Comply and Exceed

Credit risk management for Basel II and beyond

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Risk management in banking

Life has always involved risk. And people who are best able to weigh risks and make appropriate decisions have always been the most successful. Sometimes this can mean being bold. Often it means being conservative. As in the game of poker, risk and return have to be carefully balanced. Or imagine hunting in the Stone Age: is it worthwhile going for the big mammoth, even if this may place the whole group in peril? The essential risk and reward questions have remained the same throughout the centuries. What has changed is the size of the group.

In today's business world, risk has to be managed by and throughout very large organizations. This also means that gut feeling and basic instincts count less. The history of risk management has been one of making tacit knowledge explicit, of validating and supporting expert judgments by quantitative analysis and of surfacing key insights to an ever larger number of players. In short, decision making in the presence of risk is becoming a more and more rational task, to a degree where it even can be partially automated.

Think in the context of banking. Risk-taking has always been at the heart of banking —to a degree that banking has been defined as the business of managing and transforming risk. From an economics point of view, one of the main ways that banks are productive is by placing themselves in between a few corporate enterprises that demand high-volume, long-term financing, and a large number of private individuals who are willing to make low-volume, short-term deposits. Two major types of risk need to be managed in this process: the risk of counterparty default (credit risk) and the risk of market price changes—especially changes in interest rates and share prices (market risk).

These risks can only be appropriately managed when there is a sufficient degree of information about counterparties and markets. In fact, economically speaking, the bank's information transformation function—i.e., the liberation of the depositor from the need to be thoroughly informed about counterparties and markets—is another major way in which banks are productive. However, the Information Age has brought new dimensions of volume, automation and speed to the business of banking. In order to fulfill its promise of informational efficiency, the bank's capacity to turn data into intelligence needs to increase at the same rate.

This leads to the central question of how risk is best identified, quantified and measured, and how risk measurements are utilized by management for improved decision making. The answer to this question lies in the application of information technology—in particular, in using computerized statistical measurement and information delivery systems.

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Market risk

For example, in market risk banks calculate statistical measures that express price variability, or volatility as it is often referred to within the industry. The volatility associated with individual exposures is then aggregated across the portfolio of all exposures to a Value at Risk figure. Value at Risk summarizes the expected maximum loss (or worst loss) over a target horizon within a given confidence interval. Value at Risk and risk adjusted performance figures are then disseminated to decision makers, often with overall figures broken down by a variety of categories, such as time, geography or business unit. Not only do these reports help management better adjust business strategies to risk, but they are also required by regulators who have determined that Value at Risk serves as the basis for regulatory capital requirements.

Credit risk

Capital lending is a core banking function, and it takes a large variety of different forms. In the broadest form, lending can be categorized based on the type of counterparty involved, such as lending to private individuals (retail lending), small businesses or (large) corporate businesses.

The risks and returns associated with lending are very asymmetric. Unlike in market risk, where prices move up or down with largely equal probability, in the credit area moderate interest revenues from a large number of loans have to cover high losses associated with only a few default events. Another important difference between credit and market risk lies in the characteristics of the operations. Lending differs from trading in that transactions tend to be fewer in number and that human decision making is involved in a more complex way. The process of making credit decisions is also more regulated and less automated. Even in retail lending (when compared to non-retail lending), the fundamental differences in market risk characteristics remain: the number of transactions is increased, the revenue/cost proportions are less extreme and automated decision systems are more pervasive.

Operational risk

The increasing dimensions of volume, automation and speed in which banks operate today have also brought with them the new possibility of failure of these operations, which represents a risk in itself. The fact that humans or systems can fail, or that external events can disrupt operations, is by no means new. However, both the frequency and the impact of operational loss events are strongly increasing. More importantly now, operational risk remains a largely unmeasured risk that was managed through qualitative rather then quantitative approaches.

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Basel II

Industry regulation

Banking is one of the most heavily regulated industries. This is because banks can only transform deposits into loans if the depositors trust in the stability of the banking system and don't all suddenly withdraw their deposits. Such a banking run is a catastrophic event that needs to be rendered as unlikely as possible, because it can seriously affect the economy as a whole.

One way in which regulatory requirements contribute to ensuring the necessary trust and stability is by limiting the level of risk that banks are allowed to take. In order for this to be effective, the maximum risk level needs to be set in relation to another amount which cannot arbitrarily be increased by the bank, such as the bank's own capital.

At the same time, the high cost of acquiring and holding capital makes it prohibitive to have it fully cover all of a bank's risks. As a compromise, the major regulatory body of the banking industry, the Basel Committee of Banking Supervision, proposed guidelines in 1988 whereby a solvability coefficient of eight percent was introduced, i.e. the total assets, weighted for their risk, must not exceed eight percent of the bank's own capital.

From Basel I to Basel II

From Basel I to Basel II

The exact figure of 8 percent is somewhat arbitrary and has always been subject to debate, but nevertheless, the first Basel accord was adopted by more than 100 countries worldwide, becoming a major milestone in the history of global banking regulation. However, a number of the accord's shortcomings, in particular with regard to the way that credit risk is measured, became apparent over time.

Many banks today have already chosen to use internal risk measurement systems as the basis of resource allocation and even executive compensation, even though this level of detailed insight into the structure of credit risk is not reflected in regulations today. This then led to the creation of two separate capital calculation systems within these banks, and the regulatory calculations became less and less important.

With market risk, for example, the first accord allows banks to calculate their capital charge on an internally measured Value at Risk; but for credit risk, only a simplistic approach based on a broad supervisory categorization of counterparties into risk weight buckets exists. Because these buckets don't consider all relevant information on actual counterparty risk that is available to banks through external rating agencies or internal experience, banks can engage in risk arbitrage, amassing those high-return/high-risk counterparties that fall into a low-risk regulatory bucket.

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The general strategy that the Basel committee has adopted is to offer a capital incentive to those banks that move their credit risk management up toward best practice. The accord ensures capital adequacy in three ways, referred to as the three pillars:

- The accord prescribes various approaches for determining the minimum capital requirements, including more risk-sensitive standardized and internal ratings-based approaches;
- It offers guidelines for the supervisory review process, including the approval of internal rating systems;
- It demands detailed disclosure, not only to the supervisor but also to all market participants.

The accord sets broad policy guidelines that each country's supervisors can use to determine the supervisory policies they apply. It was drafted in the expectation that it will be followed more closely by supervisors worldwide. The accord is applied on a consolidated basis to internationally active banks. The scope of application of the accord will be extended to include, on a fully consolidated basis, holding companies that are parents of banking groups to ensure that it captures risks within the whole banking group. The accord applies to all internationally active banks at every tier within a banking group, also on a fully consolidated basis.

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Credit risk

Three approaches to the calculation of capital requirements

The Basel II accord offers three approaches to calculating minimum capital requirements in the credit risk area. In short, they can be described as follows:

- The standardized approach is an extension of the existing risk weight buckets approach, which is made more risk sensitive by including external ratings in the bucket definition;
- The internal ratings-based (IRB) foundation approach substitutes discrete risk weight buckets with a continuous risk weight function. The risk weight depends on an internally estimated probability of default (PD) and a loss given default (LGD) that is calculated using standard supervisory rules;
- The IRB advanced approach additionally allows the LGD to be internally estimated and includes maturity (M) as an explicit risk component in the risk weight function.

Risk-weighted exposure amounts are added to give total Risk Weighted Assets. This figure is then multiplied by 8 percent to give the credit risk-related capital charge. This charge is added to other capital charges from market and operational risk.

Some details of capital requirements calculation

A number of detailed regulations regarding the use of credit risk mitigation techniques and differences between corporate and retail portfolios make the Risk Weighted Assets calculation a bit more complicated than they appear at first sight:

- In the standardized approach, credit risk mitigation techniques, such as taking collateral, reduce the exposure amounts.
- The risk weight function in the IRB approaches is calibrated by the committee. It is different for corporate and retail exposures and the exact values will still change.
- The risk weight function is capped at a value of 12.5 so that the capital contribution of a risk-weighted exposure doesn't exceed its actual exposure amount (since 12.5 is the reciprocal of 8 percent, the product can never exceed 100 percent).
- The PD of a corporate exposure is the PD that is associated with the rating grade that the exposure is assigned to. The PD associated with the rating grade is the long term average as calculated on internal historical data. The rating rule that slots exposures into rating grades can be based on an educated guess, a mapping to external data or by using statistical models that predict individual default probabilities.
- In case of guarantees, the guaranteed exposure amount receives a PD that is the average of the guarantor PD and 15 percent of the borrower PD. The factor is called a floor, w-factor or guarantee absorption capacity.
- In the foundation approach, LGD is determined based on the seniority of the loan and on the value of financial and physical collateral;
- Both in the standardized and the IRB approaches, values of instruments used for credit risk mitigation (e.g., guarantees, collateral and credit derivatives) must be the current values as calculated by a mark-to-market analysis. Haircuts are then used to further adjust these values for volatility of the instrument itself and the currency it is denominated in, as well as the remaining maturity of the mitigation instrument.
- Netting set agreements modify the exposure at default (EAD).
- In the advanced approach, LGD is defined by facility grade. The guarantee absorption capacity as well as the EAD of off-balance sheet items must also be estimated in the advanced approach.
- In the retail portfolio, segments take the place of rating grades and facility grades, i.e., both PD and LGD are looked up by segment. There is no differentiation between foundation and advanced approaches in the retail portfolio.

Minimum requirements for the approval of internal rating systems

If a bank chooses one of the IRB approaches, its internal rating system has to fulfill a variety of detailed minimum supervisory requirements. These range from organizational and business process aspects to data, IT systems and statistical requirements.

For example, the historical data that is used in the estimation of risk components must span a minimum of five years (foundation) or seven years (advanced). The definition of the rating grades must be proven to differentiate risk well. The execution of rating-based decisions must be closely monitored, exceptions must be tracked and the accuracy of the predicted default rates must be continuously verified. Stress testing and scenario analyses have to be performed.

On the business process side, the integrity and robustness of the system must be demonstrated. The system must be well documented and changes must be archived. Any statistical methods used must be well understood and transparently documented. A dedicated credit review unit must exist within the bank that is responsible for the system and reports directly to the board. Management must demonstrate a thorough understanding of the major aspects of the rating system.

Perhaps most importantly, the concept of “use tests” ensures that the ratings provided by the internal rating system are the only ratings used in the bank for risk reporting, capital allocation, loan approval and any other rating-related activity, thereby proving that the rating system is indeed a core component of the bank’s business culture and not simply invented to satisfy the regulator.

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Disclosures

Regulatory requirements mandate that a number of detailed reports be made available to the supervisor, as well as to any interested market participant. These include various reports on Risk Weighted Assets and unweighted exposure amounts. The effect of credit risk mitigation techniques must be disclosed. The various measures need to be broken down along a variety of dimensions, including exposure type, year, industry, country, maturity and current delinquency status.

The requirements also include a large range of reports that ascertain the effective functioning of the internal rating system, including comparisons of external and internal ratings, actual and predicted default rates and qualitative information on the system’s structure and the definitions used.

Operational risk

Basel II also made the first strides toward the regulation of operational risk. Approaches for calculating capital charges include:

- Basic indicator approach, which suggests that operational risk simply be expressed as a proportion of gross income or similar overall operational activity measures.
- Standardized approach, which uses such indicators by business line.
- Internal measurement approach, which relies on quantifications of event probabilities and associated losses.

More recently, other advanced measurement techniques have been proposed, including a loss distribution approach and a scorecard approach. Because operational risk is not the focus area of this paper, these approaches are not discussed here in detail.

Credit risk management beyond Basel II

While the internal ratings-based approaches in the Basel II framework move banks toward a more extensive and sophisticated risk measurement practice, the train doesn't stop there.

For example, in the area of portfolio risk management, the regulation explicitly stops short of making a number of techniques that have been developed in recent years into requirements. These include, in particular, the calculation of Credit Value at Risk or Economic Capital. These techniques would extend the Basel II calculations by producing not only the expected (average) loss figures, but also loss distributions around that number. Value at Risk figures that quantify the maximum expected loss over a certain time period at a certain confidence level can then be read from such distributions.

The difference between the expected and the unexpected loss is sometimes referred to as the economic capital, and it is this amount that needs to be set aside additionally to cover unexpected losses.

The distributions are generated by using Monte Carlo-like simulation techniques that "shock" (apply changes to) the underlying risk factors of a risk model. These could be, for example, those risk components PD, LGD, M that are also used for Basel II Risk Weighted Assets calculation.

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Other uses of portfolio risk measures that are not required by Basel II, but are necessary components of risk management best practices, include limit setting, loan pricing and risk-adjusted performance management (RAPM), in particular in the form of risk-adjusted return on capital calculations (RAROC).

Another area that is left overlooked by regulation is the interdependence between market and credit risk. While Basel II requires some market risk techniques to be used in the valuation of collateral and guarantees, on the whole it treats market and credit risk separately. This approach doesn't account for correlations between these risk types.

Finally, it is one of the major implicit requirements of Basel II that such entities as "borrowers" exist and are described in explicit detail. Moving IT systems from a product-oriented view to such an integrated customer view has been difficult to achieve for many banks in the past. Achieving it, however, will lay down the basis for a large variety of customer relationship management analyses that could help better align risk and marketing departments.

In essence, Basel II is not just about complying with regulations. Instead, it should be seen as a catalyst that enables banks to move forward from their historical legacy into a more coherent and consistent way of analyzing their business, ultimately resulting in cost savings and increased profits.

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Implementing internal ratings-based approaches

Business processes

Even if Basel II doesn't require banks to go all the way toward full state-of-the-art credit risk management in their first attempt, the transforming effects it has had on a bank's business are already enormous, both in terms of processes and systems.

An organizational entity that is required of banks by regulation is the credit review unit. It must be independent from all those bank units that profit from giving out credit, and it must report directly to the board. Its responsibilities include the proper functioning of the internal rating system, as well as the calculation of the risk-weighted assets and the generation of disclosure and management reports. As such, it has to assure the availability of the required data for building, validating and maintaining rating models. It performs stress testing and migration analyses.

If the bank performs advanced portfolio risk management that goes beyond the mere calculation of risk-weighted assets for regulatory purposes, but engages in activities such as limit-setting analysis, portfolio optimization, concentration and correlation analysis, it may be worthwhile to create a dedicated unit for this, as a part of or separate from the credit review unit.

Both units will report their findings to a board-level committee that sets strategic directions, sets limits, allocates capital and approves all major aspects of the rating, as well as exceptions from the documented methods.

Other business units that are affected by Basel II include collection units, as well as those branch support units and branch offices that assign ratings and approve credits.

Staffing the credit review and portfolio analysis units can also be challenging, because Basel II sets high demands on the quality of staff. In particular, statistical and analytical skills are required and will become an increasingly sought-after skill.

The requirement for performing change control and thoroughly documenting business, as well as systems processes, is another major challenge and potential source of difficulty for the credit review unit.

Overall, a streamlining and merging of various fragmented functions in the lending business are in order. The compelling result of investing in Basel II should be seen as an opportunity rather than a threat by decision makers, as it will generate high-level sponsorship and resources that may otherwise be difficult to obtain.

Software and systems

One of the most important organizational units for Basel II implementation is the IT department. A number of mission-critical new or extended integrated system components are required. A close cooperation with users from a large variety of business units is the single most important success factor.

Data warehouse

The most fundamental IT system that supports the needs of Basel II and beyond is the data warehouse focused on risk management related data. A data warehouse is a collection of cleansed and integrated data that is organized and optimized to facilitate the needs of the rating, portfolio analysis and reporting systems. It typically involves the extraction of data from various sources, transformation of data to standardize formats, and loading of data into the warehouse. Typical challenges in this process include assuring data quality and consistency and creating unique identifiers for transactions, counterparties and facilities. Eventually, the data warehouse needs to guarantee one version of the truth across the bank.

The most fundamental IT system that supports the needs of Basel II and beyond is the data warehouse focused on risk management related data.

Data in the warehouse needs to be stored in a customer-centric manner that enables the efficient retrieval of current customer attributes in full detail. Even more importantly, historical data must be available for long periods of time (five to seven years) in order to track past rating assignments, provide sample data for the creation of rating models, validate rating models and monitor trends and changes.

Customer histories must, in particular, include such data on credit performance as delinquencies and losses, and typically include counterparty attributes such as account behavior data and financial (balance sheet) information, among others. In order to support reporting and portfolio analysis, detailed histories must also be kept on internal ratings, external ratings and segments, as well as associated risk components such as PD and LGD.

Finally, information from rating operations such as overrides must be retained, as well as aggregated risk measures such as Risk Weighted Assets or Value at Risk. It is an important requirement of Basel II that all data is stored in enough detail to accommodate future changes in internal rating and reporting systems.

From a technical point of view, the data warehouse needs to provide a variety of specialized storage structures and load processes, all of which need to be thoroughly documented. Support structures for reporting applications include OLAP data storage and a Web-based data exploration interface are combined so end users can quickly and interactively look at summaries of large volumes of data from multiple angles for the online aggregation and decomposition of risk measures.

From a technical point of view, the data warehouse needs to provide a variety of specialized storage structures and load processes, all of which need to be thoroughly documented.

Portfolio analysis applications are dependent on the existence of clean and complete exposure tables and require frequent feeds of current market data into a number of reference tables. Finally, the rating system requires fully denormalized tables as input both to the model creation process and to the rating assignment process. Historical default indicator flags need to be calculated based on a well-documented reference definition of default, and processes that apply the statistical rating model to rate existing or new customers need to be scheduled. The warehouse also provides the interface between the central batch rating system and front-end online rating and originating systems.

Rating system

The outputs of the internal rating system for corporate borrowers are two rules: one rule that slots borrowers into rating grades based on their attributes and another rule that associates a probability of default with each rating grade. Both rules together are sometimes referred to as a “rating model.” The PD of a corporate exposure is calculated as the PD that is associated with the rating grade that the exposure is assigned to. In case of the advanced approach, similar rules must also be created for facility grades and associated loss given default values.

Basel II allows banks to use various methods to develop a rating model. The rules can be based on an estimate, a mapping to external data, or on statistical models that predict individual default probabilities (that are later grouped into rating grades).

However the rating model is determined, it must be validated by applying it to a minimum of five years of historical data. The PD associated with the rating grade is the long-term average as calculated from this data. In fact, most banks will eventually aim for eight to ten years of historical data in order to capture at least one full economic cycle.

The rating model must be shown to differentiate risk well; for example, risk should sharply increase from rating grade to rating grade. A total of nine rating grades must be produced, two of which should designate delinquent exposures.

The most thorough and risk sensitive approach to creating a rating model uses statistical estimation techniques. The creation of statistical models requires a representative development sample that describes each borrower in all available detail and contains a sufficient number of default cases as well as non-default cases. This sample data is then analyzed interactively using appropriate analysis techniques, and the result is a rule is generated that assigns a probability of default to each individual borrower. These individual predictions are then further analyzed and grouped into rating grades, considering regulatory restraints such as the exposure per rating grade should not exceed 30 percent of overall exposure. Most banks will actually be more restrictive and require a maximum of 15 percent.

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Some banks will find it difficult to create a sufficiently meaningful development sample because they don't experience a minimum number of defaults. These banks may consider buying a "ready-made" generic rating model from a model vendor. However, each bank will still need to validate their rating models on internal data. Validation, like model creation, requires a sufficient amount of default cases, so it is unclear how generic models built on third-party data solves this issue. A more appropriate approach in this situation is to pool data with partner banks.

Generic models have a number of additional drawbacks that seriously question their suitability for PD estimation in a Basel II context. For example, they always consider only a subset of available customer attributes. Most often this is financial information from balance sheets or profit and loss statements. While this is certainly important information for judging the creditworthiness of a corporate customer, there is no justification for ignoring other important information such as account data, tenure, loyalty, product possession and even current delinquency status. Generic models often don't consider the significance of changes in financial information; for example, they only look at the last balance sheet as a snapshot, but don't account for balance sheet history.

Generic models may require very specific input data to be available. If a bank is unable to produce a particular piece of information for each and every customer the whole model is unusable. Especially in the small business sector, financial information tends to be "dirty" or even completely unavailable. It is of critical importance that banks are able to build models that use high quality variables. If a bank feeds a generic model with bad data just in order to be able to use the model, the results will be disastrous. Further problem with generic models is that they may be built on a set of borrowers that is not representative of the bank's own customers and, for this reason, will deliver inaccurate results. Rating models must be continuously monitored and need to be updated swiftly when their predictive power starts to diminish. This may prove impossible if a generic model is used. Finally, the methodology that is used to build the models must be transparent and well understood by the bank. Generic models might not meet this transparency requirement.

Generic models could be used as a benchmark with which to compare the predictive power of an internal model. Paradoxically, generic models could be used when there is a lot of data available for validation.

In the retail portfolio, segments take the place of rating grades. They need to be created using a variety of variables at the same time. These must include, at a minimum, product type, application score, vintage period and current delinquency status, but may include a variety of other variables. The segments must not only be homogeneous in these variables, they must also, like rating grades, differentiate risk well. PD and LGD values are determined by segment, again as a long-term historical average.

The regulation doesn't prescribe specific methods for defining these segments. The difficulty here is to satisfy conflicting requirements: for example, to create segments that are at the same time homogenous in a variety of variables, differentiate risk well and make business sense. A variety of approaches may be taken to do this. They may include business-rule driven high-level divisions, for example by product type. Then statistical clustering techniques may be used to create homogenous segments from the remaining variables.

However, clustering is not designed for differentiating risk. Instead, statistical default prediction models may again come in at this point. These would use the required segmentation variables as inputs. Product type and PD would then define segments, with the PD effectively summarizing the information contained in the prescribed segmentation variables and other input data.

The calculation of Risk Weighted Assets is, in principle, a clearly defined, straightforward process, completely determined by regulatory rules.

Portfolio analysis

The calculation of Risk Weighted Assets is, in principle, a clearly defined, straightforward process, completely determined by regulatory rules. The calculation requires a clean and consistent exposure table as input. This table must contain a minimum set of variables describing the exposures including, for example, the portfolio class, the nominal outstanding exposure amount, internal rating grade and PD of borrower and guarantor, loan seniority, current collateral and guarantee values and external rating classes of collateral issuers.

Some of these inputs are not that straightforward to determine. Already, the assignment of exposures to portfolios may cause problems. If one counterparty is registered under different names, this double entry needs to be removed. Other complexities include the calculation of the current collateral and guarantee values that must be based on current market prices and converted into one target currency using current exchange rates. Netting set agreements must also be accounted for in order to determine the net outstanding exposure amount.

Further complexity, but also benefits, are added when more advanced portfolio analysis techniques are employed. On the simplest level, various scenarios must be analyzed. For example, how overall shifts of risk components such as PD or LGD affect the Risk Weighted Assets.

On a higher level of complexity, Monte Carlo algorithms can be set up to automatically generate a large number of scenarios by varying underlying risk components. The result is a distribution from which “at risk” figures can be read. A variety of alternative risk models can be defined and simulated, depending on the specific purpose (for example Credit Value at Risk, Profits at Risk, Earnings at Risk, Capital at Risk). Sometimes it is useful to calculate conditional at-risk figures that only consider a subset of risk components. Often is useful to calculate marginal at-risk figures that express the incremental change when new exposures are added to the portfolio.

Marginal at-risk figures already lead into the area of supporting active portfolio management. Eventually, the credit portfolio manager will want to actively change the risk structure of his portfolio towards an optimum. Due to the long-term nature of loans this is more difficult to achieve in the credit portfolio than in portfolios with shorter durations. In addition to optimizing credit approval, for example by setting limits on certain engagements, the most common approach is to hedge against credit risks by making use of derivatives. Finally, it should once again be mentioned that risk measures play an important role in the capital allocation process through risk-adjusted return on capital (RAROC) calculations.

Reporting

The credit review unit has a number of reporting responsibilities for which it needs to depend on a well functioning IT system. For example, a wide range of disclosure reports must be created. While the regulation prescribes template reports, the reporting system should be flexible enough to accommodate changes to these reports and the creation of additional reports quickly and easily.

As mentioned above, the disclosure reports are in fact multidimensional tables that break down key risk measures along a variety of dimensions. In order to create these reports efficiently, specialized storage structures should be created that hold precalculated summaries—so called multidimensional databases. Correlation effects cause non-additivity of at-risk measures, making standard multidimensional storage structures obsolete and creating the need for a specific at-risk OLAP structure. A graphical user interface should then enable the user to interactively navigate through the dimensions. Such online aggregation and decomposition of risk measures enables the credit review unit to quickly identify suspicious risk concentrations as well as surfacing historical trends. Additionally, the interface should enable the user to define a report layout and launch a batch printing job.

Producing complex multidimensional reports and drilling down into detail is important. However, it is equally necessary to be able to display just a few key credit risk indicators in a dashboard-like fashion for strategic monitoring purposes. These credit risk indicators would typically be monitored alongside other key risk and performance indicators.

Internal rating system monitoring reports are required. These include rating grade and segment migration reports, the monitoring of default and delinquency rates (including a breakdown by vintage period), and a comparison of actual default rates with predicted values. Furthermore, the rating-based approval process must be monitored. Override frequencies and override reasons must be summarized and individual override cases must be tracked.

SAS® solutions for credit risk management

SAS offers risk management solutions that address all of the credit risk aspects mentioned in this paper, including SAS Credit Scoring for Banking and SAS Credit Risk Management for Banking. By adopting these solutions, banks can comply with Basel II regulations and establish excellence in risk management for benefits that extend far beyond compliance.

SAS provides a credit risk environment designed to calculate both regulatory and non-regulatory capital, accommodating different regulatory capital calculation rules for multiple legal jurisdictions. SAS allows clients to create their own internal models for probability of default, loss given default and exposure at default. These are then fed as parameters to the risk-weighted asset calculator. Models and calculation rules for different regulatory regimes can be stored and compared.

SAS provides a credit risk environment designed to calculate both regulatory and non-regulatory capital, accommodating different regulatory capital calculation rules for multiple legal jurisdictions.

SAS offers a solution to help customers meet their regulatory capital calculation requirements. It is not designed specifically for any one country or jurisdiction. SAS has been monitoring and reviewing documents from the Bank for International Settlements (Basel I & II), Committee of European Banking Supervisors (CEBS), the Commission of the European Communities and the US Federal Government, as they relate to credit risk.

Because some of these regulatory requirements can be met with different methodologies and approaches, SAS has created a solution that can be adapted to meet a bank's local regulatory reporting requirements. Local regulatory requirements are ever-changing and can vary across geographies. While only a regulator can certify whether or not a bank has met regulatory requirements, SAS believes that its solution is the most robust and capable solution offered, backed by continuous improvement and support.

SAS also offers other technologies and solutions for addressing a bank's operational risk, market risk and other risk measures.

Data warehouse

SAS enables the creation of an open, flexible and extendable data warehouse architecture by providing native access modules to extract data from all major database systems, a powerful fourth generation language for transforming and loading data into customer-specific data models, and storage structures that are specialized for supporting information delivery and risk management applications.

GUI-driven data warehouse administration software documents all metadata and visualizes every step of the extraction, transformation and load process, so that both the bank and its supervisor have immediate and complete insight into how information is brought together.

Rating system

SAS offers a rating model development environment that is based on the concept of process flow diagrams. A process flow diagram gives the model developer the ability to experiment interactively with a large variety of data pre-processing options and modeling algorithms in order to determine an optimal rating model. Available modeling algorithms include, among others: scorecards, logistic regression, decision trees and neural networks. A variety of clustering and segmentation algorithms are provided, as well as functionality for the assessment of predictive power (risk differentiation) and support for the determination of optimal cut-off ratings for approval purposes.

Process flow diagrams document each step of the model development process. Models can be recalibrated by re-executing the process flow on new input data. The diagrams convey and retain the bank's best practices and thereby also facilitate the training of new staff. Finally, they serve as a reference when models are updated or replaced. Diagram archives can be created to further support change control.

The rating model development environment is fed from input tables in the data warehouse, and ratings in the warehouse are continuously updated by executing rating models in batch-runs against current borrower tables. Rating models can also be deployed for online rating in branch offices using XML and Web services.

Portfolio analysis

SAS offers a portfolio analysis environment that contains template functions for the calculation of risk-weighted assets from an exposure table. The environment performs collateral valuation through mark-to-market analysis and elegantly handles currency conversion through automatic triangulation. It enables portfolio level scenario analysis and stress testing as well as the calculation of economic capital and at-risk figures. It includes a large variety of out-of-the-box simulation functionality, including Monte Carlo and historical simulation as well as delta-normal at-risk analysis. The portfolio analysis environment receives its input data from the data warehouse and feeds a number of performance reports.

Reporting

SAS provides flexible reporting that can be embedded in the bank's processes. SAS supports calculations for any legal or business hierarchy structure as specified by the user through SAS Enterprise BI technology.

SAS offers a portfolio analysis environment that contains template functions for the calculation of risk-weighted assets from an exposure table.

SAS' risk solutions employ the power of the SAS Enterprise BI environment to enable users to manage their reporting requirements through a powerful suite of integrated tools.

SAS Enterprise BI Server includes both a suite of powerful business intelligence tools and a complete, integrated business intelligence architecture to provide fast, simple access to consistent data for a more accurate picture of your business. This holistic view of customers, suppliers, partners and more will allow you to make better decisions and gain competitive advantages.

Consulting and training

SAS offers implementation consulting services that are based on decades of experience in implementing information delivery systems with major banks worldwide. Detailed component-specific project methodologies support the consultant and the bank throughout all phases of the project. The methodologies favor a phased approach and close cooperation and knowledge transfer with the bank's own staff, so that the bank can independently operate and extend the system. A large variety of training courses on all aspects of the solution are offered through a dense network of local offices.

Summary

Dealing with risk has always been a challenge for all types of organizations. This is especially true for banks, because managing risk is what defines their business. In the process of transforming small, short-term deposits into large, long-term loans, banks face market risk due to price changes, credit risk due to counterparty default and operational risk due to failure of people, processes, systems or external events.

In order for banks to be able to do their business, the depositors must trust in the stability of the banking system. In order to support this trust, regulators limit the amount of risks that banks can take on by requiring a proportion of the risk to be covered by reserved capital, which is forbidden to be invested.

New global regulations keep moving toward allowing internal risk measurement as the basis for minimum capital calculation across all risk types. Before banks can adopt these approaches and benefit from reduced capital requirements, they first have to prove to their supervisors that they can fulfill a number of minimum requirements and disclose detailed information about their risk management processes.

The internal ratings-based approaches to credit risk measurement require the internal estimation of counterparty default probabilities by internal rating systems. Individual exposures can then be aggregated to portfolio-level risk measures. Banks can adopt advanced portfolio analysis techniques in order to calculate economic capital and exercise improved risk control.

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The SAS Enterprise Intelligence Platform and SAS Risk Management solutions allow banks to not only comply with Basel II regulations, but excel in their risk management practices across all risk types. Solution components in the credit risk area include a data warehouse, an internal rating system, portfolio analysis and reporting technologies, as well as consulting and training services.

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