Homeland-Security Games with Non-strategic Players

This project will develop methods to study the optimal defender strategies in homeland-security games, taking the potential non-strategic behavior of other players into account.

Modeling Area: Risk Analysis
Principal Investigator: Jun Zhuang
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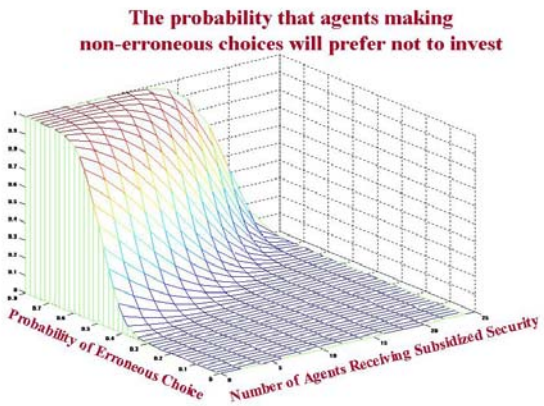

Brief Description:
Traditional risk analysis generally neglects the fact that terrorists are intelligent and adaptive, while most homeland-security games developed so far unrealistically assume that all players are fully strategic. The purpose of this research project is to integrate game theory (the search for equilibrium solutions) and decision theory (the use of subjective probabilities to describe the choices of other players) in the homeland-security context. This research will develop methods and techniques for identifying optimal strategies for rational defenders when facing non-strategic (irrational and/or behaviorally realistic) players, making it possible to explore the sensitivity of optimal defender strategies to assumptions about the behavior of other players. We plan to apply the results of this research to real-world data, and compare the results to fully endogenous game-theoretic results developed with CREATE funding. The results of this work have the potential to make game-theoretic homeland-security models more realistic and implementable.

Objectives:
This research will: (a) develop general methods and techniques for identifying equilibrium strategies for homeland-security players, under the assumption that other players may be non-strategic (irrational and/or behaviorally realistic) with some non-zero probability; (b) study the sensitivity of the defender's optimal strategy to the assumptions about the other players' behavior; (c) compare the results of this research to those of a fully endogenous game-theoretic model developed under CREATE funding, using real-world data; and (d) extend other existing game-theoretic homeland-security models to achieve greater realism.

Interfaces to Other Center Projects:
This work will maintain a close interface with the projects on risk analysis and economics underway at the University of Wisconsin-Madison. In particular, this work complements the previous game-theoretic work done by CREATE, including work on border security, portfolio allocation, and modeling of secrecy and deception. This project also relates to work on critical infrastructure protection, and basic methodological work in other CREATE projects (e.g., development of software for portfolio allocation, modeling of the terrorist decision process).

Interfaces to Non-Center Projects:
Project personnel are also working with the National Consortium for the Study of Terrorism and Responses to Terror at the University of Maryland, investigating the potential for collaboration between terrorist groups of different types, including possible non-strategic actors.

Major Products and Customers:
Project deliverables will consist of a series of academic papers, which provide guidelines and recommendations on the robustness of defensive resource allocation, considering different types of actors in the homeland security context. The major customers for this work will include: (a) CREATE and the other Centers of Excellence (especially START); (b) researchers and decision makers at the Department of Homeland Security; and (c) state and local government decision makers by supporting their decisions regarding the allocation of homeland-security resources such as target hardening and emergency response.

Technical Approach:
Traditional risk analysis generally neglects the fact that the terrorists are intelligent and adaptive, while most homeland security games developed so far unrealistically assume that all players are fully strategic. This project will use game theory, Bayesian analysis, optimization, and risk analysis to identify the optimal defender strategies for resource allocation and information disclosure strategies when facing non-strategic players. We will consider both games between decentralized defenders (in the context of interdependent security) and also games between a defender and one or more terrorists. We will compare the results of this research to those of a fully endogenous game-theoretic model developed under CREATE funding, using real-world data.

Major Milestones and Dates:
1. Finish and submit a paper on "Subsidized Security and Stability of Equilibrium Solutions in an *N*-Player Game with Errors" to *The Engineering Economist* – September 2008.
2. Finish and submit a computational paper on "Robustness of Optimal Defensive Resource Allocations in the Face of Less than Fully Rational Attackers" to *Risk Analysis* – January 2009.
3. Finish and submit a theoretical paper on "Homeland-Security Games with Non-strategic Players" to *Operations Research* – March 2009.
4. Complete work on reputation effects in repeated homeland security games with non-strategic players – May 2009.