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

http://www.finpricing.com/lib/HistoricalVaR.pptx
Value at Risk (VaR) Definition

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

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Historical VaR

VaR Roles

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

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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

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Historical VaR Methodology and Implementation

- Obtain one year historical value time series of all market factors, such as a stock price time series is $\bar{x}_1 \ldots \bar{x}_{251}$
- 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\textsuperscript{nd} and 3\textsuperscript{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 = $\sqrt{10} \times VaR_{1\text{-day}}$
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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