Grids for financial risk analysis
and
financial risk analysis for Grids

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Motivation

World Reality

Grids for financial risk analysis

Risk & Risk Management

Financial Risk & Management

Value at Risk (VaR)

Covariance

Historical

Monte Carlo

Complex, data and computational intensive
Motivation

- **Grid Usability:**
  - Discover the origins of the species, the universe, diseases, and for finding alien life forms

- **Market**
  - Grid infrastructures in Bank of America and HSBC: 3000 to 6000 processors
  - Computational services market: Customers willing to pay for use of computer systems instead of purchasing and maintaining hardware and software.
  - Grid market: HP, Amazon, Sun, IBM

- **Core:** Binding SLA with proper pricing model.
References

Financial Grids:

Grid economics:
VaR 3 methods Implementation Steps Comparison

Assume Daily Returns are normally distributed

Covariance

A Define the observation period

B Calculate Daily Returns

Obtain Mean and Standard Deviation

Calculate Quantile then VaR

(M1)

Monte Carlo

Simulation (random Num, correlation, Eigen vector, value, etc)

Generate hypothetical “historical” profits and losses

Sort into largest lose and largest profit order

Look up VaR Value

Historical

(I)

(II)

(V1)

(V2)

(H1)

(H2)

(H3)

Assume future market corresponded to the recent history

University of Surrey
VaR Portfolio (Monte Carlo)

1. Calculate Daily Returns
2. Daily Returns Correlation Matrix
3. Eigen Value Vectors
4. Standard Deviation
5. Random Numbers
6. Inverse Function
7. Random Price Changes
8. Correlated Price Changes for each asset
9. Asset Investment Amount
10. Correlated Price Changes for Portfolio
11. Sort into largest loss and largest profit order
12. Look up VaR Value with specified Confidence
Parallel VaR Monte Carlo Task

Original Financial Data

Task Decompose Service

Condor Pool

Variance-Covariance Approach

Data Simulation

Data Simulation

Data Simulation

Data Simulation

Historical Method

VaR

Results Analysis

Value at Risk Final Report

A Output/B Input: Mean & SD

B Output/C Input: Correlated Portfolio Changes

C: DAG Implementation Period
# Results Analysis

## VaR Results with 95.0% Confidence Level, 20 assets in portfolio, GBP 2.0E7 investment in total (1 M each asset), 2,048,000 simulation workload in total

<table>
<thead>
<tr>
<th>V-C Method</th>
<th>1 node</th>
<th>2 nodes</th>
<th>4 nodes</th>
<th>8 nodes</th>
<th>Monte Carlo Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1*2,048,000</td>
<td>2*2,048,000</td>
<td>2*1,024,000</td>
<td>4*2,048,000</td>
<td>4*512,000</td>
</tr>
<tr>
<td>Mean of VaRs</td>
<td>-191744.95</td>
<td>-191437.27</td>
<td>-191631.42</td>
<td>-191831.90</td>
<td>-191771.20</td>
</tr>
<tr>
<td>Away from V-C VaR (±5%)</td>
<td>-0.067%</td>
<td>-0.168%</td>
<td>-0.07%</td>
<td>-0.168%</td>
<td>-0.067%</td>
</tr>
<tr>
<td>SD of VaRs</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>46.252</td>
</tr>
<tr>
<td>Tolerance Level (±1%)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.024%</td>
</tr>
<tr>
<td>MAX of VaRs</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-191598.71</td>
</tr>
<tr>
<td>MIN of VaRs</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-191664.12</td>
</tr>
<tr>
<td>Mergered Result of VaR</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-191744.95</td>
</tr>
<tr>
<td>Away from V-C VaR (±5%)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-0.007%</td>
</tr>
<tr>
<td>Executing Time (Seconds)</td>
<td>1.76</td>
<td>288</td>
<td>371</td>
<td>677</td>
<td>216</td>
</tr>
<tr>
<td>Speedup</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>1.72</td>
</tr>
</tbody>
</table>

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The Bridge

Risk analysis
Complex financial products and markets

Service-based Financial Grids
construct

Risk-balanced portfolio
Grid Resources

Develop possible formulation

Grid Economics

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## The Bridge

<table>
<thead>
<tr>
<th></th>
<th>Financial Market</th>
<th>Grid Market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resources</strong></td>
<td>Equities, Commodities, Currencies... Financial derivatives</td>
<td>Computers, workstations, Network speed, clusters... computational power</td>
</tr>
<tr>
<td><strong>Capacity characteristic</strong></td>
<td>Storable (Stock) / Non-storable (futures, forwards)</td>
<td>Non-storable</td>
</tr>
<tr>
<td><strong>Analysis</strong></td>
<td>Underlying prices changes time series</td>
<td>Resource usage time series</td>
</tr>
<tr>
<td><strong>Time horizon</strong></td>
<td>Holding period (Hourly, daily, weekly, yearly)</td>
<td>Hourly, daily, weekly, yearly</td>
</tr>
<tr>
<td><strong>Portfolio</strong></td>
<td>Many Resources</td>
<td>Many Computer resources</td>
</tr>
<tr>
<td><strong>confidence</strong></td>
<td>Confidence Level / percentile</td>
<td>Confidence of resources availability</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td>The expected worst loss</td>
<td>Optimize the resource use</td>
</tr>
</tbody>
</table>
Financial risk analysis for Grids

• Grid based financial risk analysis (Financial Grids):
  - Great demands on available resources;
  - Assume availability at any given time.

• Aim:
  - Ability to predict (risks of resource availability for) the predictability (risks on financial investments).

• Major impetus for current work
  - Uncertainty: availability of Grid Resource
  - Predict future resource availability: monitoring status
Methodology


• Specific financial analysis for creating Grid economy over queuing-based systems: Condor, Sun Grid Engine?

  ▪ Grid Economy as a commodity market;

  Due considerations:
  1. For trading and hedging of risk, options, futures and structured products.
  2. Collecting computational resource use data -> predict resource use for such class of apps;
3. Construction of portfolios of Grid resources (Extension of financial models to Grid economics offers potential for a future market in Grid economy).

• Complex structured products: Collateralized Debt Obligations (CDOs)
Conclusion and future work

• Grids for financial risk analysis
  • VaR for portfolio implementation in Condor: Historical, V-C, MC
  • Balancing analysis between computation speed and calculation accuracy

• Financial risk analysis for Grids
  • Grid Economy over queuing-based system
  • Potential formulation of Grid Economy: CDOs
  • Main idea: predict the predictability

• NGS condor implementation investigation
• Complex structured financial risk products: options, CDOs
• Obtain and analysing the computer resources status data: predict the future availability
• Grid economics: Grids with proper SLAs and pricing model.
Thank you for your attention

Further information:

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