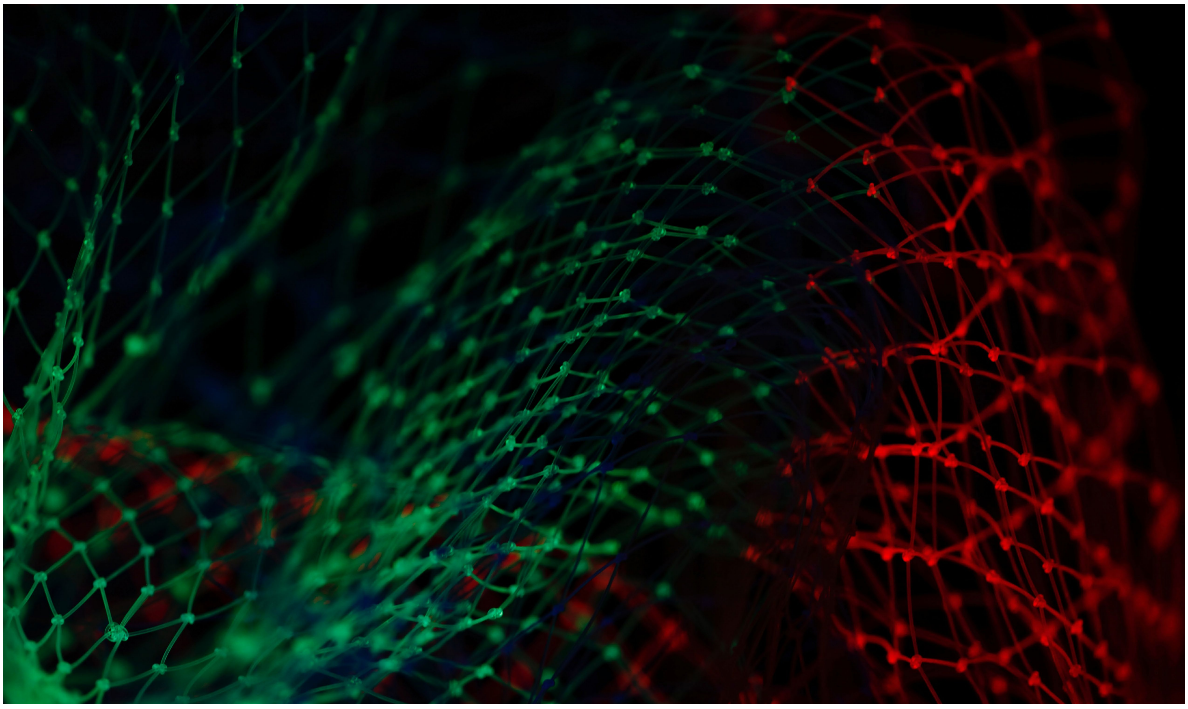
ARMS Counterparty Credit Risk

PFE - POTENTIAL FUTURE EXPOSURE &
CVA - CREDIT VALUATION ADJUSTMENT

An introduction to the arms CCR Module



Executive SUMMARY

The ARMS CCR Module combines market proven financial analytics with superior technical innovation. The latest in hardware and software advances gives the CCR Module thenecessary real time performance to make critical business decisions about counterparty credit risk before the trade is done.

Leveraging many years of financial engineering expertise, the CCR Module for counterparty credit risk solves the CVA and PFE calculation puzzle with fast deployment at low additional cost.

The ARMS CCR Module is

- a forward looking full re-pricing Monte-Carlo simulationengine
- an economic scenario generator with complete risk factorrepresentation
- statistically coherent with market risk models and theirassumptions
- able to calculate CVA and PFE within the same modeling
- framework using risk neutral and real world statistics

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UNIFIED RISK PLATFORM

ARMS - Algorithmica Risk Management System, used for market risk, stress testing and limit monitoring, has been perfected since 1996, and now provides numerous financial institutions with a comprehensive set of risk factors and in-strument types. Adding CVA and PFE calculations extends the ARMS position and risk factor set-up with additional analytics.

Using common instrument definitions, uploaded positions, and risk factor mappings, counterparty credit risk can be calculated using a simulation ap-proach from the same base and meta data. This ensures that “limit arbitrage” does not exist between market risk limits and counterparty credit limits.

Traders, risk managers and senior management can all rely on a unified way to parameterize short term market risk as well as longer term credit risk. Ad-ditionally, it is possible to generate coherent market risk figures from CCR module if a simulation approach is desired also for market risk.

All clients that have invested time in a firm wide position gathering and map-ping exercise for ARMS Market Risk, will immediately be able to install the new CVA & PFE engine, thereby reducing project time and costs to a minimum.

ENTERPRISE WIDE & LIMIT MONITORING

CVA and PFE are measures needed for calculation of capital requirements as well as for guidance on trader level cost of doing business and pre-deal limit checks.

ARMS CCR Module empowers both traders and risk managers with timely and precise calculations of counterparty risk. Incremental risk contributions can be calculated within seconds for a trading desk and within hours for a multi-country global banking operation.

Having a what-if simulation possibility for reducing CVA P&L volatility will be an indispensible tool for traders in the future.

Deployment of enterprise-wide CVA and PFE can be done either as a stand-alone system with independent clients or as an integrated calculation engine. When used as an integrated system, it can provide current front-office instal-lations with streaming calculation results using most common communication protocols. Either way, it will be the same number and background data that is used on all levels of the organization.

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SIMULATION MODELS

Some risk management applications require that risk factors evolve under the real world probability while others require that risk factors evolve under the risk neutral measure. Both are relevant, even within the same application, but for different purposes.

An example, the asset allocation problem; it obviously needs a real world simulation of forward looking risk factors, since the whole point is to create efficient portfolios given the input of estimated returns. The estimated returns are, of course, not the risk free rate, but some subjective asset specific return, i.e. the simulation of future market states evolve according to the real world measure.

A not so clear cut case; assume the objective is to estimate hedge perform-ance of adding derivatives to the portfolio. In this case it really doesn't matter which measure you use, as long as it is the same. The derivatives should of course be calibrated to the market in the risk neutral world and be able to re-cover the current market prices, and hence the choice of simulating under the risk neutral measure might seem more appropriate, but again, not necessary.

PFE and CVA calculations typically present these kinds of choices. In the CVA calculation, the objective is to price the future counterparty exposure using current prices of credit risk (in the risk neutral world), while the PFE calculation, on the other hand, should present a percentile of all future exposures under a realistic future economic state.

REAL WORLD

There are as many ways of creating realistic future scenarios as there are financial analysts doing them. Usual ways of creating future market states include working with econometric models or simply factorizing historical data using PCA and generating iid random draws.

What kind of properties would we like to see for the representation of future market states in a PFE simulation?

- To have yield-curves in forward states that remain arbitrage free, and "look plausible"
- That limits on groups of market factors are maintained. For example, we seldom want a BBB corporate spread to become narrower than the A spread, and the A spread should not be tighter than the AA spread and so on
- A possibility to enforce mean-reversion in rates in order to avoid them from exploding on long time-horizons
- That the generated paths exhibit the same statistical properties as the real historical series, such as autocorrelation, kurtosis and correlations
- The ability to set drift terms that are in line with long term forward views on different asset classes and individual series

One method that will give this type of flexibility, while preserving observed fea-tures in historical market data, is bootstrapping, i.e. using the actual historical return data as the random number generator.

These sample draws can then be stratified in order to re-create auto-correla-tion features. Yield curve nodes for each draw can be mildly "iid-perturbed", creating a yield curve propagation that preserves the general and realistic shapes of the yield curve.

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RISK NEUTRAL

As with real world models, there are numerous models to choose from, when creating a risk neutral propagation of market states. Just looking at yield curve models we find classic models such as one-factor short rate models (HW, BDT etc), forward rate models such as HJM & BGM, alternate two and three factor models.

One alternate model that can be used for CVA in the CCR module, has inher-ited its approach of block-bootstrapping in the same way as the real world simulation does. This approach is generic enough to handle cross-asset portfolios with both netting-sets and collateral, yet will price counterparty risk under the risk neutral probability.

A simulated CVA calculation will have the benefits of being a multi-factor mod-el with no potentially flawed correlation assumptions and without the problem of unstable calibration of complex analytic market models.

It is however possible to implement any types of interest rate models in the ARMS CCR module using the economic scenario generator API.

AUTOMATED OR MANUAL MODEL CALIBRATION

Different classes of risk factors have different models. In the simple case the only parameter to calibrate when drawing random historical market states is the trend. Using the automated calibration model, all simple risk factors can be calibrated to the trend of a specific time period. It is also easy to de-trend the data for comparative studies.

Some risk factor classes will require a mean-reversion effect to be properly modeled. Such a mean reversion require a calibration of both the long term mean reversion level and the speed at which it will return to the long term mean. These parameters can be calibrated using a given historical time frame, or they can be set manually in order to adjust a long term mean to a view that is currently deviating from the historical estimates.

Relative or absolute bounds can be set to several of the risk factor classes in order to maintain a specific relationship to one another. It is also possible to model mean-reversion in spreads between risk factors rather than simulation of mean reversion in the risk factors themselves.

The open architecture of ARMS also extends into the CCR module. In the CCR module, the scenario generation is separate from the calibration and valuation engine. By using the API, it is easy for the in-house modeling team to create and test proprietary models for all or some classes of risk factors. Crea-tion of in-house pay-off functions is straight forward, either using the Qlang language or the C++ API.

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COLLATERAL MODELING

The ARMS CCR module has full collateral modeling capabilities. Complete ISDA CSA, OSLA, GMSLA, GMRA, PSA/ISMA can be imported into the CCR module. Using a complete set of agreement details together with the actual collateral positions provide unrivalled modeling capabilities in terms of how transaction exposure interacts with collateral exposure.

What-if possibilities are available for testing prolonged re-margin periods or adjusted thresholds or minimum transfer amounts.
Simplified collateral position modeling is also available when such data is hard to get. Cash collateral can be simulated either as a constant level of cash or using a "dynamic posting" feature, so that it always is set to equal the expo-sure at a certain number of days prior to evaluation date (Gregory, 2010).

Transactions and collateral belong under unique agreements and will become the natural netting sets when aggregating exposure. It is also possible to aggregate over netting-sets when working within a counterparty corporate hierarchy. This will give the credit analyst a possibility to simulate cross-default situations and counterparty exposure without considering netting-sets.

DEFAULT MODELING

CVA calculation in its simplest case can be described as the practice of pric-ing the expected exposure calculated in the risk neutral world, as would the exposure be a derivative instrument. The three components missing in doing so, apart from having the expected exposure are:

1. the loss given default "LGD", is a factor typically set to 20-40% depending on the assets and counterpart
2. the discount factors, that are used to discount all future exposures back to present time.
3. the probabilities of default "PD", which is the marginal default probability for a certain counterpart

Comprehensive approaches to CVA are also available for example a positively correlated default probability with higher expected exposures. CDS spreads can be represented as risk factors and modeled together with other spread risk factors. If collateral and or netting sets are present, CVA is calculated us-ing these provisions as well.

For convenience and alternate purposes, it is possible to replace the probabil-ity of default as calculated from the current CDS spreads with in-house PD:s and LGD:s coming from the credit department. In doing so, the option to switch to an expected exposure calculated under the real probability measure can be applied and thus creating a CVA under the real measure.

Having a CVA under the real measure can be useful for credit analysts when the aim is not pricing and hedging of the CVA, but evaluation of risk expressed in CVA terms.
Incremental CVA and marginal CVA measures are calculated both on deal level as well as on the netting set level.

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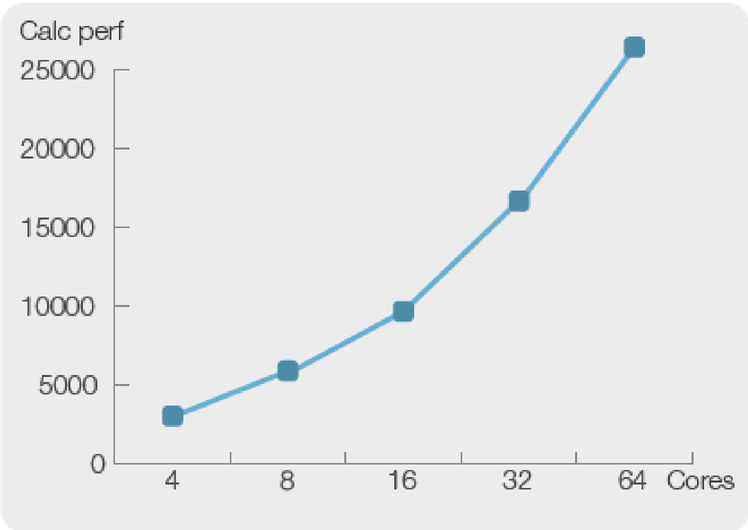
TECHNICAL IMPLEMENTATION

The ARMS CCR module was designed with one overriding goal – that of maximum computation performance, using standard hardware and software platforms.

A simulation problem such as the CVA and PFE calculation is the ideal can-didate for parallel execution, and it is possible to perform the parallelization in several dimensions such as number of positions/ transactions, paths and time-steps.

The core engine used for performing the simulations in ARMS CCR module employs cutting-edge software parallelization technology such as Microsoft's C++ OpenMP implementation and the Math Kernel Library (MKL) from Intel to achieve this in practice. Together with the latest industry standard multi-CPU, multi-core servers – powered by Intel's new Sandy Bridge architecture – this result in impressive and highly scalable performance figures that were beyond reach just a few years ago.



ABOUT ALGORITHMICA RESEARCH

Algorithmica Research is a leading provider of solutions for advanced risk management, quantitative analysis and enterprise-wide management of historical data. We help our clients manage their risks with ARMS - our Risk Management solution that provides a no-compromise financial risk framework.

The Risk Management solution is based on Quantlab®, Algorithmica's award winning development platform for quantitative financial analysis. In addition, Algorithmica provides solutions for enterprise-wide management of historical data including time-series market data, static data, and calculated data.

Founded in 1994, Algorithmica is privately held, and its head office is in Stock-holm, Sweden.

For more information, please visit www.algorithmica.com

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