ALBUKHARY INTERNATIONAL UNIVERSITY

SCHOOL OF COMPUTING AND INFORMATICS

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Task 2:*Real-Time Dashboard Project*

Title: *Visualizing Violent Crime Rates Across U.S. States: An Interactive Dashboard Approach*

Name: *Md Farman Ali*

Student Id: *AIU20092185*

Name :*Yousif Esmat Abdallah Ali*
Student Id: *AIU22102039*

Course Code: *CCS3133*

Course Name: *Information Visualization*

Lecturer: *Assoc. Prof. Ts. Dr. Leelavathi*

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Marks:

1.0 Introduction

Violent crime remains a significant problem in the United States, impacting communities throughout all fifty states to different extents. While national statistics offer a general overview, these aggregates frequently hide important regional differences in crime rates. Recognizing these distinctions is essential for developing tailored public safety approaches and efficiently distributing law enforcement resources. With cities becoming more urbanized, it is crucial to examine the relationship between demographic and geographic traits and violent crimes.

Data visualization has demonstrated its effectiveness as a powerful means to reveal concealed patterns in intricate datasets. Dashboards transform raw figures into clear visual stories, allowing a diverse audience—from policymakers to the public—to understand and engage with data effectively. This project utilizes data visualization to examine violent crime statistics across U.S. states, concentrating on murder, assault, and rape figures. The objective is to create an interactive Tableau dashboard that offers detailed insights as well as a comprehensive view of the violent crime situation in the United States.

1.2 Project Objectives

1. To acquire and prepare a trustworthy dataset on violent crime data throughout all U.S. states.
2. To represent these data through different graphical methods that facilitate comprehension and investigation.
3. Examine the data regarding urban population percentages to uncover possible relationships.
4. To create and implement an interactive Tableau dashboard that improves accessibility and usability for various stakeholders.

1.3 Dataset Description

The dataset utilized in this project was obtained from Kaggle and was initially gathered from U.S. crime datasets. It comprises a one-year overview (1973) of crime statistics for all 50 states. The collection contains these fields:

State: Name of the U.S. state:

1. Homicide: Count of arrests for homicide per 100,000 inhabitants.
2. Assault: Count of arrests for assault for every 100,000 inhabitants.
3. UrbanPop: Proportion of the population living in urban regions.
4. Rape: Rate of arrests for rape per 100,000 inhabitants.
5. To suggest future pathways for incorporating predictive analytics and other socio-economic factors.

These goals correspond with wider movements in civic technology and open data efforts that seek to enhance the transparency and usability of government data.

Sample Data Table 1:

State	Murder	Assault	Urbanpop	Rape
Alabama	**13.2**	**236**	**58**	**21.2**
Alaska	**10.0**	**263**	**48**	**44.5**
Arizona	**8.1**	**294**	**80**	**31.0**

The dataset was refined to eliminate discrepancies and normalized for consistency. A new variable, Crime Index, was created by normalizing and combining the primary crime indicators—murder, Assault, and Rape—utilizing a Min-Max scaler.

1.4 Tools and Technologies

For this project, the tools and technologies listed below were utilized:

1. Tableau Public: Allowed the development of interactive and filterable dashboards with user engagement.
2. Python: Libraries like pandas, seaborn, and matplotlib were utilized for data cleaning, normalization, and generating static visualizations.
3. Microsoft Excel: Offers a user-friendly interface for preliminary data analysis and format verification.
4. Jupyter Notebook: Enabled scripting, experimentation, and visualization in a sequential manner during preprocessing.
5. QGIS: Evaluated for spatial boundary validation and map layers to be incorporated into Tableau.

2.0 Methodology

The workflow followed in this project is outlined below:

1. Data Collection: The dataset was downloaded from Kaggle and imported into a Jupyter Notebook for processing.

2. Data Cleaning: Missing values were checked, column names were standardized, and state names were confirmed for consistency.

3. Feature Engineering: A new feature, Crime Index, was calculated using normalized values of Murder, Assault, and Rape.

4. Exploratory Data Analysis: Summary statistics and pairwise correlations were calculated. Boxplots, scatter plots, and bar charts were generated to visualize relationships between crime types and urbanization.

5. Visualization Design: Visual outputs were chosen based on their ability to convey regional disparities and categorical comparisons effectively.

6. Dashboard Development: Tableau was used to assemble the final interactive dashboard using choropleth maps, filters, heat maps, and time sliders.

2.1 Visualizations and Analysis

1. Top 10 States by Crime Index (Adjusted)

This graphic showcases the ten U.S. states that have the highest overall crime index. The Crime Index combines normalized figures for Murder, Assault, and Rape. States like Nevada, Florida, and Alaska stand out as hotspots, indicating either elevated per capita rates or ongoing severity across various crime categories.

2. Población Urbana vs. Índice de Criminalidad (Gráfico de Dispersión)

The scatter plot analyzes the relationship between the proportion of urban residents and the total Crime Index. Although certain highly urbanized states show higher crime rates, the connection is not purely linear. This indicates that urbanization by itself does not completely account for differences in crime, necessitating additional multivariate analysis.

3. Crime Rate Distribution by Category (Boxplot)

Boxplots offer a beneficial perspective on the distribution and variability of every crime category among different states. Assault exhibits the highest median and widest range, signifying considerable differences in enforcement or underlying crime rates. Homicide exhibits reduced variability but is influenced by outliers like Mississippi and Georgia.

4. Heatmap Illustrating Relationships Among Crime Variables

A heatmap was created to enhance the understanding of relationships between variables. The most significant correlation was found between Assault and Murder, suggesting possible common contributing factors or enforcement patterns. In contrast, UrbanPop demonstrated a more moderate connection with other variables, reinforcing previous findings from the scatter plot.

5. Choropleth Map of Crime Index Across U.S. States (Tableau)

A choropleth map was generated in Tableau to geographically represent crime levels. States were assigned colors according to their normalized Crime Index, enabling users to detect regional clusters or anomalies. Users can filter the map according to specific types of crime or levels of urbanization.

6. Trend Examination (Imaginary Time-Series for Dashboard Augmentation)

Although the dataset represents only one year, the dashboard is designed to accommodate future time-series data. With an extended dataset, a line graph with time sliders could be introduced to examine crime trends over time per state or by category

3.0 Challenges and Solution

Challenges and Solution:

Challenge	**Solution**

Aging dataset (1973 snapshot)	Acknowledged as historical baseline and noted limitations.
Feature imbalance	Used normalization to create a unified index.
Correlation complexity	Suggested further analysis with socio-economic features.
Visualization readability	Improved clarity using standardized color schemes and tooltips.
Lack of geographic fields	Integrated state boundaries manually via Tableau's U.S. shape map.

4.0 Conclusion and Future Work

This initiative showcases the effectiveness of visualization in improving public comprehension of crime statistics. The dashboard offers a user-friendly and thorough resource for comparing and analyzing violent crimes throughout all U.S. states. These visual insights can be advantageous for policymakers, researchers, and engaged citizens.

1. Temporal Expansion: Combine information from various years to detect patterns and changes in criminal activity.
2. Socioeconomic Relationship: Incorporate factors like income brackets, educational attainment, and joblessness to examine crime determinants.
3. Predictive Analytics: Utilize machine learning algorithms to project crime statistics using historical data and demographic factors.
4. User Customization: Allow personalized filters and notifications for user-specified areas or criteria.

The addition of these features would transform the dashboard from a fixed visual tool into an interactive decision-support system.

References

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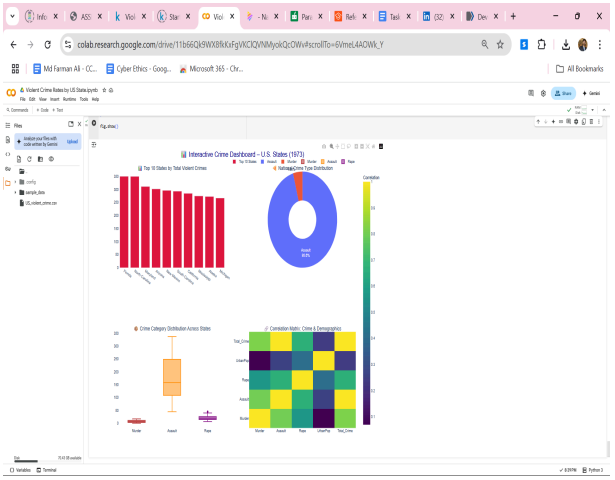
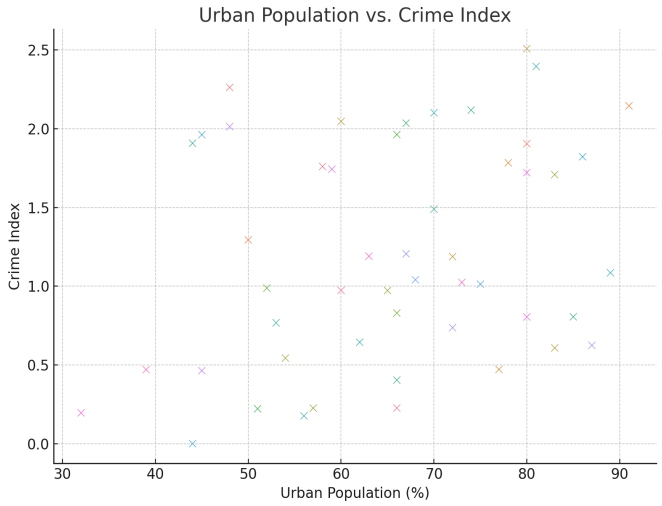
Appendix

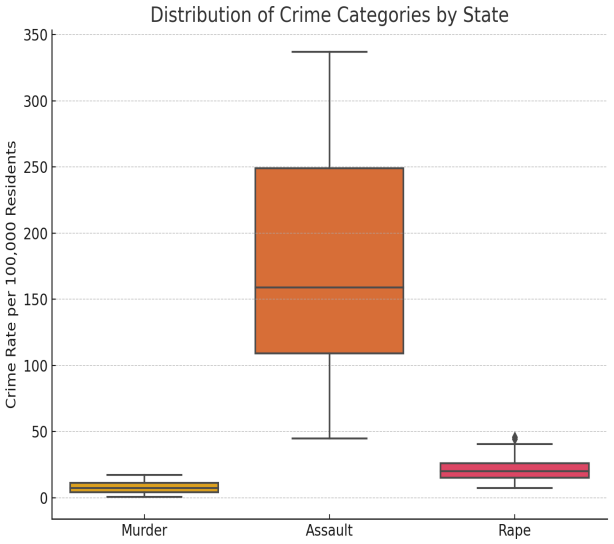
Appendix A: Sample Data Table

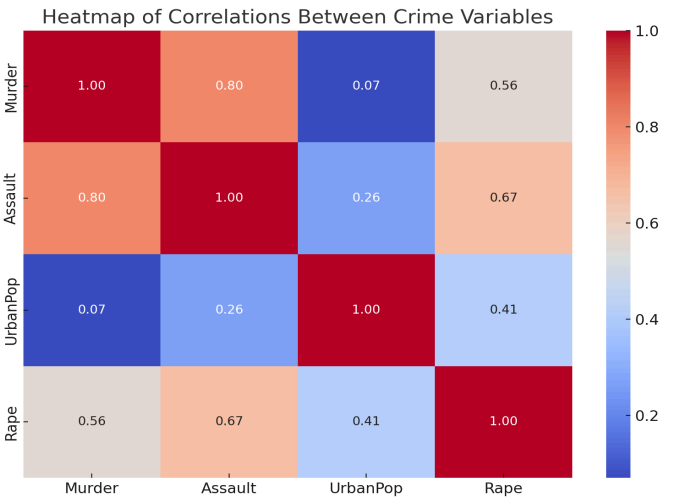
State	Murder	Assault	Urbanpop	Rape
Alabama	13.2	236	58	21.2
Alasks	10.0	263	48	44.5
Arizona	8.1	294	80	31.0

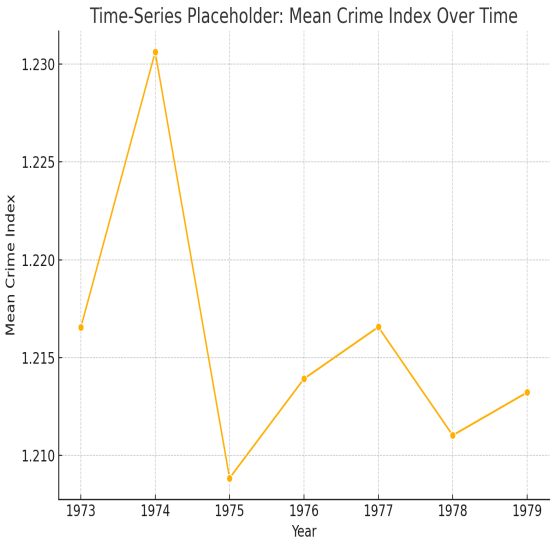
Appendix B: Dashboard and general visualization

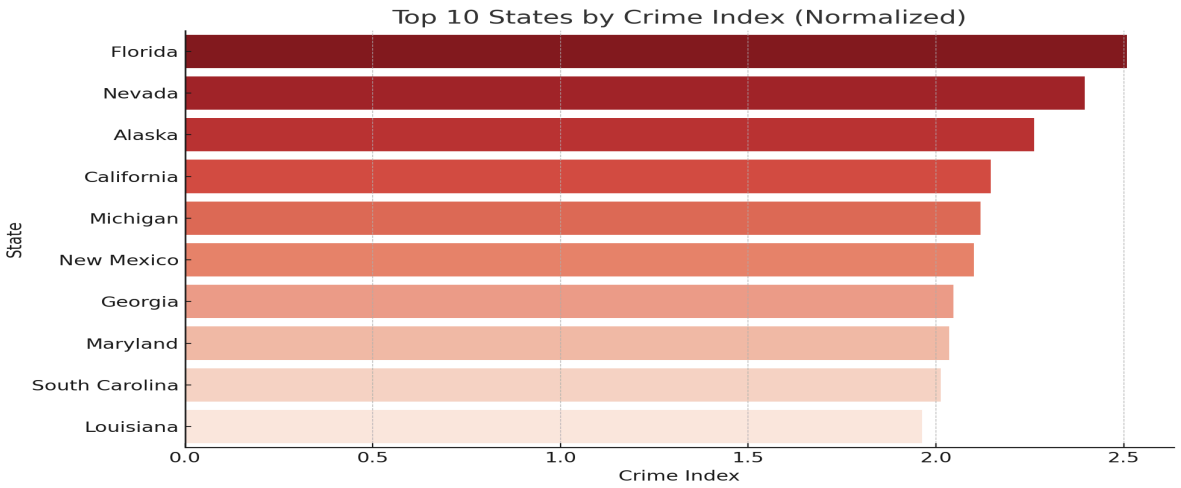


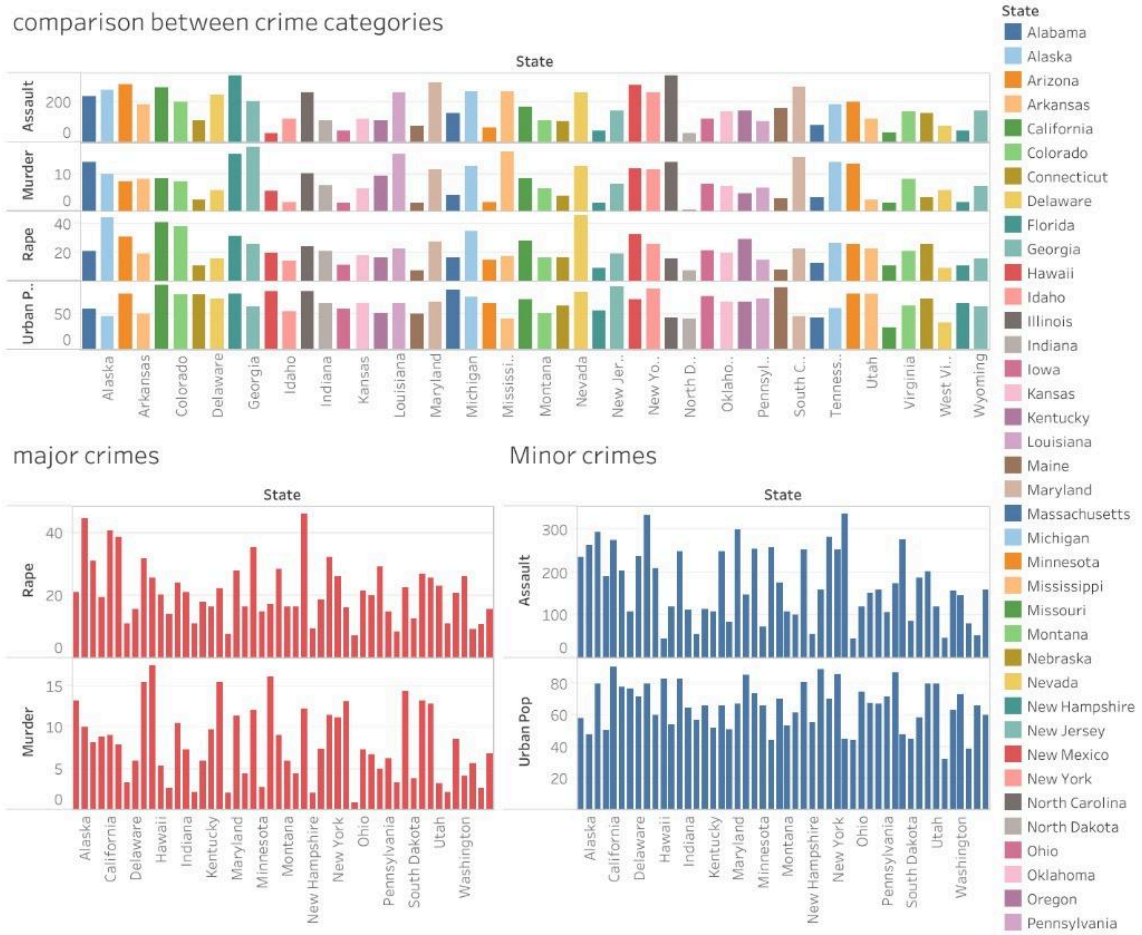

Urban Population vs. Crime Index
Crime Index
Urban Population (%)
0.0
0.5
1.0
1.5
2.0
2.5
30
40
50
60
70
80
90


Distribution of Crime Categories by State
Crime Rate per 100,000 Residents
0
50
100
150
200
250
300
350
Murder
Assault
Rape


Heatmap of Correlations Between Crime Variables
Murder
Assault
UrbanPop
Rape
1.00
0.80
0.07
0.56
0.80
1.00
0.26
0.67
0.07
0.26
1.00
0.41
0.56
0.67
0.41
1.00
Murder
Assault
UrbanPop
Rape
1.0
0.8
0.6
0.4
0.2


Time-Series Placeholder: Mean Crime Index Over Time
Mean Crime Index
Year
1.210
1.215
1.220
1.225
1.230
1973
1974
1975
1976
1977
1978
1979


Top 10 States by Crime Index (Normalized)
Florida
Nevada
Alaska
California
Michigan
New Mexico
Georgia
Maryland
South Carolina
Louisiana
State
0.0
0.5
1.0
1.5
2.0
2.5
Crime Index


comparison between crime categories
State
Assault
Murder
Rape
Urban P..
Alaska
Arkansas
Colorado
Delaware
Georgia
Idaho
Indiana
Kansas
Louisiana
Maryland
Michigan
Mississi..
Montana
Nevada
New Jer..
New Yo..
North D..
Oklaho..
Pennsyl..
South C..
Tenness..
Utah
Virginia
West Vi..
Wyoming
State
Alabama
Alaska
Arizona
Arkansas
California
Colorado
Connecticut
Delaware
Florida
Georgia
Hawaii
Idaho
Illinois
Indiana
Iowa
Kansas
Kentucky
Louisiana
Maine
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
Nebraska
Nevada
New Hampshire
New Jersey
New Mexico
New York
North Carolina
North Dakota
Ohio
Oklahoma
Oregon
Pennsylvania

major crimes
State
Rape
Murder
Alaska
California
Delaware
Hawaii
Indiana
Kentucky
Maryland
Minnesota
Montana
New Hampshire
New York
Ohio
Pennsylvania
South Dakota
Utah
Washington

Minor crimes
State
Assault
Urban Pop
Alaska
California
Delaware
Hawaii
Indiana
Kentucky
Maryland
Minnesota
Montana
New Hampshire
New York
Ohio
Pennsylvania
South Dakota
Utah
Washington