Title: Asset-Liability Management: Application of Stochastic Programming with Endogenous Randomness and Contamination

Author: RNDr. Tomáš Rusý

Department: Department of Probability and Mathematical Statistics

Supervisor: doc. RNDr. Ing. Miloš Kopa, PhD., Department of Probability and Mathematical Statistics

Abstract:

This thesis discusses a stochastic programming asset-liability management model that deals with decision-dependent randomness and a subsequent contamination analysis. The main model focuses on a pricing problem and the connected asset-liability management problem describing the typical life of a consumer loan. The endogeneity stems from the possibility of their customer rejecting the loan, the possibility of the customer defaulting on the loan and the possibility of prepayment which are all affected by the company's decision on interest rate of the loan. Another important factor, which plays a major role for liabilities, is the price of money in the market. There, we focus on the scenario generation procedure and develop a new calibration method for estimating the Hull-White model [Hull and White, 1990] under the real-world measure. We define the method for the general class of one-factor short-rate models and perform an extensive analysis to assess the estimation performance and properties. Further, we extend the contamination approach of Dupačová [1986, 1996] to models with decision-dependent randomness. This gives us a tool for investigating stability of stochastic programs with decision-dependent randomness with respect to changes in the underlying probability distributions. That represents an important step before deploying any model to production. In this thesis, we first extend the current results by developing a tighter lower bound applicable to wider range of problems. Thereafter, we define contamination for decision-dependent randomness stochastic programs and prove various lower and upper bounds. We split the cases into two separate sub-classes based on whether the feasibility set is fixed or probability-distribution-dependent and discuss several tractable formulations. The method is illustrated on the aforementioned example of the consumer loan stochastic program as well as on its extended version with implemented risk constraint.

Keywords: maximum likelihood estimation of short-rate models, stochastic programming, decision-dependent randomness, contamination

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