

Data Visualization Final Project Report – Crime and Economic Data

- By Gopi Krishna K

Introduction:

The project's goal is to explore the connection between economic variables and crime rates in the various US states. Crime data is available from 1979 to 2022 and the economic characteristics are considered for the five years from 2018 to 2022. This investigation is guided by three main research questions:

- a) What is the correlation between the unemployment rate and crime rate across different states in the United States for the year 2022, and how does this relationship vary geographically?
- b) In the United States for the year 2022, how do Economic characteristics like mean family income and per capita income relate to the crime rate in each state, and what insights does this correlation offer regarding the relationship between crime and economic prosperity?
- c) What is the relationship between the crime rate and the percentage of the population below the poverty line across different states in the United States of America, and how does this relationship illustrate the effect of socioeconomic inequality on crime rates?

The main objective of the project is to understand the crime patterns across the United States and the factors contributing to their spread. There could be many factors that are causes for these crimes. We have considered the economic characteristics like Family Income, Per Capita Income, Unemployment rate, Poverty rate, etc, and trying to analyze the relationship between the Economic characteristics and different types of crimes. Understanding this linkage will help the policymakers to concentrate on resource allocation and developmental activities, which in turn help in bringing the families and the criminals. We can observe the pattern of various crimes how they are changing over the period where to concentrate and is there any legal reforms are required to curtail the crime rate. We can discuss the patterns that we have observed concerning the research questions in the analysis section.

In addition to the economic characteristics there could be some social factors like education, high school dropping rate, health and few other factors legal framework may have an impact on this criminal rate. We can explore the possibility of studying the linkage between the crime rates and these social factors by studying some research questions in future in better understanding this topic.

Methodology:

Considering the 6 data sheets in total as part of the data source, one main data-sheet is related to the Crime Data file consists of details of the number of crimes that happened under each crime category over 44 years from 1979 to 2022. The total crime categories are Nine, they are Violent Crime, Homicide, Rape, Robbery, Aggravated Assault, Property Crime, Burglary, Larceny, and Motor Vehicle theft. We have been given the total population of the state as well. From this Crime rate has been calculated by taking the total number of crimes to the total population of that state to better understand the Crime patterns of the state.

This Crime data is sourced from the following website:
<https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/home>.

Other datasets are pertaining to the Economic characteristics of all 50 states of the USA and the District of Columbia. (Puerto Rico is excluded while plotting the visualizations) for the 5 years from 2018 to 2022 separately.

This economic data is sourced from the data.census.gov website and the link is <https://data.census.gov/table/ACSDP1Y2022.DP03?q=economic%20characters>. By using Tableau Prep Builder, we have fine-tuned the data as per the requirement considering the major economic characteristics like Mean/Median Income of the Family, Per Capita Income, Unemployment rate, Perc. per Family/Population below the Poverty Line.

We have linked these 5 data sheets of the economic data from 2018 to 2022 to the main Crime data in the Tableau Data source and created simple visualizations (total 5) considering the individual data sheets/tables. As shown above line chart, Dual axis visualization, Pie Chart, Stacked Column Chart, and Column chart between the different parameters of the data sheets initially. Later to answer the research questions pointed out below, I have plotted the combined visualizations between the parameters of different data sheets like one from the Crime Data sheet (Crime Rate) and the other Economic characteristics related data sheets (From 2018 Economic Char to 2022 Economic Char data sheets) which are shown in Visualizations 8,9,10 as shown above.

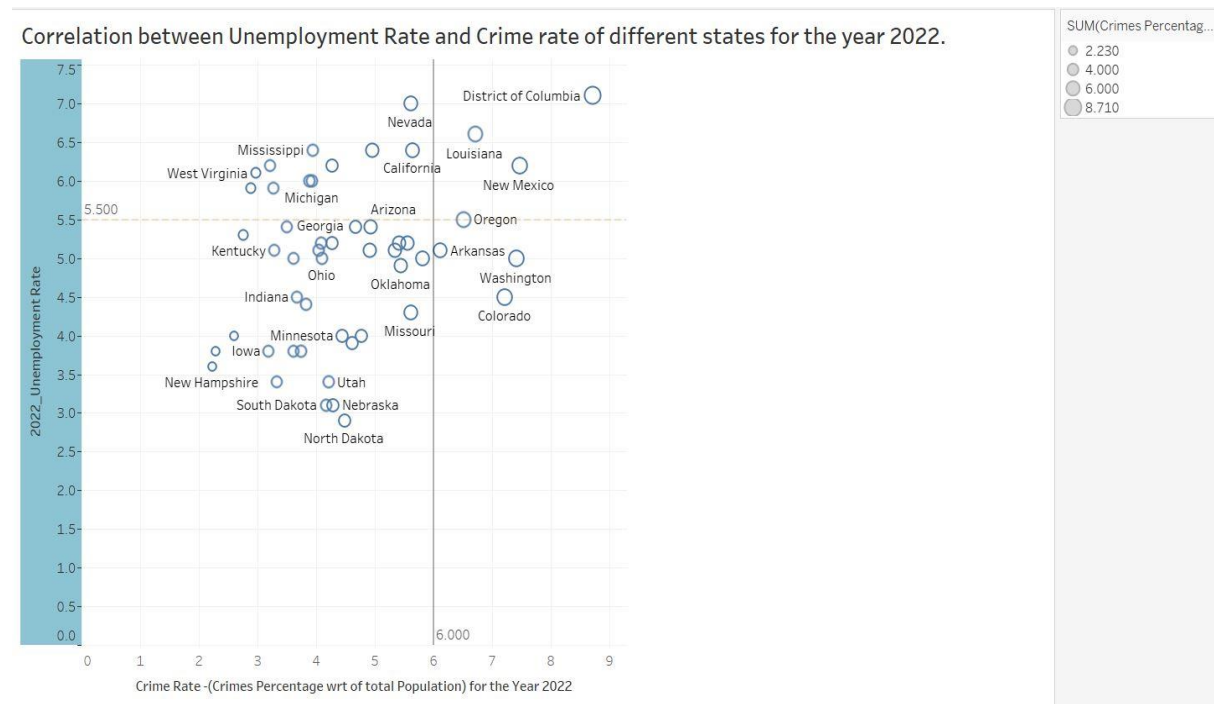
Analysis:

We have drawn some simple visualizations to understand the relationship between various parameters of the data sheets by considering them individually. Like Line chart in Simple Visualization 1 about the distribution of various crimes over the period of 44 years from 1979 to 2022 and the dual axis chart as shown in simple visualization 2 between Total number of crimes and Crime rate of various States for a given year to understand the distribution of population and the relationship between the total crime and the total number of population, pie chart as shown in the Simple visualization 3 shows about the proportion of various crimes of a given state for a given year, Stacked column chart as shown in simple visualization 4 explains the distribution of various crimes (category wise) for all the states for a given year, column chart between the Percentage of population below the poverty line and the unemployment rate explains relationship between the two economic characteristics, advanced visualization (Using parameters) explains the change in per capita income state wise for different years and map based visualization which shows the per capita income distribution of all the states for the particular year are the few examples helps us to understand the data source initially.

Later, to answer the research questions, we plotted three different visualizations 8,9, and 10 to understand the patterns between the Crime rate and the various economic characteristics.

Combined Visualizations:

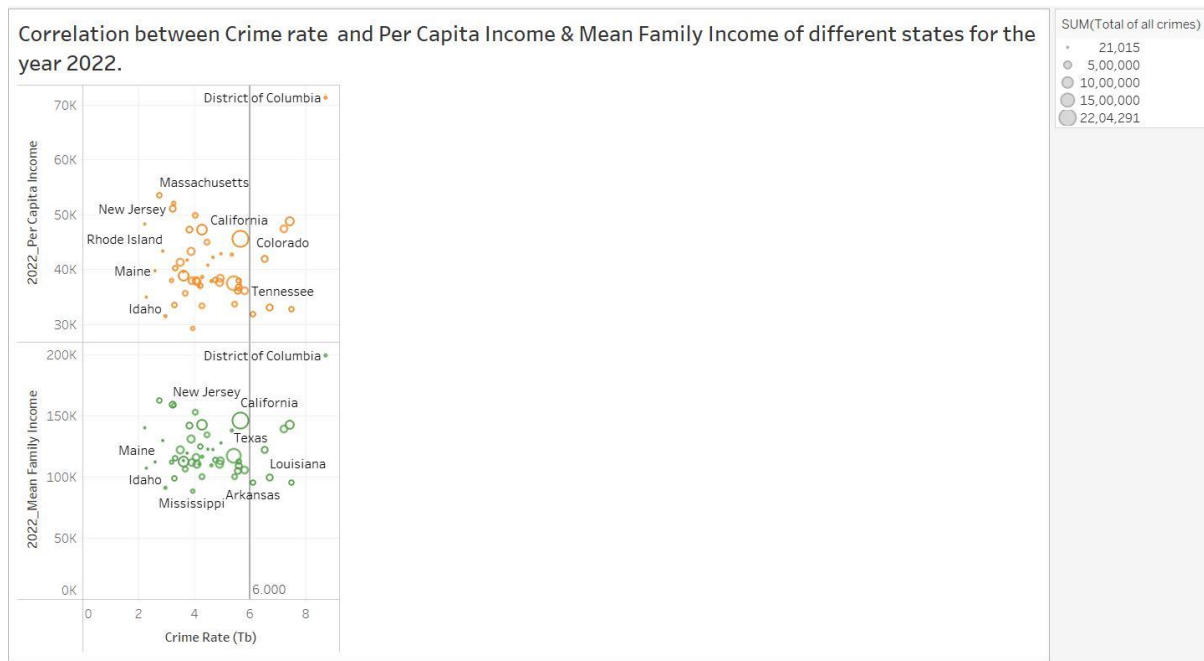
(Visualization 8) - **Correlation between Unemployment Rate and Crime rate of different states for the year 2022.**



When we compare the Unemployment rates of different states for the year 2022 concerning the crime rate. Even though there is no clear pattern, we can observe the following states have high crime rates (Above 6%) – Colorado, Washington, Arkansas, Oregon, New Mexico, and Louisiana (Leaving DC aside for a while) but when we see the Unemployment rate of these states it varies from 4.5% (Colorado) to 6.7% (Louisiana).

Other side, when we see the unemployment rate above 5.5%, few states like Rhode Island, West Virginia, New Jersey, Connecticut, Illinois, Michigan, and Mississippi have crime rates as low as below 4% despite having unemployment. Few other states like New York, Alaska, California, and Nevada have crime rates between 4-6%.

(Visualization 9): (Correlation between Crime rate and Per Capita Income & Mean Family Income of different states for the year 2022.)

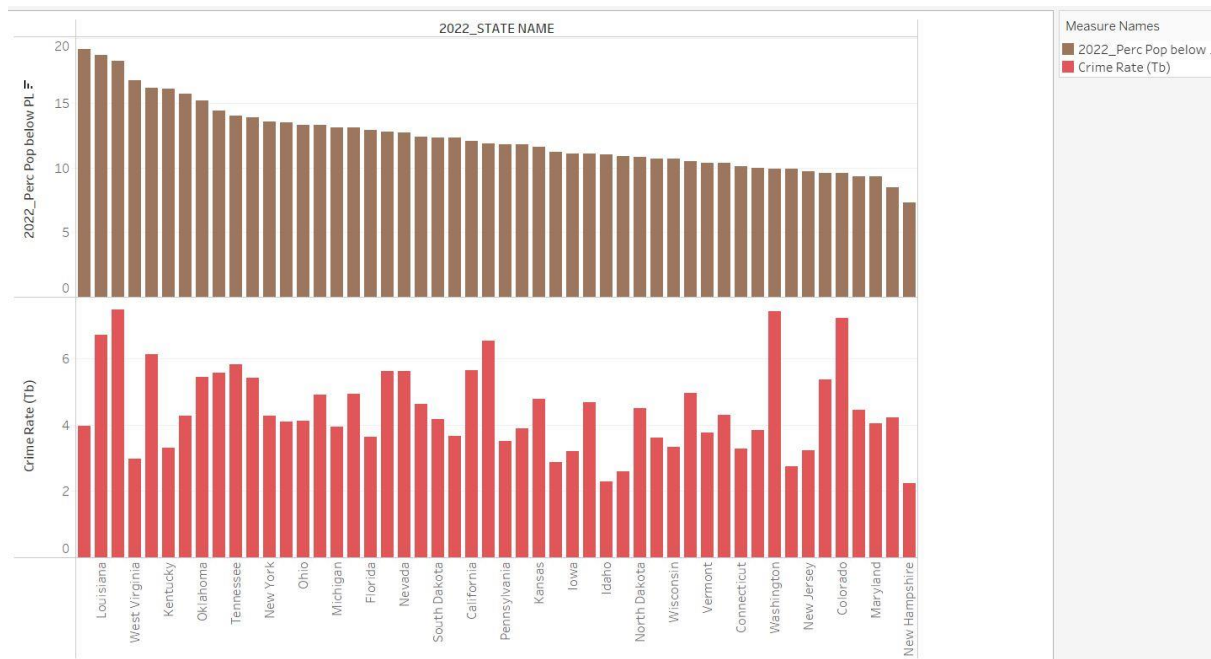


Crime Rate (Tb) is the calculated field computed (Comparing the total crimes with the Total population of the state) in Tableau and we have compared the two basic economic indicators Mean Family Income and Per capita Income for the year 2022 with the Crime Rate in this scatter plot (Where the size of the bubble represents the total number of crimes in that state).

When we observe the plots, almost all the states are having more than 2% Crime rate irrespective of their Mean family income and per capita income. Overall, there is not much deviation when we compare these two indicators with the crime rate. Most of the states are falling between 2-6% crime rate bracket.

Few states like Colorado, Washington, Oregon, Louisiana, New Mexico, and Arkansas have crime rates above 6% among all the states (Except DC having a Crime rate of 8.7 with a high value of economic indicators – Which is not a state). Out of these 6 states also, Louisiana, New Mexico, and Arkansas have low Mean family income and Per capita income compared to the other three states Colorado, Washington, and Oregon.

(Visualization 10): (Correlation between Crime Rate and Perc. of Population below Poverty Line)



When we compare the Perc. of the population below the poverty line and the Crime rate for the year 2022 and the relation between these parameters of all the states of the United States, we observe that there is no direct relationship between the Percentage of the Population below the poverty line and the Crime rate.

When we arrange all the states in descending order based on the Percentage of the population below the poverty line, we can observe the Crime rates of respective states are not in line. For example, the Mississippi has the highest perc. of population below the poverty line (19.20%) but the Crime rate is only 4% (~3.95%) many states are having more crime rate than Mississippi. Washington and Colorado have the highest crime rates (7.42 & 7.21), despite having a low Percentage of the population below the poverty line (9.90 & 9.60).

Conclusion:

In summary, our research sheds light on the connection between economic variables and American crime rates. By finding trends in the data and relationships between economic indicators and crime rates, we have successfully addressed the research questions.

We ran into a few problems with data discrepancies and missing numbers during the project, which needed to be handled carefully and pre-processed. Addressing these issues initially, ensured the reliability and validity of our findings.

I have identified the following additional research questions for possible future research.

- a) To what extent does the level of education attainment in a state influence crime rate and what are the potential mechanisms we can follow?
- b) What role does healthcare access play in crime prevention and intervention strategies? How do various forms of crime rates connect to the accessibility and availability of healthcare facilities, particularly mental health services?
- c) What effects do socioeconomic factors and demographic variables like age distribution, racial composition, and immigration trends have on crime rates, and how do these effects affect attempts to prevent and intervene in crime?
- d) Are there notable disparities in crime rates between states' urban and rural parts, and if so, how do socioeconomic factors like resource accessibility affect these differences?

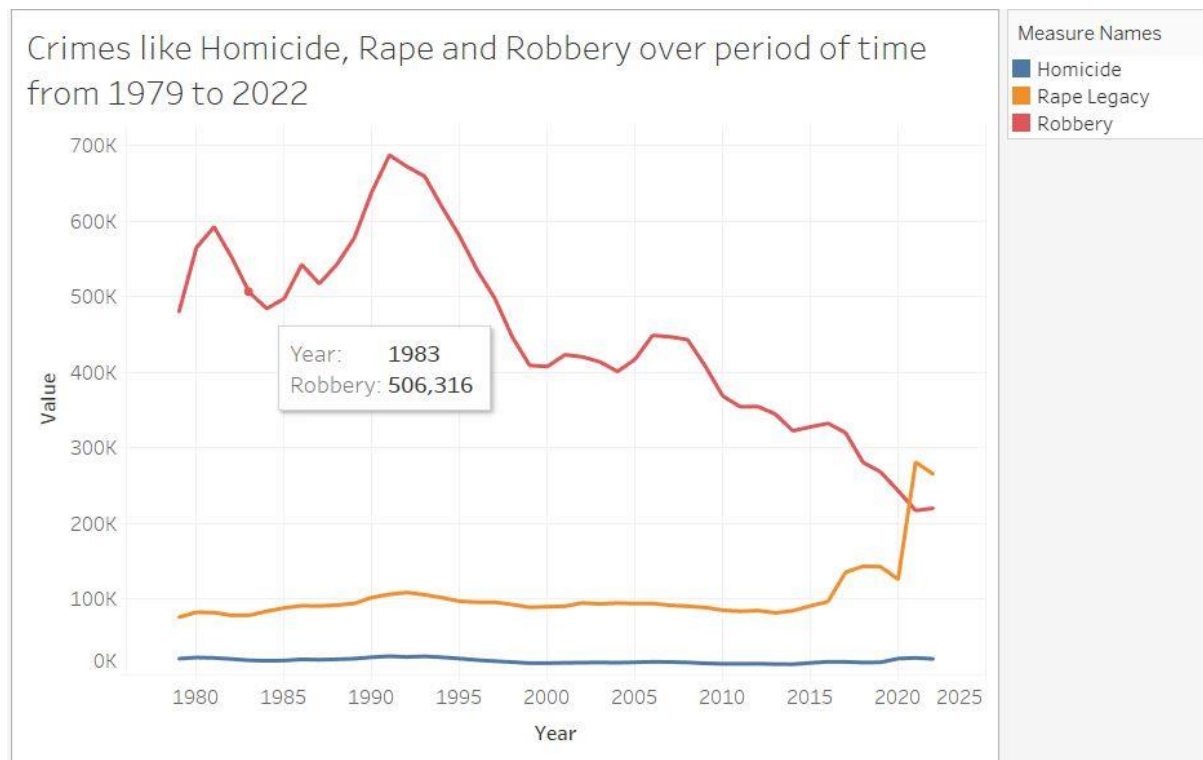
These are the few questions that will help in continuing future research in this area of understanding crime patterns. Apart from the Economic characteristics, it is important to analyze the other social parameters like education, high school dropouts, health, migration, resource allocation, and the legal policies of the states to have a holistic view of this concept.

References:

- i) Data Source: Crime data - website: <https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/home>.
- ii) Economic data is sourced from the data.census.gov website and the link is <https://data.census.gov/table/ACSDP1Y2022.DP03?q=economic%20characters>.

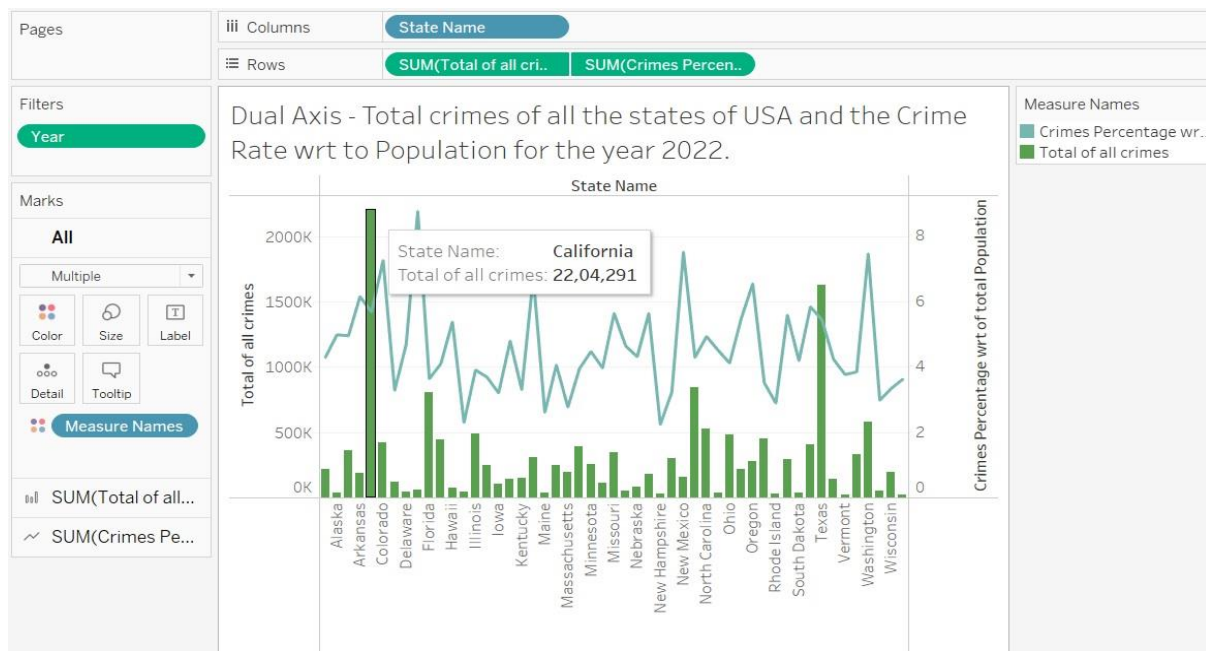
Explaining the Visualizations:

Simple Visualization 1: (Crimes like Homicide, Rape and Robbery over period from 1979 to 2022)



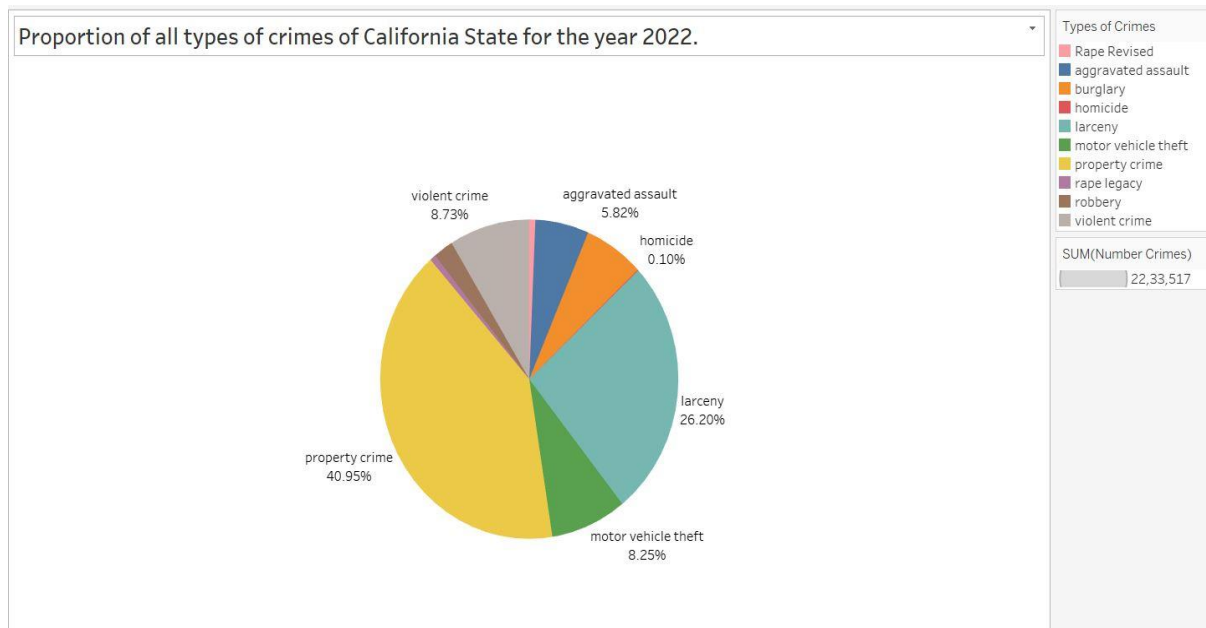
Out of a total 9 kinds of crimes as per the data source (Estimated_crimes_1979_2022_State wise), we have plotted 3 crimes – Homicide, Rape, and Robbery from 1979 to 2022 to analyze the pattern over the years across the United States (using Line Chart). We have observed a declining trend in several robbery cases whereas the other two crimes are increased in the last 5 years compared to the previous years.

Simple Visualization 2: (Dual Axis - Total crimes of all the states of USA and the Crime Rate with respect to Population for the year 2022.)



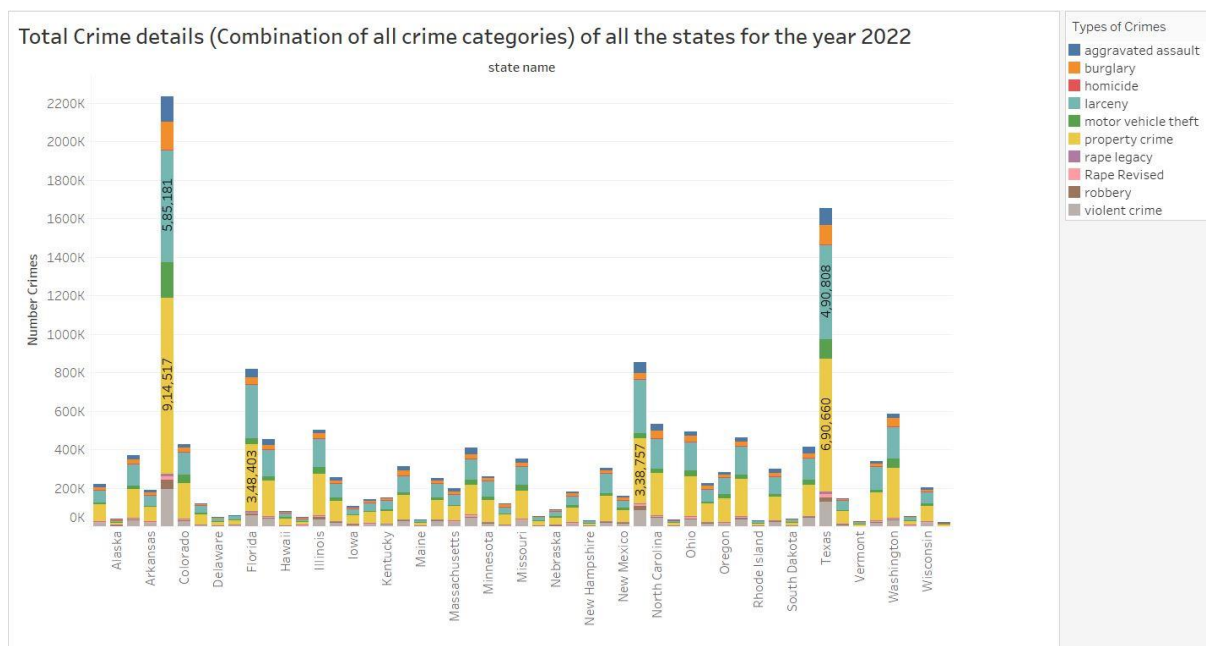
The above visualization is the Dual Axis plot between the Total crime data of all the states and the Crime rate (Total crimes concerning the total population of the state) of all the states. One thing we can observe as per this visualization is that even though the total number of crimes in the state of California is high compared to all other states, it is mainly due to its high population. When we observe the crime rate of California it stands at 5.65%, which is less than a few other states like Colorado, Louisiana, New Mexico, Oregon, Washington, and DC, etc. Crime rate is shown in the line chart even though we are not showing the movement of crime rate over the time interval it is across different states, I have done this as I chose the dual axis to show the number of crimes depends on the number population, merely having more population will also lead more crimes that doesn't mean the particular state is having high crime rate.

Simple Visualization 3: (Proportion of all types of crimes of California State for the year 2022.)



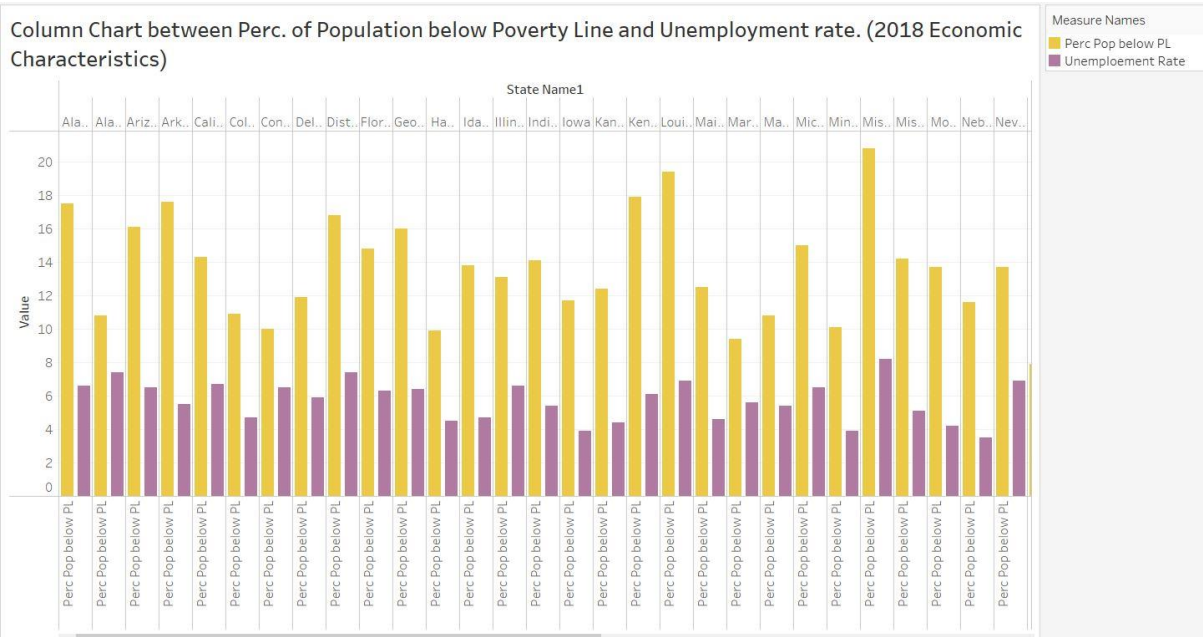
This visualization (Pie Chart) shows the proportion of various crimes that occurred in the state of California for the year 2022. Property Crime is having highest share among all other crimes with 40.95% in the state of California for 2022 followed by 26.20% by Larceny and Homicide, Rape are having less share with 0.10 and 0.65% respectively.

Simple Visualization 4: (Total Crime details (Combination of all crime categories) of all the states for the year 2022)



This visualization (Stacked Column Chart) shows the distribution of various crimes across the United States (State-wise) for the year 2022. It gives the overall idea about the major crimes across all the states of the USA. As per this visualization, Property Crime and Larceny are having the major share among all other categories of crimes.

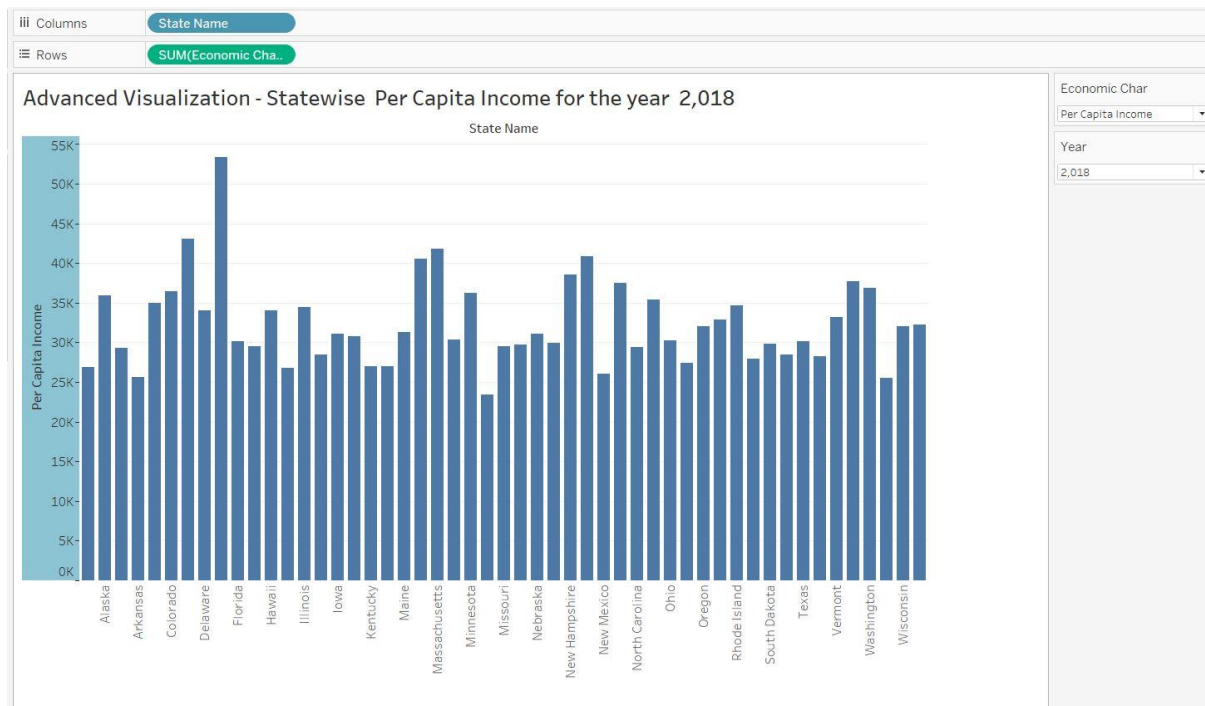
Simple Visualization 5: Column Chart between Perc. of Population below the Poverty Line and the Unemployment rate. (2018 Economic Characteristics)



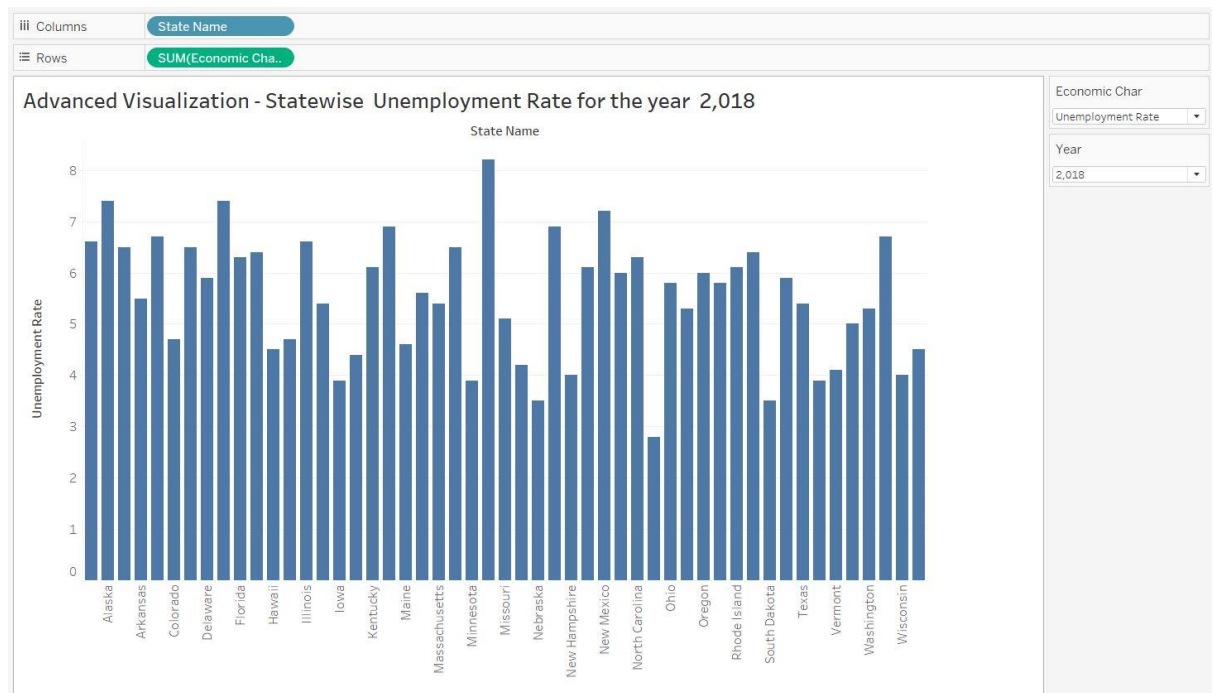
This visualization (Column Chart) shows the two important economic characteristics (Perc. of Population below the Poverty Line and Unemployment rate) of various states in the United States of America for the year 2018. Even though there is no clear relationship between the unemployment rate and the perc. of population below the poverty line, we can observe that there are few states like Mississippi, and Louisiana that have having highest perc. of population below the poverty line along with a higher unemployment rate. Another side there are a few other states with High perc. of population below the poverty line despite having low unemployment rates like Alaska, California, and Connecticut.

6_Advanced Visualization – State-wise Per Capita Income for the year 2022 (Using Parameters (Economic Char & Year))

A) Per Capita Income:

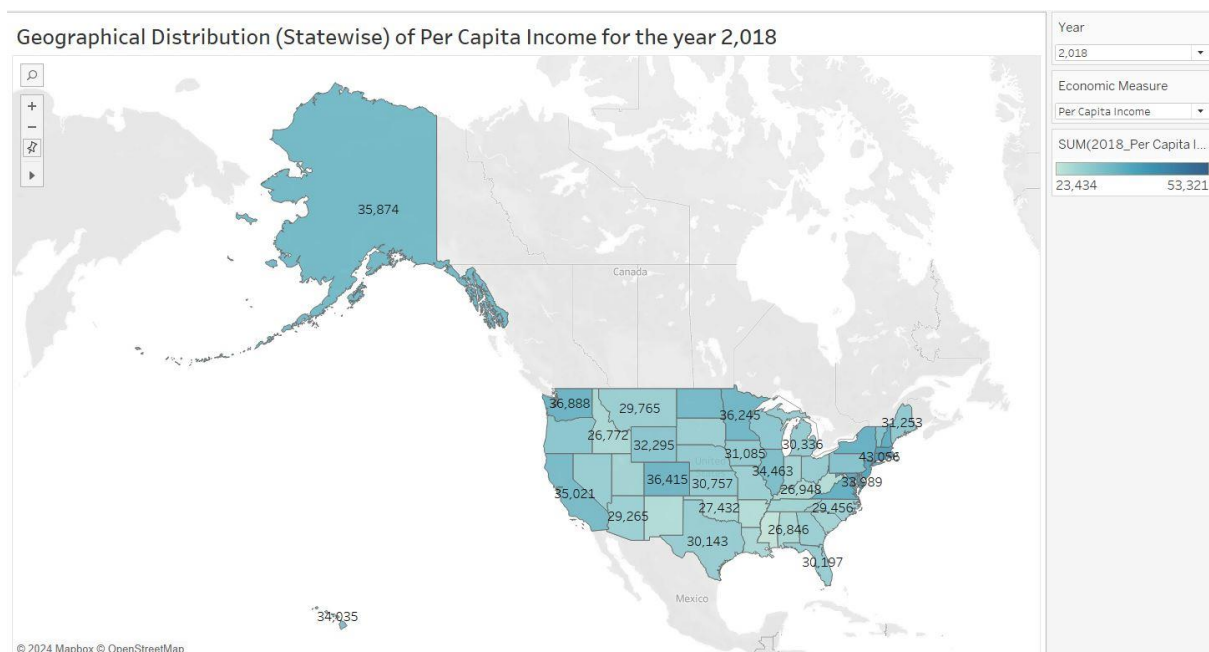


B) Unemployment Rate:



This visualization is an example of advanced visualization where we have used parameters like Year and Economic Character to plot a bar diagram between Economic Character (Economic Char - Per capita Income) and the different states in the United States for the Year (Year as Parameter). By changing the values in the Parameter, we can draw a bar diagram between different economic characteristics for the different years. In this bar diagram, we can use the economic characteristics between 'Per Capita Income' and 'Unemployment Rate'.

7_Map Based Visualization: (Geographical Distribution (State-wise) of Per Capita Income for the year 2022)



From this visualization, we can observe the geographical distribution of Economic measures (Per Capita Income for the year 2018) across the United States. States on the East Coast like Connecticut, Massachusetts, New Jersey, and Maryland have having highest per capita income compared to the inland states.

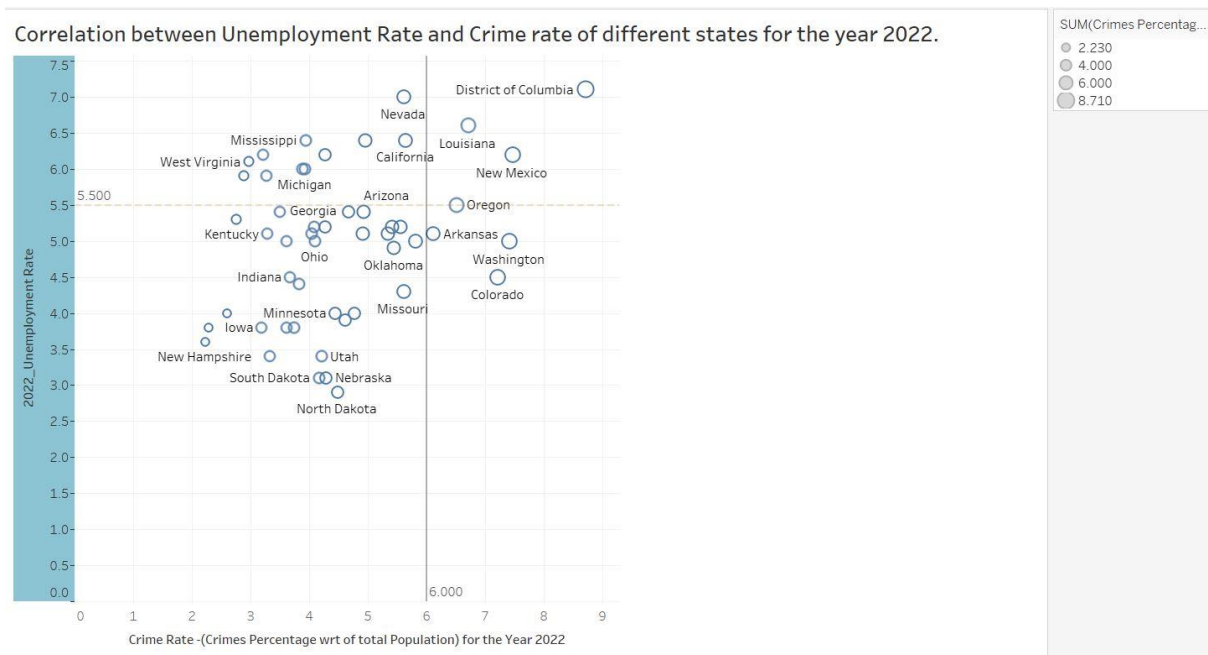
Research Questions:

What is the correlation between the unemployment rate and crime rate across different states in the United States for the year 2022, and how does this relationship vary geographically? (Refer Visualization 8)

In the United States for the year 2022, how do Economic characteristics like mean family income and per capita income relate to the crime rate in each state, and what insights does this correlation offer regarding the relationship between crime and economic prosperity? (Refer Visualization 9)

What is the relationship between the crime rate and the percentage of the population below the poverty line across different states in the United States of America, and how does this relationship illustrate the effect of socioeconomic inequality on crime rates? (Refer Visualization 10)

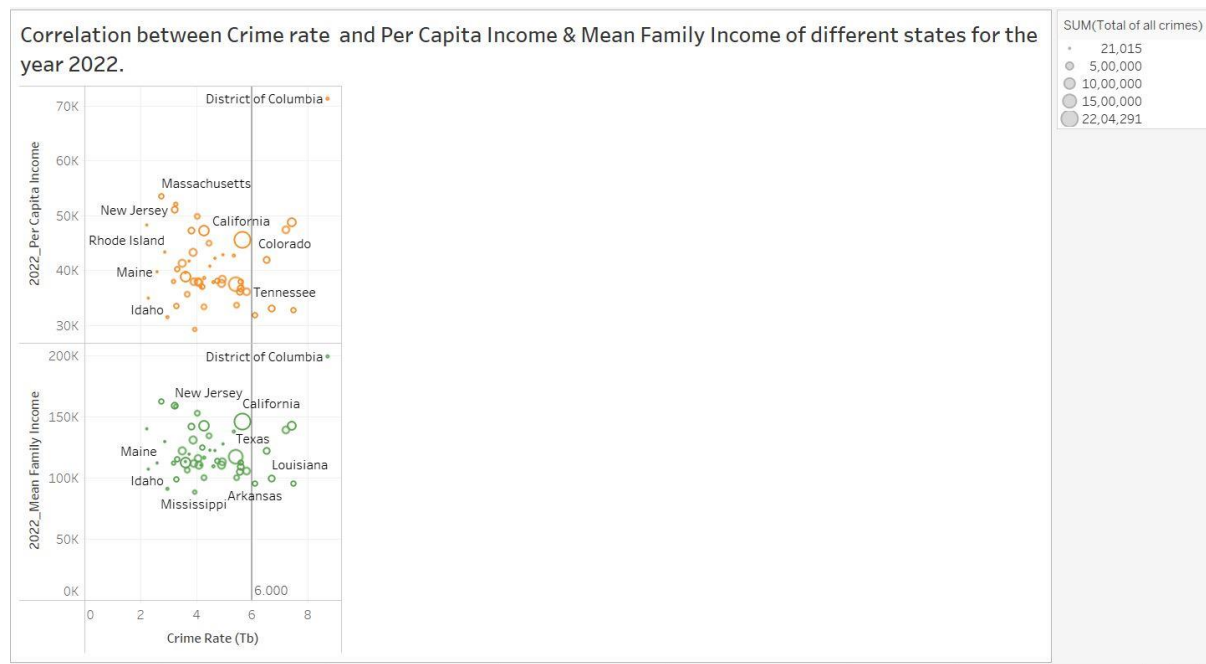
8_ Combined Visualization: (Correlation between Unemployment Rate and Crime rate of different states for the year 2022.)



When we compare the Unemployment rates of different states for the year 2022 concerning the crime rate. Even though there is no clear pattern, we can observe the following states have high crime rates (Above 6%) – Colorado, Washington, Arkansas, Oregon, New Mexico, and Louisiana (Leaving DC aside for a while) but when we see the Unemployment rate of these states it varies from 4.5% (Colorado) to 6.7% (Louisiana).

Other side, when we see the unemployment rate above 5.5%, a few states like Rhode Island, West Virginia, New Jersey, Connecticut, Illinois, Michigan, and Mississippi have crime rates as low as below 4% despite having unemployment. Few other states like New York, Alaska, California, and Nevada have crime rates between 4-6%.

9_Combine Visualization (Correlation between Crime rate and Per Capita Income & Mean Family Income of different states for the year 2022.)

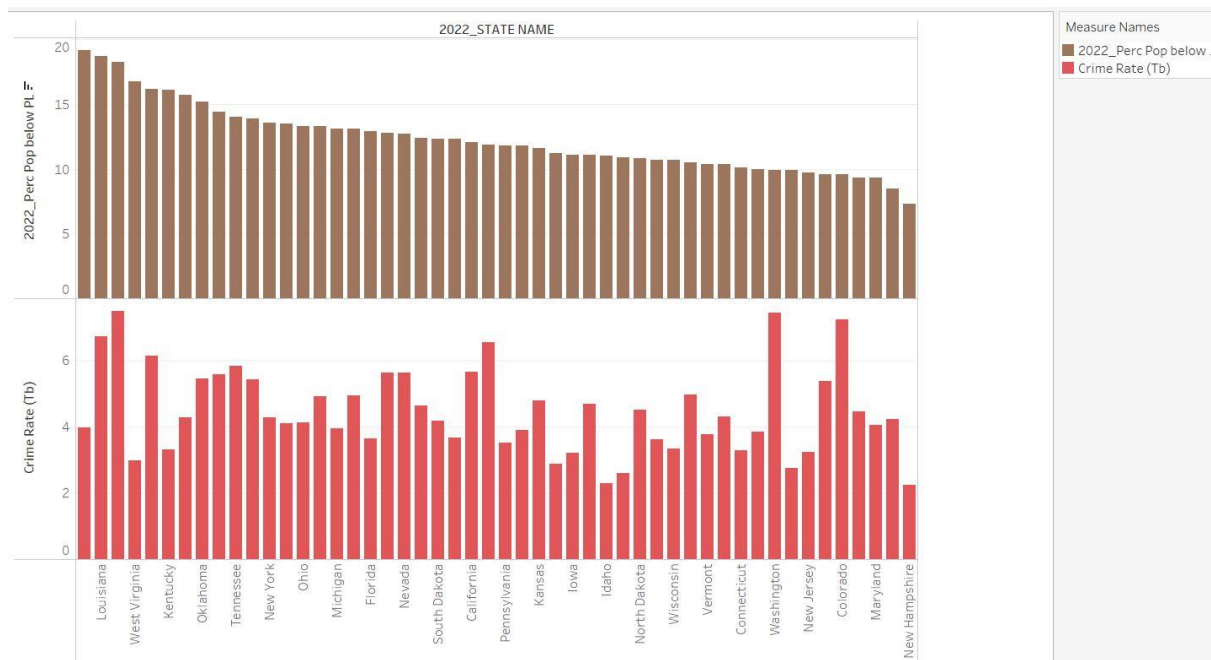


Crime Rate (Tb) is the calculated field computed (Comparing the total crimes with the Total population of the state) in Tableau and we have compared the two basic economic indicators Mean Family Income and Per capita Income for the year 2022 with the Crime Rate in this scatter plot (Where the size of the bubble represents the total number of crimes in that state).

When we observe the plots, almost all the states are having more than 2% Crime rate irrespective of their Mean family income and per capita income. Overall, there is no much deviation when we compare these two indicators with the crime rate. Most of the states are falling between 2-6% crime rate bracket.

Few states like Colorado, Washington, Oregon, Louisiana, New Mexico, and Arkansas have crime rates above 6% among all the states (Except DC having a Crime rate of 8.7 with a high value of economic indicators – Which is not a state). Out of these 6 states also, Louisiana, New Mexico, and Arkansas have low Mean family income and Per capita income compared to the other three states Colorado, Washington, and Oregon.

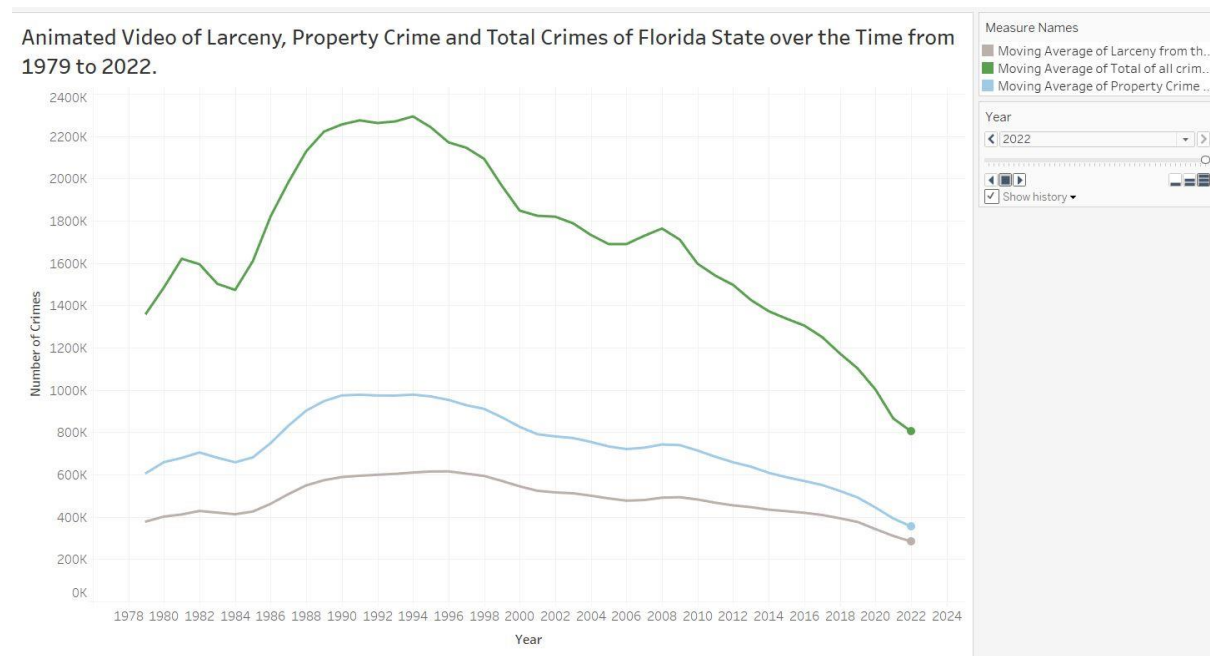
10) Combined Visualization - (Correlation between Crime Rate and Perc. of Population below Poverty Line)



When we compare the Perc. Of the population below the poverty line and the Crime rate for the year 2022 and the relation between these parameters of all the states of the United States, we observe that there is no direct relationship between the Percentage of the Population below the poverty line and the Crime rate.

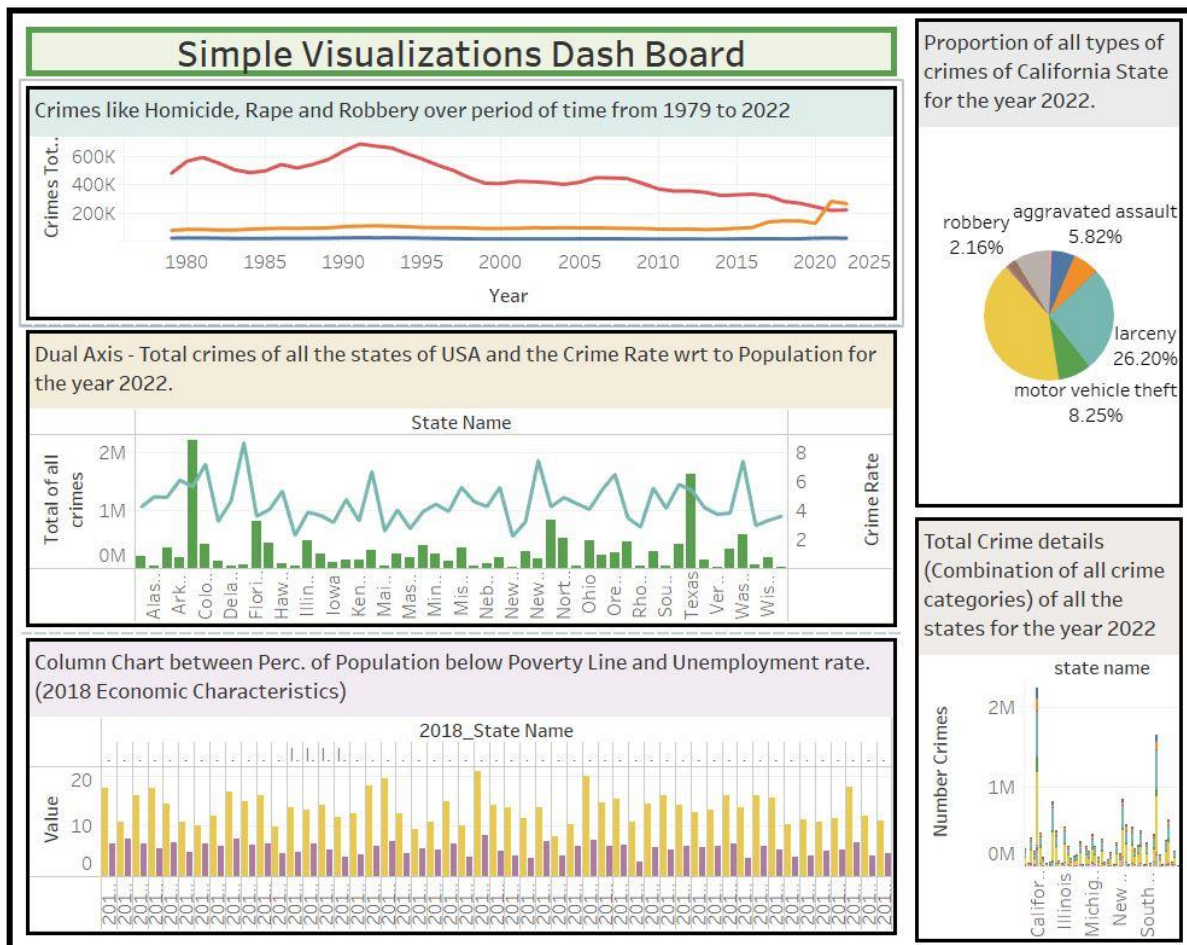
When we arrange all the states in descending order based on the Percentage of population below the poverty line, we can observe the Crime rates of respective states are not in line. For example, the Mississippi has the highest perc. of population below the poverty line (19.20%) but the Crime rate is only 4% (~3.95%) many states are having more crime rate than Mississippi. Washington and Colorado have the highest crime rates (7.42 & 7.21), despite having a low Percentage of the population below the poverty line (9.90 & 9.60).

11_Animated Visualization Video:



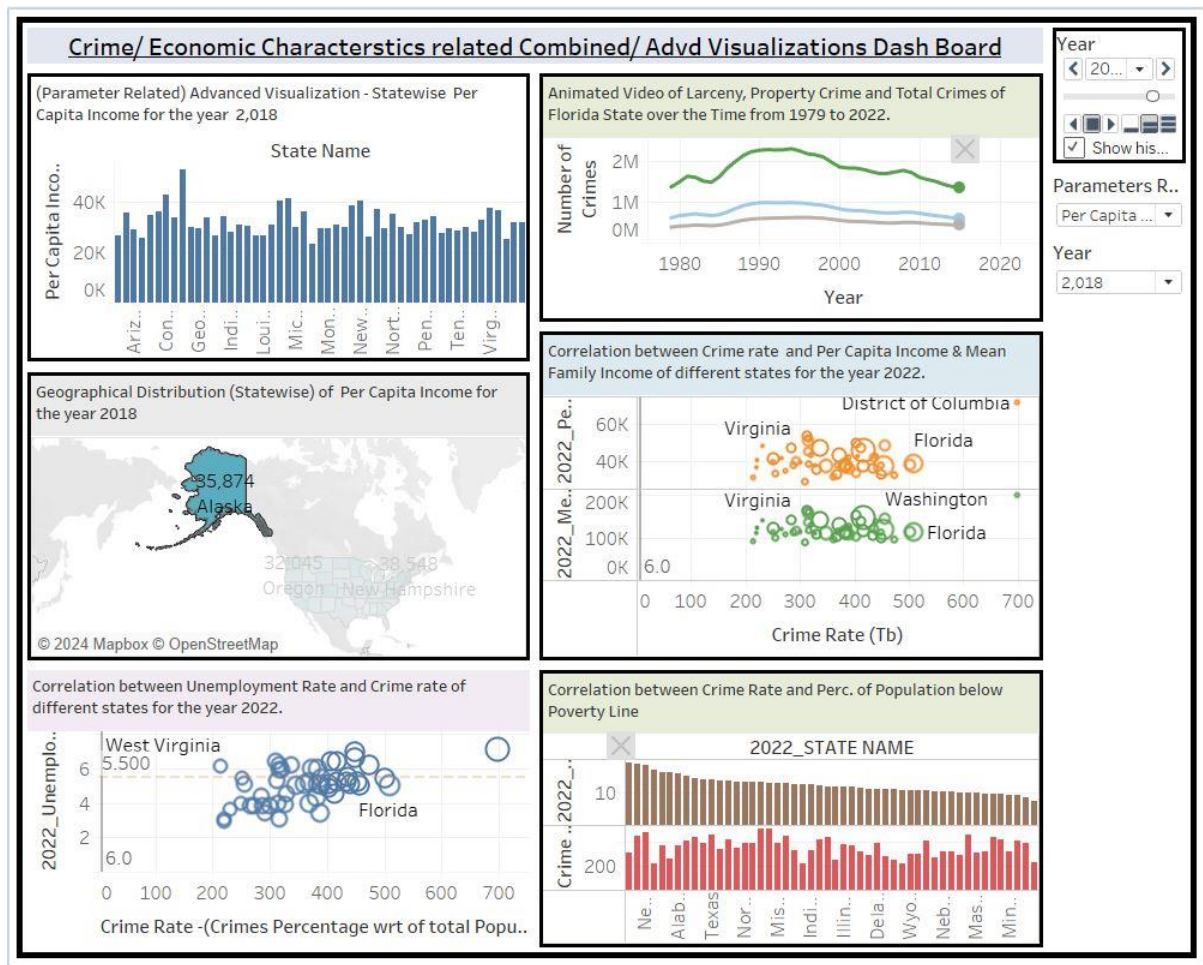
In this animated visualization Video, we have drawn the moving average of different crimes (Larceny, Property Crime, and Total of all Crimes) that happened from 1979 to 2022. We have considered the Moving average of two years at a time. Overall, the Total crimes and the Larceny & Property crimes are also decreasing over the period from 1979 to 2022, even though we have observed an increasing trend between 1984 to 1995, later it is in a downward trend only.

Dash Board 1:



The dashboard consists of Simple Visualizations from the Crime Datasheet and the Economic Characteristics Data sheets separately.

Dash Board 2:



The dashboard consists of Combined Visualizations from the Crime Datasheet and the Economic Characteristics Datasheets and the Advanced visualizations where the parameters have been used, Map-based Visualizations, and Animated Video.