ABSTRACT

Sarwar, Md. Tawfiq. M.S.C.E., Purdue University, May 2013. Modeling the Dynamics of Household-level Hurricane Evacuation Timing Decisions. Major Professor: Dr. Satish V. Ukkusuri.

Frequent occurrences of hurricanes in the coastal areas of the United States in recent times have indicated the necessity of a comprehensive evacuation planning. Failure to ensure efficient and timely evacuation causes devastating impacts including loss of lives and property damages. In order to ensure efficient evacuation, emergency officials need to understand how households make evacuation decisions and how their decisions can be influenced. Households' decisions to evacuate/stay, time of departure, route choice and destination choice are four fundamental behavioral issues in the evacuation process. In this thesis, we develop a joint modeling approach for both household-level evacuation decision and departure time. Unlike many other previous works, the major contribution of the work is the inclusion of dynamic variables, such as strength or category of hurricane, direction of hurricane, height of coastal flooding etc.. A random parameter multinomial logit model of the binary evacuate/stay decision at discrete time intervals has been developed considering not only several static factors, such as, socio-economic characteristics, mandatory/voluntary notice to evacuate, but also the dynamic nature of the hurricane itself. Data from a post storm assessment survey of Hurricane Ivan has been used to obtain the static variables in this study and dynamic variables have been collected from the published advisories of National Oceanic and Atmospheric Administration (NOAA) website. These two datasets have been merged to produce an unbalanced panel data for analysis. The model results indicate that: (1) the rate of evacuating households increases as landfall approaches, (2) maximum number of households evacuate on the last day before landfall and (3) households prefer to evacuate in the morning and afternoon periods than night and late nights.

Furthermore, the results show that receiving a mandatory notice or even a voluntary notice increases the probability to evacuate rather than receiving no notice. Moreover, the number of vehicles, number of children, post graduate degree, mobile house, and ownership of house are some other statistically significant variables. Using the insights of our model, the emergency officials can implement policy level decisions like imposing contra flow to ensure efficient evacuation. In addition, this model has been implemented in an agent based simulator (Repast Simphony) to obtain dynamic demand, which will eventually lead to a better understanding of the network clearance time.