SDAL SOCIAL & DECISION ANALYTICS LABORATORY
DATA SCIENCE FOR THE PUBLIC GOOD

HOW DO EVENTS AFFECT CRIME?

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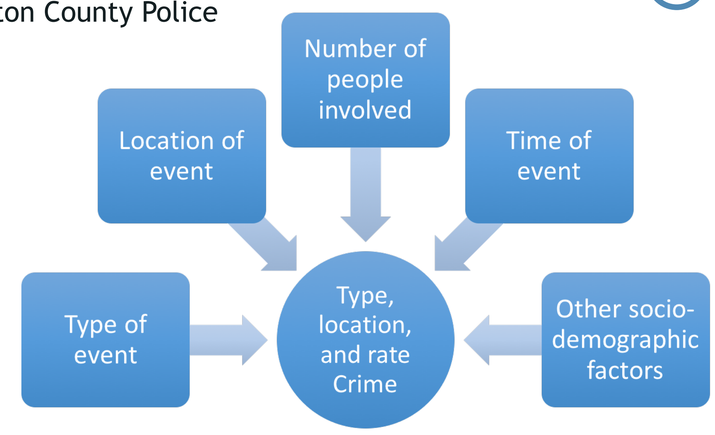
Research Question

What to expect from specific events so that the Arlington County Police Department (ACPD) can be better prepared?

Types of events of interest:

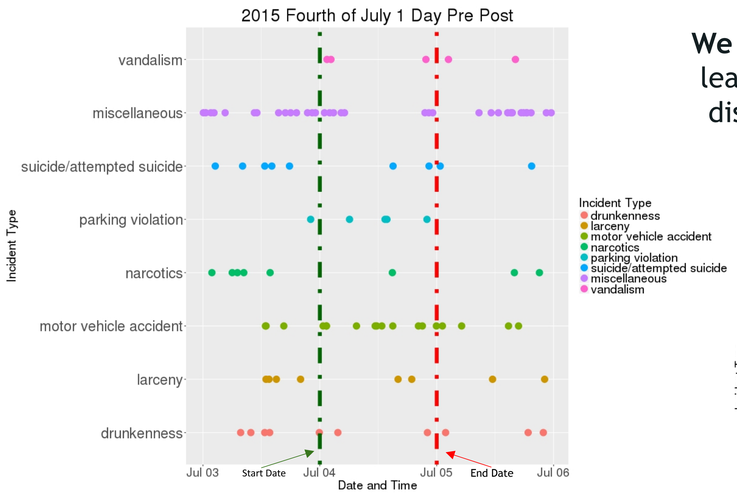
- Political events, e.g., elections and inaugurations
- Weather events, e.g., snowstorms, hurricanes, hottest day of the year, tropical storms
- Sports events, e.g., Super Bowl, playoff games for the Washington sports teams, marathons
- Holidays, e.g., Halloween, Memorial Day
- Social events: All events listed on Yelp.com for Arlington. Popular events include wine testing, pub crawls, national cheesecake day



Data

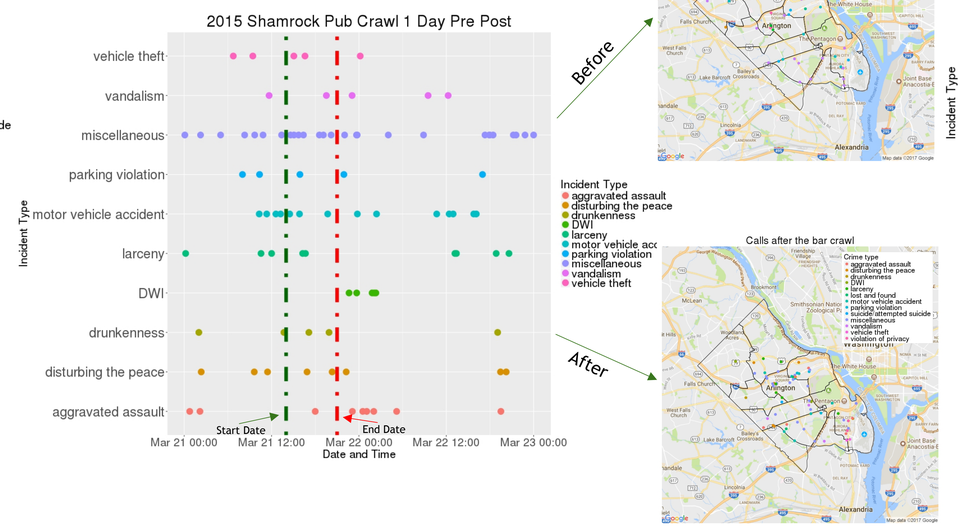
- Seven relational data tables about 911 calls and crime incidents provided by the ACPD
- Available for 2005-2015
- Reports a total of 1,064,099 Calls for Service and 261,944 incidents
- For this analysis we use:
  - Type of incident recorded
  - Exact date and time of the 911 call
  - Location of crime
- We gathered event data from various sources including Yelp.com for social events.

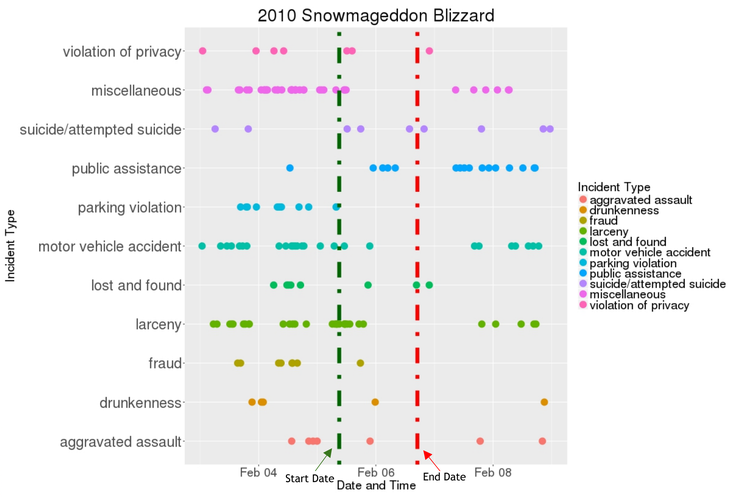
Exploratory Data Analysis



We expect that certain holidays will result in more people celebrating, leading to an increase in alcohol-related crimes. Data suggests increase in motor vehicle related incidents.

We expect that a drinking-based social event will lead to an increase in alcohol-related and public disturbance-related crimes. Data supports this.





We expect that extreme weather events would result in people spending extended periods of time in their homes, leading to an increase in domestic abuse-related crimes.

The Model & Findings

- We fit a spatiotemporal log-Cox point process to crime rates in Arlington in order to account for dependence in rate over time.
- The rate at location s_i and time t is modeled as:

$$\log\big(\lambda(s_i,t)\big) = z(s_i,t)\beta + \xi(s_i,t) + \epsilon(s_i,t)$$

$$\xi(s_i,t) = a\xi(s_i,t-1) + \omega(s_i,t)$$

where $\epsilon(s_i,t) \sim N(0,\sigma_\epsilon^2)$ and $\omega(s_i,t)$ is a time-independent spatial process with Matern covariance. Inference relies on the SPDE approximation[1] implemented in the INLA R package[2].

- The maps on the right illustrate the effects of Snowmageddon and one of the popular pub crawls in Arlington.
- We do not observe a significant change in crime rate during the **Super Bowl**, and we observe that the crime rate is generally higher **at night**.

Pub crawl in Arlington on 03/21/2015:
Intensity of estimated crime increased significantly

- After controlling for this time of day effect, we estimate an increase in crime rate during the night of the **pub crawl** (March 21st, 2-9pm)

Snowmageddon blizzard on 02/05-02/06, 2015:
Intensity of estimated crime decreased significantly

- Statistically significant reduction in crime rate when comparing the periods before the **blizzard** (Feb 1st-5th) to the days immediately following it (Feb 6th-10th)

Next Steps

- Visualize and model effect for more types of events.
- Consult with ACPD to understand which other events would be of interest to them.
- Investigate various crime types further, to understand differential effect.

References

[1] Lindgren, Finn, Håvard Rue, and Johan Lindström. "An explicit link between Gaussian fields and Gaussian Markov random fields: the stochastic partial differential equation approach." Journal of the Royal Statistical Society: Series B (Statistical Methodology) 73.4 (2011): 423-498.
[2] www.r-inla.org