The debate about emergency preparation and mitigation has become a critical issue for emergency managers, especially in relation to hurricane disasters. This research develops a model where the government and private citizens strategically interact in a hurricane evacuation scenario based on evacuation advisement, and players’ preferences. In this model, the government moves first by advising its citizens to evacuate based on the probabilistic uncertainty of disaster occurrence, and then the citizens choose to react to the government’s advisement based on their preferences for social guilt and evacuation costs. We analyze these interactions in order to find both the government’s and the private citizen’s optimal strategy given the likelihood of a disaster occurring and each players’ preferences and costs.

### Game Theoretic Hurricane Evacuation Interactions

#### Abstract

- **Players:** For the two player game, the players are the Government and Private Citizens each with a decision probability, Y and X respectively.
- **Objectives:**
  - Government: Their objective is to minimize damage.
  - Private Citizens: Their objective is to minimize cost.
- **Decisions:**
  - Government: They choose whether to advise evacuation or not with a probability Y.
  - Private Citizens: They choose whether to evacuate or not with a probability X.

#### Game Modeling

**Objective Functions:**
- **Government:** Minimize Damage (lives, property, and publicity) given the choices of the private citizens and the probability a storm will occur.
- **Private Citizens:** Minimize Costs (property damage, evacuation and non-evacuation costs, and guilt).

**Equations**

- \( D_Y(X) = \max \{ D(X) - D^Y(1) - D^Y(0) \} \)
- \( D^Y_0(X) = 0 \)
- \( D^Y_1(X) = D(X) \)

**The Best Response Functions:**

- \( \hat{x}(Y) = 0 \) if \( U(x = 0, Y = 0) < U(x = 1, Y = 0) \)
- \( \hat{x}(Y) = 1 \) if \( U(x = 0, Y = 1) < U(x = 1, Y = 1) \)
- \( \hat{y}(X) = 0 \) if \( U(y = 0, X = 0) < U(y = 1, X = 0) \)
- \( \hat{y}(X) = 1 \) if \( U(y = 0, X = 1) < U(y = 1, X = 1) \)

**Path of Hurricane Irene [3]**

Surfers heading out during Hurricane Irene [2]

Satellite image of Hurricane Sandy [1]

**Future Work**

- Use real disaster data from Hurricane Irene to model the strategic interactions.
- Develop a 3-player game with 2 types of private citizens that interact using social media.
- The model could also be generalized to other scenarios, such as terrorism, threats, and other types of natural disasters, and also consider irrational behavior of the players.

**References**


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