How Quantifying Model Risk Can Strengthen Risk Management

Implementing a quantification framework makes it easier to answer difficult questions about models

By Matthew Perconte and Cory Gunderson

Model risk is defined in most financial institutions, but procedures around measuring, monitoring and actively managing that risk are much less defined. Many events have occurred over the past two decades that have shown the financial services industry that model risk is real and can be devastating to an institution if not managed effectively.

Quantifying model risk and explaining its impact on an organization’s balance sheet or P&L is a challenge for many financial institutions, because of the volume and diversity of models and owners. Many banks and insurance companies have a defined model governance process and policy in place, but taking the next step to define, measure and report model risk is a newer concept — one that is being stressed by regulators of financial institutions.

Effectively implementing a model governance process and policy to drive consistency of model risk practices across the organization can be difficult. Financial institutions should be designing an improved framework that provides data and information related to the drivers of model risk, as well as rationale and evidence that shows why a given model is “riskier” than other models.

The framework must also attempt to estimate a model’s true contribution to risk exposure. This framework can support other governance expectations related to model validation and performance monitoring. Although it is a challenge, financial institutions need to be focusing on quantifying risk for all model types, effectively capturing all sources of model risk and calculating a measure of the institution’s overall exposure to model risk.

Why Quantify Model Risk?

Banking regulators have continued to advise banks on the merits of adequate risk management and the governance of models. Original guidance drafted in 2000 (OCC 2000-16) focused on the value of model validation and appropriate methods for institutions to validate their models, before and after implementation, sufficiently. More recent guidance (from 2011) has focused broadly on overall model risk management, and emphasizes the importance of model governance, model documentation and effective challenge.

The new Joint Supervisory Guidance on Model Risk Management describes model risk as “the potential for adverse consequences from decisions based on incorrect or misused model outputs and reports that can lead to financial loss, poor business and strategic decision-making, or damage to a bank’s reputation. Model risk can occur due to fundamental errors that may produce inaccu-
rate outputs when viewed against the design objective and intended business uses; or the model may be used incorrectly or inappropriately to make business decisions.“

Since the global financial crisis, many financial institutions have been actively assessing, measuring and monitoring different risks they faced before the financial collapse, and nearly all are doing so for risks they have faced since the crisis. Enterprise risk management (ERM) and corresponding risk appetite frameworks for managing multiple types of risks have been established and implemented at many financial institutions.

The OCC defines eight categories of risk for banking supervision: credit, interest rate, operational, liquidity, price, compliance, strategic and reputational. Certain risks (some defined by the OCC) an institution faces are hard to quantify due to their nebulous nature, comparatively low likelihood and/or uncertain effects — for example, reputational, strategic or model risks. Yet, models are utilized to measure and quantify all types of risks.

Supervisory guidance states that banks should manage model risk in a manner similar to how an institution proactively controls and mitigates other risks. To manage model risk, banks should identify the sources of the risk and measure its impact.

Model risk will increase based on a variety of factors specific to certain models, such as complexity, ambiguity of model inputs and assumptions, and how the model is used within the organization. Risk for each model also evolves and changes over time based on the design, implementation and usage of the model and the validation results.

What’s more, risks can emerge from degradation of datasets used to create the model and from changes in the environment that impact assumptions. Risk should be assessed at both an individual model level and an overall bank or enterprise level. In effect, the new regulatory guidance suggests that banks should treat model risk as they do any other type of risk.

**Model Risk Quantification Objectives**

Considering the above requirements, as well as the increased usage of models as daily tools, financial institutions need to both quantify model risk and identify the sources and drivers of that risk. The following are recommended objectives for a model risk measurement methodology:

- Address regulatory guidance on measuring and managing model risk;
- Allow for trending, tracking and reporting on individual model risks and on model risk to the bank as an enterprise;
- Define a process for quantification that can be used as a tool to drive change in governance functions and reinforce model performance monitoring;
• Provide a framework for effective challenge that defines governance roles and responsibilities; and

• Allow management to drill down into sources of model risk and determine solutions to mitigate overall model risk.

Models are complex, and reams of detailed information are necessary to create a comprehensive methodology. Consequently, to design an effective model risk quantification framework, financial institutions should consider a methodology’s ability to (1) be implemented within existing bank structures and processes; (2) deliver timely, clear and concise reporting to management, so decisions can be made to mitigate model risks; (3) drill down into the sources or drivers of risks and quantification of risk at an individual model level; and (4) link a bank’s risk appetite (to measure, for example, impacts to tier 1 capital or balance sheet exposure); and (5) separate model risk from impact, and quantify each independently.

An effective methodology must also be readily understood by non-quants and scalable over time, as new models and products are introduced. The initial iterations of the methodology should focus on trending, order of magnitude, and consistency. Over time the methodology can grow, and the institution should refine it to create more precision in quantification.

**Overview**

The basic building blocks of starting a model risk quantification methodology can be extracted from the existing bank governance processes. Key components of model risk management and the bank’s documented model life cycle should be used to identify and define sources of model risk.

The quantification methodology and process should incorporate effective challenge principles and inputs from model stakeholders. The methodology should also make use of the three “lines of defense” of model risk management: (1) model users and owners; (2) model governance (i.e., validation); and (3) internal audit.

**Scoring Risk**

Model risk sources applicable to all models can be scored periodically based upon the level of risk associated with each source (see Figure 1). Sources of model risk should be separated into a combination of qualitative and quantitative components (components not shown in Figure 1). Components used to score overall sources of model risk will vary by institution, but two examples are measures around data quality and model limitations. A flexible and pre-defined scale is used to score each model
risk’s source; this scale could be as simple as using a low, medium or high rating to calculate scores. The risk score for each source would then be aggregated to determine the overall model risk score on the same low, medium and high scale, with gradation options in between.

Responsibilities for scoring different sources of model risk should be distributed to different model stakeholders. The scoring responsibility should attempt to match skill sets with roles, as well as take into account the life cycle of the model.

Over time, as an institution becomes more comfortable with the methodology, it should transform and capture more complex relationships between models, as well as move from qualitative to more objective quantitative components to score risk.

Risk Aggregation
Aggregation of risk scores across models can be done using a statistical-based or a risk/exposure-based allocation approach. The aggregation should be dynamic and able to adapt to the bank’s changing risk profile. The institution can then aggregate risk-type scores based on enterprise risk to determine the overall institution-level model risk score.

A risk quantification methodology is needed to translate the enterprisewide risk score into an impact of model risk. As the risk score moves from period to period, the impact can be used to allocate a desired impact metric (e.g., capital) specific to model risk.

The impact scale could be based, for example, on scenario analysis to quantify amounts associated with model failures. Quantification of model risk should then be incorporated into the institution’s existing risk appetite framework, using specific model-risk metrics that are the output of the risk quantification methodology.

Performance Monitoring
The risk quantification methodology should be designed to include model performance monitoring and ensure that it is operational for all models in use. This includes looking at basic statistical measures, period to period and against benchmarks, to assess each model’s performance.

The performance monitoring results then can be input into the risk quantification methodology and used to drive re-scoring of sources of model risk through defined thresholds.

Risk Reporting
A methodology that quantifies the amount of model risk and its associated impact is a useful tool that can be utilized by all financial institutions. By incorporating a methodology similar to the one discussed here and developing a process around it, an institution can identify sources of model risk and drive decision-making about all models developed and utilized by the bank.

Technology tools, in addition to making reporting easier, should ultimately support the process of executing the risk quantification methodology. There is a substantial amount of reporting that can be built into the model risk quantification framework discussed here (to serve multiple stakeholders). The figure on page 3 details some of the types of reporting that a successfully implemented model risk quantification methodology can deliver.

Parting Thoughts
Expectations for model risk management aren’t going away, even as organizations struggle to answer the following basic questions: “Are my models riskier today than yesterday? Which ones? Why?” Implementing a model risk quantification framework makes answering these important questions, from period to period, much easier.

A key to successful implementation is to start simple and enhance/evolve the model risk quantification framework over time, reflecting the way major model enhancements themselves have occurred, such as the progression in complexity and sophistication of economic capital models. Ultimately, a model risk methodology that allows the institution to track and manage its model risk more effectively over time will lead to better decision making and a healthier balance sheet.

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