

L'Attuario nella gestione dei rischi per le imprese e per la collettività

SCOR's Internal Model and its use cases

A key tool for risk management

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SCOR's Internal Model and its use cases

1	The Risk Profile: how it is built and how to read it
2	SCOR's Internal Model: architecture and main principles
3	IM's Use Cases: some examples
4	Focus on Dependency
5	Conclusion and next challenges

Internal model: the major question





The change in economic value distribution: how it is derived



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*) Note that these are examples for illustration purposes only, and do no not necessarily represent actual GIM scenarios

The risk profile: how to read it



- The simulated scenarios are sorted (by change in economic value) and are plotted on the graph in relation to their likelihood the horizontal axis shows the return periods in logarithmic scale, the vertical axis shows the respective change in economic value for the return period
- SCR" is the worst 1-in-200-year (VaR 0.5%) event of the annual change in economic value
- tVaR 1% is the change in economic value averaged over the shortfall, which are the worst 1% results, and xtVaR 1% is the difference between tVaR 1% and the expected (average) change in economic value

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Architecture of SCOR's Internal Model



Efficient operating set-up based on clear separation of system components

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SCOR's internal model main principles

Risk is modelled at the origin

- Data is entered and signed-off by the people who are in charge of the corresponding business
- Models are developed in their related divisions in close cooperation with the Financial Modelling team who is the ultimate responsible for the GIM and the integration of all risk models
- The responsibility of the parameterisation and the life cycles of the partial models lies in the divisions

Strong focus on dependency modelling

- Non-linear treatment by mirrored-clayton copulas to ensure strong dependence in the tails
- The Economic Scenario Generator relies on a bootstrapping approach to conserve historical dependencies between economic variables and to produce consistent scenarios
- Dependencies are also calibrated using expert judgments within the PrObEx framework

Full balance sheet approach

- From the current balance sheet a stochastic oneyear projection of future balance sheets is calculated
- All risks are considered, such as underwriting, market, yield, credit, foreign and exchange risks
- All valuation is done on a market consistent basis

Capital allocation via Euler principle

- Full change in economic value distribution is produced
- Expected profit and capital requirements at the different thresholds and for different risk measures are computed
- Capital allocation is calculated by the marginal contribution to the TVaR (Euler principle) and preserve RoRaC compatibility

SCOR's guide in business and risk management decisions

Strategic Investment Allocation	ALM	Economic and Solvency Capital Calculation	Capital Allocation	2 Capital Management
Strategy Risks Assessment			3 Risk Profile and Appetite	
Pricing and Valuation	Internal Model			Risk Management Market Credibility
Multi-year views	Cash Flow projection	Client Support in Modelling	Education and Communication	1 Risk Mitigation

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Risk appetite framework - quantitative limits are set and monitored

Strategic plan	"Optimal Dynamics"		
	Solvency target	<u>Capitalization level</u> SCR, Buffer capital and flexible solvency target driving a process of gradual escalation and management responses	
Risk	System of limits	Risk drivers (probabilistic) Post-tax net 1:200 annual aggregate loss for each risk driver ≤ 20% Available Capital	
tolerances		Extreme scenarios (probabilistic) Post-tax net 1:200 per-event loss for each risk ≤ 35% Buffer Capital	
	Limits per risk in the underwriting and investment guidelines		
Footprint scenarios	Impact assessment of past events (deterministic)		



Solvency is actively monitored via a clear and flexible escalation framework



- The optimal capital range enables the Group to achieve maximum profitability and satisfy the level of solvency which SCOR aims to offer its
- SCOR aims to make optimal use of the numerous options at its disposal to manage its capital position

Target evolution of risk profile, measure sensitivity to external factors



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Standalone versus diversified capital

Diversification benefit

- Standalone capital is the amount of capital needed if we had only "one risk"
- Diversified capital is the amount of capital required if the risks are part of the overall portfolio
- Standalone capital is higher than diversified capital
- □ The ratio: 1 Diversified/Standalone is defined as the diversification benefit and is a measure of how well this one risk can be pooled with other risks
- The overall diversification benefit between Life and P&C divisions amounts to 26% for 2015



Diversification between P&C and Life (1 of 2)

Composite (re)insurance are exposed to both Life and P&C risks, leveraging from the resulting diversification effect.



Life and P&C standalone Risk Profiles



Diversification between P&C and Life (2 of 2)

Contribution to 1% worst case scenarios for Life and P&C Worst 1% of P&C standalone scenarios P&C U/W Life+P&C U/W 100 10 1000 10000 Life and P&C U/W scenarios contributing to 1% tail of Combined Life+P&C U/W **Diversified Life and P&C** scenarios P&C Nat Cat drives the near-tail losses Life U/W P&C U/W Life+P&C U/W 10000 100 1000

Return period in years (log-scale)

P&C U/W scenarios contributing to Combined Life+P&C U/W

- Of 1000 P&C UW scenarios in the 1% (>100-year return period) P&C UW tail, most of them are replaced by less onerous scenarios in the combined Life and P&C UW risk 1% tail.
- As a result the P&C UW xTVaR 1% diversified with Life UW risk is significantly lower than the standalone P&C UW xTVaR 1%.
- This diversification benefit is especially strong for those scenarios in the far tail

Contribution of Life mortality dominates the extreme tail

Change in economic value

Change in economic value

The scenarios and corresponding charts are for illustration purpose only and are not meant to represent the actual SCOR's risk profile

Dependency structures

Modelling of (tail) dependencies is a key component for appropriate calculation of capital requirements.



And how to calibrate the model?



Sources: EIOPA: Technical Specifications for the Solvency II valuation and Solvency Capital Requirements calculations, 2012 M.-P. Côté and Chr. Genest: A copula based risk aggregation model, Canadian Journal of Statistics vol 43, No 1, 2015

The risk aggregation tree for Specialty Non-Life LoBs



Dependencies calibration and the PrObEx process





Arbenz, P. and Canestraro, D. (2010): PrObEx - A new method for the calibration of copula parameters from prior information, observations and expert opinions. SCOR Paper n. 10
 Arbenz, P. and Canestraro, D. (2012): Estimating copula for insurance from scarce observations, expert opinion and prior information: a Bayesian approach. ASTIN Bulletin,
 42 (1): 271-290

PrObeEx – what we asked to SCOR experts

How to measure dependence?



The experts were asked to answer a question like

"Suppose Y exceeds the 1-in-100 year threshold. What is the probability that also X exceeds its 1-in-100 year threshold?"

...which is equivalent to quantify the so called Quantile Exceedance Probability

 $P[X > VaR_{0.99}(X) | Y > VaR_{0.99}(Y)]$

Expert judgement and psychological effects

- Human beings tend to utilize certain shortcuts when providing answers in condition of uncertainty. Such shortcuts allow to come up with a quick answer, but unfortunately they also introduce systematic biases in the assessment
- In the expert judgment literature, these biases are called heuristics an approach that deduces a solution from a limited set of available information
- At SCOR, experts get trained to be aware of these heuristics, understand how they are influenced by them and learn to avoid their pitfalls

	Heuristics		
	Representativeness	Availability	Anchoring
Description	Human beings tend to judge more likely what they consider as more representative		
Examples	 "Linda is young, outspoken, very bright and majored in philosophy. She is deeply concerned with issues of discrimination and participated in anti nuclear demonstrations". What is more likely? (A) Linda is a bank teller (B) Linda is a bank teller and active in the feminist movement 		
Popular Answer	В		
Correct Answer	A		
Guidance for experts' training	Look at a range of scenarios instead of focusing on one specific scenario for judgment		

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	Heuristics		
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Examples	 "Linda is young, outspoken, very bright and majored in philosophy. She is deeply concerned with issues of discrimination and participated in anti nuclear demonstrations". What is more likely? (A) Linda is a bank teller (B) Linda is a bank teller and active in the feminist movement 	"Which hazard claims more lives in the United States?(A) Tornados(B) Lightning	
Popular Answer	В	A	
Correct Answer	A	В	
Guidance for experts' training	Look at a range of scenarios instead of focusing on one specific scenario for judgment	If an information is easier to recall it is not necessarily true that it refers to something happening more frequent	

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Heuristics			
	Representativeness	Availability	Anchoring
Description	Human beings tend to judge more likely what they consider as more representative	Human beings tend to judge as more likely what they can recall more easily	Naming a figure ("anchor") when asking someone to give an estimate will influence the outcome
Examples	 "Linda is young, outspoken, very bright and majored in philosophy. She is deeply concerned with issues of discrimination and participated in anti nuclear demonstrations". What is more likely? (A) Linda is a bank teller (B) Linda is a bank teller and active in the feminist movement 	"Which hazard claims more lives in the United States?(A) Tornados(B) Lightning	How will asking the following question to a test group and a control group influence the results? "Is the population of Chicago more or less than 200.000?" "Is the population of Chicago more ore less than 5 million?
Popular Answer	В	A	The answer will often be close to either 200.000 or 5 million
Correct Answer	A	В	2.7 million
Guidance for experts' training	Look at a range of scenarios instead of focusing on one specific scenario for judgment	If an information is easier to recall it is not necessarily true that it refers to something happening more frequent	Experts should not be exposed to anchors, neither when confronted with the expert judgment questionnaire nor during brainstorming session

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- The internal model is a fundamental tool from a risk management perspective. It should not be used only for regulatory purposes, but first and foremost it should be at the center of or supporting a variety of business and risk management decisions.
- The diversification benefit is core to (re)insurers business. Thus modeling dependencies is an essential component of an internal model.
- Including expert judgment in the model calibration requires special care about the psychological effects which are necessarily involved.
- What are the next challenges?
 - An healthy internal model is a living tool, it always needs to be maintained and kept up-to-date, both in terms of technical implementation and modelling methodology/assumptions.
 - The industry just experienced the entry into force of S2 and there is a tendency to include more and more solvency results in the public disclosure – are different IM's results comparable?
 - Are there new material risks on the horizon which should be modelled? (Risk Map)

Q&A

Thank you for your attention !



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