Modeling Insurance Losses Resulting from Natural Catastrophes

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In this talk, we examine the modeling of insurance losses resulting from natural catastrophes, particularly losses to residential and commercial structures as a result of earthquakes. The model proposed can also be used for other types of natural catastrophes such as floods and hurricanes. It is based on the three main components or characteristics of natural catastrophes, which are intensity, damage to insured properties and frequency (or occurrence). Intensity of earthquakes is defined as a function of the Modified Mercalli Index (MMI) and hence is a discrete random variable (r.v.). It can also be a function of the time elapsed between two successive earthquakes. Extent of damage is strongly related to both earthquake's magnitude and design of the building, i.e. height, materials used in the construction, etc. Hence, we represent damage by a Beta distribution bounded by the value of the insured property. Given the intensity and the structure of the building, one can calibratre the Beta r.v.'s to the results from the Applied Technology Council (ATC) study. Earthquake arrival during a given time period (or frequency) is represented by Weibull renewal processes, either ordinary or stationary. The behavior of earthquake occurrence depends on the distribution of the time between events, particularly the failure rate function of that r.v. Using data from earthquakes that occurred in Montreal (Quebec) and Vancouver (British Columbia), we compare the behavior of individual and aggregate losses when we vary frequency and intensity models given the same damage model.