Historical Value At Risk Introduction

Value at Risk (VaR) is the regulatory measurement for assessing market risk. It reports the maximum likely loss on a portfolio for a given probability defined as x% confidence level over N days. VaR is vital in market risk management and control. Also regulatory and economic capital computation is based on VaR results. Although VaR measure is objective and intuitive, it doesn’t capture tail risk. There are three commonly used methodologies to calculate VaR – parametric, historical simulation and Monte Carlo simulation. This presentation focuses on historical VaR.

Keywords:
Value at Risk, VaR, historical VaR, market risk, financial market, trading risk, risk analytics, risk implementation

1. Historical VaR
1.1 Definition
Value at Risk (VaR) is the regulatory measurement for assessing market risk. It reports the maximum likely loss on a portfolio for a given probability defined as x% confidence level over N days. VaR is vital in market risk management and control.

1.2 VaR Roles
- Risk measurement
- Risk management
- Risk control
• Financial reporting
• Regulatory and economic capital

1.3 VaR Pros & Cons
• Regulatory measurement for market risk
• Objective assessment
• Intuition and clear interpretation
• Consistent, flexible and stable measurement
• Doesn’t measure risk beyond the confidence level: tail risk
• Non sub-additive

1.4 VaR Approaches
• Parametric VaR
• Historical VaR
• Monte Carlo VaR

1.5 Historical Simulation
• Assumption
  The past is a good indicator of the near-future
• Pros
  Simple
  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

1.6 Historical VaR Methodology
• Obtain one year historical value time series of all market factors, such as a stock price time series is \( \bar{x}_1 \ldots \bar{x}_{251} \)
• 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 2\(^{nd}\) and 3\(^{rd}\) lowest (negative) numbers

1.7 VaR Scaling
- Normally firms compute 1-day 99% VaR
- Regulators require 10-day 99% VaR
- Under IID assumption, 10-day VaR = $\sqrt{10} \times VaR_{1\text{-day}}$

1.8 VaR Backtest
- The only way to verify a VaR system is backtest
- At a certain day, compute hypothetic P&L (valuation date and portfolio unchanged)
  If (hypothetic P&L > VaR) \(\Rightarrow\) breach
- For one year
  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

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