Predicting Targeted Violence: An Update

National Counterterrorism Innovation, Technology, and Education Center

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Predicting Targeted Violence: An Update

Given recent events in Buffalo and Uvalde, can we predict where targeted violence, specifically active shooter attacks, is most likely to occur? Building on our 2021 report, we re-examine the risk of targeted violence – as measured by mass shooting incidents – across the United States.\(^2\)

In our original report, we examined whether Machine Learning (ML) techniques could help forecast the location of domestic extremist hate groups and targeted violence. We found that basic ML algorithms could accurately forecast hate group operations, but the location of mass shootings was relatively stochastic. In other words, community-level risk indicators poorly predicted where a mass shooting was likely to occur.

At the time, we noted the model’s poor forecast accuracy could potentially be due to the 2020 COVID pandemic, which generated a sharp reduction in mass shooting incidents due, in part, to stay at home orders.\(^3\) Since a ML model learns from historical reporting to forecast future trends, an outlier year could erroneously cause the model to look worse than it is. Since 2020, the FBI reported active shooter incidents increased 52% in 52%, suggesting a return to prior levels.\(^4\) In practice, this means we have better data for re-evaluation.

Procedure

To re-assess, we built an updated set of Generalized Boosting Models (GBM) using repeated 10-fold cross validation. As before, the model studies historical patterns in active shooter incidents from two data sources: the Gun Violence Archive and Everytown for Gun Safety. The model trains on information about active shooter incidents from 2017-2020; we evaluate its predictive accuracy based on incidents in 2021. We use the same controls listed in our original report and also include new state-level information from the Correlates of State Policy dataset on gun control policies.\(^5\) This allows us to assess how much information about gun licensing, open carry laws, waiting time requirements, and restrictions on the number of firearms that can be purchased matters.

Results

We find that predicting mass shooting incidents like those in Buffalo and Uvalde in advance remains an incredibly hard task. Geographic patterns of targeted violence continue to appear as-if random despite socio-economic, demographic, political, or gun safety measures (Table 1).

Model 1 assesses how well community-level risk indicators predict any targeted violence incident resulted in at least four casualties. The model performs reasonably well with a 91% accuracy rate on the out-of-sample set of cases, meaning historical patterns of active shooter incidents predict the presence or absence of mass violence incidents nine times out of ten. However, this includes criminal shootings or family-related shootings.

As a more precise test, we only focus on trying to predict mass shootings that resulted in a minimum of four fatalities (Models 2-3). We also exclude cases where victims were family or personal acquaintances (Model 4). These models have very low sensitivity rates This means that the model was very good at predicting the absence of an active shooter incident in some areas (e.g. North Dakota), but struggled to predict the occurrence of an active shooter incident. As a result, we find that almost all of the mass shootings – 80% – occurred in states that had not increased gun safety measures.

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shooter incident in areas where it actually occurred. These models tend to predict an active shooter incident in approximately 60% of cases or just slightly above random chance.

**Extension: State Gun Control Policies**
As an extension, we explore how much standing gun control policies by state correlate with the location of active shooter incidents. Using our different mass shooting outcome variables, we examine how well this information explains variation in county-level incidents (Figure 2). Across a variety of state-level restrictions, there is surprisingly little correlation between the number of incidents and state-level restrictions. We cautiously interpret this as stemming, in part, from a non-standardized set of national policies.

### Table 1. Repeated 10-Fold CV GBM Model Results of Mass Shooter Incidents

<table>
<thead>
<tr>
<th>Outcome: Mass Shooter Incidents</th>
<th>(1) Minimum Four Casualties</th>
<th>(2) Minimum Four Fatalities</th>
<th>(3) Minimum Four Fatalities &amp; Non-Family Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome Data Source</td>
<td>Mass Violence Archive (MVA)</td>
<td>Mass Violence Archive (MVA)</td>
<td>Everytown for Gun Safety (ET)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.91</td>
<td>0.90</td>
<td>0.88</td>
</tr>
<tr>
<td>Sensitivity Rate</td>
<td>0.75</td>
<td>0.62</td>
<td>0.58</td>
</tr>
<tr>
<td>Specificity Rate</td>
<td>0.93</td>
<td>0.90</td>
<td>0.79</td>
</tr>
<tr>
<td>Kappa Score</td>
<td>0.56</td>
<td>0.08</td>
<td>0.06</td>
</tr>
</tbody>
</table>

**Figure 1. Correlation Matrix and Choropleth Map of State Gun Control Policies and Active Shooter Incidents**