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CREATE Using Game Theory to Study Resource Allocation

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With just under four million square miles and 315 million people to protect, the Department of Homeland Security (DHS) faces a daunting task. Terrorists can strike anywhere, from symbolic targets to vital assets across the nation.

CREATE researcher Dr. Jun Zhuang, assistant professor in the Department of Industrial and Systems Engineering at the University at Buffalo, the State University of New York (SUNY-Buffalo), and his former Ph.D. student Dr. Xiaojun Shan, argue that game theory is the most effective way of allocating limited resources to such a large area. They have recently published two papers that outline effective strategies.

In "Hybrid Defensive Resource Allocations in the Face of Partially Strategic Attackers in a Sequential Defender-attacker Game," they conclude that defensive resource allocations based on game-theoretic models are ideal. In "Cost of Equity in Homeland Security Resource Allocation in the Face of a Strategic Attacker," they analyze "the tradeoff between equity and efficiency in homeland security resource allocation."

"In general game-theoretic models incur less expected loss than non-game-theoretic models," Dr. Zhuang said. "The significance is that when making decisions about a large but limited amount of defensive resource allocations, the general guideline would be to adopt game-theoretic reasoning."

The allocation of funding is often controversial, especially when special interests factor into the equation. The researchers studied five types of equity allocation: per-target, per-valuation, per-capita, per-population density, and per-weighted capita. For per-capita resource allocation, they found that Wyoming received a significantly larger amount than California.

"We agree that it could be more efficient to determine homeland security resource allocations based on the strategic and symbolic value of locations," Dr. Zhuang said. "However, to the best of our knowledge, there is no precise estimation of the strategic and symbolic value of locations."

The most effective allocation method, according to Dr. Zhuang, takes the strategic and symbolic value of locations into consideration.

"The model we developed provides a general framework, which could take the data of the strategic and symbolic value of locations once they are available in order to derive more insights," he said. "Game-theoretic models seem to suggest allocating more resources to targets with higher values."

From a policy standpoint, this suggests that some states are unlikely to receive DHS funding.

"Whether some states need little or no money from the federal government for homeland security would be a practical decision based on several other factors such as consideration of symbolic meaning of locations," Dr. Zhuang said. "We could argue that it could be systematically optimal if some states receive little or no money from the federal government for homeland security, in order for other states that are more valuable or more vulnerable in the homeland security context, to receive more money."

Dr. Zhuang is not the only person advocating for a smarter way to allocate DHS funding. In "Safety at Any Price--Assessing the Impact of Homeland Security Spending in U.S. Cities," Sen. Tom Coburn, a member of the Homeland Security and Governmental Affairs Committee, argued that "DHS needs to implement a systematic approach to define and measure the preparedness capabilities it desires."

"This may include better risk definition, risk assessment, public-private partnership, and measuring cost effectiveness of all alternative defense measures," Dr. Zhuang said.