

**A DISCUSSION OF “ESTIMATING THE HISTORICAL AND FUTURE PROBABILITIES OF LARGE TERRORIST EVENTS”, BY AARON CLAUSET AND RYAN WOODARD**

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**1. Introduction.** The terrorist attacks in the United States on September 11, 2001 appeared to be a harbinger of increased terrorism and violence in the 21<sup>st</sup> century, bringing terrorism and political violence to the forefront of public discussion. Questions about these events abound, and “Estimating the Historical and Future Probabilities of Large Scale Terrorist Event” (Clauset and Woodard, 2013) asks specifically, “how rare are large scale terrorist events?”, and in general, encourages discussion on the role of quantitative methods in terrorism research and policy and decision making.

Answering the primary question raises two challenges. The first is identifying terrorist events. The second is finding a simple yet robust model for rare events that has good explanatory and predictive capabilities. The challenges of identifying terrorist events is acknowledged and addressed by reviewing and using data from two well-known and reputable sources: the Memorial Institute for the Prevention of Terrorism-RAND database (MIPT-RAND) (Memorial Institute for the Prevention of Terrorism) and the Global Terrorism Database (GTD) (National Consortium for the Study of Terrorism and Responses to Terrorism (START), 2012; LaFree and Dugan, 2007). Clauset and Woodard (2013) provides a detailed discussion of the limitations of the data and the models used, in the context of the larger issues surrounding terrorism and policy.

The models proposed fit tail probabilities for power-law and alternative models based data from both the MIPT-RAND database and the GTD. These models are thoroughly explained and well executed, as are the results. The predictive capabilities and forecasts, along with consideration of the influence of exogenous factors such as attack type, target, and economic development are considered, presented, and discussed clearly, affirming the robustness of the methods. The authors estimate that, in the 40 year period since 1968, there is an 11–35% chance of a terror event at least the size of the September 11, 2001.

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**2. Comments.** Terrorism and political violence are complex phenomenon of human behaviour (Horgan and Boyle, 2008; Taylor and Horgan, 2006), and rely on the fear and uncertainty surrounding rare events to create a disproportionate effect that is difficult to directly measure (Crenshaw, 1986; Waugh, 1983; Crenshaw, 1981; Thornton, 1964). In this context, making predictions about human behaviour is a tricky business, and interpreting an 11–35% probability for an extreme event illustrates part of this problem. An 11–35% probability sounds ominous, but, over a 40-year period, that translates to a seemingly innocuous daily probability around 1 in 100,000. The temptation is to interpret an 11–35% chance as near certainty, and a 1 in 1,000,000 chance as near impossibility. Neither of these time scales for interpretation is useful, and belie a further problem with considering large scale historical trends when making predictions about rare events using only previous history.

For example, In 224 years there have been 44 US Presidents; 4 (9%) were assassinated. The first was in 1865; in the period between 1865 and 1901, 3 of the 10 US Presidents were killed in office (30%). Since 1901, only 1 (5%) US President was assassinated. Making a forecast in 1864, and relying solely on historical data, the expected number of US Presidential killed in office in the ensuing 40 years would be 0. In 1902 looking back at the previous 40 years, there would be an expected 5 US Presidents killed in office during the 20<sup>st</sup> century. This example is hardly definitive, but it illustrates the point that rare events involving humans are difficult to predict.

While Clauset and Woodard (2013) (rightfully) does not address this, it does address the caveats of its results in great detail, which provide the basis for raising the question, “what is the role of quantitative methods in terrorism research and in assisting policy and decision makers?”

In Lum, Kennedy and Sherley (2006), a systematic review of the literature reveals a significant increase in research on terrorism and counter-terrorism efforts since 2001, though only a small minority apply quantitative methods. Despite this, there are some notable examples, both included in Lum, Kennedy and Sherley (2006) and after. Enders and Sandler (1993) uses vector auto-regression (VAR) and an interrupted time series approach to model the effects counter-terrorism policies on transnational terrorism from 1968 through 1988. Dugan, LaFree and Piquero (2005) and Dugan (2011) use Cox proportional hazard models, and their variants, to analyse the effects of interventions on hijackings, and IRA terrorist activity in Northern Ireland (LaFree, Dugan and Korte, 2009). Arce M and Sandler (2005) proposes a game theoretic frame work for modelling the interactions between terrorists and counter-terrorism efforts, and Sapperstein (2008) and Minami and Ku-

[cik \(2009\)](#) suggest modelling the interaction between terrorists and counter-terrorism efforts using a dynamic linear modelling approach. Recent research shows that patterns of terrorist activity are well modelled using a cluster process interpretation of self-exciting process models ([Hawkes, 1971b,a](#); [Hawkes and Oakes, 1974](#)). Self-exciting models have been applied to airline hijackings ([Holden, 1986, 1987](#)), insurgent activity in Iraq ([Mohler, 2010](#); [Mohler et al., 2011](#); [Lewis et al., 2011](#); [Lewis and Mohler, 2012](#)), and terrorism data from Southeast Asia and Colombia ([Porter and White, 2012](#); [White, Porter and Mazerolle, 2013](#); [White and Porter, 2013](#)).

One important aspect of modelling terrorism that is not explicitly stated, but is implicit in [Clauset and Woodard \(2013\)](#), is the notion of different processes for different levels and types of terrorist activity. This idea, illustrated by the fitting of tail probabilities for rare events, can help explain the relative scarcity and sporadic nature of terrorism ([Porter and White, 2012](#); [Raghavan, Galstyan and Tartakovsky](#)). This extends to a complex, unobserved latent process as a model for the occurrence, and resulting characteristics, of terrorist events. The capability to model and describe complex unobserved processes is well-established and is an ongoing area of significant research in the mathematical and statistical sciences. The advent of newly available data sources, like the GTD and the MIPT datasets, and increased awareness outside of the field of terrorism studies creates an opportunity for mathematicians and statisticians to work more closely and in conjunction with experts from academia, and policy and decision making roles to create new models and methods to expand our understanding of terrorism and terrorist activity.

For the quantitative researcher, the utility of these models is obvious. As exploratory tools they can reveal heretofore unobserved patterns in activity. As confirmatory tools they can be used to test specific ideas and theories about these patterns. The challenge for the quantitative researcher is to understand their place in the field of terrorism studies as a whole, assisting in the building of sound knowledge, and aiding policy and decision makers.

**3. Conclusion.** Terrorism studies itself faces an important epistemological quandary, and there is an ongoing debate over whether terrorism—however it is understood—should be analysed within its individual context or whether it can be assessed on a more universal level, across space and time ([Silke, 2001](#); [Weinberg, Pedahzur and Hirsch-Hoefler, 2004](#); [Duyvesteyn, 2004](#); [Neumann, 2009](#)). As a result, the role of quantitative (particularly statistical) methods in terrorism studies is often lost in this debate. The argument of terrorism scholars is that individual terrorists and acts of ter-

rorism are too unique to benefit from statistical analysis. The statistical perspective is that the purpose of the statistical analysis of data is to make inferences about the underlying process or *context* that produce the data, not specific observations. Or, in the words of Sherlock Holmes:

“..while the individual man is an insoluble puzzle, in the aggregate he becomes a mathematical certainty. You can, for example, never foretell what any one man will do, but you can say with precision what an average number will be up to. Individuals vary, but percentages remain constant.”

While Holmes is a fictional character, his statement neatly sums up the the miscommunication that often occurs between statisticians non-statisticians. Terrorism studies scholars and policy and decision makers want (and rightly so) predictions at a very fine level, down to the individual’s behaviours. Statisticians should agree that this is often beyond the reasonable expectation of their methods. But statistical and quantitative methods can contribute understanding and combating terrorism by identifying and measuring specific differences *between* contexts (i.e. countries, regions, or groups). These can be analysed to identify contextual differences and explore *why* they exist, providing a deeper understanding of terrorism and political violence.

Statistical methods do not intend to provide definitive answers; their results, couched in uncertainty, should inform, not make decisions. In order to advance the understanding of terrorism, the benefits and limitations of quantitative methods need to be clearly understood, and it is the role and duty, of the expert to clearly and effectively communicate the benefits and limitations of quantitative methods to qualitative researchers and policy and decision makers.

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