



Kamakura
Corporation

KAMAKURA

RISK INFORMATION SERVICES

Default Probability Correlations Kamakura Public Firm Models

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I. Introduction

Kamakura Risk Information Services public firm default probabilities were launched in November 2002, followed by the KRIS Sovereign Default Service in 2008. The KRIS service provides estimates of the full term structure of default probabilities of an individual public firm based upon current public information about the firm, its economic environment, firm-specific financial ratios and equity market inputs. Maturities are available 1 month, 3 months, 6 months, 1 year, 2 years, 3 years, and 5 years.

KRIS default probabilities are utilized by major corporations and financial institutions in Europe, Asia and the Americas for two major purposes: monitoring the risk of single counterparties and monitoring the risk of large portfolios of counterparties whose default risk is highly likely to be correlated. The KRIS default probability service contains the pairwise correlation of every pair of companies covered in the KRIS service. In the next section, we discuss these correlations and their use in modern portfolio management.

II. KRIS Default Probability Correlations

Many market participants talk about three different definitions of default “correlation” as if they were interchangeable:

Asset correlation: the correlation in the returns on company assets for two firms, for example Lehman Brothers and Bear Stearns, in a Merton or copula modeling context.

Correlation in the event of default: the correlation between a variable that is 0 in a non-defaulting period and 1 in the defaulting period. Such a variable would be 0 for every observation prior to the defaulting period and one in the period in which the firm defaults. For two firms that have not gone bankrupt, these variables contain nothing but zeros and this definition of correlation is problematic.

Correlation in the default probabilities themselves: the simple correlation in the time series of default probabilities for two firms, such as Lehman Brothers and Bear Stearns.

Each of these correlations could potentially be useful, depending on the nature of the portfolio simulation that the user chooses. If the user feels that default probabilities are constant, a common assumption in the copula approach, then one would use the first definition of correlation. If one were modeling default probabilities that are random and rise and fall over the business cycle, then one would use the third definition. Robert Jarrow and Donald R. van Deventer showed that these alternative definitions of default correlation are mathematically linked (see “Estimating Default Correlations Using a Reduced Form Model,” Risk Magazine, January, 2005). The KRIS default probability service includes default correlations to aid analysts who are modeling enterprise credit risk either in the Kamakura Risk Manager system or some other system.

III. KRIS Default Correlations

The KRIS default probability service provides correlations in the default probabilities of any pair of public firms for each of the four default models described below, each of which has 7 different maturities of default probabilities available (note only 1 year maturities are available for the Merton model because of the single period nature of that model). All together, more than 4.85 million pair-wise default probability correlations are available in KRIS at its 2008 level of coverage: 21,000 public firms in 30 countries.

Default correlations have much in common with the beta calculation commonly used in the capital asset pricing model and extensions of that model for equity portfolio management. In the equity market, betas are commonly estimated using 60 months of historical data. Using this convention as a precedent, Kamakura measures default probability correlations incorporating 60 months of historical data for each pair of companies. Kamakura is pleased to include other correlation definitions at the request of a serious user. Jarrow and van Deventer (2005) show how to convert this correlation figure to alternative definitions of correlation described above.

The KRIS default probability correlations are essential to ensuring accurate simulation of portfolio credit risk, whether the portfolio is a traditional bank loan portfolio or a collateralized debt obligation. It is important to know, for example, that Citigroup and Ford have a default probability correlation in excess of 70% in addition to the obvious 88% correlation in the default probabilities of Ford and General Motors. Analysts who simulate portfolio credit risk without taking advantage of these insights run the risk of seriously underestimating total credit risk, the same error that led to the failure of so many firms in the 2007–2008 crisis.

The remainder of this brochure summarizes the main types of default models available under the KRIS default probability service.

IV. KRIS Public Firm Models: A Summary

Kamakura's Public Firm Models currently offer four different quantitative approaches to modeling default probabilities: two versions of the Jarrow Chava Model (KDP-jc), the Merton Structural Model (KDP-ms), and the Jarrow Merton Hybrid Model (KDP-jm). Both the third generation (version 3.0, released in October 2004) and the fourth generation (version 4.1, released January 9, 2006) of the Jarrow-Chava models are available on the web site at the request of the KRIS client base. All approaches incorporate information on market prices of firm equity and interest rates so that current market expectations are fully reflected in the default probability estimates. The availability of multiple Public Firm Models provides subscribers with theoretically sound alternative views on the likelihood a particular firm will default.

V. The Jarrow Chava Model

The Jarrow Chava Model is a statistical hazard model that relates the probability of firm default to several explanatory variables. The explanatory variables include firm financial ratios, other firm attributes, industry classification, interest rates and information about firm and market equity price levels and behavior. In this model, firm default can occur randomly at any time with an intensity determined by the explanatory variables. Originally developed by Kamakura's Director of Research, Robert Jarrow, the Jarrow Chava Model provides an objective, statistically reliable method of predicting potential firm defaults. The Federal Deposit Insurance Corporation of the United States announced in December 2003 that it was adopting the methodology incorporated in the Jarrow Chava Model for its Loss Distribution Model for the bank and savings and loan insurance funds. Both the third and fourth generation Jarrow-Chava models incorporate multiple equations for forecasting default at different forward time intervals, conditional on survival to that point in time. These equations share the same inputs but they have different weightings depending on the time horizon. The current and forward conditional default probabilities are combined to derive the full default term structure out to five years.

VI. Merton Structural Model

The Merton Structural Model uses option pricing methods to relate the probability of firm default to its financial structure and information about the firm's market price of equity. The explanatory variables include a measure of the firm's outstanding debt, its market valuation, and information about firm and market equity price behavior. In this model, firm default occurs when the market value of the firm's assets decline below a threshold related to the firm's outstanding debt. Robert Merton, winner of the Nobel Prize in Economic Sciences in 1997, originally developed this model.

VII. Jarrow Merton Hybrid Model

The Jarrow Merton Hybrid Model is a statistical hazard model that relates the probability of firm default to the same explanatory variables as the Jarrow Chava Model, but it also incorporates the default probability of the Merton Structural Model as an additional explanatory variable. In this model, firm default can occur randomly at any time with an intensity determined by the explanatory variables. Kamakura offers this Model to combine the default prediction capabilities of the associated models. Forward default probabilities and the full term structure of default are derived in the same fashion as for the Jarrow-Chava models.

VIII. About Kamakura Corporation

Founded in 1990, Kamakura Corporation is a leading provider of risk management information, processing and software. Kamakura has been a provider of daily default probabilities and default correlations for listed companies since November, 2002. Kamakura launched its collateralized debt obligation (CDO) pricing service KRIS-CDO in April 2007. Kamakura is also the first company in the world to develop and install a fully integrated enterprise risk management system that analyzes credit risk, market risk, asset and liability management, transfer pricing, and capital allocation. Kamakura has served more than 185 clients ranging in size from \$3 billion in assets to \$1.6 trillion in assets. Kamakura's risk management products are currently used in 27 countries, including the United States, Canada, Germany, Russia, the Netherlands, France, Switzerland, the United Kingdom, Eastern Europe, the Middle East, Africa, Australia, Japan, China, Korea and many other countries in Asia.

Kamakura's research effort is led by Professor Robert Jarrow, who was named Financial Engineer of the Year in 1997 by the International Association of Financial Engineers. Professor Jarrow and Kamakura founder Dr. Donald R. van Deventer were both named to the 50 member RISK Hall of Fame in December 2002. Kamakura management has published more than 100 publications on credit risk, market risk, and asset and liability management. Kamakura has world-wide distribution alliances with Fiserv (www.fiserv.com), Unisys (www.unisys.com), and Zylog Systems (www.zylog.co.in) making Kamakura products available in almost every major city around the globe.



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