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Asset liability management for pension funds using multistage mixed-integer stochastic programming

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Chapter 7

Conclusions

In this thesis, we have presented an optimization model to tackle ALM problems for pension funds. In this model, special attention is paid to the incorporation of risk constraints, so that they fit into the framework of the requirements of the supervisor in The Netherlands. Because the model is formulated as a multistage stochastic program, we need scenarios in order to find numerical results. These scenarios, which describe future developments of uncertain parameters like returns on stocks and bonds, are the outcome of the scenario generator presented in Chapter 5.

Given the ALM model and the numerical values which describe future uncertainties, we apply a heuristic to find numerical results for the decision variables in our model. A heuristic is needed, since, due to the introduced binary decision variables, which are needed to incorporate the realistic flexible risk measures and to penalize unfavorable events, optimization is not possible in reasonable time for realistically sized instances. However, given a setting for the binaries, optimal decisions for the continuous decision variables of the multistage stochastic program could be found by the optimization software OSL [71], using the callable library OSL Stochastic Extensions [72].

The ALM model described in this thesis closely fits the developments and interests in society. Indeed, the relative positions of the interested parties in the ALM decision process can be represented by choosing appropriate parameter values. The fixed penalty costs play an important role in describing the relative positions of the interested parties.

However, it is not easy to find a suitable setting for the parameter values. Moreover, fine tuning of these values is very time consuming. Therefore, an expert is needed to find a good setting to represent the characteristics and interests of a specific pension fund. Moreover, this expert is needed, since the outcomes of the model are sensitive to the choice of some parameter values on certain intervals. Therefore, computational experience is indispensable to work with such models in real world practice.

From the numerical experiments of the presented illustrative case, in which future uncertainties were represented by 900 scenarios and 1,123 decision nodes, we conclude that a heuristic solution can be found in reasonable time. Moreover, the first impressions of the performed sensitivity analyses with respect to modeling

choices and model justification, are not unsatisfactory: the changes in the decisions are almost always in line with our expectations. The numerical results show that it is possible to find numerical solutions for mixed-integer stochastic programs in spite of a large number of binary decision variables. However, we also found that the outcomes are (extremely) sensitive with respect to the scenarios. Indeed, for the computational experiences presented in Section 6.2.5, one sees that if one set of scenarios is replaced by another, the decisions may be changed considerably. There are two potential sources why this happens. The first one is that the scenarios may be too sensitive with respect to some small adjustments. In Section 5.5 we have listed some elements which may improve the quality of the scenarios. Moreover, this may influence the stability of the outcomes. A second source of the unstable outcomes may be the heuristic approach to find results for the mixed-integer stochastic program. To make more definite statements about these two sources of instability, more research is needed.