# Creating an Interactive Visualization Tool to Explore Crime in Los Angeles in Times of Economic Crisis and Stability

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**Abstract.** A web-based interactive visualization interface was developed using data of reported crimes within Los Angeles (LA) County from the Los Angeles Police Department. The tool, created using JavaScript, the d3.js library, and HTML (styled with cascading style sheets, CSS) displays crime in LA using dendrograms, slopegraphs, faceted slopegraphs, choropleths, heatmaps, barcharts, and simulations with interactive selections, tooltips, and toggling. The result is a user-based learning experience that explores the relationship between crime rates and the economy by comparing crime activity between 2010 and 2015, the years immediately following the most recent recession and recovery.

## 1  Introduction

Crime is a constant and major issue in all areas of the globe. As a society, we are aware that crimes occur, and will avoid areas that we interpret to have higher crime rates than others, even subconsciously. However, there are very few available and easily interpretable tools for the public to explore crime in their cities, despite large amounts of publicly available data.

The goal of this work is to create an interactive learning-based tools for users to learn about crime in their city and the influencing factors that impact crime occurrence over time. This visual tool focuses on the influence of the state of the economy on crime, using Los Angeles as a study area. The relationship between crime and the economy, although complex, has been detailed and studied extensively over the past 40 years( e.g., [1], [2]). Los Angeles county was chosen as a study area for its dense and multicultural population, concentrated urban centers, and wide distribution of wealth. The prototype interface allows users to learn about the impact of economic recession on crime rates in their city. The tool uses data between 2010 and 2015, when the country was exiting the most recent economic recession (2007-2009) and when the economy was relatively stable, respectively. This interface will allow users to explore and interpret crime across the entire county as well as within Los Angeles Police Department (LAPD) reporting districts. More specifically, users will be able to examine the influence

of the national economic status on crime rates within the county by interacting with graphics that display crime rates, densities, types, and locations over time.

Although there is an abundance of data recording reported crimes for most major cities in the US, there have been relatively few efforts to transform these data into useful visualizations or tools for public education and awareness. There have been efforts by some outlets, especially news organizations, to create interactive visual tools about crimes in their cities. For example, the Los Angeles Times has an online crime map that details crime occurrences in LA neighborhoods.[5] The tool includes recent crime alerts, as well as rankings for neighborhoods with the most violent crimes and the most property crimes. The tool allows the user to further explore violent crimes, property crimes, and specific neighborhoods by clicking on the map or the ranked neighborhoods. A similar effort for crime visualization has been made by the Chicago Tribune.[6] Researchers at the University of Virginia developed a crime search engine that incorporates spatial, temporal, and textual cues for Washington, DC using geographic information systems (GIS). [7]

These types of tools are incredibly useful for real-time crime data visualization, an instrumental technology for so-called "intelligent policing," helping law enforcement agencies to quickly interpret large amounts of data. [8] However, most crime visualization tools geared towards the public do little more than provide the user with information on the relative number and type of crimes in a particular area. Often, there is little effort to provide the user the option to explore crime occurrences and to examine the links between large societal disruptions and crime rates. To fill this gap, this project creates a user-driven learning environment to explore the impacts that economic stress can have on crime rates across LA county.

The visual tool resulting from this project will create a visual comparison between the state of crime in LA immediately following economic crisis (2010) as well as during a time of economic stability (2015) to guide user learning about the relationship between economic status and crime rates. Users will be able to answer queries about where crimes are occurring, what types of crimes are being committed, and how many crimes are occurring across the entire LA County as well as across the 2010-2015 time horizon.

## 2   Dataset and data manipulation

Data for this project was downloaded from the city of Los Angeles' online public repository.[3] The raw dataset includes information for all crimes reported in LA county from the year 2010, such as the date and time reported, date and time occurred, location, and type of crime. In total, the database is almost 370 Megabytes, with 26 unique columns of information for each crime recorded in the database. Due to the size of the dataset, considerable data manipulation was performed using R to clean and filter the data pertinent to the visualization project. Geographic boundaries and population data for the LAPD reporting districts is available from the LA Times website.[4]

Firstly, in order to reduce the size of the dataset, the time horizon for the project was set between 2010 and 2015. This horizon allows for the comparison of the crime rates in the county during times of relative economic prosperity (2015) and economic crisis during the most recent depression (2010) as well as the years between. The dataset was then filtered to include only information on the date, time, location, and type of crime (i.e., day, month, year, hour, longitude, latitude, LAPD reporting area, crime type). The data were further reduced by consolidating the original 136 reported crime types into 43 crime descriptions and further consolidating these descriptions into 11 unique categories: assault and battery, fraud, property damage, domestic disturbance, homicide, human trafficking, kidnapping, theft, resisting arrest, other. Finally, the data were separated into smaller csv files relevant to groups of visualizations to reduce loading times. (See included R script for specific code used in data wrangling)

## 3  Visualization design

The visualization interface was developed with the goal of providing an informative and investigative platform for users to compare crime rates for different crime types, locations, and times for years when the national economy was relatively stable versus when the country was in economic depression. As such, the design focused on developing a tool that would lead users to discover their own answers to the main questions of this project: where, when, and what type of crimes happen in LA county? How does this change in different areas? How does this change for 2010 and 2015?

The platform is separated into six sections to guide the user learning experience: the introduction (homepage), exploration of crime types reported to the LAPD, investigation of crime rates over time, comparison of crime density across locations, simulation of crimes in different areas, and investigation of crime occurrence at different times of the year, times of the month, and times of the day for 2015. A deep red color scheme is used consistently throughout the interface and within the visualizations, where possible. The color green was avoided in the design to minimize issues with color-blindness. All mock-ups for the project design were developed using Sketch.

## 4  Visualization development

The homepage introduces the user to the visual platform and gives context to exploration of crime in LA county during times of economic hardship and times of economic stability. The second element of the page describes the crimes reported to the LAPD in detail using a tree visualization created using a the tree layout from the JavaScript d3 library.

A slopegraph was created to describe the frequency of reported crimes for each crime type between 2010 and 2015. This slopegraph is coupled with a choropleth map and a series of 21 small multiple slopegraphs showing the spatial distribution of crime rates and the percent change in crime rates between

2010 and 2015, respectively. These visualizations are grouped and react to user interaction when areas, small multiples, or crime types are selected by the user.

A crime simulator was built using JavaScript to visualize the probability of crime occurrences and the type of crimes in the 21 LAPD reporting districts. The simulator shows the probability of crime occurrences across a sample of the population or the likelihood of different crime types occurring across total reported crimes for a selected district. Interactive tooltips are incorporated in the simulator to describe if a crime was committed and what type of crime it was.

Heatmaps are used to show crime density across reporting districts in the county using the Google Maps API. A dual heatmap layout allows for side-by-side comparison of crime density across different reporting districts. Each heatmap element also includes an option to display 2010 or 2015 data to allow for comparison of crime density between years as well. Furthermore, the heatmaps are fully integrated with Google Maps functionality, allowing users to zoom easily and toggle between map and satellite view based on preference.

Finally, a stacked barchart is used to show the frequency of crimes reported throughout 2015, separated by month, day of the week, and hour of the day. The height of the bars corresponds to the total count of reported crimes and the color of each stacked area corresponds to the hour of the day. Users can select crime categories from a drop-down menu to generate an updated barchart specific to each crime type. The webpage was compiled using JavaScript (with extensive use of the d3 library), HTML, and styled using CSS.

## 5   Insights from the visual platform

The result of this project is an interactive visual tool that users can explore to learn about crime rates in Los Angeles. With this tool, users can learn about the impact that the national economic status has on crime rates in different areas of the county. The website is interactive, prompting users to guide their own learning journeys by exploring the visualizations. The following section details some examples of insights that can be gained from using this visual tool.

### 5.1   Changes in types of crimes committed

Crimes rates for theft and fraud saw steady increase in every area of LA county from 2010 to 2015. This trend can be easily predicted because a rise in wealth amongst all community members should create an influx of crimes based around money and material possessions. The amount of thefts that occurred in the Central district of downtown LA increased from around 3,000 to approximately 5,000 reported cases in 2010 and 2015, respectively. The cause is likely a combination of an increased interest in material possessions as well as increased economic activity within the urban area from economic stimulus.

Another interesting trend to note is that violent, inhumane crimes saw a significant rise in suburban areas of LA between 2010 and 2015. The districts of

Van Nuys, Topanga, Mission, Devonshire, West Valley, North Hollywood, and Northeast experienced the greatest increases in human trafficking and homicides. Although urban crime rates increased as compared to suburban areas, the type of crimes committed in suburban areas has shifted to be much more gruesome. Crime organizations have more opportunities to thrive when the economy is better, which could explain the increase in sever crime activity. Although the increase in crime rates cannot be directly attributed to the economic state using the visuals presented in this project, the exploration of the visual platform is intended to spark user curiosity and drive learning and understanding of crime in LA county.

## 5.2 Changes in location of crimes

The location information for each reported crime is helpful for identifying crime trends based on levels of wealth within areas of the county. This allows users to challenge the phrase "impoverished areas are more crime ridden" by observing trends across the LAPD reporting districts, which vary significantly in affluence. Coupled with the economic downtime of 2008, the data presented provides a rare opportunity to see change in a district's average wealth and the crimes rates that follow. The choropleth and slope graph visualizations show more areas of the county that are more urban have increased crime rates from recent economic prosperity, while suburban crime rates have decreased since the recession.

It is likely that increases in crime in urban areas can be attributed to economic growth in commerce and an influx of residents that can afford to live in the urban centers. The Central police district, which encompasses Downtown Los Angeles and Northern Elysian Park, experienced a 43% increase in total reported crimes from 2010 to 2015. This area experiences abundant economic stimulus by businesses to prime a revival of a central hub for LA. Naturally, an increase of wealth and population density from gentrification have raised counts of robbery, assault, and fraudulent activity in this region. However, the increase in crime in the Central district more than doubles that of West Los Angeles, the second highest in the county (18%). From the example of the Central district, a user could see that economic prosperity could also have a big opportunity to welcome more crime.

## 6 Conclusion and future work

In conclusion, this application brings forth incredible information for the residents of Los Angeles to analyze their surroundings. Peace of mind and security are of the utmost importance to us as individuals, and this visualization prototype can be a great platform for public education about crime. This visual tool serves as a stepping-stone to further investigation of educational visual tools for the public. Not only could the techniques used in this prototype be applied to other areas of society, but the crime visualization platform itself could be greatly expanded by exploring past economic recessions or creating comparisons across other cities and countries,for example.

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