



VaR Introduction III: Monte Carlo VaR

Monte Carlo VaR

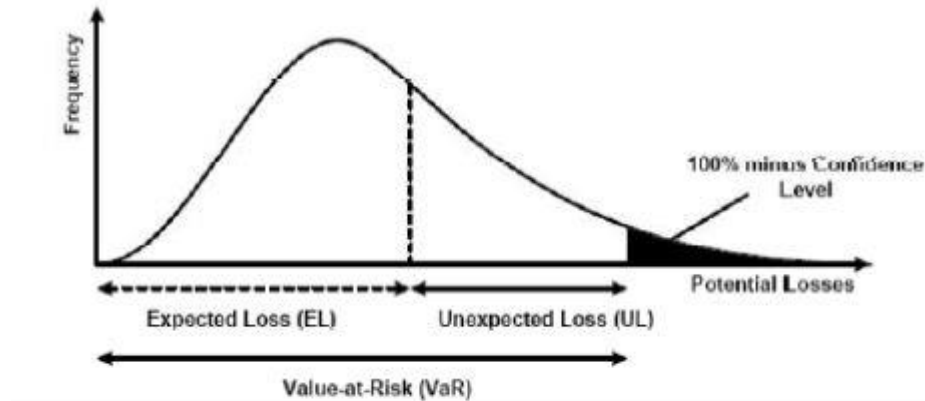
Summary

- ◆ VaR Definition
- ◆ VaR Roles
- ◆ VaR Pros and Cons
- ◆ VaR Approaches
- ◆ Monte Carlo VaR
- ◆ Monte Carlo VaR Methodology and Implementation
- ◆ VaR Scaling
- ◆ VaR Backtest

Monte Carlo VaR

Value at Risk (VaR) Definition

- ◆ The maximum likely loss on a portfolio for a given probability defined as $x\%$ confidence level over N days
- ◆ $\Pr(\text{Loss} > \text{VaR}(x\%)) < 1 - x\%$



Monte Carlo VaR

VaR Roles

- ◆ Risk measurement
- ◆ Risk management
- ◆ Risk control
- ◆ Financial reporting
- ◆ Regulatory and economic capital

VaR Pros & Cons

- ◆ Pros
 - ◆ Regulatory measurement for market risk
 - ◆ Objective assessment
 - ◆ Intuition and clear interpretation
 - ◆ Consistent and flexible measurement
- ◆ Cons
 - ◆ Doesn't measure risk beyond the confidence level: tail risk
 - ◆ Non sub-additive

Three VaR Approaches

- ◆ Parametric VaR
- ◆ Historical VaR
- ◆ Monte Carlo VaR

The presentation focuses on historical VaR.

Monte Carlo VaR

Monte Carlo VaR

◆ Assumption

Assuming market factors follow certain stochastic processes.

◆ Pros

- ◆ Easy back and stress test
- ◆ Good for high confidence level and tail risk

◆ Cons

- ◆ Dependent on distribution assumption
- ◆ Calibration required
- ◆ Extensive computation

Monte Carlo VaR Methodology and Implementation

- ◆ Assume each market factor follows certain stochastic process: $\vartheta(\sigma_i W_i)$ where W is a Wiener process
- ◆ Calibrate volatility σ_i for each market factor and pair-wise correlation ρ_{ij} for any two market factors
- ◆ Simulate market factor changes δ_i based on the stochastic processes and correlated random variables.
- ◆ Generate market scenarios $x_i = x_0 \delta_i$
- ◆ Compute scenario PVs: $P(x_i)$ and scenario P&L: $P(x_i) - P(x_0)$
- ◆ Sort all scenario P&Ls. The VaR is the number at 1% lowest level

VaR Scaling

- ◆ Normally firms compute 1-day 99% VaR
- ◆ Regulators require 10-day 99% VaR
- ◆ Under IID assumption, 10-day VaR = $\sqrt{10} * VaR_{1-day}$

VaR Backtest

- ◆ The only way to verify a VaR system is to backtest
- ◆ At a certain day, compute hypothetical P&L. If (hypothetical P&L > VaR) → breach, otherwise, ok
- ◆ Hypothetic P&L is computed by holding valuation date and portfolio unchanged
- ◆ In one year period,
 - ◆ If number of breaches is 0-4, the VaR system is in Green zone
 - ◆ If number of breaches is 5-9, the VaR system is in Yellow zone
 - ◆ If number of breaches is 10 or more, the VaR system is in Red zone



Thanks!



You can find more online presentations at
<https://finpricing.com/lib/CdCreditSpreadCurve.html>