CASE STUDY: VaR Optimization Retail Portfolio of Bonds (var_dev)

Background

The case study is conducted with the portfolio retail loans dataset provided by the Kukmin Bank, Korea. Default scenarios of bonds are generated at the Kukmin Bank with the CreditMetrix software from RiskMetrics Group. Scenarios data are imported to PSG by the Converter_VaR_Optimizaion intended for processing the outputs from the CreditMetrix. For a portfolio of clusters of retail loans the expected return is maximized subject to constraint on VaR deviation. It is assumed that weights for clusters can be rebalanced within 10% and 20% of original weights.

Problems (1) and (2) are solved using 4 datasets:

- Dataset1 for "short case study" including matrix of scenarios with 10,000 scenarios and weights for clusters rebalanced within 10% original weights;
- Dataset2 for "long case study" including matrix of scenarios with 100,000 scenarios and weights for clusters rebalanced within 10% original weights;
- Dataset3 for "short case study" including matrix of scenarios with 10,000 scenarios and weights for clusters rebalanced within 20% original weights;
- Dataset4 for "long case study" including matrix of scenarios with 100,000 scenarios and weights for clusters rebalanced within 20% original weights.

Notations and Input Data Description

I = number of instruments (clusters) in the portfolio; $i=\{1,\ldots,I\}$ index of instrument in the portfolio;
J = number of scenarios, $j=\{1,\ldots,J\}$ index of scenarios;
$\mathbf{x} = (x_1, ..., x_I)$ = vector of exposures (weights) of instruments $i=1,\ldots I$;
l_i = lower bound on exposure to instrument i ;
u_i = upper bound on exposure to instrument i ;
r_i^t = rate of return of i-th instrument;
r_{ij} = rate of return of i-th instrument under the risk scenario j ;
$\mathbf{r}_j = \left(r_{1j}, ..., r_{Ij}\right)$ =vector of rates of returns of instruments $i=1,\ldots I$ under the scenario j ;
$L(\mathbf{x}, r_j) = -\sum_{i=0}^{I} r_{ij} x_i$ = loss under scenario j ;
α = confidence level in VaR DEVIATION for the portfolio;
r = target level of rate of return of the portfolio;
C = upper bound on the loss risk (in this case study VaR DEVIATION) .

Optimization Problem 1

maximizing total estimated return

$$\max \sum_{i=1}^{I} r_i^t x_i \tag{CS.1}$$

subject to

internal constraint on credit risk

$$VaR\_DEV(L(x,r)) \le C \tag{CS.2}$$

upper/lower bounds on exposures

$$\boldsymbol{l_i \le x_i \le u_i, \quad i = 1, \ldots I} \tag{CS.3}$$

Optimization Problem 2

minimizing portfolio VaR DEVIATION

$$\min_{\boldsymbol{x}} \boldsymbol{VaR\_DEV(L(x, r))} \tag{CS.4}$$

subject to

constraint on the portfolio rate of return

$$\sum_{i=1}^{I} r_i^t x_i \ge r \tag{CS.5}$$

upper/lower bounds on exposures

$$\boldsymbol{l_i \le x_i \le u_i, \quad i = 1, \ldots I} \tag{CS.6}$$