Hurricane Evacuation Modeling

Using Regression and Agent-Based Modeling to Simulate Decision-Making in Hurricane Evacuation Scenarios

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Abstract. Hurricanes cause catastrophic damage to coastline communities. Community response to hurricane events is critical in minimizing injury and loss of life, and individual decision making in the evacuation process can result in complications. This paper is meant to help better understand the nuances of decision making during a hurricane event. We will outline how regression modeling and survey data has been used to predict whether a household chooses to evacuate based on certain individual characteristics. An subsequent agent-based model will utilize spatial and regression data to track movement throughout the evacuation event. ***cut and insert results***

1. Introduction

During Hurricane Sandy, 70% of people who received an evacuation order in New York and New Jersey chose not to evacuate (Worrall (2021). During Hurricane Rita in 2005, evacuation orders mobilized nearly four million individuals, but resulted in traffic under extreme heat conditions that resulted in over 100 deaths (Baker (2018)). Understanding risk perception and evacuation challenges can influence evacuation policy, planning, and information distribution methods (Yi et al. (2017)). As these disasters become more severe, the ability to streamline emergency response becomes more critical.

The complications that result from hurricane evacuation efforts are twofold. At the scale of the individual, a number of factors effect risk assessment, which in turn impact evacuation decision. This paper will simulate the movement and decisions of households and individuals during a hurricane evacuation scenario. Being able to predict agent response during natural disaster events can allow communities to build resilience to deadly events. It can inform health and safety policy and equip disaster response entities with important information in an analogous event. Current literature simulating hurricane response cover certain geographical regions using different methods. This paper will extend the study to Charleston, South Carolina using agent-based modeling.

An agent based model simulates autonomous, decision making entities. A growing base of research concerning evacuation modeling involves the treatment of evacuating bodies as the entities in question, and simulating their movements through space. Zhu et al. (2018) employs an agent-based model using logistic regression data to identify congestion and bottlenecks during a simulated evacuation scenario. In addition, evacuation timing and agent speeds can also be identified (Zhu et al. (2018)). Yang et al. (2020) applies an agent based simulation to model the social-

network impact on evacuation. The result of their model was used to validate a dependent variable in their findings on evacuation decision making—namely, the ”social contagion” of a household’s evacuation decision (Yang et al. (2020)).

2. Methods

This project will utilize both regression and agent-based modeling to spatially model hurricane evacuation, and will expand on existing literature by targeting the county of Charleston. The data used in this paper will be obtained through a survey sent out to (x number of people). The survey contains characterizing metrics for each household, and additionally collect hypothetical responses to an evacuation scenario.

A regression will be used to process survey data and determine whether or not a household will evacuate during a hurricane event. The regression will then inform an agent based model, which seeks to model the movement of households during an evacuation event.

The agent-based model with be run using an open-source software called MATSim.

References

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