census, [4]

- Silver spring: 81,015 (rank 5 in Maryland)
- Rockville: 67,117 (rank 12 in Maryland)
- Gaithersburg: 69,657 (rank 9 in Maryland)

It is difficult to see how the three areas compared to others in the scope of Montgomery County, however, the high ranks within Maryland state made us conclude that population number has some effects on the crime rate of a city, although it is unclear to what degree.

Point B - Unemployment Rate

The paper claimed that:

- (a) Crime against property is the highest in Maryland because the higher the unemployment rate, the more crimes of this type are committed. This type's occurrence is high because of Maryland's unemployment rate (13/50) (pg. 3)
- (b) Silver Spring has the highest crime rate due to the unemployment rate (pg. 4)

- > Inconsistent claims
- > Based on labor statistics [5] and ranking by different rate values (lower rank = higher unemployment rate):
 - Maryland 2016 unemployment rate rank = 10/28
 - District of Columbia = 26/28
- > Based on FBI data [6], 2016 crime rates:
 - Maryland crime rank = 12/52
 - District of Columbia = 1/52
- > The claim that might be acceptable would be, the higher a city's unemployment rate is, the higher the crime rate (not specifically crime against property).
- > Claim (a) is unacceptable because Maryland's unemployment rate is relatively low and the comparison in this paper is within Maryland, not the states of the United States.
- > Claim (b) is unacceptable because Silver Spring's unemployment rate was not mentioned and so, there can't be any conclusion related to unemployment rate and the crime rate in Silver Spring.
- > However, we accept that proximity to the District of Columbia may affect the crime rate in Silver Spring. (Fig.12)

Point C – Other Problems

- Total data of 3 categories is >200,000 data. A sample of 1000 data for each type is not enough to represent the whole set of data.
- The definition of crime rate used in the paper is the number of crime cases in a particular city over the total number of cases, while government definition of crime rate is the number of crime that happens for every 100,000 habitants [6]
- The data did not only include cities, but also census-designated places (CDP) which made a deeper research and data gathering more difficult since some included CDP as towns and others do not.

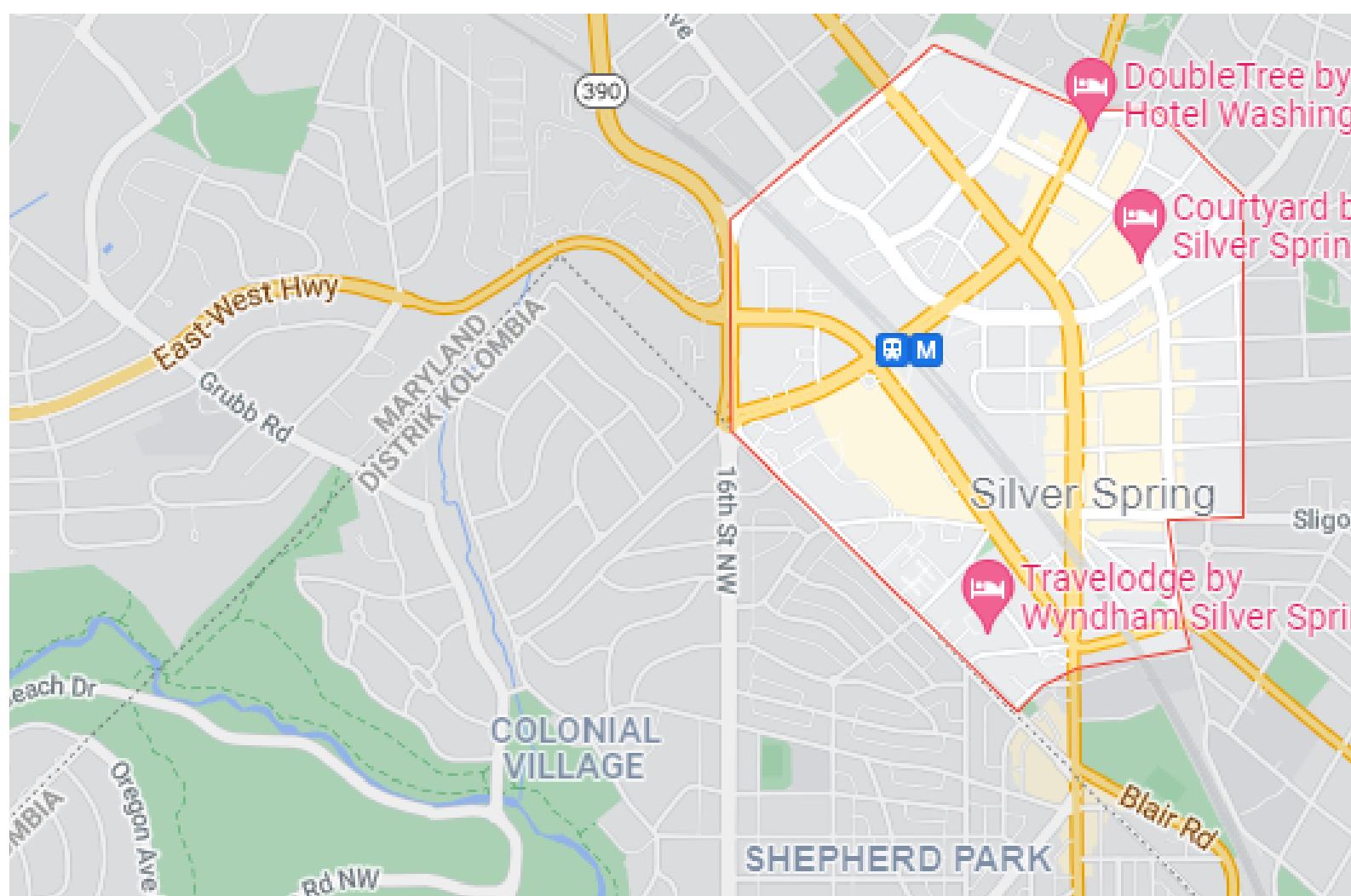


Figure 12: Silver Spring Map

Conclusion

This project focused on analysis and interacted visualization of crimes data with three types (crimes against the person, crimes against property, and crimes against society) in 2016 Montgomery County of Maryland State, USA.

- (1) The highest number of crime cases in Montgomery County belongs to crime against property (60.08%).
- (2) The city with the highest number of crime cases in each type is Silver Spring (41.13%) with crime against society as the most frequent crime (17.67%). Consequently, Silver Spring almost instantly has the most victims (39.07%).
- (3) The most frequent time interval for all types of crime is at night.
- (4) The most frequent day is Friday for crimes against society. The most frequent day is Monday for crimes against property. Monday and Friday are the most frequent for crimes against person.
- (5) The most frequent crimes for each type are simple assault for crimes against person (65.10%), drug/narcotic violation for crimes against society (32.50%), and theft from motor vehicle for crimes against property (24.60%).
- (6) The high number of crime cases in Silver Spring may be caused by the proximity to the District of Columbia that has the highest rate of crime in the US and also has the third highest unemployment rate.

RT



Thank You!

Bayoumi, S., AlDakhil, S., AlNakhilan, E., Al Taleb, E., & AlShabib, H. (2018, April). A review of Crime Analysis and Visualization. Case study: Maryland State, USA. In 2018 21st Saudi Computer Society National Computer Conference (NCC) (pp. 1-6). IEEE.

RT

https://www.researchgate.net/profile/Hana-Alshabib/publication/328638553_A_Review_of_Crime_Analysis_and_Visualization_Case_Study_Maryland_State_USA/links/5c85e68d299bf1268d4f9817/A-Review-of-Crime-Analysis-and-Visualization-Case-Study-Maryland-State-USA.pdf

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Additional References:

- [2] Mairs, J. (2012, August 10). *Parts of the Day: Early morning, late morning, etc.* Learner's Dictionary. <https://www.learnersdictionary.com/qa/parts-of-the-day-early-morning-late-morning-etc>. Accessed 24 October 2021.
- [3] Skilling, T. (2018, November 1). *How do you define daytime and evening times in a weather forecast?* WGNTV. <https://wgntv.com/weather/how-do-you-define-daytime-and-evening-times-in-a-weather-forecast/>. Accessed 24 October 2021.
- [4] Cubit Planning, Inc. (n.d.). *Maryland Cities by Population*. Maryland Demographics by Cubit. https://www.maryland-demographics.com/cities_by_population. Accessed 24 October 2021.
- [5] U.S. BUREAU OF LABOR STATISTICS (2021, March 3). *Unemployment Rates for States*. U.S. BUREAU OF LABOR STATISTICS. <https://www.bls.gov/lau/lastrk16.htm>
- [6] State (2016). *Crime in the United States*. FBI: UCR. <https://ucr.fbi.gov/crime-in-the-u.s/2016/crime-in-the-u.s.-2016/tables/table-3>. Accessed 24 October 2021.