Global Patterns in Terrorism

Lecture 10
29 September 2011
CSCI 7000-001
Inference, Models and Simulation for Complex Systems

Prof. Aaron Clauset
University of Colorado
terrorism (noun)
a violent act
by non-governmental actors
to create fear
for political purposes

“terrorism from below” vs. “terrorism from above”
a brief history of modern terrorism
wave 1: anarchist  
c.1880 - c.1920

examples:
1881 Narodnaya Volya assassinates Tsar Alexander II
1901 Leon Czolgosz assassinates US President McKinley
1905 Terrorist Brigade operates in Switzerland and Finland
1914 Archduke Ferdinand’s assassination starts World War I
wave 1: anarchist  
c.1880 - c.1920

wave 2: anti-colonial  
c.1910 - c.1960

dates:
1880 - 1920
1910 - 1960

examples:
1928-66 Muslim Brotherhood's Secret Apparatus in British Egypt
1931-48 Irgun fights to create Israel out of British Palestine
1955-59 EOKA fights for Cyprus’ independence from Britain
1954-62 FLN fights for Algerian independence from France
wave 1: anarchist c.1880 - c.1920
wave 2: anti-colonial c.1910 - c.1960

examples:
1964+ PLO in Palestinian territories
1970-90 “Contras” in Nicaragua
1970-93 Red Army Faction in West Germany
1980-92 Shining Path in Peru

tacit encouragement from USSR and USA
wave 1: anarchist  
c.1880 - c.1920
wave 2: anti-colonial  
c.1910 - c.1960
wave 3: revolutionary  
c.1960 - c.2000
wave 4: religious  
c.1980 - present

elements:
1976-09    Tamil Tigers in Sri Lanka (Hindu)
1984-00    Aum Shinrikyo in Japan (Cult)
1987+      Hamas in Palestinian territories (Islamic)
1991+      Lord’s Resistance Army in Uganda (Christian)
1994+      Taliban in Afghanistan, Pakistan (Islamic)
**tactics**

**wave 1**  
assassinations, dynamite, suicide missions

**wave 2**  
assassinations, firearms, guerrilla attacks

**wave 3**  
hostages, firearms, high explosives, guerrilla attacks, assassinations

**wave 4**  
suicide bombs, improvised explosives, firearms, unconventional methods

**targets**

government, heads of business

government, military

mainly military, some civilians

mainly civilians, some military
conventional studies of terrorism

- historical, descriptive, policy-oriented
- focused on incidence and strategy
  (spoiler effects, substitution, public support)
- correlations
  (democracies, political motivation, strategic opportunities, alliances, material support)
- mainly use aggregate measures
  (totals, binary variables)
- general linear model
  (regressions)
thus

• theories of rational behavior, context and strategic issues  
  \textit{(a la} economics)\n
• severity of events typically ignored

• theories rarely mechanistic  
  \textit{(but often psychological)}

• few general “laws”

• little hope of forecasting  
  \textit{(context, context, context)}
where is terrorism today?
RAND-MIPT data

- 40 years (1968-2008)
- Domestic + International
- 5000+ cities, 187 countries
- 36,018 events (37% deadly)
## deaths per million people, USA 2007

<table>
<thead>
<tr>
<th>Cause</th>
<th>Rate</th>
<th>× Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>terrorism</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>lightning</td>
<td>0.15</td>
<td>1</td>
</tr>
<tr>
<td>bee sting</td>
<td>0.18</td>
<td>×1.2</td>
</tr>
<tr>
<td>airplane crash</td>
<td>0.23*</td>
<td>×1.5</td>
</tr>
<tr>
<td>homicide</td>
<td>61.74*</td>
<td>×408.3</td>
</tr>
<tr>
<td>car crash</td>
<td>124.43</td>
<td>×829.5</td>
</tr>
</tbody>
</table>

* most recent available data, from 2006

**Sources:** US Census, MIPT, NWS, CDC, NTSB and NHTSA

Thursday, September 29, 2011
is terrorism getting worse?
is terrorism getting worse?

![Graph showing terrorism deaths per year from 1968 to 2008](image)

- **Terrorism worldwide**
- **Smoothed data**
- **Exponential trend**

[tot. deaths](t)
is terrorism getting worse?

![Graph showing terrorism deaths per world capita over years.](image)
is terrorism getting worse?

[Graph showing average deaths per lethal attack from 1968 to 2008 with trend analysis.]
is terrorism getting worse?

\[
\left[ \frac{\text{ave. deaths}}{\text{world pop.}} \right] (t)
\]
comments

• individual events no worse, on average

• number of fatal events increased exponentially

• odd lulls in 1992, 2006
severe events ("outlier" events)

• relatively few casualties (automobiles > terrorism)

• very infrequent

• disproportionate economic, political effects

For example: major re-organization of US/UK national security apparatus after 9.11.2001
21 Dec. 1988: Pan Am Flight 103, Lockerbie Scotland (270 deaths)
19 Apr. 1995: Oklahoma City bombing (168 deaths)
11 Sept. 2001: World Trade Center (2749 deaths)
12 Oct. 2002: Bali nightclub bombing (202 deaths)
26 Nov. 2008: Lashkar-e-Taiba attack in South Mumbai (173 deaths)
13,274 deadly attacks, 1968-2008

“normal” 92%

“severe” 8%
13,274 deadly attacks, 1968-2008

"severe" 8%
13,274 deadly attacks, 1968-2008

percent with greater severity

“severe” 8%

\[ \alpha = -2.4 \]

Thursday, September 29, 2011
testing the power law

<table>
<thead>
<tr>
<th></th>
<th>( \hat{x}_{\text{min}} )</th>
<th>( \hat{\alpha} )</th>
<th>( \hat{n}_{\text{tail}} )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>deaths</td>
<td>10</td>
<td>2.4 ± 0.2</td>
<td>1024</td>
<td>0.44</td>
</tr>
</tbody>
</table>

power-law is \textit{plausible} model for deaths

- no fundamental difference, big vs. small
- \( \hat{x}_{\text{min}} \) marks “severe event” range
- could estimate risk of future severe events
  (additional validation needed for this)
- can use power-law model for additional analysis
variations

how does frequency-severity distribution vary with

• time
• weapon type
• economic development
variation with time

study events in each 24 month interval
variation with time

• ave. log-severity largely stable over 40 years

• apparent periodicity in ave. log-severity at years $\tau \approx 13$
variation with time

• scaling exponent largely stable over 40 years
• suggests severity distribution largely stable
• main difference today: many more events
variation by weapon

• chem/bio
• explosives
• fire/arson
• firearms
• other/unconventional
variation by weapon

- more apparent power-law behavior
- but different $\hat{\alpha}$, $\hat{x}_{\text{min}}$
- not ubiquitous: no power laws by region
- explosives most deadly, overall

\[ P(x) = 10^{-4} \cdot 10^{-2} \cdot 10^{0} \]

\[
\begin{align*}
\text{severity, } x \text{ (total)} & : 10^{0} 10^{2} 10^{4} \\
\text{Chem/Bio} & \quad \text{Explosives} \\
\text{Fire} & \quad \text{Firearms} \\
\text{Knives} & \quad \text{Other}
\end{align*}
\]
variation by economy

• 30 countries (USA, Japan, France, UK, Turkey...)

• tracks economic statistics and data for these 30 + 70 others
developed nations 5%
developing nations 95%


**economy alone?**

<table>
<thead>
<tr>
<th>severe events</th>
<th>( x \geq x_{\text{min}} )</th>
<th>of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>335</td>
<td>26.9%</td>
</tr>
<tr>
<td>France</td>
<td>201</td>
<td>16.2%</td>
</tr>
<tr>
<td>Spain</td>
<td>109</td>
<td>8.8%</td>
</tr>
<tr>
<td>Germany</td>
<td>98</td>
<td>7.9%</td>
</tr>
<tr>
<td>USA</td>
<td>93</td>
<td>7.5%</td>
</tr>
<tr>
<td>Greece</td>
<td>76</td>
<td>6.1%</td>
</tr>
<tr>
<td>Italy</td>
<td>73</td>
<td>5.9%</td>
</tr>
<tr>
<td>UK</td>
<td>62</td>
<td>5.0%</td>
</tr>
<tr>
<td>total</td>
<td>1047</td>
<td>84.2%</td>
</tr>
</tbody>
</table>

other factors must be involved
comments

power-law pattern holds for

- different decades (70s, 80s, 90s, 00s)
- different types of weapon (guns, fire, bombs, etc.)
- different levels of economic development (OECD)
- but not for “regions” or suicide attacks

open questions

- what creates this simple and robust pattern?*
- what does this mean for long-term planning? (can we make accurate statistical forecasts?)
generating the power law

model 1:
  • competition between states and terrorists leads to exponential sampling (a la Reeds & Hughes)
    [Clauset, Young & Gleditsch (2007)]

model 2:
  • population density fluctuations + density-dependent targeting (a la Reed & Hughes)
    [Clauset, Young & Gleditsch (2010)]

model 3:
  • self-organized critical, fission-fusion model of group dynamics leads to power-law in cell sizes
    [Johnson et al. (2009), Clauset & Weigel (2010)]
tuesday:

terrorist organizations  or  civil wars