

## CDO-Risk Management (RM-CDO)

RM-CDO provides sophisticated investors an independent and state of the art ability to evaluate both the market value and loss distribution of credit portfolios and tranches of portfolios, especially those of synthetic collateralized debt obligations.

RM-CDO features enormously high ease of use. Clients need only to select the modeling techniques, upload the references names underlying the CDO, specify the maturity date and tranche "attachment" and "detachment" points. Setting up and initiating a RM-CDO analysis takes less than five minutes for a first time user. Initiating a run thereafter takes only seconds.

RM-CDO has a number of very important features that make it unique among CDO analytical packages:

- ✚ It takes a multiple models approach
  1. Users can select from four different default models, including two reduced form credit models, Merton default probabilities, and a hybrid default probability which includes the Merton default probabilities as inputs to an advanced reduced form model
  2. Users can select any "on the run" default probability maturity to use in the simulation: 1 month, 3 months, 6 months, 1 years, 2 years, 3 years and 5 years.
  3. Users can select from an array of portfolio simulation techniques: copula/Merton style simulation, historical default probability simulation, macro-factor driven simulation, and a base case assuming no correlation
  4. Users can select any number of modeling periods from a 1 single period to N periods.
- ✚ RM-CDO features high "ease of use" and allows an end-user with no special information technology skills to get up and running in minutes
- ✚ RM-CDO uses powerful servers hosted by us in a highly secure computer facility shared with major financial institutions and agencies of the U.S. government.
- ✚ Our underlying 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.
- ✚ Our default probabilities and CDO analytics are free of conflict of interest. We do not trade in collateralized debt obligations or profit from the ratings on collateralized debt obligations. As a result, RM-CDO valuations in general show a less optimistic view of CDO valuation that views advocated by market participants with a vested interest in expanding the volume of CDO issuance.

## CDO-Risk Management (RM-CDO)

### Portfolio Modeling Techniques in RM-CDO

Many market participants use a single period model for modeling CDO tranches. While this technique is common and widely used, it implies that as the correlation in the events of default increase, the value of the equity tranche actually rises. When modeling is done on a multiple period basis, however, it becomes clearer to the analyst that two forces are at work when correlation (however modeled in RM-CDO) rises:

- All other things being equal, an increase in correlation tends to shift the burden of default to more senior tranches in the CDO
- All other things being equal, an increase in correlation tends to move the losses nearer to the valuation date, reducing coupon income, increasing payments by the tranche holder for the losses, and reducing value.

The net effect of these two factors can either be positive or negative, not always positive as a single period model may indicate. The next few sections briefly discuss our portfolio modeling techniques.

### Copula / Merton Portfolio Modeling

The copula/Merton approach to portfolio modeling in RM-CDO can be used with any of the default probability models in RM-CDO. This means analysts can employ both reduced form and Merton default probabilities 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 RM-CDO, 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.

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### ✚ Historical Sampling for Portfolio Modeling

Many users of RM-CDO feel that the copula approach is unrealistic in two important respects:

- ✚ they feel that default probabilities in fact are not constant and
- ✚ that multiple economic factors drive default probabilities up and down over the business cycle.

Historical sampling is one approach that captures the implicit correlation in default probabilities as they rise and fall over time. When users of RM-CDO select historical sampling, the RM-CDO calculation engine in period 1 randomly chooses a period in history and selects default probabilities from a historical point in time for all reference names. Default/no default is then simulated for period 1 for all reference names. RM-CDO then moves ahead to period 2 and selects another historical period. Again, default probabilities from that point in time are taken for all reference names. This process is repeated over and over for however many periods and however many scenarios the user has specified.

This technique is commonly used by portfolio managers who also have common stock in their portfolios because historical returns are the basis for much of risk management in portfolios of common stock.

The historical sampling contains an important implicit assumption. Because the historical periods are sampled randomly, instead of sequentially, this technique assumes that the level of default probabilities that results from the sampling is more important than the sequence in which they occur.

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### ✚ Macro-Factor Driven Default Probability Portfolio Modeling

Many other users of RM-CDO believe it is very important to capture two key features of the “real world”:

- ✚ 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, RM-CDO pulls critical modeling information from our default probability data base. Using a core set of 27 international macro-economic factors, we have 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 our 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 to both the systematic macro factors and the idiosyncratic risk of the individual company's default probability are captured. This sharply contrasts with the common assumption in the copula approach that the 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. For this reason, this technique generally produces losses and value distributions for CDO tranches that are less optimistic than a copula simulation, even if both runs are based on the same default model and the same starting default probability values.

## CDO-Risk Management (RM-CDO)

The final 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 RM-CDO 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 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.

### Zero Correlation Portfolio Modeling

RM-CDO also has a number of other features that allow for maximum accuracy in the valuation of synthetic CDOs and the related simulation of losses:

-  **Periodicity of the Analysis:** User-selected--Monthly, Quarterly, or Annually
-  **Number of Periods:** User-selected from 1 period to N periods
-  **Number of Scenarios:** User-selected from 100 to 500,000 (with authorization)
-  **Graphic User-Interface:** Any industry standard web-browser
-  **User Servers Needed:** None, other than a standard personal computer with a web-browser

### Other Features of RM-CDO

## CDO-Risk Management (RM-CDO)

### Benefits of Our RM-CDO

#### Objective Credit Quality Measurement

RM-CDO employs the RM public firm default models. Our 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 RM-CDO service is based on a multiple models approach to default simulation that gives the user the unmatched ability to compare portfolio simulation techniques. The differences in CDO tranche values that result from different 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

Our 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 allows correct modeling of risk throughout the credit cycle. This long historical data set back to 1990 is also the basis for the historical sampling and macro-factor driven default probabilities that can be used in RM-CDO.

#### High Performance Default Prediction

Default probability estimates provided by our default models have shown historically high performance in predicting firm defaults across a wide range of credit-risky firms. Our default models have been extensively tested versus ratings and rating agency default models and show a significant performance advantage.

#### Excellent Hosted Server Facility

RM-CDO runs on very sophisticated multi-chip servers that are hosted by us in a very high security facility that is shared by government and financial institutions users.

#### High Ease of Use

A new user of RM-CDO can be up and running in synthetic CDO analysis in a matter of minutes. Subsequent runs take only seconds to initiate and review.

#### Value Distribution and Loss Distribution

RM-CDO produces detailed "no arbitrage" value distributions and loss distributions both for the full reference portfolio and for each tranche of the 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

We do not trade securities in competition with our clients. We also have 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.