Abstract

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A Mathematical Model for Dynamic Stochastic Asset Liability Management of Uganda's Retirement Benefit Schemes

In this thesis, we study a long term projection of Uganda's pension funds to assess their sustainability, and develop a mathematical model for dynamic stochastic asset liability management of Uganda's retirement benefit schemes. We discuss the retirement benefits sector in Uganda, and then focus on the Parliamentary Pension Scheme (PPS) and the Bank of Uganda Defined Benefits Scheme (BoUDBS).

We explain about Defined Contribution and Defined Benefit pension funds. We use non-linear regression to project the PPS scheme members, and a Markov model is used to capture the schemes' composition by aggregate age states. We incorporate the guaranteed period of pension payment by using two survival probabilities. We obtain the financial evolution for the projection period and ascertain the schemes' sustainability. A family of Stochastic Programming models is developed for Uganda's retirement benefit schemes, and applied to the financial planning problems for the PPS and BoUDBS. The decision model based on Multi-stage Stochastic Programming is mainly used to manage assets and liabilities, by combining the Markov population model with the salary growth model and benefit payments.

We use scenario generators which capture the uncertainties of asset returns, salary contribution, pension and lump sum liability payments. The scenario generation models for assets and liabilities were developed and calibrated using historical data. Using different asset investment limits, we obtain the optimal investment strategies and associated cost and risk, together with the funding situation of the schemes at each stage.