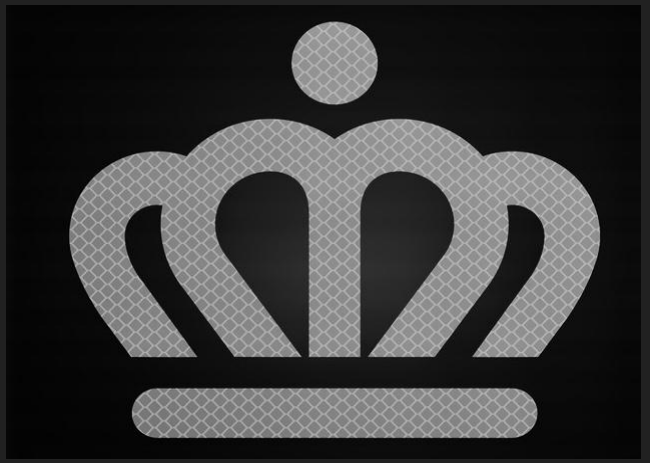
Analyzing Crime Data in the Charlotte Area



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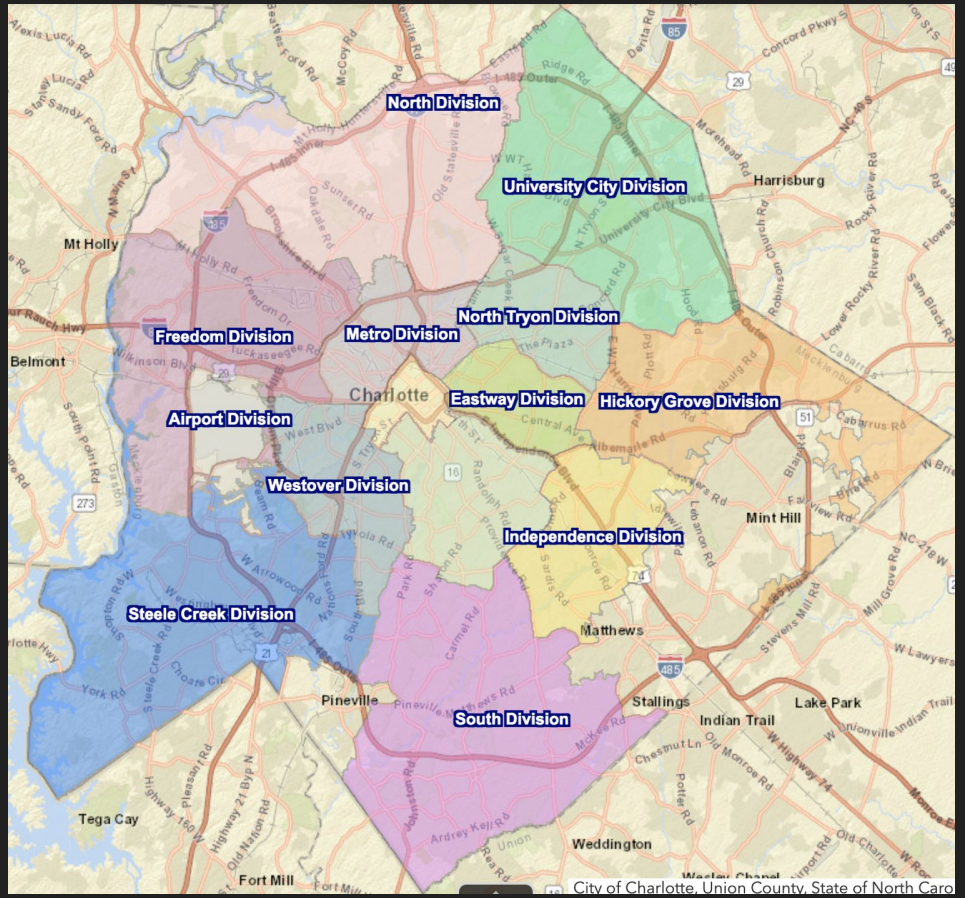
Reason for Choosing Topic and Questions to be Answered

- **Why topic was selected**
  - Team members live in the area
  - Vested interest in public safety
  - Area's steady growth
  - More effective law enforcement

- **Questions we're hoping to answer**
  - In which Division/Patrol ID are crimes occurring the most?
  - Is there a Division/Patrol ID that holds the most violent crime and does that differ from the overall number?
  - What is the most frequent type of crime occuring in the Charlotte area?
  - Is there a season in which crime is the highest?
  - Is there a type of location, in which crime is the highest. (ex. residential vs. commercial, etc)
  - How much violent vs. non-violent crime is there?

Data Used

- **City of Charlotte Open Data Portal**
  - https://data.charlottenc.gov/
- **CMPD Incident Data**
  - Within this data set, main data points of our interest were:
  - -Divison/Patrol ID
  - -NIBRS Incident Code (FBI code categorizing types of crime)
  - -Time(Year/Month) of Incidents
- **We also created our own column of data which binned each incident into Violent vs. Non-Violent Crime. This column was important for our Machine Learning Model**



Cleaning the Data

- **Remove**
  - irrelevant columns
  - Remove nulls
- **Create Consistency**
- **Changed strings to floats in order to improve ML model accuracy**

In [83]:
```
clean_date_4_df.CITY.unique()
```

Out[83]:
```
array(['CHARLOTTE', 'MATTHEWS', 'MECKLENBURG', 'PINEVILLE',
       'HUNTERSVILLE', 'MINT HILL', 'CHARLOTTE, NC 28211', 'CHAROLETTE',
       '28277', 'CHARLOTTE NC', 'CHARLOTE', 'HUMTERSVILLE', 'CHARLOLTTE',
       'CHARLOTTE, NC 28209', 'CHARLOTTE,', 'CHARLOTT', 'MIDLAND',
       'MATTHES', 'MATHEWS', 'CORNELIUS', 'C', 'CHARLOTTTE',
       'CHARLOTTE, NC 28206', 'CHARLOOTE', 'CHARLOTTE, NC',
       'CHARLOTTE,  28211', 'DAVIDSON', 'CHAROLTTE', 'CHRALOTTE',
       'PINEVLE', 'MINT HIL', 'FORT MILL', 'CHARROLTE', 'CHARLTOTE',
       'RT SIDE', 'CHARLOTT3215E', 'MECKLENBRUG', '28273',
       'UNKNOWN/REFUSED', 'BALLANTYNE', 'HUNTERVILLE', 'CHARTLOTTE',
       '110', 'OTHER/NOT LISTED', '28205', 'CHRLOTTE', 'MOUNT HOLLY',
       '28226', 'CHARRLOTE', 'CONCORD', 'CHAARLOTTE', '1640 DEWBERRY TER',
       'CHARLOTTE/NC/28269', 'CHARLOTTLE', 'MECKLENBERG',
       'CHARLOTTEJAVASCRIPT:VOID PT_SU', 'CHARLOTTEE', 'MINTHILL', 'H',
       '28210'], dtype=object)
```

In [97]:
```
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('CH', case=False), 'CITY_NEW'] = 'Charlotte'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('MAT', case=False), 'CITY_NEW'] = 'Matthews'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('MECK', case=False), 'CITY_NEW'] = 'Mecklenburg'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('HU', case=False), 'CITY_NEW'] = 'Huntersville'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('MINT', case=False), 'CITY_NEW'] = 'Mint Hill'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('PIN', case=False), 'CITY_NEW'] = 'Pineville'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('CORNELIUS', case=False), 'CITY_NEW'] = 'Cornelius'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('MIDLAND', case=False), 'CITY_NEW'] = 'Midland'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('DAVIDSON', case=False), 'CITY_NEW'] = 'Davidson'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('BALLANTYNE', case=False), 'CITY_NEW'] = 'Ballantyne'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('FORT MILL', case=False), 'CITY_NEW'] = 'Fort Mill'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('MOUNT HOLLY', case=False), 'CITY_NEW'] = 'Mount Holly'
clean_date_4_df.loc[clean_date_4_df['CITY'].str.contains('CONCORD', case=False), 'CITY_NEW'] = 'Concord'
clean_date_4_df
```

Database

- **PostgreSQL**- store tabular data
- **SQLAlchemy**- communicate databases and machine learning model
- **Schema**

```
Call_Data
-
ROW_TYPE PK string FK >- Offense_Data.ROW_TYPE
GEOGRAPHY string INDEX FK >- Offense_Data.GEOGRAPHY
CALENDAR_YEAR int FK >- Offense_Data.CALENDAR_YEAR
CALENDAR_MONTH int FK >- Offense_Data.CALENDAR_MONTH
CALL_DESCRIPTION string
CALL_COUNT int


Offense_Data
-
ROW_TYPE PK string
GEOGRAPHY string
CALENDAR_YEAR int
CALENDAR_MONTH int
OFFENSE_DESCRIPTION string
OFFENSE_COUNT int

Incident_Data
-
CMPD_PATROL_DIVISION string
HIGHEST_NIBRS_DESCRIPTION string
PLACE_TYPE_DESCRIPTION string
CLEARANCE_STATUS string
```

Machine Learning

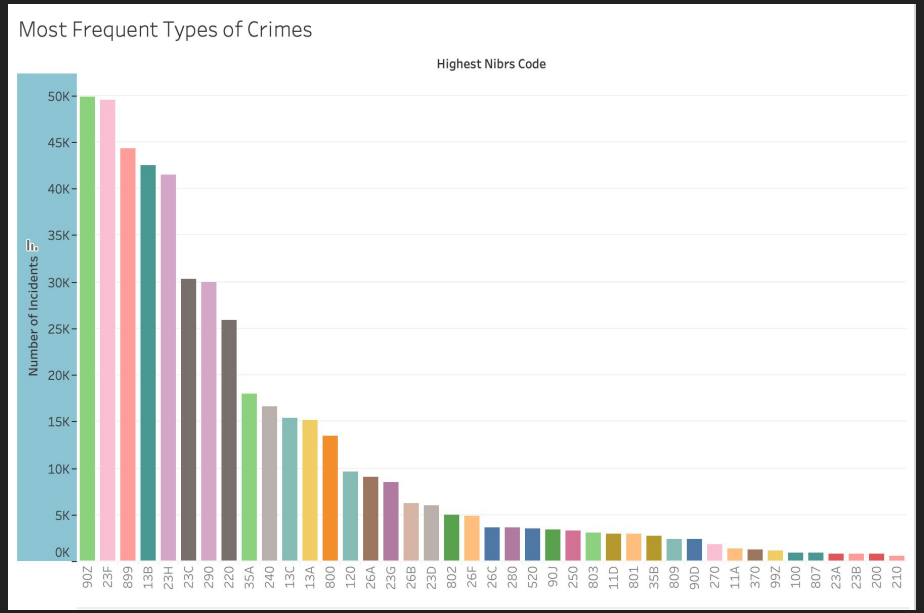
- **Supervised Learning-Classification**
  - Logistic Regression- used to conduct analysis when the dependent variable is binary. Examples are “Yes/No” or “True/False”
- **Categorize violent versus non-violent crimes**
  - Split into input and target features
  - Create test and training sets
  - Utilize NIBRS to help determine the category
  - Create predictions
  - Evaluate test performance
  - Connect to dataframe

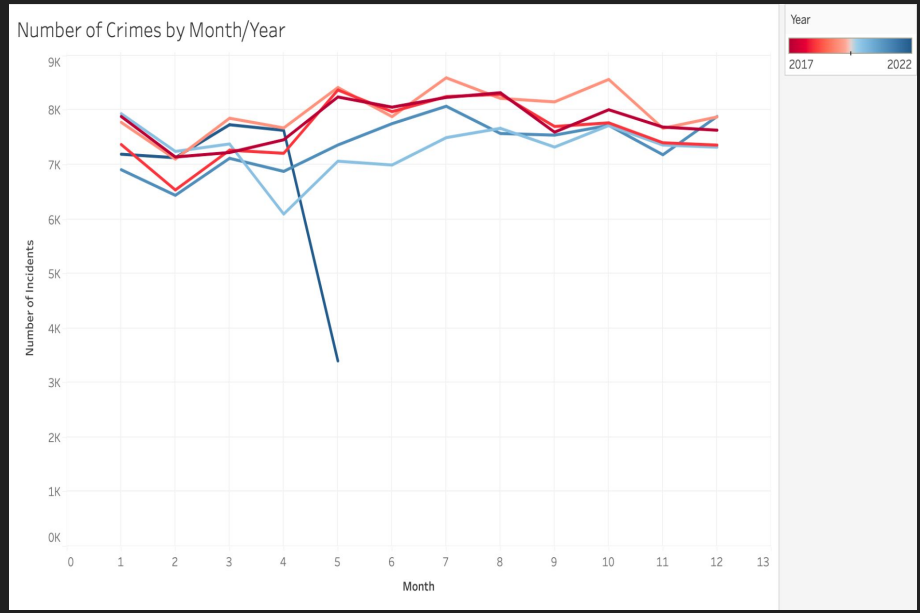
```
# generating classification report
print(classification_report(y_test, y_pred))
```

	precision	recall	f1-score	support
non-violent	1.00	1.00	1.00	65600
violent	1.00	1.00	1.00	56896
accuracy			1.00	122496
macro avg	1.00	1.00	1.00	122496
weighted avg	1.00	1.00	1.00	122496

Dashboard

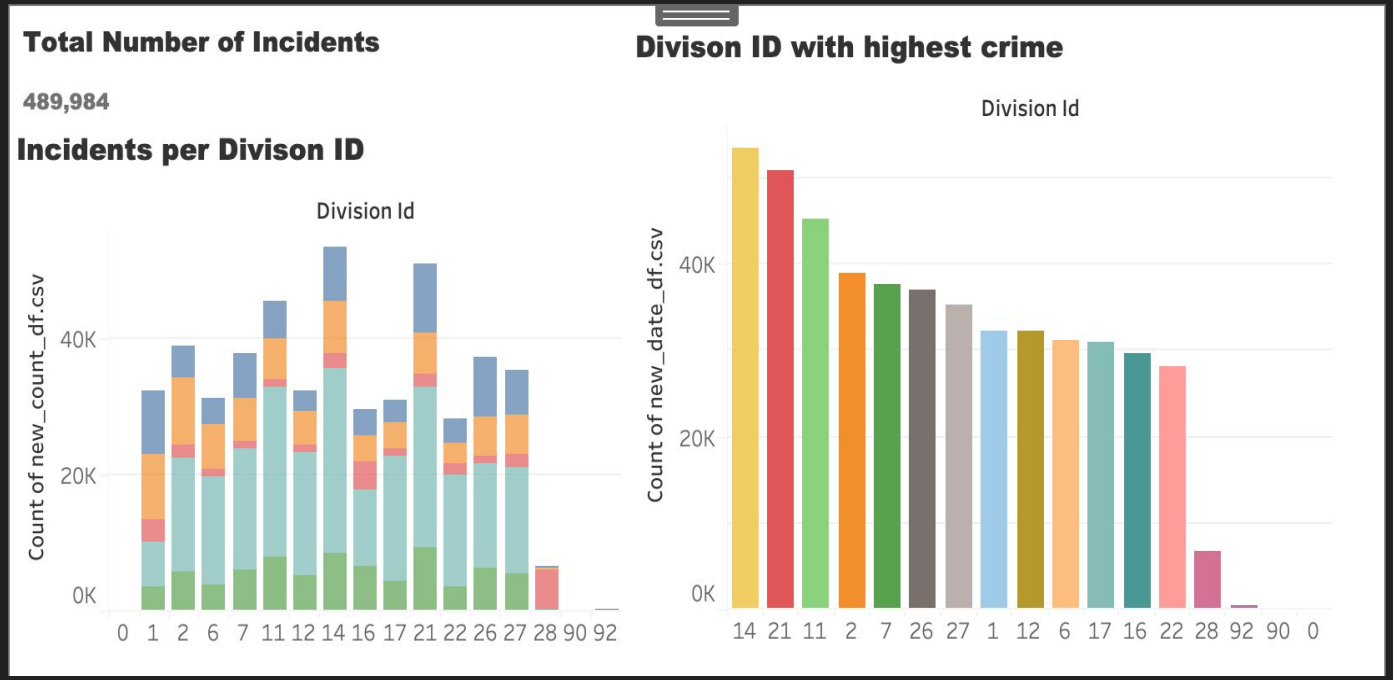
- [CMPD Crime Dashboard]





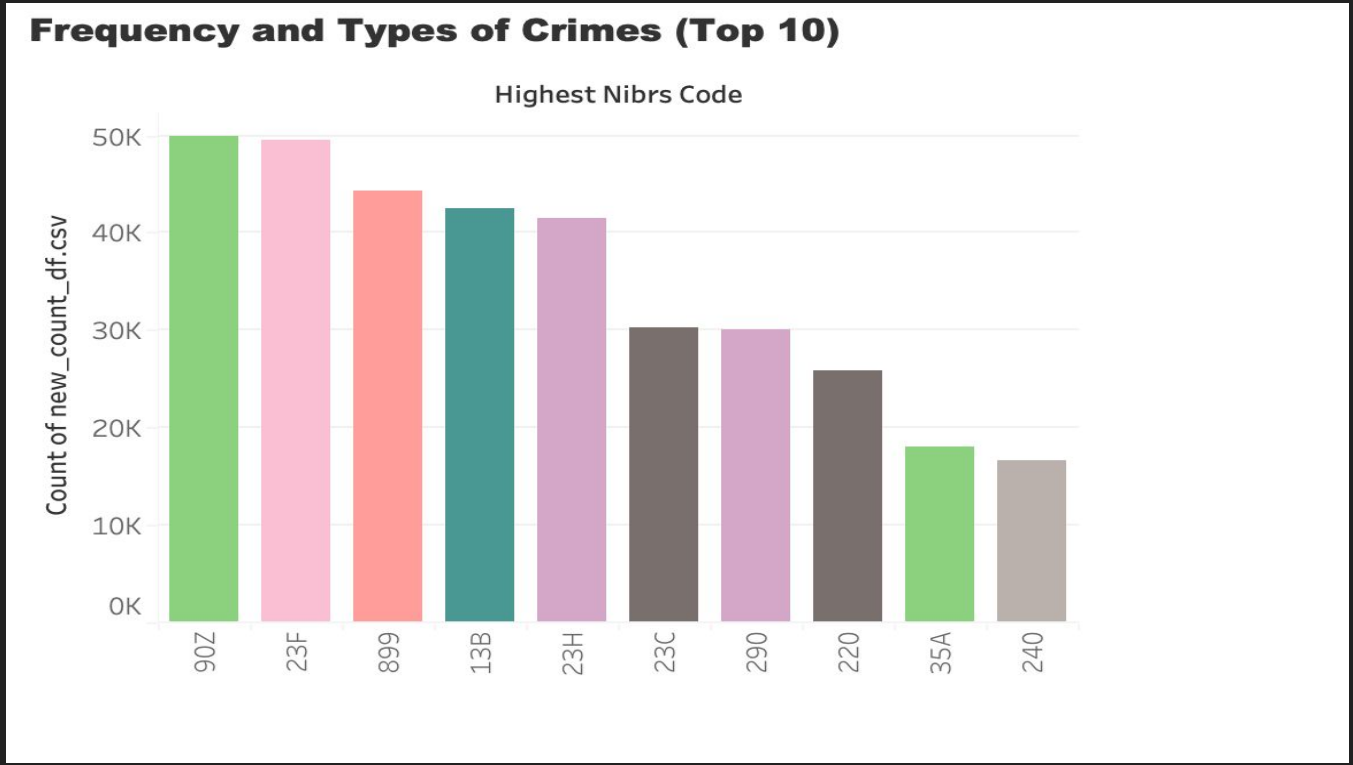
Results

- Incidents per Division ID/Division ID with highest crime



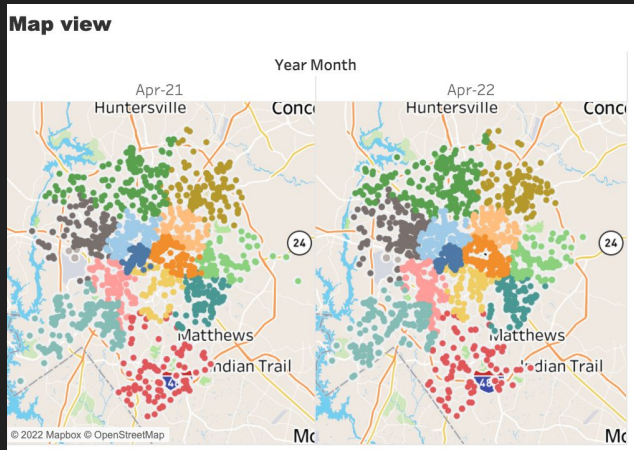
Results

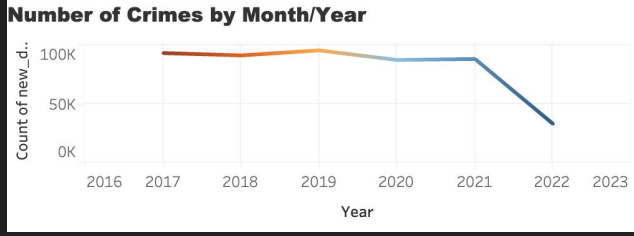
- **Frequency and Types of Crimes**

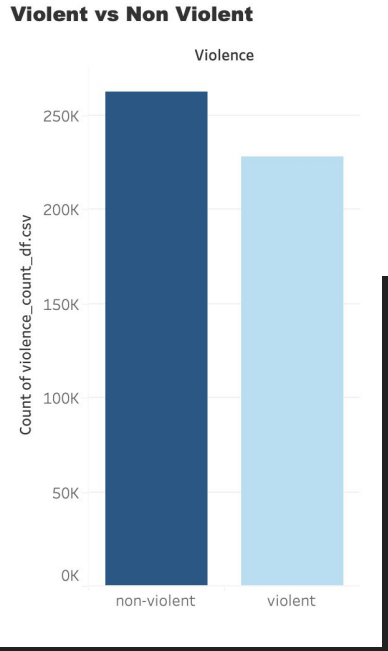


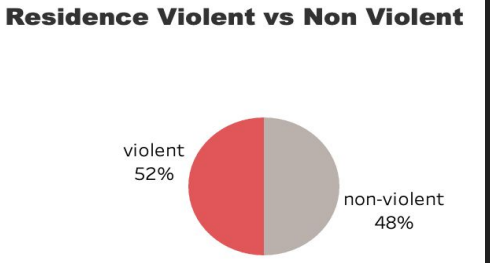
Results

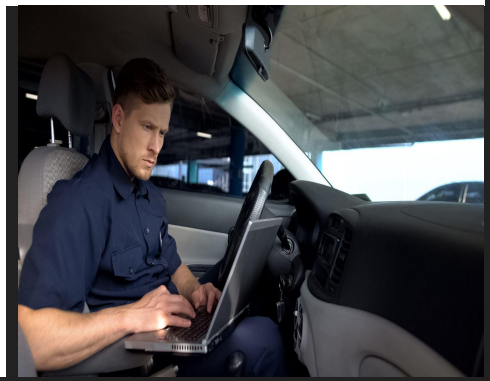
- Map View
- Number of Crimes by Month/Year
- Violent vs Non Violent



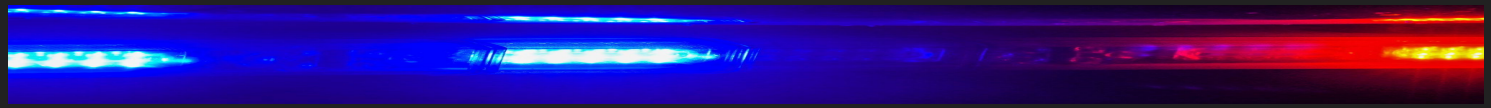








Summary



- This model can be used to determine the optimal deployment of various resources by looking at where and when the most dangerous incidents are happening
- We determined that out of nearly 500,000 calls across 17 divisions, two of them , divisions 21 and 14 represented over 20% of all calls.
  - We were also able to determine that the most dangerous incidents were occurring in these divisions.
- The most frequent type of crime occurring in the Charlotte area is "Theft from Motor Vehicle." The most frequent violent crime is "Simple Assault"
- A view of the data by season didn't show a significant change in reporting from season to season. The winter and spring months show a slight uptick.
- Since 2017, CMPD has logged nearly 500,000 incidents with an average of about 91,000 per year. It should be noted that there was a spike in 2019 at 95,794 while the subsequent 2 years have logged less than 90,000.
  - So far in 2022 the monthly average of 7,420 is on pace to continue the downward trend and fall somewhere around 87,000 calls
- The data shows that nearly half of all calls come from a personal residence. At these residences calls classified as "violent" are outpacing the "non-violent" calls 52% to 48%