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Statistical Sciences Support for Homeland Defense

The following capabilities may be relevant to **all** of the projects being proposed in response to the current national crisis. There are three major ways Statistical sciences can contribute to the homeland defense efforts:

- incorporation and integration of data/information sources including simulation models to support homeland defense studies;
- elicitation and knowledge modeling to fill gaps in knowledge and incorporate human behavior into homeland defense analyses and models, and/or the integration of those models with external data/information;
- uncertainty quantification for all aspects of the decision processes.

Incorporation and Integration of Additional Data/Information Sources:

Data/information sources will play a principal role in the identification and mitigation of vulnerabilities. The integration and analysis must be structured to incorporate human behaviors of both the decision maker and the “terrorist.”

- Integrated design of experiments for both the collection of data/information and the for defining scenarios to exercise models vis-à-vis objectives, e.g., threats to analyze, vulnerabilities to identify, consequences to evaluate, etc.
- Statistical record linkage to integrate and amass the databases.
- Data quality and relevancy assessments.
- Distributional change-point detection (e.g., to discover changes in certain patterns or behaviors), including determination of the resolution of change you can statistically detect vis-à-vis all available data/information/simulation models.
- Time series and intervention analyses (e.g., to determine if an intervention has occurred, or to model changes after a known intervention), scoped to the specifics of the scenarios being studied.
- Statistical bounding of anticipated behaviors based on data sources, to include historical related catastrophic events.
- Data mining for extreme events, outlier detection, and sequence of “failures” identification.

Elicitation and Knowledge Modeling: The elicitation and knowledge modeling capabilities of statistical sciences can be used to support the national security projects through the use of formal methods to fill gaps in knowledge and statistical/mathematical characterization of human behavior. These characterizations are needed for integrated risk assessments of vulnerabilities.

- Formally develop scenarios, working with decision makers, red and blue teams, technical experts, and analysts.
- Characterization and modeling of the unreliability of the terrorist and their infrastructures.

- Capture and reuse of knowledge going into war gaming exercises.

Uncertainty Quantification For All Aspects Of The Decision Processes: Uncertainty quantification is critical in the study of these national security problems. There needs to be a clear and definitive understanding of limitations of the results.

- Multivariate analyses of simulation model output, coupled with external data, to determine the statistical significance of “changes” being generated by homeland defense models.
- Evaluation of historical data of catastrophic events and the use of these analyses to develop uncertainty models for the forecasts derived for homeland models.
- Design of computer experiments to develop uncertainty bounds on the predictive capabilities of the simulation models.
- Design of computer experiments to reduce the compute time needed to find and bound the rare/extreme events.