Monte Carlo Scenario Generation for Retail Loan Portfolios

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Monte Carlo simulation is a common method for studying the volatility of market traded instruments, however in retail lending Monte Carlo simulation has not been employed, probably because of the inherent nonlinearities in consumer behavior. In this paper, we leverage the approach of Dual-time Dynamics to separate loan performance dynamics into three components: a maturation function of months-on-books, an exogenous function of calendar date, and a vintage quality function of vintage origination date. Of these three, the exogenous function captures the impacts from the macroeconomic environment. As such, we might naturally want to generate scenarios for the possible futures of these environmental impacts.

To generate such scenarios, we must go beyond the random walk methods most commonly applied in the analysis of market-traded instruments. Retail portfolios exhibit significant autocorrelation structure and variance growth with time, requiring more complex modeling than a random walk. This paper describes work using ARMA and ARIMA models for scenario generation, rules for selecting the correct model given the input data, and validation methods on the scenario generation. We find when the goal is capturing the future volatility via Monte Carlo scenario generation, that model selection does not follow the same rules as for forecasting. Instead, more appropriate tests are proposed, which assure that distributions of scenarios have the proper statistical characteristics. These results are supported by studies of the variance growth properties of macroeconomic variables and theoretical calculations of the variance growth properties of various models. We also provide studies on historical data showing minimum training lengths, differences by macroeconomic epochs, and systematic effects across different product types.

We conclude with applications of this technique to portfolio stress testing and computation of economic capital. Throughout these steps, results for retail loan portfolios are shown.