

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

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Revision: April 25th, 2018

There are basically three methods of calculating Value at Risk: Variance-Covariance, Historical and Monte Carlo methods. While Athena VaR engine supports all of them, we tend to favor the Historical simulation method over the other two choices for the following reasons:

- Suited to the portfolio structure (Variance-Covariance does not cope well with options)
- Less prone to numerical instability (as it can sometimes be Monte Carlo)
- Less demanding on computing resources

The Historical VaR method calculates past returns using the current portfolio structure, then it sorts out the results from worst to best and picks the one at the requested confidence interval. 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 past prices (default: 300)
- Confidence interval (default: 95%)
- Decay (default: 0.95)

All calculations are performed at 1-day horizon. A 5-day horizon VaR can be obtained by multiplying the 1 day numbers by $\sqrt{5}$ 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.

The Historical VaR engine returns the following data:

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

There are four VaR-related columns in the positions report:

- 95% CI. 1 Day Horizon (300 Px LB) (this is the Historical VaR at 95% confidence interval, 1 day horizon; 300 data points in the past)
- 99% CI. 1 Day Horizon (300 Px LB) (this is the Historical VaR at 99% confidence interval, 1 day horizon; 300 data points in the past)
- 95% Marginal VaR 1 Day Horizon (this is the Marginal VaR of the position at 95% confidence interval, 1 day horizon; 300 data points in the past)
- 99% Marginal VaR 1 Day Horizon (this is the Marginal VaR of the position at 99% confidence interval, 1 day horizon; 300 data points in the past)