



Capital Modelling – Stress Testing on Steroids

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Content

- Making sense of capital models, drawing direct comparisons with stress testing
- Benefits of capital modeling, with case studies related to practical uses
- Encourage everyone to consider potential uses of capital modeling to their work

Singapore Stress Testing

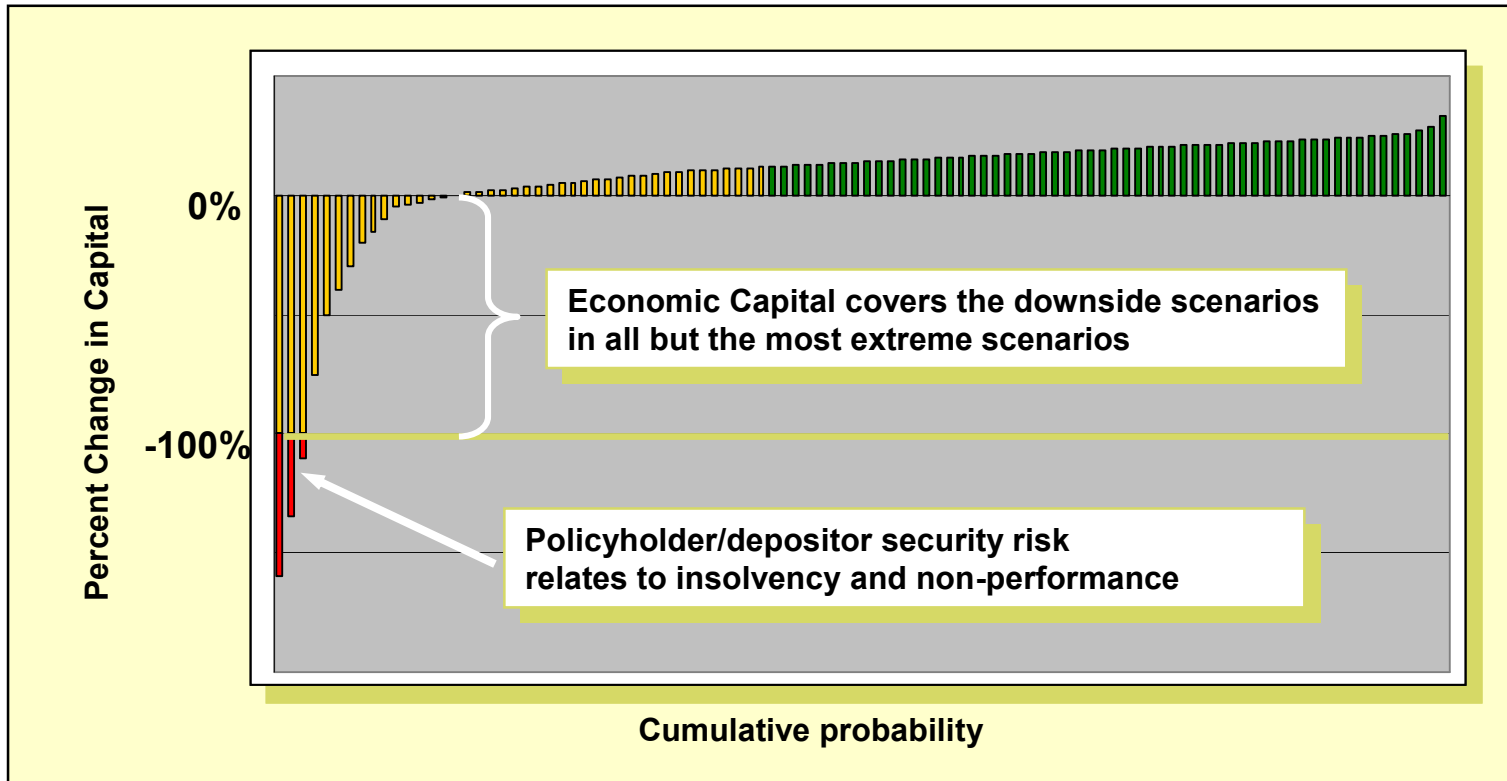
- Base scenario with forecasted capital positions for next 3 years
- Short term stress scenarios only (12 months)
 - Macroeconomic scenario
 - Large loss event scenario (man made or natural)
 - Short term stress-to-failure scenario
- Senior management must review the certifying actuary's report and respond to certifying actuary's proposed recommendations

What is capital?

- For modeling purposes:
 - Capital is generally a constraint on business
 - It is quantifiable
 - Return on capital is generally seen as a measure of performance
- But in order to measure risk and performance, an absolute measure doesn't work well for everyone, so we use relative measures
 - In stress testing, we use risk-based capital
 - For more sophisticated decision-making, Economic Capital can be more useful

The basic idea of Economic Capital is straightforward

- At its most fundamental level, economic capital addresses the question: *What level of assets is needed today to provide reasonable assurance that future obligations can be met?*



Why model capital?

Some results from Towers Watson Solvency II survey

- Industry has embraced the concept
 - Roughly 68% of the industry participated in the latest Quantitative Impact Study (QIS 5)
- Benefits
 - Improved understanding of risks in insurers, leading to better capital management and pricing
 - Consistent reporting leading to a better understanding of the insurance industry by investors
 - A risk based regulatory capital requirement that responds to changes in the insurer's risk profile
- Growing shift in taking risk and capital management seriously
 - 2/3 of survey respondents say Solvency II will benefit the industry
 - 1/3 think that it will benefit their company, more believe that it will benefit other companies

Next step: the business plan

- Typical items needed for stress testing:
 - Gross premiums
 - Gross claims
 - Reinsurance payments and recoveries
 - Expenses
 - Investment returns
 - Other items...
 - Financial resources
 - Risk charges
 - FSR/ CAR
- Important to keep the business plan realistic

Typical integrated / stochastic capital model inputs

- Gross Premiums
 - Variability around premium income
- Gross Claims
 - Variability around attritional claims
 - Large Simulated individually – e.g. Poisson Frequency, Pareto Severity
 - Cats from External CAT model
 - Historic claims runoff - Reserve risk from bootstrapping
- Reinsurance
 - Individual Excess of loss layers applied to simulated losses
 - RI bad debt from reinsurers on each layer defaulting
- Expenses
- Investments
 - Driven by ESG
- Dependencies

Determine impact on capital if actual business deviates from plan

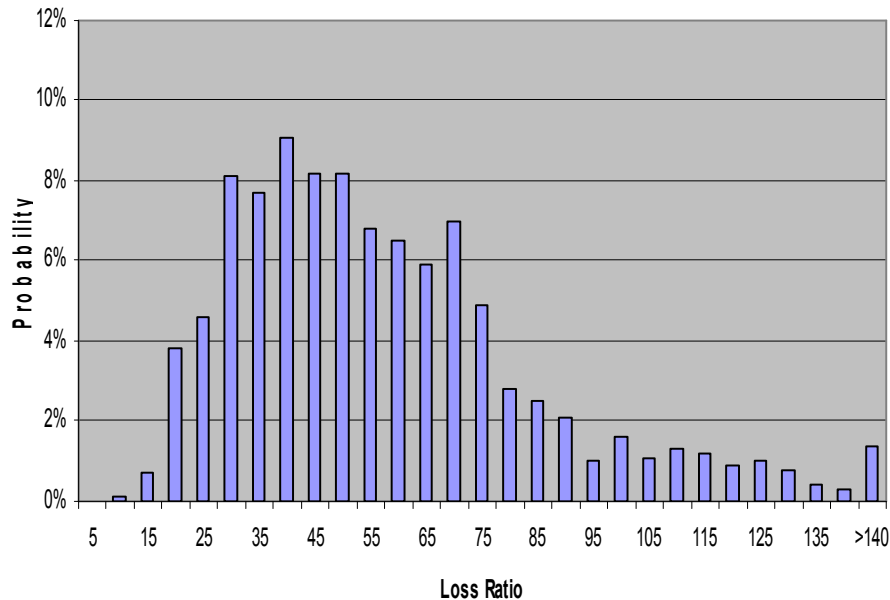
SIMPLE Insurance Company – Projected Balance Sheet: Dec 2011

SCENARIO →	Starting Balance Sheet	Projected 1 Year Base Case	STRESS: Large Loss	STRESS: Macroeconomic	STRESS: Stress to Failure
Income Statement Profit/ (Loss)		34	24	-10	-36
Assets	120	155	145	110	120
Liabilities					
- Property Loss Rx	37	37	44	37	37
- Property UPR	30	30	30	30	30
- Cat Rx	0	0	0	0	35
- Total liabilities	67	67	74	67	102
Equity	53	87	71	43	17
Financial Resource	53	87	71	43	17
Risk Charges	36	42	42	35	45
CAR	129%	207%	169%	122%	37%

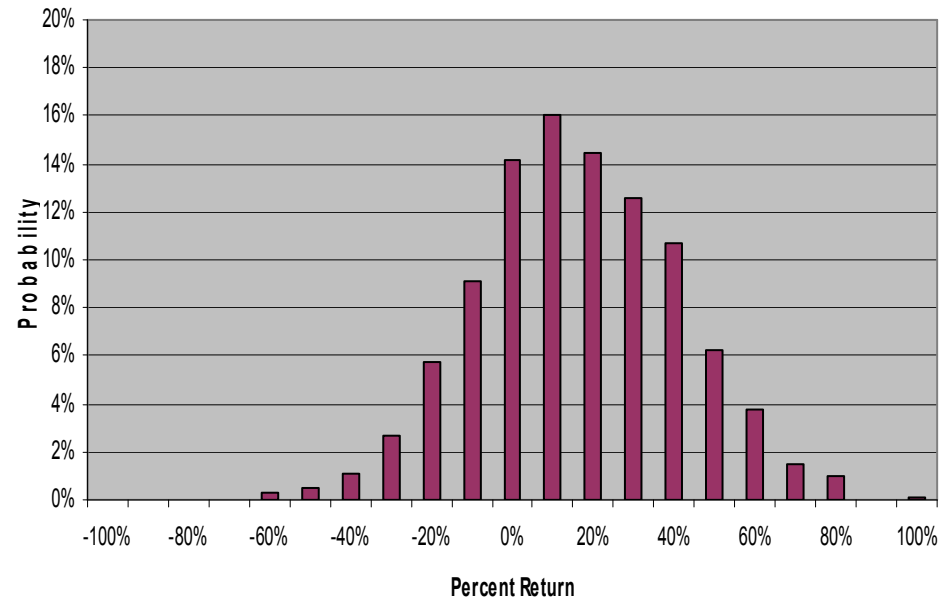
Stochastic Analysis

- Instead of one stress or hypothetical scenario at a time, what if you could look at nearly all possibilities together?
- I have modeled asset and loss distributions for SIMPLE Insurance Co. over a one year horizon
- The following are property (non-CAT) and asset return distribution for SIMPLE Insurance Co.

Property (non CAT): Distribution of Losses



Assets: Distribution of Returns

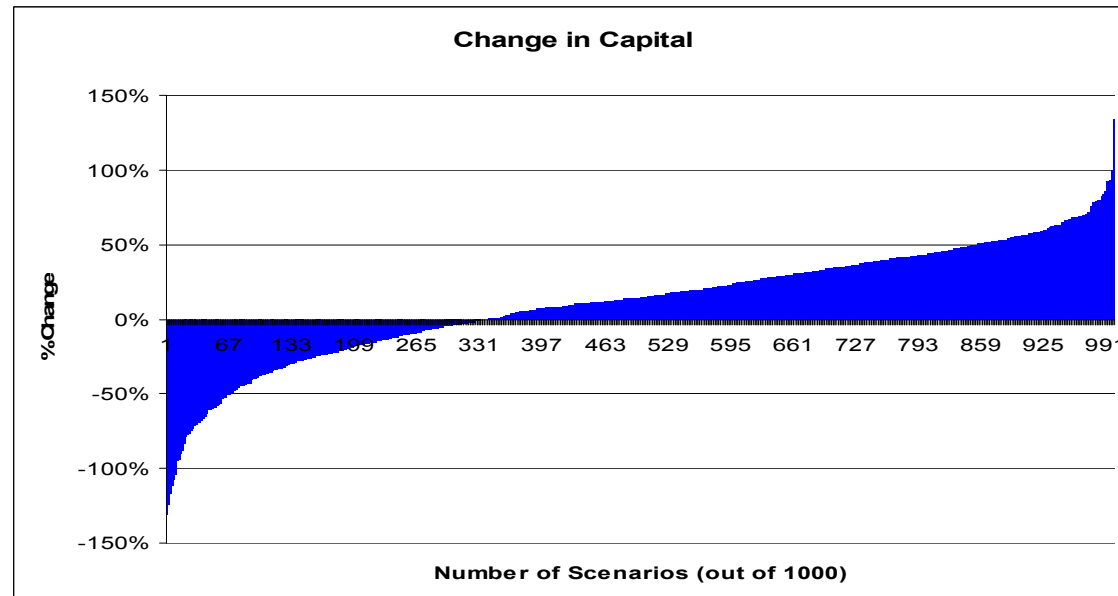
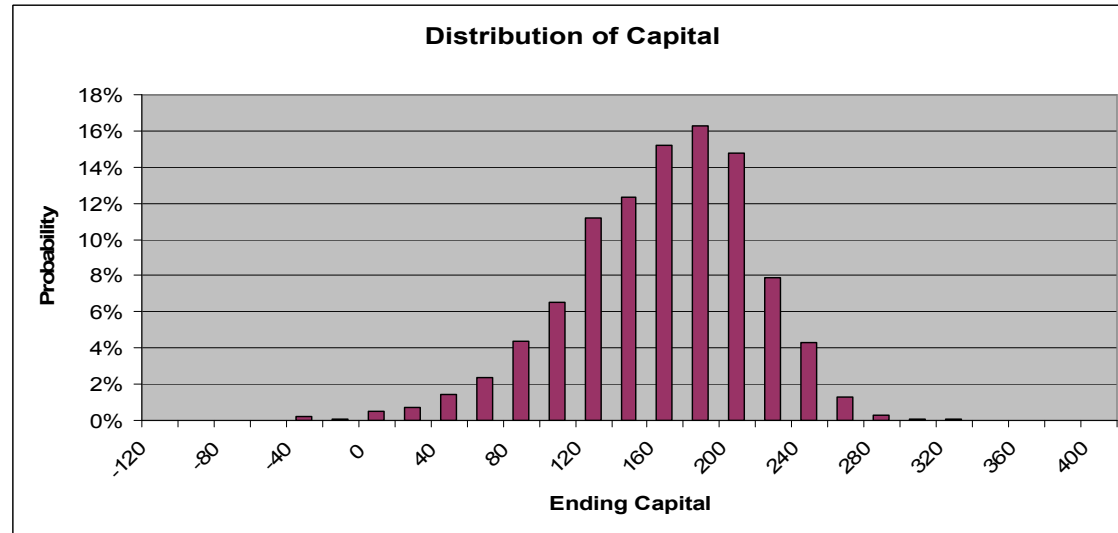


Aggregate all asset and loss distributions to determine the distribution of ending capital

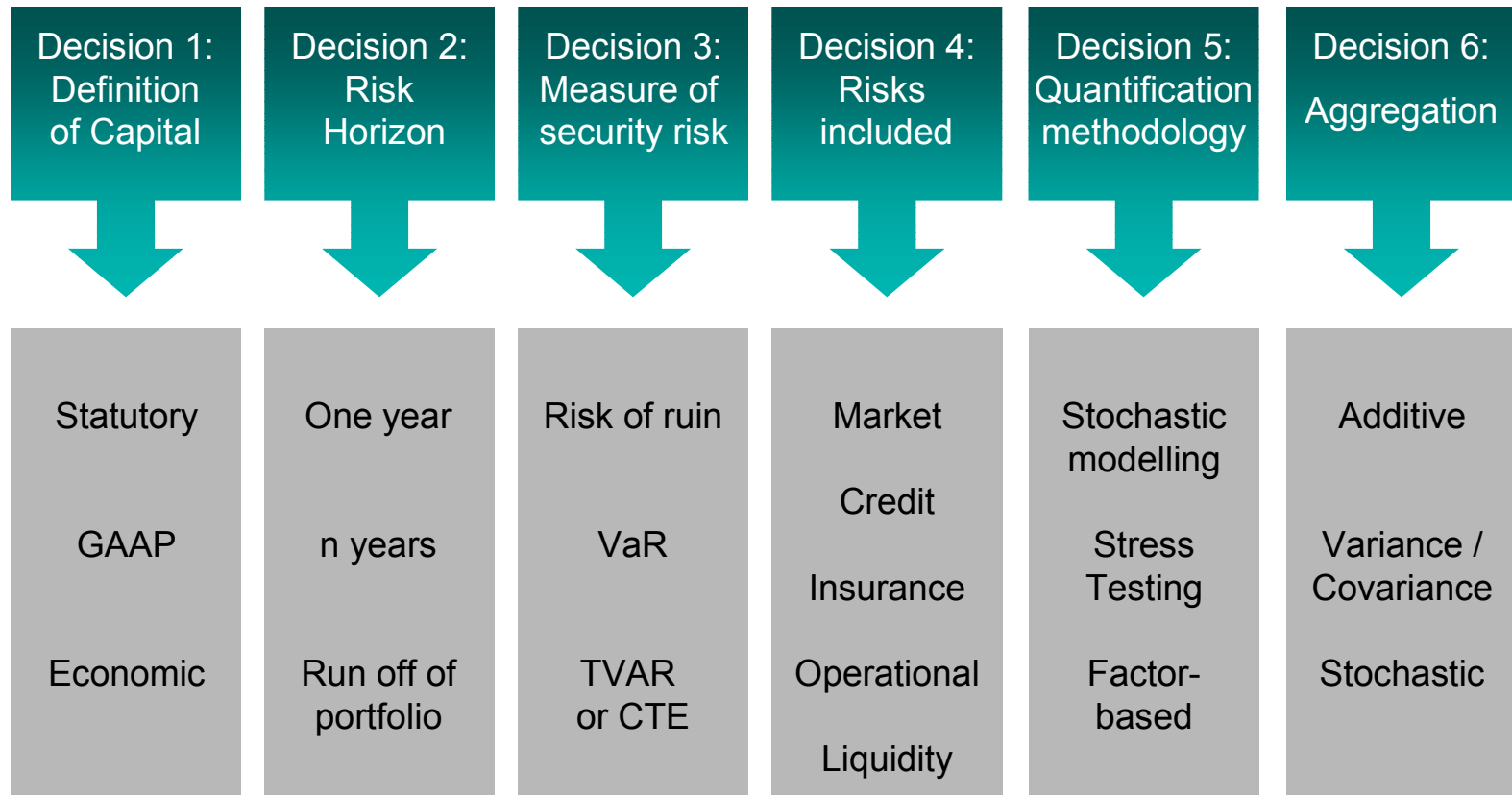
To determine the capital needed to have a 99% chance of survival over the next one year, we can look at the % of projected surplus amounts that end up less than zero, and check for what amount of starting capital gives 1% chance of ending capital being less than zero.

In our example: starting capital of 135 million gives probability of default as 1%. At this level of capital, the return on surplus is 11%.

This 135 million is the Economic Capital based on our selected risk tolerance of 99% VaR (i.e., 1% probability of default).



Recap: Considerations in assessing capital



Case Studies

- **Adding a LOB to SIMPLE Insurance Co.**
- **Risk vs. Return for SIMPLE Insurance Co.**
- **Reinsurance optimization using Igloo**

Case study 1 – adding a LOB to SIMPLE Insurance Co.

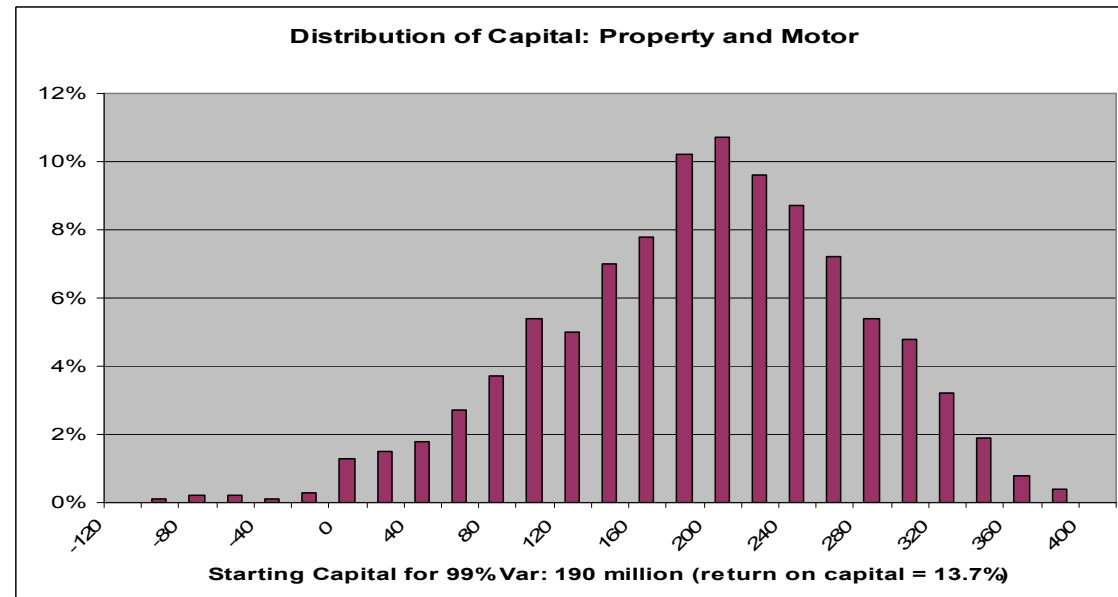
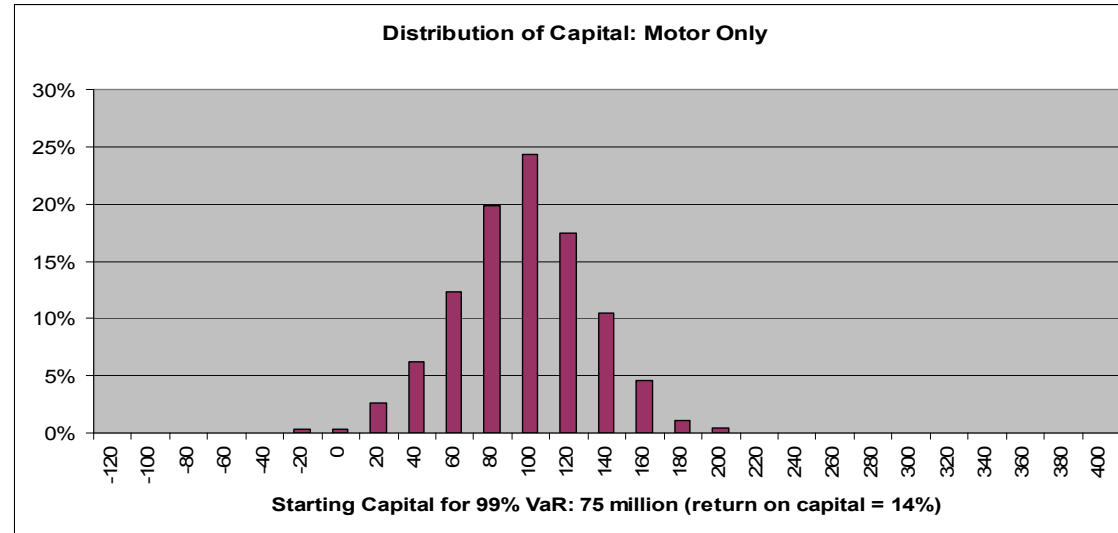
- Going back to SIMPLE Insurance company, say you wanted to add another line of business – Motor. You target to double your premium volume using the new LOB.
- What you want to know not just how the new business will perform, but also how it will interact with your existing business
- For comparison purposes, we will look at how much capital is needed to run a company with just Motor business, and then how much additional capital you need if you want to add Motor to your existing business

Case study 1 – marginal capital requirement

Our required capital at 99% VaR for Property only was 135 million. If we analyze Motor line of business in isolation, we come up with a new capital requirement of $135 + 75 = 210$ million.

However, if we analyze Property and Motor together, taking into account that they are not going to be perfectly correlated, our actual capital requirement is only 190 million (~10% diversification benefit).

Starting with 210 million would provide a higher level of protection but lower return.



Case study 2 - risk vs. return

SIMPLE Insurance Company		
Starting Capital	Protection Level	Return on Capital
237 million	99.75% VaR	10.7%
215 million	99.50% VaR	12.2%
190 million	99.00% VaR	13.7%
160 million	98.00% VaR	15.2%

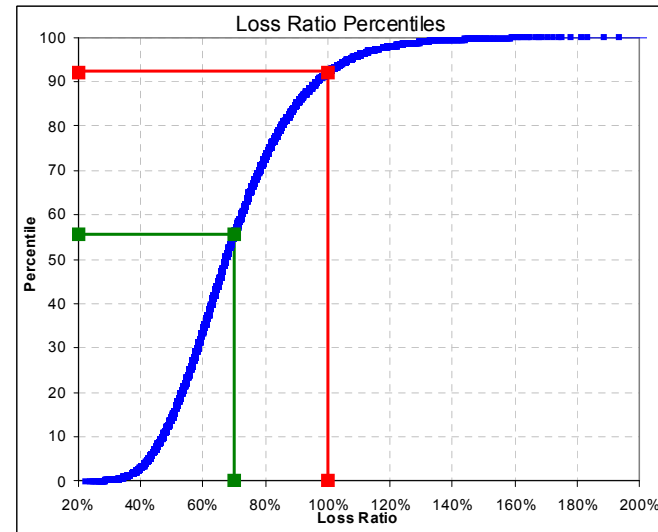
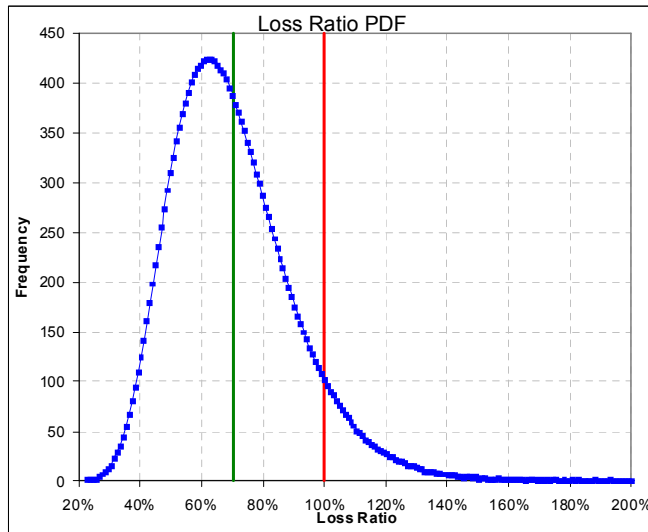
- Practical issues:
 - You may want to use 99.00% VaR as your risk appetite, but want a return higher than 13.7%
 - Or you may have more capital than needed for 99.00% VaR
- Having a clearly articulated risk appetite can help derive your decision in such a situation

Case study 3 - reinsurance optimization



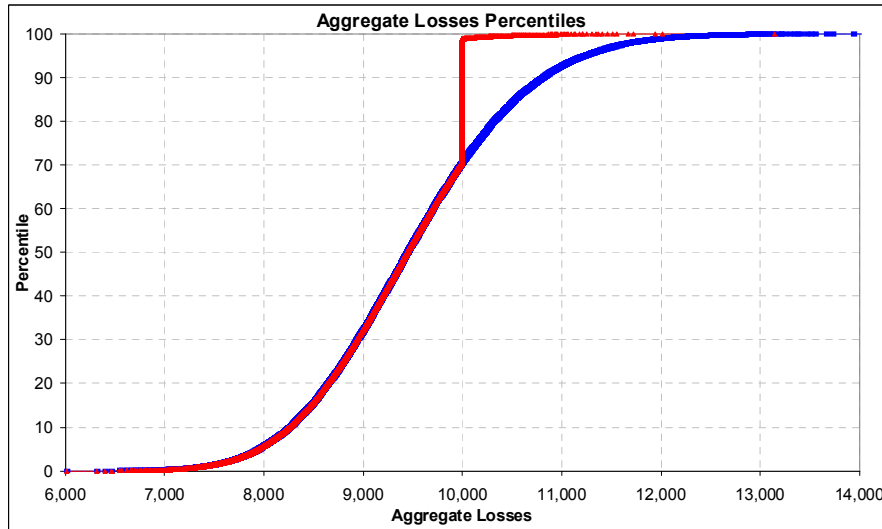
Case study 3 - start with a distribution of gross business

- From business plan loss ratio: 70%
- To distribution of losses



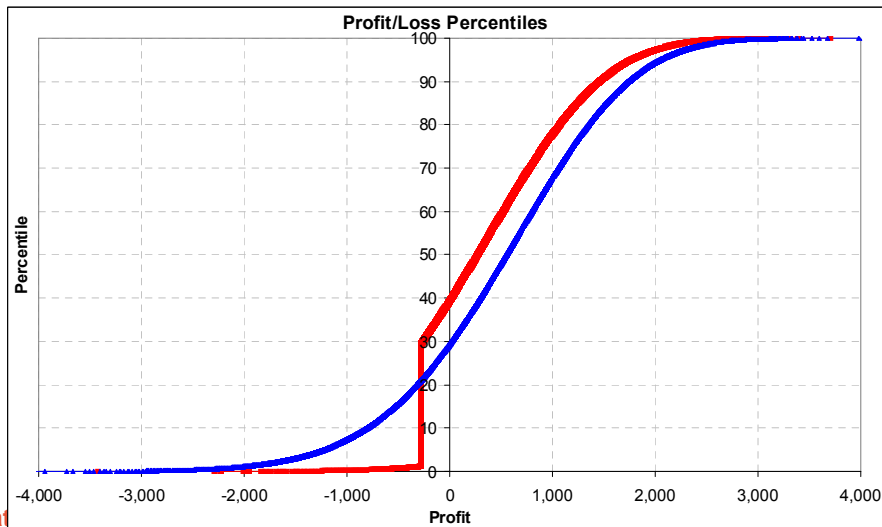
- Probability of achieving plan or better = 56%
- Probability of making a loss = 8%

Case study 3 - stop loss



- Gross
 - Expected Profit = 500
 - 29% chance of loss
 - Capital = 2,380 => ROC = 21%

- 2,000 xs 10,000 layer
 - Price = 286
 - Expected recoveries = 201
 - 30% chance of recovery
 - 21% chance of Reinsurer loss



- Net
 - Expected Profit = 414
 - 40% chance of loss
 - Capital = 666 => ROC = 62%

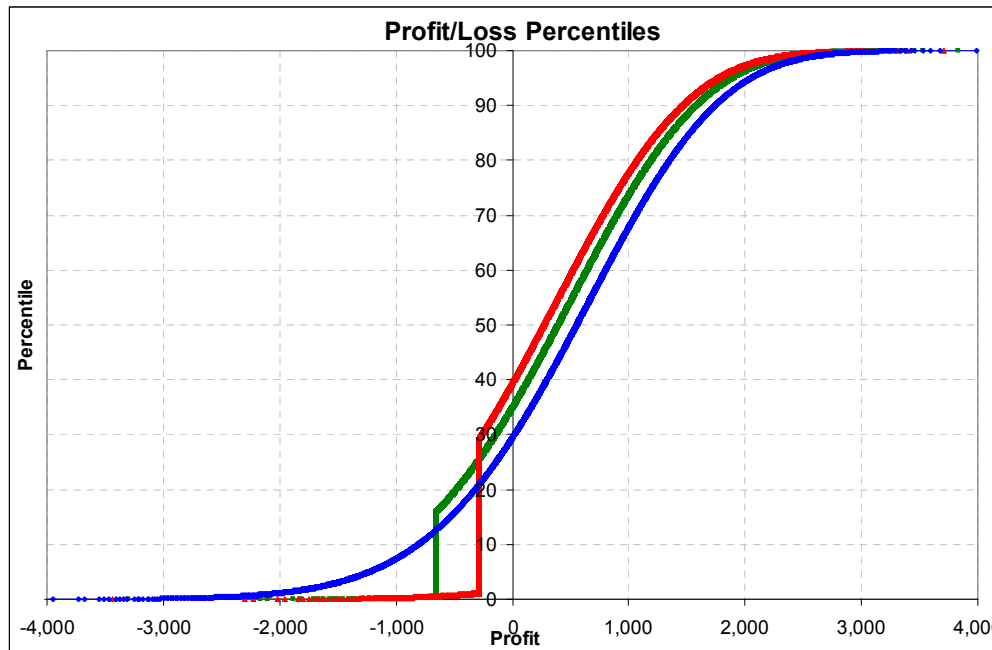
Case study 3 - alternative layer

•2,000 xs 10,000

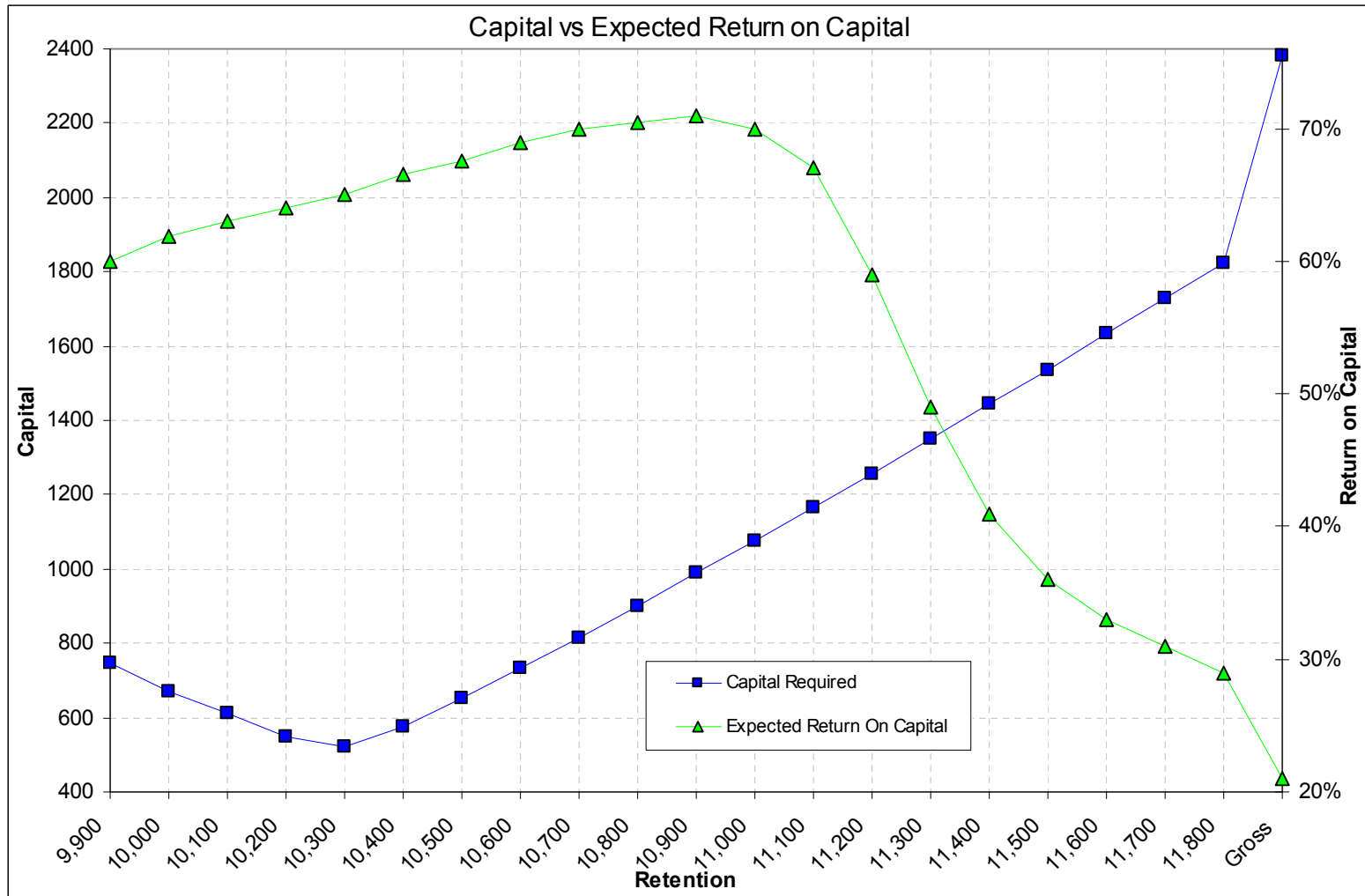
- Price = 286
- Expected recoveries = 201
- 30% chance of recovery
- 21% chance of Reinsurer loss
- Expected Net Profit = 414
- 40% chance of Net loss
- Capital = 666 => ROC = 62%

2,000 xs 10,500

- Price = 153
- Expected recoveries = 94
- 16% chance of recovery
- 13% chance of Reinsurer loss
- Expected Net Profit = 441
- 35% chance of Net loss
- Capital = 653 => ROC = 68%



Case study 3 - optimise



“The purpose of computing is insight, not numbers.”

-- Richard Hamming



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