

related in some way to PD, LGD, or EAD. More than one reference data set may be used.

**Estimation**—Second, the bank applies statistical techniques to the reference data to determine a relationship between characteristics of the reference data and the parameters (PD, LGD, or EAD).

The result of this step is a model that ties descriptive characteristics of the obligor or facility in the reference data set to PD, LGD, or EAD estimates. In this context, the term ‘models’ is used in the most general sense; a model may be simple, such as the calculation of averages, or more complicated, such as an approach based on advanced regression techniques. This step may include adjustments for differences between the IRB definition of default and the default definition in the reference data set, or adjustments for data limitations. More than one estimation technique may be used to generate estimates of the risk components, especially if there are multiple sets of reference data or multiple sample periods.

**Mapping**—Third, the bank creates a link between its portfolio data and the reference data based on common characteristics.

Variables or characteristics that are available for the current portfolio must be mapped to the variables used in the default, loss-severity, or exposure model. (In some cases, the bank constructs the link for a representative exposure in each internal grade, and the mapping is then applied to all credits within a grade.) An important element of mapping is making adjustments for differences between reference data sets and the bank’s portfolio. The bank must create a mapping for each reference data set and for each combination of variables used in any estimation model.

**Application**—Fourth, the bank applies the relationship estimated for the reference data to the actual portfolio data.

The ultimate aim of quantification is to attribute a PD, LGD, or EAD to each exposure within the portfolio, or to each internal grade if the mapping was done at the grade level. This step may include adjustments to default frequencies or loss rates to “smooth” the final parameter estimates. If the estimates are applied to individual transactions, the bank must in some way aggregate the estimates at the grade level. In addition, if multiple data sets or estimation methods are used, the bank must adopt a means of combining the various estimates.

A number of examples are given in this chapter to aid exposition and

interpretation. None of the examples is sufficiently detailed to incorporate all the considerations discussed in this chapter. Moreover, technical progress in the area of quantification is rapid. Thus, banks should not interpret an example that is consistent with the standard being discussed, and that resembles the bank’s current practice, as creation of a “safe harbor” or as an indication that the bank’s practice will be approved as-is. Banks should consider this guidance in its entirety when determining whether systems and practices are adequate.

#### General Principles for Sound IRB Quantification

Several core principles apply to all elements of the overall ratings quantification process; those general principles are discussed in this introductory section. Each of these principles is, in effect, a supervisory standard for IRB systems. Other supervisory standards, specific to particular elements or parameters, are discussed in the relevant sections.

Supervisory evaluation of IRB quantification requires consideration of all of these principles and standards, both general and specific. Particular practical approaches to ratings quantification may be highly consistent with some standards, and less so with others. In any particular case, an ultimate assessment relies on the judgment of supervisors to weigh the strengths and weaknesses of a bank’s chosen approach, using these supervisory standards as a guide.

S. IRB institutions must have a fully specified process covering all aspects of quantification (reference data, estimation, mapping, and application). The quantification process, including the role and scope of expert judgment, must be fully documented and updated periodically.

A fully specified quantification process must describe how all four stages (data, estimation, mapping, and application) are implemented for each parameter. Documentation promotes consistency and allows third parties to review and replicate the entire process. Examples of third parties that might use the documentation include rating-system reviewers, auditors, and bank supervisors. Periodic updates to the process must be conducted to ensure that new data, analytical techniques, and evolving industry practice are incorporated into the quantification process.

S. Parameter estimates and related documentation must be updated regularly.

The parameter estimates must be updated at least annually, and the process for doing so must be documented in bank policy. The update should also evaluate the judgmental adjustments embedded in the estimates; new data or techniques may suggest a need to modify those adjustments. Particular attention should be given to new business lines or portfolios in which the mix of obligors is believed to have changed substantially. A material merger, acquisition, divestiture, or exit clearly raises questions about the continued applicability of the process and should trigger an intensive review and updating.

The updating process is particularly relevant for the reference data stage because new data become available all the time. New data must be incorporated, into the PD, LGD, and EAD estimates, using a well-defined process.

S. A bank must subject all aspects of the quantification process, including design and implementation, to an appropriate degree of independent review and validation.

An independent review is an assessment conducted by persons not accountable for the work being reviewed. The reviewers may be either internal or external parties. The review serves as a check that the quantification process is sound and works as intended; it should be broad-based, and must include all of the elements of the quantification process that lead to the ultimate estimates of PD, LGD, and EAD. The review must cover the full scope of validation: evaluation of the integrity of data inputs, analysis of the internal logic and consistency of the process, comparison with relevant benchmarks, and appropriate back-testing based on actual outcomes.

S. Judgmental adjustments may be an appropriate part of the quantification process, but must not be biased toward lower estimates of risk.

Judgment will inevitably play a role in the quantification process and may materially affect the estimates. Judgmental adjustments to estimates are often necessary because of some limitations on available reference data or because of inherent differences between the reference data and the bank’s portfolio data. The bank must ensure that adjustments are not biased toward optimistically low parameter estimates for PD, LGD, and EAD. Individual assumptions are less important than broad patterns; consistent signs of judgmental decisions that lower parameter estimates materially may be evidence of bias.