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

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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

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Three VaR Approaches

- Parametric VaR
- Historical VaR
- Monte Carlo VaR

The presentation focuses on 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 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 2$^{nd}$ and 3$^{rd}$ lowest (negative) numbers
Historical VaR

VaR Scaling

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

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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.

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Thanks!

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