

IBM Algo Market Risk

Measure, manage and optimize market risk across the enterprise with a leader in risk analytics

IBM® Algo Market Risk provides firms with the fundamentals of scenario-based risk management, giving financial institutions a leading solution for measuring and managing market risk across asset classes and geographies. With broad instrument coverage and vast libraries of pricing functions and statistical models, firms can create simulations for testing and optimizing their strategies.

IBM Algo Market Risk applies the award-winning Mark-to-Future framework that offers firms a solid foundation for capturing the interactions between risk types and managing risk as an integrated system across market, credit and liquidity risk.

The standard for scenario-based risk management

Financial risk management is more than an end number—it is the process of understanding how data is transformed by models into business insights that drive better decisions. Fundamental changes in risk management approaches are being led by firms that recognize the business benefits of a rigorous and holistic approach to risk and by regulators that are demanding a new level of transparency.

IBM Algo Market Risk is leading the industry with new developments in advanced risk analytics, valuation methodologies and scenario generation techniques. The award-winning Mark-to-Future architecture underlying IBM Algo Market Risk is asset class and risk factor agnostic, enabling the solution to span all holdings and investment strategies of large multinational trading operations.

IBM Algo Market Risk offers accepted approaches for portfolio optimization, back-testing, limits management, and on-demand scenario-based simulations. To accurately identify trends, IBM Algo Market Risk is configured with data services that categorize current and historical securities information on every risk factor used for scenario generation, model calibration, and variance/covariance generation.



The interfaces and reporting options of IBM Algo Market Risk can be customized by individual users to efficiently deliver risk analysis that meets the diverse requirements of different roles. This tailored approach facilitates effective communication across all levels of the organization, providing actionable insights to decision makers in senior management, risk management, and the front office.

IBM Algo Market Risk helps to enable better, faster decision support for firms to manage market risk, and establishes the foundation required to support ongoing business needs as risk management approaches are expanded to include credit and liquidity risk across the enterprise.

Risk insights that people can act on

IBM Algo Market Risk provides banks with real-time risk insights. Risk managers and traders can define what-if scenarios and monitor limits across all business lines.

Middle office risk managers can create automated daily reports that include stress test results with a variety of aggregations on mark-to-market measures and the impacts on Value at Risk (VaR). The award-winning Mark-to-Future methodology for simulation-based risk management runs full forward valuations requiring no constraining assumptions or short cuts. Since IBM Algo Market Risk does not require analytical approximations of risk, the approach helps firms meet regulatory requirements for the Basel Internal Model Approach (IMA), including VaR, Stressed VaR, Incremental Risk Charge (IRC), and debt and equity specific risk.

Front office traders can assess historical replays and the potential P&L impact of user-specified risk factor movements including shocks to interest rate curves, equity indices, and volatility surfaces. With intraday updates of market data, traders can run real-time reports during periods of market volatility and apply insights from sensitivities to rebalance positions and maintain hedges. Options for more effective hedging strategies can be constructed and compared with instrument level analytics such as key rate durations, key spread durations, convexity risks, industry beta exposures, risk factor exposures, and Greeks (quantities representing the pricing sensitivities on derivatives, named because these sensitivities are often denoted by Greek letters).

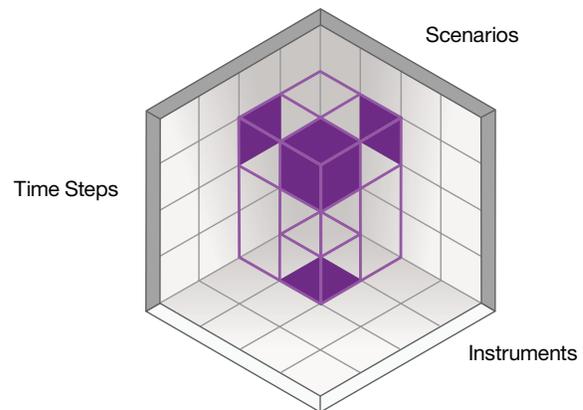


Figure 1: Mark-to-Future: the building blocks of risk

A working approach to understanding risk

Designed to produce a robust, consistent, and accurate view of the future, the scenario-based methodology of IBM Algo Market Risk provides an integrated view of risk across multiple asset classes, instrument types, and risk factors, spanning multiple countries and currencies. Risk measures generated by IBM Algo Market Risk are aggregated from distributions of simulated valuations through time across a wide range of scenarios. The resulting array of valuations, generated across multiple dimensions, supports in-depth analysis to help users better understand the risks within any portfolio. Users can compare VaR results day over day to look for shifts and investigate how positions have been impacted by drilling down through hierarchies and opening context-specific views. At each level, a user has options for performing further analysis such as highlighting changes in market data, graphing numerical sensitivities, performing custom stress tests, running historical replays and tabulating probabilistic risk measures.

Because every valuation depends upon the underlying risk factors used to generate the scenarios at each time step, IBM Algo Market Risk also includes a sophisticated modeling environment for calibrating risk factors and defining risk factor processes.

Industry-leading risk management

Over 150 banks and financial institutions around the world depend on IBM Algo Market Risk.

IBM Algo Market Risk provides firms with the fundamentals of measuring risk and reward for risk-informed decision making, and offers a wide range of solutions through extension packages.

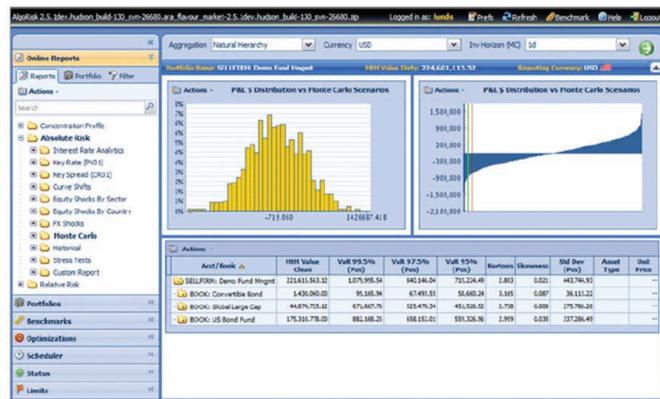


Figure 2: P&L Distribution vs Monte Carlo Scenarios

Options to meet business needs

Dynamic strategies—Improve hedge effectiveness and lower hedging costs with risk management tools for optimizing trading strategies. Simulation results give insights on what is best to trade, how much, and when, based on multiple market scenarios that outline the potential profit and loss impacts.

Optimization—The patented scenario-based optimization framework allows firms to replicate the characteristics of their enterprise portfolio with a small set of liquid instruments. This gives banks an efficient approach to better understanding their risk profile, and supports planning discussions with Chief Risk Officers and the executive management to proactively develop hedging strategies that can be quickly put in place during periods of market turmoil.

Comprehensive picture of risk—Construct an enterprise view of risk by integrating the building blocks of IBM Algo Market Risk with other products like IBM® Algo One Counterparty Credit Risk Base, IBM® Algo One Asset Liability Management (ALM) Base, and IBM® Algo One Liquidity Risk Base to meet complex business challenges.



Figure 3: Concentration risk profile

Key features and benefits

Understand sources of risk

The advanced scenario-based Mark-to-Future framework of IBM Algo Market Risk provides financial institutions with a consistent forward-looking picture of risk. This approach to risk and reward analysis helps firms to mitigate unexpected losses and maximize returns through more informed business decisions.

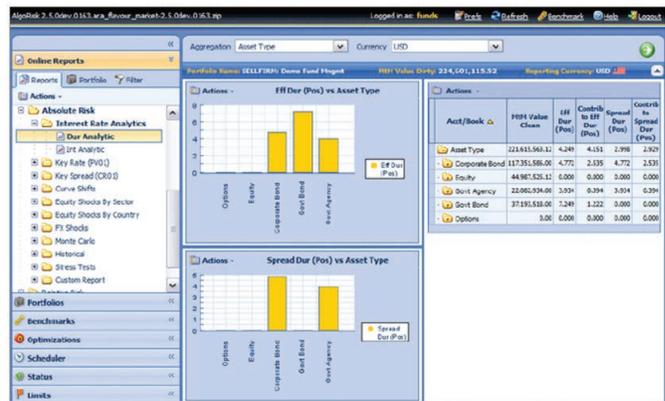


Figure 4: Absolute Risk report

Adapts to evolving business needs

IBM Algo Market Risk is designed to meet the growing business needs of firms as they emerge in the market. The data architecture captures and consolidates positions across the enterprise, with a highly scalable data handling capacity. IBM's industry leading performance is based on a multi-threading approach that can be distributed horizontally and vertically onto a single multi-processor server or within grid computing farms.

Existing installations can be quickly reconfigured to include new asset classes, business lines, investment strategies, and risk methodologies without interrupting existing workflows or disrupting results.

Promotes transparency and helps reduce regulatory capital requirements

The analysis and risk reporting extracted through IBM Algo Market Risk promotes dialogue between business lines and senior management regarding the key drivers of risk, and potential strategies that can be initiated to manage exposures. The functionality and reporting framework of IBM Algo Market Risk has enabled many financial institutions around the world to free up significant capital reserves by achieving regulatory approval of their internal models on market risk and specific risk.

Integrates the front and middle office for active management of risk

On-demand risk measures have become a standard requirement from risk managers and front office traders. IBM Algo Market Risk applies award-winning computational speed to perform what-if analysis on portfolio impacts from potential trades or new economic situations.

Provides comprehensive instrument coverage and model support

To address the unprecedented growth of the derivatives market, IBM Algo Market Risk includes instrument coverage for more than 20 different geographic markets and over 400 financial instruments including fixed income, foreign exchange, equity, credit, energy, commodity, and derivatives markets. It also includes support for structured products such as MBS/CMO/ABS/CMBS. IBM Algo Market Risk features an extensive library of pricing models that can be adapted and expanded with Risk++, an open language for scripting pricing functions, and can support rapid integration of third party pricing models already in use by firms. Advanced analytics and scenario generation techniques for stress testing over multi-period stress events is also supported.

Ongoing support for new challenges

Led by one of the industry's largest group of risk professionals, the Algorithmics Lab Services team includes financial engineers, integration specialists, and project managers. IBM's support teams utilize a reliable engagement methodology to assist clients in the implementation of IBM's solutions, and help clients adapt their existing risk systems to meet new challenges.

Comprehensive product coverage

Effective risk-based decisions rely on risk measures that address both individual positions and their interactions within a broader portfolio. Accurately valuing all open positions within a single framework therefore becomes an important step toward measuring the market, credit, and liquidity risks that those positions create or mitigate. IBM provides a number of alternatives for valuing financial instruments to ensure that the entire book may be incorporated into the risk measurement process. This provides firms with the necessary flexibility to appropriately model any type of position within their portfolio, from exotic, one-off deals to high-volume vanilla transactions.

Extensible...

Stochastic Pricing Models are a special class of standard valuation models that facilitate the pricing of exotic derivatives (interest rate, foreign exchange, or equity) using a Monte Carlo approach. Clients can select from a payoff function or specify their own using a straightforward using a straightforward C++ or Python interface.

Examples of standard pay-off functions include:

- Arithmetic Asian on Baskets
- Best-of
- Barriers
- Basket Equity Derivatives
- Reverse Cliquets
- Pendulums
- Best-of/Worst-of (standard, digital, locked, sequential)
- Hi-Low Swaps
- Reverse Podiums
- Max/Min Options
- Forward Accumulators
- Mountain Options

Dynamic Expressions provide flexibility in defining valuation functions for non-financial products and risk (e.g., physical assets) by allowing clients to specify arbitrary functions of risk factors and instrument attributes. Extending the example, consider project finance, where one might vary the value of the underlying project using a formula based on macroeconomic factors or commodity prices. In addition to standard functions, dynamic expressions also allow more complex functions written in Python to be incorporated.

Synthetic Products allow multiple component products to be grouped into a single transaction or product. For example, two swap legs may be modeled individually then combined into a synthetic product to facilitate the reporting of the risk measures and validation against the source system.

Collaborative...

Custom Pricing Extensions are used by many of IBM's clients to create customized valuation functions for non-standard products or to incorporate in-house pricing models. There are three options for coding an extension: Risk++ (a set of C++ libraries), Python (using the Python language to code functions via scripts), and RiskScript, a variant of Visual Basic for Applications (VBA). These provide a range of choices depending on desired performance, flexibility, and time to market. In all cases, the terms and conditions are loaded in the same manner.

External Pricing, also known as Open MtF, allows clients to import their own simulation results, calculated with their own models. Open MtF provides for the export of scenarios on risk factors across time (e.g., the EUR interbank zero curve). These scenarios support valuation of transactions by an external engine. The import of the resulting values across time/scenario is enabled by Open MtF. The values are then combined with those evaluated using other techniques to produce a thorough picture of risk.

Practical...

Grid Evaluation is most effective when the value of a transaction is related to only one or two risk factors, but where the valuation itself is time-consuming or intractable. Each transaction is evaluated across a grid of risk factor values to produce a look-up table. This table is loaded into the system as part of the terms and conditions of the transactions. During simulation transaction values from the table are interpolated as required. This technique is most commonly used for market risk purposes.

Sensitivity-Based Evaluation is used to approximate the behavior of instruments when complete terms and conditions and/or evaluation functions are unavailable. This approach may often be used in the initial phases of a project, with a view to replacing it with a model-based approach at a later date. This technique is most commonly used for market risk purposes.

Portfolio Replication reduces large, complex portfolios to a manageable number of representative instruments for risk measurement purposes. For example, a block of life insurance policies may be evaluated against 100 plausible scenarios. These scenarios and the corresponding values of the block feed an optimization algorithm. It produces a smaller portfolio of financial instruments that replicates the risk profile of the original larger portfolio. This replicating portfolio is used as a proxy of the original portfolio for the purposes of risk measurement and benchmarking.

Standard Models are the most commonly used valuation methods. Terms and conditions are specified for each product type and loaded into the transaction database. A standard function for valuation and simulation of the trade, allowing settlement (cash and physical) and through-time valuation to be realized; sensitivities, cash flows, and other attributes are also calculated.

In most cases, model calibration algorithms are also provided, helping ensure consistency and facilitating validation.

The flexibility of the IBM's framework means that users can model a wide variety of products that exist in the market today. The following are examples of products supported by IBM and actively used by our clients.

Interest rate products

IBM offers flexible valuation methodologies for a wide range of interest rate products. Users can build fixed income instruments from terms and conditions or specify payments individually. Pricing algorithms include discounting, numerical methods, lattices, and Monte Carlo. Supported interest rate evolution processes include forward-based pricing, normal, Hull-White, two-factor Hull-White, Amin-Jarrow, and Black- Karasinski.

Money Market

- Banker Acceptance (BA)
- Commercial Paper
- Deposits (CD)
- Treasury Bills

Bonds

- Government Bonds
- Corporate Bonds
- Municipal Bonds
- Zero Coupon Bonds
- Step-up (Variable Rate) Bonds
- Floating Rate Notes
- Inflation Indexed Bonds
- TARN Notes
- Ratchet Notes
- Callable Bonds (Fixed and Floating)
- Range Accrual Bonds (Callable)
- Amortizing Bonds (Callable)
- Mixed Fixed/Floating Bonds (Callable)
- Generic Cash Flows (Fixed, Floating, Amortizing)
- Compounding Bonds
- Mortgage Products (via INTEX and Andrew Davidson)
- MBS/CMBS/RMBS
- CMOs
- IO/POs
- Sequential Bonds
- PAC Bonds
- Asset-Backed Securities (ABS)
- Fixed MBS Pools
- ARM MBS Pools
- Target redemption notes

Forwards

- Repos and Reverse Repos
- Bond Forwards
- Money Market Forwards
- Forward Rate Agreements (FRA)

Futures

- Bond/Note Futures
- Eurodollar Futures
- Fed Funds Futures
- Money Market Futures

Swaps

- Interest Rate Swaps/Swaptions
- Basis Swaps/Swaptions
- Zero Coupon Swaps/Swaptions
- Variable Notional/Coupon Swaps/Swaptions
- Forward Starting Swaps
- CMS/CMT Swaps/Swaptions
- Compounding Swaps
- Average Rate Swaps
- Cancelable Swaps
- Extendible Swaps
- Trigger Swaps
- Delayed Reset (In-Arrears) Swaps
- Differential (Quanto) Swaps
- Index Amortizing Swaps/Swaptions
- Amortizing Swaps/Swaptions
- Asset Swaps
- Capped Floater Swaps/Swaptions
- Fixed/Float Range Accrual Swaps/Swaptions
- Inverse-Floater Swaps/Swaptions
- OIS/EONIA Swaps
- TARN Swaps
- CMO Swaps
- Swaptions (European, American, Bermudan)
- Snowball Swaps
- RDC
- Ratcheting Swaps
- Power Reverse Dual Currency (PRDC)
- Notes/Swaps

Cap, Floor, Collar

- Vanilla Caps
- Digital Caps
- CMS Caps
- Differential (Quanto) Caps
- Average Rate Caps
- Spread Caps
- Flexi (Chooser) Caps
- Limit (Auto) Caps
- Captions
- Barrier Caps
- Generic Cash Flows (Caps, Floors, Digital Caps, Digital Floors, Amortizing)

Inflation

- Inflation Derivatives
- Zero Coupon Inflation Swap
- Year-Over-Year Inflation Swap
- LPI/RPI Swaps
- Inflation Caps/Floors
- Compounding Inflation Swaps

Other Options

- Money Market Futures Options
- Eurodollar Futures Options
- Fed Funds Futures Options
- Bond/Notes Futures Options
- Bond Options (European, American, Bermudan)
- Barrier Bond Options
- Bond Basket Options
- Structured Products
- Callable CMS Spread
- Callable Capped Floaters (LIBOR/CMS)
- Callable Inverse Floaters (LIBOR/CMS)
- Forward-Based Options

Foreign exchange products

IBM Algo Market Risk supports multiple currencies and a number of specific foreign exchange (FX) products.

Spot, Forwards, Futures, Swaps

- Spot
- Currency Forwards
- Non-Deliverable Currency Forwards
- Currency Futures
- Currency Swaps
- Notional Reset Swaps
- Dual FX Correlation Swaps
- Variance/Volatility Swaps
- Total Return Swaps
- Forward Volatility Agreements

Options

- European Options
- American Options
- Futures Options
- Forward Start Options
- Average Rate Options
- Spread Options
- Asian Options
- Basket Options
- Single, Double and Window Barriers
- Cliquet
- Quantos
- Napoleon Options
- Forward-Based Generic Options
- Monte Carlo Generic Options

Equities

Equities may be modeled directly or modeled using a multi-factor CAPM approach. On this basis, a wide variety of options models are available, including closed form, lattices, and Monte Carlo. Supported evolution processes include GBM and Heston.

Spot, Forwards, Futures, Swaps

- Common/Preferred Stock
- Equity Indices
- American Depositary Receipts
- Equity Forwards
- Equity Index Futures
- Equity Index Swaps
- Variance/Volatility Swaps
- Forward Volatility Agreements
- Correlation Swaps

Options

- European Options
- American Options
- Bermudan Options
- Equity Index Future Options
- Forward Start Options
- Basket Options
- Spread Options
- Single, Double, and Window Barriers
- Asian Options
- Cliquet Options
- Quantos
- Floating Strike American Options
- Range Options
- Forward-Based Generic Options
- Monte Carlo Generic Options

Convertibles

An extensive model includes key features such as:

- Dual Currency
- Calls/Puts
- Mandatories
- Hard/Soft Calls
- Accreting Calls
- Screw Clauses
- Fixed/Floating Callable and Convertible Bonds

Commodities and energy

Commodities are valued based on forward pricing using: constant maturity or rolling nearby. The Schwartz and Smith model is also used.

- Commodity Forwards
- Commodity Futures
- European Options
- American Options
- Futures Options
- Barrier Options
- Average Price Options
- Precious Metal Swaps
- Commodity Swaptions
- Spot/Term Physicals
- Fixed/Floating Price Cargos
- Swaps (Index, Basis/Spreads)
- Spread Options
- Basket Options
- Asian (Average Price)
- Long-Term Gas Contracts
- Forward-Based Options
- Spread Options (FEA)
- Crack Options (FEA)
- Asian Options—Average Price/Strike (FEA)
- Asian Spread Options—Average Price/Strike (FEA)
- Calendar Spread Options (FEA)
- Swaptions (FEA)
- Best-of (FEA)

Credit derivatives

For synthetic CDO, three types of valuation procedures are provided: Analytic¹, Convolution², and Monte Carlo Simulation. Moreover, IBM provides the means to estimate the inputs into the models: base correlation, hazard curves, and spreads are all estimated from market quotes.

Single Name

- Total Return Swaps
- Credit Default Swaps
- Credit Default Swaptions
- Credit Linked Notes
- Credit Spread Options (European, American)

Multi-name

- Synthetic CDO
- Index CDS (CDX and iTraxx)
- Index Tranches (CDX and iTraxx)
- Bespoke CDO Tranches
- 1st-to-Default, N-to-Default Baskets

Model Calibration

- Hazard Rate or Spread Curve
- Index CDS (CDX and iTraxx)

Generic derivatives

IBM's models exploit the common features of products that have a variety of underliers. Forward-based models can be used with the following product types: FX, Bonds, Commodities, EDF and FFF, Equities and Market Indices, Baskets, etc.

Forward Based

- Asian
- Asian Cliquets
- Asian Forwards
- Forwards
- Futures
- Forward Start
- American
- Quantos

Single Barrier

- European Up & In, Up & Out, Down & In, Down & Out
- Cash-or-Nothing Binary One-Touch
- Cash-or-Nothing Binary No-Touch
- Cash-or-Nothing Digital One-Touch
- Cash-or-Nothing Digital No-Touch
- Asset-or-Nothing Binary One-Touch
- Asset-or-Nothing Binary No-Touch
- Asset-or-Nothing Digital One-Touch
- Asset-or-Nothing Digital No-Touch
- Quanto Barrier

Double Barriers

- European Double Knock-out/Knock-in
- Cash-at-Expiry-or-Nothing Binary One-Touch
- Cash-at-Hit-or-Nothing Binary One-Touch
- Cash Binary No-Touch
- Cash Digital No-Touch
- Cash-or-Nothing Digital One-Touch
- Asset-at-Expiry-or-Nothing Binary One-Touch
- Asset-at-Hit-or-Nothing Binary One-Touch
- Asset Binary No-Touch
- Asset Digital No-Touch
- Asset-or-Nothing Digital One-Touch
- Window Barriers
- Quanto Barrier

Banking book products

A variety of functions support the inclusion of banking book and retail products, either individually or as cohort groups.

- Commitments
- Fixed Rate Loans
- Floating Rate Loan
- Lines of Credit
- Letters of Credit
- Guarantees
- Receivables
- Demand Deposits
- Retail Bonds (amortizing and prepaying)

Regional models

As a vendor with an international client base, IBM empowers users to precisely model instruments in different regions. Equipped with an extensive library of standard models, additional specialized features are available for particular regions.

Australian Module

- Exchange Bond Futures
- Futures Exchange Bank Bill Futures
- Options on Exchange Bond Futures
- Options on Exchange Bank Bill Futures

Brazilian Market Module

- Interest Rate Bonds/Notes
- Interest Indexed Bonds/Notes
- Inflation Indexed Bonds/Notes
- Dollar Indexed Bonds/Notes
- DI and DDI Futures
- Indexed Swaps

Japanese Market Module

- JGB

Mexican Market Module

- UDI Indexed Bonds
- TIE Futures

South African Market Module

- Bonds
- Bond Futures
- Bond Futures Options
- Bond Options (European, American)
- Bond Forwards

United Kingdom Market Module

- UK Gilts

About Business Analytics

IBM Business Analytics software delivers data-driven insights that help organizations work smarter and outperform their peers. This comprehensive portfolio includes solutions for business intelligence, predictive analytics and decision management, performance management, and risk management.

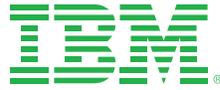
Business Analytics solutions enable companies to identify and visualize trends and patterns in areas, such as customer analytics, that can have a profound effect on business performance. They can compare scenarios, anticipate potential threats and opportunities, better plan, budget and forecast resources, balance risks against expected returns and work to meet regulatory requirements. By making analytics widely available, organizations can align tactical and strategic decision-making to achieve business goals.

For more information

For further information please visit ibm.com/business-analytics.

Request a call

To request a call or to ask a question, go to ibm.com/business-analytics/contactus. An IBM representative will respond to your inquiry within two business days.



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- 1 The Analytic valuation follows Iscoe and Kreinin: Pricing and Valuation of CDOs, which provides the closed-form solution of the expected Tranche Loss.
- 2 The Convolution form follows Hull and White: Valuation of a CDO and an nth to Default CDS without Monte Carlo Simulation, which describes the convolution method to compute the distribution for the number of defaults in the underlying asset pool.



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