Universal Patterns in Modern Conflicts

Talk given at Georgetown University,
November 30, 2007

Michael Spagat,
Department of Economics,
Royal Holloway College,
University of London

There are many people involved in this research:

University of Miami:
Neil Johnson

Oxford University:
Sean Gourley
Alex Dixon

Universidad de Los Andes:
Juan Camilo Bohorquez
Alvaro Moreno
Elvira Restrepo
Juan Pablo Calderon
Roberto Zarama

CERAC and Universidad Javeriana: Jorge Restrepo

Is there a common structure of modern warfare that remains more or less constant across diverse wars?

Aside from the inherent interest of this question, the answer can have important implications for the practical conduct of war, including medical and insurance planning.

What is the relationship between terrorism and modern warfare?

The distinction between the two is often blurred, e.g., in the concept of the “war on global terrorism”. But there does appear to be a real relationship between the two and knowledge of its nature will be very welcome.

We find remarkable regularities and similarities in the size distribution of violent events in large number of modern conflicts: Colombia, Iraq, Afghanistan, Indonesia, Peru, Israel-Palestine, Northern Ireland, Casamance (Senegal), Sierra Leone, Uganda and El Salvador.

We organize and explain these findings for modern conflicts with a model of the coalescence and fragmentation of insurgent groups.

One can learn about the nature of an insurgency from studying the size distribution of casualties that it throws up.

Our findings greatly resemble those of Clauset, Young and Gleiditsch (2007) on the size distribution of casualties in terrorist attacks.

The links between terrorism and insurgency deserve deeper study.

We also find striking similarities in the timing of violent events across four modern conflicts: Colombia, Iraq, Afghanistan and Peru.

It seems that there are common and predictable patterns to the way that humans wage war that transcends particularities of time and place.

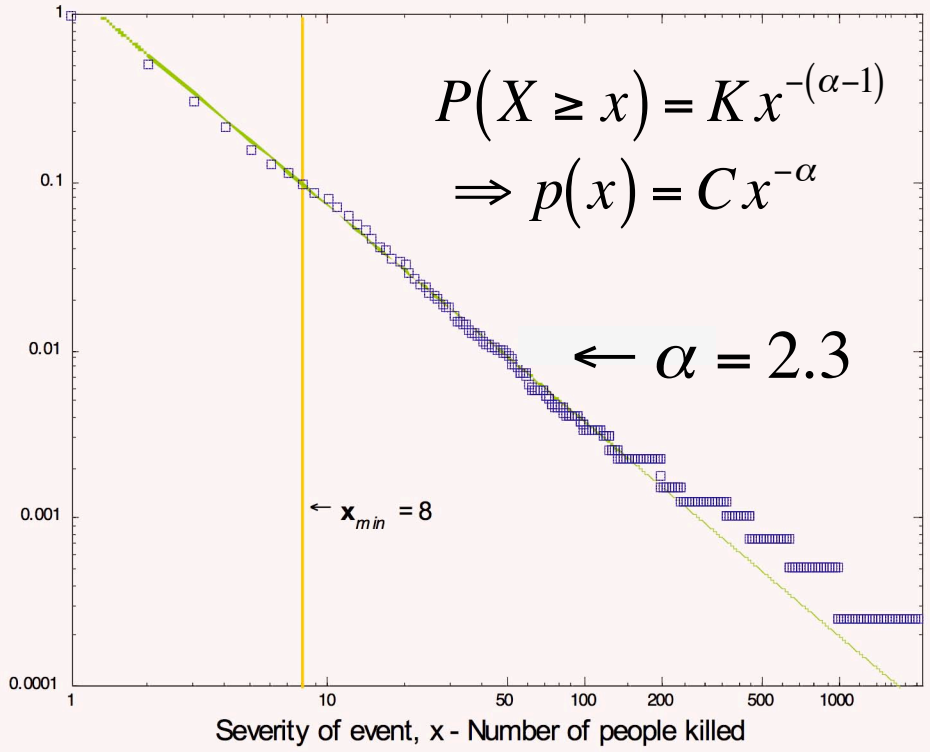
Common Patterns in Insurgency

$P(X \geq x)$

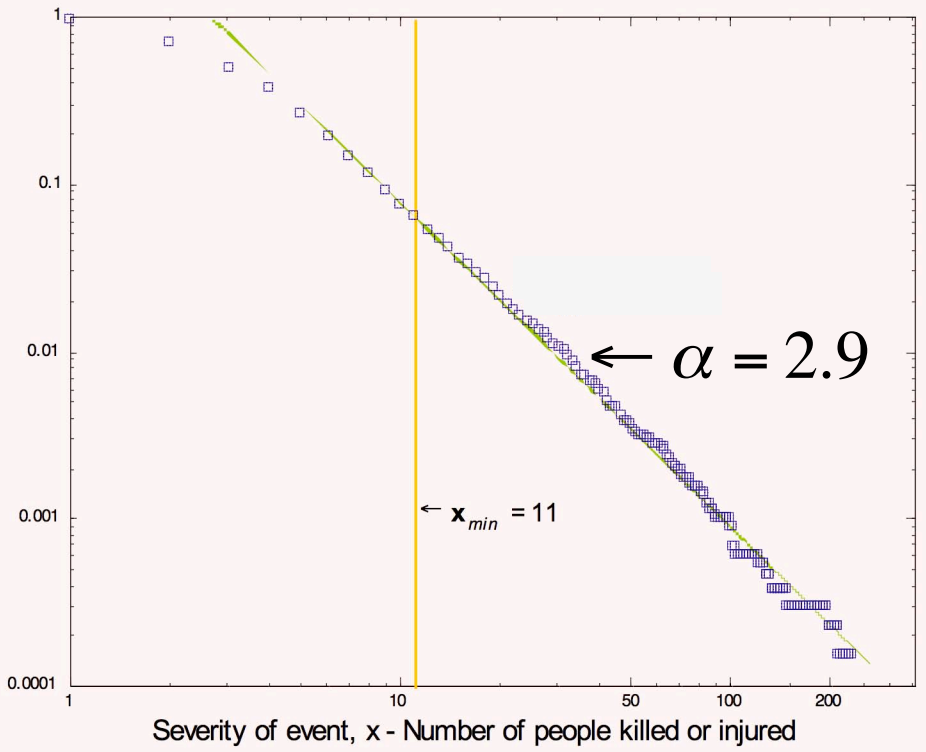
$$P(X \geq x) = K x^{-(\alpha-1)}$$

$$\Rightarrow p(x) = C x^{-\alpha}$$

$\leftarrow \alpha = 2.3$



$\leftarrow \alpha = 2.9$

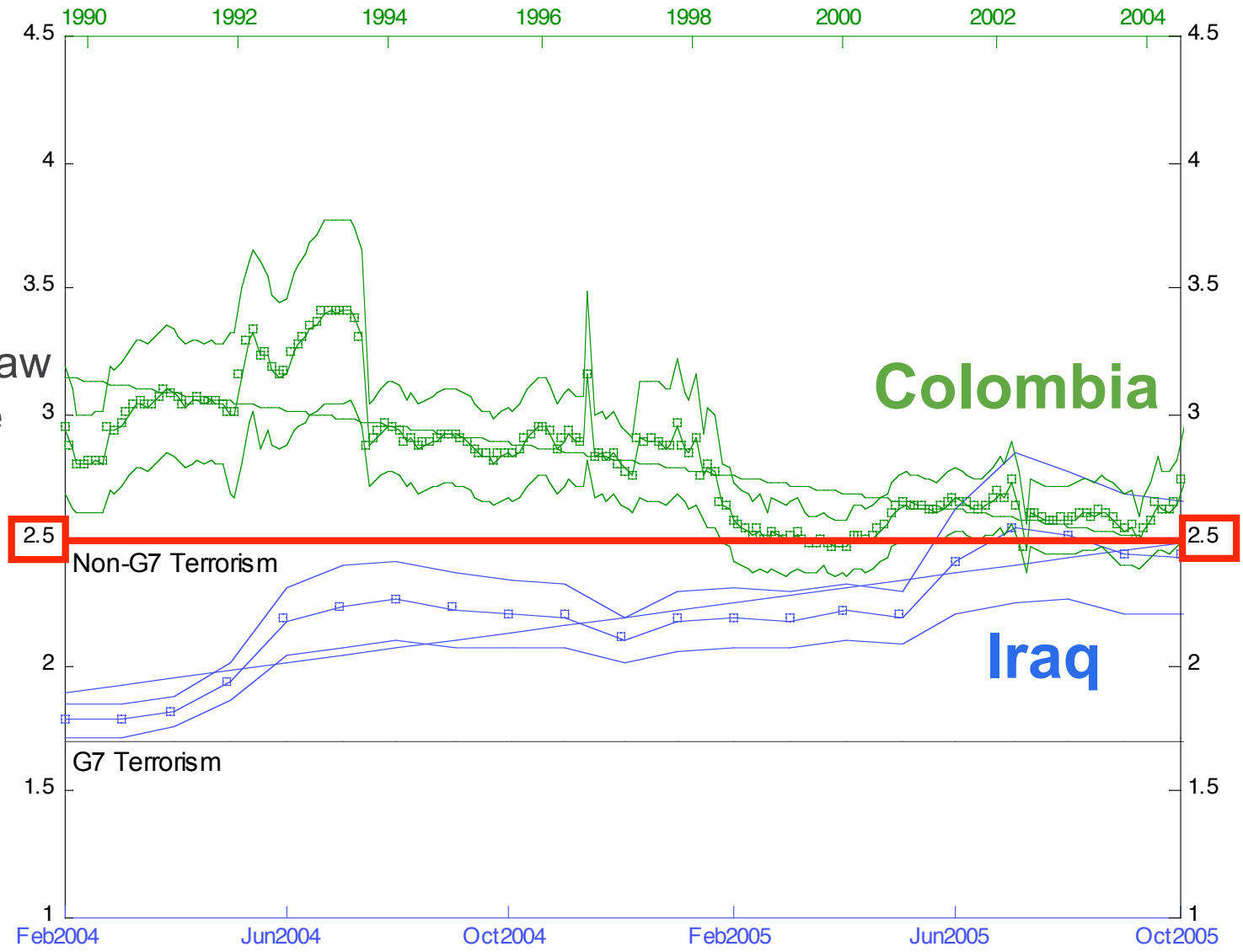


use max. likelihood + Kolmogorov-Smirnov

http://xxx.lanl.gov/abs/physics/0605035

Variation through time using a sliding time-window

power-law slope α



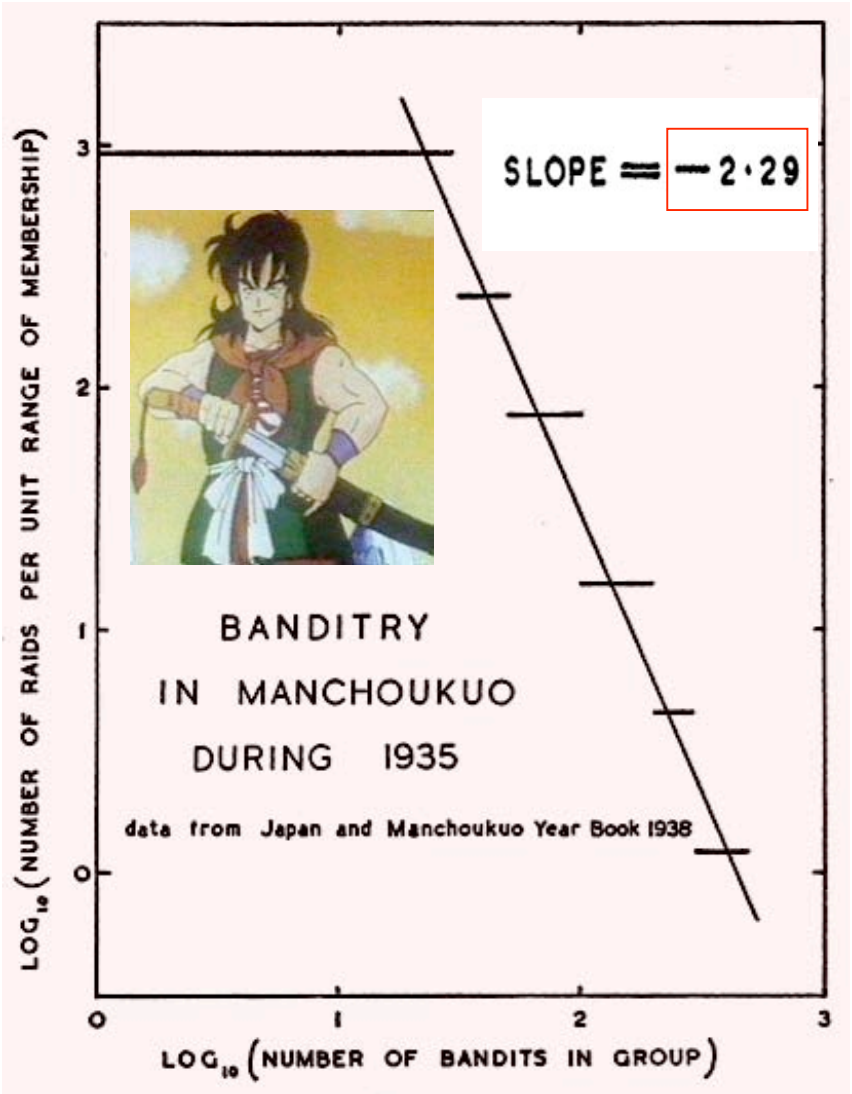
why?

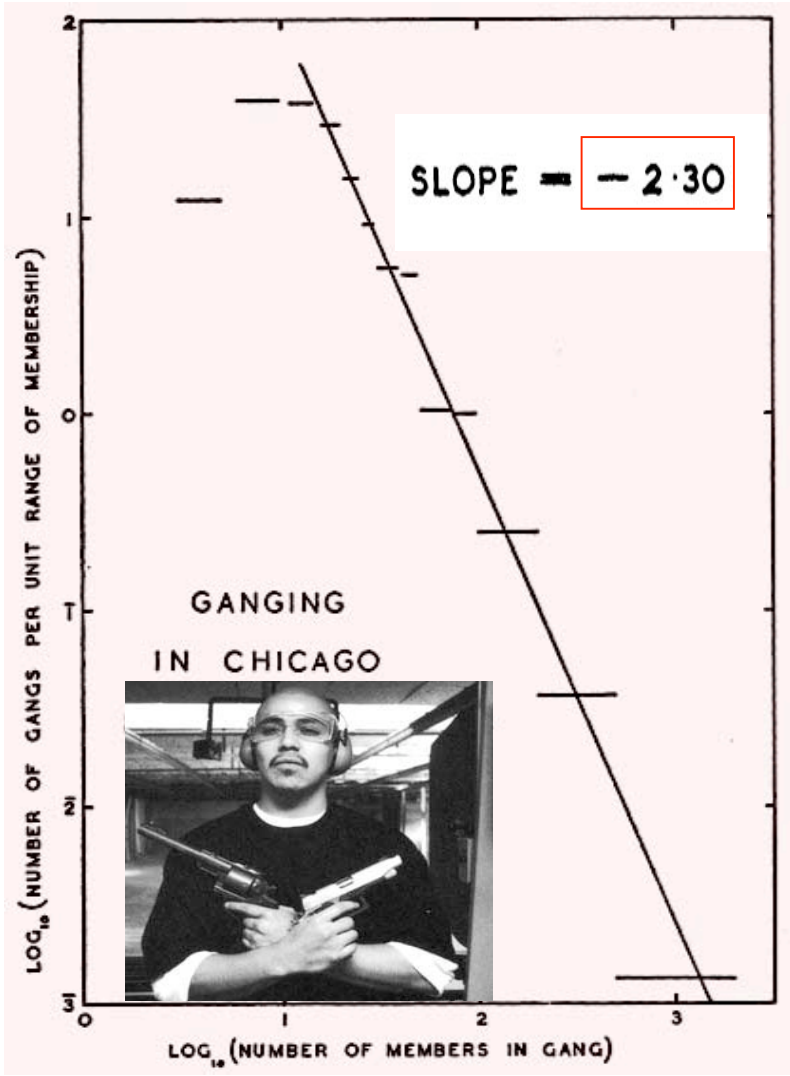
http://xxx.lanl.gov/abs/physics/0605035

Variation of the Frequency of Fatal Quarrels With Magnitude

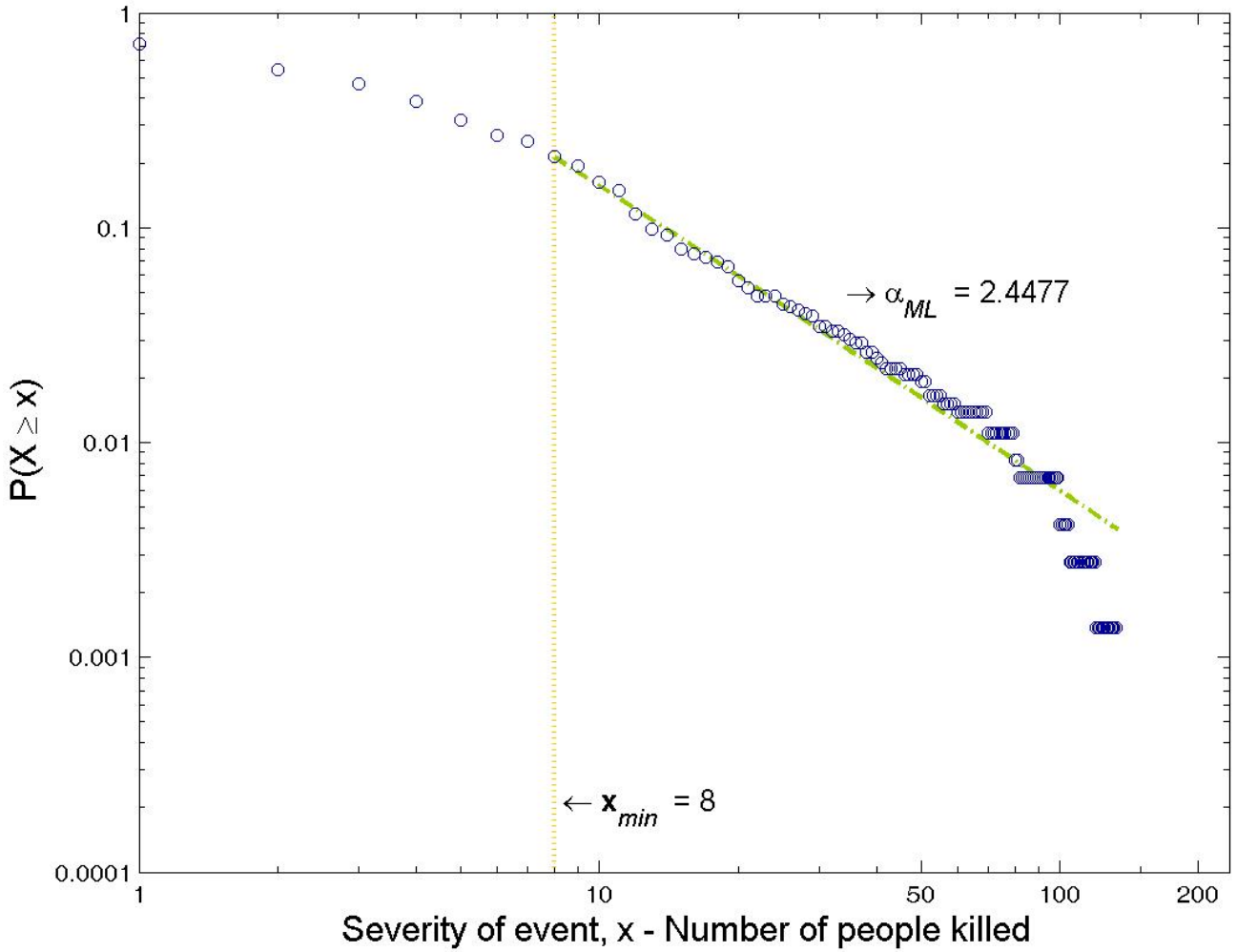
Lewis F. Richardson

Journal of the American Statistical Association, Volume 43, Issue 244 (Dec., 1948), 523-546.

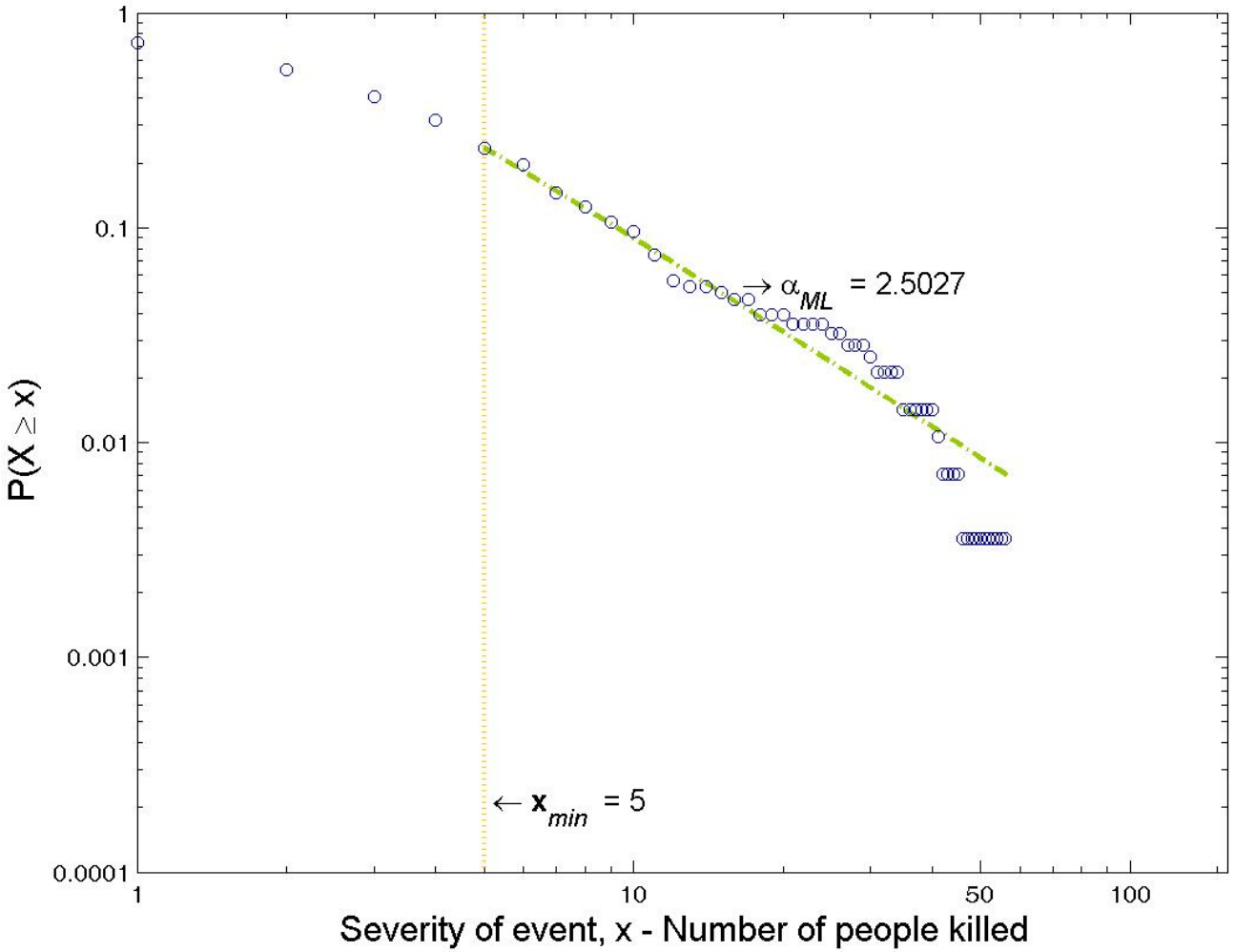




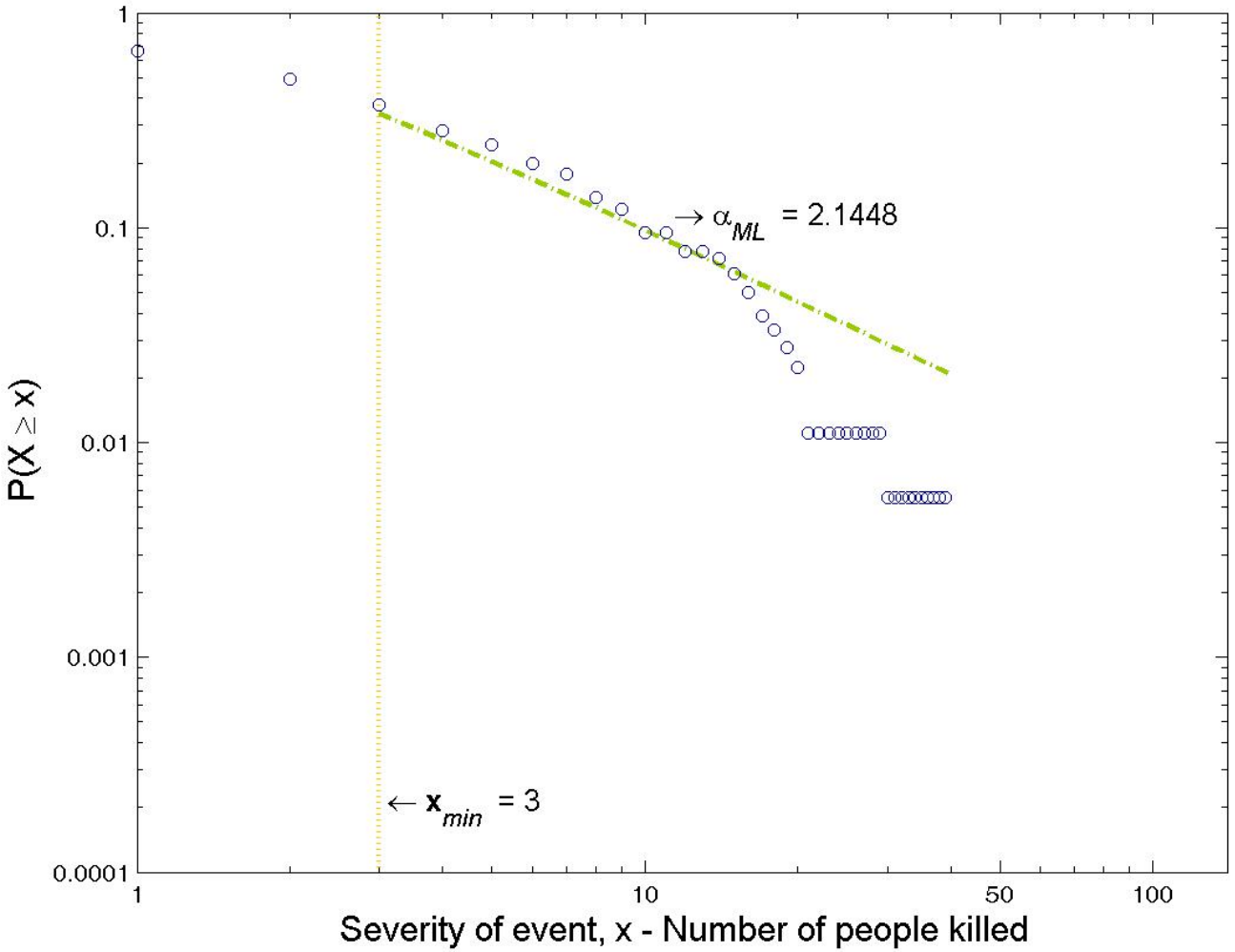
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Afghanistan



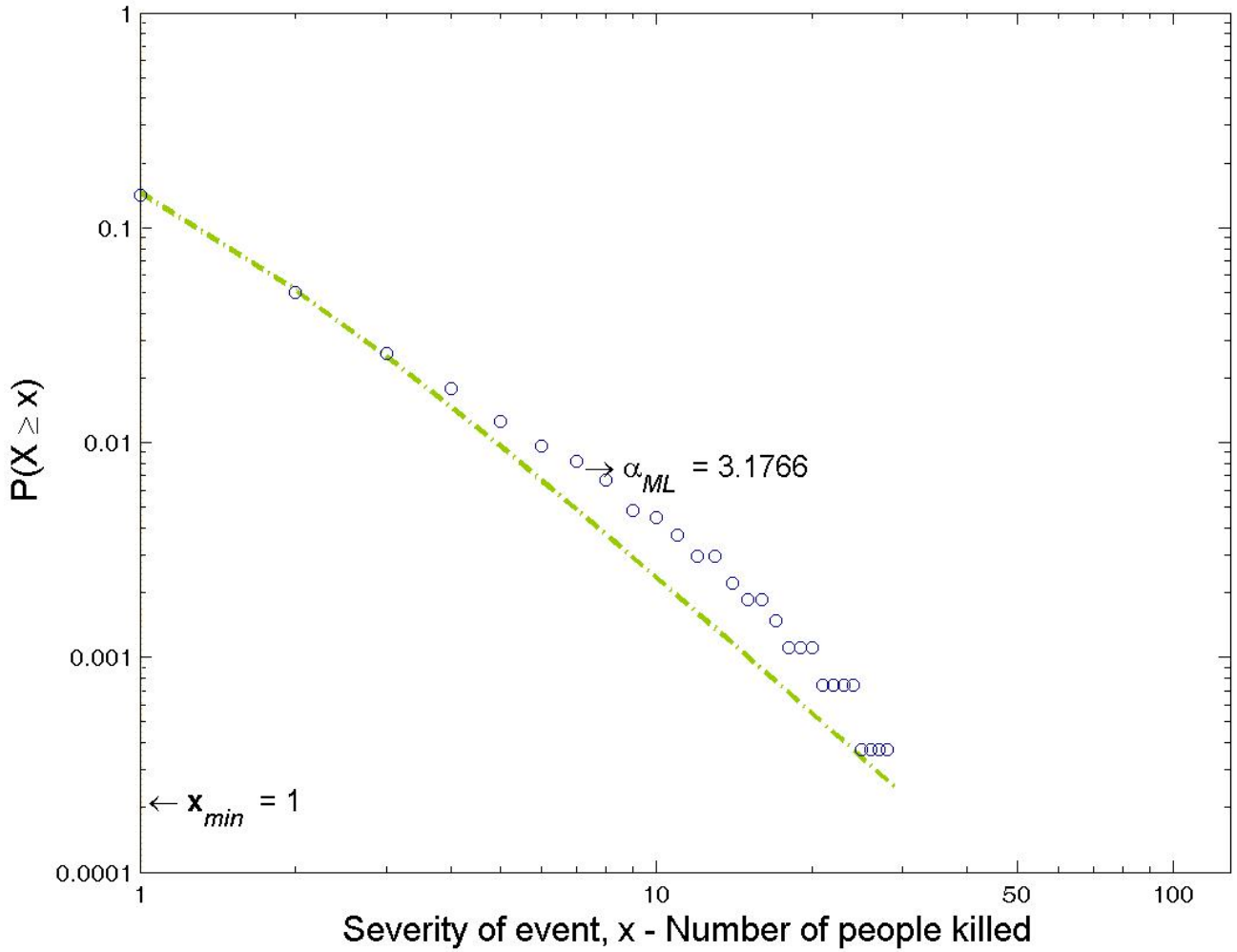
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Indonesia (separatist)



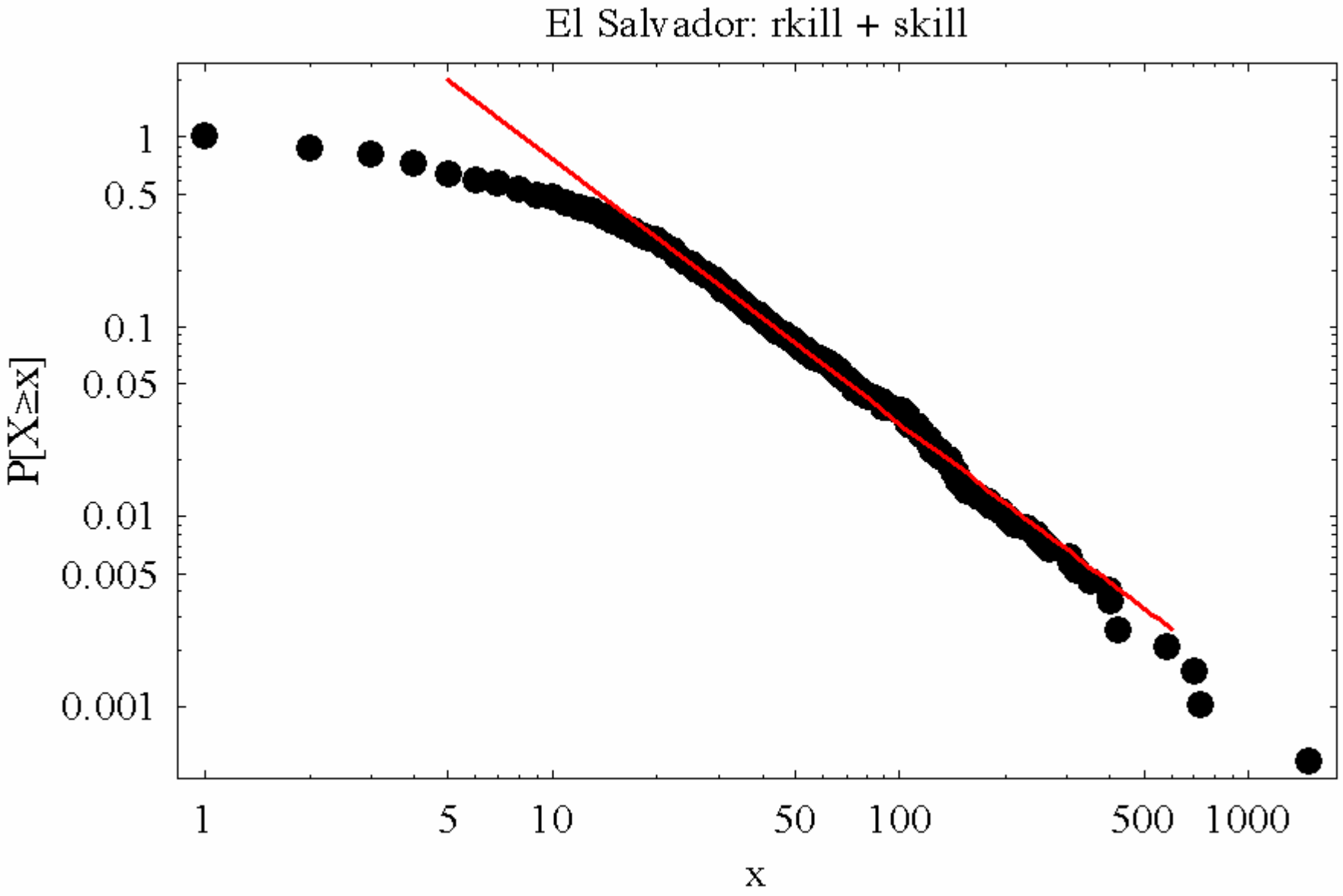
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Israel-Palestine Conflict



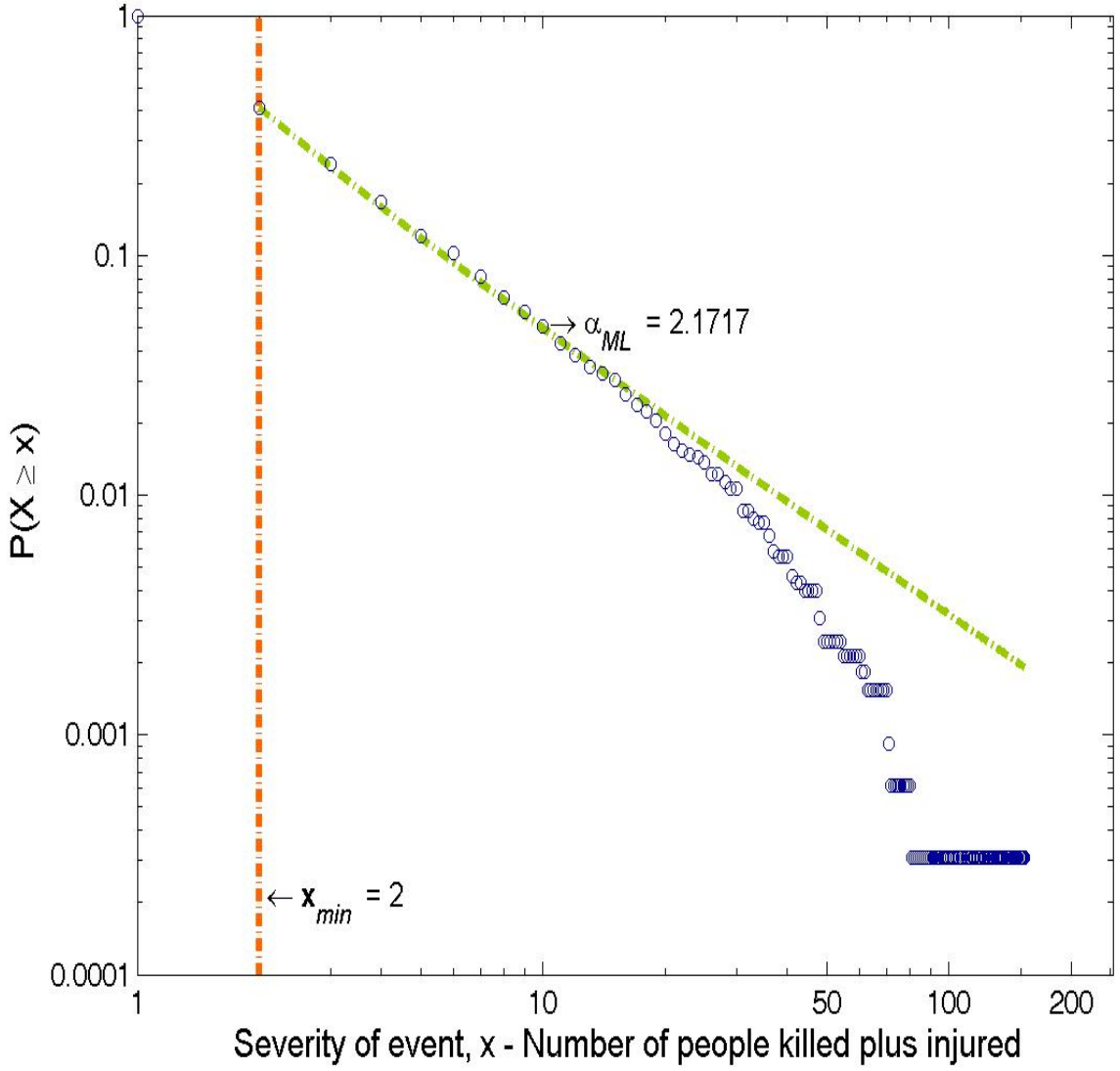
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Northern Ireland



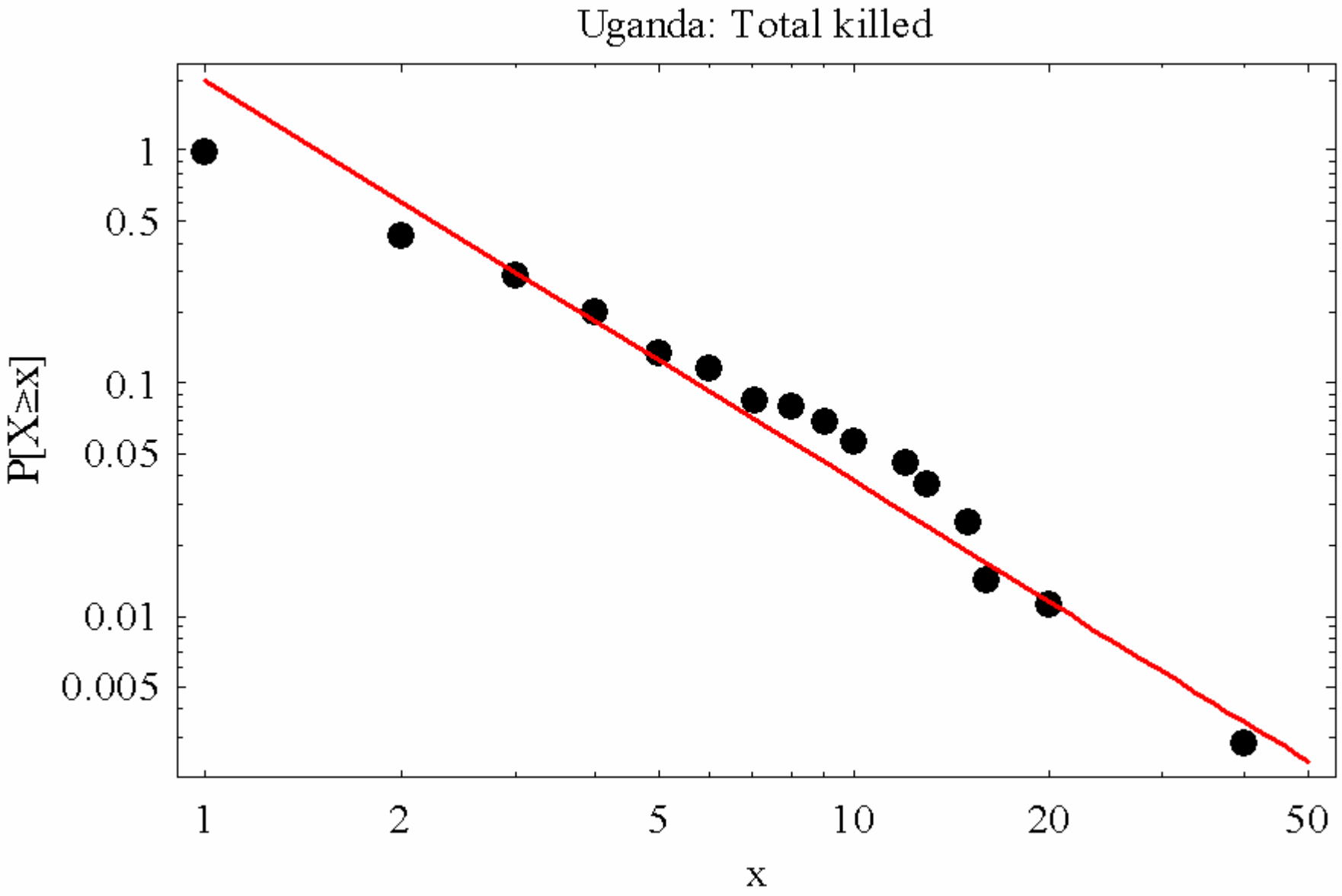
Database: EL SALVADOR
Variable: rkill + skill
Xmin: 20
Alpha: 2.39



Log-Log Plots for 1 – the Cumulative Distribution Function for the Severity of Events in Peru



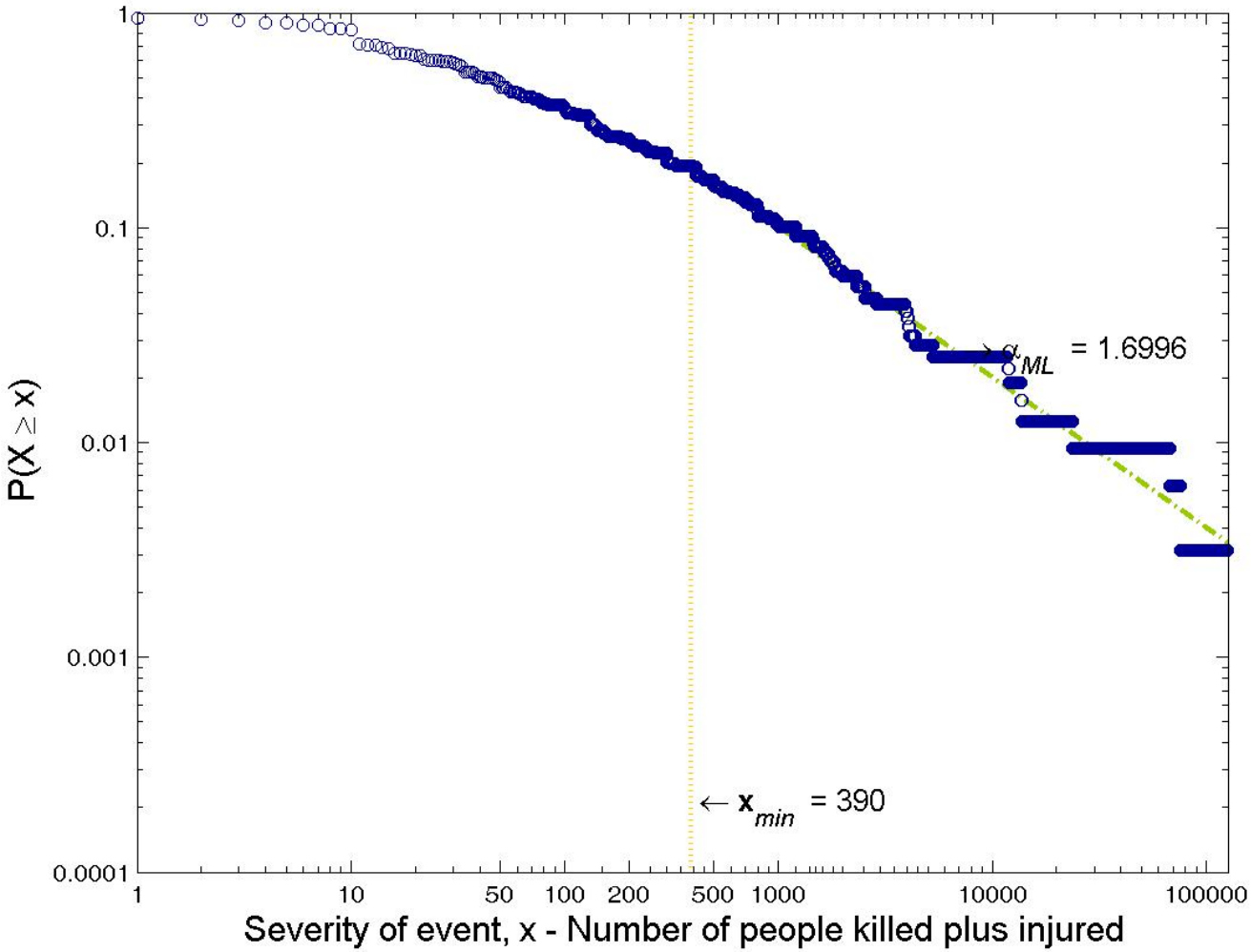
Database: UGANDA
Variable: Effects-Total Killed
Xmin: 5
Alpha: 2.71



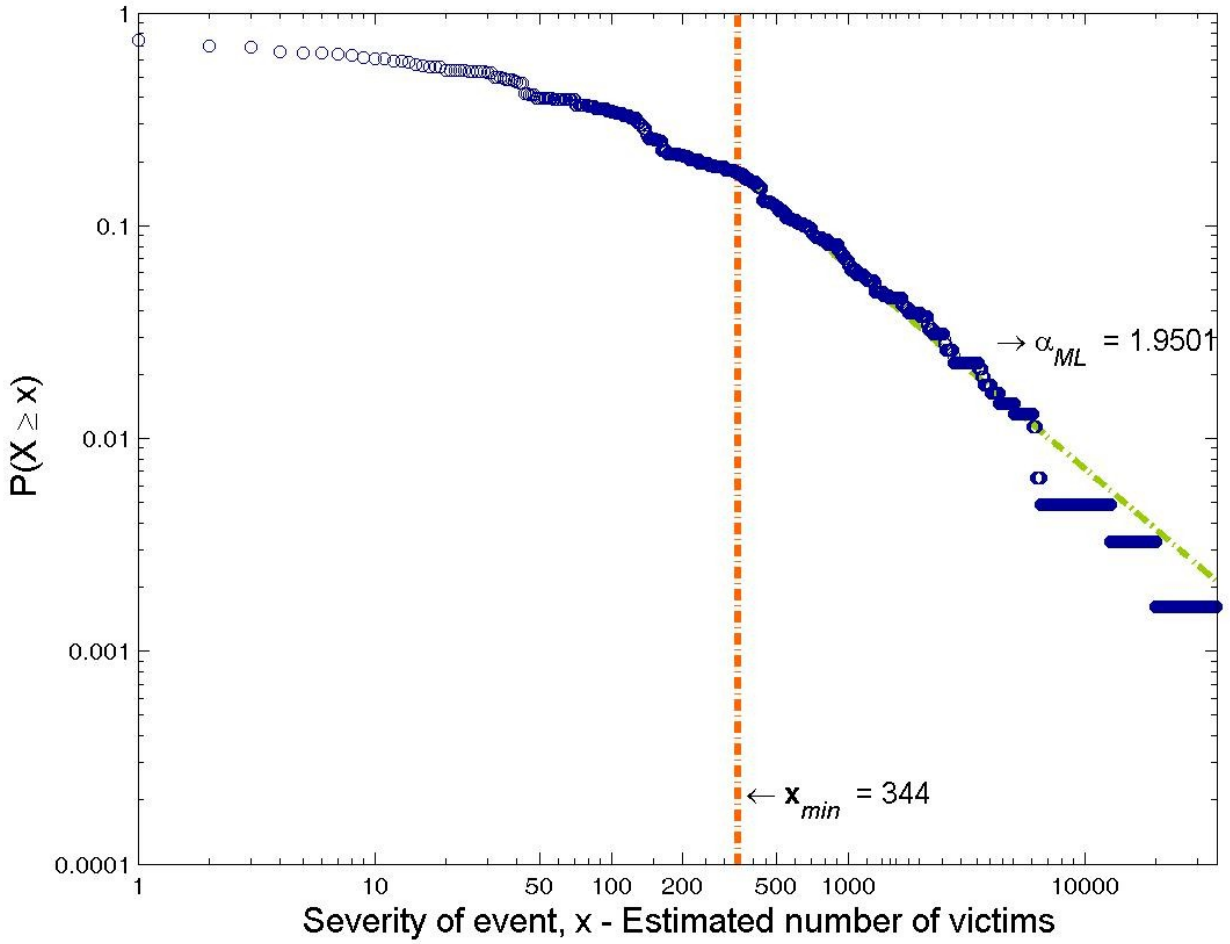

joe-ks.com

Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for US civil war

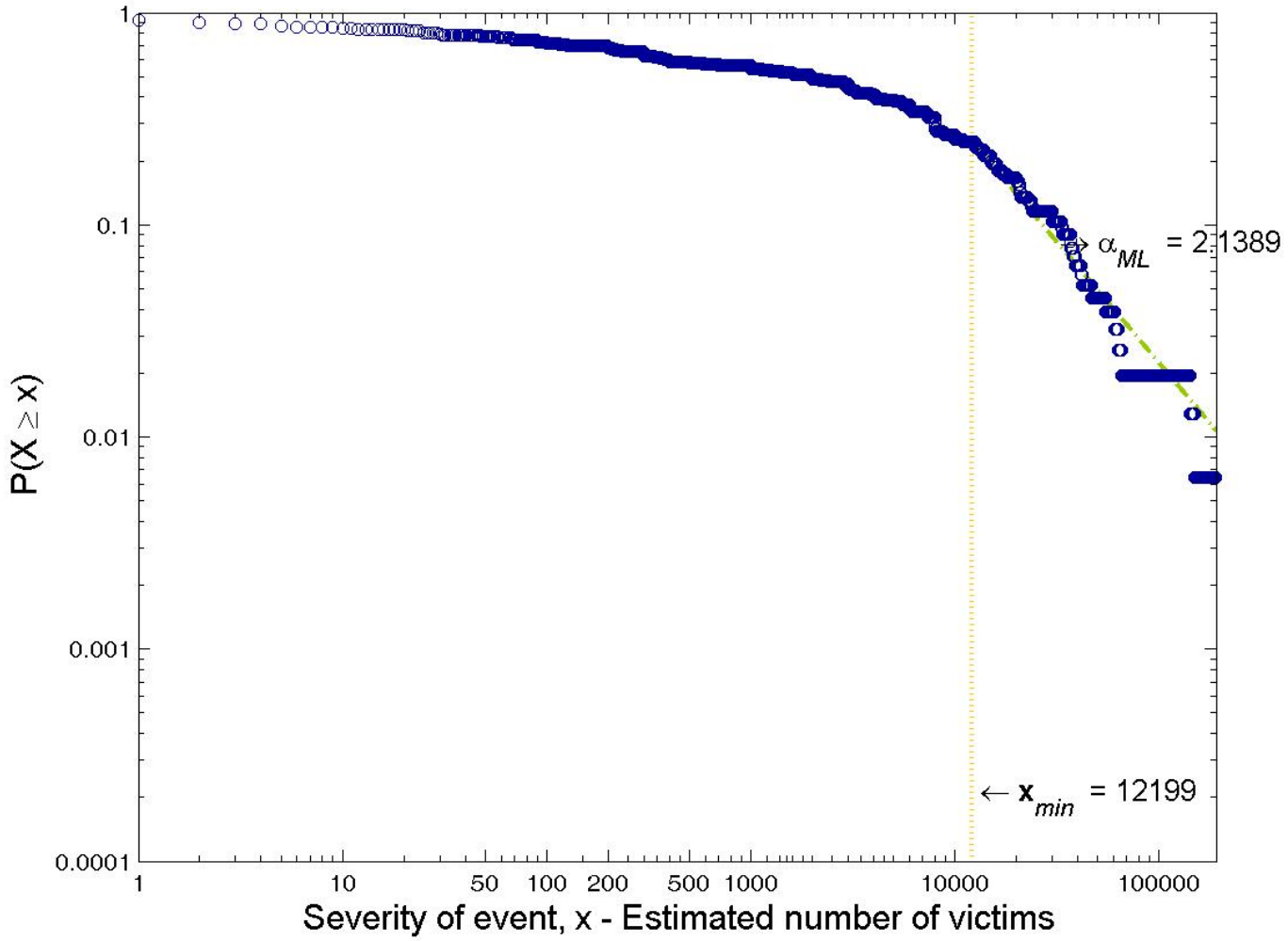
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Spanish civil war



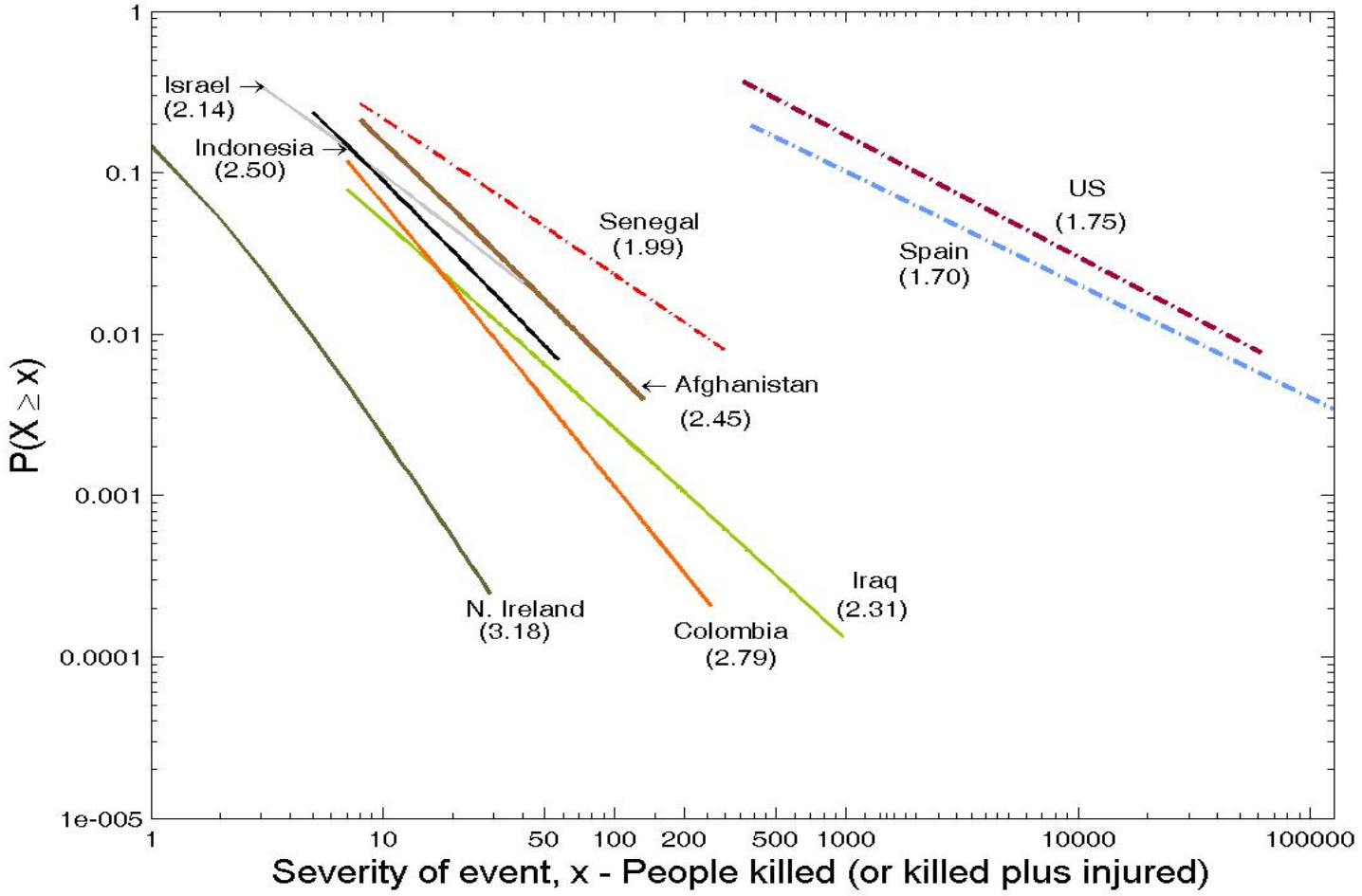
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Russian civil war



Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Rwanda-Genocide



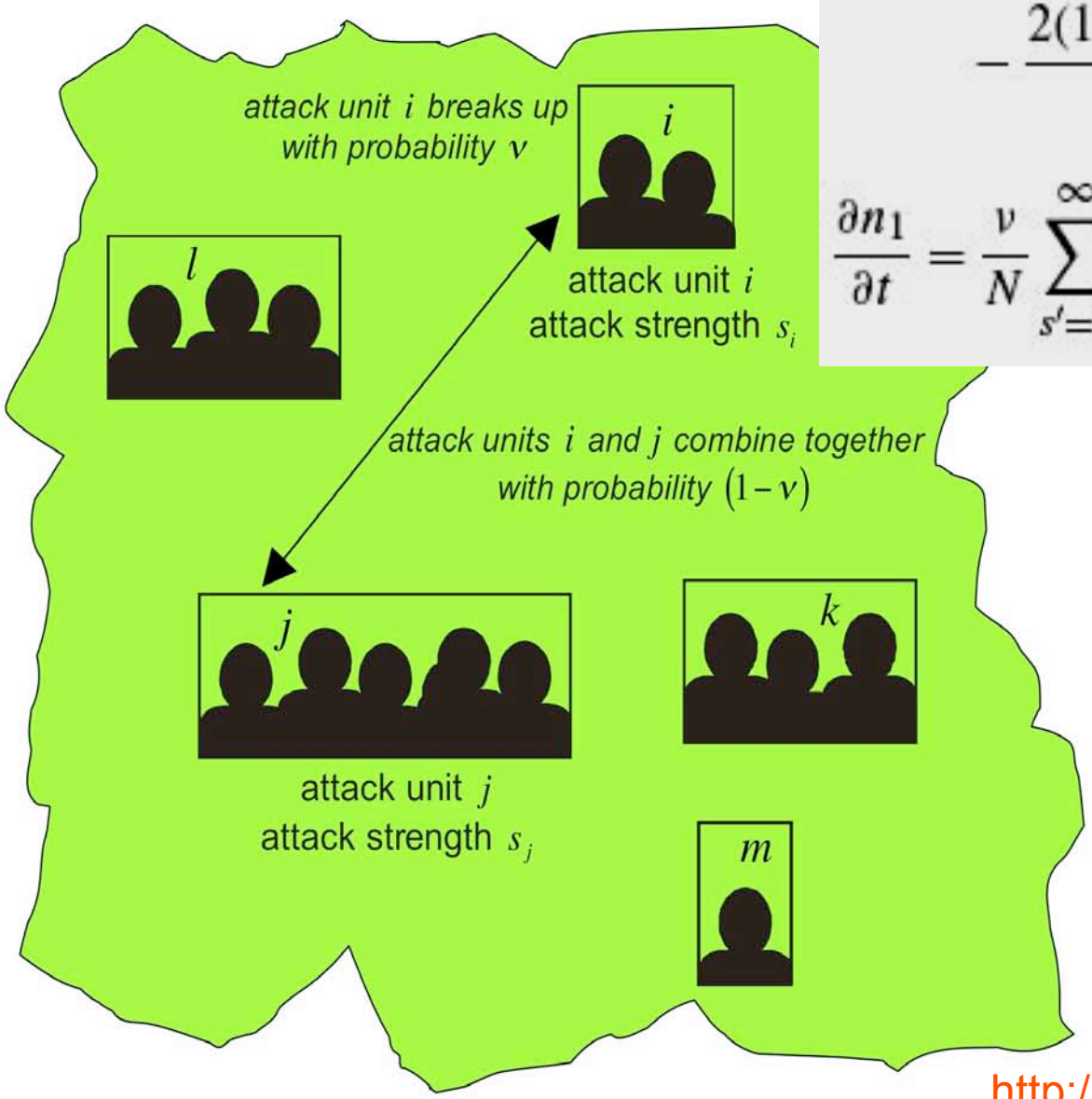
Log-Log plots of 1 – the Theoretical Cumulative Distribution Function for Severity of Events for old wars and new wars (without Iterate)



$$\frac{\partial n_s}{\partial t} = -\frac{\nu s n_s}{N} + \frac{(1-\nu)}{N^2}\sum_{s'=1}^{s-1} s' n_{s'}(s-s')n_{s-s'}$$

$$-\frac{2(1-\nu)\,s\,n_s}{N^2}\sum_{s'=1}^{\infty} s' n_{s'}, \quad \text{for } s \geq 2$$

$$\frac{\partial n_1}{\partial t} = \frac{\nu}{N}\sum_{s'=2}^{\infty}(s')^2 n_{s'} - \frac{2(1-\nu)n_1}{N^2}\sum_{s'=1}^{\infty} s' n_{s'}.$$



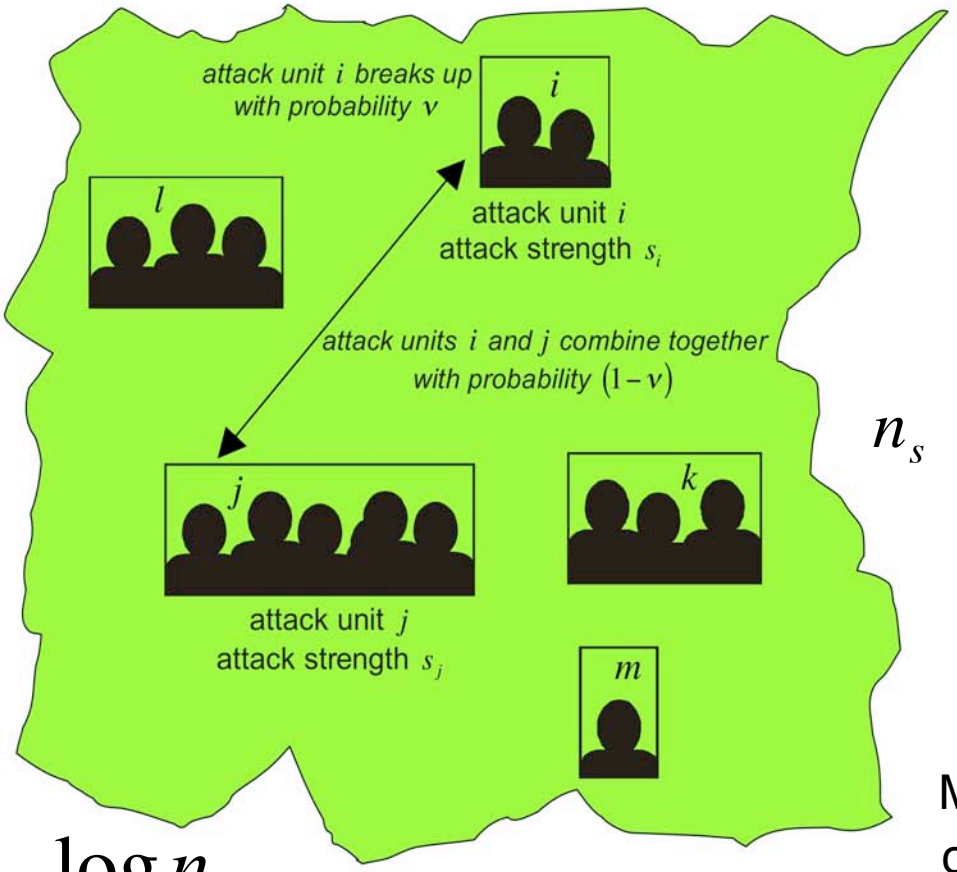
$$n_{s=1} = 1$$

$$n_{s=2} = 1$$

$$n_{s=3} = 2$$

$$n_{s=6} = 1$$

http://xxx.lanl.gov/abs/physics/0605035

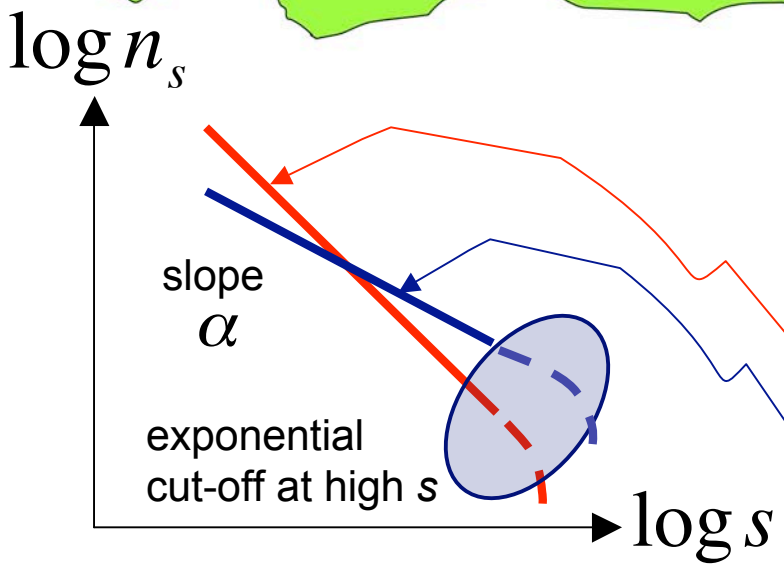


total attack strength = N

$$n_s \propto N \,.\, \exp -\left\{ s.\ln\left[\frac{\left(1-\frac{\nu}{2}\right)^2}{(1-\nu)}\right]\right\} .\; s^{-\frac{5}{2}}$$

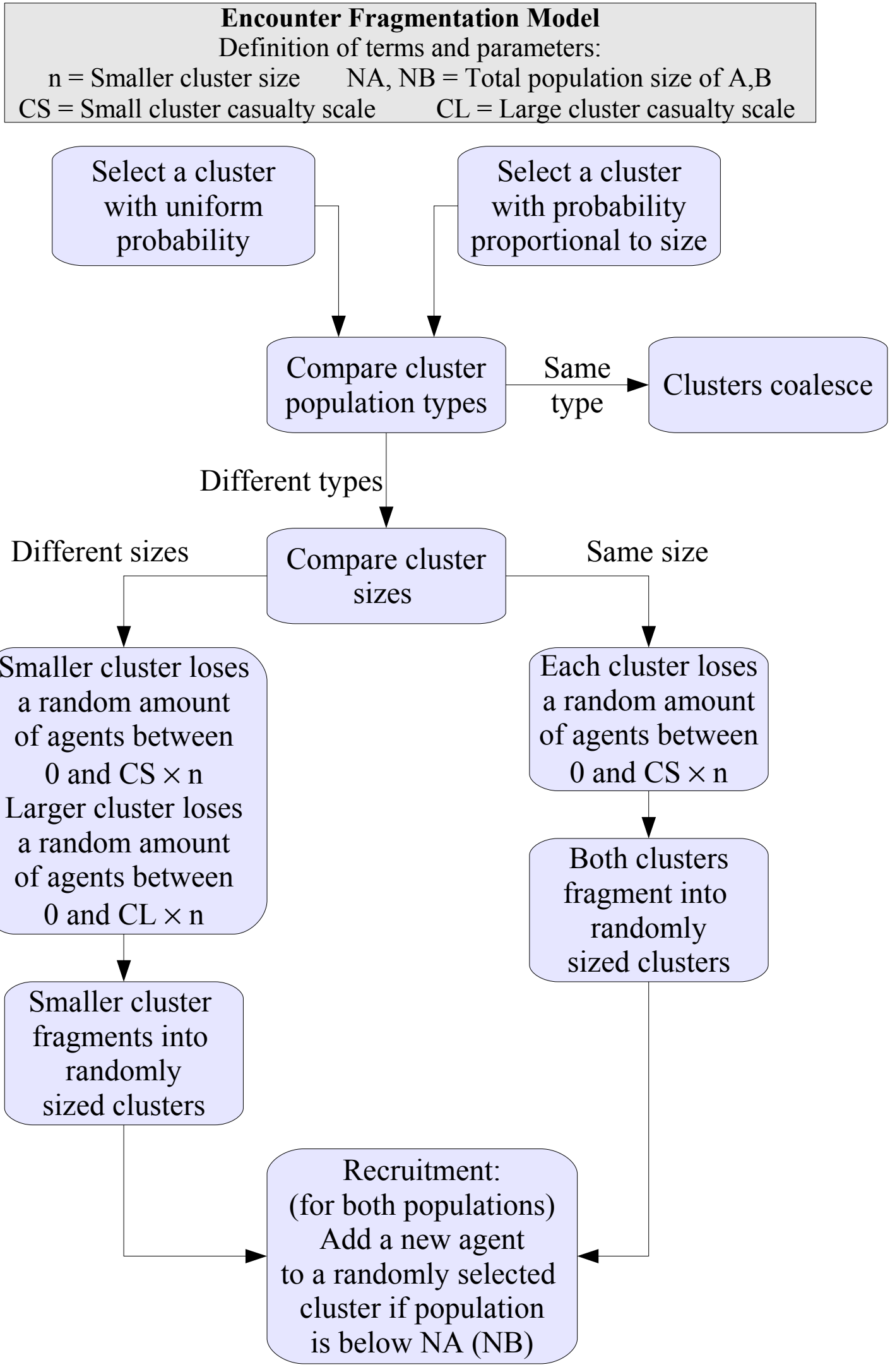
Modifying the probability of coalescence-fragmentation so that larger attack units are more rigid, gives

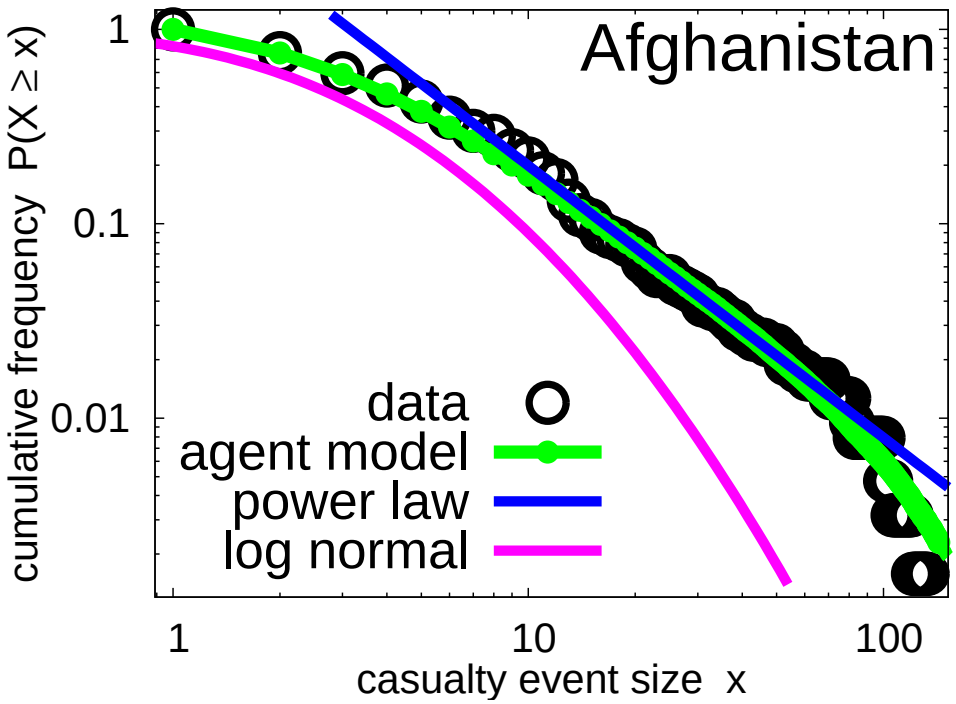
$$n_s \propto s^{-\left(\frac{5}{2}-\delta\right)}$$

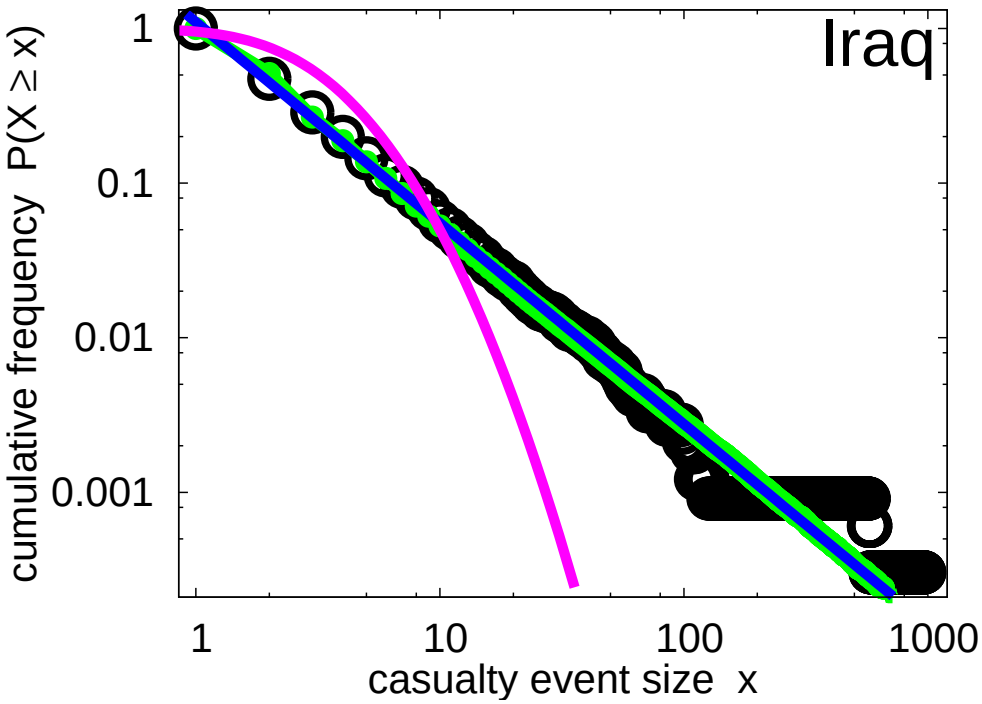


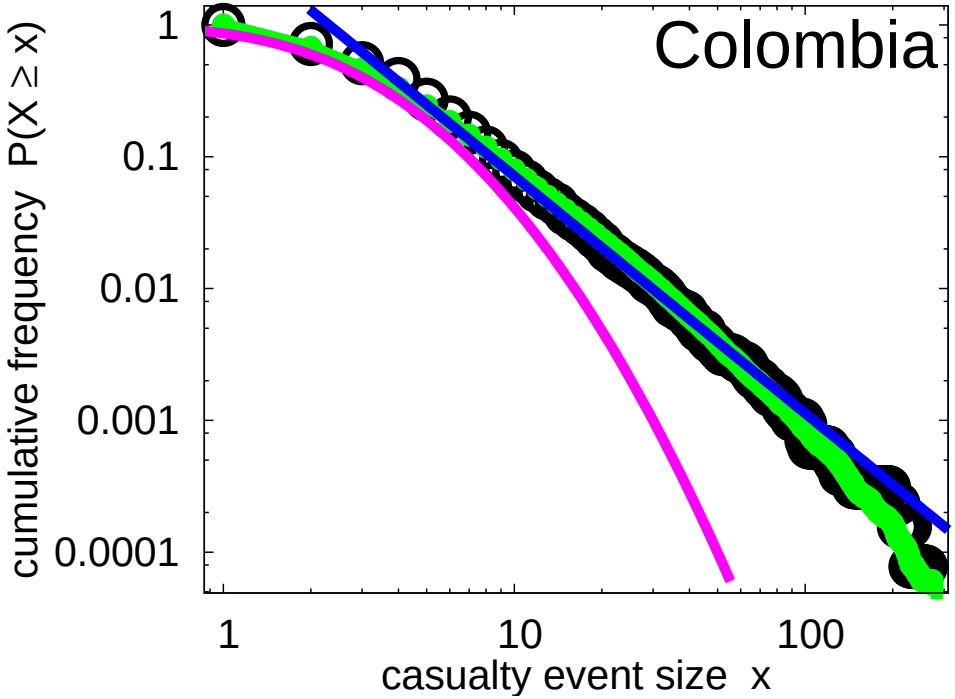
$\delta = 0$ corresponds to a power - law with $\alpha = 2.5$

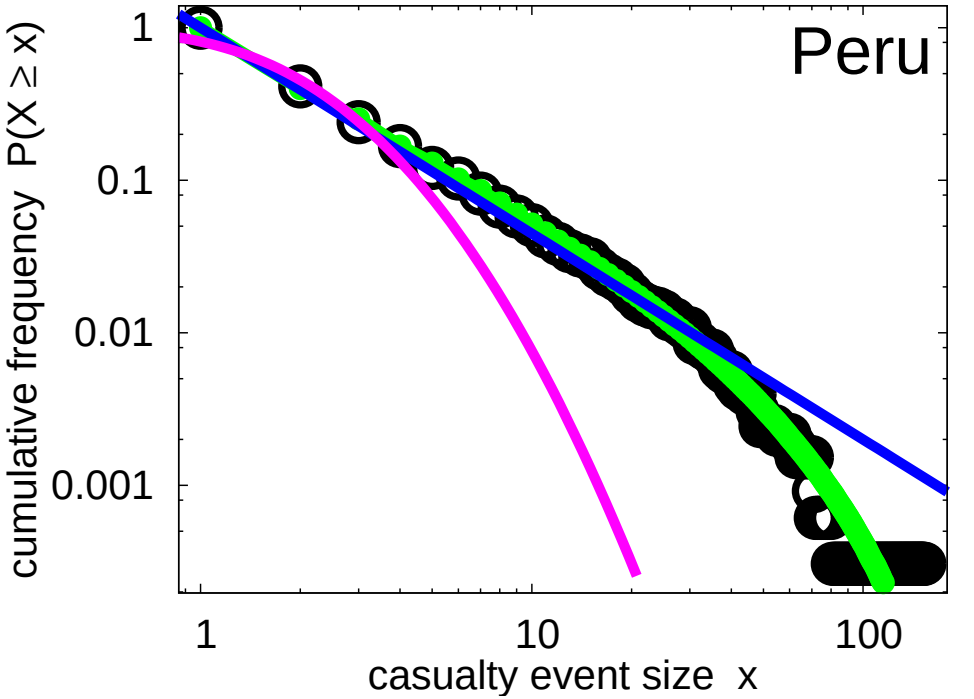
$\delta = 0.7$ corresponds to a power - law with $\alpha = 1.8$

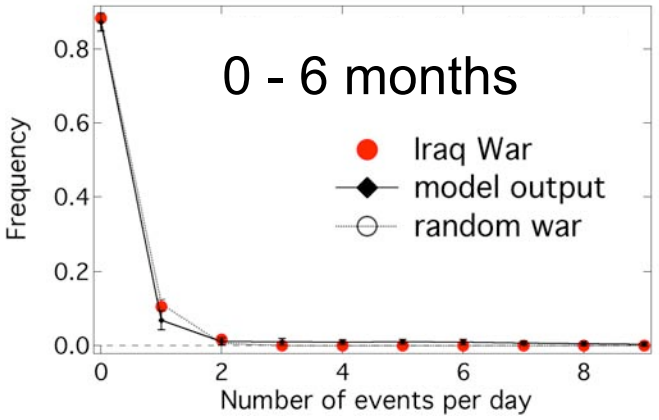

Encounter Fragmentation Model
Definition of terms and parameters:
n = Smaller cluster size NA, NB = Total population size of A,B
CS = Small cluster casualty scale CL = Large cluster casualty scale
Select a cluster with uniform probability
Select a cluster with probability proportional to size
Compare cluster population types
Same type
Clusters coalesce
Different types
Compare cluster sizes
Different sizes
Same size
Smaller cluster loses a random amount of agents between 0 and CS × n
Larger cluster loses a random amount of agents between 0 and CL × n
Each cluster loses a random amount of agents between 0 and CS × n
Smaller cluster fragments into randomly sized clusters
Both clusters fragment into randomly sized clusters
Recruitment:
(for both populations)
Add a new agent to a randomly selected cluster if population is below NA (NB)

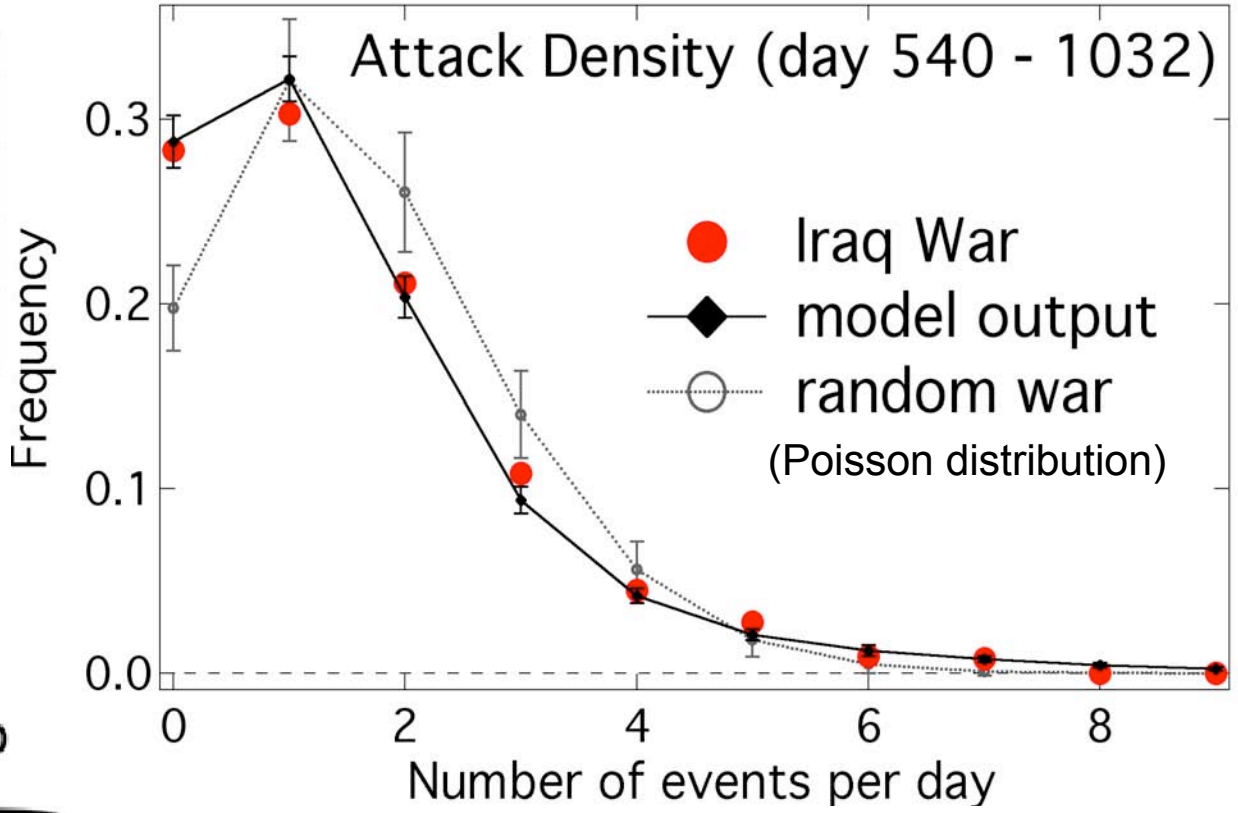

Afghanistan
cumulative frequency P(X ≥ x)
casualty event size x
data
agent model
power law
log normal
1
0.1
0.01
1
10
100

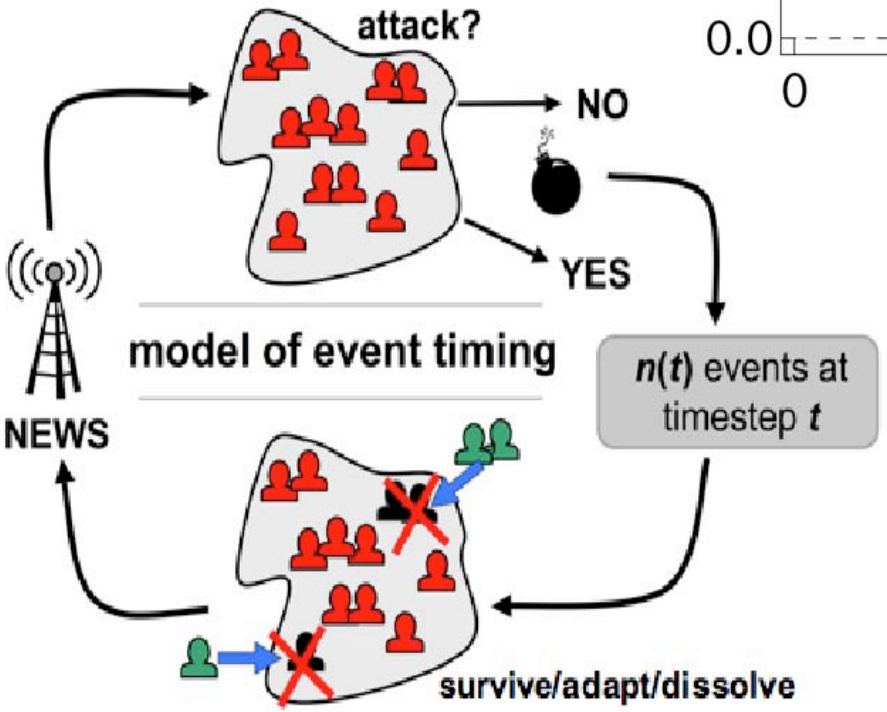

Iraq
cumulative frequency P(X ≥ x)
casualty event size x
1
0.1
0.01
0.001
1
10
100
1000


Colombia
cumulative frequency P(X ≥ x)
casualty event size x
1
0.1
0.01
0.001
0.0001
1
10
100


Peru
cumulative frequency P(X ≥ x)
casualty event size x
1
0.1
0.01
0.001
1
10
100







. . . and similar results for the conflicts in Colombia, Afghanistan, etc..

Conclusion

We find extraordinary similarities in the size distribution of violent events and the timing of insurgent/guerrilla attacks in Iraq and Colombia.

Iraq and Colombia differ strongly in a number of highly visible ways.

- Colombia has “rough terrain”, i.e., extensive mountains and jungles, completely contrary to Iraqi geography.
- Iraq has strong ethnic/religious cleavages, completely unlike Colombia.
- The ideologies of Colombia’s insurgent groups, more or less Marxism, differ strongly from the ideologies of the insurgent groups in Iraq.

But a common underlying logic renders both conflicts structurally almost identical along two key dimensions.

Moreover, we get strikingly similar patterns on the size distribution of events for Afghanistan, Indonesia, Israel-Palestine, Nothern Ireland, Senegal (Casamance), Sierra Leone, El Salvador, Uganda and Peru, i.e., there seems to be a very reliable pattern to modern insurgency.

These patterns are also very similar to the size distribution of casualties in terrorist events.

So “Modern War” seems to be a valid category of analysis.

Geography, ethnicity, religion and ideology are not unimportant - various wars and global terrorism do differ and good analysis must make reference to local specifics.

But there seems to be an underlying logic to insurgency and terrorism that should be central to the study of modern conflict.

There is a potentially high payoff to in-depth, micro-level studies of individual wars combined with comparative work ranging across these wars and terrorism.