Numerix CrossAsset Suite

- **Fair Pricing & Transparency**: Pre/post-trade pricing of financial derivatives
- **Model Validation**: Richest set of models & full transparency
- **Counterparty Risk**: Providing cutting edge CVA, DVA, PFE & FVA
- **Consistent & Accurate Risk Reports**: Accurate risk numbers across all asset classes
- **Scenario Analysis**: Bump & twist any risk component
With over 700 clients across buy- and sell-side institutions, insurance, governments, auditors and regulators—and broad deployment inside the world’s largest trading and risk systems—the Numerix CrossAsset engine provides a single analytics platform for all of your analytic needs, powering mission critical operations—from trading through risk management, enabling consistency and transparency enterprise-wide.

“By implementing Numerix analytics and utilizing its models and methods library we’re able to reduce operational risk and external valuation costs across the bank.”

— Chairman of the Valuation Steering Group, Swedbank

**A SINGLE ANALYTICS PLATFORM**

Whether you need a single asset class or a complete cross-asset solution, Numerix CrossAsset can be scaled to meet your company’s needs, from stand-alone desktop installations to enterprise-wide deployments. At the foundation of the Numerix architecture is the most sophisticated library of cross-asset models and methods that has been developed and integrated by our award-winning quantitative research team.

*The Numerix Analytics Architecture: A flexible & transparent framework within a single analytics platform*
### NUMERIX CROSSASSET SUITE

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<th>For Structurers</th>
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<td>Large Portfolio Valuation, Exposures and Risk, Pre-trade &amp; Post-trade Risk Analysis</td>
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<td>Primary users</td>
<td>Traders, Sales, Treasurers, Portfolio Managers</td>
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<td>●</td>
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<tr>
<td>Scalability/portfolio size (# trades)</td>
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<td>&lt;100</td>
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<tr>
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<td>Up to Excel limits</td>
<td>Up to Excel limits</td>
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<tr>
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<td>1–2 days plus structuring time</td>
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<tr>
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<tr>
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<td>Bloomberg, Thomson Reuters, user preference</td>
<td>Bloomberg, Thomson Reuters, user preference</td>
<td>Bloomberg, Thomson Reuters, user preference</td>
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<tr>
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<tr>
<td>Integration to third party systems</td>
<td>—</td>
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</table>
NUMERIX: LEADING THE INDUSTRY IN ADVANCED MODELS AND METHODS

Comprehensive CrossAsset Library
The Numerix CrossAsset library offers the industry’s most comprehensive collection of models and methods, allowing institutions to price any conceivable instrument using the most advanced calculations, in addition to a wide range of calibration options for generating market-consistent valuations.

With an infinitely flexible architecture for defining bespoke deals—and the ability to integrate your own internal models—Numerix allows you to deploy a unified pricing and risk solution for all your derivative and fixed income positions across all trade types.

Optimized Numerical Methods
Pricing derivatives often involves intense computations. Our quantitative analysts have developed methods that have been optimized for speed and accuracy, enabling rapid calculations for even the most complex instruments.

The Industry’s Only Independent Solution for Hybrids
Numerix hybrid model framework produces accurate valuations for instruments consisting of multiple underlyings through joint calibration, and incorporating multiple stochastic processes.

Numerix Model Calibration
- Many choices per model
- View/determine/examine quality of calibration
- “Advanced Markovin projection” for hybrid model calibration
- Best practices for model calibration

The Numerix Hybrid Model Framework: Unifying All Asset Classes

LMM
BK
CIR(RN+RW)
HW

Heston(RN+RW)
Bates(RN+RW)
LSV
Dupire
BS

CIR
GS Copula
CR/IR
Student TCopula
NIG Copula
Credit Transition Model (JLT)(RN+RW)
BK1F

Heston
Gabillon
Black
Schwartz1F
GS2F

IMM
HIMM
SABR IMM
JY (BK)
JY (HW)

Lee-Carter

Numerix hybrid model framework helps hedge risk that is consistent with market-observed behavior, bringing together all risk factors.
NUMERIX CROSSASSET AND MODEL VALIDATION

Independent, Transparent, Trusted
To help institutions accelerate their operations Numerix has developed analytics feature automated testing for model validation, to ensure models have been implemented properly, perform as expected providing good hedges in all market conditions, and to understand model behavior and limitations under extreme market scenarios.

Standardized Testing
Whether your front office and risk department are utilizing Numerix analytics or you are utilizing proprietary models, Numerix CrossAsset provides the necessary standardized tests to confirm model accuracy and performance confirming both mathematical and financial correctness of Numerix models.

Standardized tests for Mathematical Correctness that we apply to our own models include:

- A direct Comparison test for each model, method, with a single payoff feature (e.g. barrier, early exercise, range accrual), which aids Decomposition Testing of more complex deals.
- Limiting Cases of Identities for Payoff (e.g. Knock-in/Knock-out) and for Model (e.g. Heston v. Black Sholes)
- Smoothness Tests for Greeks
- Calibration Round Trip Tests
- Convergence and Convergence Rate Tests

Additionally, tests for the performance of the model’s hedges can be run, either on Numerix models or on proprietary models.

- Calibration Stability Tests
- Calibration Error Tests
- P&L Attribution Tests
- Variance of Hedged Portfolio Test
- Cost of Hedging Test

Auditability
Any validation test can be serialized and exported into a self-contained Numerix XML file that captures all model inputs, including terms and conditions, market data, model choice and calibration assumptions, calendars and more. For those utilizing Numerix models in trading and risk operations, once converted to XML, the model can be ported throughout the institution for use within any operations. Additionally models can be “rehydrated” at any future date allowing users to audit and review the model all without the need to reconstruct historical pricing environments. The Numerix XML can also be ported to any regulatory or audit agency if required.

“…The effective delivery of pricing and risk analytics within a firm represents a critical lifeblood to make better decisions—that is recognized in most capital markets, insurance and investment firms. However, in our experience, the real hurdle to clear for firms is to be able to deliver and maintain a cohesive analytics platform in the context of changing economics of trading businesses with internal cost pressures, regulatory reforms and ongoing accounting demands....”

— Axel Pierron, Senior Vice President, Celent
STRUCTURE AND PRICE ANY TYPE OF DERIVATIVE OR STRUCTURED PRODUCT—FROM VANILLAS TO EXOTICS

Structure and price any deal type with our infinitely flexible deal-structuring architecture. Whether using “out-of-the-box” analytic pricers, PaymentStreams or our unique payoff scripting language—users can leverage the most comprehensive cross-asset library of market-standard models and proprietary numerical methods.

Analytic Pricers
Numerix offers hundreds of industry-standard, pre-defined templates and closed-form pricers that represent commonly traded deals, using market-accepted models and pricing practices.

PaymentStreams
Many complexities can arise in over-the-counter derivatives, such as: introductory periods, adjustments in the payoff formula, multiple termination conditions and contractual changes in terms (such as daycount basis). Numerix PaymentStreams approach accounts for these types of variations in a very intuitive way, closely resembling a term sheet and extending all of the flexibility of Numerix beyond quantitative developers.

Our PaymentStreams method of structuring also allows for advanced cashflow logging, giving the user detailed information such as: fixing date, accrual start and end, payment date, daycount fraction, discount factor, expected coupon rate, notional repayment—and even the implied fx forward rate, for each and every coupon period. This level of detail enables a high level of transparency into the underlying analytics.

Scripting Capability
Users can also define any bespoke custom instrument—and keep on top of derivatives innovation using Numerix scripting capabilities. For example, users can define a wide range of extremely complex instruments, including: equity baskets (Himalayan options), performance options, basket knock-out options, in addition to structured loans and variable annuities.
Numerix introduced the Risk Scenario Framework capability to enable financial institutions to automate the modeling and pricing of portfolios of non-loan securities and derivatives held by operations, such as treasury departments and investment banking subsidiaries—specifically for structuring custom greeks and stress tests.

Numerix uses this stress testing framework to automate the estimation of a portfolio’s value changes, gains, and losses under circumstances that reflect different scenarios required by a financial institution for stress testing. A financial institution’s book of records is the primary data set with which the Risk Scenario Framework is integrated in order to perform scenario-based analyses and projections on all of the firm’s positions.

Scenarios are built using a language-based scripting tool that can be used by staff with a strong finance background but minimal programming experience. By combining the use of the Greeks, access to a financial institution’s book of records, a library of market-tested pricing & risk models, and scripting capabilities for the creation of custom scenarios, the Risk Scenario Framework can be used to model the performance of a portfolio under a broad range of parameters and assumptions.

A strength of the framework is the capability to easily create customized shocks which can be used to build firm-specific worst case scenarios. Users preparing to roadmap their stress test capability should appreciate the benefits of the capabilities within the Risk Scenario Framework.

Solution Analysis

Risk Scenario Framework, Numerix’s stress testing capability, can be used to calculate central difference Greek sensitivities such as Interest Rate DV01, equity delta, and vega sensitivities but can also be used to create large scale scenario shocks.

- A framework that allows Greeks and sensitivities to be calculated across asset classes for any market data environment
- One report that has user-defined statistics that can be calculated consistently across one or all asset classes
- The Greeks can be aggregated by asset class
- Create your own market scenarios, risk and P/L decomposition reports

**Market Scenarios from Basic Building Blocks**

Create customized market environments, which can be saved to your library—or combine shocks to create bespoke market scenarios.
Supporting Critical Trading and Risk Decisions

Numerix CrossAsset’s valuation and risk reporting framework supports numerous kinds of pre- and post-trade pricing and risk analyses, from mark-to-market valuations and Greeks, to Counterparty Credit Risk and Value at Risk, to advanced stress testing and more. Analysis can be performed at the trade level, portfolio level, or counterparty level, to help users make the most informed trading and risk management decisions possible. And to support time-sensitive decisions, even the most advanced risk calculations can be performed in real-time by leveraging the high performance computing power of Numerix CrossAsset Server.
For nearly two decades, financial services professionals around the world, as well as our strategic partners, have come to rely on the Numerix CrossAsset Library and its sophisticated pricing and analytical tools. Numerix CrossAsset Server (CAS) is a single source, cross-asset, enterprise platform that enhances these capabilities to provide portfolio-level pricing, analytics, risk aggregation, simulation and optimization.

Numerix CrossAsset Server extends the rich features of the Numerix CrossAsset Library into an active, gridded server platform both sell-side and buy-side firms can use to compute pre-trade pricing, Mark-to-Market (MTM), greeks, sensitivities, cash-flows, and both market risk (all flavors of VaR) and counterparty risk (CVA, DVA, PFE, FVA) for all enterprise requirements—from front office to compliance and regulatory reporting. CrossAsset Server leverages multiple third-party middleware and related web service-based technology to deliver a scalable, high performance computing environment that can be easily integrated with an organization’s existing trading platforms.
FROM TRADING DESK TO ENTERPRISE RISK MANAGEMENT—NUMERIX EASILY INTEGRATES WITHIN YOUR OPERATIONS

Whether on a single desktop, across different trading desks, or enterprise-wide—Numerix users are empowered to structure trades in Excel and load them into a single CrossAsset Integration Layer Trade and Data Repository.

CrossAsset Integration: Trade Template Repository

Predefined & Custom Deal Templates
- FX KO/KI
- Autocallable Note
- IR Swap
- CMS Spread Bermudan
- FX Option
- TARN

Curve Management Templates
- Cubic USD Curve
- Smoothed JPY Curve
- Internal Rate 3

CrossAsset Integration Layer Trade Repository

How the CrossAsset Integration Layer Will Benefit Your Organization

The Numerix SDK includes CrossAsset Integration Layer—a data-driven interface that empowers users and partners to non-programmatically extend CrossAsset with custom interfaces, new models and business logic. The integration layer interface that enables Numerix pricing and analytics to be consumed as a cloud-based calculation node. This allows complex calculations for valuations and risk to be scaled using cloud computing resources such as Microsoft Windows Azure.

Using the Numerix SDK with the CrossAsset Integration Layer, clients and partners can:

- Leverage Numerix market-tested models and methods in existing systems across the full trading and risk lifecycle
- Easily extend production platforms’ deal coverage across asset classes, including exotics and structured products
- Employ consistent valuation methods across the enterprise
- Enable advanced risk analysis and reporting
- Integrate a wide range of custom applications, such as visualization and master data management tools
ABOUT THE COMPANY

The Industry Standard for Cross-Asset Derivatives Risk Management

Numerix is the market’s leading provider of risk analytics technology for the pricing, structuring, modeling and valuation any derivative instrument, or portfolio. Numerix risk solutions enable global financial institutions to understand performance, analyze and anticipate future derivatives risks with unparalleled speed and accuracy.

A Global Presence

Founded in 1996, Numerix is the leading provider of computational analytics software for the derivatives market supporting risk calculations, pricing and trading across all areas of the enterprise. With the industry’s broadest instrument coverage spanning cross-asset and hybrids, commodities, credit, equity, fixed income, FX, life and inflation solutions, Numerix brings together unparalleled expertise across all asset classes and engineering disciplines. Headquartered in New York, Numerix works with over 700 clients and 90 partners across more than 26 countries.

The Numerix Partner Ecosystem

Many of the top trading and risk platforms used by today’s financial institutions and corporate treasuries have embedded the Numerix model library and pricing architecture inside their systems. Resulting in over 90 partnerships with leading technology providers from around the world, Numerix has helped to solve some of the industry’s most complex derivatives challenges. From expanding model coverage to capture local market needs or being imbedded as an enterprise risk engine for counterparty credit risk management, the Numerix CrossAsset platform has helped to form the industry’s most robust partner ecosystem for derivatives and structured products.

For more information, contact sales@numerix.com.