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Introduction to SAS® Risk Management for Banking
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ABSTRACT

This paper introduces a new solution from SAS, SAS® Risk Management for Banking. This solution has been designed as a comprehensive and integrated suite of quantitative risk management applications that cover market risk, credit risk, asset and liability management, and firmwide risks in one solution. The solution leverages the underlying SAS 9.2 platform and the SAS® Business Analytics Framework to provide users with a flexible and modular approach to risk management. Users can start with one of the predefined workflows and then customize or extend the functionality to meet its ever-changing risk and business needs. The introduction of SAS Risk Management for Banking will take the industry's standards to a higher paradigm for analytics, data integration, and risk reporting.

INTRODUCTION

The continued impact on the banking Industry of the 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 to enable 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. The necessity of an integrated data infrastructure to support methodology capabilities and consistent policies is well-understood. To establish these policies, you need risk methodologies that are tied to economic capital management, pricing, and performance measurement. A significant step is the execution of policies that are based on comprehensive risk measurements of the business process. Only then can you be sure that risk is integrated and consistent with business strategies.

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 distress experienced 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), the Financial Stability Forum (2008), the Institute of International Finance (2008), and the 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.

The Institute of International Finance report summarizes the key elements that 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 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 would 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.

The SAS response to these challenges is to deliver an integrated risk offering that can meet the immediate requirements that banks are looking for, while providing a framework to support future business needs.

FUNCTIONALITY

Organizations need 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 consists of the following, integrated applications:

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

These 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 enables users to support not only current business requirements but also future requirements for 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.
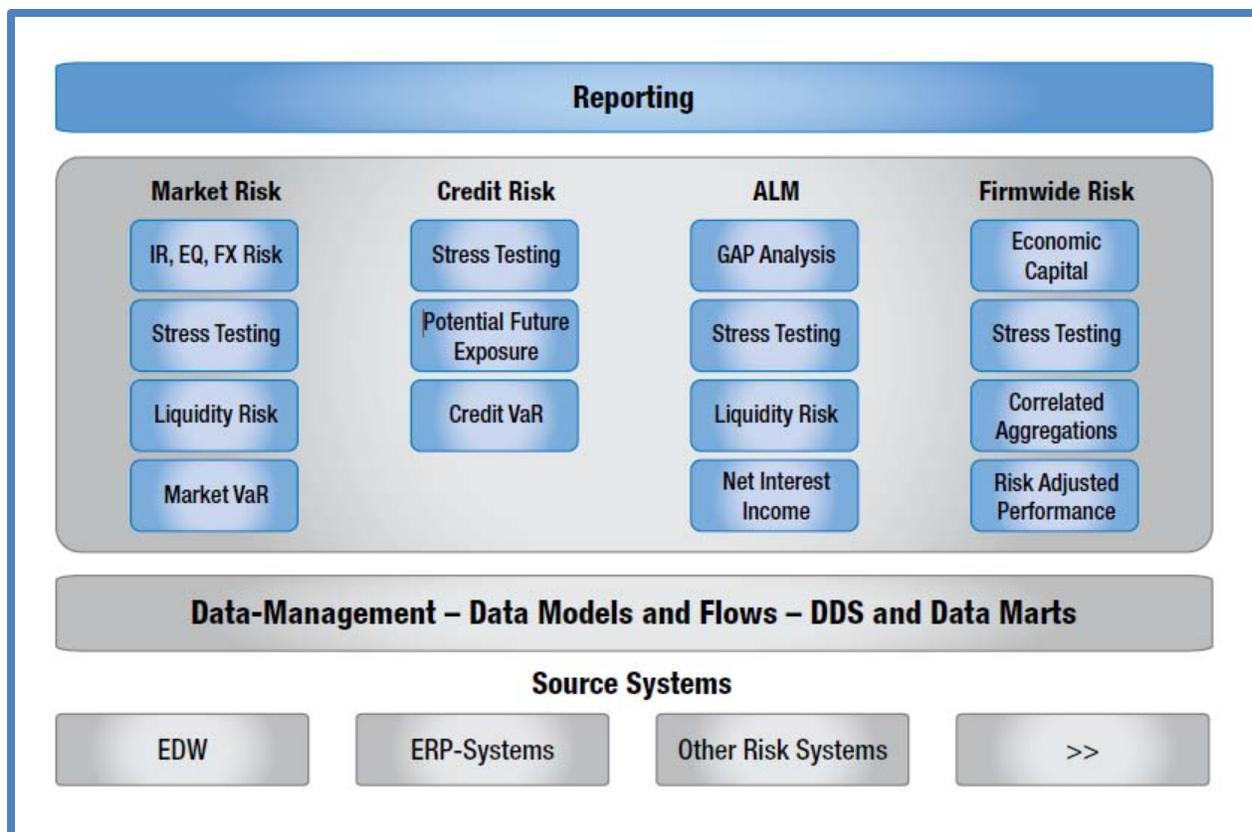
Figure 1: SAS Risk Management for Banking Application Components

SAS Risk Management for Banking enables users to do the following:

- 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— for example, 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, including risk-return optimization, hedge optimization, and cash flow replication optimization.

- Perform model back-testing and scenario testing of models.

FUNCTIONAL FACTS

INTEGRATED RISK PLATFORM

One of the fundamental design goals for this solution was to start with a common risk platform that would be used by all applications. This approach places integration at the core of the solution rather than as an afterthought. The solution was designed to leverage a common data model, the SAS Detailed Data Store for Banking. This data model has been proven and validated by over 200 SAS banking customers. From this data model, the solution creates a common solution mart that is used to enrich the data and prepare the data for analysis by the various applications.

To perform the analysis, all the applications leverage a common risk engine. This risk engine is powered by the proven risk capabilities provided by SAS® Risk Dimensions®. 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. SAS Risk Dimensions supports the following analysis types:

- Mark-to-Market
- Current Exposure
- Potential Exposure
- Profit & Loss Curves and Surfaces
- Delta-Normal Analysis
- Historical Simulation
- Scenario Simulation
- Covariance Simulation
- Model-based Monte Carlo Simulation
- Mixed Simulation
- Portfolio Optimization
- Cash Flow Analysis

Each application supports predefined workflows that leverage these analysis types. The workflows are data-driven and can be extended to meet unique user requirements. This approach enables a user to get all the benefits and speed of a black-box solution, while maintaining the flexibility of a bespoke development environment.

The risk platform also supports a common set of sample pricing methods used across all the applications to create cash flows and to value the instruments in the portfolio. Users can extend this sample library by modifying the existing samples or creating their own pricing methods. These samples, while not exhaustive, cover a wide range of instruments, including the following:

- 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

For customers who prefer to incorporate external pricing methods, the solution includes sample integration code for both FINCAD and FEA libraries. Users can call proprietary functions that can be made callable from C.

This common risk platform supports a common set of utility functions that can be used by all of the applications for segmenting the portfolio, performing back-testing of the analysis results, and creating reports.

SAS MARKET RISK FOR BANKING

This application enables users to value complex market instruments, perform stress tests, and calculate VaR, expected shortfall, and other risk measures using a variety of methods. Users of SAS Market Risk for Banking are interested in better understanding how changes to exchange rates, forward rates, and interest rates impact their portfolio.

The solution supports all required analysis types, including P&L distribution, Delta-Normal calculations, historical simulation, covariance simulation, and Monte Carlo simulations. Users can decompose portfolio risk in additive risk contributions and analyze the relative importance of risk factors in determining portfolio losses. In addition, users can

perform back tests and scenario tests of the model, analyze the effect of static and dynamic hedges and trade strategies, and determine optimal portfolios.

SAS CREDIT RISK FOR BANKING

The value of many instruments will be affected by changes in credit quality. The financial crisis emphasized the need for banks to have adequate collateral to cover exposures. As real estate values declined, counterparties began to default and banks were left with assets that did not maintain sufficient value to cover the exposure. This effect escalated and many markets observed severe declines. As many of these mortgages were securitized, many highly rated securitized instruments began to default. Participants did not foresee how this event would snowball and cause a severe market correction.

Organizations now understand the need to better analyze how changes in credit availability and credit quality affect the value of their portfolio. Users might want to focus only on default, but others might want to include the potential effect of ratings migration, up to and including default.

The SAS solution supports preconfigured workflows for measuring credit risk. The first approach uses an actuarial approach that looks at the effects of default on the portfolio. For a more comprehensive approach, there is a workflow that uses a single risk factor model along with a transition matrix approach. This workflow lets users see the impact of ratings migration on the portfolio, up to and including default.

The solution also supports the ability for users to configure any of the underlying analysis types to support Credit VaR. Users can then define scenarios that can be used to stress the portfolio. And users can perform portfolio optimization to determine the ideal weights of the portfolio, or to identify the best approach for using risk mitigants to offset exposures by counterparty.

SAS ASSET AND LIABILITY MANAGEMENT FOR BANKING

The solution enables users to calculate cash flows for instruments in the portfolio. Users can then define cash flow buckets, and perform analysis to determine any asset/liability gaps. This includes the ability to calculate funds transfer pricing, maturity mismatch, and repricing mismatch.

The solution is very flexible and enables users to define their own cash flow buckets and perform analyses using different cash flow bucket intervals. This flexibility can help organizations fine tune and identify any gaps or any potential mismatches.

Regulators are now requiring organizations to take more sophisticated approaches to how they measure their liquidity risks. In addition, organizations are not only being asked to provide a 30-day liquidity report, but in some cases this is being extended from 90 days to one year.

The SAS Asset and Liability Management for Banking application will also enable users to perform stress tests and back-testing of their ALM models. Beyond just value, users can customize the risk measures to include net interest income and economic value.

SAS FIRMWIDE RISK FOR BANKING

Historically, the focus in most organizations has taken a more siloed approach to risk management. In this context, credit risk analyses were performed while keeping market risk factors static. And market risk measures were evaluated holding credit risk factors as static. Today, firms need to use new approaches that will capture the correlations and interdependencies between all risk types and all risk silos.

An overly simplistic approach might take just the various risk measures and add them together. This approach would create aggregated risk measures that could drastically overstate the risk to the organization. Some estimates would suggest this simple aggregation method could overstate risk by as much as 40 percent.

A more sophisticated approach would be to create a true economic capital model that would incorporate all the risk factors and all the various risk types into one model. This approach would be more precise, but academic research suggests that, even under the best circumstances, this approach could take between three to five years to develop. One of the biggest challenges to this approach is in bringing together all the various risk factors that represent all the various risk types across the organization. The data management constraints can be overwhelming.

The compromise would be an approach that enables users to aggregate results while respecting the underlying correlations. The underlying SAS risk engine supports correlated aggregations through a two-step process.

In the first step, users define a correlation matrix for the underlying risks to be combined. Users can provide this correlation matrix or use the underlying SAS analytical capabilities to calculate these correlation measures from the marginal distributions.

In the second step, users to define a copula to combine all of the underlying market states together into an aggregated risk measure. Users can specify a normal, t-distribution, or normal-mixture copula to calculate the aggregated risk measure.

Combining financial information to these integrated risk measures, users can create performance measures, such as RAROC and RAPM. The solution includes the mapping tables and sample reports for users to create reports that can be surface to senior management, business unit directors, or other management roles that can benefit from seeing risk performance measures. This flexibility can help an organization promote a risk-aware culture and improve the entire decision-making process.

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 can 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.

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. For example, 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 as follows:

- 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

- o   integrated risk assessment
- o   stress test and scenario tests
- o   risk-adjusted profitability
- o   economic capital

As the bank creates risk measures, employees might 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 historicization support required by rigorous reporting requirements. The SAS Risk Reporting Repository enables the bank to meet both current and future reporting requirements while exploiting the power of the SAS Business Analytics Framework.

CONCLUSION

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.

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

To meet the key challenges in risk management highlighted in this paper, SAS Risk Management for Banking provides an integrated risk platform that banks can depend on to support their market, credit, ALM, and firmwide risk needs. The powerful SAS Business Analytics Framework enables the solution to support all reporting requirements. Whether the reports are for senior management, regulatory compliance, or business unit performance, the solution can meet these requirements.

REFERENCES

- Senior Supervisors Group. "Observations on Risk Management Practices during the Recent Market Turbulence." March 2008. Available at http://www.newyorkfed.org/newsevents/news/banking/2008/SSG_Risk_Mgt_doc_final.pdf.

- Financial Stability Forum. "Report of the Financial Stability Forum on Enhancing Market and Institutional Resilience." April 2008. Available at http://www.financialstabilityboard.org/publications/r_0804.pdf.

- Institute of International Finance. "Final Report of the IIF Committee on Market Best Practices: Principles of Conduct and Best Practice Recommendations." July 2008. Available at http://www.ieco.clarin.com/2008/07/17/iff.pdf.

- Basel Committee on Banking Supervision. "Principles for Sound Liquidity Risk Management and Supervision." June 2008. Available at http://www.bis.org/publ/bcbs144.pdf.

- Basel Committee on Banking Supervision. "Range of practices and issues in economic capital modelling." August 2008. Available at http://www.bis.org/publ/bcbs143.pdf.

- Basel Committee on Banking Supervision. "Principles for sound stress testing practices and supervision." January 2009. Available at http://www.bis.org/publ/bcbs147.pdf.

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