# AN EXPOSURE RATING APPROACH TO PRICING PROPERTY EXCESS OF LOSS REINSURANCE

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## BIOGRAPHY:

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## ABSTRACT:

Included in the 1963 Proceedings is the paper "Rating by Layer of Insurance", by Ruth Salzmann. In her paper, Salzmann examines the relationship between homeowners fire losses and the corresponding amount of insurance. Using 1960 accident year data from INA, each homeowners fire claim was ratioed to the amount of insurance on the policy affording the coverage. An accumulated loss cost distribution by percentage of insured value was then developed. These distributions can be (and indeed still are) used to exposure rate property excess of loss reinsurance.

In order to determine whether the relationship between size of loss and amount of insurance is a stable one over time, Salzmann's methodology has been applied to a more current set of data (Hartford Insurance Group Homeowners losses for accident years 1984-88). Any changes in this relationship over time would have obvious implications for any reinsurer currently using Salzmann's Tables to exposure rate property excess of loss reinsurance. Salzmann's methodology has also been applied to The Hartford's small commercial property book of business, in order to determine whether the commercial property relationships of loss size to amount of insurance differ from those of homeowners.

# INTRODUCTION

Included in the 1963 Proceedings is the paper "Rating by Layer of Insurance" by Ruth Salzmann. In this paper, Salzmann develops cumulative loss distributions by percentage of insured value, in order to demonstrate that there is a direct relationship between property size of loss distributions and the corresponding amounts at risk. As testimony to the thoroughness of her analysis, the "Salzmann Tables" contained in her paper are still used today by many reinsurers as one means of rating property excess of loss reinsurance.

In reviewing Salzmann's paper, however, it becomes evident that she never represented her study as being the final word on property excess rating, but rather intended it to be a modest first step into this arena. Furthermore, there are a number of important points not addressed by the study, such that the continued use of these tables as a reinsurance rating tool is inappropriate. While the methodology employed by Salzmann is theoretically sound, the loss data used in her analysis differs significantly from that which is typically covered by a property excess of loss treaty. However, by applying Salzmann's methodology to a more appropriate set of loss data, it is possible to produce a revised set of tables that are directly applicable to the rating of property excess of loss reinsurance.

## SALZMANN'S STUDY

In compiling the loss data for her study, Salzmann captured individual claim level (and policy level) information for each of the following variables:

| | |
|---|---|
| Company: | INA |
| Line of Business: | Homeowners |
| Accident Year: | 1960 |
| Cause of Loss: | Fire |
| Coverage: | Building Losses Only (Coverage A) |
| Construction: | Frame, Brick |
| Protection: | Protected, Unprotected |
| Insured Values (Homeowners Coverage A Limit): | $10,000; $15,000; $20,000; $25,000 |

The stated reasons for selecting the Homeowners line of business were that (1) the insured value, or policy amount, was a fair approximation of the amount at risk, and (2) under-insurance, if any, would be relatively consistent by class, due to the built-in incentive to fully insure in order to satisfy the replacement cost clause, which comes into operation when the insured value equals 80% of the building's replacement cost. Also, only the building loss portion of each claim was considered, since it was felt that these losses would have the most direct relationship with the policy amount and thus provide the best basis for the study.

For each claim, the building loss was divided by the corresponding amount of insurance from the policy affording the coverage. By changing the claim size scale from a pure dollar basis to a percentage of insured value basis, the following claim count distribution was produced:

TABLE 1

CUMULATIVE CLAIM COUNT DISTRIBUTION BY % OF INSURED VALUE

| Loss as a % of Insured Value | Frame-Protected | Frame-Unprotected | Brick-Protected | Brick-Unprotected |
|---|---|---|---|---|
| 5% | 92.0% | 91.3% | 93.9% | 92.9% |
| 10% | 95.4% | 94.1% | 96.4% | 95.8% |
| 20% | 97.3% | 95.4% | 97.8% | 96.8% |
| 30% | 98.0% | 96.0% | 98.2% | 97.9% |
| 40% | 98.6% | 96.5% | 98.5% | 98.4% |
| 50% | 98.9% | 97.1% | 98.8% | 98.7% |
| 60% | 99.1% | 97.4% | 99.2% | 98.9% |
| 70% | 99.3% | 97.5% | 99.4% | 98.9% |
| 80% | 99.5% | 97.9% | 99.7% | 98.9% |
| 90% | 99.6% | 98.1% | 99.7% | 99.2% |
| 100% | 100.0% | 100.0% | 100.0% | 100.0% |

In addition to looking at the distribution of claim counts by percentage of insured value, Salzmann also produced a cumulative loss distribution by percentage of insured value. To derive the dollar amount for losses contained within the first X% of insured value, Salzmann combined two values - (1) X% of insured value, per claim, for those claims which exceeded X% of insured value, and (2) 100% of each claim's incurred loss, per claim, for those claims which did not exceed X% of insured value. The results of Salzmann's calculations are shown in Table 2.

TABLE 2

CUMULATIVE LOSS COST DISTRIBUTION BY % OF INSURED VALUE

| Loss as a % of Insured Value | Frame-Protected | Frame-Unprotected | Brick-Protected | Brick-Unprotected |
|---|---|---|---|---|
| 5% | 42.8% | 26.9% | 39.3% | 28.8% |
| 10% | 54.2% | 35.9% | 49.4% | 39.2% |
| 20% | 67.4% | 47.8% | 61.9% | 52.2% |
| 30% | 76.8% | 57.5% | 71.7% | 63.1% |
| 40% | 83.9% | 65.7% | 79.7% | 70.6% |
| 50% | 89.0% | 73.2% | 86.5% | 77.5% |
| 60% | 92.7% | 79.6% | 91.9% | 82.8% |
| 70% | 95.5% | 85.7% | 96.0% | 87.3% |
| 80% | 97.6% | 91.3% | 98.3% | 91.8% |
| 90% | 99.1% | 95.7% | 99.3% | 95.9% |
| 100% | 100.0% | 100.0% | 100.0% | 100.0% |

Salzmann concluded that there was a direct relationship between loss size distributions and insured values. She also pointed out several potential uses for her tables, with one of them being their potential incorporation as a reinsurance rating tool. Some thirty years later, her tables are still considered to be a very useful source of reinsurance rating information.

## USING SALZMANN TABLES TO PRICE REINSURANCE

Using Salzmann Tables to price property excess of loss reinsurance represents a so-called "exposure rating" technique. Exposure rating does not rely on the ceding company's actual loss history as a basis for developing a reinsurance rate, but rather is based on their distribution of direct premium by policy limit. For each policy limit written by the ceding company, an estimate is made as to the proportion of losses that will fall within the reinsurance layer being priced. In casualty reinsurance, one standard means of estimating these proportions is through the use of increased limits factors, while in property reinsurance, Salzmann Tables serve an equivalent function.

An example of how Salzmann Tables are used to exposure rate a property reinsurance program is shown in Exhibit 1, for a company which is considering purchasing a $100,000 XS of $100,000 reinsurance treaty to cover its homeowners property losses. The only input necessary to perform the exposure rating is the ceding company's estimated distribution of premium by its Coverage A (Building) limits, for the period to be covered by the treaty.

By using the Salzmann Tables, it is estimated that the primary company will collect $22,000 in direct premium to cover losses and expenses in the $100,000 XS $100,000 layer. To convert this to a reinsurance premium, several additional adjustments are necessary:

1) Ceding company expenses (acquisition costs and other expenses) need to be removed. This can be accomplished by multiplying the gross exposure premium by the expected pure loss component (excluding loss adjustment expenses). For purposes of this example, assume an expected pure loss component of 60%.

2) If the reinsurer is to share the cost of allocated loss adjustment expenses, then an appropriate loading must be added to the reinsurance rate. For purposes of this example, the rate will be loaded by 10%.

3) The ceding company's rate adequacy needs to be assessed. If the ceding company's underlying rates are inadequate, the reinsurer's exposure premium resulting from use of the Salzmann Tables will also be inadequate by the same percentage. In this example, it is assumed that the underlying rates are adequate, so no adjustment is necessary.

EXHIBIT 1

EXPOSURE RATING EXAMPLE - $100,000 XS OF $100,000 LAYER

| (1) Coverage A Limit | (2) Direct Premium | (3) Reinsurance Retention as a % of Coverage A Limit | (4) Percentage Allocation of Total Premium-Salzmann Table Frame-Protected | (5) Reinsurance Retention Plus Limit as a % of Coverage A Limit | (6) Percentage Allocation of Total Premium-Salzmann Table Frame-Protected | (7) Exposure Factor (6)-(4) | (8) Exposure Premium (2)X(7) |
|---|---|---|---|---|---|---|---|
| $ 25,000 | $ 200,000 | 400% | 100% | 800% | 100% | 0% | $ 0 |
| $ 50,000 | $ 200,000 | 200% | 100% | 400% | 100% | 0% | $ 0 |
| $ 75,000 | $ 200,000 | 133% | 100% | 267% | 100% | 0% | $ 0 |
| $100,000 | $ 200,000 | 100% | 100% | 200% | 100% | 0% | $ 0 |
| $200,000 | $ 200,000 | 50% | 89% | 100% | 100% | 11% | $22,000 |
| | $1,000,000 | | | | | | $22,000 |

4) Finally, the reinsurer will include a loading for expenses and profit. For purposes of this example, it will be assumed that this element represents 20% of the final premium - this loading would be expressed as "100/80ths".

These adjustments result in a final indicated exposure rate of 1.815%:

$$\text{Exposure Rate} = \frac{\$22{,}000 \text{ X } .60 \text{ X } 1.10}{\$1{,}000{,}000} \text{ x } 1.0 \text{ x } \frac{100}{80} = 1.815\%$$

Thus, based on the ceding company's estimated distribution of direct premium by policy limit, an exposure rating estimate produced by using the Salzmann Tables indicates that the reinsurer needs only $18,150 to provide for losses within the $100,000 XS of $100,000 layer. The remaining $981,850 is presumably required by the ceding company to pay losses and expenses within the first $100,000 loss layer.

If the ceding company was considering a further reduction in its retention to $25,000, the cost of the additional necessary reinsurance ($75,000 XS of $25,000) would be estimated as shown in Exhibit 2.

As indicated in Exhibit 2, the cost to the ceding company of reducing its retention from $100,000 to $25,000 is 15.02% of its direct premium, or $150,200. The ceding company may view this additonal reinsurance purchase as both an effective, and relatively inexpensive, means of removing some unwanted volatility from its books.

EXHIBIT 2

EXPOSURE RATING EXAMPLE - $75,000 XS OF $25,000 LAYER

| (1) Coverage A Limit | (2) Direct Premium | (3) Reinsurance Retention as a % of Coverage A Limit | (4) Percentage Allocation of Total Premium-Salzmann Table Frame-Protected | (5) Reinsurance Retention Plus Limit as a % of Coverage A Limit | (6) Percentage Allocation of Total Premium-Salzmann Table Frame-Protected | (7) Exposure Factor (6)-(4) | (8) Exposure Premium (2)X(7) |
|---|---|---|---|---|---|---|---|
| $ 25,000 | $ 200,000 | 100.0% | 100.0% | 400% | 100% | 0.0% | $ 0 |
| $ 50,000 | $ 200,000 | 50.0% | 89.0% | 200% | 100% | 11.0% | $22,000 |
| $ 75,000 | $ 200,000 | 33.0% | 79.0% | 133% | 100% | 21.0% | $42,000 |
| $100,000 | $ 200,000 | 25.0% | 72.1% | 100% | 100% | 27.9% | $55,800 |
| $200,000 | $ 200,000 | 12.5% | 57.9% | 50% | 89% | 31.1% | $62,200 |
| | $1,000,000 | | | | | | $182,000 |

$$\text{Exposure Rate} = \frac{\$182{,}000 \times .60 \times 1.10}{\$1{,}000{,}000} \times 1.0 \times \frac{100}{80} = 15.02\%$$

The natural alternative to exposure rating is experience rating. In experience rating, the ceding company's actual claim history for the previous three to five accident years provides the basis for developing a reinsurance rate. First, actual historical losses are adjusted for inflation, on a claim-by-claim basis, from the date of loss up to the average loss date anticipated for the treaty. These trended claim values are then cast against the proposed reinsurance structure, to determine how they would impact both the $75,000 XS of $25,000 and $100,000 XS of $100,000 layers. On a trended basis, then, you have an estimate of how each accident year's actual reported claims would have impacted each layer. Excess loss development factors are then applied to these trended figures, in order to produce an estimate of ultimate trended excess losses by layer for each accident year. By then comparing these accident year ultimate loss figures to their respective premium bases (with historical premiums adjusted to either present rate levels, or proposed treaty year rate levels) a three to five-year average burning cost can be developed. By then loading this "trended and developed" burning cost for reinsurer expenses and profit, an "experience rate" results.

A reinsurer will typically produce both an exposure rating estimate and an experience rating estimate for each layer of reinsurance. These two rating methodologies may not always produce similar answers, however. Determining which of the two estimates is most credible is not always a straightforward process. Generally, however, experience rating is only useful on working layers, while exposure rating theoretically works well on all layers. In our example, experience rating is apparently not well suited for the $100,000 XS of $100,000 layer, given that expected losses are only $13,200 ($22,000 X .60); experience rating may produce a useful pricing estimate for the $75,000 XS of $25,000 layer, where expected losses are $109,200 ($182,000 X .60).

## COMMENTS ON SALZMANN'S ANALYSIS

Salzmann achieved her goal of demonstrating that there was a direct relationship between homeowners building loss distributions and their corresponding insured values. When viewed as a pricing tool for property excess of loss reinsurance, however, the Salzmann Tables are far from ideal, due to the following considerations:

1) Building Losses Only - By restricting her analysis to only the building loss portion of each homeowners claim, Salzmann was satisified that losses would thereby have the most direct relationship with the policy amount. In a homeowners policy, however, all of the following property coverages are provided, and would typically be covered by a property excess of loss treaty:

   Coverage A: Building

   Coverage B: Other Structures - Limit provided is 10% of the Coverage A limit

Coverage C: Contents - Limit provided is 50% of the Coverage A limit, unless Replacement Cost coverage is purchased, in which case the limit is increased to 70% of the Coverage A limit.

Coverage D: Loss of Use - Limit provided is 20% of the Coverage A limit

Clearly, when considering a "total" homeowners property loss, we are not dealing with just a complete payment of the Coverage A limits, but rather we are looking at a loss which could go as high as two times the Coverage A limit. By considering building losses only, Salzmann was ignoring this possibility.

2) Cause of Loss - In demonstrating that a direct relationship existed between building loss distributions and amounts at risk, Salzmann considered only one cause of loss - fire. Therefore, if Salzmann Tables are used to price a property excess of loss reinsurance treaty, an implicit assumption in that price is that all other causes of property losses will exhibit the same relationship between loss size and amount at risk.

3) Line of Business - Salzmann limited her study to the homeowners line of business, apparently as a means of avoiding the multiple insured location situation often found in commercial property policies. Again, if Salzmann Tables are used to rate commercial property excess of loss treaties, an implicit assumption is that commercial risks possess the same loss size to insured value relationships as do homeowners risks.

None of these three points should in any way be construed as a criticism of Salzmann, as she clearly stated the goal of her study. It seems clear, however, that due to the three points mentioned above, the way in which the Salzmann Tables are currently used to rate property excess of loss reinsurance is inappropriate.

## AN UPDATED ANALYSIS OF PROPERTY LOSSES

In order to address several of the shortcomings inherent in the Salzmann Tables, a number of steps were taken. First, an updated review of homeowners fire loss experience was performed, using Hartford Insurance Group data for the 1984-88 accident years. Second, a similar review of homeowners loss experience was performed on all wind losses, in order to determine whether the distribution of wind losses as a percentage of insured value differs from that of the fire losses. Finally, a review of commercial property loss experience was performed, again looking at both fire and wind losses.

## HOMEOWNERS FIRE LOSS DISTRIBUTIONS

For all homeowners fire losses, individual claim information was obtained, with losses emanating from all of the property coverages (A,B,C and D) being included. Losses were then restated as a percentage of the Coverage A limit, with the upper bound on an individual claim's ratio being two times that Coverage A limit. As shown in Table 3, by including all of the property coverages within the definition of loss, a much different cumulative claim count distribution emerges.

TABLE 3

CUMULATIVE CLAIM COUNT DISTRIBUTION BY % OF INSURED VALUE

HOMEOWNERS FIRE LOSSES ONLY

| | Frame-Protected | | Frame-Unprotected | | Brick-Protected | | Brick-Unprotected | |
|---|---|---|---|---|---|---|---|---|
| Loss as a % of Insured Value | Hartford 1984-88 | INA 1960 | Hartford 1984-88 | INA 1960 | Hartford 1984-88 | INA 1960 | Hartford 1984-88 | INA 1960 |
| 5% | 85.5% | 92.0% | 82.1% | 91.3% | 91.4% | 93.9% | 89.6% | 92.9% |
| 10% | 90.3% | 95.4% | 85.7% | 94.1% | 94.9% | 96.4% | 92.6% | 95.8% |
| 20% | 93.4% | 97.3% | 87.9% | 95.4% | 96.8% | 97.8% | 94.0% | 96.8% |
| 30% | 94.4% | 98.0% | 89.0% | 96.0% | 97.2% | 98.2% | 94.2% | 97.9% |
| 40% | 95.0% | 98.6% | 89.4% | 96.5% | 97.5% | 98.5% | 94.6% | 98.4% |
| 50% | 95.5% | 98.9% | 89.8% | 97.1% | 97.8% | 98.8% | 95.0% | 98.7% |
| 60% | 95.9% | 99.1% | 90.4% | 97.4% | 98.0% | 99.2% | 95.2% | 98.9% |
| 70% | 96.3% | 99.3% | 90.9% | 97.5% | 98.2% | 99.4% | 95.6% | 98.9% |
| 80% | 96.7% | 99.5% | 91.1% | 97.9% | 98.4% | 99.7% | 95.6% | 98.9% |
| 90% | 97.0% | 99.6% | 91.7% | 98.1% | 98.5% | 99.7% | 95.8% | 99.2% |
| 100% | 97.2% | 100.0% | 92.0% | 100.0% | 98.7% | 100.0% | 96.1% | 100.0% |
| 110% | 97.6% | 100.0% | 92.2% | 100.0% | 98.9% | 100.0% | 96.6% | 100.0% |
| 120% | 97.9% | 100.0% | 92.5% | 100.0% | 99.1% | 100.0% | 96.8% | 100.0% |
| 130% | 98.2% | 100.0% | 93.4% | 100.0% | 99.2% | 100.0% | 96.9% | 100.0% |
| 140% | 98.5% | 100.0% | 94.7% | 100.0% | 99.3% | 100.0% | 97.3% | 100.0% |
| 150% | 98.9% | 100.0% | 95.8% | 100.0% | 99.5% | 100.0% | 97.7% | 100.0% |
| 160% | 99.3% | 100.0% | 98.0% | 100.0% | 99.7% | 100.0% | 98.1% | 100.0% |
| 170% | 99.5% | 100.0% | 98.8% | 100.0% | 99.8% | 100.0% | 99.0% | 100.0% |
| 180% | 99.7% | 100.0% | 99.7% | 100.0% | 100.0% | 100.0% | 99.4% | 100.0% |
| 190% | 99.9% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| 200% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

When we then look at the cumulative distribution of losses by percentage of insured value, the difference becomes even more pronounced (Table 4).

What are the implications of these revised homeowners fire loss tables? By returning to our example for the $100,000 XS of $100,000 layer, several significant changes become apparent. (See Exhibit 3)

As shown, the exposure rate of 7.409%, produced by using the revised homeowners property loss distributions, compares to a Salzmann Table exposure rate of 1.815%. This tremendous increase in the ceding company's exposure rate has two main sources. First, both the $75,000 and $100,000 policy limits represent an exposure to the layer, a fact which was not reflected in the Salzmann Tables. Second, the estimated exposure to the layer produced by the $200,000 policy limits more than doubled.

As an additional consideration, these revised tables also indicate that the $200,000 policy limits represent a potential property loss which could reach as high as $400,000. The property program, as currently structured, would leave the ceding company vulnerable to homeowners property losses within the $200,000 XS of $200,000 layer. An obvious solution to this problem would be for the ceding company to purchase an additional layer of reinsurance protection.

If we look at the revised exposure rate for the $75,000 XS of $25,000 layer (Exhibit 4), the increase over the Salzmann Table estimate is less substantial, with a revised rate of 27.03%, as compared to a Salzmann Table estimate of 15.02%.

TABLE 4

CUMULATIVE LOSS COST DISTRIBUTION BY % OF INSURED VALUE

HOMEOWNERS FIRE LOSSES ONLY

| Loss as a % of Insured Value | Frame-Protected Hartford 1984-88 | Frame-Protected INA 1960 | Frame-Unprotected Hartford 1984-88 | Frame-Unprotected INA 1960 | Brick-Protected Hartford 1984-88 | Brick-Protected INA 1960 | Brick-Unprotected Hartford 1984-88 | Brick-Unprotected INA 1960 |
|---|---|---|---|---|---|---|---|---|
| 5% | 23.2% | 42.8% | 13.6% | 26.9% | 32.3% | 39.3% | 18.4% | 28.8% |
| 10% | 30.9% | 54.2% | 19.0% | 35.9% | 39.9% | 49.4% | 23.6% | 39.2% |
| 20% | 41.1% | 67.4% | 27.6% | 47.8% | 49.2% | 61.9% | 31.6% | 52.2% |
| 30% | 48.8% | 76.8% | 35.2% | 57.5% | 56.4% | 71.7% | 38.3% | 63.1% |
| 40% | 55.6% | 83.9% | 42.3% | 65.7% | 62.9% | 79.7% | 44.7% | 70.6% |
| 50% | 61.7% | 89.0% | 49.1% | 73.2% | 68.3% | 86.5% | 50.6% | 77.5% |
| 60% | 67.1% | 92.7% | 55.3% | 79.6% | 73.1% | 91.9% | 56.1% | 82.8% |
| 70% | 72.1% | 95.5% | 61.2% | 85.7% | 77.3% | 96.0% | 61.3% | 87.3% |
| 80% | 76.5% | 97.6% | 66.7% | 91.3% | 81.3% | 98.3% | 66.3% | 91.8% |
| 90% | 80.6% | 99.1% | 71.9% | 95.7% | 84.9% | 99.3% | 71.2% | 95.9% |
| 100% | 84.2% | 100.0% | 76.7% | 100.0% | 88.0% | 100.0% | 75.9% | 100.0% |
| 110% | 87.5% | 100.0% | 81.3% | 100.0% | 90.8% | 100.0% | 80.1% | 100.0% |
| 120% | 90.3% | 100.0% | 85.8% | 100.0% | 93.1% | 100.0% | 84.0% | 100.0% |
| 130% | 92.7% | 100.0% | 89.9% | 100.0% | 94.9% | 100.0% | 87.7% | 100.0% |
| 140% | 94.8% | 100.0% | 93.4% | 100.0% | 96.5% | 100.0% | 91.1% | 100.0% |
| 150% | 96.5% | 100.0% | 96.2% | 100.0% | 97.9% | 100.0% | 94.2% | 100.0% |
| 160% | 97.7% | 100.0% | 98.2% | 100.0% | 98.8% | 100.0% | 96.8% | 100.0% |
| 170% | 98.6% | 100.0% | 99.3% | 100.0% | 99.4% | 100.0% | 98.5% | 100.0% |
| 180% | 99.2% | 100.0% | 99.8% | 100.0% | 99.7% | 100.0% | 99.7% | 100.0% |
| 190% | 99.6% | 100.0% | 100.0% | 100.0% | 99.9% | 100.0% | 100.0% | 100.0% |
| 200% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

EXHIBIT 3

EXPOSURE RATING EXAMPLE - $100,000 XS OF $100,000 LAYER

| (1) Coverage A Limit | (2) Direct Premium | (3) Reinsurance Retention as a % of Coverage A Limit | (4) Percentage Allocation of Total Premium-Hartford Table Frame-Protected | (5) Reinsurance Retention Plus Limit as a % of Coverage A Limit | (6) Percentage Allocation of Total Premium-Hartford Table Frame-Protected | (7) Exposure Factor (6)-(4) | (8) Exposure Premium (2)X(7) |
|---|---|---|---|---|---|---|---|
| $ 25,000 | $ 200,000 | 400% | 100.0% | 800% | 100.0% | 0% | $ 0 |
| $ 50,000 | $ 200,000 | 200% | 100.0% | 400% | 100.0% | 0% | $ 0 |
| $ 75,000 | $ 200,000 | 133% | 93.4% | 267% | 100.0% | 6.6% | $13,200 |
| $100,000 | $ 200,000 | 100% | 84.2% | 200% | 100.0% | 15.8% | $31,600 |
| $200,000 | $ 200,000 | 50% | 61.7% | 100% | 84.2% | 22.5% | $45,000 |
| | $1,000,000 | | | | | | $89,800 |

$$\text{Exposure Rate} = \frac{\$89{,}800 \times .60 \times 1.10}{1{,}000{,}000} \times 1.0 \times \frac{100}{80} = 7.409\%$$

EXHIBIT 4

EXPOSURE RATING EXAMPLE - $75,000 XS OF $25,000 LAYER

| (1) Coverage A Limit | (2) Direct Premium | (3) Reinsurance Retention as a % of Coverage A Limit | (4) Percentage Allocation of Total Premium-Hartford Table Frame-Protected | (5) Reinsurance Retention Plus Limit as a % of Coverage A Limit | (6) Percentage Allocation of Total Premium-Hartford Table Frame-Protected | (7) Exposure Factor (6)-(4) | (8) Exposure Premium (2)X(7) |
|---|---|---|---|---|---|---|---|
| $ 25,000 | $ 200,000 | 100 0% | 84.2% | 400% | 100.0% | 15.8% | $31,600 |
| $ 50,000 | $ 200,000 | 50.0% | 61.7% | 200% | 100.0% | 38.3% | $76,600 |
| $ 75,000 | $ 200,000 | 33.0% | 51.1% | 133% | 93.4% | 42.3% | $84,600 |
| $100,000 | $ 200,000 | 25.0% | 45.0% | 100% | 84.2% | 39.2% | $78,400 |
| $200,000 | $ 200,000 | 12.5% | 33.5% | 50% | 61.7% | 28.2% | $56,400 |
| | $1,000,000 | | | | | | $327,600 |

$$\text{Exposure Rate} = \frac{\$327,600 \text{ X } .60 \text{ X } 1.10}{1,000,000} \text{ X } 1.0 \text{ X } \frac{100}{80} = 27.03\%$$

## HOMEOWNERS - WIND LOSS DISTRIBUTIONS

In order to address the second shortcoming in the Salzmann Tables, an evaluation of Homeowners wind losses was made, with this being identical in every respect to the fire loss study, except for the removal of the protected/unprotected data split. Cumulative claim count and loss dollar distributions are shown in Table 5.

Clearly, the distribution of wind losses is dramatically different from that of the fire losses. It should be noted, however, that the 1984-88 period did not contain any significant catastrophes, so that the potential for claims to exceed any given percentage of the Coverage A limit may be substantially understated. An industry review of wind losses resulting from Hurricane Hugo could be used as one means of evaluating the loss distribution resulting from a major catastrophe.

Given the large disparity that exists between the fire and wind loss distributions, the question becomes one of how this information can be combined into a coherent rating plan for homeowners property excess of loss reinsurance. One possible method follows:

1. Obtain the ceding company's historical distribution of homeowners losses by cause of loss. For example, fire losses may represent 35% of total incurred losses historically, while wind losses (non-catastrophes) equal 15%, other property losses (theft, water, etc.) equal 35%, and liability losses equal 15%.

2. Calculate exposure rates using both the fire loss tables and the wind loss tables. Assume that the other property causes of loss do not represent an exposure to the treaty.

TABLE 5

CUMULATIVE CLAIM COUNT AND LOSS COST DISTRIBUTIONS
BY % OF INSURED VALUE

HOMEOWNERS WIND LOSSES ONLY

| Loss Size as a % of Insured Value | FRAME Claim Counts | FRAME Losses | BRICK Claim Counts | BRICK Losses |
|---|---|---|---|---|
| 5% | 95.0% | 86.7% | 94.8% | 87.8% |
| 10% | 98.9% | 93.1% | 99.1% | 93.8% |
| 20% | 99.7% | 95.6% | 99.7% | 96.3% |
| 30% | 99.8% | 96.6% | 99.8% | 97.3% |
| 40% | 99.9% | 97.3% | 99.9% | 97.9% |
| 50% | 99.9% | 97.8% | 99.9% | 98.3% |
| 60% | 99.9% | 98.2% | 99.9% | 98.6% |
| 70% | 99.9% | 98.5% | 99.9% | 98.8% |
| 80% | 99.9% | 98.8% | 100.0% | 99.1% |
| 90% | 100.0% | 99.0% | 100.0% | 99.2% |
| 100% | 100.0%* | 99.2% | 100.0%** | 99.3% |
| 110% | 100.0% | 99.4% | 100.0% | 99.4% |
| 120% | 100.0% | 99.5% | 100.0% | 99.6% |
| 130% | 100.0% | 99.6% | 100.0% | 99.7% |
| 140% | 100.0% | 99.7% | 100.0% | 99.8% |
| 150% | 100.0% | 99.8% | 100.0% | 99.8% |
| 160% | 100.0% | 99.9% | 100.0% | 99.9% |
| 170% | 100.0% | 99.9% | 100.0% | 99.9% |
| 180% | 100.0% | 100.0% | 100.0% | 100.0% |
| 190% | 100.0% | 100.0% | 100.0% | 100.0% |
| 200% | 100.0% | 100.0% | 100.0% | 100.0% |

* .04% of claims exceed 100% of insured value
** .03% of claims exceed 100% of insured value

3. Produce a weighted-average exposure rate by weighting the exposure rates produced in (2) by the percentage weights obtained in (1). In our example:

| CAUSE OF LOSS | LOSS WEIGHTS | EXPOSURE RATES $75,000 XS OF $25,000 | EXPOSURE RATES $100,000 XS OF $100,000 |
|---|---|---|---|
| Fire | 35% | 27.03% | 7.41% |
| Wind | 15% | 2.11% * | .43% * |
| Other Property | 35% | 0% | 0% |
| Liability | 15% | N/A | N/A |
| Weighted-Average Exposure Rate: | | 9.78% | 2.66% |

* Derived from loss distributions in Table 5

4. A catastrophe loading would then be added to the weighted average exposure rate, to account for those years which might contain a major windstorm loss. The magnitude of this loading would be dependent upon the expected frequency and severity of such a storm, as well as the cumulative loss distribution developed for catastrophe losses.

This proposed rating methodology has several advantages over simply using the Salzmann Tables. First, it explicitly recognizes the fact that all causes of loss need to be considered, not just fire. If fire losses are only 35% of total losses historically, the exposure rate derived by application of the fire tables should only receive a 35% weight. Second, it recognizes the fact that each cause of loss has its own loss distribution, as was shown with fire and wind. Finally, the revised tables, as previously shown, are directly applicable to the rating of property excess of loss treaties, whereas the Salzmann Tables were based on building losses only.

## COMMERCIAL PROPERTY

In order to address the third shortcoming inherent in the Salzmann Tables, an evaluation of commercial property loss experience was also made. In order to keep things on a manageable level, this analysis was performed on only the small commercial package segment, the so-called "Main Street" book that every primary company professes to write, and every reinsurer has targeted as its "niche." This analysis was further limited to only those policies covering a single location, so that losses and insured values (policy limits) would be directly comparable.

One complication not encountered in the homeowners study was that the building and contents components of commercial property losses needed to be reviewed separately, rather than in combination. Two factors necessitated this split. First, due to the fact that many commercial buildings are leased out to tenants, some commercial policies (the owner's) may cover the structure itself, while other policies (the tenant's) may only include contents coverage. Secondly, for commercial risks there is not the same direct relationship between the building limit and the contents limit as there is with homeowners risks. The relationship of required building and contents limits will vary dramatically by class of business within this commercial segment.

Table 6 provides a comparison between the commercial property claim count distributions and those produced by Salzmann, while Table 7 provides the same comparison for the cumulative loss distributions. As can be seen, the cumulative loss distributions for commercial property fire losses are remarkably similar to the homeowners distributions derived by Salzmann. As with homeowners, however, the distribution of commercial property wind losses is much different from the fire loss distributions (Table 8).

TABLE 6

CUMULATIVE CLAIM COUNT DISTRIBUTION BY % OF INSURED VALUE

COVERAGE: BUILDING LOSSES ONLY    CAUSE OF LOSS: FIRE LOSSES ONLY

| Loss as a % of Insured Value | Frame-Protected Hartford Commercial 1984-88 | Frame-Protected INA Homeowners 1960 | Frame-Unprotected Hartford Commercial 1984-88 | Frame-Unprotected INA Homeowners 1960 | Brick-Protected Hartford Commercial 1984-88 | Brick-Protected INA Homeowners 1960 | Brick-Unprotected Hartford Commercial 1984-88 | Brick-Unprotected INA Homeowners 1960 |
|---|---|---|---|---|---|---|---|---|
| 5% | 86.2% | 92.0% | 76.6% | 91.3% | 88.8% | 93.9% | 81.3% | 92.9% |
| 10% | 92.1% | 95.4% | 82.8% | 94.1% | 93.3% | 96.4% | 87.0% | 95.8% |
| 20% | 94.7% | 97.3% | 88.2% | 95.4% | 95.5% | 97.8% | 89.1% | 96.8% |
| 30% | 96.0% | 98.0% | 89.1% | 96.0% | 96.5% | 98.2% | 89.6% | 97.9% |
| 40% | 96.8% | 98.6% | 91.4% | 96.5% | 97.2% | 98.5% | 89.6% | 98.4% |
| 50% | 97.3% | 98.9% | 92.2% | 97.1% | 97.8% | 98.8% | 90.6% | 98.7% |
| 60% | 97.7% | 99.1% | 93.0% | 97.4% | 98.2% | 99.2% | 91.7% | 98.9% |
| 70% | 98.1% | 99.3% | 93.0% | 97.5% | 98.5% | 99.4% | 92.2% | 98.9% |
| 80% | 98.3% | 99.5% | 93.8% | 97.9% | 98.7% | 99.7% | 94.8% | 98.9% |
| 90% | 98.5% | 99.6% | 94.5% | 98.1% | 99.1% | 99.7% | 94.8% | 99.2% |
| 100% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

TABLE 7

CUMULATIVE LOSS COST DISTRIBUTION BY % OF INSURED VALUE

COVERAGE: BUILDING LOSSES ONLY   CAUSE OF LOSS: FIRE LOSSES ONLY

| Loss as a % of Insured Value | Frame-Protected Hartford Commercial 1984-88 | Frame-Protected INA Homeowners 1960 | Frame-Unprotected Hartford Commercial 1984-88 | Frame-Unprotected INA Homeowners 1960 | Brick-Protected Hartford Commercial 1984-88 | Brick-Protected INA Homeowners 1960 | Brick-Unprotected Hartford Commercial 1984-88 | Brick-Unprotected INA Homeowners 1960 |
|---|---|---|---|---|---|---|---|---|
| 5% | 42.2% | 42.8% | 21.9% | 26.9% | 40.4% | 39.3% | 21.8% | 28.8% |
| 10% | 52.1% | 54.2% | 32.5% | 35.9% | 51.5% | 49.4% | 28.5% | 39.2% |
| 20% | 63.8% | 67.4% | 44.5% | 47.8% | 64.3% | 61.9% | 38.5% | 52.2% |
| 30% | 72.4% | 76.8% | 54.2% | 57.5% | 73.3% | 71.7% | 47.7% | 63.1% |
| 40% | 79.1% | 83.9% | 63.6% | 65.7% | 79.9% | 79.7% | 56.8% | 70.6% |
| 50% | 84.4% | 89.0% | 72.2% | 73.2% | 85.2% | 86.5% | 65.7% | 77.5% |
| 60% | 88.9% | 92.7% | 80.2% | 79.6% | 89.4% | 91.9% | 74.1% | 82.8% |
| 70% | 92.2% | 95.5% | 87.2% | 85.7% | 93.1% | 96.0% | 81.8% | 87.3% |
| 80% | 95.2% | 97.6% | 93.8% | 91.3% | 96.1% | 98.3% | 88.8% | 91.8% |
| 90% | 97.9% | 99.1% | 97.6% | 95.7% | 98.4% | 99.3% | 94.9% | 95.9% |
| 100% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

TABLE 8

CUMULATIVE CLAIM COUNT AND LOSS COST DISTRIBUTIONS
BY % OF INSURED VALUE

COVERAGE: COMMERCIAL PROPERTY - BUILDING LOSSES ONLY
CAUSE OF LOSS: WIND LOSSES ONLY

| Loss Size as a % of Insured Value | FRAME | | BRICK | |
|---|---|---|---|---|
| | Claim Counts | Losses | Claim Counts | Losses |
| 5% | 94.2% | 88.7% | 92.6% | 82.9% |
| 10% | 98.4% | 96.1% | 98.0% | 91.9% |
| 20% | 99.8% | 97.9% | 99.3% | 95.6% |
| 30% | 99.8% | 98.2% | 99.4% | 96.4% |
| 40% | 99.8% | 98.5% | 99.6% | 97.1% |
| 50% | 99.8% | 98.7% | 99.7% | 97.7% |
| 60% | 99.8% | 99.0% | 99.8% | 98.2% |
| 70% | 99.8% | 99.2% | 99.8% | 98.8% |
| 80% | 99.8% | 99.5% | 99.8% | 99.3% |
| 90% | 99.8% | 99.7% | 99.9% | 99.8% |
| 100% | 100.0% | 100.0% | 100.0% | 100.0% |

Contents loss distributions have also been developed for the commercial package segment, with both fire (Table 9) and wind (Table 10) distributions being shown. Generally, contents-only losses would not represent a significant exposure to a property excess of loss reinsurance treaty.

While the commercial property tables that have been developed help address some of the issues that were not addressed by Salzmann, they still do not represent an ideal reinsurance rating tool, due to the fact that building and contents losses have been viewed separately, rather than in combination. This split was necessitated by the relatively small volume of commercial property losses available for analysis. If a larger set of loss data were available, perhaps through ISO, losses could be segregated for a number of building/contents limits combinations, with combined building/contents loss distributions being derived for each combination:

| Building Limit | Contents Limit |
|---|---|
| \$ 0 | \$10,000; 20,000; 50,000; ... 500,000 |
| \$ 25,000 | None; \$10,000; 20,000; ...500,000 |
| \$ 50,000 | None; \$10,000; 20,000; ...1,000,000 |
| \$ 100,000 | None; \$10,000; 20,000; ...2,000,000 |
| . | . . . . |
| . | . . . . |
| . | . . . . |
| \$1,000,000 | None; \$10,000; 20,000; ...10,000,000 |

TABLE 9

CUMULATIVE CLAIM COUNT AND LOSS COST DISTRIBUTIONS

BY % OF INSURED VALUE

COVERAGE: COMMERCIAL PROPERTY - CONTENTS LOSSES ONLY
CAUSE OF LOSS: FIRE LOSSES ONLY

| | Frame-Protected | | Frame-Unprotected | | Brick-Protected | | Brick-Unprotected | |
|---|---|---|---|---|---|---|---|---|
| Loss as a % of Insured Value | Claim Counts | Losses | Claim Counts | Losses | Claim Counts | Losses | Claim Counts | Losses |
| 5% | 53.3% | 25.3% | 48.7% | 17.8% | 64.7% | 29.4% | 59.0% | 23.3% |
| 10% | 69.0% | 35.9% | 60.9% | 26.4% | 77.8% | 40.5% | 74.4% | 33.1% |
| 20% | 79.5% | 49.8% | 73.0% | 39.4% | 86.4% | 54.5% | 81.4% | 46.3% |
| 30% | 84.1% | 59.9% | 78.3% | 49.1% | 89.7% | 64.3% | 84.0% | 56.5% |
| 40% | 86.2% | 68.5% | 80.0% | 57.9% | 91.4% | 72.1% | 86.5% | 65.5% |
| 50% | 88.5% | 75.9% | 81.7% | 66.5% | 92.5% | 78.8% | 87.8% | 73.5% |
| 60% | 90.0% | 82.1% | 81.7% | 74.7% | 93.4% | 84.6% | 89.1% | 79.9% |
| 70% | 91.2% | 87.6% | 86.1% | 82.7% | 94.4% | 89.5% | 89.7% | 85.8% |
| 80% | 92.2% | 92.4% | 88.7% | 89.7% | 95.0% | 93.7% | 89.7% | 91.3% |
| 90% | 93.3% | 96.4% | 88.7% | 95.1% | 95.7% | 97.2% | 91.0% | 96.2% |
| 100% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

TABLE 10

CUMULATIVE CLAIM COUNT AND LOSS COST DISTRIBUTIONS
BY % OF INSURED VALUE

COVERAGE: COMMERCIAL PROPERTY - CONTENTS LOSSES ONLY
CAUSE OF LOSS: WIND LOSSES ONLY

| Loss Size As A % of Insured Value | FRAME | | BRICK | |
|---|---|---|---|---|
| | Claim Counts | Losses | Claim Counts | Losses |
| 5% | 62.3% | 58.7% | 73.2% | 65.0% |
| 10% | 78.7% | 68.4% | 86.6% | 80.8% |
| 20% | 83.6% | 78.8% | 94.7% | 94.4% |
| 30% | 86.9% | 86.4% | 97.6% | 96.4% |
| 40% | 93.4% | 90.2% | 98.1% | 97.4% |
| 50% | 93.4% | 93.2% | 98.6% | 98.2% |
| 60% | 95.1% | 95.4% | 98.6% | 98.9% |
| 70% | 96.7% | 96.8% | 99.0% | 99.5% |
| 80% | 98.4% | 98.3% | 99.5% | 99.6% |
| 90% | 98.4% | 99.1% | 99.5% | 99.8% |
| 100% | 100.0% | 100.0% | 100.0% | 100.0% |

Obviously, Tables 6-10 address only a small number of these limit combinations. It should be noted that in addition to the Building and Contents exposures, Time Element (Business Interruption) coverages should also be included in the definition of loss, and would represent an exposure to a property excess of loss reinsurance agreement. Expanding this analysis by further segregating losses into various Building/Contents/Time Element limits combinations would therefore provide the most appropriate commercial property rating tool. Clearly, however, a massive amount of loss data would be required to perform this analysis.

One possible means of condensing the analysis described above would be to produce a single combined Building/Contents/Time Element loss distribution for each class of commercial business, e.g. Retail/Wholesale; Service/Office; Apartment/Condominium; and Restaurants. Within a given class of business, there may be a consistent relationship between the relative magnitudes of the Building, Contents and Time Element limits required. By comparing the total loss generated from these three coverages to the total limits purchased, an aggregate loss cost distribution can be developed for each class of business. While further investigation into the feasibility of this alternative is required, it seems that this approach has the most potential for advancing the "state of the art" of commercial property excess of loss reinsurance pricing.

# CONCLUSION

In the ongoing debate of art versus science, reinsurance rating remains as much of an art as ever. However, the continued use of Salzmann Tables, under the guise of introducing "science" into the rating equation, is ill-advised. Salzmann Tables are being used inappropriately in many property excess pricing applications today. While this may not pose a serious problem for the working layers of a treaty, due to the existence of a credible experience rate, their continued use on non-working layers is inappropriate. Through the introduction of the revised homeowners loss tables, and the introduction of the commercial property tables, it is hoped that reinsurance actuaries and underwriters can move one step closer to the "science" end of the rating spectrum.