Clarification and Errata to *Catastrophe Modeling: A New Approach to Managing Risk* (Grossi, P. and Kunreuther, H., Editors)

Casualty Actuarial Society Syllabus Committee *

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Abstract

This notes presents an errata and clarifying remarks to Section 2.4 Derivation and Use of an Exceedance Probability Curve of *Catastrophe Modeling: A New Approach to Managing Risk*.

1 Clarification

The use of the phrase "exceedance probability" in Section 2.4 is ambiguous. Specifically, "exceedance probability" can be used in one of three ways:

Occurrence Exceedance Probability (OEP) The OEP is the probability that at least one loss exceeds the specified loss amount.

Aggregate Exceedance Probability (AEP) The AEP is the probability that the sum of all losses during a given period exceeds some amount.

Conditional Exceedance Probability (CEP) The CEP is the probability that the amount on a single event exceeds a specified loss amount; this is equal to 1-CDF of the severity curve as used by actuaries in other contexts.

For actuaries who have not worked with catastrophe models, the OEP may be a new concept. Actuaries usually think of severity distributions, which correspond to the CEP - not the OEP. In Section 2.4, the term "exceedance probability" refers to the **Occurrence Exceedance Probability (OEP)**. The *OEP* is the distribution of the largest loss in the period and is based on the theory of order statistics.

*This note was originally prepared by Rajesh Sahasrabuddhe, FCAS, MAAA, CAS Syllabus Committee Chairperson in 2013. It has been revised based on similar comments provided contemporaneously by Josh Taub, FCAS and Matthew M. Iseler, FCAS.

2 Errata

- The end continued paragraph at the top of page 30 is corrected as follows:

  A list of ~~15~~ 14[1] such events is listed in Table 2.1 ranked in descending order of the amount of loss. ~~In order to keep the example simple and the calculations straightforward, these events were chosen so the set is exhaustive (i.e., sum of probabilities for all events equals one).~~

- The first complete paragraph on page 30 is corrected as follows:

  The events listed in Table 2.1 are assumed to be independent Bernoulli random variables ~~., each with a~~. It is assumed that each event only occurs at most once with the probability mass function defined as: …

- The second complete paragraph on page 30 is corrected as follows:

  If an event E_i does not occur, the loss for that event is 0. …

- The fourth complete paragraph on page 30 is corrected as follows:

  Assuming that during a given year, at most only one of each disaster occurs, the OEP ~~exceedance probability~~ for a given level of loss, $OEP(L_i)$, can be determined by calculating: …

- The first sentence of the fifth complete paragraph on page 30 is corrected as follows:

  The resulting OEP is the probability that at least one loss exceeds a given value ~~exceedance probability is the annual probability that the loss exceeds a given value~~.

- The upper limit of the product in the last equation on page 30 is corrected from i to $i-1$ as follows:

$$OEP(L_i) = 1 - \prod_{j=1}^{i} \prod_{j=1}^{i-1} (1 - p_i)$$

[1] Editor's note: The definition of E_i includes events that "*could* damage a portfolio of structures" (emphasis added). We assume that event #15 in the original Table 2.1 would have met this standard (e.g. a hurricane that turns away from land). We have removed event #15 in order to emphasize that the probabilities need not sum to 1.000.

- Table 2.1 is replaced with the following:

Table 2.1: Events, Losses and Probabilities

Event (E_i)	Annual Probability of Occurrence (p_i)	Loss (L_i)	Occurrence Exceedance Probability $[OEP(L_i)]$	$E[L] = p_i \times L_i$
1	0.002	$25,000,000	0.0000	$50,000
2	0.005	15,000,000	0.0020	75,000
3	0.010	10,000,000	0.0070	100,000
4	0.020	5,000,000	0.0169	100,000
5	0.030	3,000,000	0.0366	90,000
6	0.040	2,000,000	0.0655	80,000
7	0.050	1,000,000	0.1029	50,000
8	0.050	800,000	0.1477	40,000
9	0.050	700,000	0.1903	35,000
10	0.070	500,000	0.2308	35,000
11	0.090	500,000	0.2847	45,000
12	0.100	300,000	0.3490	30,000
13	0.100	200,000	0.4141	20,000
14	0.100	100,000	0.4727	10,000
Total		Average Annual Loss (AAL)		760,000