

Using Quantitative Analysis in Support of Military Intelligence

P. Dobias, P. Eles
DRDC CORA

J. Schrodén
CNA

J. Wanliss
Presbyterian College

28th International Symposium on
Military Operational Research
29 Aug-2 Sep 2011, UK



Outline

- Context
- Data sources/considerations
- Traditional methods
 - Trends
 - Seasonality
 - Forecasting violence
 - Assessing enemy
- Fractal nature of conflicts
 - Implication of data structure
 - Multi-fractal forecasting
 - Current status of research



Context

- Providing information to enable mission planning:
 - Enemy intent/capabilities
 - Terrain/Environment
 - Human terrain, culture, social structure
- How to **conduct assessment** in the environment characterized by:
 - **Lack of** cultural/social/tribal/religious understanding
 - **Insufficient sources** of varying reliability
 - Incoherent and mutually competing enemy groups

Data sources

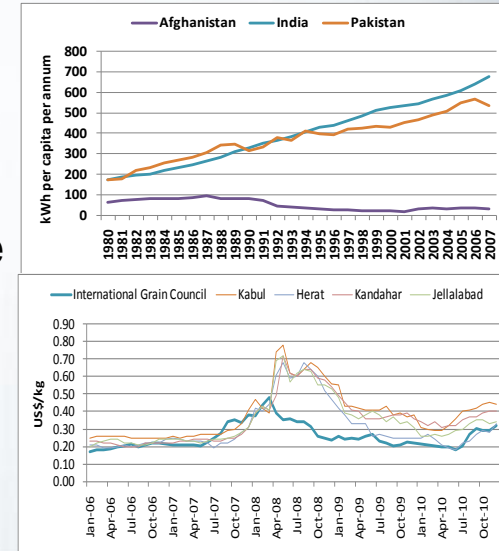
- Demographics

Afghan Central Statistical Office collects and disseminates variety of population stats



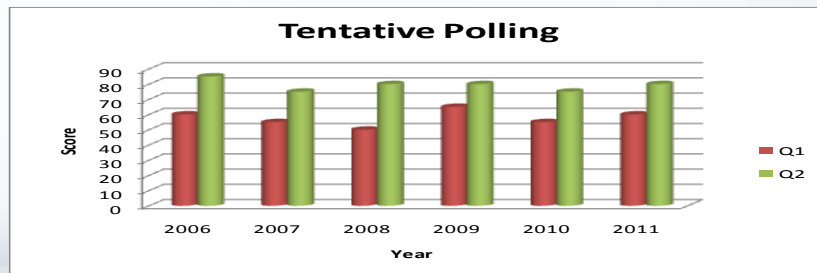
- Economics

Many NGO sources provide info such as wheat/sheep prices or power usage



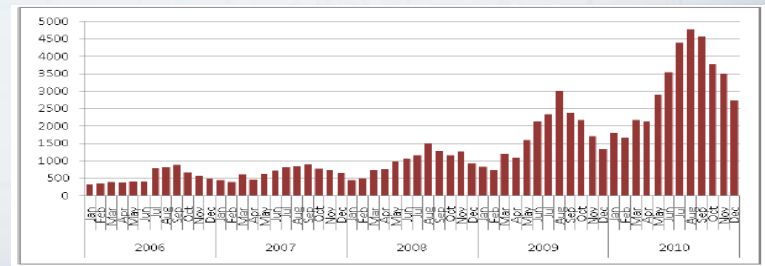
- Polling

According to some estimates Afg is the most polled country in the world. Kabul group, NGO's, ISAF, all conduct polls asking a variety of questions



- Violence Metrics

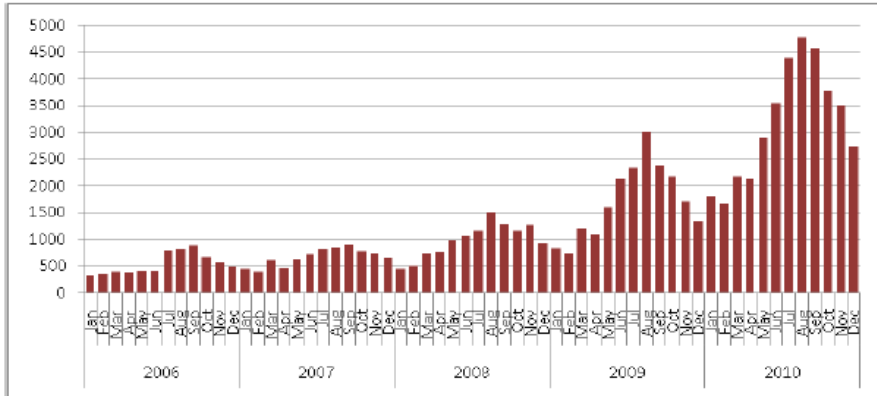
Collected by security forces, it is one of the most reliable data sources around. Most data is stored in CIDNE (replaced JOIIS in 2010)



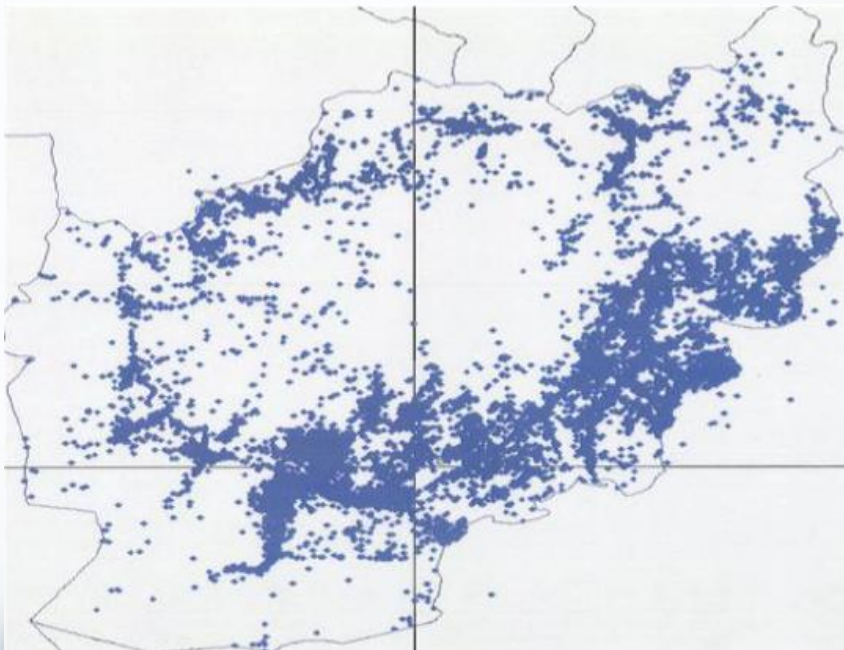
Concerns about data

- “One-of” reportings
 - Some organization collects data; process not repeated
 - Impossible to produce trends
- Changes in collection methodology and timing
 - Incoherent and internally inconsistent data
 - Trends of limited validity
- Lack of continuity
 - Discontinued collection
 - Data gaps
 - Limited usefulness of trends
- Multiple, often conflicting sources
- Parallel data storage
 - All mil data should be in CIDNE
 - Number of authoritative spreadsheets containing specific info
 - Difficult correlating of various data

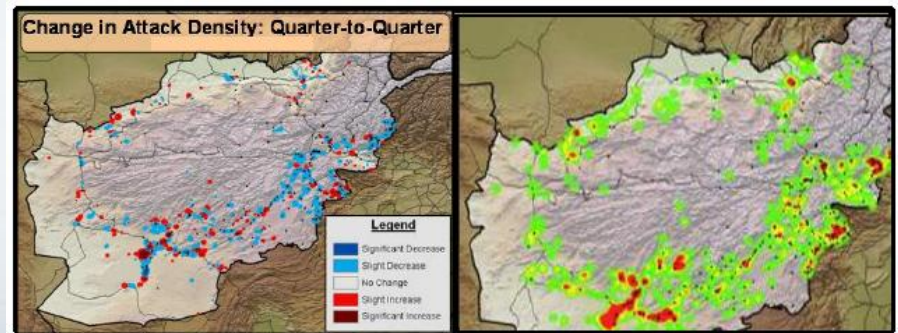
Trends in violence



- Strong seasonality
 - Peaks in July-August
 - Lowest in December-January
 - Dips in April due to poppy season
- Long-term increase

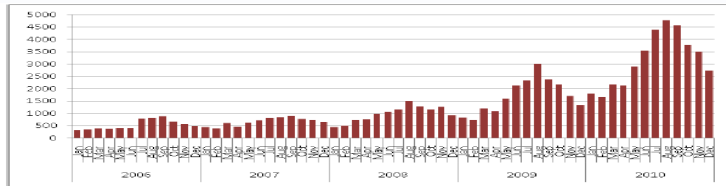


- Concentrated along Ring-Road (populated areas)
 - Most violence in South and East



Seasonal decomposition

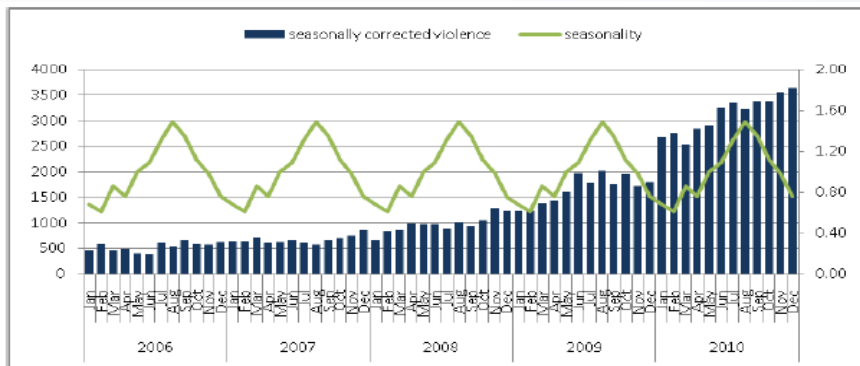
- Seasonality in Afghanistan



- Annual cycle, difference over 50%
- Must be considered when analyzing changes

- Long-term trend

Can be used to correlate with factors that do not have seasonal components



- Methodology

Multiplicative model $X = T \times S$

- Average X over one season
- $X / \langle X \rangle$ provides raw seasonality, is used to obtain S
- $T = X / S$ for each point

- Assessment

- Identification of recurrent patterns
- Identification of long-term trend
- Correlations with other factors (friendly activity, weather anomalies)
- Deviations from the trend
- Implications for the future activities

Use of violent data

- **Understanding enemy**
 - What is the enemy's intent?
 - What are the enemy's capabilities?
 - How does the enemy allocate resources?
 - What is the enemy's refit/resupply cycle?
 - How does the enemy adapt to our OPS?
- Limited value if used alone; needs supplementary info sources and qualitative analysis
- **Forecasting and risk assessment**
 - What violence levels are expected?
 - Management of resources (medical, materiel, personnel)
 - Based on assumption that historical trend can be projected to the future
 - Usually encapsulates some relationship between violence and other factors (e.g. troop numbers, major events)

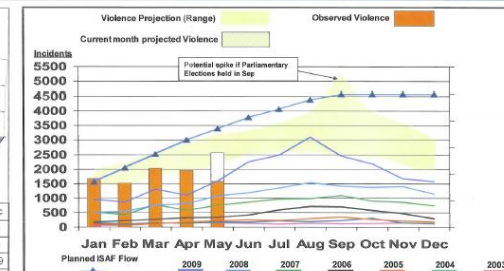
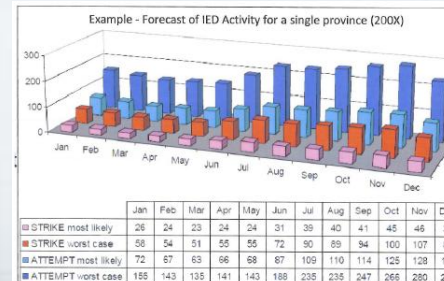
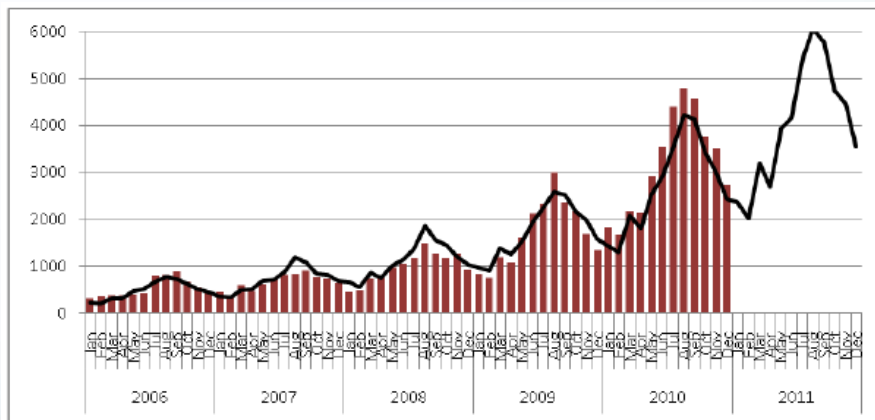
Assessment of Insurgency

- What is the state of insurgency?
 - What are their capabilities, intent, morale?
- Model and Indicators
 - Developing a model of insurgency to identify indicators
 - Combination of violence categories:
 - Effectiveness
 - Particular attack categories
 - Ratios of particular categories
 - Target
 - Supported by other sources
- What are the insurgent resources?
 - How are they distributed?
 - Origin of resources (local/external)
- Violence as indicator
 - Particular event categories
 - Distinguish between dedicated and opportunist fighters
 - Indication of insurgent focus and intent

Forecasting

- Assumptions:
 - Past connection between violence and a factor X will hold
 - Seasonality will remain the same
 - Behaviour of factor X

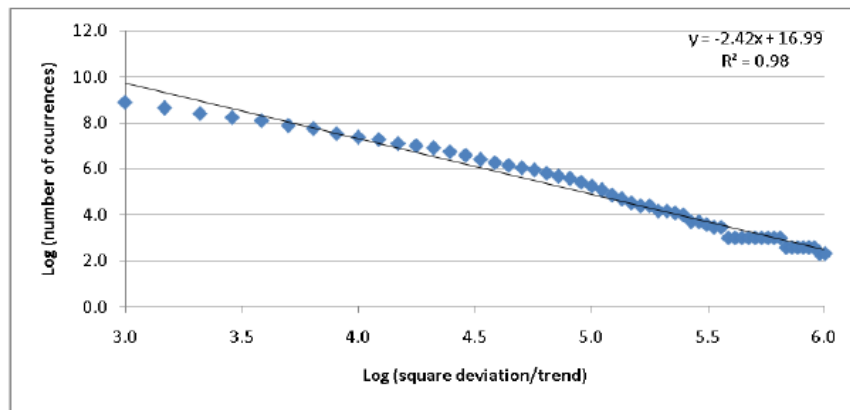
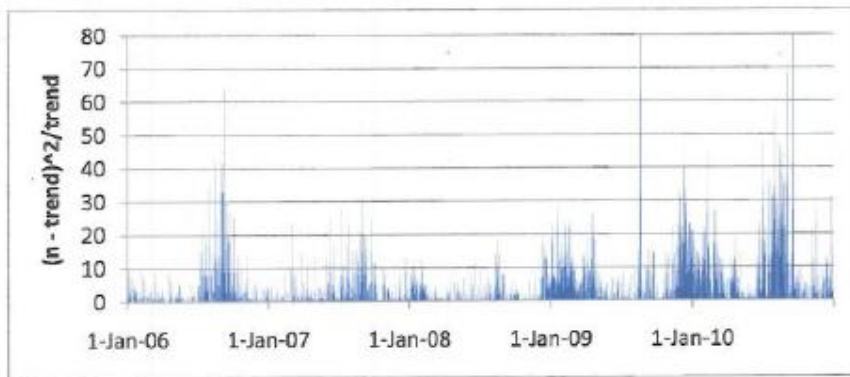
- Deterministic vs. stochastic model
 - What are other uncertainties?
 - Is the nature of randomness known?
 - Are the trials independent?
 - Is the statistical distribution known or can it be inferred?



Fractal Structure of Violence

- Power-law

- Fractal nature of the data is reflected in the power law distributions



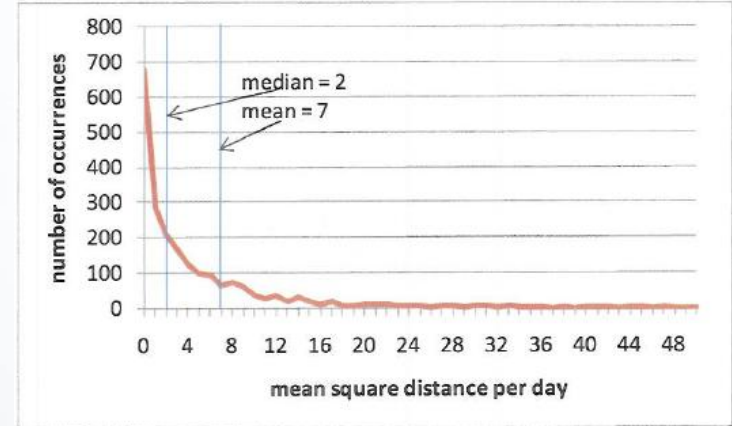
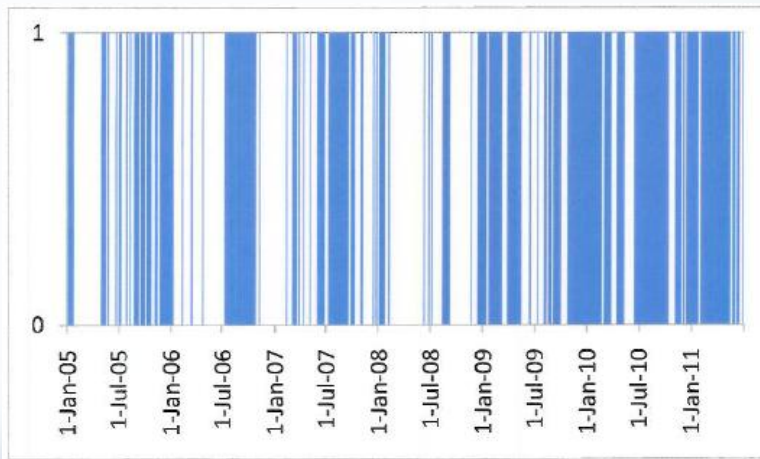
- Temporal, Spatial, Event-based characteristics

- Persistence

- A result of the memory in the system (the numbers of events at various times not independent)
- Implies criticality or near-criticality

Multi-fractal forecasting

- Identify “trigger” threshold
 - Binary approach (below/above threshold)
 - Time between crossing threshold (waiting time)
 - Exploits universality of scaling and persistence



- Enable short term forecast:
 - More efficient resource allocation
 - Expectation management
 - Consequence management

Ongoing activities and future plans

- **Fractal Properties of Irregular Warfare**

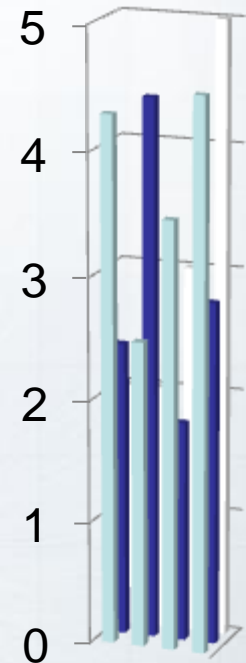
- Revisit scaling properties for extended data sets
- Revisit intermittency and persistence
- Agent-based modeling of small to large scale combat
- Identifying key drivers of fractal behaviour

- **Multi-Fractal Forecasting**

- Revisit persistence of expanded data sets
- Test thresholding algorithms
- Test multi-fractal forecasting on limited data sets
- Test predictive power and validate on real data

Conclusions

- Quantitative analysis can provide a different perspective and additional insights into the enemy
- It cannot be a standalone activity and needs to be supplemented by qualitative assessments
- Simple, conventional methods can provide insights directing further analysis
- Advanced methods can capitalize on the internal dynamics of conflicts as complex systems



DEFENCE



DÉFENSE