

PredPol Predicts Gun Violence

PredPol accurately predicts where and when crimes are most likely to occur. It is the only predictive analytic system that has repeatedly demonstrated the ability to predict more than double the amount of crime in head-to-head field deployments against dedicated crime analysts with all of the tools of the trade. PredPol can now deliver the same predictive accuracy for gun violence using unique mathematical methods. A study of Chicago data shows that PredPol successfully predicts 50% of gun homicides by flagging in real-time only 10.3% of city locations. Knowing where and when gun homicides are most likely to occur empowers law enforcement to use their knowledge, skills and experience to disrupt gun crime before it happens.

The Challenge of Gun Violence

In 2012 there were 507 homicides and 12,137 crimes involving handguns in Chicago, Illinois. In light of recent gun violence across the country including school shootings and as police departments across the nation face tighter budgets and scarcer resources, reducing violence and gun related crime from the high levels observed in cities like Chicago is a significant challenge.

While no one strategy may serve as a silver bullet, PredPol makes possible the efficient distribution of limited policing resources. Developments in mathematical and statistical modeling, high-performance cloud computing, and GPS-enabled mobile devices make it possible for real-time crime forecasts to be at the disposal of officers in the field. PredPol technology gives officers the best chance to be in the right place, at the right time, to stop crime before it occurs.

The purpose of this white paper is to show how big data, predictive analytics, and hotspot policing are currently used in practice, and how they are adapted for the purpose of suppressing gun violence in a city like Chicago. Our methodology allows for several years of crime data and many different crime types to be systematically combined to yield accurate, real-time crime predictions. PredPol predictions provide tactically clear recommendations about where and when to deploy precious police resources. We illustrate the methodology with a large, open-source data set from the Chicago Police Department.

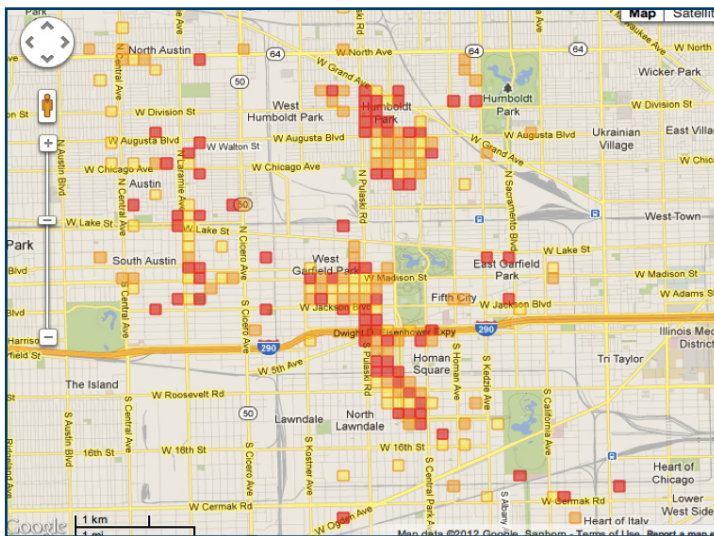


Figure 1. Prediction map in 2011: 1% (red boxes), 2% (red and orange boxes), and 3% (red, orange and yellow boxes) of Chicago flagged, corresponding to 6km², 12km², and 18km². The percentage of homicides predicted at these thresholds are 10%, 13%, and 20%.

PredPol Success in the Field

PredPol has been extensively evaluated using historical crime data and controlled field trials with multiple law enforcement agencies. Analyses demonstrate that PredPol outperforms existing methods for forecasting crime such as kernel density estimation, which underlies most crime hotspot mapping programs. Controlled trials also show that PredPol predicts more than two-times as much crime as a trained crime analyst.

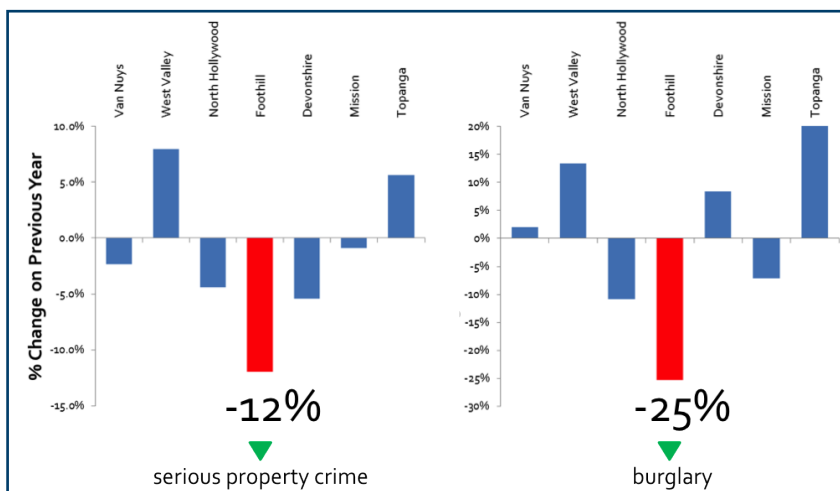


Figure 2. Property crime rates fell during the period of PredPol deployment in LAPD's Foothill Division. Serious property crimes include burglary, car theft and burglary/theft from vehicle. Comparisons are between Foothill Division and six other geographically adjacent Divisions in LAPD.

The PredPol technology offers microscale, real-time geospatial intelligence, displayed in a way that is tactically clear to supervisors and patrol officers; unlike current models such as hotspot maps that are often underused because they are ambiguous and confusing. Over the course of a six-month period of deployment from November 2011 to May 2012 with the Los Angeles Police Department (LAPD), patrol officers nearly doubled the amount of time on predictive missions from 48 hours per week to 88 hours per week. Setting clear mission expectations and regular reinforcement of mission priorities from supervisors were important during this process.

Crime rates can be impacted significantly by the use of PredPol. In the two longest-standing deployments, with the Santa Cruz and Los Angeles Police Departments, declines ranging from -12% to -25% during the same period in the previous year were seen in burglary, car theft and theft from motor vehicle (Figure 2). PredPol serves as a force-multiplier in allowing officers to use their expert knowledge, skills and experience in a timely manner in the highest risk locations on the landscape.

Predicting Gun Violence with PredPol

PredPol is based upon a marked point process methodology that allows for several years of crime data, and multiple crime types, to be utilized by hotspot maps, incorporating both fixed risk heterogeneity across the city and temporally dynamic risk. Chronic hotspots are long term in duration and necessitate problem-oriented policing strategies to address the root causes of crime. Temporary hotspots, on the other hand, last on the time scale of days to weeks. Policing strategies must be able to anticipate emerging trends to disrupt emerging hotspots. Without predictive analytics, officers end up chasing yesterday's crime. The Los Angeles Police Department updates its PredPol models for every 8-hour shift and directs patrols accordingly.

In many instances there may be little difference in the situation and intent separating gun violence and a homicide. The occurrence of serious violent crimes may provide as much, or more, information on where and when homicides are most likely to occur as actual homicides themselves. We take the following marked point process approach to modeling the intensity of homicides. Given marks, M_i , representing crime types believed to be precursory to homicide, the intensity of homicide is modeled as:

$$\lambda(x, y, t) = \mu(x, y) + \sum_{t > t_i} g(x - x_i, y - y_i, t - t_i, M_i)$$

The background rate $\mu(x, y)$ represents fixed risk across the city, whereas the kernel $g(x, y, t)$ determines the time and spatial scales over which near-repeat crime patterns occur.

Chicago Gun Crime & Gun Homicide

We apply PredPol to an open source data set consisting of 38,740 violent crimes occurring in Chicago, Illinois in the years 2009, 2010, and 2011. In total there are 1,331 homicides and the following gun related crimes with “handgun” in the description field: 17,020 robberies, 6,560 assaults, 8,252 weapons violations, 5,274 batteries, and 303 criminal sexual assaults. The data can be downloaded from the website “<https://data.cityofchicago.org/Public-Safety/Crimes-2001-to-present/ijzp-q8t2>”.

Homicide	Robbery	Assault	Weapons	Battery	Sex.Assault
5.5%	13.9%	23.6%	32.1%	24.8%	0%

Table 1. Percentage contribution of different precursor crimes to PredPol predictions of gun homicides.

Crimes involving guns continue to have an impact on future gun homicides for 30-100 days and risk spreads over as much as 1/2 mile in area. With knowledge of the increase in crime risk following precursory gun-related crimes, officers are in a better position to deter more serious gun crimes through directed patrol. In Table 1, we display the crime types that comprise the highest portion of the estimated risk of homicide and thus play the largest role in predicting homicide. We note that past homicides are not the highest predictor of future homicides, rather weapons violations, batteries, and then assaults are the highest predictors in decreasing order. PredPol predictions leverage these relationships allowing resources to be directed to where they have the greatest potential impact.

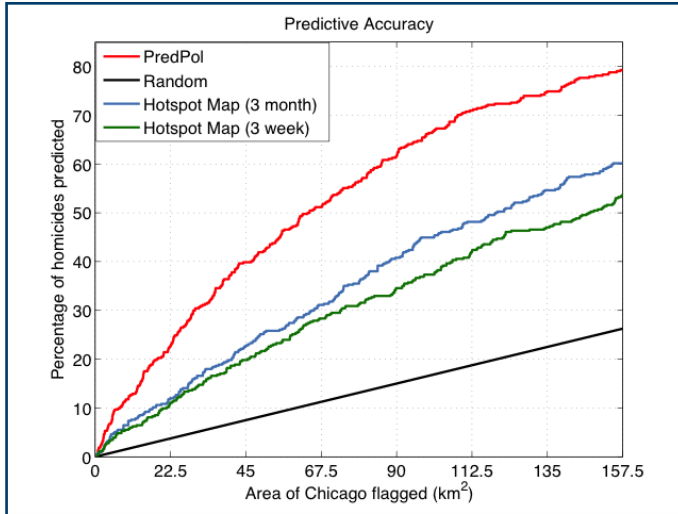


Figure 3. Percentage of crime occurring within flagged areas vs. total area of Chicago flagged with predictions using 2011 historical data. PredPol accurately predicts a greater number of gun homicides at all levels of deployment compared with standard hotspotting.

PredPol predicts a greater number of gun homicides using its unique prediction methodology compared with alternative approaches. Figure 3 compares the predictive accuracy of PredPol against both 3-month and 3-week kernel density hotspot maps. As police resources increase, more of the city can be flagged for directed patrol and the number of gun homicides correctly predicted increases. PredPol successfully predicts 50% of gun homicides by flagging in real-time only 10.3% of Chicago.

PredPol Guides Police Practice

PredPol fits seamlessly into existing police practice and creates strategic and tactical opportunities that would not exist otherwise. PredPol accurately predicts where and when gun homicides are most likely to occur. Police can therefore position their resources to make the best use of officer knowledge, skills and experience to disrupt gun violence. Moreover, the PredPol methodology creates clear tactical guidelines to focus on weapons violations, assault and battery as the major drivers of gun homicides. In a manner similar to 'broken-windows' policing, targeting these precursor crimes can have a significant impact on gun homicide and ultimately on crime reduction.

For more information about this paper or PredPol, please contact us at: info@predpol.com or 831.331.4550