**Catastrophe Modeling**

May 1, 2007

Catastrophe Modeling, according to the Insurance Information Institute, is a risk management tool used by insurers, reinsurers, and risk managers to assess potential future losses from catastrophic events.[1] The Department of Homeland Security's Catastrophic Incident Annex to the National Response Plan defines a catastrophic event as "any natural or manmade incident that results in extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions."[2] The insurance industry is particularly interested in the affected economic matters. Such events include earthquakes and the resulting fires, hurricanes, typhoons, cyclones, windstorms, storm-surges, river flooding, tornadoes, hailstorms, and terrorist attacks.[3] These events, however, are relatively unlikely to happen, or unexpected. They will be statistical outliers to most loss models and thus, catastrophic events cannot be properly predicted by other loss models. Therefore, the expertise of meteorologists, seismologists, geologists, engineers, mathematicians, actuaries, decision scientists, and statisticians must be utilized to create separate catastrophe models for predicting these events.[1]

These experts must account many variables in their models, primarily geographic location. The economic consequences of catastrophic events will be even more disastrous due to their tendencies to occur in more densely populated areas. Population centers tend to exist near natural resource centers. Coastal ports spawn cities that are more susceptible to tropical cyclones and earthquakes from the fault lines that follow the coasts, especially along the Pacific Ocean's "Ring of Fire". River port cities are susceptible to flooding. Agricultural trade centers are

located in “Tornado Ally”. Terrorists are more likely to attack heavily populated cities. The structural integrity of the buildings must also be accounted for. Various meteorological, seismological, and other variables must also input into the model. For example, a recent study by Thomas R. Knutson of Princeton’s Geophysical Fluid Dynamics Laboratory and Robert E. Tuleya of Old Dominion University’s Center for Coastal Physical Oceanography showed that hurricanes will increase in intensity in the presence of higher levels of greenhouse gases, particularly carbon dioxide.[4] Furthermore, water temperatures in the Gulf of Mexico and the Atlantic Ocean are rising, whether by human causes or by the natural cycle of the Earth’s weather patterns, which will likely cause an increase in frequency and severity of hurricanes.[1] These factors must be carefully considered in current and future models.

The three top catastrophe modeling firms currently are Applied Insurance Research (AIR) Worldwide, Risk Management Solutions (RMS), and EQECAT.[1] Risk Management Solutions is the largest catastrophe modeling company. Its models represent over 90% of the global property insurance premiums.[3]

After the exceptionally intense hurricane seasons of 2004 and 2005, catastrophe models were intensely criticized as the losses for those seasons were grossly underestimated. However, in each state, the pricing strategies and premium increases recommended by a catastrophe models must be approved by government regulations. Catastrophe modeling companies are also criticized for their models being “black boxes”. For competition reasons, the details of the equations and algorithms of their models are not disclosed, so the models are accused of taking in input and spitting out results with little or no explanation.[1]

1. http://www.iii.org/media/hottopics/additional/catmodeling/
2. http://www.fas.org/sgp/news/secrecy/2005/09/092605.html

3. http://www.rms.com/Catastrophe/

4. http://www.gfdl.noaa.gov/reference/bibliography/2004/tk0401.pdf