Title: **Athena Aura's Value at Risk**

Owner: Stefano Guarnieri (stefano@athenasystems.com)
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Athena Aura includes in its suite of financial software modules a Value at Risk engine that provides timely valuations of the client's portfolios both on a near-real-time and a historical basis.

Athena Aura VaR engine offers three different calculation methods to provide a wider choice to the client:

- Variance-Covariance VaR method
- Historical VaR method
- Monte Carlo VaR method

The Variance-Covariance method can be applied to linear portfolios only. The Historical and Monte Carlo methods can be applied to non-linear portfolios (i.e. portfolios with options).

The Variance-Covariance approach uses past log-returns for the positions in the current portfolio to build the statistical information that will end up in the correlation matrix, thereby assuming normal distributions. It enjoys a very good numerical stability, it can require a moderate amount of processing power. The parameters that can be acted upon to drive the calculations are:

- Number of data points (default: 300)
- Confidence Interval (default: 95%)

The Historical approach uses historical price series for the positions in the current portfolio to generate simulations. The results are sorted from worst to best P&L and the one that corresponds to the chosen confidence interval is picked as the solution. It is very stable numerically and it requires a relatively low amount of processing power. The fact that actual unadjusted historical prices are used in the calculation means that no assumption on the price distributions are made, and dividend are taken into account in the calculations. In order to account for the diminishing predictability of data that are further away from the present, a decay parameter is provided to smooth out the returns in the past. The parameters that can be acted upon to drive the calculations are:

- Number of data points (default: 300)
- Confidence Interval (default: 95%)
- Decay (default: 0.95)

The Monte Carlo approach is a purely statistical approach where many portfolio simulations are built by using price generators. Every asset class may have different price generators that better model the asset class' price distribution. The results are sorted from worst to best P&L and the one that corresponds to the chosen confidence interval is picked as the solution. The method can be prone to numerical instability, and it requires a lot of computing resources to provide a reliable solution.

The parameters that can be acted upon to drive the calculations are:

- Number of simulations (default: 50,000)
- Confidence interval (default: 95%)

All calculations are performed at 1 day horizon. A 5 day horizon VaR can be obtained by multiplying the 1 day numbers by √5 as per the current literature.

The calculation process is run on the Aura server on a periodical basis (currently every 5 minutes), to capture changes in the positions and update the VaR numbers accordingly.

All the calculation methods return the following data:

- Portfolio-level VaR
- Position-level VaR corresponding to the portfolio-level VaR

Additionally, thanks to its low requirement for processing power the Historical VaR engine also returns the following data:

- Position-level Marginal VaR

The Marginal VaR is calculated as follows:

- The Portfolio VaR is calculated at the requested confidence interval
- Then, each position is iteratively removed from the portfolio and VaR recalculated for the same confidence interval
- At this point, the Marginal VaR for the position is calculated as Initial Portfolio VaR – Current Portfolio VaR.
- The resulting Marginal VaR is assigned to the position