Axioma Risk Model Update:

Enhancements to the Axioma Global Multi-Asset Class Risk Model bring new levels of insight to portfolio construction and performance attribution

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Qontigo’s cloud-based enterprise risk platform, Axioma Risk, delivers extensive flexibility in risk factor definition, risk model construction, stress testing, risk analysis, and reporting. The Axioma Global Multi-Asset Class Risk Model embedded in Axioma Risk combines the industry leading suite of Axioma Equity Risk Factor Models with extensive commodities coverage and fixed income risk models capturing all aspects of rate, inflation, volatility and credit risk. Broad pricing and analytics capabilities for debt instruments and derivatives ensure full flexibility in risk analysis of MAC portfolios, whether driven by linear parametric models or full repricing Monte Carlo or historical simulations.

Following a long history of innovation in risk modeling and risk technology, we are now pleased to announce several major enhancements and modeling options to the suite of fixed income risk models available in Axioma Risk. These include the new Axioma Factor-based Fixed Income Risk Model for credit spreads, which leverages thousands of issuer spread returns in a cross-sectional regression to estimate a parsimonious set of factor returns, including style factors such as Value, Momentum and Beta. Also available for agency mortgage-backed securities is a new modeling option that incorporates the latest MBS pricing analytics from Andrew Davidson & Co. For securitized debt including CMOs, CMBS and ABS bonds, the ability to run advanced modeling based on Moody’s Analytics cash flow waterfall models and econometric collateral cash flow generation models is now incorporated. Further details on these enhancements appear below.

Axioma Factor-based Fixed Income Risk Model

With the launch in 2019 of the issuer curve-based Axioma Granular Fixed Income Risk Model, a new generation of risk models was born derived from the Axioma Fixed Income Spread Curves, a suite of over 18,000 issuer and aggregate rating-sector spread curves with a 16-year history. Leveraging the same set of issuer curves in its estimation, the new Factor-based Fixed Income Risk Model provides portfolio and risk managers with an unprecedented ability to analyze fixed income portfolios with credit-risky assets through a cross-sectional factor model perspective. The model’s parsimonious factor structure allows for intuitive risk and performance attribution analysis, as well as robust portfolio construction aligned with passive and active strategies. In particular, the inclusion of style factors such as Momentum, Beta and Value in the risk models facilitates the construction of portfolios that capture these risk premia.

Major challenges that arise in the construction of cross-sectional regression-based fixed-income risk models, such as weak factor significance and strong factor collinearity, have been addressed through sophisticated data processing and advanced curve-construction techniques supporting the estimation of issuer spread returns. The
superior input return data ensure that significant distinct systemic factor returns can be extracted from the data and that issuer spread returns are not viewed primarily as idiosyncratic noise. Key innovations of the risk model include:

> **Extensive Issuer Spread Return Curves:** New methodology allows the construction of over 12,000 full term structure issuer curves on a daily basis with a 16-year history, leveraging sophisticated outlier detection to produce robust, market-consistent spread level and spread return curves. Trustworthiness scores facilitate the identification of a robust estimation universe for estimating factor returns, as well as drive a shrinkage estimator for issuer specific risk.

> **Issuer Credit Spread Return Factor Model Coupled with Granular Rate Model:** Leveraging an extensive universe of quality issuer spread returns allows us to robustly estimate credit spread factor returns through a global cross-sectional regression model capturing currency, country, sector, quality and style factors. The factors have been carefully selected and tested to ensure both interpretability and statistical significance. When coupled with granular key-rate sovereign and swap risk factors, as well as rate volatility factors, the resulting parsimonious fixed income risk model captures systemic risk in a manner well suited for portfolio construction and risk and performance attribution.

> **Issue/Issuer-Specific Credit Risk:** The issuer-specific credit risk is captured natively in the factor model through the residual spread return not explained by the factor returns, combined with a shrinkage estimator to sector and quality group averages based on a trustworthiness score for the quality of the issuer curve data. Additional bond-specific risk is captured through the bond spread residual return in excess of the issuer spread return. The noise introduced with standard sector-average spread models in which specific risk is computed from spread level residuals is greatly reduced in this approach.

> **DTS Exposure to Credit Risk Factor Model:** By using log returns to derive individual issuer spread return curves at higher spread levels to drive the factor return estimation, bond-specific duration times spread exposure naturally pairs with the factor covariance and specific variance in capturing bond price return risk. Here the exposures are computed as price sensitivities to relative changes in spread, which is approximately the negative of spread duration times option-adjusted spread (i.e. DTS). Moreover, through the use of relative return shocks to the credit spread curve, the DTS framework can also be used in historical and Monte Carlo simulations. The DTS framework provides much greater risk responsiveness in periods of rapid spread changes than models capturing credit risk through volatility of returns measured as absolute changes in spread level.

> **Ability to Drive Portfolio Optimization:** The parsimonious factor structure supports portfolio construction objectives, such as benchmark tracking with a limited number of names and optimal exposure to sector or style factor tilts. When combined with benchmark-tracking constraints such as bounds on portfolio key-rate duration deviations, sector exposure bounds and DTS deviation bounds, the risk model can be used with portfolio optimization tools to minimize tracking error or maximize portfolio factor exposure to construct realistic portfolios aligned with investment objectives.
MBS Modeling

By partnering with Andrew Davidson & Co. (ADCo), a leading mortgage analytics and research firm, we are able to incorporate advanced cash flow and pricing models for agency mortgage pools into the Axioma Risk risk factor framework. The current enhancements to the mortgage analytics suite include integration of the latest version of the ADCo Agency Loan Dynamics Model, which features:

- **Cash Flow Model**: A state-transition model to explicitly capture interaction between prepayment and credit events.
- **Economic Calibration**: Analysis and calibration to over a decade of post-global financial crisis economic and behavioral data.
- **Performance History Calibration**: Post-crisis performance data with direct modeling of borrower capacity to service mortgage obligation.
- **Detailed Loan Data**: Enhanced geographic and credit quality detail sourced from the mortgage agencies (Freddie Mac, Fannie Mae, Ginnie Mae)

Structured Debt Modeling

Qontigo has partnered with Moody's Analytics to deliver enhanced modeling of structured debt instruments. This enhancement provides Qontigo's clients with transparent and seamless modeling of structured debt holdings through bottom-up cashflow-based risk analysis. The Advanced Model complements our existing spread-based risk model by supporting a broad range of securitization asset classes, full waterfall modeling and efficient estimation of computationally intensive risk measures such as Value-at-Risk (VaR). Key capabilities include:

- **Cashflow projections linked to diverse credit and geographic factors**: All major collateral types are modeled. The new analytics module infers future cashflows from historical collateral performance by linking the credit response to geographic region and collateral features.
- **Model updates reflecting current economic conditions**: Forecasting cashflows on structured holdings entails modeling the relationship between general conditions (e.g. property values and unemployment rates) and collateral performance (e.g. prepayment and default rates). Moody's Analytics periodically monitors the quality and relevance of assumptions employed in projecting cashflows.
- **Accurate representation of complex payoff rules**: Payments to structured holdings often follow labyrinthine principal, interest and loss allocation rules. These rules determine investment return profiles by tiering and distributing risk across the capital structure of the securitization vehicle. When Axioma Risk estimates market value, it determines instrument cashflows according to the appropriate payoff rules embedded in securitized capital structures as encoded in Moody's Analytics cashflow engine.
- **Efficient scenario sampling for accelerated risk calculation**: Standard risk reporting methods require the generation of thousands of hypothetical market scenarios and instrument level profit and loss estimates corresponding to those scenarios. Axioma Risk employs efficient scenario sampling and risk sensitivity inference to accelerate computation runtimes for simulation-based Value-at-Risk (VaR) calculations.
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