PLP Project Summary

Team 2

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Preparations

Analysed: the principle of operation of the Vasicek model

Proved:

- The risk X_i of i-th asset in the Vasicek model is standardly normally distributed $X_i \sim N(0,1)$
- An i-th asset defaults when its risk X_i crosses a critical threshold c_i, which is determined by the inverse cumulative standard normal distribution of the probability of default of the asset $N^{-1}(p_i)$

Set:

1. For the simulation:
   - No total lending amount
   - Asset split ratios for personal and coprorate loans: 3:7, 2:3, 1:1, 3:2, 7:3
2. For personal loans:
   - Single loan amount of 11,500 EUR
   - Loan amount distribution: PD $< 25\% \rightarrow$ 11,500 EUR ; PD $> 25\% \rightarrow$ 0 EUR
   - Asset correlations:
     - recommended correlation of $\rho = 0.22$ (0.05 when squared)
     - test corellations of $\rho = \{0.01, 0.2, 0.3, 0.9\}$
   - LGD: bimodal combination of 2 Beta-distributions $f(x, \alpha, \beta)$:
     - Distribution 1 for collateralized assets: $\alpha = 0.5, \beta = 2, \mu \rightarrow 0$
     - Distribution 2 for unsecured assets: $\alpha = 2, \beta = 0.5, \mu \rightarrow 1$
3. For corporate loans:
   - Various loan amounts 25,000 - 600,000 EUR
   - Loan amount distribution:
     - PD $< 0.01\%$ (AAA) $\rightarrow$ 600,000 EUR
     - $0.01\% <$ PD $< 0.07\%$ (AA+, AA, AA-) $\rightarrow$ 450,000 EUR
     - $0.07\% <$ PD $< 0.19\%$ (A+, A, A-, BBB+) $\rightarrow$ 300,000 EUR
     - $0.19\% <$ PD $< 5.36\%$ (BBB, BBB-, BB+, BB, BB-, B+, B, B-) $\rightarrow$ 100,000 EUR
     - $5.36\% <$ PD $< 25.23\%$ (CCC+, CCC, CCC-) $\rightarrow$ 25,000 EUR
     - PD > 25.23 (CC, C, Rd, D)% $\rightarrow$ 0 EUR
   - Asset correlations:
     - recommended correlation of $\rho = 0.45$ (0.2 when squared)
     - test corellations of $\rho = \{0.02, 0.4, 0.5, 0.99\}$
   - LGD: bimodal combination of 2 Beta-distributions $f(x, \alpha, \beta)$:
     - Distribution 1 for average assets: $\alpha = 6, \beta = 10, \mu \rightarrow 0.375$
     - Distribution 2 for strong assets: $\alpha = 4.5, \beta = 2, \mu \rightarrow 0.7$

Execution

The simulation was run 25 times for each combination of portfolio distribution and correlation values, yielding key risk metrics: Expected Loss (EL), Unexpected Loss (UL), and Value at Risk (VaR) at 95% and 99% confidence levels.

Conclusions

Key Findings

Personal Loan Proportion: Higher proportions of personal loans led to higher Expected Losses, reflecting their generally higher default probabilities. Correlation Effects: Higher rho values increased Unexpected Loss, indicating greater susceptibility to large deviations from the expected loss in portfolios with highly correlated assets.

VaR Sensitivity: VaR at 99% confidence level was particularly sensitive to correlation values, underscoring the importance of considering asset correlations in risk assessments.

Simulation 31 Insights

Simulation 31, with rho_personal = 0.22 and rho_business = 0.45 and a 30/70 personal to corporate loan distribution, provided a balanced 'middle of the road' risk profile. Key metrics included:

- EL: €44,316.36
- UL: €113,549.23
- VaR at 99% confidence: €379,406.64
- VaR at 95% confidence: €107,336.57

CDF graphs highlighted tail risk and the likelihood of extreme losses, varying with correlation settings.

The Plot of Mean Risk Metrics vs. Rho Values showed EL as relatively stable while VaR was highly sensitive to correlation changes, indicating increased tail risk with higher correlations. Portfolio Loss Distribution Histograms showed concentration of losses at the lower end with significant long tails, confirming potential for extreme losses in highly correlated portfolios.

Final Thoughts

The simulation demonstrated the model's capability to assess credit risk for mixed loan portfolios. Varying portfolio composition and asset correlations provided valuable insights, emphasizing the importance of considering both in risk management.