Extreme Events: Statistical Extreme Value Theory and Its Applications

Casualty Loss Reserve Seminar

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- Agenda
  - Our objectives are to introduce the topic
  - Look at its implications via simple order statistics
  - develop some of the mathematics of Extreme Value Theory
  - Offer some references for further study

Extreme Events: Statistical Extreme Value Theory and Its Applications

- The base text: Emil Julius Gumbel: Statistics of Extremes. Publisher Unknown 1958
- Stuart Coles: An Introduction to Statistical Modeling of Extreme Values. Springer Verlag (Springer Series in Statistics) 2001
- Paul Embrechts, Claudia Klüppelberg & Thomas Mikosch: Modelling Extremal Events: for Insurance and Finance. Springer Verlag 1997

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- Two papers available free on the internet:
  - Thorough -- Richard L. Smith: Statistics of Extremes with Applications in Environment, Insurance and Finance. March 12, 2003. www.stat.unc.edu/postscript/rs/semstatrls.pdf
  - Short & Fun – Valerie Chavez-Demoulin & Armin Roehrl: Extreme Value Theory can save your neck. January 8, 2004 www.approximity.com/papers/evt_wp.pdf

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- A basic conclusion of Extreme Value Theory is that the probability of a new record high next year (of anything stable over time) is 1/(n+1) where the record has been kept for n years.
- More generally, the probability of exceeding the k^{th} largest event of the past n years is k/(n+1).
- These intuitively obvious results do imply some important things:

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- If you are insuring something rare, use a long experience period, so as to get a "big n" in 1/(n+1) and minimize surprises.
- For almost anything we insure, try to normalize the history to a stable current level:
  - Correct for inflation
  - Correct for building density
  - Adjust for change policy limits
  - Or whatever you can

☞ If you don't, you will underestimate your future exposure, and a "big n" won't help

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- War stories: Mortgages and Homeowners in New England
- My major objective is simply to alert attendees that Extreme Value Theory is a relevant and active branch of statistics for actuarial work, and that actuaries aren't the only ones chasing fat tails.
- We could learn something from the academics and finance guys.