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The Modeling Continuum

By Henry Essert

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Introduction

Models have long been an essential fixture in the insurance industry. However, the level of interest in and discussion of models and model risk management (MRM) has increased significantly over the last few years. There are two main reasons:

- First, a large number of important model-related initiatives are in active development or nearing completion. These include principles-based reserving (PBR) on the U.S. statutory front, as well as periodic, ongoing deliberations on reserving methodologies of the U.S. Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS). For capital models, Solvency II is moving toward implementation in Europe and other jurisdictions are developing or implementing similar regimes. Moreover, in the United States, there is an initiative to modernize risk-based capital (RBC) as well as developments at the federal level. Perhaps most noteworthy, though, are International Association of Insurance Supervisors (IAIS) developments. The IAIS' 2014 release of a base capital requirement (BCR) has been followed by a concerted attempt to create an international capital standard (ICS) and a higher loss absorbency (HLA) model. In all of these initiatives, there has been extensive discussion of the pros and cons of different modeling approaches.

- Second, as insurers' risk management functions move to a new level of embedding and utilization, MRM takes on a new level of importance and urgency. With quantitative enterprise risk management (ERM) fundamentals (e.g., economic capital models) actively being used for decision-making, it becomes essential that insurers manage their modeling process. In particular, insurers need to ensure proper governance, effective controls and model validation. Different types of models and differences in use will impact how MRM should be conducted.

With so many different models and so many different ways to build them, the task of organizing our thinking about models can seem overwhelming. Sorting all of the different kinds of models into a framework should help our understanding of both the models and model risk management. This paper proposes four categories for this framework, defines seven model attributes, and then compares the different categories across these attributes. With this comparison as a guide, we address some practical questions, including:

- Are some modeling approaches inherently better than others?
- Are different approaches better for different purposes?
- How should the level of MRM effort depend on the category of the model?

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Model category definitions and examples

Models can be sorted into the four categories described below. While broad distinctions between the categories should be apparent, the divide between them is not always precise. Accordingly, it is appropriate to see the different categories as a continuum rather than as discrete variations. Note also that the term “model” is frequently used to describe a collection of connected subparts, each of which is a model itself. It is not uncommon for the subparts to be from different categories.

Category I: Simple factor

These are models that apply factors to proxy exposure amounts. There frequently are a number of exposure proxies with corresponding factors. These proxy/factor products are then added together to develop the model’s output value. The most common examples relate to capital. The IAIS’ BCR model is a good example, as is most of the RBC calculation. Though less commonly used in liability valuation, the Bornhuetter-Ferguson technique could be seen as an example of this type.

A typical, though not defining, feature of these models is that proxy exposures frequently use public, vetted information.

Category II: Complex single scenario

These are similar to simple factor models except that, instead of proxies, factors are applied to values more directly representative of the exposure. In other words, they aim for real exposure rather than proxies. This category includes models that represent an algebraic statement of an expected future event, such as the present value of anticipated future costs less future revenue. Models in this category differ from those next along the continuum in that they utilize only a single scenario. That single scenario typically is a best estimate scenario or best estimate plus a defined margin. Most of the Solvency II standard formula falls into this category, as do most GAAP and IFRS liability models.

Category III: Constrained multi-scenario

As the name implies, category III models differ from the first two categories in that they use multiple scenarios of possible futures. Importantly, there are constraints of some sort, which can apply to assumptions or relationships between model elements. Often the scenarios themselves are constrained. That is, specified future events are required to be modeled. Each scenario develops its own model outcome. If the model’s objective is a binary outcome (i.e., a pass/fail), then the extreme value among the scenario outcomes is often used. For example, in a risk model, the most costly outcome could be used to establish the capital required.

Cash flow testing, with required scenarios, is a good example of a model in this category. As some insurers start to prepare for Federal Reserve oversight, Comprehensive Capital Analysis and Review (CCAR) (another example of this category) is gaining wider understanding.

A significant part of the IAIS’s December 2014 proposal for the ICS also fits in this category. Two scenarios are used, a best estimate plus margin and a defined stress.

Category IV: Unconstrained enterprise specific

The fourth category is an extension of the third. Limitations are removed. Instead of a small number of prescribed scenarios, a larger number are used, including user-specified scenarios and often stochastically generated scenarios. Likewise, relationships between formula elements, such as policy lapses relative to market conditions, are typically less constrained in an effort to reflect enterprise-specific circumstances. When a large number of stochastic scenarios are developed, statistical measures like the mean of the distributions, or values at a defined confidence interval, can be developed and utilized.

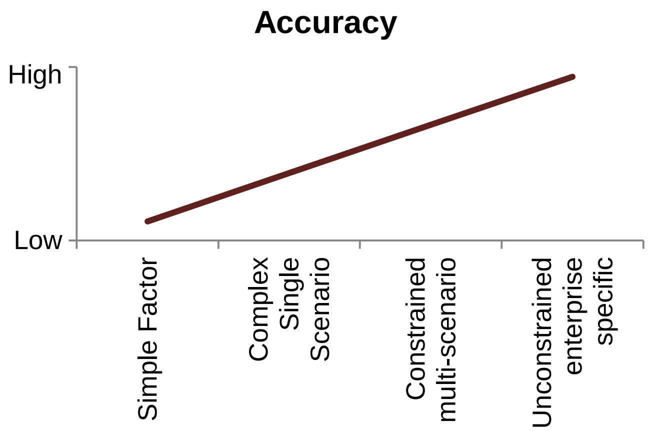
Examples in this category are Solvency II internal models and PBR.

Comparing model attributes across categories

We identify seven model attributes below and compare model categories across them.

Accuracy

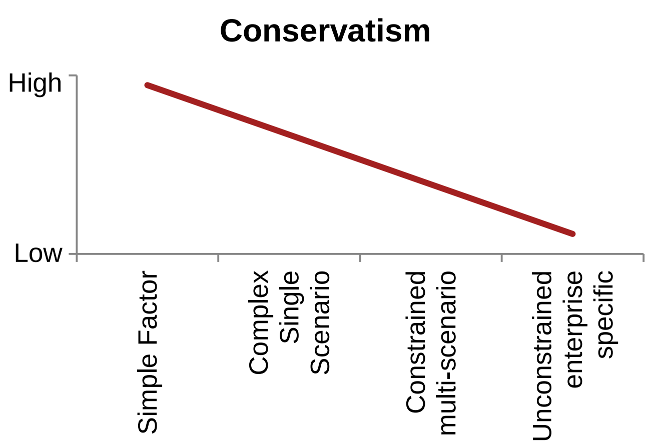
This attribute considers the potential for models in the category to accurately represent reality. Accuracy potential increases from category I through to category IV. Compared to the simple factor approach, the complex single scenario utilizes a more refined and realistic representation of events. The constrained multi-scenario extends the degree of realism further by allowing for a number of different futures. Finally, the last category extends realism even further by removing constraints in the formulation of each future's depiction and accommodating many more possible futures.



Conservatism

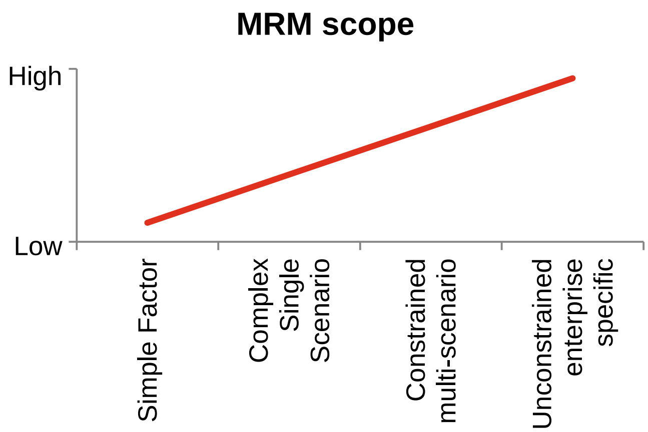
This attribute addresses the need to build conservatism into the model. As expected, it follows a pattern opposite to accuracy potential. That is, category I, the least accurate, requires the most conservatism. Category IV, the most accurate, requires the least.

Conservatism can be added at the final stage. For example, capital goals relative to RBC are typically three or four times the generated RBC value. Or, conservatism can be added at the level of assumptions, including the selection of scenarios.



MRM scope

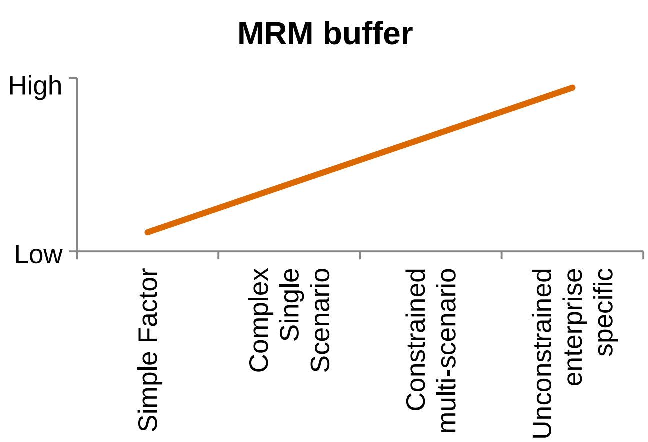
This attribute considers the need and also the potential for managing model risk. Category I models are simple factors applied to prescribed exposures. There are very few moving parts. Therefore, any model risk management program applied to category I models would be limited by the basic simplicity of these models. On the other hand, category IV models are complex at many levels and are unconstrained. Accordingly, there is more that can and should be managed at higher categories of the modeling continuum.



MRM buffer

This attribute considers the necessary response to insufficient MRM. As one might expect, the progression parallels the progression of model risk. Category I models have the least potential to apply and benefit from model risk management, so suffer least if model risk management is insufficient. The greater the need and ability to manage model risk, the greater the requirement for a buffer if this need is not addressed.

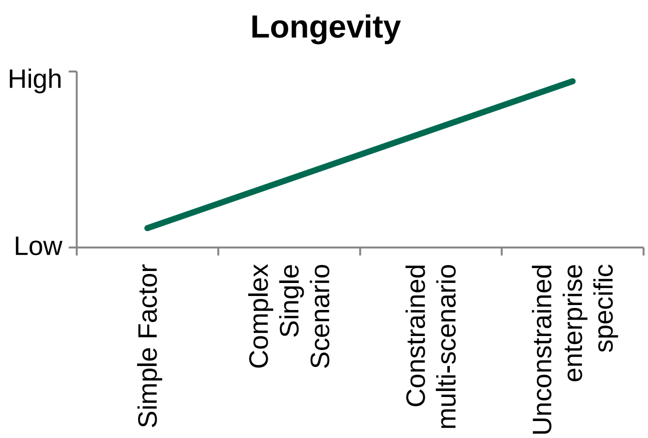
It is also worth comparing this attribute to conservatism. Although they may appear similar (both are accommodated by adding "extras" to the assumptions or outcomes), their different nature is important and worth exploring. Conservatism is an attribute intrinsic to the category. For example, category I models always need a higher conservatism allowance. No amount of model risk management will alter this need. On the other hand, category IV models, if managed, attract low "extras" in the form of an MRM buffer; however, if MRM is insufficient, then those "extras" need to increase. In other words, MRM buffer is an attribute dependent on the level of model risk management not, like the conservatism allowance, intrinsic to the category.



Longevity

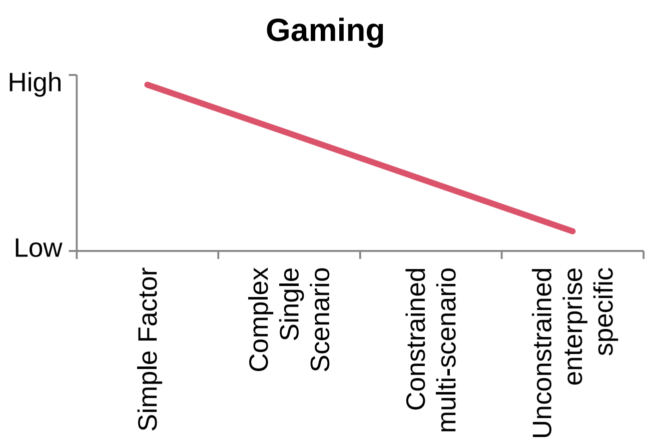
Longevity considers how long a model can "survive" without needing to be updated to reflect changing circumstances. In theory, the progression from category I to category IV is from low to high. The simple, less accurate categories fit fewer factors to the many variables that represent the underlying reality. As the underlying reality changes over time, the fit becomes poorer and needs to be updated. On the other hand, unconstrained enterprise specific models (category IV) are by their nature constantly changing to reflect the changing circumstances in the environment and at the enterprise.

However, in practice, simple factor models remain constant for a surprisingly long time. This is likely because users recognize that these models are at best a rough approximation. Their value lies less in their accuracy than in their other attributes.



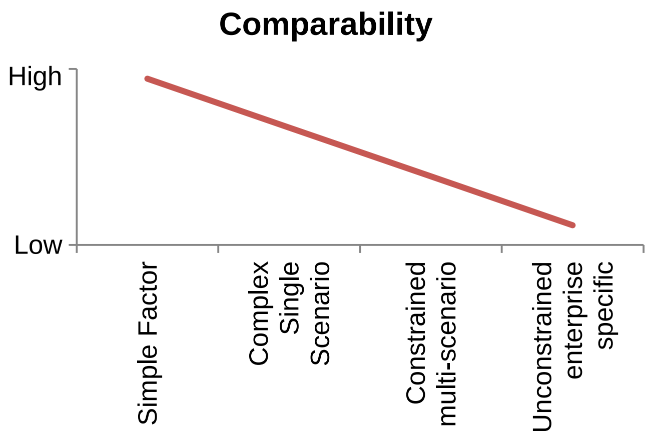
Gaming

This attribute considers how easy it is to "game" models in the category—that is, how easy is to advantageously rearrange the underlying reality without signaling that rearrangement through a change in model results. The progression from category I to category IV is from highest to lowest.



Comparability

This attribute addresses how readily comparable model results are between enterprises. For example, for category I, it is easy to confirm that the same factors were applied to the appropriate exposures (which presumably will differ between enterprises). For a category IV model, comparing two enterprises is significantly more difficult. Assumptions are fit to the specific circumstances of each of enterprise. There will need to be an examination and comparison of each of these differences in order to establish equivalence.



Model categories and attributes and how they relate to model risk management

Are some modeling approaches inherently better than others? Comparing the different categories over multiple attributes, it would appear that this is not the case. Accuracy increases from category I to category IV and the need for conservatism correspondingly decreases. But this comes at a price: The scope and need for model risk management escalates. And, if effective model risk management is not instituted, then the need to incorporate a buffer increases. It is interesting to speculate how the increased buffer for an unmanaged category IV model would compare to the level of conservatism required in a similar category I model. Without proper model risk management, has all the extra work and cost to move to the higher category been worthwhile?

Despite the fact that category I models, in theory, should be updated often and can be gamed, there is much benefit in being able to compare enterprises by the same yardstick. And if the category I yardstick is too inaccurate, then moving up the continuum could reduce that problem but still maintain an adequate level of comparability.

Consider the merits of different types of models for different purposes:

- *Granular business decisions:* For the most granular business decisions, category IV models would seem to be the best choice. These decisions, such as trading complex assets or designing variations in equity guarantee policy provisions, benefit from the most comprehensive reflection of reality attainable. Even an artificial constraint in the scenario set could lose important data points. Needless to say, model risk management is essential.

- *Board-level business decisions:* The term “board level” is used to differentiate these types of decisions from granular decisions considered above. An example of a board-level decision is the determination of the amount of shareholder dividends. What kind of model would be best to use for decisions like these? A reflexive response would be “the more accurate the better.” But, recognizing the need for the decision-maker to attain sufficient comprehension and comfort, a category IV model could be too much, even with robust model risk management in place. Likewise, a category I model is almost certainly too imprecise.

  Consider again the determination of the funds available for shareholder dividends. While a category IV economic capital model could play a role, practical experience suggests that decision-makers will want to see capital impacts of specific scenarios (category III) and measures that afford some comparability to other enterprises (category II) before making their decision.

- *Regulatory decisions:* As with board-level business decisions, aiming for the most accurate category might not be the best approach. Certainly comparability between enterprises takes on a very high level of importance. Despite their shortcomings, category I models might suffice given the intended decision and the level of conservatism in the model. For example, if there needs to be a decision whether or not to escalate regulatory intervention, a clear and comprehensible yardstick is very useful. For more nuanced actions, more precise measures may be needed, but it seems unlikely that the precision a category IV model provides would be necessary.

Conclusion: The importance of an MRM framework

Despite the fact that the different categories have different scope for model risk management, the need to develop and implement an appropriate MRM framework is universal. A proper model inventory should include appropriate models regardless of category. Assigning and documenting responsibilities for managing model risk between and among model owners, risk management and internal audit should not differ by category. Likewise, model development and change management are independent of model category.

As far as model validation is concerned, the policy should not depend on category, although the differing scope will mean that resource expenditure will differ significantly. For category I models, inputs and calculations are easy to validate, and the models' limitations should be made clear. On the other hand, for category IV models, elements needing validation are extensive and the resulting demands on resources can be very high.

Because higher level model categories require more resources, another reason for increased attention to models and MRM becomes evident: As insurers utilize more sophisticated models, the need to address all the elements of an effective model risk management framework become that much more important. As insurers move up the model continuum, they will need to pay more attention and commit more resources to model risk management.

References

Actuarial Standards Board. “Proposed Actuarial Standard of Practice: Modeling.” Second exposure draft, November 2014.

Board of Governors of the Federal Reserve System. “Guidance on Model Risk Management.” SR 11-7, April 4, 2011.

Glasserman, Paul, and Xingbo Xu. “Robust Risk Measurement and Model Risk.” *Quantitative Finance* 14, no. 1 (2014): 29–58.

Morini, Massimo. *Understanding and Managing Model Risk: A Practical Guide for Quants, Traders and Validators*. Chichester: Wiley (2011).