# Pricing Property Per-Risk – Advanced Topics

CAS Seminar on Reinsurance, 2008

David R. Clark

Munich Re America
Munich Re Group

## Agenda





## Preliminary Definitions

Experience Rating:

Price based on the actual historical losses for the ceding company, adjusted to the "as if" level of the prospective period.

Exposure Rating:

Price based on the historical loss experience for the industry, adjusted to be similar to the risk characteristics of the client company.

Subscription Policy:

A policy for a large risk, shared between more than one insurance carrier.



## A Proverb on Exposure Rating

*In order to exposure rate a per-risk treaty,*

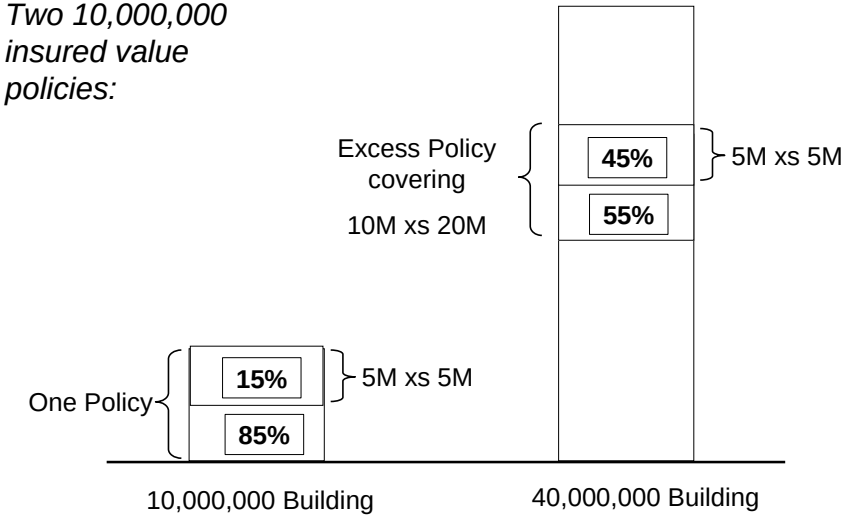
*you have to know what risks expose the treaty.*

This means we need details on what is being covered

- Ideally splitting out by types of businesses (e.g., by occupancy)
- Challenges:
  - Large risks (excess and subscription policies)
  - Inland marine
  - Builders risk (construction projects)

## Subscription Policies

*Two 10,000,000 insured value policies:*

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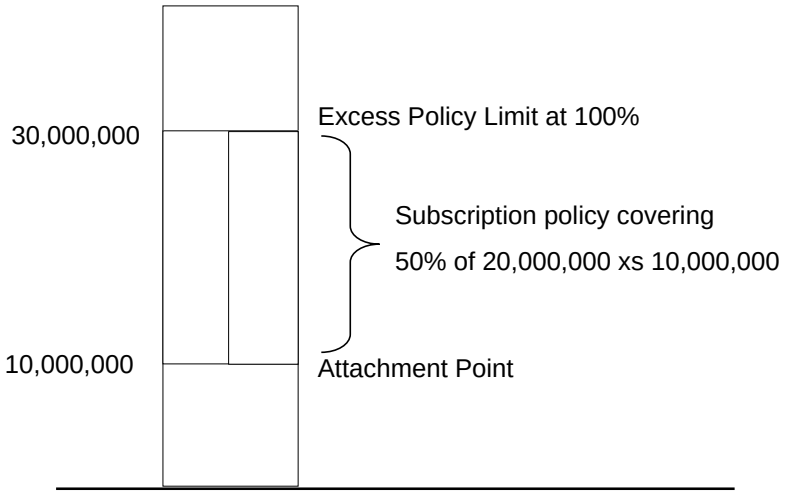
## Subscription Policies - Ceding Company takes share of layer






## Subscription Policies

Subject Policy: 50% of 20,000,000 excess of 10,000,000
on a 40,000,000 building (TIV)

Reinsurance: 5,000,000 excess of 5,000,000 per risk

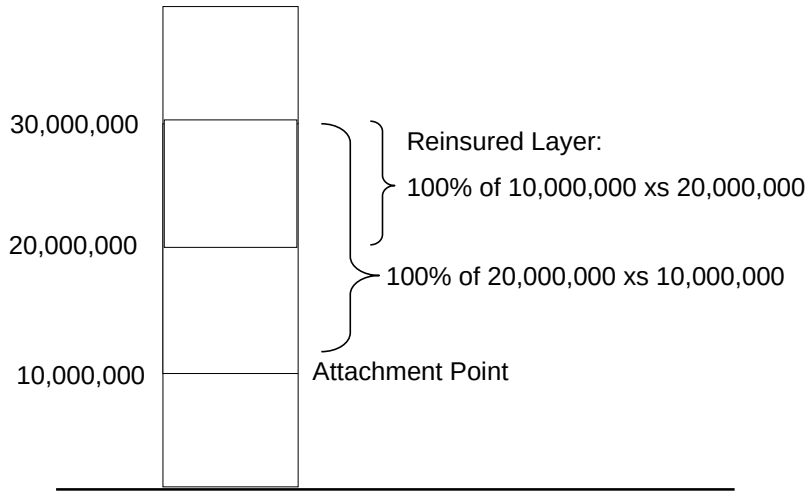
How might we represent this reinsurance for exposure rating?

$$Exposure\ Rate = \frac{LEV_{30,000,000} - LEV_{20,000,000}}{LEV_{30,000,000} - LEV_{10,000,000}}$$

*LEV* = Limited Expected Value function; a.k.a. "first loss curve"



## Subscription Policies



## Subscription Policies

Summary: You need information per risk

- Gross value of the building being covered
- Attachment Point and Limit of Excess Layer
- Share % of Excess Layer covered by ceding company



## Creating a Collective Risk Model

One challenge for the pricing actuary is to reconcile experience and exposure rating estimates.

When the two estimates are different, we need to evaluate if they are both valid estimates to be weighted together or if one is invalid.

- Changing exposures throughout the experience period
- Poor quality TIV Profile (e.g., by policy not by location)

A collective risk model, can be helpful in identifying where there may be problems.



## Creating A Collective Risk Model

Decompose the Expected Loss Cost into Frequency and Severity components:

$$\text{Conditional Layer Severity} = \frac{LEV_{\text{Limit+Retention}} - LEV_{\text{Retention}}}{1 - F(\text{Retention})}$$

$$\text{Layer Frequency} = \frac{\text{Layer Loss Cost}}{\text{Conditional Layer Severity}}$$

We can also approximate the severity distribution from an exposure-rating curve:

$$F(x) = 1 - \frac{\partial\, LEV_X}{\partial\, x}$$



## Creating a Collective Risk Model

The collective risk model is an aggregate distribution of possible loss outcomes, based on explicit assumptions for frequency and severity.

**1)** Evaluate Treaty Adjustable Features

- Limited Reinstatements
- Annual Aggregate Deductible (AAD) or Limit (AAL)
- Apply exposure rate to **prospective premium**

**2)** Comparison of Exposure and Experience Rating

- Consider “Hypothesis Test” as to whether the experience rate could have come from the distribution implied by the exposure rating.
- Apply exposure rate to **historical adjusted premium**

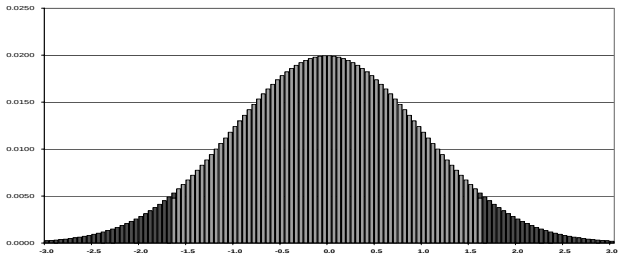
## Collective Risk Model - Hypothesis Testing

Hypothesis testing asks the question: "What is the probability that the results of the experience rating came from the curves in the exposure rating?"

$H_0$: Experience came from this distribution

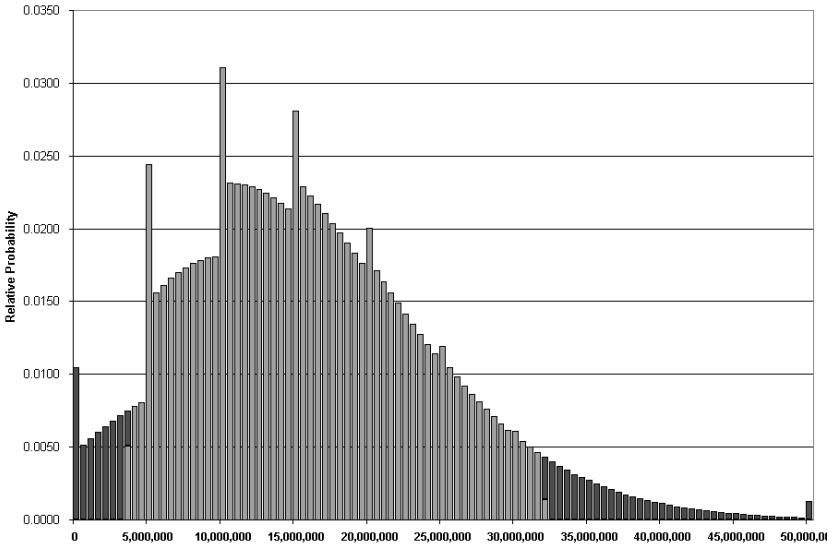
$H_A$: Experience came from some other distribution

In classical statistics, this is represented by the tails of a Normal distribution.






## Collective Risk Model – Hypothesis Testing






## Collective Risk Model – Credibility of Experience Rating

| | | |
|---|---|---|
| Annual Claim Counts: | 0.5 | Poisson |
| # Years in Experience: | 10 | |
| Experience Period Counts: | 5 | =0.5*10 |
| | | |
| Layer Limit | 5,000,000 | |
| excess of | excess of | |
| Layer Attachment Point | 5,000,000 | |
| | | |
| Pareto Shape Parameter: | 1.4 | |
| | | |
| Conditional Severity | 3,026,771 | Pareto or |
| Severity Standard Deviation | 1,883,433 | exposure rate |
| | | |
| Expected Loss in Experience Period | 15,133,857 | $\mu$ |
| Standard Deviation | 7,971,407 | $\sigma$ |
| Coefficient of Variation | 52.7% | $\sigma / \mu$ |

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## Collective Risk Model – Credibility of Experience Rating

To follow this example:

Assume we have indications from experience and exposure ratings.

Experience Rate = 6.0% based on ten years of experience

Exposure Rate = 4.0%

Could the 6.0% experience rate have been produced randomly if the distributions in the exposure rating were truly correct?

If the CV=.527, then the exposure rate range plus or minus one standard deviation is (1.9%, 6.1%). We would "fail to reject" this null hypothesis, but more reconciliation may still be a good idea.

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## Collective Risk Model – Credibility of Experience Rating

Having decomposed the loss cost into frequency and severity, we can review other statistics:

- Compare expected counts and average severity
- Compare “Survival Ratio” = % of losses completely exhausting the layer
- Probablility of having no losses in a given year



## Thank you very much for your attention.

David R. Clark
daveclark@munichreamerica.com