

VaR Introduction II: Historical VaR

Historical VaR

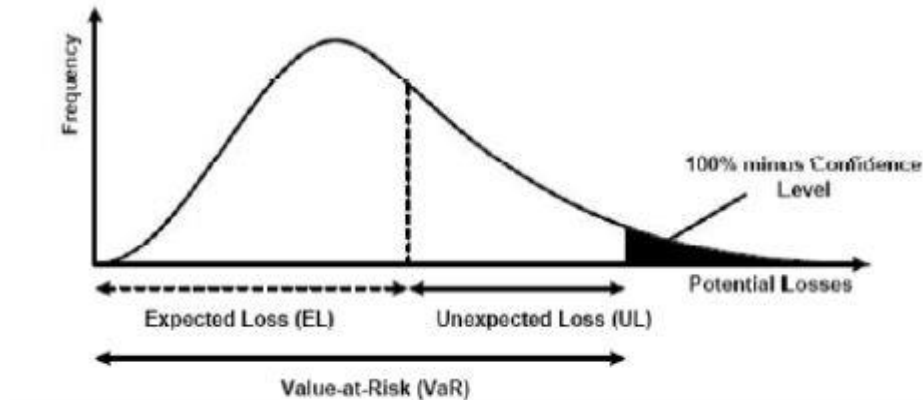
Summary

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

Historical 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
- ◆ $\Pr(\text{Loss} > \text{VaR}(x\%)) < 1 - x\%$



Historical VaR

VaR Roles

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

Historical VaR

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

Historical VaR

Three VaR Approaches

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

The presentation focuses on historical VaR.

Historical VaR

Historical VaR

◆ Assumption

The past is a good indicator of the near-future or history repeats itself

◆ Pros

- ◆ Simple and intuitive
- ◆ Easy back and stress test
- ◆ No distribution assumption
- ◆ No calibration

◆ Cons

- ◆ Poor accuracy for higher confidence level and tail risk
- ◆ Difficult for long horizons
- ◆ Limited scenario

Historical VaR

Historical VaR Methodology and Implementation

- ◆ Obtain one year historical value time series of all market factors, such as a stock price time series is $\bar{x}_1 \cdots \bar{x}_{251}$
- ◆ Assuming today's value is x_0 , generate 250 historical scenarios. The i -th is $x_i = (\bar{x}_i / \bar{x}_{i-1} - 1)x_0$
- ◆ Compute base PV at today t as $P(x_0)$
- ◆ Compute 250 scenario PVs: $P(x_i)$
- ◆ Compute 250 scenario P&L: $P(x_i) - P(x_0)$
- ◆ Sort 250 scenario P&L. The VaR is the average between 2nd and 3rd lowest (negative) numbers

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
- ◆ Hypothetical 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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