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SCENARIO EARTHQUAKES IN FINANCIAL RISK MANAGEMENT

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Catastrophes such as earthquakes do not occur often enough to establish an actuary base to support risk management decisions in the conventional manner. Consequently, computer simulation and phenomenology models play an important role in quantifying potential losses. An important element of the simulation approach is single-scenario simulation, i.e., assume an event has occurred, simulate the corresponding hazards, and compute the damages and losses. The technique has been applied to historic events, e.g., Loma Prieta 1989 and Northridge 1994, to support claim-processing and resource allocation, and to hypothetical events of interest, i.e., Newport-Inglewood and recurrence today of San Francisco 1906 and Tokyo 1923, to address exposure and solvency concerns. However, a much more important use of scenario earthquakes is in multiple-scenario simulation in which the simulation process is repeated for all probable events and scenarios. It gives the loss exceedance probabilities and the correlation among losses, which are the foundation of all financial risk management strategies, e.g., CRERF, NDC, CEA.

SCENARIO SIMULATION FRAMEWORK

Major known faults in the U.S. and the world, and their associated seismicity data, are programmed in databases which can be activated to initiate a scenario. Any magnitude can be assigned to the event, but the database suggests a credible maximum and upper limit. Seismicity parameters associated with the fault embody current knowledge on the recurrence probability of an event of given magnitude.

SINGLE-EVENT SIMULATION

The scenario for a *historic event* is exercised for three main reasons: (1) To estimate the magnitude and distribution of damage before such data become available, so as to facilitate the claim processing operation; (2) To calibrate and improve the computer models based on damage data collected; and (3) To study specific issues of interest, e.g., business interruption losses (Figure 1). Scenarios for *credible events* are also postulated in order to quantify their impact on a portfolio or risk management strategy. For instance, Figure 2 shows the residential property losses by city/ward in the Greater Tokyo area in the event of a recurrence of the Kanto earthquake of 1923, which are based on current building stock, valuation and demographics. Scenario simulation of other similar postulated events such as a M7 event on the Newport-Inglewood fault

(Los Angeles area) and a M8.3 event on the San Andreas North fault (San Francisco area) yield astounding loss estimates that are appreciated by few until now.

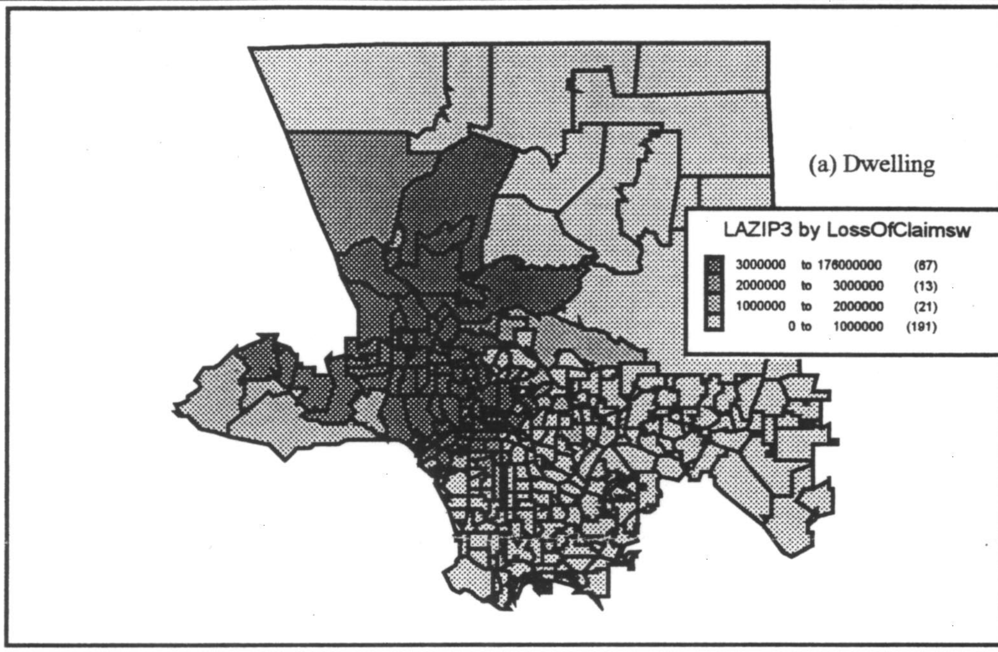

Figure 1. Distribution per zipcode of total insured loss for dwellings, Northridge 6.8 event.

MULTIPLE-EVENT SIMULATION

Single-scenarios whether they derived from historic recreation or postulation are deterministic exercises that serve the purpose intended. For risk management multiple-event simulations are more useful because recurrence of major earthquakes is infrequent and unpredictable, and can, at best, be defined in stochastic terms. Results from multiple scenario simulation, with the proper probability weights, lead to distributed loss information such as the expect loss, loss exceedance probabilities and correlation. This information is fundamental to the assessment of the stability, capacity and solvency of a financial institution.

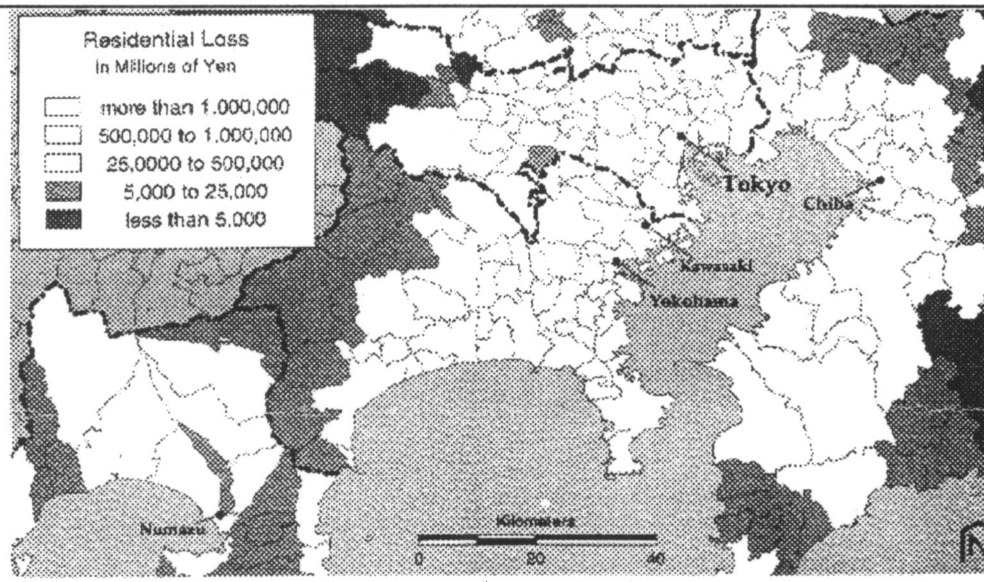

Figure 2. Residential property loss by city or ward, recurrence today of the Great Kanto 1923 earthquake.

DEVELOPMENT NEEDS

Experience gained over the past several years in applying the scenario approach to financial risk management shows that the method is extremely helpful in assessing the impact of catastrophes such as earthquakes and hurricanes. While all aspects of the methodology still have inherent uncertainties governed by the state of knowledge, the computation framework appears solid. Effectiveness can be improved with better data and models including: better inventory of building stock and up-to-date valuation; continued calibration of structural damage with new data and improved vulnerability and casualty models; improved models for fires following earthquakes. For financial risk management, indirect losses are also important. Hence, improved lifeline damage estimates and algorithms for business interruption loss should be developed.