

Kamakura
Corporation

KAMAKURA

RISK INFORMATION SERVICES

Credit Portfolio Manager
KRIS-CPM

Version 5.0

— APRIL 2011 —

www.kamakuraco.com

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Contents

- I. KRIS-CPM Introduction
- II. KRIS-CPM Benefits
- III. KRIS-CPM Portfolio Modeling Techniques
 - a. Zero Correlation
 - b. Copula/Merton
 - c. Term Structure of Default Probabilities
 - d. Macro-Factor Driven Default Probabilities
- IV. About Kamakura Corporation
- V. References

I. Introduction

KRIS-CPM provides sophisticated investors and credit risk managers an independent, state-of-the-art ability to evaluate both the market value and loss distribution of credit portfolios and tranches of portfolios, including those of synthetic collateralized debt obligations. KRIS CPM is a separate service that is fully compatible with Kamakura Risk Information Services' KRIS Version 5.0 and 4.1 default probabilities. To use KRIS-CPM, clients must subscribe to both the KRIS default probability service and to KRIS-CPM.

KRIS-CPM is extremely user-friendly due to its seamless integration with the Kamakura default probability service and its utilization of the extensive Kamakura network of multi-processor servers which perform the calculations in high security server farms maintained by Kamakura in Honolulu and California. Other server farm locations are being added. Clients need only to select the modeling techniques, upload the reference names underlying the credit, specify the maturity date, and (if relevant) tranche "attachment" and "detachment" points. Setting up and initiating a KRIS-CPM analysis takes less than five minutes for a first time user. Initiating a run thereafter takes only seconds.

KRIS-CPM has a number of important features that make it unique among credit portfolio management analytical packages that are focused on valuation, losses and economics capital:

- **Multiple Models Approach:** Users may select from either the KRIS version 5.0 Jarrow-Chava reduced form default model, its predecessor the version 4.1 Jarrow-Chava reduced form model, or both. By using both models in separate simulations, users can compare the relative differences in loss that would have been forecast prior to the 2007-2009 credit crisis using both a model benchmarked before that period (Version 4.1 models used a data base from January 1990 to October 2004) and a model benchmarked after that period (Version 5.0 models were estimated on a data base from January 1990 to December 2008).

The screenshot shows a 'Parameters' configuration window with the following settings:

Parameter	Value
Value Date	2/27/2011
Number of Scenarios	100,000
Default Method	Macro Factors
KDP Model	KDP-jc5
KDP Term	KDP-jc5
Period Size	KDP-jc4 Annual
VaR Percentile	.950
Reporting Currency	USD

- Users may select any “on the run” default probability maturity for use in the simulation: 1 month, 3 months, 1 year or 5 years.

Parameters	
Value Date	2/27/2011
Number of Scenarios	100,000
Default Method	Macro Factors
KDP Model	KDP-jc5
KDP Term	5 Year
Period Size	1 Month
VaR Percentile	3 Month
Reporting Currency	1 Year
	5 Year

- Users may select from four different credit portfolio simulation techniques: the copula/ Merton style simulation that was at the heart of losses in the CDO market in 2007-2009, macro-factor driven default probabilities using reduced form model simulation, analysis using the term structure of default from KRIS, and a base case assuming no correlation.

Parameters	
Value Date	2/27/2011
Number of Scenarios	100
Default Method	No Correlation
KDP Model	No Correlation
KDP Term	Gaussian Copula
KDP Date	Term Structure
	Macro Factors
VaR Percentile	.950
Reporting Currency	USD

- Users may select any periodicity: monthly, quarterly, or annual, for the simulation.

Parameters	
Value Date	2/27/2011
Number of Scenarios	100,000
Default Method	Macro Factors
KDP Model	KDP-jc5
KDP Term	1 Month
Period Size	Annual
VaR Percentile	Annual
Reporting Currency	Monthly
	Quarterly

- KRIS-CPM features high “ease of use” and allows an end-user with no special information technology skills to be up and running quickly.
- KRIS-CPM boasts powerful servers hosted by Kamakura in a highly secure computer facilities shared with major financial institutions and agencies of the U.S. government in Honolulu and California.
- The underlying KRIS default probabilities have been repeatedly demonstrated as more accurate than agency ratings and agency-supplied default probabilities as a basis for default prediction. This accuracy advantage prevails at all time horizons tested out to five years. Please contact Kamakura at info@kamakuraco.com for a list of the world’s most sophisticated institutions which can confirm such performance advantages.
- Kamakura’s default probabilities and credit portfolio management analytics are free of conflict of interest. Kamakura’s KRIS service is an “investor pay” business model, not the highly conflicted “issuer pays” ratings model identified in a U.S. Senate report in April 2011 as being largely responsible for aggravating the seriousness of the 2007-2009 credit crisis. Kamakura does not trade in securities in conflict with its clients. It was well documented by Kamakura before the credit crisis began that KRIS-CPM valuations in general show a less optimistic view of CDO valuation than views advocated by market participants with a vested interest in expanding the volume of CDO issuance. See the references for this documentation.

For more details on Kamakura’s KRIS default probability services, please see the KRIS Version 5.0 brochure dated April 2011 and the KRIS Version 5.0 Technical Guide (2010) which is provided to users of the KRIS default probability service.

Other Features of KRIS-CPM

KRIS-CPM incorporates a series of features that allow for maximum accuracy in the valuation of synthetic CDOs and the related simulation of losses:

- **Number of Scenarios:** User-selected from 100 to 500,000 (with authorization)

Parameters	
Value Date	2/27/2011
Number of Scenarios	100
Default Method	100
KDP Model	1,000
KDP Term	10,000
KDP Date	500,000
VaR Percentile	.950
Reporting Currency	USD

- **Graphical User-Interface:** Any industry standard web-browser
- **VAR Percentiles:** The percentage “survival” target for credit adjusted VAR or economic capital measurement is selected by the user:

Parameters	
Value Date	2/27/2011
Number of Scenarios	100,000
Default Method	Macro Factors
KDP Model	KDP-jc5
KDP Term	1 Month
Period Size	Monthly
VaR Percentile	.995
Reporting Currency	

- **User Servers Needed:** None, other than a standard personal computer with a web-browser. The analysis runs on Kamakura servers and is displayed on the user’s machine via the web-browser.
- **Monitoring of Simulation Progress:** KRIS-CPM provides a constantly updated status report of the simulation, which is important for high scenario count analyses:

Run Description	Status	Submit Time
SectorTest	COMPLETE	4/16/2011 1:48:51 AM
SectorTest	COMPLETE	4/16/2011 1:30:20 AM
COP0.3JPY_0311	COMPLETE	4/1/2011 4:07:11 AM
COP0.3USD_0311	COMPLETE	4/1/2011 4:06:54 AM

- **Easy Mapping of Proxies for Private Firms:** KRIS contains a high ease of use capability to assign private firms (say Ford Motor Credit) to a public firm (say Ford) that the user believes has a highly correlated default probability:

MANAGE PROXIES			
New Company Name	Unique Ticker Code	Proxy to Type Public Firm	
Company Name	TickerCode	Type	Name
AIGA	AIGA	Public Firm	AMERICAN INTERNATIONAL GROUP
FMAC	FMAC	Public Firm	GENERAL ELECTRIC CO
FORD CREDIT	FORDC	Public Firm	FORD MOTOR CO

- **Loading client portfolios:** Client portfolios can either be loaded via the web browser, as shown below, into the KRIS-CPM graphical user interface or uploaded via Excel.

PORTFOLIO

Credit Class Sovereign	Obligor Afghanistan	Type	Notional	Currency USD
---------------------------	------------------------	------	----------	-----------------

Company Name	Type	Notional	Currency	Rec Rate
3M CO	CRP	42,000,000.00	USD	0.40
ABBOTT LABORATORIES	CRP	32,000,000.00	USD	0.40
AEGON NV	UK	5,170,000.00	GBP	0.40
AEGON NV	CRP	68,850,000.00	USD	0.40
AES CORP	CRP	63,725,000.00	USD	0.40
AES CORP	HY	5,000,000.00	USD	0.40
AETNA INC	CRP	20,000,000.00	USD	0.40
AGILENT TECHNOLOGIES INC	CRP	10,000,000.00	USD	0.40

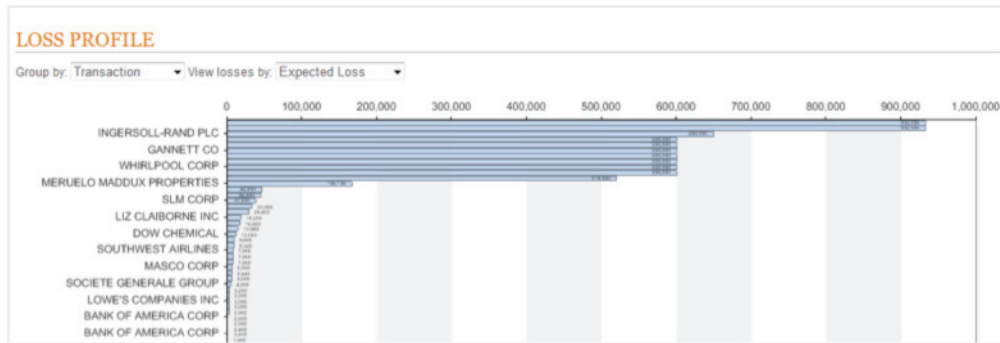
- **Base Currency for the Analysis:** The base currency for reporting of results is selected by the user.

Parameters

Value Date	2/27/2011
Number of Scenarios	100,000
Default Method	Macro Factors
KDP Model	KDP-jc5
KDP Term	1 Month
Period Size	Monthly
VaR Percentile	.995
Reporting Currency	<div style="border: 1px solid black; padding: 2px;"> USD CAD EUR GBP JPY </div>

Reporting of Results in KRIS-CPM

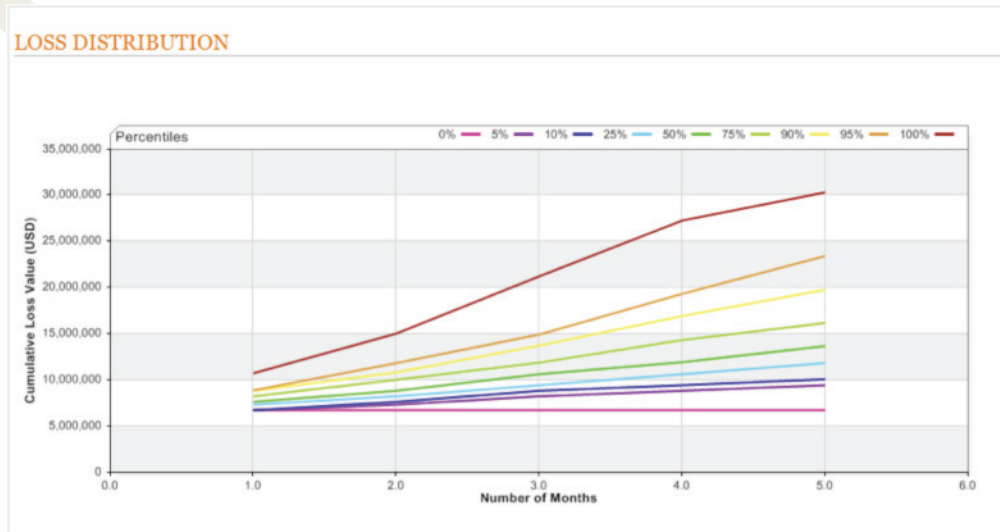
KRIS-CPM includes a rich array of standard reports for loss analysis, valuation, and economic capital analysis. KRIS-CPM is a multi-period simulation engine, just like its more powerful relative, the Kamakura Risk Manager integrated enterprise wide risk management system. For this reason, KRIS-CPM has the unparalleled ability to display results of the full probability distribution of outcomes with the periodicity specified by the user. One of the most popular reports in KRIS-CPM displays the expected losses by counterparty in graphic form:



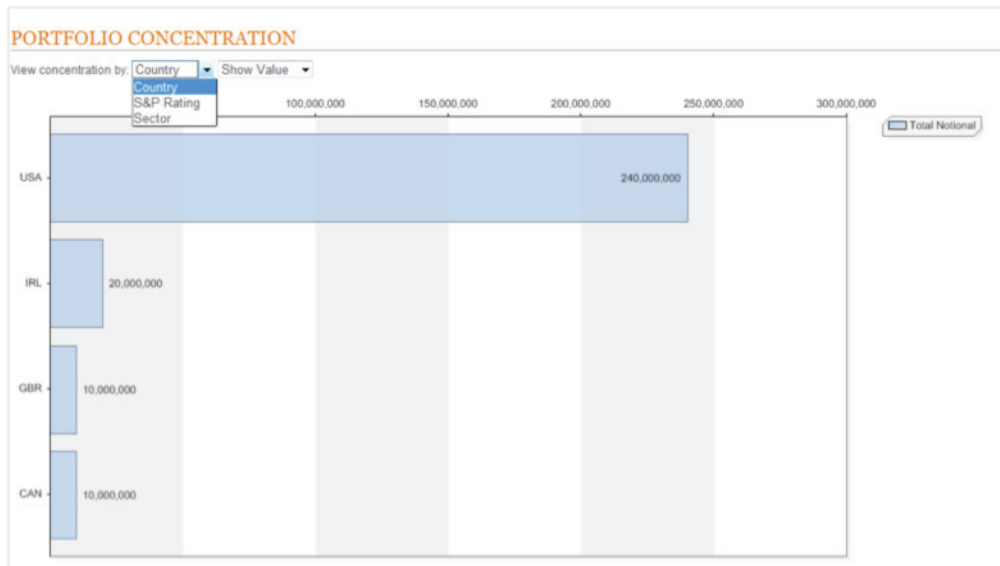
A companion report specifies expected and unexpected loss in tabular form with easy download to Excel:

LOSS PROFILE		
Group by: Transaction	View losses by: Value	
Group	Notional	Expected Loss
3M CO	1,000,000.00	650.00
3M CO	1,000,000.00	600.00
AKZO NOBEL NV	1,000,000.00	0.00
ARCHER-DANIELS-MIDLAND CO	1,000,000.00	0.00
ASSURED GUARANTY LTD	1,000,000.00	1,200.00
AUTOZONE INC	1,000,000.00	0.00
BANK OF AMERICA CORP	1,000,000.00	2,600.00
BANK OF AMERICA CORP	1,000,000.00	2,400.00
BELGACOM SA	1,434,702.00	2,582.46

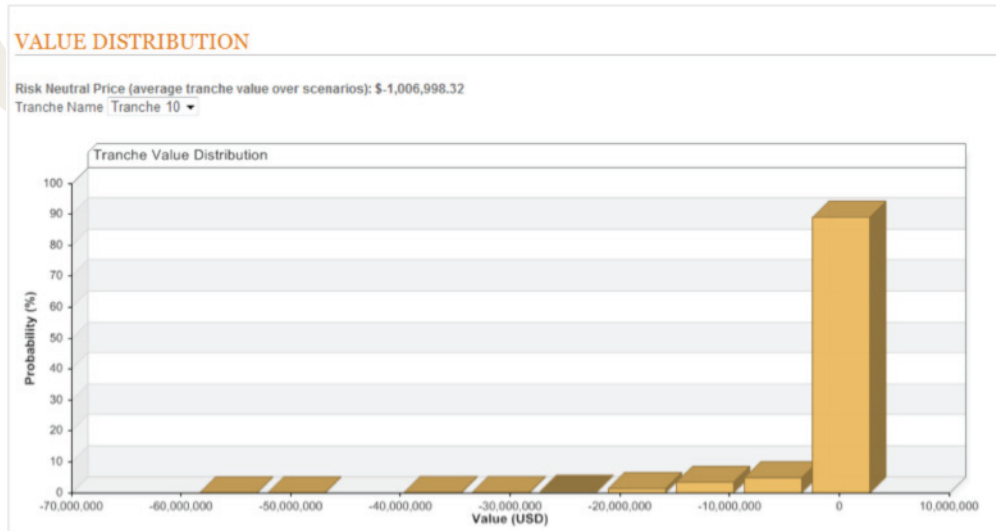
One of the most important outputs in KRIS-CPM is the percentile distribution of losses with the periodicity specified by the user, not just the “expected” and “unexpected” losses alone. This graph shows the percentile distribution of losses on a 5 year simulation with annual periodicity:



In order to understand the results produced, KRIS-CPM includes standard reports like portfolio concentration by various dimensions:



Another key KRIS-CPM report shows the histogram of the N random valuation outcomes specified by the user, along with the risk neutral value of the portfolio or the tranche:



KRIS-CPM, like all Kamakura products, is completely open and transparent to paid clients and financial institutions regulators. Kamakura does not believe that “black-box” solutions are solutions in today’s marketplace where risk managers must certify their belief in the accuracy of the calculations to regulators, senior management, the Board of Directors, and the shareholders. The legacy of the 2007-2009 credit crisis is that black box solutions failed and many institutions using them failed as well.

As part of that transparency, KRIS-CPM lists the macro factors driving default probabilities if the user has selected the “macro factor” driven simulation. This is an excerpt from the full list of factors, which includes oil prices, stock index values, foreign exchange rates, and interest rates:

MACRO FACTORS

Macro Factor	Description
CS_IDX	Case Schiller Index
CSRET1YR	1 year change of CS Index
CSRET2YR	2 year change of CS Index
CSRET3YR	3 year change of CS Index
CSRET5YR	5 year change of CS Index

KRIS-CPM also displays macro factor values for any historical date, in this case for the Case-Shiller index and its returns:

MACRO FACTORS [Download](#)

Macro Factor	Value
CS_IDX	154.650000
CSRET1YR	-0.020521
CSRET2YR	-0.020955
CSRET3YR	-0.211251
CSRET5YR	-0.304819

KRIS-CPM shows the probability distribution which has been assumed for that macro factor:

MACRO FACTORS [Download](#)

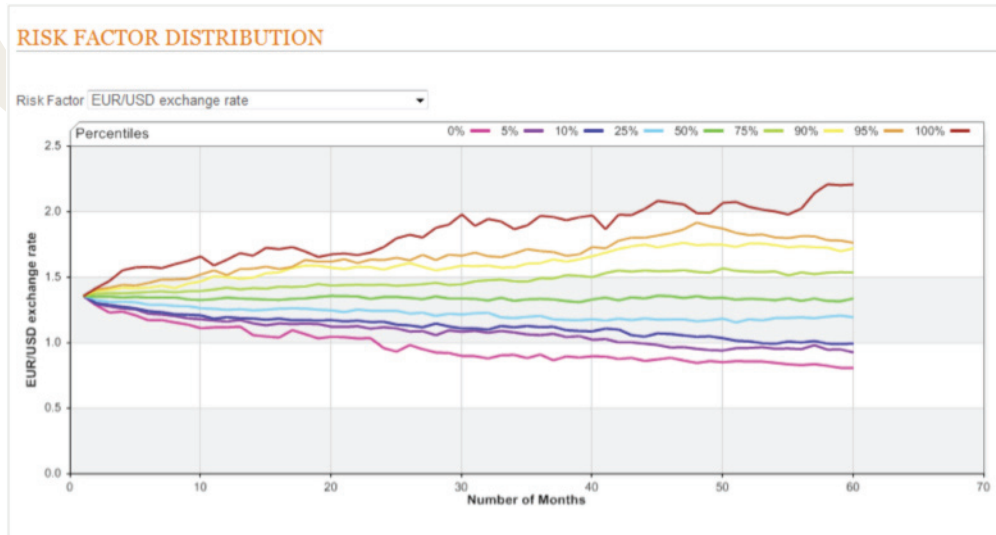
Macro Factor	Volatility	Distribution
CS_IDX	0.034650	LOGNORMAL
CSRET1YR	0.028409	NORMAL
CSRET2YR	0.046810	NORMAL
CSRET3YR	0.043251	NORMAL
CSRET5YR	0.054842	NORMAL

KRIS-CPM also displays the volatilities and correlations that are used for each macro factor variable and each pair of macro factor variables in this true multi-variate simulation:

MACRO FACTORS

	EUR_USD	EUR_USD1	EUR_USD2
EUR_USD	1.0000	0.6506	0.7338
EUR_USD1	0.6506	1.0000	0.4598
EUR_USD2	0.7338	0.4598	1.0000
EUR_USD3	0.6981	0.4516	0.5113

Finally, after a run is complete, the KRIS-CPM user can examine the full probability distribution of the simulated macro factors on a multi-period basis:



For each company whose default probability is simulated forward, there is a separate and distinctive probability function linking the default probability to those macro factors which are statistically significant. There is a different formula for each model (version 5.0 or 4.1) and each maturity (1 month, 3 months, 1 year, and 5 years). Here is a partial screen print for such a relationship for Citigroup as it is displayed by KRIS-CPM. As shown on the screen, the relationship explains 92% of the variation in Citigroup default probabilities since January 1990.

Macro Factors PD Functions Proxies Portfolio Analysis Status

Type Public Firm Ticker c USA Model KDP-jc5 Term 1 Month

CITIGROUP INC

Adjusted R Squared: **0.920291** [Download](#)

Macro Factor	Coefficient	Standard Error	T Statistic
INTERCEPT	-16.4810736644		
EUR_USD2	-3.1014902054	0.8700821901	-3.5645945184
EUR_USD3	2.0737765840	0.7487046186	2.7698194089
JPY_USD2	3.3201914109	0.6560613723	5.0607939301
JPY_USD3	-2.3482178134	0.6750482858	-3.4785923659
OILPRICE	0.0220224248	0.0052194086	4.2193333260
TR10YR_J	0.4275541150	0.1518970838	2.8147618388

We now summarize the benefits of KRIS-CPM.

II. Benefits of Kamakura's KRIS-CPM

Objective Credit Quality Measurement	KRIS-CPM employs the KRIS public firm default models. The KRIS default models are statistical and option theoretic models measuring credit quality based upon objective relationships between observed default behavior and firm attributes, economic conditions, and industry risk or between market expectations embedded in equity prices and firm characteristics.
Modern Default Correlation Technology	The KRIS-CPM service is based on a multiple models approach to default simulation that gives the user the unmatched ability to compare portfolio simulation techniques. The credit portfolio values and CDO tranche values that result from alternative techniques can be quite different, so it is critical for sophisticated market participants to be aware of these differences and to establish a view on which approach is most accurate.
Future Economic Expectations	The KRIS default probabilities incorporate market equity price information that reflects investor expectations about the future performance of individual firms and their default potential.
Maximum Utilization Of Historical Data	The multi-period statistical estimation approach incorporated in the Jarrow Chava Default Models maximizes utilization of historical default, financial and economic data observations often excluded in other models. This allows correct modeling of risk throughout the credit cycle. This long historical data set back to 1990 is also the basis for the macro-factor driven default probabilities that can be used in KRIS-CPM.
High Performance Default Prediction	Default probability estimates provided by the KRIS default models have shown historically high performance in predicting firm defaults across a wide range of credit-risky firms. The KRIS default models have been extensively tested versus ratings and rating agency default models and show a significant performance advantage.
Kamakura Hosted Server Facility	KRIS-CPM runs on very sophisticated multi-chip servers that are hosted by Kamakura in a very high security facility that is shared by government and financial institutions users.
High Ease of Use	A new user of KRIS-CPM can be up and running in credit portfolio management analysis in a matter of minutes. Subsequent runs take only seconds to initiate.
Value Distribution and Loss Distribution	KRIS-CPM produces detailed "no arbitrage" value distributions and loss distributions both for the full reference portfolio and for each tranche of the credit portfolio or CDO. It does much more than the "expected loss" calculation that often distracts the view from rich/cheap analysis of value.
No Conflict of Interest	Kamakura does not trade securities in competition with its clients. Kamakura also has no vested interest in increasing the size of the CDO market, contrary to rating agencies who benefit from an increase in the size of the structured products markets.
Compatibility with Kamakura Risk Manager	For advanced users of KRIS-CPM who seek more hands on control or who seek to model cash flow CDOs, KRIS-CPM is highly consistent with Kamakura's industry leading enterprise wide software package Kamakura Risk Manager.

III. Portfolio Modeling Techniques in KRIS-CPM

Many market participants, prior to the 2007-2009 credit crisis, used a single period model for evaluating CDO tranches that focused as much on expected loss as it did on valuation. The problems with the popular but deeply flawed copula/Merton credit portfolio management tools were featured on page one of the Wall Street Journal as early as 2005. In spite of the flaws in the copula approach that lead to wildly inaccurate valuations and loss distributions, this approach is the only approach offered by the legacy rating agencies to their clients. Kamakura believes it is critical that multiple models be offered on the same platform so that market participants have a clear view of the modeling error that results from these flawed and discredited legacy techniques.

The following sections discuss KRIS-CPM's portfolio modeling techniques.

Zero Correlation Portfolio Modeling

The most basic credit portfolio modeling technique available to users is the base case which assumes zero correlation in the events of default. While this assumption is unrealistic, it is a critical point of comparison for KRIS-CPM users. This approach, like the Copula approach, holds default probabilities constant over the modeling period. Its results should be identical with a copula simulation with the same number of periods in which the pair-wise correlation is assumed to be zero. Because zero correlation portfolio modeling is simulated using the uniform distribution instead of the normal distribution, it runs much more quickly than the copula method with zero correlation.

Copula/Merton Portfolio Modeling

The copula/Merton approach to portfolio modeling in KRIS-CPM can be used with any of the default probability models in KRIS-CPM. This means analysts can employ Kamakura reduced form default model versions 5.0 and 4.1 in the modeling effort. The copula approach (as widely used in the market place) assumes that the return on the value of company assets is random and that this factor triggers the default/no default occurrence and (in the multiple periods case) timing. If there are N reference names in the portfolio underlying the CDO, there are $N(N-1)/2$ pairs of companies in the portfolio. The copula approach assumes that the correlation between the returns on the value of company assets is the same for all $N(N-1)/2$ pairs of companies. In KRIS-CPM, this correlation value is user controlled. Users can vary the correlation coefficient to see the impact of changing correlation on both value and the loss distribution. The copula method implicitly assumes that there is only one common random factor driving the event of default. It also assumes that default probabilities are held constant for the entire length of the modeling period. For richer assumptions about macro-factors driving default, see the alternative techniques in KRIS-CPM listed below.



Term Structure Approach for Portfolio Modeling

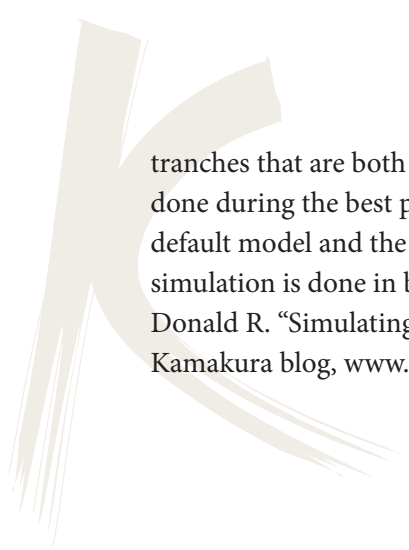
Many users of KRIS-CPM feel that the copula approach is unrealistic in two important respects: they feel that default probabilities in fact are not constant and not uniform across all pairs of companies. They also believe that multiple economic factors drive default probabilities up and down over the business cycle. KRIS version 5.0 and 4.1 default probabilities have a term structure that extends out 120 months and 60 months respectively. This term structure is constructed from logistic regressions for month 1, for month 2 conditional on surviving month 1, for month 3 conditional on surviving month 2, and so on. When the KRIS-CPM user selects the term structure approach, for each counterparty in the portfolio the default probabilities will drift over time consistent with these statistical formulas in KRIS. In general, this will lead to upward sloping default probabilities over time for high quality credits. Credits of intermediate quality may see a rise and then a fall in default probabilities as the time horizon lengths. For distressed credits for which default risk is very high, default probabilities will either stay very high or slope slowly downward if there is a chance that credit quality may be restored. Even this logical extension of the traditional copula model, however, does not take explicit account of the impact of external macro-economic conditions on default behavior. For this we must use the last, and in Kamakura's view the prevailing best practice, approach to simulating default probabilities.

Macro-Factor Driven Default Probability Portfolio Modeling

Many other users of KRIS-CPM believe it is important to capture two key "real world" features:

- The macro-factor drivers of default probabilities which rise or fall over the business cycle
- The division in default probability movements between systematic macro-factor driven movement and non-systematic idiosyncratic movements in default probabilities.

When a user selects macro-factor driven portfolio simulation, KRIS-CPM pulls critical modeling information from the KRIS default probability data base. Using a core set of 40 international macro-economic factors, including home prices, Kamakura has created a linkage between these macro-economic variables and the historical movements in default probabilities for every company, every default model, and every maturity of default probability in the KRIS data base. The time period used for estimation starts in 1990 and continues to the present. For each company, statistically significant macro-factors have been identified and the magnitude of the idiosyncratic risk has been captured. When using this portfolio modeling technique, the default probability movements due both to the systematic macro factors and to the idiosyncratic risk of the individual company's default probability are captured. This sharply contrasts with the common assumption in the Copula approach that default probabilities are known with certainty and the only unknown is whether the company defaults or not, given the default probability. The macro-factor driven approach recognizes the uncertainty in the default probabilities and models it explicitly. Thus this technique generally produces losses and value distributions for credit portfolios and CDO



tranches that are both more accurate and less optimistic than a copula simulation that is done during the best part of the business cycle, even if both runs are based on the same default model and the same starting default probability values. For more on how this simulation is done in both KRIS-CPM and Kamakura Risk Manager, see van Deventer, Donald R. “Simulating Credit Portfolios Using the ‘Reduced Reduced’ Form Approach,” Kamakura blog, www.kamakuraco.com, April 21, 2011.

IV. About Kamakura Corporation

Founded in 1990, Honolulu-based Kamakura Corporation is a leading provider of risk management information, processing, and software. Kamakura has taken Credit Technology Innovation Awards from Credit Magazine each year since 2008. In 2010, Kamakura was the only vendor to win 2 innovation awards, one each with distribution partners Fiserv and Thomson Reuters. Kamakura, along with its distributor Fiserv, was ranked number one in asset and liability management analysis and liquidity risk analysis in the RISK Technology Rankings in 2009. Kamakura Risk Manager, first sold commercially in 1993 and now in version 7.2, was also named in the top five for market risk assessment, Basel II capital calculations, and for “risk dashboard.” Kamakura was also ranked in the RISK Technology Rankings 2008 as one of the world’s top 3 risk information providers for its KRIS default probability service. The KRIS public firm default service was launched in 2002, and the KRIS sovereign default service, the world’s first, was launched in 2008. KRIS default probabilities are displayed for 4000 corporates and sovereigns via the Reuters 3000 Xtra service and the Thomson Reuters Eikon service. Kamakura has served more than 200 clients ranging in size from \$3 billion in assets to \$1.6 trillion in assets. Kamakura’s risk management products are currently used in 34 countries, including the United States, Canada, Germany, the Netherlands, France, Austria, Switzerland, the United Kingdom, Russia, the Ukraine, Eastern Europe, the Middle East, Africa, South America, Australia, Japan, China, Korea, and many other countries in Asia.

Kamakura has world-wide distribution alliances with Fiserv (www.fiserv.com), Sumisho Computer Systems (<http://www.scs.co.jp/english/>), Unisys (www.unisys.com), and Zylog Systems (www.zsl.com) making Kamakura products available in almost every major city around the globe.



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