P&C Reinsurance Pricing 101
Ohio Chapter IASA
Focus on Treaty, P&C Reinsurance
Certain concepts apply to Facultative and/or LYH Reinsurance

- Pro-Rata Reinsurance
- Excess of Loss Reinsurance
- Catastrophe Reinsurance
Agenda

- Pro-Rata Reinsurance
  - Types (Quota Share / Surplus Share)
  - Ceding Commission

- Excess of Loss Reinsurance

- Catastrophe Reinsurance
Quota Share: Definition and Example

- A form of Pro Rata reinsurance whereby the reinsurance company assumes a **predetermined, fixed percentage** of all subject business coming within the parameters of the agreement

- **Example:** 75% QS, $1M Policy Limit, $100,000 loss

![Diagram](image)

- $100,000 Loss shared
- 75% Retained and 25% Ceded
Surplus Share: Characteristics

- Surplus Share refers to the concept of ceding the “surplus” amount of liability – the proportion of the policy limit exceeding the retention (of liability)

- A line is equal to the amount retained by the company – the retention of liability

- Limit of coverage is commonly expressed as a given number of lines above the retention, subject to a maximum cession (dollar amount)

- The retention can be fixed or variable and relates to liability (not loss)

- Risk Definition
  - Unique to Surplus Share
  - An essential element, since contracts cede on a per-risk basis
Surplus Share: Fixed Retention Example

What is the amount retained, amount ceded, and cession % for a Surplus Share Agreement with a fixed retention of $100,000 and 9 lines of capacity?

<table>
<thead>
<tr>
<th>Risk Size</th>
<th>Amount Retained ($)</th>
<th>Amount Ceded ($)</th>
<th>Percent Ceded</th>
</tr>
</thead>
<tbody>
<tr>
<td>$400,000</td>
<td>$100,000</td>
<td>$300,000</td>
<td>75.0%</td>
</tr>
<tr>
<td>$300,000</td>
<td>$100,000</td>
<td>$200,000</td>
<td>66.7%</td>
</tr>
<tr>
<td>$75,000</td>
<td>$75,000</td>
<td>$0</td>
<td>0.0%</td>
</tr>
<tr>
<td>$1,500,000</td>
<td>* $600,000</td>
<td>$900,000</td>
<td>60.0%</td>
</tr>
</tbody>
</table>

* As maximum cession is $900,000, the cedent must retain the remainder ($100,000 plus the $500,000 in excess of the maximum cession parameter).
Surplus Share vs. Quota Share

- **Similarities**
  - Both SS and QS are cessions of liability
  - Both offer “first dollar coverage” on all subject risks
  - Premium, losses, and expenses are shared on a proportional basis

- **Differences**
  - Calculation of the cession percentage
    - Fixed with a QS
    - Variable with a SS, based upon risk size
  - SS offers more flexibility, but more administration
  - SS used primarily for property lines, while QS used for both property and casualty
Agenda

- Pro-Rata Reinsurance
  - Types (Quota Share / Surplus Share)
  - Ceding Commission

- Excess of Loss Reinsurance

- Catastrophe Reinsurance
Pro Rata: Ceding Commission Insight

- Insurance Companies have unique expenses that are not present for Reinsurers
- Unless they are reimbursed for these expenses, the cedent is placed at a disadvantage – by sharing a pro rata portion of the premium, but retaining 100% of the associated acquisition costs
- A Ceding Commission is an expense reimbursement paid by the reinsurer to the Ceding Company, for expenses such as:
  - Agents’ Commissions
  - Boards
  - Bureaus
  - Taxes (premium taxes, not income taxes)
  - Other Home Office Expense, but not expenses common to both reinsurer and insurer (e.g., rent, electricity, salaries)

*Acquisition expenses generally range from about 25% to 35% of EP
- Ceding Commissions are the source of surplus relief to a cedent
Pro Rata: Why Have a Ceding Commission?

Income Statement:

<table>
<thead>
<tr>
<th></th>
<th>Reinsurer</th>
<th>Cedent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earned Premiums</td>
<td>$400,000</td>
<td>$600,000</td>
</tr>
<tr>
<td>Incurred Losses</td>
<td>(240,000)</td>
<td>(360,000)</td>
</tr>
<tr>
<td>Expenses</td>
<td>0</td>
<td>(300,000)</td>
</tr>
<tr>
<td>Profit</td>
<td>$160,000</td>
<td>(60,000)</td>
</tr>
</tbody>
</table>

Dis disadvantageous for the cedent
### Pro Rata: 30% Ceding Commission Added to Earlier Example

Here is how the income statement looks with a 30% Ceding Commission:

<table>
<thead>
<tr>
<th></th>
<th>Reinsurer</th>
<th>Cedent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earned Premium</td>
<td>$400,000</td>
<td>$600,000</td>
</tr>
<tr>
<td>Incurred Losses</td>
<td>(240,000)</td>
<td>(360,000)</td>
</tr>
<tr>
<td>Expenses (EP * 30%)</td>
<td>(120,000)</td>
<td>(180,000)</td>
</tr>
<tr>
<td><strong>Profit</strong></td>
<td>$40,000</td>
<td><strong>$60,000</strong></td>
</tr>
</tbody>
</table>

Equitable for the cedent.
Agenda

- Pro-Rata Reinsurance
  - Types (Quota Share / Surplus Share)
    - Ceding Commission
      - Flat
      - Sliding Scale
      - Contingent

- Excess of Loss Reinsurance

- Catastrophe Reinsurance
## Pro Rata: Flat Ceding Commission Example

- Pre-determined, fixed Ceding Commission taken as a percentage of ceded premium

- 40% Quota Share with a flat 30% Ceding Commission:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject Written Premium:</td>
<td>$20,000,000</td>
</tr>
<tr>
<td>% Ceded to Quota Share:</td>
<td>x 40%</td>
</tr>
<tr>
<td>Ceded Written Premium:</td>
<td>$ 8,000,000</td>
</tr>
<tr>
<td>Ceding Commission %:</td>
<td>x 30%</td>
</tr>
<tr>
<td><strong>Ceding Commission:</strong></td>
<td>$ 2,400,000</td>
</tr>
</tbody>
</table>
Pro Rata: Flat Ceding Commission Characteristics

- Very common, popular with both cedents and reinsurers
- Easy to administer
- Ceding commission does NOT change – regardless of loss experience
- *Ideally*, set at cedent’s expenses (acquisition costs)
Pro Rata: Flat Ceding Commissions & RI Margins

- **Year 1 (40% QS, with a 30% Flat CC):**
  - Ceded EP: $8,000,000
  - Ceded IL: -$4,800,000 (= 60% Ceded L/R)
  - Ceding Commission: -$2,400,000 (= 30% of CEP)
  - Reinsurer Margin: $ 800,000 (= 10%)

- **Year 2 (40% QS, with a 30% Flat CC):**
  - Ceded EP: $8,000,000
  - Ceded IL: -$3,840,000 (= 48% Ceded L/R)
  - Ceding Commission: -$2,400,000 (= 30% of CEP)
  - Reinsurer Margin: $1,760,000 (= 22%)

- **Year 3 (40% QS, with a 30% Flat CC):**
  - Ceded EP: $8,000,000
  - Ceded IL: -$6,800,000 (= 85% Ceded L/R)
  - Ceding Commission: -$2,400,000 (= 30% of CEP)
  - Reinsurer Margin: -$1,200,000 (= -15%)

* Note: the Reinsurer Margin is the “cost” of the Quota Share
Pro Rata: Determining the Ceding Commission

- Target is the cedent’s acquisition costs but CCs could also be influenced by:
  - Historical Experience (Loss Ratio)
  - Historical Expenses
  - Override Percentage (Target Profit Margin)
  - Territory of the Business (Catastrophe Exposure)
  - Line of Business / Class of Business
  - Amount of Risk Transfer
  - Cost of Capital (Expected ROE)
  - Other Reinsurance (Inuring Protection)
  - Market Conditions
Pro Rata: Gross Loss Ratio Pick

- A cedent’s historical loss experience is used to generate a loss ratio pick

- Reinsurers need to become comfortable with a loss ratio pick in order to agree upon a ceding commission percentage

- Margins are then developed based on this rate
### Pro Rata: Gross Loss Ratio Analysis Example

<table>
<thead>
<tr>
<th>Policy Year</th>
<th>Annual Written Premium</th>
<th>Reported Loss &amp; ALAE</th>
<th>Estimated Loss Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>19,386,512</td>
<td>28,272,031</td>
<td>145.8%</td>
</tr>
<tr>
<td>2001</td>
<td>22,054,328</td>
<td>53,289,466</td>
<td>241.6%</td>
</tr>
<tr>
<td>2002</td>
<td>30,183,513</td>
<td>48,683,302</td>
<td>161.3%</td>
</tr>
<tr>
<td>2003</td>
<td>46,618,602</td>
<td>50,742,626</td>
<td>108.8%</td>
</tr>
<tr>
<td>2004</td>
<td>89,734,906</td>
<td>64,643,814</td>
<td>72.0%</td>
</tr>
<tr>
<td>2005</td>
<td>107,665,802</td>
<td>72,640,153</td>
<td>67.5%</td>
</tr>
<tr>
<td>2006</td>
<td>101,829,627</td>
<td>68,335,941</td>
<td>67.1%</td>
</tr>
<tr>
<td>2007</td>
<td>81,690,622</td>
<td>22,153,002</td>
<td>27.1%</td>
</tr>
<tr>
<td>2008</td>
<td>47,277,946</td>
<td>11,409,105</td>
<td>24.1%</td>
</tr>
<tr>
<td>2009</td>
<td>45,216,082</td>
<td>8,157,634</td>
<td>18.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>591,657,940</strong></td>
<td><strong>428,327,074</strong></td>
<td><strong>72.4%</strong></td>
</tr>
<tr>
<td><strong>3-Yr. Avg.</strong></td>
<td><strong>230,798,195</strong></td>
<td><strong>101,898,049</strong></td>
<td><strong>44.2%</strong></td>
</tr>
<tr>
<td><strong>5-Yr. Avg.</strong></td>
<td><strong>428,198,903</strong></td>
<td><strong>239,182,016</strong></td>
<td><strong>55.9%</strong></td>
</tr>
</tbody>
</table>

- Company loss ratios vary over the course of ten years
- Newer years less developed than older ones
- Key is to get reinsurers comfortable with the overall pick and to explain changes to the cedent’s portfolio over time
Productivity: Other Factors Influencing Ceding Commissions

- Reinsurers willing to accept a smaller margin

- Changes in primary pricing
  - Rate increases that reduce loss ratios

- Changes in claims adjusting practices

- Re-underwriting the book of business

- Certain risk types being eliminated

- Agents with poor experience being cancelled

- Changing primary deductibles, policy coverages, etc.
Pro Rata: Reinsurer’s Margin

- Reinsurers need to make a margin on reinsurance transactions

- Components of the reinsurer’s margin:
  - The amount reinsurers charge for use of their surplus
  - Risk transfer charge
  - Brokerage
  - Charges for reinsurers’ expenses and profits
  - Charges for ECO/XPL and other miscellaneous coverages
  - Charges for catastrophe exposures
Pro Rata: Sliding Scale Commission Characteristics

- The ceding commission fluctuates based upon the ceded experience of the treaty (Ceded Loss Ratio)
  - Higher commission to the ceding company in the event of better than expected experience
    - Incentivize the cedent to keep the loss ratio low
  - Lower commission in the event of worse than anticipated experience
    - Downside protection for the reinsurer

- Components:
  - Provisional Commission
  - Minimum Commission
  - Maximum Commission
  - Slide
Pro Rata: Sliding Scale Commission Components

- **Provisional Commission:**
  - Provides a starting point for cessions throughout the year

- **Minimum Commission:**
  - Set so the reinsurer retains some risk
  - Without this, the reinsurer could essentially be guaranteed a profit

- **Maximum Commission:**
  - Set so there is a cap on the amount of profit the reinsurer is expected to return to the cedent
  - Without this, the reinsurer would be returning 100% of profit above a certain level
## Pro Rata: Sliding Scale Commission

<table>
<thead>
<tr>
<th></th>
<th>Ceding Commission</th>
<th>Loss Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>25%</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td><strong>Slides 1:1 ⬇️</strong></td>
<td></td>
</tr>
<tr>
<td>Provisional</td>
<td>30%</td>
<td>65%</td>
</tr>
<tr>
<td></td>
<td><strong>Slides 1:1 ⬇️</strong></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>35%</td>
<td>60%</td>
</tr>
</tbody>
</table>
Pro Rata: Contingent Commission Characteristics

- Flat ceding commission with a profit sharing mechanism included

- Contingent commission calculation resembles an income statement
  
  Ceded Earned Premium
  - Ceded Incurred Loss
  - Flat Ceding Commission
  - Reinsurer’s Margin Factor
  - Deficit Carry forward

  Net Profit*

*Apply the Contingent Commission Percentage to Net Profit
Pro Rata: Contingent Commission Example

**Needed Information**
- 60% Quota Share
- 32% Flat Commission
- 15% RHOE
- 40% of Net Profit
- Subject EP $25,000,000
- Subject IL $11,250,000

**Contingent CC Calculation**
- Ceded EP [SEP * 60%] $15,000,000
- Ceded IL [SIL * 60%] -$6,750,000
- Flat CC [CEP * 32%] -$4,800,000
- RHOE Factor [CEP * 15%] -$2,250,000
- Deficit Carry Forward -0-
- Net Profit $1,200,000
- Contingent [NP * 40%] $480,000

**RHOE is a % of CEDED EP Not Subject EP**
Pro Rata: Contingent Commission Considerations

- Setting the flat commission*
  - Analyze cedent’s costs
  - Consider projected loss ratios
  - Reinsurer’s desired margin

* Compared with sliding scale structures, generally lower than a provisional but higher than minimum

- Setting the Reinsurer’s margin (RHOF)
  - Same as sliding scale

- Setting the profit sharing amount
  - Predictability of results
    - Moderate risk may mean up to 50%
    - Higher volatility means a lower contingent % is likely
Agenda

- Pro-Rata Reinsurance

- Excess of Loss Reinsurance
  - Setting Retentions and Limits
  - Developing Rates
    - Loss Costs
    - Exposure/Experience Rating
    - Flat vs. Retrospective Rates

- Catastrophe Reinsurance
General Characteristics of Excess Reinsurance

- $1,500,000 xs $500,000 UNL Per Risk Per Occurrence:
  - **Basis of Coverage**: Per Risk, Per Occurrence
  - Triggers coverage (What is a risk, occurrence?)
  - Other bases of coverage include Per Event, Per Person, Per Policy, Per Insured, etc.

![Diagram showing excess reinsurance layers with $2,000,000 retention, $1,500,000 x $500,000 for loss exceeding $500,000 for recovery.]

Loss Must Exceed $500,000 For Recovery

Retention

$1,500,000 xs $500,000

$2,000,000

$500,000

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Empower Results®
Retentions & Limits

- Factors influencing the determination of retentions and limits:
  - Historical loss frequency / severity
  - Policy limits distribution
  - Company risk appetite
  - Company financial strength and leverage (rating agency implications)
  - Market conditions
  - Price
Retentions & Limits – Loss Trends & Policy Profiles

- Analyze loss frequency and severity; determine predictable losses at various retentions
- Calculate the “Loss Cost” for each layer:
  
<table>
<thead>
<tr>
<th>Year</th>
<th>Ceded Incurred Loss</th>
<th>Subject Earned Premium for the Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>5.20%</td>
<td>3.00%</td>
</tr>
<tr>
<td>2006</td>
<td>5.10%</td>
<td>3.00%</td>
</tr>
<tr>
<td>2007</td>
<td>5.20%</td>
<td>2.95%</td>
</tr>
<tr>
<td>2008</td>
<td>5.10%</td>
<td>3.05%</td>
</tr>
<tr>
<td>2009</td>
<td>5.00%</td>
<td>2.90%</td>
</tr>
</tbody>
</table>

- Review changes to underwriting guidelines, claims-handling philosophy, product types, policy limits distribution, and geographic regions for potential impact on historical trends
- Analyze policy limits distribution for natural “breaks” in the limits profiles
- Determine maximum required treaty capacity to meet needs of the reinsured’s policyholders
  - Some automatic capacity is expensive and facultative may be a more cost-effective option
- Track loss patterns vs. policy limits
Retentions & Limits – Risk Appetite & Market Conditions

- What is management’s attitude toward risk?
  - Are underwriters well-seasoned or inexperienced?
  - Are there new territories and/or lines of business?
  - Is the composition of the portfolio stable over time?
  - Any changes to legal climate or insurance legislation?
  - Any concerns about emerging trends (Pollution, Mold, Terrorism, Cyber-Risk)?

- Can the Company withstand earnings volatility?

- At times, marketplace may require Companies to accept higher (or lower) retentions or limits
  - Reinsurers limit their offerings
  - Reinsurer capacity affected by events reducing their capital bases (i.e., stock market crash, large catastrophe events)

- Recent increase in alternative risk transfer methods has put downward pressure on reinsurance prices
  - Collateralized reinsurance
  - Industry Linked Securities
  - Catastrophe Bonds
Agenda

- Pro-Rata Reinsurance

- Excess of Loss Reinsurance
  - Setting Retentions and Limits
  - Developing Rates
    - Loss Costs
    - Exposure/Experience Rating
    - Flat vs. Retrospective Rates

- Catastrophe Reinsurance
**Excess Reinsurance Rates**

- Generally a percentage of subject premium
  - Based on written or earned premium
- Excess reinsurance rate development:
  - Actuaries estimate the proportion of the subject premium that the reinsurer requires to cover the anticipated loss to the layer (loss cost)
  - The loss cost is the result of a combination of two actuarial studies:
    - Experience Analysis - past loss experience of the ceding company
    - Exposure Analysis - company’s expected book of business and industry data
  - The experience and exposure loss costs are then blended to create one Credibility-Weighted Loss Cost

- Rate = Loss Cost + Expenses + Profit
- Premium rates can be flat or swing rated
Projected Loss Cost

What we want:

Projected Loss Cost = \frac{\text{Trended Ultimate Losses in Reinsurance layer}}{\text{Trended On Level Subject Premium}}

What we have:

“Burn Cost” = \frac{\text{Historical Losses in Reinsurance layer}}{\text{Historical Subject Premium}}
Burn Cost to Projected Loss Cost – Three Adjustments

- **Trend** - Losses are not comparable to losses in other years because they are at different historical cost levels.
  - Example - A house burns down in 2002, the cost to the insurance company was $200,000. If the exact same event were to happen in 2012, the cost would be higher.

- **Development** - Losses are not comparable because they are in different points of their “claim life cycle” & not at ultimate (final) loss amount. (Development)
  - Example - Losses from 2011 are new and their final amount paid is uncertain, whereas most losses from 2001 are closed and their ultimate loss is certain.

- **On-Level** - Historical premium paid for a policy has changed over time due to increases/decreases in exposures and rate changes. (“On–Leveling” premium)
  - Example – A company charged $100 per policy in 2001. Over the last 10 years, the company had filed several rate changes and now the company charges $200 per policy.
Burn Cost to Projected Loss Cost
Solution #1 – Determine Loss Trend Assumption

- Loss trend assumption can be based on...
  - Historical experience
  - Industry data
Loss Development – Several Considerations

- Changes in claim closure rates
- Changes in average case reserves
- New claims department philosophy
- Selection & implementation of trend factors
- Consistency between adjoining excess layers
- Policy Year vs. Report Year vs. Accident Year
- Tail Estimation
- Coverage Issues: Claims Made vs Occurrence
- Shifting claims between years
- Consistent spacing of evaluation ages
- Various methods can be used (B-F, Cape Cod, Paid vs. Incurred)
- Industry development patterns
### Experience Analysis - Example

**ABC Insurance Company**  
**Homeowners Experience Rating - 750,000 xs 250,000**

<table>
<thead>
<tr>
<th>Accident Year</th>
<th>Subject Premium</th>
<th>On-Level Factor</th>
<th>On - Level Premium</th>
<th>Trended Case Incurred LALAE</th>
<th>Case Incurred LDF</th>
<th>Ultimate LALAE</th>
<th>Ultimate Loss Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>10,000,000</td>
<td>1.2560</td>
<td>12,560,000</td>
<td>823,254</td>
<td>1.000</td>
<td>823,254</td>
<td>6.55%</td>
</tr>
<tr>
<td>2001</td>
<td>10,250,000</td>
<td>1.2060</td>
<td>12,361,500</td>
<td>1,500,000</td>
<td>1.000</td>
<td>1,500,000</td>
<td>12.13%</td>
</tr>
<tr>
<td>2002</td>
<td>10,500,000</td>
<td>1.1100</td>
<td>11,655,000</td>
<td>750,000</td>
<td>1.000</td>
<td>750,000</td>
<td>6.44%</td>
</tr>
<tr>
<td>2003</td>
<td>10,750,000</td>
<td>1.0800</td>
<td>11,610,000</td>
<td>750,000</td>
<td>1.000</td>
<td>750,000</td>
<td>6.37%</td>
</tr>
<tr>
<td>2004</td>
<td>11,000,000</td>
<td>1.0700</td>
<td>11,770,000</td>
<td>750,000</td>
<td>1.000</td>
<td>750,000</td>
<td>6.37%</td>
</tr>
<tr>
<td>2005</td>
<td>16,000,000</td>
<td>1.0450</td>
<td>16,720,000</td>
<td>1,368,382</td>
<td>1.000</td>
<td>1,368,382</td>
<td>8.18%</td>
</tr>
<tr>
<td>2006</td>
<td>21,000,000</td>
<td>1.0354</td>
<td>21,743,400</td>
<td>879,056</td>
<td>1.000</td>
<td>879,056</td>
<td>4.04%</td>
</tr>
<tr>
<td>2007</td>
<td>21,250,000</td>
<td>1.0222</td>
<td>21,721,750</td>
<td>734,560</td>
<td>1.0100</td>
<td>741,906</td>
<td>3.42%</td>
</tr>
<tr>
<td>2008</td>
<td>21,500,000</td>
<td>1.0800</td>
<td>23,220,000</td>
<td>875,071</td>
<td>1.0500</td>
<td>918,824</td>
<td>3.96%</td>
</tr>
<tr>
<td>2009</td>
<td>21,750,000</td>
<td>1.0500</td>
<td>22,837,500</td>
<td>928,840</td>
<td>1.2250</td>
<td>1,137,829</td>
<td>4.98%</td>
</tr>
<tr>
<td>2010</td>
<td>22,000,000</td>
<td>1.0030</td>
<td>22,066,000</td>
<td>896,900</td>
<td>1.4000</td>
<td>1,255,660</td>
<td>5.69%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>176,000,000</strong></td>
<td></td>
<td><strong>188,265,150</strong></td>
<td><strong>9,684,214</strong></td>
<td><strong>10,303,062</strong></td>
<td><strong>5.47%</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Last Five</strong></td>
<td><strong>107,500,000</strong></td>
<td></td>
<td><strong>111,588,650</strong></td>
<td><strong>4,314,426</strong></td>
<td><strong>4,933,274</strong></td>
<td><strong>4.42%</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Selected**  
4.42%
Experience Analysis - When to Use

- When experience rating should be used (in conjunction with exposure analysis):
  - Established book of business
  - No significant changes in the book of business

- When experience rating should NOT be used:
  - The necessary data for experience rating is not available
  - There are not enough claims to credibly estimate the expected losses (experience rating may work in lower layers for an account but not have enough claims in higher layers to use experience rating)
  - There are reasons to believe that the book of business has changed significantly or will change significantly
Exposure Rating - Basics

- An exposure analysis looks at a Company’s current policies and industry loss statistics to examine the loss exposure of a reinsurance treaty.

- Similar to an experience analysis, the final output of an exposure analysis is a loss cost.

\[
\text{Projected Loss Cost} = \frac{\text{Projected Losses in Reinsurance layer}}{\text{Expected Subject Premium}}
\]
Exposure Analysis - Key Data Elements

- Current in force policy limit profile with premium
- Projected subject premium by line of business
  - The more detailed, the better
- Industry loss distribution
- Premium by Hazard Group and State (Workers’ Compensation only)
- Projected loss ratio
Exposure Analysis – Projected Loss Ratio Analysis Example

<table>
<thead>
<tr>
<th>AY</th>
<th>Earned Premium</th>
<th>Earned On-Level Factor</th>
<th>Earned Premium</th>
<th>Untrended Premium</th>
<th>Untrended Paid</th>
<th>Untrended Incurred</th>
<th>Trended Premium</th>
<th>Trended Paid</th>
<th>Trended Incurred</th>
<th>Ult LDF Premium</th>
<th>Ult LDF Paid</th>
<th>Ult LDF Incurred</th>
<th>Selected Ultimate</th>
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<tbody>
<tr>
<td>2000</td>
<td>10,000,000</td>
<td>1.256</td>
<td>12,560,000</td>
<td>6,145,120</td>
<td>6,145,120</td>
<td>8,506,283</td>
<td>8,506,283</td>
<td>1.000</td>
<td>1.000</td>
<td>8,506,283</td>
<td>67.7%</td>
<td></td>
<td></td>
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<tr>
<td>2001</td>
<td>10,250,000</td>
<td>1.206</td>
<td>12,361,500</td>
<td>7,828,384</td>
<td>7,828,384</td>
<td>10,520,694</td>
<td>10,520,694</td>
<td>1.000</td>
<td>1.000</td>
<td>10,520,694</td>
<td>85.1%</td>
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<tr>
<td>2002</td>
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<td>1.110</td>
<td>11,655,000</td>
<td>5,506,939</td>
<td>5,506,939</td>
<td>7,185,306</td>
<td>7,185,306</td>
<td>1.000</td>
<td>1.000</td>
<td>7,185,306</td>
<td>61.6%</td>
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<tr>
<td>2003</td>
<td>10,750,000</td>
<td>1.080</td>
<td>11,610,000</td>
<td>7,393,721</td>
<td>7,393,721</td>
<td>9,366,144</td>
<td>9,366,144</td>
<td>1.000</td>
<td>1.000</td>
<td>9,366,144</td>
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<td>2004</td>
<td>11,000,000</td>
<td>1.070</td>
<td>11,770,000</td>
<td>8,361,764</td>
<td>8,361,764</td>
<td>10,283,915</td>
<td>10,283,915</td>
<td>1.000</td>
<td>1.000</td>
<td>10,283,915</td>
<td>87.4%</td>
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<td>16,000,000</td>
<td>1.045</td>
<td>16,720,000</td>
<td>12,254,274</td>
<td>12,254,274</td>
<td>14,632,244</td>
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<td>1.000</td>
<td>1.000</td>
<td>14,632,244</td>
<td>87.5%</td>
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<td>2006</td>
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<td>1.035</td>
<td>21,743,400</td>
<td>10,034,006</td>
<td>10,034,006</td>
<td>11,632,163</td>
<td>11,632,163</td>
<td>1.000</td>
<td>1.000</td>
<td>11,632,163</td>
<td>53.5%</td>
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<td>2007</td>
<td>21,250,000</td>
<td>1.022</td>
<td>21,721,750</td>
<td>14,984,421</td>
<td>15,284,110</td>
<td>16,865,098</td>
<td>17,202,400</td>
<td>1.061</td>
<td>1.010</td>
<td>17,629,930</td>
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<td>2008</td>
<td>21,500,000</td>
<td>1.080</td>
<td>23,220,000</td>
<td>12,479,712</td>
<td>12,978,900</td>
<td>13,636,918</td>
<td>14,182,395</td>
<td>1.103</td>
<td>1.050</td>
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<td>2009</td>
<td>21,750,000</td>
<td>1.050</td>
<td>22,837,500</td>
<td>8,502,649</td>
<td>8,842,755</td>
<td>9,020,460</td>
<td>9,381,279</td>
<td>1.286</td>
<td>1.225</td>
<td>11,547,317</td>
<td>50.6%</td>
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<td>2010</td>
<td>22,000,000</td>
<td>1.003</td>
<td>22,066,000</td>
<td>9,279,850</td>
<td>9,929,440</td>
<td>10,227,323</td>
<td>10,427,323</td>
<td>1.470</td>
<td>1.400</td>
<td>14,184,436</td>
<td>64.3%</td>
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<tr>
<td>Total</td>
<td>176,000,000</td>
<td></td>
<td>188,265,150</td>
<td>102,770,840</td>
<td>104,559,412</td>
<td>121,207,471</td>
<td>123,120,145</td>
<td>130,451,541</td>
<td>69.3%</td>
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<tr>
<td>Last 5</td>
<td>107,500,000</td>
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<td>111,588,650</td>
<td>55,280,638</td>
<td>57,069,211</td>
<td>60,712,885</td>
<td>62,625,559</td>
<td>69,956,955</td>
<td>62.7%</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Credibility Considerations

- Actuaries use the term “credibility” to mean the weight they give to a body of experience.
- There are extreme cases:
  - New (standard) line, new state: Pure exposure
    - Starting a new company to write standard Auto insurance in Arizona
  - Quirky line that few others write, years and years of stable experience: Pure experience
    - Company writing policies on string instruments for symphony members for 50 years
Developing Final Rates

- Using experience and exposure analysis, and considering credibility of analyses, an expected loss cost is generated

- Other factors need to be considered before generating a “final” reinsurance rate
  - **Discount** (time value of money)
    - Payout patterns vary by line of business
    - Excess generally pays out later and may take time for payments to reach that layer
  - **Risk Load**
    - If volatile loss history, more premium may be necessary to bear that risk, even if expected losses are the same
    - Risk load reflects really bad outcomes in the excess layer
  - **Profit and expenses**
    - Reinsurer incurs costs (Contracts, administrative, premium tax)
    - Reinsurer needs to make a profit over time
Flat Rates and Accounting Example

- The following method is used to calculate results under a flat-rated reinsurance Contract:

  Subject Earned Premium: $15,000,000
  
  X Rate: 7.00%
  
  = Developed Premium: $1,050,000
  
  – Ceded Incurred Loss: $500,000
  
  = Reinsurer Margin: $550,000
Swing Rates – Losses Loaded

- Losses Loaded Rate Calculations
  - Minimum = Lowest Lost Cost * Load
  - Provisional = Expected Lost Cost * Load
  - Maximum = Expected Loss Cost * Factor * Load
  - Developed = Ceded incurred losses loaded subject to the min. and max.

- Reinsurer Margin under a losses loaded contract is a function of ceded incurred losses.

- As the ceded incurred losses increase the load times the ceded incurred losses results in a higher developed premium until the maximum rate is reached.
Swing/Retrospective Rating Mechanisms

- Swing Rates have *issues*
  - They might have trouble passing risk transfer tests, due to:
    - Deficit carry forward provisions
    - Cumulative accounting treatment
  - More difficult to administer than flat rates
  - Accounting regulations require insurers to “book to the developed” premium
  - May or may not address IBNR in the developed premium calculation
- Common in professional lines and Europe but not so common in “main street” lines of business
- They are used at the “bottom portion” (i.e., working layers) of a reinsurance program, not “top portions” (i.e., Cat Contracts)
Swing / Retrospective Rating Considerations

- Is the underlying business stable or volatile?
  - Volatile business might simply allow shock losses to drive a swing rate to the maximum reducing the leveling benefit of reinsurance.

- What is the difference between possible flat rates and maximum rates under the swing? Are max rates that much higher than the flat rate?

- Are minimum rates realistically achievable?

- What would be the difference in a reinsurer’s margin under the flat rate or swing rate options, given the expected losses (or range of expected losses)?

- Is there reason to believe future experience will be better or worse than the past?
  - Exposures up/down?
  - Primary rates up/down?
  - Tighter underwriting standards?
Other Rating Issues

- Coverage modifications impact rating/pricing process:
  - Annual Aggregate Deductible (AAD)
  - Franchise Deductible
  - Annual Aggregate Limit/Cap
  - Limited Reinstatements
  - Loss Ratio Limitation/Cap
  - Per Occurrence Limitation (Per Risk treaties)
- All of the above reduce the risk transfer to some extent
Agenda

- General Characteristics of Reinsurance
- Pro-Rata Reinsurance
- Excess of Loss Reinsurance
- Catastrophe Reinsurance
  - Types of Catastrophe Reinsurance
  - Catastrophe Modeling & Effect on Pricing
  - Pure Premium & Pricing
Agenda

- Pro-Rata Reinsurance
- Excess of Loss Reinsurance

- Catastrophe Reinsurance
  - Types of Catastrophe Reinsurance
  - Catastrophe Modeling & Effect on Pricing
  - Pure Premium & Pricing
Types of Catastrophe Reinsurance

- Per Occurrence
  - Responds to the accumulation of smaller losses from one event, such as hurricanes and tornadoes
  - These losses could be net of per risk or other inuring reinsurance Contracts

- Aggregate Excess
  - Responds to the total amount (hence the name “aggregate”) of losses suffered by an insurer over a period of time
  - Usually, these losses are net of the insurer’s Per Occurrence Catastrophe coverage

- Aggregate Stop Loss
  - Responds to the total amount of losses suffered by an insurer over a period of one year
  - Coverage is net of any Per Occurrence or Aggregate Excess coverage and responds on a loss ratio basis
  - Aggregate Stop Loss treaties respond to both cat and non-cat losses
**Reinstatements**

- **Definition of Reinstatement**
  - Restoration of a reinsurance limit after a loss has been paid
- **Reinstatements are simultaneous and mandatory**
- **Additional reinstatement premium based on three elements:**
  - Annual premium
  - Time element
  - Limit being reinstated
    \[ \text{(% of limit reinstated)} \times \text{(time element)} \times \text{(annual premium)} \]

- **Possible options for reinstatement provisions:**
  - “Free” (included in original limit cost as a “pre-paid” reinstatement)
  - Fixed percentage (i.e., 100%, 80%, etc.) for the time element
  - Pro rata as to time element (proportion of the year remaining)
Issues Involved in Setting Cat Retentions & Limits

- Size of Company PHS / Impact on PHS if a Cat occurs

- Sensitivity to Rating Agencies
  - Best’s, S&P, Moody’s

- PMLs for major perils
  - Wind, Tornado/Hail, Earthquake, Terrorism
  - Confidence in model output

- Sensitivity to Earnings per Share (EPS) of a Stock Company

- Inuring Reinsurance affects total limit needed by a Company
  - Public (FHCF, CEA, Wind Pools)
  - Private (inuring reinsurance purchased by Company)

- Past loss experience
  - Too much or too little?

- Pricing and market conditions
Building Property Cat Capacity – Sample Program

- Florida Hurricane Catastrophe Fund
  - 90% of $53M xs $15M
- Retention
  - FHCF (Inures to Per Occ. Cat)

$100M

$60M

$30M

$15M Retention

Per Occurrence Catastrophe XOL

$40M xs $60M

$30M xs $30M

$15M xs $15M

Aggregate Catastrophe

$20M xs $20M

$20M Retention
Agenda

- Pro-Rata Reinsurance

- Excess of Loss Reinsurance

- Catastrophe Reinsurance
  - Types of Catastrophe Reinsurance
  - Catastrophe Modeling & Effect on Pricing
  - Pure Premium & Pricing
Cat Pricing vs. Excess of Loss Pricing

- Excess of Loss pricing is largely an exercise in examining past history
  - Analysis of a Company’s loss history to make assumptions and predict future results
  - Apply loads to historical average loss costs to determine rates

- History alone cannot predict future results
  - Cat reinsurance protects against large single events
  - Little credibility in experience due to so few events
  - Company’s past cat loss history has less bearing than standard XOL pricing

- Cat pricing relies on three models:
  - Applied Insurance Research (AIR)
  - Risk Management Solutions (RMS)
  - EQECAT
Model Output: Exceedance Probability

- AKA “EP”, formerly known as “PML”
- ELTs create EP Curves as well as EP Summaries
- Annual probability that a certain loss threshold is exceeded
- Example: “100-year Gross EP loss is $212M”
  - Probability of exceeding $212M in one year is 1%
  - Return Periods are for a one-year perspective
    - It does not mean that there is a 100% probability of exceeding $212M over the next 100 years
    - It does not mean that 1 year of the next 100 will have loss > $212M
    - It does not mean that there is no chance of having 2 losses > $212M over the next 100 years
- Used for reinsurance purchasing decisions and portfolio management

<table>
<thead>
<tr>
<th>Probability of Non-Exceed</th>
<th>Avg Return Time (Years)</th>
<th>HU+EQ RMS v9</th>
<th>HU+EQ RMS v9</th>
<th>HU+EQ RMS v9</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.90%</td>
<td>1,000</td>
<td>797,142</td>
<td>413,288</td>
<td>399,303</td>
</tr>
<tr>
<td>99.80%</td>
<td>500</td>
<td>700,646</td>
<td>358,104</td>
<td>346,638</td>
</tr>
<tr>
<td>99.60%</td>
<td>250</td>
<td>595,020</td>
<td>298,169</td>
<td>289,195</td>
</tr>
<tr>
<td>99.50%</td>
<td>200</td>
<td>558,778</td>
<td>277,803</td>
<td>269,618</td>
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<tr>
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<td>100</td>
<td>439,554</td>
<td>211,940</td>
<td>206,077</td>
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<tr>
<td>98.00%</td>
<td>50</td>
<td>315,308</td>
<td>146,206</td>
<td>142,312</td>
</tr>
<tr>
<td>96.00%</td>
<td>25</td>
<td>200,485</td>
<td>89,065</td>
<td>86,852</td>
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</table>

Losses in thousands
Exceedance Probability (EP)

- Types of EP Curves:
  - Per Occurrence
    - Addresses question of “How high can the loss get?”
    - Probability of a single occurrence producing a loss of a certain size (i.e. one event)
    - Frequently used in reinsurance placements
  - Aggregate Loss
    - Addresses question of “What is the volatility in the Annual Aggregate Catastrophe Loss?”
    - Probability of having an aggregate loss of a certain size over the course of a year (i.e. multiple events)
    - NOT an Annual Aggregate Loss (AAL)
There is a 1% chance this company will experience a hurricane loss that will exceed $722M in a year.

<table>
<thead>
<tr>
<th>Probability of Non-Exceed</th>
<th>Avg Return Time (Years)</th>
<th>RiskLink v9.0 Oct '09</th>
<th>RiskLink v9.0 Apr '09</th>
<th>Difference</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.90%</td>
<td>1000</td>
<td>1,263</td>
<td>1,809</td>
<td>(546)</td>
<td>(30.2%)</td>
</tr>
<tr>
<td>99.80%</td>
<td>500</td>
<td>1,022</td>
<td>1,486</td>
<td>(464)</td>
<td>(31.2%)</td>
</tr>
<tr>
<td>99.60%</td>
<td>250</td>
<td>783</td>
<td>1,153</td>
<td>(370)</td>
<td>(32.1%)</td>
</tr>
<tr>
<td>99.50%</td>
<td>200</td>
<td>708</td>
<td>1,045</td>
<td>(337)</td>
<td>(32.2%)</td>
</tr>
<tr>
<td><strong>99.00%</strong></td>
<td><strong>100</strong></td>
<td><strong>490</strong></td>
<td><strong>722</strong></td>
<td>(232)</td>
<td><strong>(32.1%)</strong></td>
</tr>
<tr>
<td>98.00%</td>
<td>50</td>
<td>313</td>
<td>464</td>
<td>(151)</td>
<td>(32.6%)</td>
</tr>
<tr>
<td>96.00%</td>
<td>25</td>
<td>188</td>
<td>284</td>
<td>(95)</td>
<td>(33.6%)</td>
</tr>
<tr>
<td>Annual Avg.</td>
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<td>41</td>
<td>61</td>
<td>(20)</td>
<td>(33.0%)</td>
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<tr>
<td>Std. Dev.</td>
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<td>112</td>
<td>162</td>
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<tr>
<td>Insurance in Force</td>
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<td>184,581</td>
<td>193,948</td>
<td>(9,367)</td>
<td>(4.8%)</td>
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<tr>
<td>Risks (Ones)</td>
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<td>127,240</td>
<td>209,917</td>
<td>(82,677)</td>
<td>(39.4%)</td>
</tr>
</tbody>
</table>

In Millions Unless Otherwise Noted
Model Output: Exceedance Probability Frequency vs. Severity

- Regional EP Summaries
  - Florida Region: Higher Frequency and Severity
  - Northeast Region: Lower Frequency, Higher Severity
  - Gulf Region: Higher Frequency, Lower Severity

<table>
<thead>
<tr>
<th>Probability of Non-Exceed</th>
<th>Avg Return Time (Years)</th>
<th>Florida</th>
<th>Gulf</th>
<th>Northeast</th>
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<td>2,154</td>
<td>646</td>
<td>3,004</td>
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<tr>
<td>99.60%</td>
<td>250</td>
<td>1,576</td>
<td>473</td>
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<td>100</td>
<td>936</td>
<td>309</td>
<td>1,028</td>
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<tr>
<td>96.00%</td>
<td>25</td>
<td>372</td>
<td>134</td>
<td>146</td>
</tr>
<tr>
<td>Annual Avg.</td>
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<td>72</td>
<td>22</td>
<td>39</td>
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<tr>
<td>Insurance in Force</td>
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<td>47,194</td>
<td>47,192</td>
<td>471,664</td>
</tr>
<tr>
<td>Risks (Ones)</td>
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<td>135,961</td>
<td>155,393</td>
<td>1,162,463</td>
</tr>
</tbody>
</table>

In Millions Unless Otherwise Noted

RMS Hurricane - Apr '09 Exposures
Average Annual Loss = Mean Loss * Rate
- Rate = Probability of occurring
- Model’s estimate of average loss that can be expected each year
- Reflects combined impact of frequency and severity of events

SAMPLE: AAL BY STATE

AVERAGE ANNUAL LOSS

Florida 45.1%
RI 8.9%
MA 10.9%
TX 9.3%
CT 10.7%
Others 15.1%
Model Output: Average Annual Loss

### Hurricane Loss Model Output

<table>
<thead>
<tr>
<th>Probability of Non-Exceed</th>
<th>Avg Return Time (Years)</th>
<th>RiskLink v9.0 Oct '09</th>
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<tr>
<td><strong>Std. Dev.</strong></td>
<td></td>
<td><strong>112</strong></td>
<td><strong>162</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Millions Unless Otherwise Noted

This company should expect $61M in hurricane losses each year.
# Model Output: Other Measures of Risk Using EP & AAL

<table>
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<tr>
<th>Probability of Non-Exceed</th>
<th>Avg Return Time (Years)</th>
<th>HU+EQ RMS v8 8/31/2009</th>
<th>HU+EQ RMS v8 9/30/2008</th>
<th>2009 to 2008 Percent Change</th>
<th>HU+EQ RMS v9 8/31/2009</th>
<th>2009 v9 to v8 Percent Change</th>
<th>2009 v9 to 2008 v8 Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.90%</td>
<td>1,000</td>
<td>406,657</td>
<td>380,496</td>
<td>6.9%</td>
<td>399,303</td>
<td>(1.9%)</td>
<td>4.9%</td>
</tr>
<tr>
<td>99.80%</td>
<td>500</td>
<td>354,787</td>
<td>328,622</td>
<td>8.0%</td>
<td>346,638</td>
<td>(2.3%)</td>
<td>5.5%</td>
</tr>
<tr>
<td>99.60%</td>
<td>250</td>
<td>298,021</td>
<td>272,863</td>
<td>9.2%</td>
<td>289,195</td>
<td>(3.0%)</td>
<td>6.0%</td>
</tr>
<tr>
<td>99.50%</td>
<td>200</td>
<td>278,636</td>
<td>254,040</td>
<td>9.7%</td>
<td>269,618</td>
<td>(3.2%)</td>
<td>6.1%</td>
</tr>
<tr>
<td>99.00%</td>
<td>100</td>
<td>215,407</td>
<td>193,409</td>
<td>11.4%</td>
<td>206,077</td>
<td>(4.3%)</td>
<td>6.5%</td>
</tr>
<tr>
<td>98.00%</td>
<td>50</td>
<td>150,924</td>
<td>132,574</td>
<td>13.8%</td>
<td>142,312</td>
<td>(5.7%)</td>
<td>7.3%</td>
</tr>
<tr>
<td>96.00%</td>
<td>25</td>
<td>93,483</td>
<td>79,489</td>
<td>17.6%</td>
<td>86,852</td>
<td>(7.1%)</td>
<td>9.3%</td>
</tr>
<tr>
<td>95.00%</td>
<td>20</td>
<td>77,675</td>
<td>65,241</td>
<td>19.1%</td>
<td>71,744</td>
<td>(7.6%)</td>
<td>10.0%</td>
</tr>
<tr>
<td>Total Insured Value</td>
<td>8,987,724</td>
<td>8,256,254</td>
<td></td>
<td>8.9%</td>
<td>8,987,724</td>
<td>0.0%</td>
<td>8.9%</td>
</tr>
<tr>
<td>Insurance in Force</td>
<td>7,384,046</td>
<td>8,154,476</td>
<td></td>
<td>(9.4%)</td>
<td>7,384,046</td>
<td>0.0%</td>
<td>(9.4%)</td>
</tr>
<tr>
<td>Premium</td>
<td>34,128</td>
<td>35,799</td>
<td></td>
<td>(4.7%)</td>
<td>34,128</td>
<td>0.0%</td>
<td>(4.7%)</td>
</tr>
<tr>
<td>Risks (ones)</td>
<td>37,969</td>
<td>44,197</td>
<td></td>
<td>(15.0%)</td>
<td>37,969</td>
<td>0.0%</td>
<td>(15.0%)</td>
</tr>
<tr>
<td>Annual Avg.</td>
<td>13,851</td>
<td>11,765</td>
<td></td>
<td>17.7%</td>
<td>12,686</td>
<td>(8.4%)</td>
<td>7.8%</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>43,385</td>
<td>38,744</td>
<td></td>
<td>12.0%</td>
<td>41,358</td>
<td>(4.7%)</td>
<td>6.7%</td>
</tr>
<tr>
<td>PML:Premium - 100 yr</td>
<td>6.3:1</td>
<td>5.4:1</td>
<td>NA</td>
<td>6.1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>PML:Premium - 250 yr</td>
<td>8.7:1</td>
<td>7.6:1</td>
<td>NA</td>
<td>8.5:1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Loss Ratio (%)</td>
<td>40.6%</td>
<td>32.9%</td>
<td>NA</td>
<td>37.2%</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Loss Cost (%)</td>
<td>0.188%</td>
<td>0.144%</td>
<td>NA</td>
<td>0.172%</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**PML: Premium – 100 year**

- Loss Ratio (%) = 100 Year EP / Premium
- Loss Cost (%) = AAL / Premium
- PML: Premium – 250 Year

**AON Empower Results®**

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Model Output: Exceedance Probability Curve vs. Average Annual Loss

- EP curves are **NOT** additive – When two EP curves are combined the order of the curve changes
- Average annual loss is additive

<table>
<thead>
<tr>
<th>Results</th>
<th>250 Year EP</th>
<th>AAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane</td>
<td>$450.00</td>
<td>$144.00</td>
</tr>
<tr>
<td>Earthquake</td>
<td>$300.00</td>
<td>$48.00</td>
</tr>
<tr>
<td>Combined</td>
<td>$500.00</td>
<td>$192.00</td>
</tr>
</tbody>
</table>

**Combining EP Curve - Simplified Example**

<table>
<thead>
<tr>
<th>EventID</th>
<th>Event Rate</th>
<th>Loss</th>
<th>AAL (Rate*Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HU1</td>
<td>0.050</td>
<td>$1,000</td>
<td>$50</td>
</tr>
<tr>
<td>HU2</td>
<td>0.100</td>
<td>$800</td>
<td>$80</td>
</tr>
<tr>
<td>HU3</td>
<td>0.020</td>
<td>$450</td>
<td>$9</td>
</tr>
<tr>
<td>HU4</td>
<td>0.010</td>
<td>$400</td>
<td>$4</td>
</tr>
<tr>
<td>HU5</td>
<td>0.010</td>
<td>$125</td>
<td>$1</td>
</tr>
</tbody>
</table>

<p>| Earthquake |           |       |                  |</p>
<table>
<thead>
<tr>
<th>EventID</th>
<th>Event Rate</th>
<th>Loss</th>
<th>AAL (Rate*Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ1</td>
<td>0.010</td>
<td>$450</td>
<td>$14</td>
</tr>
<tr>
<td>EQ2</td>
<td>0.010</td>
<td>$500</td>
<td>$9</td>
</tr>
<tr>
<td>EQ3</td>
<td>0.030</td>
<td>$300</td>
<td>$9</td>
</tr>
<tr>
<td>EQ4</td>
<td>0.050</td>
<td>$200</td>
<td>$10</td>
</tr>
<tr>
<td>EQ5</td>
<td>0.100</td>
<td>$100</td>
<td>$10</td>
</tr>
</tbody>
</table>

<p>| Combined - (Earthquake + Hurricane) |           |       |                  |</p>
<table>
<thead>
<tr>
<th>EventID</th>
<th>Event Rate</th>
<th>Loss</th>
<th>AAL (Rate*Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HU1</td>
<td>0.050</td>
<td>$1,000</td>
<td>$50</td>
</tr>
<tr>
<td>HU2</td>
<td>0.100</td>
<td>$800</td>
<td>$80</td>
</tr>
<tr>
<td>HU3</td>
<td>0.020</td>
<td>$450</td>
<td>$9</td>
</tr>
<tr>
<td>HU4</td>
<td>0.010</td>
<td>$400</td>
<td>$4</td>
</tr>
<tr>
<td>HU5</td>
<td>0.010</td>
<td>$125</td>
<td>$1</td>
</tr>
</tbody>
</table>

*"250 Year" height + "250 Year" height = "NOT $450 + $300"

*Does not includes secondary uncertainty, standard deviation or full event set.

"250 Year" height + "250 Year" height = $192 (ADD $144 + $48)
Pure Premiums

- Portion of the Average Annual Loss falling into a specific reinsurance Contract
  - AKA: “Expected Loss”
  - NOT the reinsurance premium
  - Akin to an exposure loss cost
  - Needs to be “grossed-up” for a reinsurer’s margin / expenses
  - May not include all perils (i.e., straight line winds, demand surge, storm surge)
Standard Deviation & Coefficient of Variation

- **Standard Deviation**
  - Measure of volatility around the mean
  - Higher layers have greater standard deviations than lower frequency layers, given measure of uncertainty
  - A percentage of the standard deviation is added to pure premium to generate the price of the layer
  - Commonly referred to as “Risk Load” of “MSD”
  - Cannot compare the SD of one analysis to the SD of another

- **Coefficient of Variation (CV)**
  - Standard Deviation ÷ Mean
  - The larger the CV, the greater the relative variability around the mean loss
  - CV has no “units” (better than using SD for comparison purposes)
Origin of Standard Deviation: Uncertainty

- **Primary Uncertainty**
  - “Uncertainty around whether or not an event will occur, and if an event does occur, which event it will be.”

- **Secondary Uncertainty**
  - “Uncertainty in the size of the loss, given that a specific event has occurred.”

Payout is either $0 or $100. The uncertainty in the payout is considered primary uncertainty.

Payout is $0 or a range between $80 and $120. The uncertainty in how much will be paid given that there is a payout is the secondary uncertainty. If there is a payout, avg payout is $100 – as with the first example.
### Pure Premium Calculator Output

#### Analysis of Excess of Loss Layers Using RiskLink v9

**Exposure Data as of 6/30/2009**

**Near-term Perspective**

<table>
<thead>
<tr>
<th>Hurricane</th>
<th>Yes</th>
<th>Storm Surge</th>
<th>Yes</th>
<th>Pure Premium</th>
<th>4,406,201</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake</td>
<td>No</td>
<td>Fire Following</td>
<td>No</td>
<td>Standard Deviation (Expected Basis)</td>
<td>15,014,884</td>
</tr>
<tr>
<td>Tor/Hail</td>
<td>No</td>
<td>Pure Standard Coefficient</td>
<td>3.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss Amp.</td>
<td>Yes</td>
<td>Coefficient of Variation</td>
<td>4.13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Limit Retention</th>
<th>Pure Premium</th>
<th>Standard Deviation</th>
<th>Coefficient of Variation</th>
<th>Attachment Probability</th>
<th>Return Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000,000 15,000,000</td>
<td>680,141</td>
<td>2,956,025</td>
<td>4.35</td>
<td>6.76%</td>
<td>14.79</td>
</tr>
<tr>
<td>30,000,000 30,000,000</td>
<td>532,272</td>
<td>3,630,175</td>
<td>6.82</td>
<td>2.92%</td>
<td>34.20</td>
</tr>
<tr>
<td>40,000,000 60,000,000</td>
<td>247,655</td>
<td>2,850,656</td>
<td>11.51</td>
<td>1.00%</td>
<td>100.39</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Limit Retention</th>
<th>Deposit Premium</th>
<th>ROL</th>
<th>Risk Load Factor</th>
<th>Reinstatement Premium</th>
<th>Total Premium</th>
<th>Including Reinstatement</th>
<th>Excluding Reinstatement</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000,000 15,000,000</td>
<td>2,253,292</td>
<td>15.02%</td>
<td>53.22%</td>
<td>102,170</td>
<td>2,355,463</td>
<td>71.12%</td>
<td>69.82%</td>
</tr>
<tr>
<td>30,000,000 30,000,000</td>
<td>2,553,821</td>
<td>8.51%</td>
<td>55.69%</td>
<td>45,311</td>
<td>2,599,132</td>
<td>79.52%</td>
<td>79.16%</td>
</tr>
<tr>
<td>40,000,000 60,000,000</td>
<td>1,958,055</td>
<td>4.90%</td>
<td>60.00%</td>
<td>12,123</td>
<td>1,970,178</td>
<td>87.43%</td>
<td>87.35%</td>
</tr>
</tbody>
</table>

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Making Pure Premiums into Deposit Premiums

- Pure Premium + (Standard Deviation * Load %) = Deposit Premium
  - Each reinsurer has a different approach
  - Market pricing trends support this approach most often
  - Geography (Midwest vs. Southeast) and peril (Wind vs. Earthquake) cause variations to this approach
  - Research shows somewhere between 30% and 50% of the Standard deviation added to the pure premium gives a close approximation to the range of quotes
Pricing Example

- Estimated Deposit Premiums using 50% load on Standard Deviation.

<table>
<thead>
<tr>
<th>Limit</th>
<th>Retention</th>
<th>Pure Premium</th>
<th>Standard Deviation</th>
<th>Deposit Premium</th>
<th>Rate on Line</th>
<th>Margin $</th>
<th>Margin %</th>
</tr>
</thead>
<tbody>
<tr>
<td>$15,000,000</td>
<td>$15,000,000</td>
<td>$680,141</td>
<td>$2,956,025</td>
<td>$2,158,153</td>
<td>14.39%</td>
<td>$1,478,012</td>
<td>68.49%</td>
</tr>
<tr>
<td>$30,000,000</td>
<td>$30,000,000</td>
<td>$532,272</td>
<td>$3,630,175</td>
<td>$2,347,360</td>
<td>7.82%</td>
<td>$1,815,088</td>
<td>77.32%</td>
</tr>
<tr>
<td>$40,000,000</td>
<td>$60,000,000</td>
<td>$247,655</td>
<td>$2,850,656</td>
<td>$1,672,983</td>
<td>4.18%</td>
<td>$1,425,328</td>
<td>85.20%</td>
</tr>
</tbody>
</table>

- Actual Deposit Premiums based on Market Feedback.

<table>
<thead>
<tr>
<th>Limit</th>
<th>Retention</th>
<th>Pure Premium</th>
<th>Standard Deviation</th>
<th>Deposit Premium</th>
<th>Rate on Line</th>
<th>Margin $</th>
<th>Margin %</th>
</tr>
</thead>
<tbody>
<tr>
<td>$15,000,000</td>
<td>$15,000,000</td>
<td>$680,141</td>
<td>$2,956,025</td>
<td>$2,250,000</td>
<td>15.00%</td>
<td>$1,569,859</td>
<td>69.77%</td>
</tr>
<tr>
<td>$30,000,000</td>
<td>$30,000,000</td>
<td>$532,272</td>
<td>$3,630,175</td>
<td>$2,850,000</td>
<td>9.50%</td>
<td>$2,317,728</td>
<td>81.32%</td>
</tr>
<tr>
<td>$40,000,000</td>
<td>$60,000,000</td>
<td>$247,655</td>
<td>$2,850,656</td>
<td>$2,200,000</td>
<td>5.50%</td>
<td>$1,952,345</td>
<td>88.72%</td>
</tr>
</tbody>
</table>
Pricing Mechanisms: Rate on Line and Payback

- Cat pricing is often done on a Rate on Line or Payback basis
- Rate on Line (ROL) is stated as a function of what percentage of the treaty (or layer) limit is funded by the reinsurance premium collected for that year
  - Reinsurance premium / layer limit
  - Premium of $2.25M and a reinsurance layer limit of $15M generates a 15% rate on line
- Payback is stated as the number of years a reinsurer would need to collect premium in order to be “paid back” in the event of a total loss
  - Layer limit / reinsurance premium
  - A layer limit of $15M and a reinsurance premium of $2.25M translates to a payback of 6.7 years
  - In the event of a total loss, it would take a reinsurer 6.7 years to be paid back if the layer limit and reinsurance premium were to stay constant
Agenda

- Pro-Rata Reinsurance
- Excess of Loss Reinsurance
- Catastrophe Reinsurance

Thank you for your time and attention!

Any questions?