



Better Risk Management for Improved Business Decision Making

SAS® Risk Management for Banking



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Introduction

The recent turbulence in financial markets has made risk management an increasingly critical part of the decision-making process in financial institutions. An integrated approach to risk management is crucial for enabling organizations to consolidate exposures, measure risk and perform stress tests across all lines of business. However, the ability to measure risk comprehensively is not sufficient. A significant step is the execution of policies based on comprehensive risk measurements the business process. This includes risk methodologies tied to economic capital management, pricing and performance measurement – ensuring that risk is integrated and consistent with business strategies.

The necessity of an integrated data infrastructure to support methodology capabilities and consistent policies is well-understood. However, its actual implementation is far from trivial. The situation is further complicated by the fact that efficient policies require an integrated data foundation and comprehensive methodology capabilities as a prerequisite for establishing effective policies.

Efficient risk-based policies for continuously managing a firm's risk and return profile and capital are key for the long-term success of financial institutions. Transparency of risk and value-based business processes is critical for investors, rating agencies and regulators. The recent distress in financial markets has placed greater emphasis on a financial institution's ability to demonstrate a comprehensive approach to viewing firmwide exposures and risk. In a series of papers, the Senior Supervisors Group, 2008; Financial Stability Forum, 2008; Institute of International Finance, 2008; and Basel Committee, June and August 2008 and January 2009, point to the deficiencies of many financial institutions' risk management practices and the concrete actions that need to be taken.

Some of the key issues – as outlined by the Financial Stability Forum of national and international financial regulators – revolve around the integration of risks, the measurement of risk, and the lack of constant challenges to accepted methods in light of changing market conditions. Similarly, the Senior Supervisors Group report concludes that strong governance and value-based performance management were probably the dominant differences between the firms that performed poorly and the ones that performed well. The January 2009 Basel Committee consultative document on principles for sound stress testing practices and supervision also highlights the weaknesses in infrastructure that limited the ability of banks to identify and aggregate exposures across the bank. This weakness limits the effectiveness of risk management tools – including stress testing.

■ SAS Risk Management for Banking comprises numerous integrated risk application components. The solution allows customers to deploy specific risk applications – e.g., asset and liability management, market risk, credit risk and firmwide risk. SAS Risk Management for Banking is highly configurable to support current market requirements for risk management applications, as well as provide a platform that will evolve to handle future requirements.

The Institute of International Finance report summarizes the key elements firms should incorporate into their risk management practices as follows:

- Ensure that risk management does not rely on a single risk methodology, and analyze groupwide risks on an aggregate basis.
- Ensure that metrics are calibrated appropriately to risk-appetite horizons.
- Take into account the technical limitations of risk metrics, models and techniques (such as Value at Risk, or VaR).
- Eschew the silo approach to risk management and take a comprehensive approach instead, integrating strands such as credit, market, operational, liquidity and reputational risk.
- Ensure that the appropriate governance structure that has been adopted is actually implemented in managing day-to-day business.

The effect of the recent financial crisis on the economy and the related performance of financial institutions have also been followed by the rating agencies. Rating agencies are beginning to focus more on the quality of a firm's enterprise risk management practices in their rating processes. For example, in 2008, Standard & Poor's announced that it will review the quality of enterprise risk management as a new component in its reviews of credit ratings (Standard & Poor's, 2008). In this new component of Standard & Poor's credit rating process, a rating of excellent enterprise risk management is required for a firm to qualify for a top-notch credit rating. Performing good classical siloed risk management will only qualify as "adequate" in Standard & Poor's risk management rating model.

SAS® Risk Management for Banking

The challenges faced by financial institutions demand these key requirements:

- A quality integrated risk data infrastructure with timely access.
- The ability to measure exposure and risk across all risk types and books of business.
- The ability to distribute incentives for consistent optimization of risk-adjusted returns throughout the organization.

Infrastructure

SAS Risk Management for Banking enables banks to meet these requirements through an architecture that supports the data requirements, methodology requirements, usability criteria and ability to distribute key risk information effectively across the enterprise for many different users.

- **Integrated Infrastructure.** An end-to-end solution with an integrated data model, data management, advanced analytics and reporting.
- **Methodology Capabilities.** Comprises numerous integrated risk application components that can be used either together, individually or as a combination of risk applications.
- **User Extendable.** User-configurable to meet the needs of an organization's specific requirements on data, models, analytics and reporting, depending on capabilities licensed.
- **Enterprise-Level Web-Based Reporting.** Web-based risk analyst and reporting user interface allows risk capabilities and reporting to be distributed efficiently across the enterprise.

Risk Data Flow and Process Management

SAS Risk Management for Banking comes with a risk data model with pre-configured data flows. Existing data flows can be modified for customer-specific conditions and data quality controls, such as rules for handling bad data, unclassified data or data not fitting the model.

Functionality

One key requirement of a risk management system is the ability to support several different risk application streams within one common environment. Business units need specific risk calculations and monitoring capabilities. At the higher levels of the organization, these risks will need to be integrated and aggregated to create firmwide measures.

SAS Risk Management for Banking comprises several risk applications:

- SAS Market Risk for Banking
- SAS Credit Risk for Banking
- SAS Asset and Liability Management for Banking
- SAS Firmwide Risk for Banking

The applications are based on a common data model with predefined extraction, transformation and loading (ETL), risk analytics and risk reporting.

The risk applications in SAS Risk Management for Banking enable users to get up and running quickly, while the open infrastructure of the solution allows users to support not only current business requirements but also future requirements on data and risk analytics.

Figure 1 displays the risk application components of SAS Risk Management for Banking – market risk, credit risk, asset and liability management, and firmwide risk. All the risk applications are built on a common data model and a common risk engine, thus ensuring a truly integrated risk management architecture.

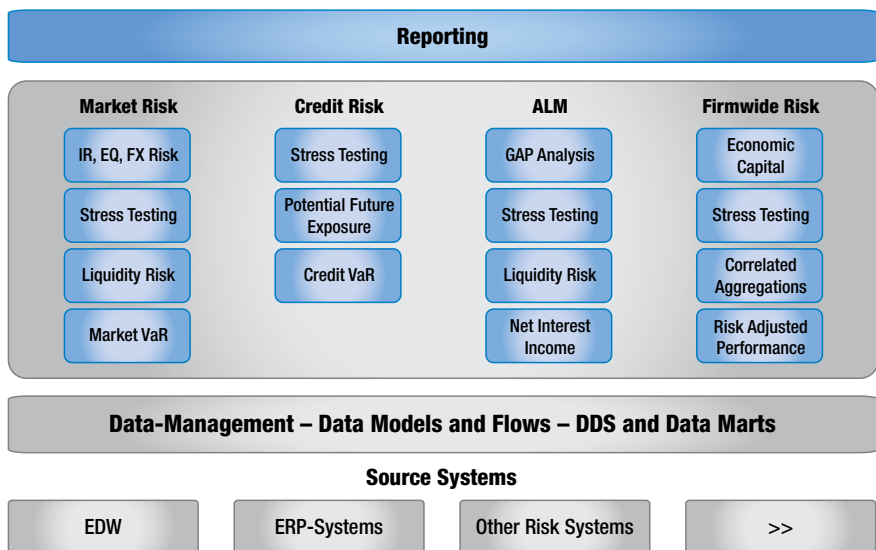


Figure 1: SAS Risk Management for Banking application components.

SAS Risk Management for Banking enables users to:

- Value instruments in their portfolios using third-party libraries or user-defined functions.
- Perform VaR and stress test analysis using standard and advanced methods.
- Assess the rating of their credit portfolios and calculate advanced credit portfolio and counterparty exposure analytics, including netting, collateral and margining.
- Perform integrated asset and liability risk management and stress testing, taking into account other risks – e.g., credit risk, market risk, liquidity risk and behavioral risks – as appropriate.
- Assess firmwide risks using economic capital, correlated aggregations, bottom-up correlated risk drivers methodology or a combination thereof.
- Perform fair value calculations, funds transfer pricing, risk-adjusted transfer pricing and RAROC calculations.
- Perform portfolio optimizations – risk-return optimization, hedge optimization and cash flow replication optimization.
- Perform model back-testing and scenario testing of models.

Functional Facts

Asset and liability management

Value traditional balance-sheet instruments, such as loans and deposits, factoring in embedded options such as prepayment and withdrawal as well as credit risk, liquidity risk, etc. Assess fund transfer rates, with or without risk-based spreads such as credit and liquidity spreads and option-adjusted spreads, and calculate economic value. Perform advanced analysis across risk types, stress testing and modeling of liquidity risk, net interest income and economic value. Assess the effect of hedge instruments, and analyze optimal cash flow replication hedges.

Market risk

Value complex market instruments, perform stress tests and calculate VaR, expected shortfall and other risk measures using a variety of methods – historical simulation, covariance simulation, analytical models and advanced user-defined models. Decompose portfolio risk in additive risk contributions, and analyze the relative importance of risk factors in determining portfolio loss. Perform back tests and scenario tests of the model. Analyze the effect of static and dynamic hedges and trade strategies, and determine optimal portfolios.

Credit risk

Calculate and stress test firmwide exposures, taking into account the effect of netting, collateral and margining, as well as credit derivatives book. Perform advanced simulation of potential future exposure. Calculate portfolio credit risk measures using advanced portfolio credit risk models, such as actuarial models, multivariate Merton models and reduced form stochastic transition matrix models. Optimize the credit portfolio with respect to assets held or collateral needed or both.

Firmwide risk

Calculate the firm's aggregate risk using correlated copula aggregations of marginal risk distributions. Perform bottom-up firmwide risk exposure calculations, taking into account different risk type sensitivity of exposures, such as market risk and credit risk. Calculate risk-based performance of the firm based on the effect from balance sheet items as well as off-balance-sheet items. Sample economic capital calculations provided.

A Powerful Risk Engine

SAS® Risk Dimensions® is the powerful and versatile risk engine underlying the analytical functionality of SAS Risk Management for Banking. The SAS risk engine supports a wide range of risk analysis methods and is the preferred user interface for the quantitative risk analyst and model builder. While SAS Risk Management for Banking has preconfigured both standard and advanced risk analyses as well as pricing in the risk engine, the risk engine is also designed to support a flexible custom method development framework. This custom development framework includes the ability to configure proprietary risk factor models as well as user-defined pricing and cash flow models. The SAS Risk Dimensions Java client allows the user to analyze advanced risk results graphically based on detailed or summarized output.

Flexible Programming Language

Using the powerful SAS programming language, users can define their own pricing functions in SAS. The solution does include some sample functions that users may use to develop their own proprietary functions. These samples, while not exhaustive, cover a wide range of instruments, including:

- Fixed income securities like bonds and floating-rate notes.
- Loans, mortgages, leasing, deposits and facilities.
- Interest rate, foreign exchange, basis and equity swaps.
- Caps, floors and embedded options.
- Futures and forwards.
- European, Bermudan and American options.
- Convertible bonds.
- Credit derivatives.
- Exotic options.

Users may also integrate third-party pricing libraries. SAS provides sample code for integrating libraries from these companies:

- FEA
- FINCAD

Advanced risk users with a need for building new proprietary pricing models and analyzing complex instruments like bespoke CDOs will benefit from a structured framework and their pricing functions written in C or SAS.

Risk Models and Risk Aggregation

The risk factor modeling subsystem analyzes general systems of nonlinear models as well as standard market models, such as GARCH models and multifactor models. Codependence among risk models can be modeled using covariance matrices or copulas.

Users may configure their own models or make use of existing customer behavior models, such as prepayment models and deposit and facility balance models. Preconfigured credit risk models include advanced actuarial models, multivariate Merton models and models based on stochastic transition matrices.

Aggregation of dependent risks is supported using linear risk aggregations based on covariance matrices, as well as using copulas. Copulas supported include the normal copula, the t-copula and the normal mixture copula. Both the t-copula and the normal mixture copula allow asymmetric parameters. In addition, users may build their own copulas for use in risk aggregation of either risk models or distributions.

Risk Analysis

Risk analysts can take advantage of preconfigured risk analyses – e.g., cash flow analysis, delta-normal, historical simulation and covariance matrix – advanced models-based risk analysis and stress testing. Users may also incorporate hedges, benchmark or liability portfolios to analyze deviation, as well as perform advanced value or cash flow-based portfolio optimization.

Preconfigured risk analysis may use one or several risk models of exposures – e.g., the simultaneous assignment of market risk models, credit risk models and customer behavioral models to an exposure – facilitating risk integration at the lowest level.

Advanced risk analysts may analyze the risk and return impact of various trading strategies and portfolio growth scenarios.

Reporting and Workflow Configuration

SAS Risk Management for Banking is part of the SAS Business Analytics Framework, which combines advanced data integration, analytics and reporting capabilities. With this framework, users get the information they need, when they need it, in their preferred format. The SAS Business Analytics Framework also offers a robust and flexible presentation layer for the full breadth of SAS Analytics capabilities – all integrated within a business context for better, faster decision making.

Using SAS Stored Processes, users can configure their own workflows and integrate daily and ad hoc advanced risk analytics procedures into their preferred environments – e.g., using the SAS Add-In for Microsoft Office, users can integrate their reporting and analysis workflows into their desktop environments.

SAS Risk Management for Banking comes with a wide array of preconfigured reporting and risk analysis workflows. The report framework includes sample reports, OLAP cubes and interactive analysis results for all the application components of SAS Risk Management for Banking. Sample reports included are:

- **Asset and liability management.**
 - Funds transfer rates.
 - Liquidity risk.
 - Interest rate risk.
 - Net interest income.
 - Economic value and fair value.
 - Stress test and scenario tests.
 - Cash flow replication and hedge optimization.
- **Market risk management.**
 - Portfolio report.
 - Market risk VaR.
 - Stress test and scenario tests.
 - Portfolio optimization.
- **Credit risk management.**
 - Exposure and potential future exposure.
 - Stress tests and scenario tests.
 - Portfolio credit risk model VaR.
- **Firmwide risk.**
 - Correlated aggregations.
 - Integrated risk assessment.
 - Stress test and scenario tests.
 - Risk-adjusted profitability.
 - Economic capital.

As the bank creates risk measures, employees may quickly find that bringing risk information together to support enterprisewide reporting is also very challenging. To meet this challenge, SAS Risk Management for Banking provides a common reporting data model. This data model – the SAS Risk Reporting Repository – supports the integration and reporting of enterprise risk measures as well as decomposed measures at the entity, business unit, geography or any other user-defined hierarchy. This repository provides the audit, change, archive and historization support required by rigorous reporting requirements. The SAS Risk Reporting Repository allows the bank to meet both current and future reporting requirements while exploiting the power of the SAS Business Analytics Framework.

Solution Components – A Summary

SAS Risk Management for Banking includes the following components:

- SAS® Detail Data Store for Banking
- SAS® Risk Dimensions®
- SAS® Risk Reporting Repository

SAS Risk Management for Banking helps organizations achieve comprehensive risk governance by incorporating a performance management approach into all areas of risk. SAS Business Intelligence provides companies with a way of distributing risk information to users across the organization. Based on their access profiles, users can view the reports and results, as well as create and distribute their own analyses and reports without IT support. With ready access to key performance measures and key risk indicators, managers throughout the organization can contribute to more effective business strategies. Using stored processes and the SAS Add-In for Microsoft Office, users can integrate risk management into their desktop environments.

SAS Risk Management for Banking is integrated with the SAS Detailed Data Store for Banking, using predefined flows registered in SAS Data Integration Studio.

SAS Risk Dimensions is the powerful and versatile risk engine. The SAS risk engine supports a wide range of risk analysis methods.

The SAS Risk Reporting Repository is designed to support the integration and reporting of enterprise risk measures. Whether it is simply supporting a common Web page for market, credit and operational risk or if it is actually bringing together economic capital and risk-adjusted performance management, the common data model will support all enterprise infrastructure requirements. In addition, the risk reporting repository can be used to support the partitioning and archiving of data.

The risk reporting repository adheres to common data modeling standards, including the use of valid-to and valid-from dates, and mapping tables for integrating external sources and hierarchies. The repository supports aggregated risk measures, as well as decomposed measures at the entity, business unit, geography or any other user-defined hierarchy.

Using a top-down approach, users may want to look at an aggregated risk measure and then drill down into the measure to identify where and how the risk may be attributed. This information can be used to help management identify areas of concern or reward groups that adhere to policies and methodologies and add value to the business. Because many risk measures may not be additive, reporting capabilities must be flexible and powerful enough to deliver the right information to the right people at the right time.

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