VaR Introduction III: Monte Carlo VaR

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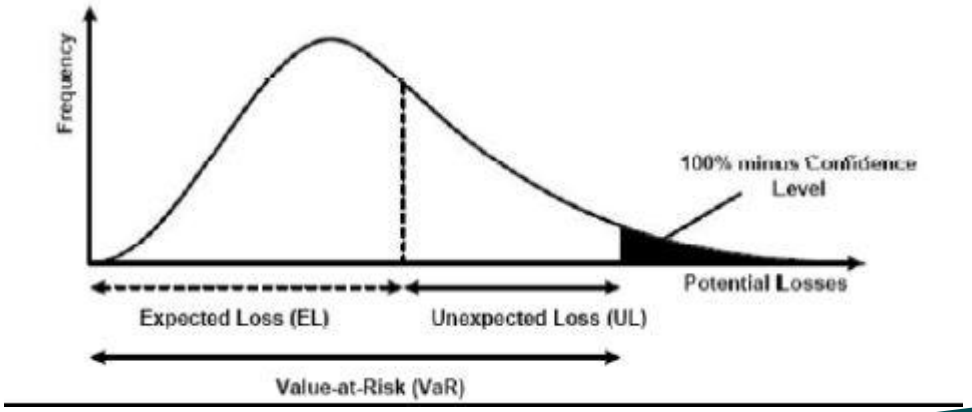
Monte Carlo VaR

Summary

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

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(*Loss* > *VaR*(*x*%)) < 1- *x*%



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

- 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 hypothetic P&L. If (hypothetic 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!

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