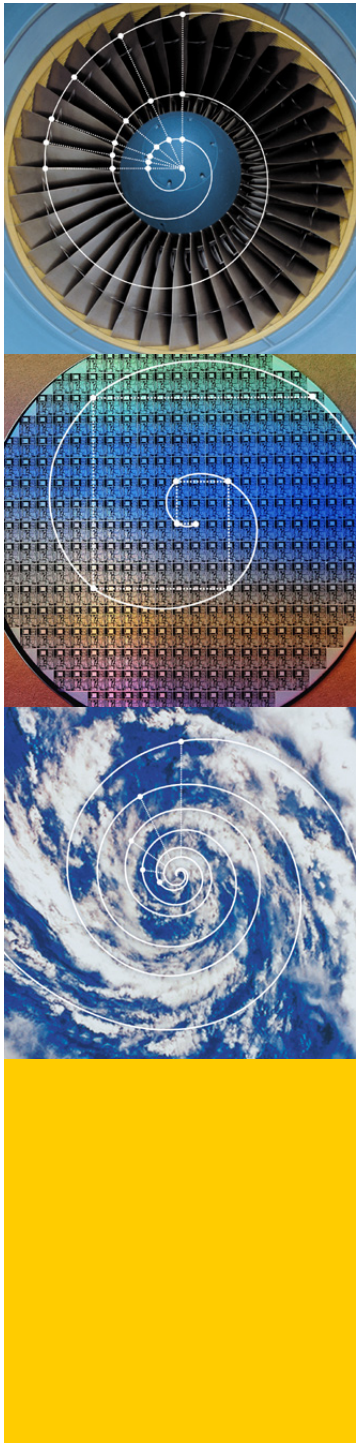


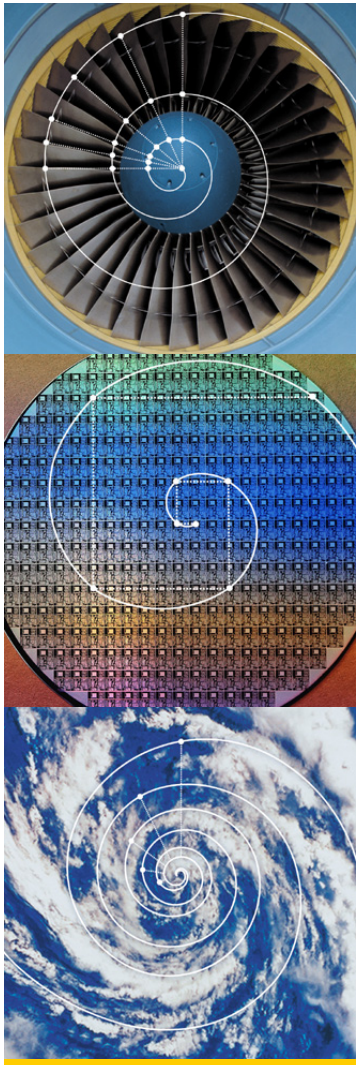
Endurance

Unique Applications of Exposure Rating: Surety

June 1 & 2, 2006

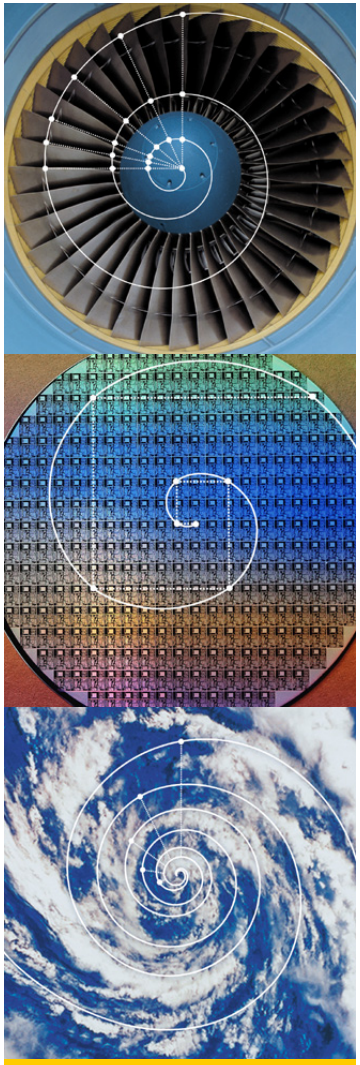
David Curtis, Pricing Actuary

Endurance Reinsurance Company of America



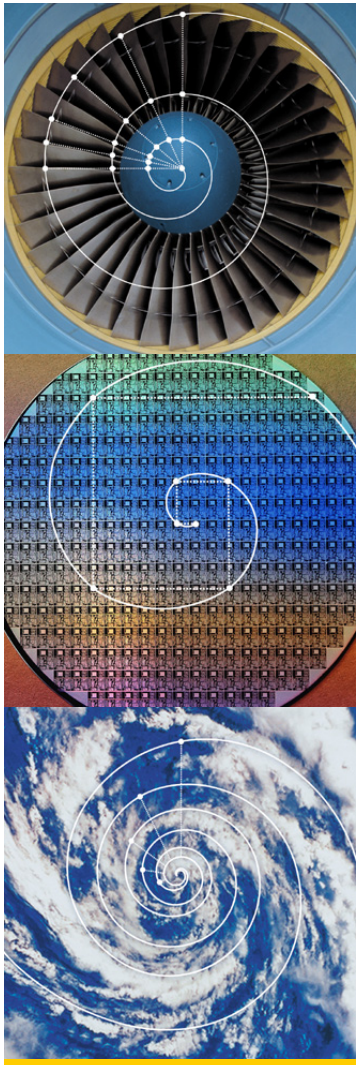
What is a surety bond?

- A surety bond is a written agreement that usually provides for monetary compensation in case the principal fails to perform the acts as promised. There are two general categories:
  - **Contract Surety** – Used in the construction industry
    - Performance Bonds
    - Payment Bonds
    - Bid Bonds
  - **Commercial/Miscellaneous Surety** – Usually required by law for a particular profession, occupation or activity. Guarantees some kind of financial or indemnity obligation or the fidelity of an individual. Includes License and Permit, Public Official, Financial Guarantee, Court, Maintenance, Supply, Customs, Self insured WC, etc.



Surety Excess of Loss Rating Prior to 2004 SAA Study – Typical Approaches

- Lack of industry severity curves and data.
- Swiss Re PML Study
  - Provided average loss as a percent of work on hand, which varied by size of risk.
  - Not available to most people in the industry.
- Largely experience rating & judgment based.
- Some reinsurers created rough exposure models:
  - Property Per Risk Methodology applied to work on hand.
  - Simulation models: Default rates used for frequency, rough variability around average loss for severity
- Results: Combination of soft market & weak pricing tools led to poor excess of loss experience. Lack of good exposure model hurt credibility of actuaries & underwriters working in this LOB.



SAA 2004 Construction Loss Severity Study - Data

- SAA conducted industry-wide study collecting losses >$250k for contractors in the US.
- 40 member companies submitted 1,000+ losses that occurred between 1/1/97 & 12/31/02.
- The losses include indemnity, loss adjustment expense and are net of salvage.
- The study classifies each loss by contractor type, region & concentration and projects the following:
  - PEL: average loss severity, i.e. for a given open bond limit band the average loss divided by the open bond limit.
  - PML: 90th percentile of possible loss severities.
- Data is on a per principal (not per bond) basis.
  - Corresponds to most excess of loss treaty structures.

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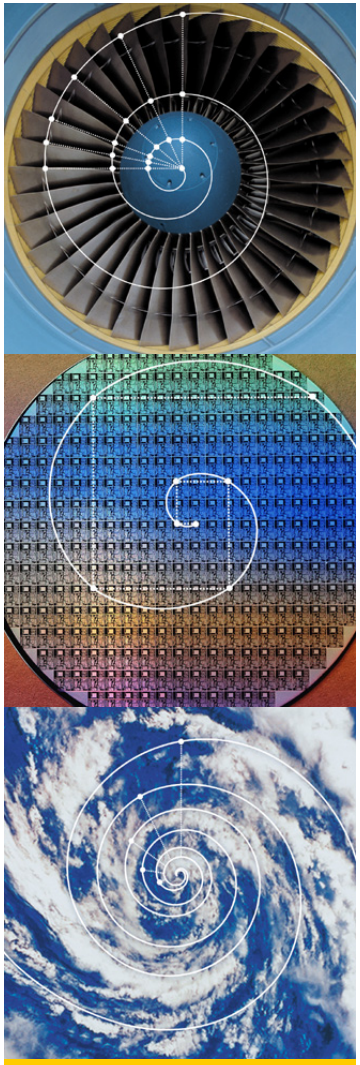

SAA Exposure Base

Determining an exposure base.

- SAA recommends Total Open Bond Limits = In-Force Bond Limits + Bond Limits expired in the last 12 months.
- Includes bond limits expired in the past 12 months to account for exposure to defective workmanship and payment bonds after job has been completed.
- Better than Work on Hand
  - Definition: For any bond, an estimate of the uncompleted work. Prior to SAA study, work on hand was the most commonly used exposure base.
  - Open bond limits are a more objective measure that is standard for all companies.
  - Calculation of work on hand varies considerably by client.

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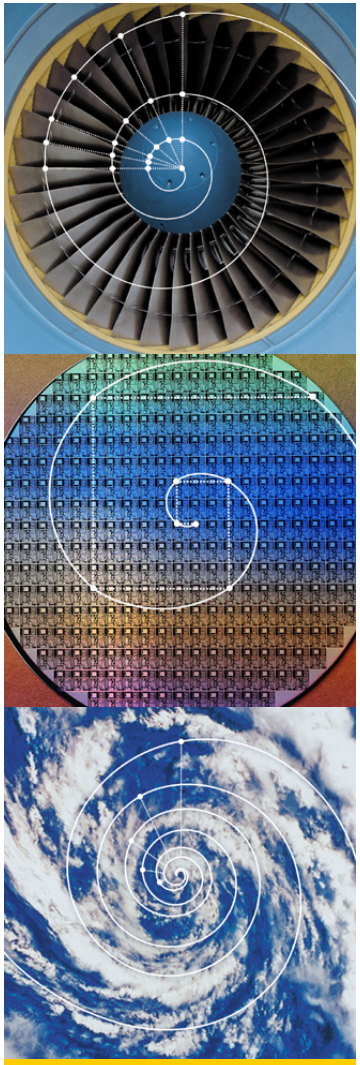
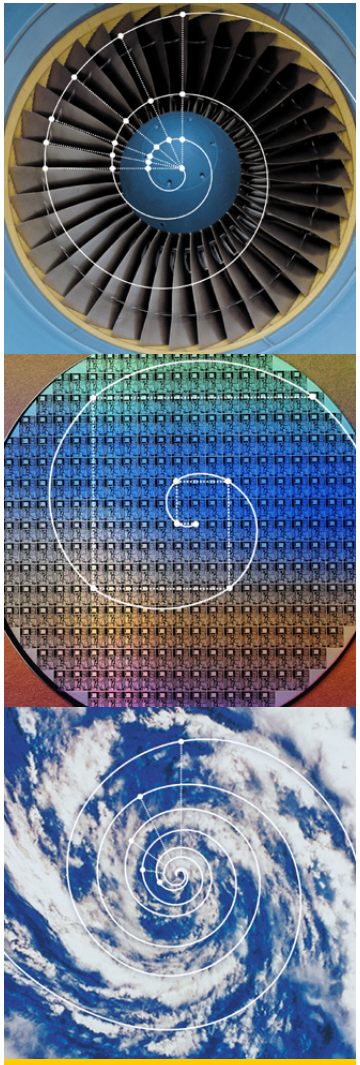


SAA Classifications

The PEL and PML vary by:

- **Type of Contractor** - General Contractor, Sub-Contractor, Highway Contractors, Subdivisions, Other Specialty
- **Size of Contractor** - as principal size increases the PEL's and PML's as a percent of the open bond limit decreases.
- **Concentration Factor** – The percent of the total open bond limit represented by the largest bond.
  - The higher the concentration factor the higher the PEL and PML.
- **Region Factor** – Certain regions have historically had higher severities. Credibility of these factors are questionable.



SAA Calculation of PEL and PML

PEL% = (BASE PEL% + CONC FACTOR%) x (1 + REGION FACTOR%)

PML% = (BASE PML% + CONC FACTOR%) x (1 + REGION FACTOR%)

- Concentration and region factors vary in each calculation.
- MFL (Maximum Foreseeable Loss) is based on max loss as a percent of limit observed in the study.

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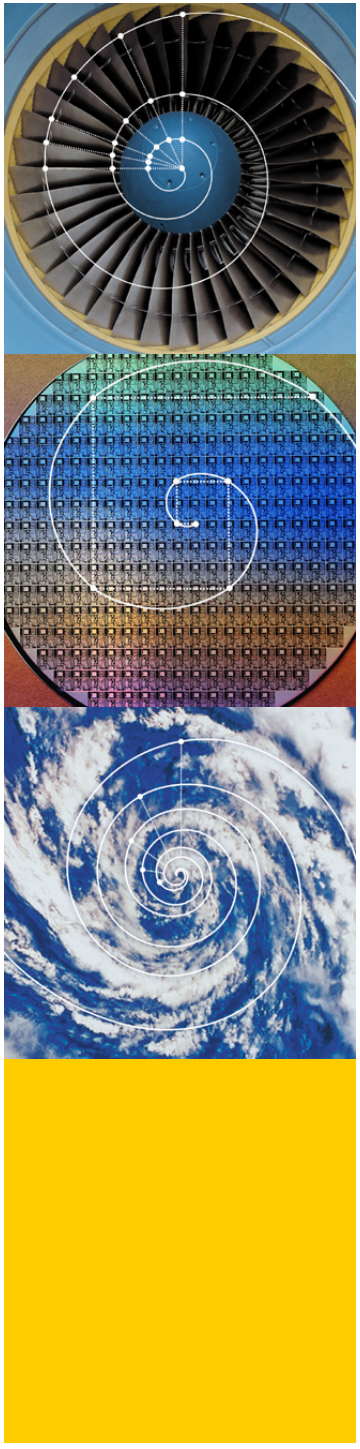

Sample Results by Principal Size

PEL, PML, MFL Comparison by Limit Band

Limit	Avg PEL	Avg PML	MFL
0-1m	60%	120%	650%
1m-2m	50%	105%	550%
2m-5m	30%	60%	175%
5m-20m	20%	40%	125%
20m-50m	15%	30%	95%
50m-100m	15%	30%	90%
100m-200m	10%	25%	80%

As limits increase, PEL and PML percentages decrease.

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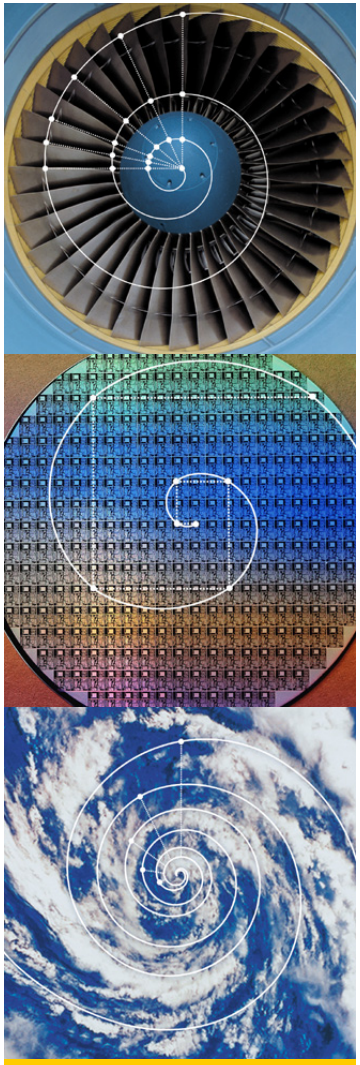
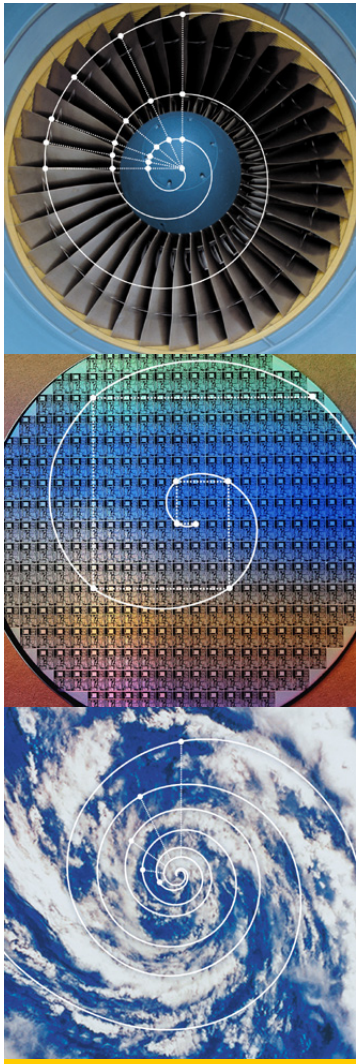


Fitting to a Beta Distribution

- Solving for Alpha, Beta and Theta (maximum loss as a % of open bond limit):
  - If alpha = 1, then find parameters that best fit to the SAA PEL and PML (i.e. 90th percentile)
    - PEL = (Theta)/(Beta +1)
    - 10% = (1-PML/Theta)^Beta
    - Solution:
      - If Alpha = 1 then the PML/PEL ratio is about 2 – 2.3
      - If Alpha = 2 then the PML/PEL ratio is about 1.6 – 1.9.
  - Since data from study indicates that this ratio is between 1.9 and 2.25 we selected an alpha close to 1.0.
  - Once we have a PEL, Theta and Alpha we can back into Beta using the formula Beta = (Theta * Alpha / PEL) – Alpha.

- Plug the parameters into Limited Expected Severity formula and divide by the PEL to create a "percent of loss" formula.



Beta Distribution Formulas

$$F(x) = \beta(a, b; x / \theta)$$

$$E[X] = \theta * a / (a + b)$$

$$LEV[X] = E[X] * \beta(a+1, b; x / \theta) + x[1 - \beta(a,b; x / \theta)]$$

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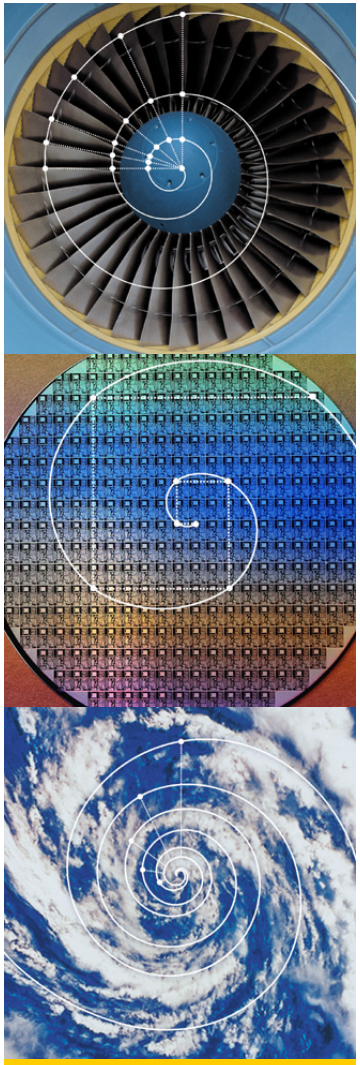
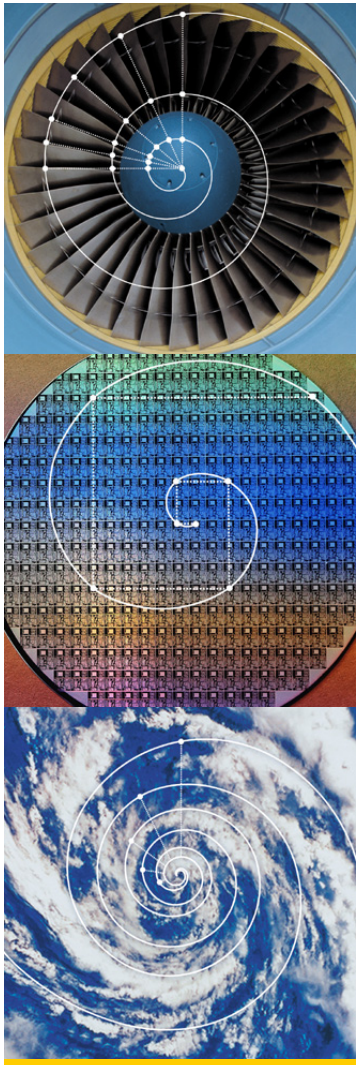


Exposure Rating Application

- Approach 1: Determine client gross loss ratio. Apply gross loss to each principal, allocate loss to layer using Beta curves.
- Approach 2: Use default rates by principal for frequency, average severity and allocation of loss to layer provided by Beta curves.
- Issues
  - Some client have internal credit rating that can be matched to Moody's default rates
  - Approach 2 can be used to test adequacy of client pricing.
  - Credit rating of contractors rarely provided in reinsurance submission.
  - Many contractors are too small to be rated by S&P or Moody's.
  - Moody's default is a missed payment, which may not lead to a surety default. May need softening factor (see Steinbach & Alwis paper – give more details)
  - Validation: Compare loss ratio implied by SAA PEL's and selected default rates to client historical loss ratios.



Using Default Rates in Exposure Rating

Year	Loss Ratio	Average 1 Year Default Rate
1995	30.0%	0.5%
1996	44.0%	0.6%
1997	31.0%	0.5%
1998	55.0%	0.5%
1999	42.0%	0.6%
2000	80.0%	1.0%
2001	50.0%	0.7%
2002	41.0%	0.9%
2003	50.0%	1.0%
2004	39.0%	1.0%
2005	69.0%	1.1%
Current		0.5%
Average	**48.0%**	0.7%

- Although current default rates are lower we decided to take a long term average to avoid fluctuation in loss costs.
- 2002-Current Default Rates are median Moody's 1 year EDF based on financial statements at the end of 1Q for the construction industry. Prior years are estimated using the change in the overall Moody's 1 year EDF for all industries.
- Loss Ratios seem to be weakly correlated with default rates.

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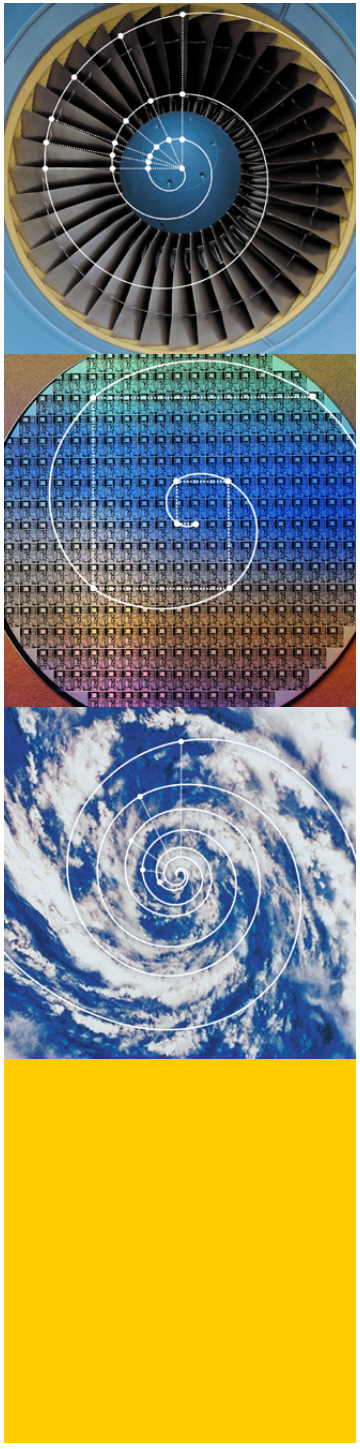

Using Default Rates in Exposure Rating, continued

R/I Limit:	$1,000,000									
R/I Retention:	$1,000,000									
Loss Ratio:	48.0%									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Principal	Total Open Bond Limit	Premium	PEL	% of Loss in Layer Per Exposure Model	Freq. Using Loss Ratio	Default Rate for the principal	Adjusted Default Rate	Loss in Layer using Loss Ratio	Loss in Layer using Default Rates	Loss Ratio used in Default Rate Scenario
A	$250,000	$2,250	$150,000	0.01%	0.72%	0.28%	0.39%	$0	$0	25.9%
B	$250,000	$3,991	$150,000	0.01%	1.28%	1.70%	2.34%	$0	$0	87.9%
C	$1,250,000	$7,446	$625,000	18.00%	0.57%	0.20%	0.28%	$643	$312	23.3%
D	$1,250,000	$13,204	$625,000	18.00%	1.01%	1.10%	1.52%	$1,141	$1,708	71.9%
E	$6,000,000	$24,034	$1,500,000	28.05%	0.77%	0.17%	0.23%	$3,236	$962	14.3%
F	$6,000,000	$42,621	$1,500,000	28.05%	1.36%	0.76%	1.05%	$5,738	$4,429	37.1%
G	$30,000,000	$64,927	$4,500,000	16.04%	0.69%	0.15%	0.20%	$5,000	$1,479	14.2%
H	$30,000,000	$115,138	$4,500,000	16.04%	1.23%	1.10%	1.52%	$8,867	$10,979	59.4%
I	$75,000,000	$149,079	$10,500,000	7.44%	0.68%	0.14%	0.19%	$5,325	$1,463	13.2%
J	$75,000,000	$264,368	$10,500,000	7.44%	1.21%	1.81%	2.49%	$9,442	$19,493	99.1%
		$687,058			9.53%	7.40%	10.21%	$39,392	$40,825	57.3%
	(5) Average Loss Ratio * column 2 / column 3									
	(7) Average Default Rate / Current Default Rate * column 6									
	(8) Average Loss Ratio * column 2 * column 4									
	(9) column 7 / column 5 * column 8									
	(10) column 3 * column 7 / column 2									

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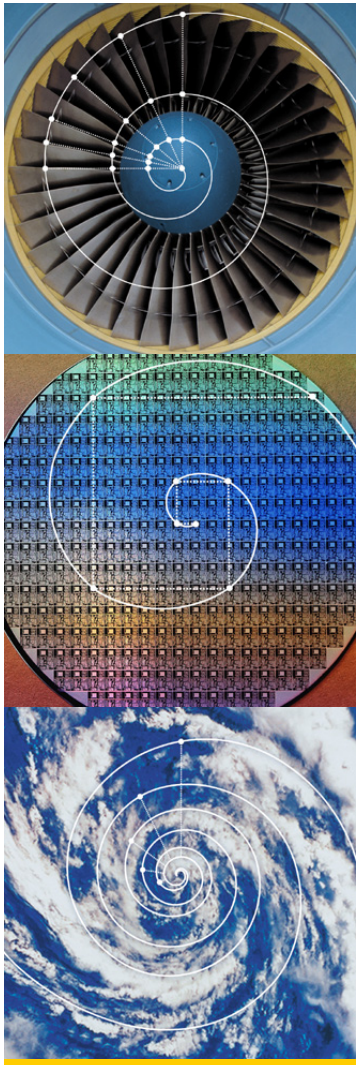


Model Modifications

Testing:

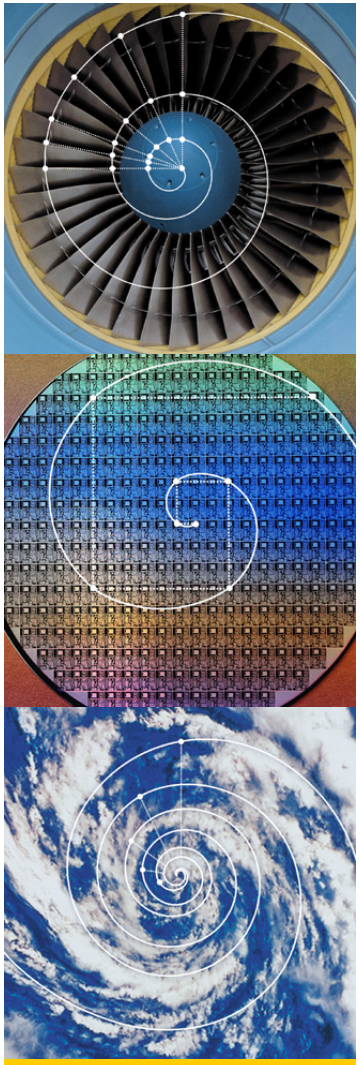
- Across a portfolio of excess of loss contracts, compare indicated exposure and experience loss costs.

Commercial Bonds:

- SAA is considering performing a commercial surety severity study but the general consensus is that there is a lack of large losses to evaluate. In the meantime, we modify the contract study for use on the commercial side.
- Judgmentally assume severity is 25% to 50% higher than for contract surety.
- Don't include expired bond limits in exposure base, as there are no faulty workmanship issues.
- Cap Theta, the maximum loss parameter, at 100% since no loss can exceed the bond amount.

Foreign Bonds:

- Some countries require bond penalties less then 100%, In these instances, I would divide the amount bought by the percentage requirement to convert it to the 100% amount, Then I would adjust the MFL (Theta) to equal the normal MFL * the percentage purchased.
  - Example: If a $500,000 bond is purchased in a 50% bond penalty country I would evaluate this bond as a $1 million bond and used a MFL of 50% of the $1 million MFL



Final Comments

- Exposure rating approach reasonable compared to experience
- Exposure rating approach supported by industry data has increased credibility of actuaries in this line of business.
- Approach should be applied to pro-rata treaties in determining large risk load

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