Note on Internal Models

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Abstract

This paper intends to describe some main concepts of the IAA paper on internal models for risk and capital management purposes. When properly embedded in an insurer's risk and capital management processes, internal models are a rich and vital source on information about the insurer's inherent and residual risks

Keywords

Internal model, modeling, solvency, enterprise risk management, economic capital, risk assessment

IAA Papers

The International Actuarial Association (IAA) has developed papers on solvency and related issues. These papers were developed also in support of the IAIS for its project to formulate a consistent, reliable and transparent approach to the assessment of insurer solvency.

Some of the published IAA papers are as follows:

- Global Framework for Insurer Solvency Assessment, 2004
- Note on Enterprise Risk Management for Capital and Solvency Purposes in the Insurance Industry, March 2009
- Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins, April 2009
- Comprehensive Actuarial Risk Evaluation (CARE), May 2010
- Stochastic Modeling – Theory and Reality from an Actuarial Perspective, 2010

Internal Model

"Note on the use of Internal Models for Risk and Capital Management Purposes by Insurers" was published by the IAA in November 2010. It was developed by the Solvency Subcommittee of the Insurance Regulation Committee. This note is supportive of the Standards and Guidance material developed by the International Association of Insurance Supervisors (IAIS) for supervisors.

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1. Introduction

The note provides educational material for those responsible for constructing, using and approving the use of models to assess and manage risk and capital within insurers. The note does not and should not be taken to set standards for practitioners.

Fundamentally, an internal model is a mathematical representation of the insurer's business operations.

The use of internal models for insurer risk assessment and capital management is increasing due to the:

- emergence of comprehensive insurer risk management practices
- widespread use of economic capital, etc

It may also be useful and advisable to employ the same model in stress/scenario testing.

2. Model Fundamentals

An internal model is used to estimate a range of possible future financial states an insurer may find itself in as a result of the variety of risks to which it is exposed and the methods used by the insurer to manage those risks.

An insurer's financial position is affected by many variables, such as financial market performance, insurance risk outcome, operational events and management choices and strategies.

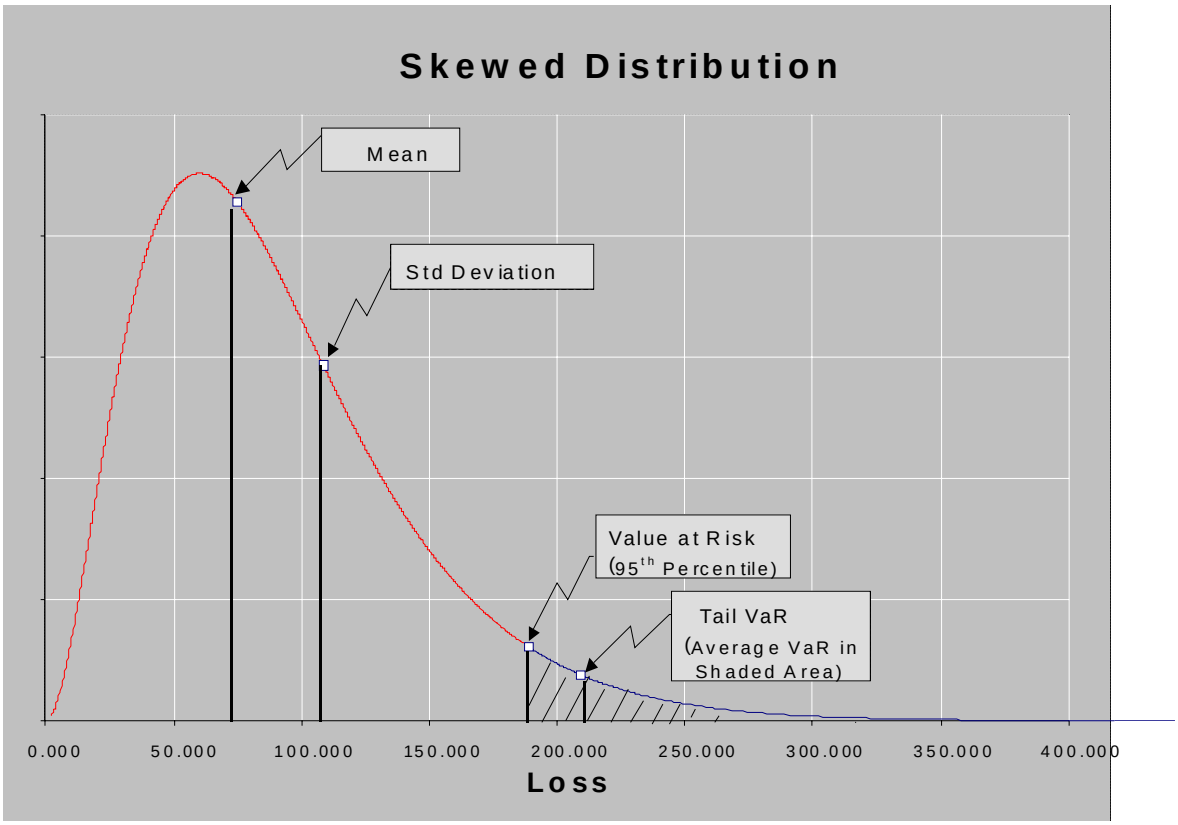
Financial effects of some of the variables (ex. operational events) may be difficult to quantify except through stress/scenario testing. There can be significant dependencies between these variables indicated above. The nature of these dependencies may change significantly in times of stress.

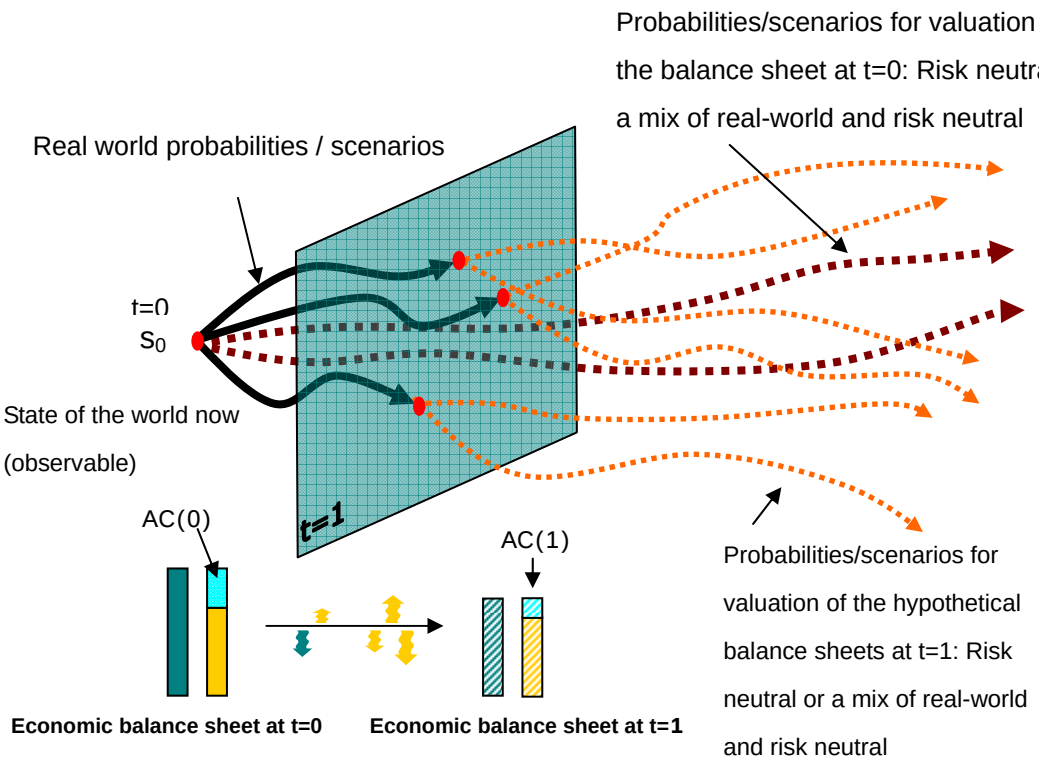
The design of an internal model will likely be based upon the concept of proportionality. The structure of the model should reflect the nature, size and complexity of an insurer's risks.

An internal model can only be considered as a tool within the risk assessment framework of the insurer. The framework will likely include the following elements: time horizon, risk measure, confidence level and terminal provision, which form a necessary foundation for the internal model design.

The selection of an appropriate time horizon may vary with the specific use made of the internal model. A risk measure is a numeric evaluation that can be used to help determine the solvency capital requirement for an insurer. The selection of an appropriate confidence level for an insurer to use in an internal

model will depend on the specific use of the model, its time horizon and choice of risk measure. A terminal provision must be calculated whenever the time horizon is shorter than the full lifetime of the insurer’s obligations.
Real world probability measures project economic scenarios based on historical experience and actuarial techniques. Real world probabilities have to be used to arrive at a future, observable state of the world. Risk neutral valuation is a mathematical tool to arrive at a market consistent valuation that reflects the markets view and expectation of risk.


Skewed Distribution
Mean
Std Deviation
Value at Risk
(95th Percentile)
Tail VaR
(Average VaR in
Shaded Area)
0.000
50.000
100.000
150.000
200.000
250.000
300.000
350.000
400.000
Loss


Probabilities/scenarios for valuation of
the balance sheet at t=0: Risk neutral or
a mix of real-world and risk neutral
Real world probabilities / scenarios
t=0
S0
State of the world now
(observable)
AC(0)
t=1
AC(1)
Probabilities/scenarios for
valuation of the hypothetical
balance sheets at t=1: Risk
neutral or a mix of real-world
and risk neutral
Economic balance sheet at t=0
Economic balance sheet at t=1

3. Design Considerations

The model can be constructed to produce the desired results. There should be a way of reproducing all results for audit purposes and for checking and correcting errors. It is important to include reports that can be used to check the internal consistency of the computed results.

The order in which calculations are carried out can significantly affect the model's ability to reflect specific interactions between modeled components.

Centralized coordination and/or control over common assumptions are essential. Because any change in assumptions needs to be properly reflected.

It is important to be able to run a model several times with the same data and assumptions and verify that the same results are obtained each time

Models should be constructed to be flexible and facilitate the reflection of future changes such as new products and changes in internal policies.

4. Construction of Model

In choosing an appropriate granularity the modeler should balance accuracy against materiality, computing power and run time.

Products should be modeled so as to generate projected future cash flows that are sufficiently close to those that would be generated by the actual products under a wide variety of scenarios covering the insurer's possible experience. In choosing groupings, the modeler should take into account whether the group of products would exhibit similar financial results under all possible future scenarios.

While the greatest accuracy in life product modeling would be obtained from use of seriatim listing of all an insurer's policies, it is often appropriate to represent each group of broadly similar policies by a group of an equal number of identical hypothetical policies, referred to as a "model point".

The determination of the segment structure to be used in the internal model is one of the most important conceptual steps of modeling the non-life business. Some of the segmentation criteria to be considered are of statistical nature, like homogeneity and statistical mass.

Mapping of the insurer's assets to proxy asset classes or indices should be plausible, intuitive and conceptually sound.

Assumptions about future experience for insurance risks are among the most difficult issues in constructing an internal model. If the experience is insufficient

to yield sufficiently credible information, make use of industry data. If there are sufficiently strong doubts concerning the applicability of past experience to the future, it may be appropriate to use new assumptions which are considered to be sound. The insurer may have new products under which experience is expected to differ from that of its older products.

The form in which assumptions about future experience appear within a model may be different for different risks. Most mortality or morbidity studies focus on the derivation of expected rates and long-term improvements. The current models of general insurance usually use stochastic simulation techniques. Less is known about probability distributions with respect to surrender or lapse rates which are significantly driven by policyholder behaviour.

Calibration refers to the process of validating estimated parameters and assumptions used in the model to their real life values as relevant to the particular modeled circumstance at hand. In the case of a model employing stochastic projections of economic scenarios, the parameters which govern the Economic Scenario Generator should be calibrated so that the specific implementation of the economic model produces results consistent with historical experience or current market data.

Internal model for insurers often need to incorporate assumptions about the insurer's future policies and practices in its on-going operations.

Random number generators are algorithms and produce pseudo-random numbers. The generator's periodicity should exceed by a considerable margin the number of random numbers that will be needed in any simulation.

Internal models of an insurer are usually large and complex. The determination of how many simulations are sufficient is difficult. In many cases, this will only be determined through empirical testing.

It may be advisable to supplement stochastic modeling by testing of deterministically selected extreme scenarios (effectively a form of stress scenario testing).

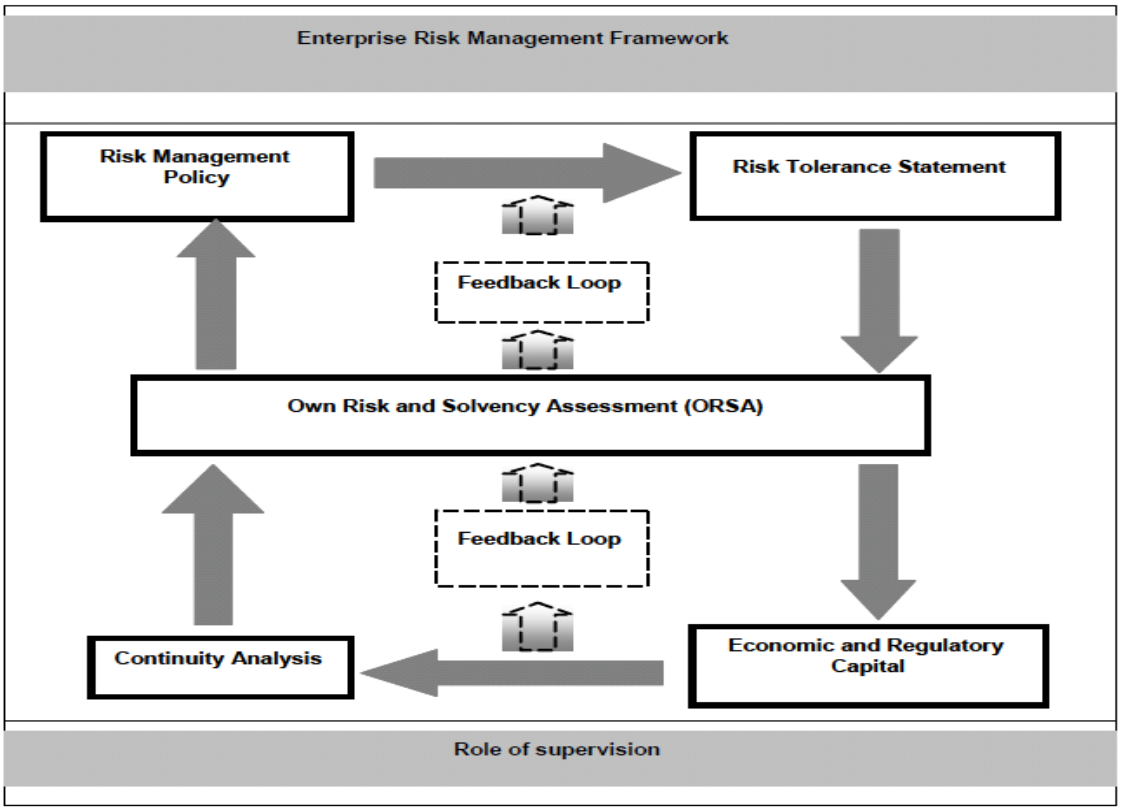
Own Risk and Solvency Assessment (ORSA)

IAIS is currently revising its Insurance Core Principles by October 2011. Among these principles, new Insurance Core Principle 16 ERM and related standard and guidance were approved at the general meeting in October 2010. In the ICP 16, importance of ORSA is focussed.

The standards on ERM states:

- *16.11 The solvency regime requires the insurer regularly to perform its own risk and solvency assessment (ORSA) to assess the adequacy of its risk management and current, and likely future, solvency position*
- *16.13 The solvency regime requires the insurer's ORSA to encompass all reasonably foreseeable and relevant material risks including, as a minimum, underwriting, credit, market, operational and liquidity risks and additional risks arising due to membership of a group*

ORSA sits at the center of the ERM framework.



Guidance on the ORSA states:

- *16.13.1 In its ORSA an insurer should consider all material risks that may have an impact on its ability to meet its obligations to policy holders, including in that assessment a consideration of the impact of future changes in economic conditions or other external factors...*
- *16.13.3 An insurance group should perform its ORSA to assess the adequacy of the group's risk management and current, and likely future, solvency position...*

Conclusion

When properly embedded in an insurer's risk and capital management processes, internal models are a rich and vital source on information about the insurer's inherent and residual risks.

Internal models are also useful tool in the ORSA, especially for insurance groups. Insurance groups may have complex structure which cannot be appropriately assessed by standardized approach.

IAA Insurance Regulation Committee and Solvency Subcommittee are developing the papers on Systemic Risk Regulation and Stress/Scenario Testing respectively for the next steps. We are pleased to have inputs from our colleagues around the world in the developments of these interesting and important papers.