CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
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Project Number
S0809

Project Title
Constructing a Multi-Variate Regression Model for Hurricane Loss and Its Application to Hurricane Sandy

Abstract

Objectives/Goals
Many empirical hurricane loss models consider only wind speed but neglect storm size. Such models may not accurately predict the losses from super-sized storms such as Hurricane Sandy in 2012, the largest Atlantic hurricane on record. The goal of this project was to construct a hurricane loss model as a function of both wind speed and size, and then apply this model to estimate the loss of Hurricane Sandy and quantify the relative role of wind speed and size.

Methods/Materials
I analyzed 32 hurricane cases that hit the United States between 1989 and 2008. The normalized hurricane loss and wind speed data were downloaded from the ICAT Damage Estimator. The hurricane size data were taken from the Extended Best Track data at the National Hurricane Center. I used the Microsoft Excel Data Analysis Toolpak to conduct multi-variate regression analysis to find the best fit to the data.

Results
I found that hurricane loss (L) approximately follows a power law relation with wind speed (V) and storm size (R), with L = c V^a R^b, where c is a scaling factor, and a and b are about 6.7 (7.4) and 2.4 (2.9) for unweighted (weighted) regression, respectively. By using both wind speed and size as predictors, the best fit model captures 75% of the variance of the losses, whereas by using wind speed or size alone, the captured variance is only 55% or 50%, respectively. Using the best-fit model, I estimated the normalized loss for Hurricane Sandy to be 51.4 billion in 2012 USD, the third most expensive storm behind Hurricane Katrina (2005) and Hurricane Andrew (1992). The size of Hurricane Sandy was 3.3 times of the average storm size, causing a loss about 30 times of the average-sized storm assuming the same wind speed.

Conclusions/Discussion
The enormous size of Hurricane Sandy played a predominant role in determining its loss. The actual loss of Sandy may be greater than what my best-fit model predicts because many complicating factors are not represented in the model. The example of Hurricane Sandy highlights the importance of storm size in determining hurricane loss. Hence, it is important to consider both wind speed and size in predicting hurricane loss.

Summary Statement
The enormous size of Hurricane Sandy played a predominant role in determining its loss. It is important to revise existing empirical hurricane loss models to include both wind speed and size as predictors.

Help Received
Parents taught me to use Microsoft Excel regression analysis tool. A JPL scientist, Dr. Lee Poulsen, provided the data for Hurricane Sandy.