

Internal Model – Advanced Uses

Pricing in the London Market

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Foreword

One of the key Solvency II principles is that insurers' internal capital models must be embedded at the heart of risk and capital evaluation and they must be used as a key input to a wide range of business and strategic decisions. However, one particular area of challenge/opportunity for the industry is about consistently identifying the capabilities insurers will need to support uses of the model that go beyond solvency calculations as well as finding ways to share best practices.

Within this context, this booklet provides a practical perspective of using internal capital models to support risk pricing decisions in general insurance. This case study is one of a series that is being published following research by our 'Flexibility and Advanced Uses of Internal Models' IMIF workstream. I would like to thank Raphael Borrel for his leadership of that workstream, our author Gemma Dawson and UMACS for agreeing to share their experience in this field.

The Internal Model Industry Forum (IMIF) has produced a series of documents offering guidance and sharing best practice on the validation and use of insurers' internal risk models. We are a market-wide initiative aiming to ensure that these models create value for the business beyond regulatory compliance.

José Morago

IRM Chairman and Founder of the Internal Model Industry Forum

Introduction

The IMIF work-stream on 'Flexibility and Advanced Uses of Internal Models' was set up to allow insurance firms to share insights on how they use internal risk models for business purposes beyond Solvency II compliance and how these various uses are communicated and embedded into the business.

Internal risk models can potentially provide helpful input or support to a range of business decisions and processes but it is vital that their use is appropriate and their limitations – and the impact of these limitations - properly understood by all those involved. This requirement extends beyond the risk modelling team to any part of management that might use or rely on the models, and also potentially to other interested parties like board members, regulators and investors.

A recent survey conducted by IMIF asked firms how those involved with these wider business decisions understood the limitations of the internal model. The results – shown in Chart 1 below – showed that there is significant scope for better understanding.

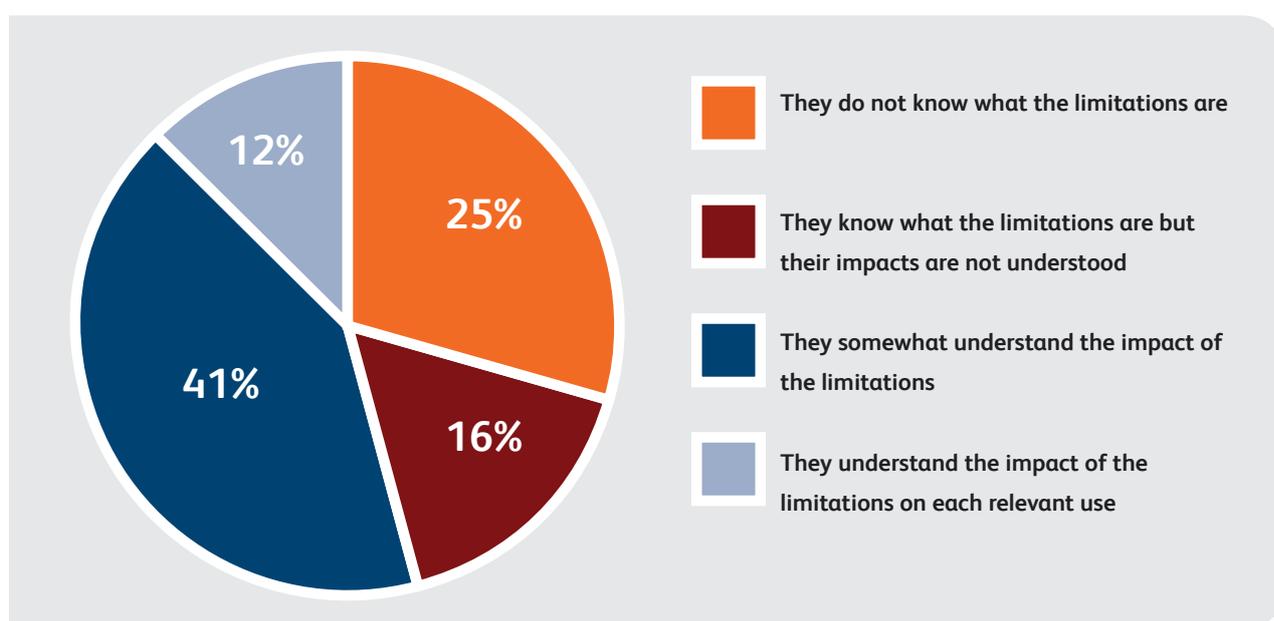


Chart 1: To what degree are the impacts of the limitations of the model on its intended use understood by all required business decision makers? (Source: IMIF 2015)

To assist in this matter this work-stream intends to publish a number of case studies that will highlight:

- model capabilities and functionalities that can be built to enable specific model uses;
- model limitations, and their impact on the model use, on the reliability of the consequent management information and on managing the resulting implications;
- practical examples of the uses of internal models

Ultimately, this work-stream will draw the key points from these case studies to publish a booklet to provide general guidance on using models for different purposes. It will also provide a framework to document the model use, and its limitations at use level. This will be available from the IMIF's web page¹.

¹ www.theirm.org/knowledge-and-resources/thought-leadership/creating-value-through-internal-models/documents-and-resources.aspx

Insurance industry uses of internal models

A survey conducted by the IMIF found a wide variation in how firms were using internal model outputs to drive business decisions for different processes. The results are summarized in Chart 2 below.

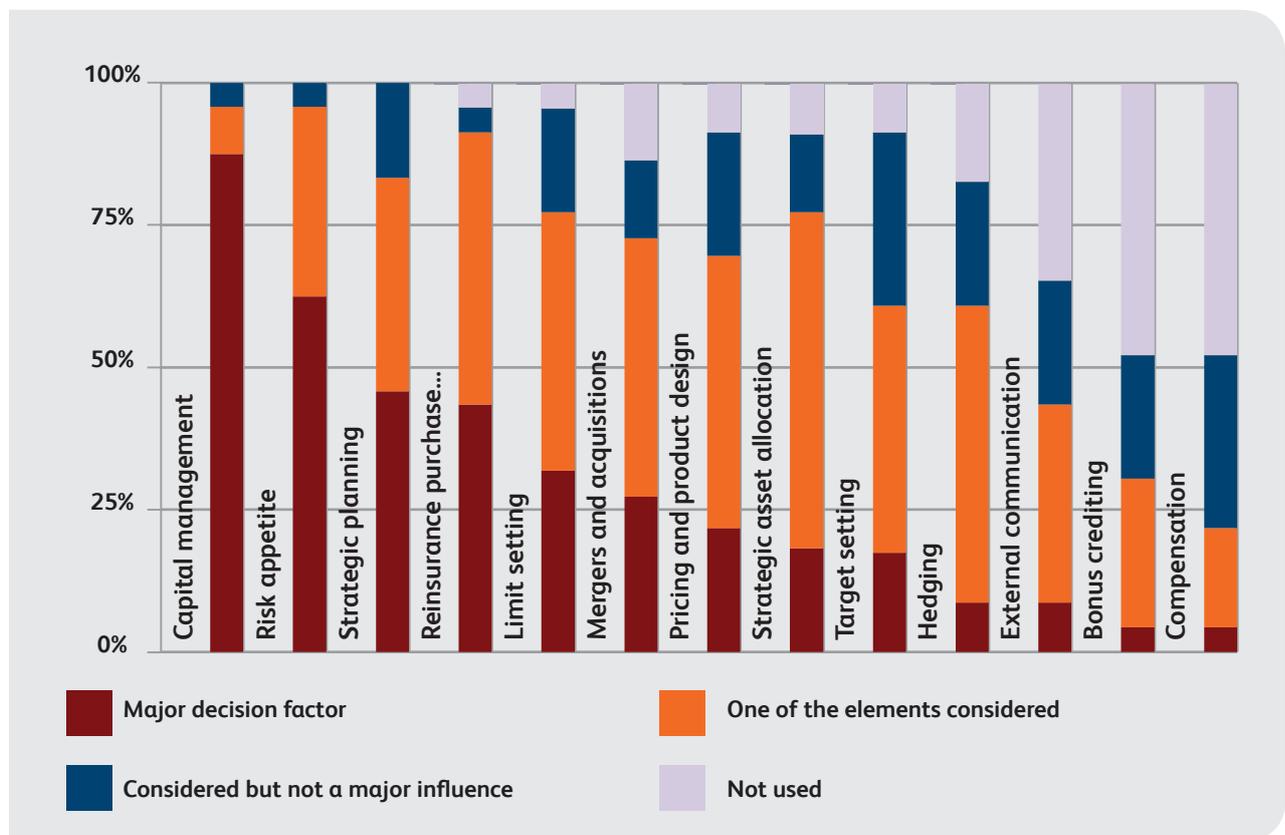
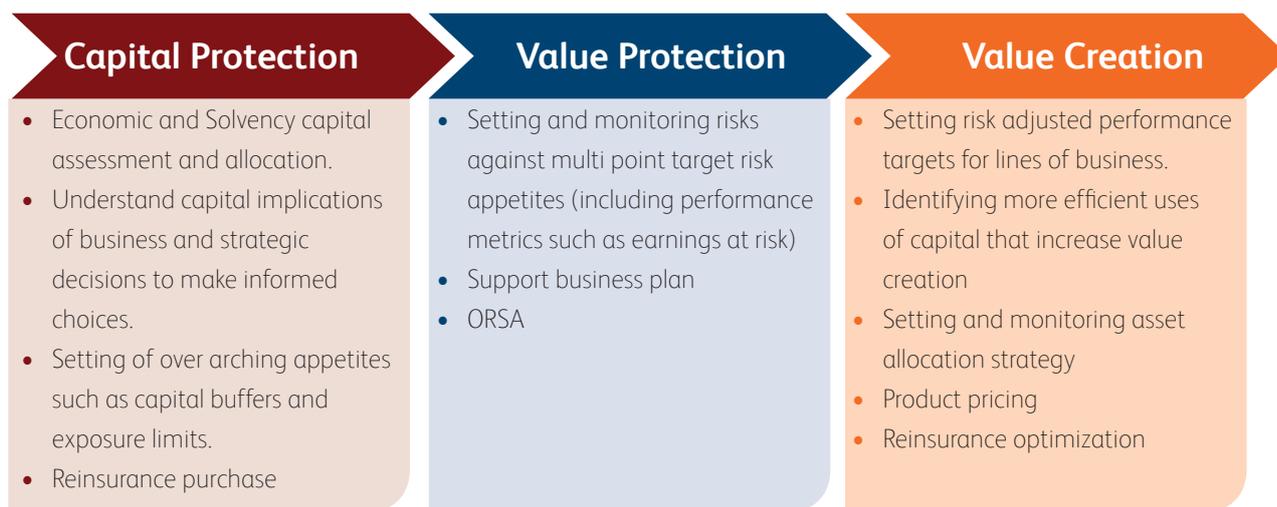


Chart 2: Rating of the importance of uses of the model in decision making (Source: IMIF 2015)

- The survey indicated, as we would expect, that most insurance firms use their internal models to drive business decisions aiming at protecting capital. This encompasses activities such as the allocation of solvency capital and the setting of over-arching risk appetites.
- The survey also showed that market leading insurance companies increasingly use their internal models for more advanced uses which can protect and add value for the business.

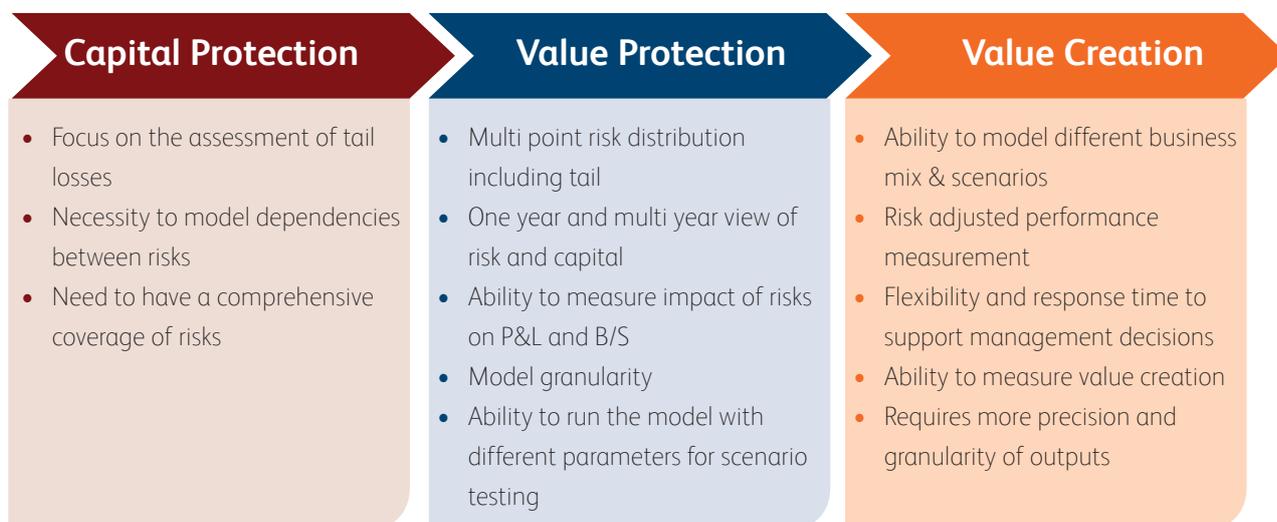
We can trace a progression of key uses of internal models that indicates three increasing levels of maturity, moving from capital protection, through value protection to value creation:



Supported by its survey and case study results, the work stream concluded that the current status quo for uses of internal models is bound by constraints that can be generalized as follows:

- The level of reliance that the management of a firm will place on a model is largely dependent on the level of maturity of this model.
- The uses of an internal model are expected to vary according to the scope, capabilities and limitations of the model.

The table below provides examples of key capabilities that can typically be expected for different model maturity levels together with the typical uses of the model.



In this case study Gemma Dawson from UMACS demonstrates how capital models can be used to add value in the area of risk pricing in general insurance.

Internal model and pricing

In recent years companies have become more joined up between different departments and, as a result, output from capital models is becoming increasingly used across the business to aid decisions. There has always been a close link between reserving and capital, and now there is an increasing focus on linking pricing and capital.

Pricing models in the London Market are now commonplace across all classes of business. With the increased focus on reporting from these models, there is now a need to include further assumptions into the pricing models to estimate what the rates within models are calibrated to (for example, a specific loss ratio or return on capital).

With the profitability of different classes of business being dependent not just on claims experience but also on expenses and capital, there is a requirement to more accurately calibrate pricing models to take account of these items and allow the performance from different classes and accounts to be compared on a consistent basis.

Whilst this paper only discusses the use of capital modelling output for use within pricing, the benefits of using information from pricing within capital modelling should also be considered.

Model use description

Output from capital models can feed into the pricing process in a number of different ways. These include:

Targeting class specific loss ratios based on business plans consistent with those in the capital model

- This would be relatively simple and quick to implement and update as business plans are revised but it does not so easily allow for comparisons between classes in terms of profitability as different classes will have different target loss ratios due to expenses and capital loads.

Using capital allocations by class to calibrate pricing models to target a specific return on capital

- This would allow comparisons between classes as models are calibrated to a specific return on capital, however model base rates should be calibrated to a specific loss ratio rather than return on capital as changes in capital requirements will not affect the expected claim amount of a risk. This makes updating pricing models more complicated.

Using full range loss curves from capital models to aid quantification of adjustments to premium for deductibles and limits

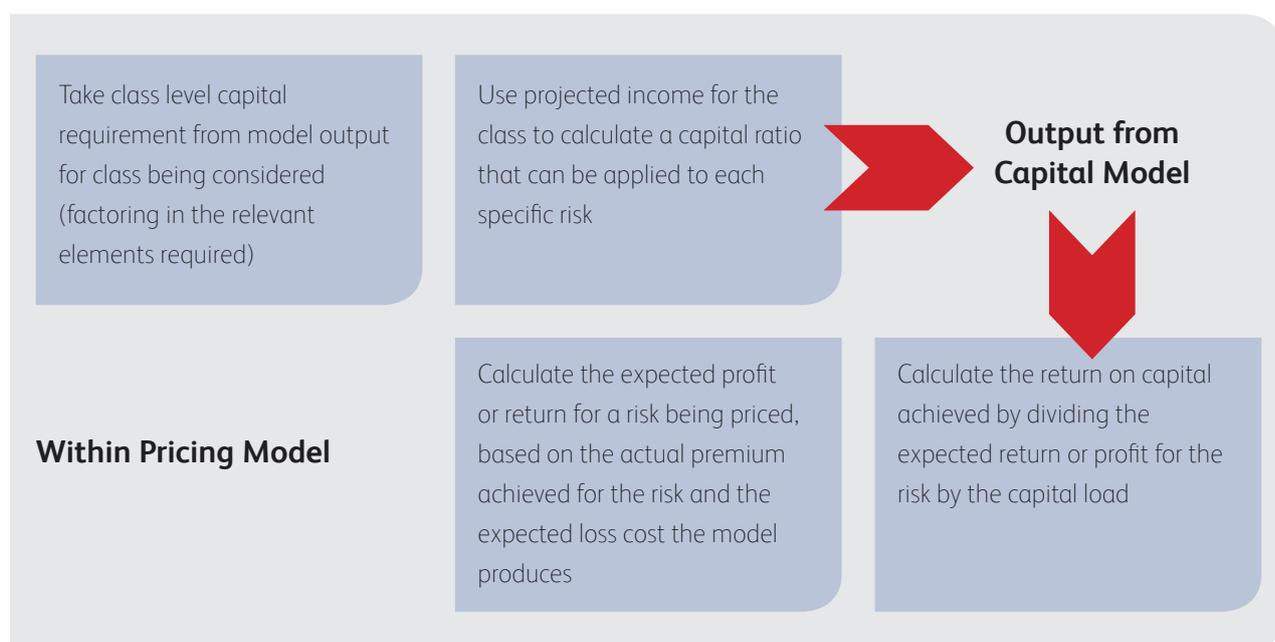
- This will aid the calculation of adjustments for specific areas within a pricing model rather than provide overall calibration. There may also be other factors to consider when adjusting for deductibles that are not accurately allowed for within high level full range loss curves such as claims from different perils, removing low level claims or the insured's behaviour.

Using capital allocations by class to find what return on capital is achieved on a risk by risk basis where often the actual price achieved for a risk will be different from the model price

- This provides additional KPIs within the model to aid decision making and comparisons between classes without the need to calibrate model base rates to capital requirements.

This case study examines how output from a capital model is used to calculate the capital requirement for a given risk and therefore, with a few other assumptions, the return on capital can be calculated.

The general flow of the process involved is:



Where a company or Lloyd's syndicate write a number of different classes spanning very different lines of business, it can be difficult to compare these on a like-for-like basis, as expenses and capital loadings can vary significantly between classes. By setting a target return on capital, a consistent measure can be used across all classes to compare performance, taking into account the differences between classes.

For example, a class like Political Risks is likely to have a lower target loss ratio than Motor, but without a return on capital approach it will be difficult to estimate what loss ratios are reasonable due to the significantly different expenses and capital charges for each.

The return on capital approach provides a consistent metric across all classes, while factoring in the class specific intricacies. So, the target loss ratio for Political Risks may be 50 % and Motor may be 70 % (for example) with both achieving an overall return on capital of 12 %.

Outputs of the internal model used for pricing

Using output from the internal model for pricing poses a number of challenges.

The first decision to make is the capital basis to use where different capital figures are reported, whether this is the regulatory capital requirement, shareholder capital or economic capital. While regulatory capital requirements may seem most appropriate as this represents the capital held by the business, if there are different internally reported figures these may provide more valuable insight.

When using regulatory capital figures, they are likely to be based on the 1 in 200 year return period, which is dictated by the regulators. However the split of capital between classes for different return periods may be very different. If a different return period was to be selected in the future the capital allocation may be significantly affected where classes vary widely in terms of volatility. An alternative approach that takes different, or all, return periods into account may provide more accurate insight by utilising more information.

Other considerations include:

- Which capital components should be included – the full capital figure or just specific components? Within Underwriting Risk it may be preferable to include only the portion relating to future business to be written or to include additionally the unexpired exposure from previous years. As well as deciding whether to include the run-off of unexpired exposure, it is also necessary to consider whether to include other risk categories such as Operational Risk or Market Risk.
- Historic classes no longer written – if these have a large Reserve Risk, it may be difficult to achieve a specific return on the total capital. Conversely, new classes may benefit from having no Reserve Risk compared to existing classes if all elements of capital are included.
- Accurately splitting capital requirements by class of business – as more scrutiny will be paid to class level capital figures the accuracy of these class level figures is more important, particularly where certain parameters may not split precisely by class, for example cross subsidies between reinsurance layers.
- Allocation of diversification benefit to class – how this is calculated may have a significant impact on the results. It may be that some classes are not as profitable as others but are useful for reducing the proportional capital requirements. Consideration should be given to whether the overall diversification benefit deals with varying levels of profit between classes sensibly. IMIF has published guidance on diversification benefit which can be found on the IMIF web pages..
- Which capital figure to use – 1 year SCR or ultimate SCR. The one year SCR will not factor in claims development after the first year but there is a cost here that should not be ignored. However, it may be the one year SCR that is required by regulators.

Even where it is possible to split capital by class, there may be other issues that need to be dealt with. How this information is being used within the business and what decisions are made as a result should be considered, particularly where there are known limitations in the results.

From a pricing perspective there may be issues if large swings in capital charges in pricing models are experienced year on year due to change in capital, mix of classes written or a change in allocation methodology. How this is perceived by underwriters should be considered, as well as any conclusions drawn by senior management or other key stakeholders due to large movements in reported KPIs year-on-year.

Estimating class level return on capital for parameterisation within pricing models

Once a capital figure for the class of business has been calculated, including all risk elements required and the agreed level of diversification credit, the ratio of capital to the class projected written premium can be calculated.

Example of information from the capital model output

Note that diversification has been allowed for in the capital measure used so the total is equal to the sum of the different classes. The capital measure only includes the agreed elements of capital so the total capital requirement will be higher than the £48.9m showing below.

Class	Capital included	Prospective year premium	Capital: Premium
Marine	6,300,000	8,400,000	75.0%
Liability	2,100,000	2,000,000	105.0%
Property Cat	20,000,000	15,000,000	133.3%
Motor	9,200,000	20,000,000	46.0%
Reinsurance	11,300,000	10,000,000	113.0%
Total	48,900,000	55,400,000	88.3%

This ratio can then be applied to each individual risk to provide the capital requirement for that risk. By calculating the expected return from the risk once claims, expenses and all other costs have been deducted from the premium and dividing by the capital requirement for that risk, a return on capital is produced.

Example of information from the capital model used in a pricing model:

(In this example the pricing model produces a model price of £5m and targets a loss ratio of 60%. The risk is written at a price lower than the model premium, has an expected loss ratio 66.7% and a return on capital of 7.4%.)

Premium summary

Model Premium	5,000,000	Premium Breakdown:		From Capital Model:	
Actual Premium	4,500,000	Expected Claims	3,000,000	Capital: Premium	75%
		Expenses	750,000		
Target Loss Ratio	60.0%	Brokerage	450,000	Capital outputs:	
Expected Loss Ratio	66.7%	Other costs	50,000	Capital requirements	3,375,000
				Return on capital	7.4%
		Return	250,000		

There are a number of decisions to be made when taking this approach, for example, what premium to use when calculating the capital requirement for each risk.

The actual premium charged for the risk or the model premium calculated for the risk in some cases in a follow market can be quite different and using actual premium may underestimate the capital requirement for a risk if the risk is priced below the model premium. However, by using the model premium, total premium for the year may be more difficult to report and if actual premium volumes were as expected, the capital allocated to the risks written may differ significantly to the total capital initially calculated.

There is then the issue of deciding whether the premiums should be gross or net of reinsurance. Most pricing models target gross loss ratios and ignore the impact of reinsurance, but when using output from the capital model (which is influenced by the expected reinsurance protection) it may be necessary to factor this in, particularly if reinsurance costs are very different between risks, for example if facultative reinsurance is purchased on some risks. Regardless of the approach taken, it is important to consider the material items for the business and to be consistent throughout the calculations.

Model capabilities to enable use

To ensure that the model is fit for purpose for this use, the following capabilities must be considered.

Capabilities	Description	Comments
Outputting required capital figures	Providing a split of just the required capital figures at the chosen return period rather than the total capital	The model will need to output the required capital, segmented from the total capital if only part is included in the calculations (for example, if minor risk categories are removed or reserve risk for discontinued classes). This will then be used within the pricing model to estimate the capital requirement for an individual risk.
Granularity	Flexible grouping of lines of business	The model has to be able to group lines of business within the same major / minor lines that apply to the pricing models.
Consistency	Same split of classes for capital modelling as for pricing	The split of classes should be consistent between the capital modelling output and the pricing models. If different sub classes group together for pricing classes compared with capital modelling classes, the output may not be relevant or may require thought on any adjustments that should apply to make the model output relevant.
Dependencies	Class level capital, factoring in the dependency structure between classes	The dependency structure between classes is needed to accurately calculate class level capital requirements. This will factor in dependencies and diversification between classes.
Link to risk appetite	Assess the impact on risk appetite	Risk appetite statements may be made relating to the pricing of business, possibly with return on capital thresholds for business to be written at. This could be used to set specific thresholds within the pricing models to indicate whether writing each specific risk is within risk appetite.
Full range loss curves	Full range of simulated gross and net results	This allows investigation of how the capital requirements by class vary at different return periods. This may be of particular benefit for other pricing methods using output from the capital model, for example quantifying the impact of different limits and deductibles on price.
Reconciliation / P&L attribution	Distributions generated from the model should reconcile back to the business plan	The expected losses and class level volumes of business and expenses will need to reconcile to the business plan and to the parameters used within the pricing model to ensure consistency. This is in addition to any reconciliations that can be done to add credibility to the model output and use.

Model limitations

Every model is a simplification on reality and so will always have limitations. When using capital models for different uses it is necessary for management to be aware of the data and model limitations and the business implication of these.

There will always be limitations however this should not stop the model being used throughout the business. In fact, often when using the output to aid decision making it will highlight areas for future development and improvement.

Below are a number of limitations although none of them are expected to be significant enough that the model cannot be used for calibration of pricing models. However the output should always be sense-checked and compared to expectations and previous parameterisation.

Data Limitation	Link to model capability	Comments
Split of classes may not be granular enough and/or relevant	Granularity	One class of business may divide into a number of different areas with separate pricing models (for example, Marine Liability may be divided into large P&I club cover and small Ship Repairers Liability risks which would have very different capital requirements but for a diverse company these may be grouped together for capital modelling purposes. Thought is needed to ensure that any capital output and loads applied are relevant for the business being priced.
Risk specific volatility transferred from cedant/ insured	Granularity	As with the above, class level capital requirements will not be granular enough to consider risk specific characteristics and therefore any differences in loss ratio required (for example, higher excess business compared with primary risks).
No validation of base rates within pricing models	Reconciliation	Any uplifts to the rates or premiums within pricing models for cost of capital are likely to be set from an existing assumed loss ratio that the base rates target (as two companies writing the same risk at the same price will have the same loss ratio from the risk but may have different capital allocated to the risk due to mix of business, expenses etc.). If this is not accurate then nor will the uplifted premium figures or any return on capital KPIs.
Portfolio changes	Reconciliation	If the business written within a class of business changes significantly from that assumed when the capital modelling took place then the capital figures may no longer be valid within the pricing models. The profile of business actually written may have higher excess levels and therefore require more capital to support it.
Negative return on capital	Link to risk appetite	Depending on market conditions for certain classes and the company's strategy, there may be a negative return on capital for a given class. This may raise some difficult discussions internally about the viability of classes, especially if there is some debate over the split of expenses or views on the benefits of this class (for example, increased diversification). It may also lead to unhelpful pricing model output in terms of return on capital figures reported.

Modelling Limitation	Link to model capability	Comments
Large variation of risks written within a class	Consistency / reconciliation	This simple cost of capital approach may not be appropriate where very different risks (in terms of capital requirements) are written within a class. For example, catastrophe excess of loss risks may require very different capital loads for a primary layer compared with a high excess layer. These differences will not be captured in this approach.
Return period used and the resulting risk ranking	Full range loss curve	Different classes may exhibit different characteristics at different return periods, so by using different return periods different classes may deliver significantly different returns on capital. An approach using more than one return period (or indeed all return periods) may be fairer.

Conclusion

With a more joined up approach to pricing across the business and utilising information from other departments, using information from the capital model can provide useful insight for both pricing model users and senior management and allow more consistent comparison of expected results and profitability between classes.

However, much thought is required on what to include within the calculations, in terms of capital figures and expenses. Caution should be exercised to not provide results that may be misleading or vary dramatically over time.

As with many model uses there will be limitations and changes or refinements may be needed over time, but this is all part of the feedback loop, connecting different areas of the business and utilising information from other areas. It may also lead to better insight and expert judgement used within the capital model from the underwriters who are best positioned to comment on future changes expected to their portfolio.

There are other considerations when using pricing models for reporting purposes that may be seen as more fundamental items to address before applying approaches based on capital modelling output, such as validation and calibration of the base rates and rating factors. Any data and modelling limitations from capital modelling output should be taken into account at the same time as any limitations of the pricing model to ensure any weaknesses and their combined impact are fully understood.

Authors:



Gemma Dawson, is a Fellow of the Institute of Actuaries and a Senior Actuary at UMACS, as specialist actuarial consultancy. Gemma has led the build and implementation of pricing models across a number of syndicates, as well as delivering various rate monitoring, reinsurance modelling and data analysis initiatives with underwriters and brokers. She also works on the delivery of key Solvency II work including capital modelling and SII reporting.



Raphael Borrel is a member of the IMIF steering committee and leads the 'Advanced Uses of Internal Models' work-stream. He manages the Solvency II Experts Group, a large non-commercial European network of Solvency II interested parties. He is an experienced risk strategy, risk transformation and compliance consultant with over 15 years of experience within financial services. He previously worked within the Lloyd's market, Big 4 consultancies and Aon. He currently focuses on assisting companies to transform their risk management capability through the integration of an enterprise-wide approach, shifting the risk focus to a more strategic and forward looking perspective and driving a significant strengthening in Internal Model capabilities and use.

The Internal Model Industry Forum

The logo for the Internal Model Industry Forum, featuring the text "Internal Model Industry Forum" in a sans-serif font. "Internal Model" is in a light blue color, "Industry" is in a darker blue, and "Forum" is in a very dark blue. The text is set against a light blue rectangular background.

This document has been produced by the Internal Model Industry Forum (IMIF). The Institute of Risk Management (IRM) set up the IMIF in 2014 to address the key questions and challenges that insurers face in the use, understanding and validation of internal risk models. It is designed to work in a collaborative way to develop and share good practice to ensure that these models add value to the organisation and support regulatory compliance. IMIF now has over 300 members and we have run a series of Forum meetings to explore key issues. A number of workstreams are also undertaking research and we aim to publish the results along with other useful resources and guidance.

The IMIF work is led by a steering committee comprising modelling experts from insurers alongside representatives from EY, KPMG, LCP, Milliman, PWC, the Institute and Faculty of Actuaries and the Bank of England Prudential Regulation Authority.

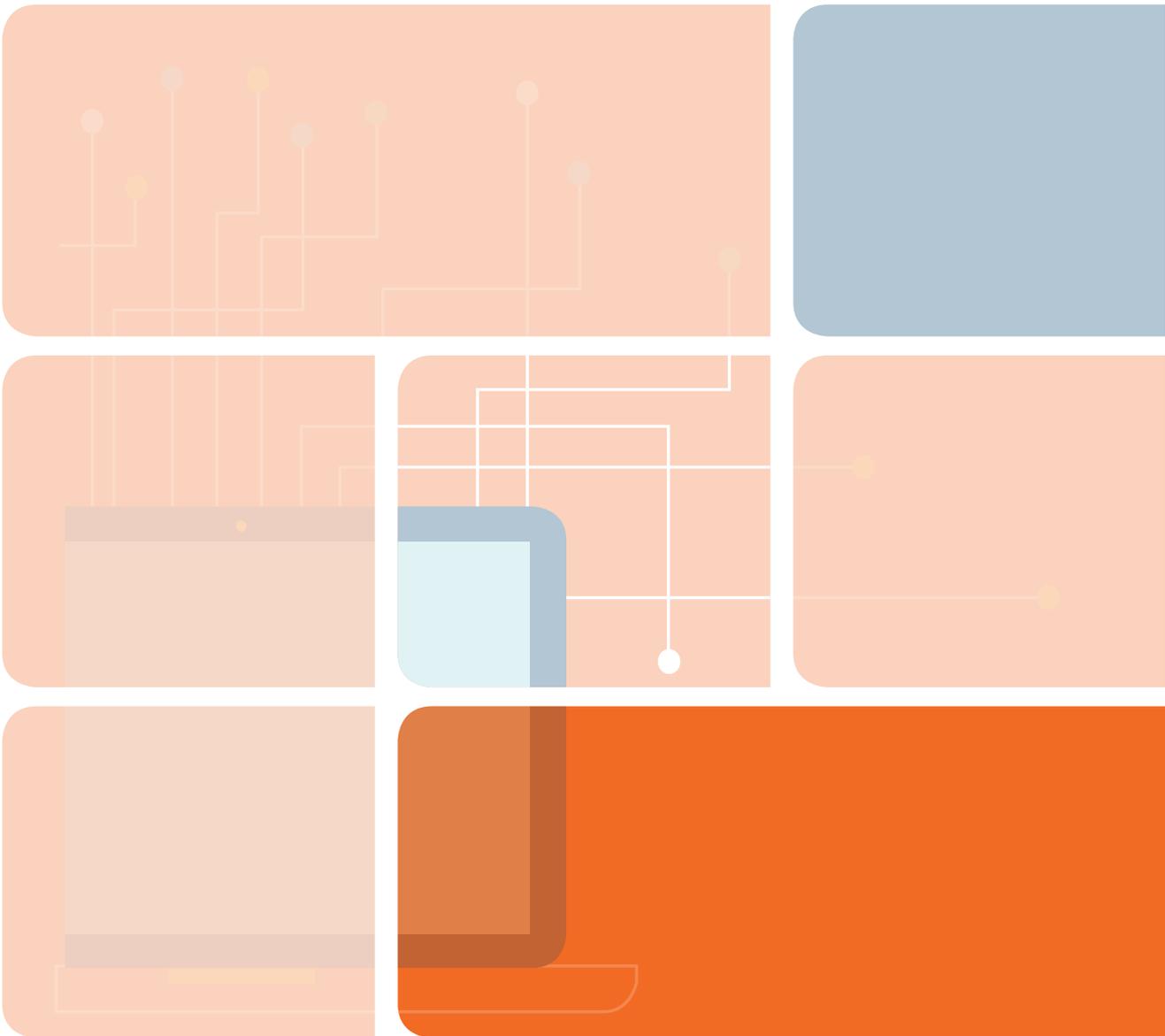
As the leading organisation promoting education and professional development in all aspects of risk management, IRM is pleased to be able to support this industry initiative to share good practice

More information about the IMIF and its work can be found on the IRM website www.theirm.org

Who are the IRM?

This work has been supported by members of IRM, which has provided leadership and guidance to the emerging risk management profession for over 25 years. Through its training, qualifications and thought leadership work, which includes seminars, special interest and regional groups, IRM combines sound academic work with the practical experience of its members working across diverse organisations worldwide. IRM would like to thank everyone involved in the IMIF project.





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