

## Risk based pricing of unsecured loans under model risk

Loans pricing is one of the key decisions that retail lenders face to maximise long term returns on capital. Efficient credit pricing is a complex constrained optimisation problem requiring (among others) an understanding of default, prepayment, elasticity, capital consumption, costs and other income (this description still ignores cross-subsidisation of other products or future sales) across different segments of the population. Many organisations have looked to apply a variety of optimisation techniques to improve efficiency of price segmentation and allocation. In many practical cases however estimating all these components is not feasible (e.g. elasticity may be driven by aggregator websites unknown prioritisation algorithms). Furthermore many of the components will be unstable over time (e.g. default rates or prepayments change unpredictably over time) therefore a full pricing optimisation will not be robust over even quite short periods of time.

To simplify the problem it is often proposed to ensure some sort of "fairness" in pricing – generating equal margin for different segments. This is a common approach within a range of risk based pricing techniques. This is beneficial to the lender as profits spread over many segments implies that if one segment changes behaviour (so as to become less profitable) there are other segments which continue to generate profit. This is in essence a form of diversification across model risk. To exploit this it is important that the pricing segments are as independent as possible in model errors. This paper considers how approaches such as Monte Carlo based optimisation models under uncertainty or alternatively using ideas of sharing in cooperative game theory (as described by Shapley value) can be applied to the loan pricing problem and provides insight into how pricing segmentations can be built and prices set to achieve distinct business objectives.