

Aalto University

MS-E2177 - Seminar on Case Studies in Operations Research

Interim Report:
Impacts of solvency requirements on optimal asset
allocation

Project manager: Mikko Närhi
Team: Vesa Ranta-aho, Oskar Emelianov

May 27, 2023

Disclaimer: The content and findings presented in this report are solely the opinions and work of the students involved and do not represent the views, opinions, or endorsement of Varma or any of its employees. Varma neither endorses nor assumes responsibility for the accuracy, completeness, or validity of any information presented in this report. The content of this analysis is intended for academic purposes only and should not be considered as professional advice or guidance. The students involved in this study are solely responsible for the content, analysis, and conclusions presented herein.

Contents

1	Changes in project scope and objectives	1
2	Project status	1
2.1	Completed tasks	1
2.2	Current tasks	2
2.3	Remaining tasks	2
3	Updated schedule	2
4	Updated risk management plan	3
	References	4

1 Changes in project scope and objectives

The project scope and objectives have remained unchanged since the initial project plan and our initial meetings with Varma's contact person, Hamed Salehi. Mr. Salehi provided us with clear guidance from the start, helping us understand the objective of the study and guiding us in the direction of relevant papers for solving the problem.

Given the limited number of members in our team, which comprises of three individuals, and our busy schedules, we have made the decision to restrict our analysis to two asset baskets, namely equity and bonds. This will allow us to concentrate our resources more effectively towards developing the model and completing the project within the given time constraints.

2 Project status

2.1 Completed tasks

The literature review for choosing the model has been completed. We largely follow [de Oliveira et al. \(2017\)](#) both in the way we simulate scenarios and in the design of the optimization model, as they are designed for a very similar study.

The task of converting stock and bond return data into a covariance matrix has also been completed.

Our simulation uses the CIR model to simulate future bond yields based on historical data, and the GBM model to simulate the prices of equity and bond assets over a 20-year period. These models generate multiple scenarios of possible asset price trajectories, which can be used to analyze risk and return profiles and inform investment decisions.

A simple optimization model which reads as input data the prices of assets in different scenarios and outputs the optimal initial asset allocation has been created using the Python library Pyomo. However, it currently lacks most of the constraints, as well as the dynamic rebalancing of assets.

Overall, the project is a bit behind the original schedule, as all of the model implementation tasks were planned to be completed by the start of April.

2.2 Current tasks

The optimization model is currently being adapted to the Finnish pension insurance company environment by considering technical provisions (as defined by [Eläketurvakeskus \(2023\)](#)) as liabilities and adding relevant constraints to the model. At the moment, we are making output from the simulations in Excel format, which can be used as input in the optimization model. The results that come out of the simulations still need to be verified. We are not yet completely sure that the code generates the scenarios completely correctly.

2.3 Remaining tasks

After the model has been implemented, the remaining tasks are the validation of the model, the analysis of the results and the writing of the final report.

3 Updated schedule

The project timeline has been updated such that the model implementation is planned to be completed by the end of week 16, while the analysis and writing of the report is planned to be completed by the end of week 18 (as was originally planned). The planned time for the analysis and report writing is thus shortened to just two weeks. This is compensated by the fact that for all team members all other courses end by the end of week 16, which allows the team to allocate considerably more time for the project during the final weeks.

4 Updated risk management plan

Table 1: Project risks, their likelihood, effect, and actions for mitigation

Risk	Likelihood	Effect	Mitigation
Lack of skill	Low	Project objectives can not be fulfilled	Task division based on team members' strengths, open communication on need of help to team members, course staff and client
Issues in communication	Low	Time wasted redoing tasks, result will not be cohesive	Weekly meetings
Issues in group dynamics	Low	Result will not be cohesive, loss of motivation and poor results	Open communication, goodwill
Team member has to drop out	Low	More workload for remaining team members, project delivered late	Redefinition of scope
Result does not satisfy client	Low	Unsatisfied client	Active communication with client
Too ambitious goals	Medium	Time wasted on too complicated models or overly detailed analysis	Develop minimum viable model and analysis first, active communication with course staff and client
Members lack time to work on project	Medium	Project delivered late, not all objectives met	Weekly meetings and scheduling time for working on the project

References

- A. D. de Oliveira, T. P. Filomena, M. S. Perlin, M. Lejeune, and G. R. de Macedo. A multistage stochastic programming asset-liability management model: An application to the brazilian pension fund industry. *Optimization and Engineering*, 18:349–368, 2017.
- Eläketurvakeskus. Rahastonsiirtovelvoitteeseen, perustekorkoon, vakuutusmaksukorkoon ja siirtyvään vakavaraisuuspääomaan liittyvät laskentakaavat ja periaatteet. <http://www.saadospalvelu.fi/fi/perusteet/laskuperusteet/kerroinmuistiot/laskentakaavat/08022023.pdf>, 2023. Accessed: 2023-04-10.