



MONTE CARLO SIMULATION

FINANCIAL SERVICES THIRD PARTY APPLICATION

Monte Carlo Simulation for Pricing Derivatives with Netezza OnStream™ Analytics

Monte Carlo simulations for the financial industry typically require a grid of independent computers that is expensive to operate and inefficient to manage. In contrast, this Monte Carlo simulation for pricing derivatives consolidates all analytic and database operations onto the Netezza data warehouse appliance, greatly simplifying deployment and operation.

Structured derivatives contracts on a broad range of assets require complex conditions (range accrual, contingent claims, etc.). This Monte Carlo engine efficiently calculates prices as well as P&L results, and allows simple and rapid development of “what if” parameters. The application was developed by Netezza partner HCL and illustrates the advantages of running complex financial algorithms on-stream, taking advantage of the massively parallel processing architecture of the Netezza system. The more Monte Carlo simulations can be run and the more variables can be included, the more accurate are the results. This is where the HCL application and Netezza architecture make a dramatic difference.

Technical Overview

Monte Carlo simulations are data intensive and require caching large intermediate data sets for use in future steps in the computational process. The traditional approach for storing and managing this data on a grid of independent computers is both technically challenging and expensive.

The HCL application for pricing stock options solves this problem by taking advantage of Netezza’s architecture that integrates analytic and database operations. Analytic functions run as queries within the database using Netezza OnStream analytics, greatly simplifying programming and dramatically reducing hardware costs. The ability to store and interrogate intermediate results on-stream within the appliance allows very efficient — and very fast — calculation of Monte Carlo simulations as well as other risk functions for large credit portfolios.

The user interface provides a simple abstraction for SQL based development. The details of the C/C++ library are conveniently hidden, allowing end users to quickly develop their own applications and “what if” analyses. Users can perform easy ad hoc analysis of simulated data and simulation paths, dramatically reducing the need for full simulation runs and allowing faster decisions. Data and analytics are integrated in a logical abstraction (data cache), and the data manipulated on complex business scenarios.



Key Features

- Ability to run complex Monte Carlo simulations from within a SQL query
- Powerful Netezza appliance combines analytic and database functions within one system
- Ability to intensively interrogate intermediate data, store historical simulation results and reuse the results
- Supports the largest portfolio databases
- Appliance simplicity eliminates traditional tuning and administration tasks
- Much simpler and more cost-efficient to set up and utilize than a grid of independent servers

Key Benefits

- **FASTER DECISION TIME:** Run more simulations in less time, for faster decisions and more accurate results
- **LOWER INFRASTRUCTURE COST:** Netezza appliance eliminates the need for costly grid computing and caching infrastructures
- **MORE THOROUGH ANALYSIS:** The ability to examine more variables allows a more comprehensive view of portfolio risk
- **LOWER DEVELOPMENT COST:** Analytic functions run within queries on the appliance, eliminating the need for an external development effort
- **MORE DETAILED REPORTS:** With the ability to reuse intermediate result sets, reports can examine more details and run in less time than previously possible.

Simulation Options

The following example illustrates how intermediate results are calculated and stored inside the appliance, allowing the user to compare two different simulation runs. This is not easily achieved within a grid infrastructure.

In this example, an investment bank maintains a database of all stock options it has to price. To price these options, the analyst invokes a single SQL query:

```
“select S, X, T, V, R, PriceOptionMC
(S, X, T, V, R, 100000) from optionTable;”
```

Storing the results (in this case, in a table called “optionPrices”) is equally easy:

```
“insert into optionPrices select S, X, T, V, R,
PriceOptionMC (S,X,T,V,R, 100000) from
optionTable;”
```

Now suppose the analyst wants to determine stock option prices using two different values of the same parameter, such as the risk-free interest rate. The analyst can run two different SQL queries, using R1 and R2 as the “R” value, before extracting the result tables into an Excel spreadsheet, creating bar charts and printing the results.

With analytic and database infrastructure consolidated into a single powerful appliance, financial institutions now have new capabilities for pricing stock options and managing risk.

- **Easier, faster analysis:** Users can perform non-traditional analytic functions within an SQL query to evaluate option prices, using Netezza’s streaming architecture to return results in a fraction of previous times.
- **Managing large portfolios:** Keeping a database current is much easier within the appliance than over a distributed database on a grid of independent servers. The Netezza appliance scales into the multi-hundred terabyte range, readily accommodating the largest portfolio databases.
- **Running computationally-intensive reports:** With the ability to store and reuse intermediate result sets, additional reports can be run faster and results examined more closely than previously possible.

Stock Pricing Formula Example

The potential stock price at time “T” is given by the formula:

$$ST = S * \exp((R - 0.5 * V^2) * T + V * \sqrt{T} * \text{NormalRandomNumber});$$

Where:

ST – Stock price at time T

R – Risk free interest rate

T – Time at which stock price is calculated

S – Current stock price

V – Volatility of the stock in question

The stock value at time T is calculated as an average of all values of ST using a normal distribution of random numbers. The higher the number of values considered for averaging, the more accurate are the results.

The OnStream function takes **(S, X, T, V, R, numSamples)** as inputs and outputs the value of the option.


- **“numSamples”** represents the number of Monte Carlo cycles requested
- **“X”** is the strike price of the stock option

Partnership Detail

HCL and Netezza have solved a major problem for institutions with large risk portfolios, allowing a broader range of risk calculations in less time and at lower cost. The Monte Carlo solution for stock options is of interest to any organization where risk is an issue and data sizes are significant, including: investment and commercial banks, energy companies, financial services firms and insurance companies.

Large financial services institutions are already taking advantage of the operational simplicity and unmatched price/performance of Netezza’s analytic appliance. Combined with HCL’s global experience delivering high-value solutions for the financial industry, the result is a new and powerful example of advanced analytics. And with high-speed, highly accurate calculation of option pricing, ROI can be quickly realized.

HCL Technologies is one of India’s leading global IT Services companies, providing software-led IT solutions, remote infrastructure management services and BPO. The company leverages an extensive global offshore infrastructure and its global network of offices in 18 countries to deliver solutions across select verticals including

Financial Services, Retail & Consumer, Life Sciences & Healthcare, High-Tech & Manufacturing, Telecom and Media & Entertainment (M&E). For more information, please visit www.hcltech.com or email UKBI@hcl.in. 



Netezza Corporation

26 Forest Street, Marlborough, MA 01752

+1 508 382 8200 TEL

+1 508 382 8300 FAX

www.netezza.com

About Netezza

Netezza (NYSE: NZ) is the global leader in data warehouse and analytic appliances that dramatically simplify high-performance analytics across an extended enterprise. Netezza's technology enables organizations to process enormous amounts of captured data at exceptional speed, providing a significant competitive and operational advantage in today's data-intensive industries including digital media, energy, financial services, government, health and life sciences, retail and telecommunications. Netezza is headquartered in Marlborough, Massachusetts and has offices in Northern Virginia, Canada, the United Kingdom, Germany, France, Japan, Korea, Australia and Singapore.

For more information about Netezza, please visit www.netezza.com.