Aalto University

MS-E2177 - Seminar on Case Studies in Operations Research

Project Plan:
Impacts of solvency requirements on optimal asset allocation

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Contents

1 Background **1**

2 Objectives **2**

3 Tasks **2**

4 Schedule **3**

5 Resources **4**

6 Risks **5**

1 Background

The Finnish pension system is financed through a combination of contributions from employers, employees, and the government, as well as investment returns. The level of contributions is determined by factors such as the age of the employee and the type of work they perform. The contributions are then used to pay for the pensions of current retirees. Any excess funds are invested in a variety of instruments to help ensure the long-term viability of the pension system. The Finnish pension system is designed to be sustainable and adaptable to changing demographic and economic conditions.

Technical provisions are an important aspect of the financing of pensions in Finland. These are the funds that pension providers set aside to ensure they can meet their future obligations to pay out pensions to their clients. Technical provisions are calculated based on actuarial assumptions, taking into account factors such as life expectancy, inflation, and investment returns. They are designed to ensure that pension providers have adequate reserves to cover future payouts and can maintain financial stability in the long term. The Financial Supervisory Authority monitors technical provisions to ensure that pension providers have sufficient reserves and can meet their obligations to their clients. Overall, technical provisions are a crucial component of the pension system in Finland and help to ensure the financial security of retirees.

The Solvency Regulation in Finland is a set of rules that govern the financial stability of pension providers. It ensures that pension providers have enough assets to cover their liabilities and can meet their obligations to pension recipients. The regulation requires pension providers to maintain a certain level of solvency, which is the difference between their assets and liabilities. If the solvency level falls below the required amount, the pension provider must take corrective measures to restore its financial stability. The Solvency Regulation is an important part of the Finnish pension system, which aims to provide secure and sustainable pensions for all citizens.

Portfolio optimization is a process of selecting the best mix of assets to achieve a desired level of return for a given level of risk. It involves analyzing various investment options, their historical performance, and their correlations with each other to create a diversified portfolio that balances risk and return. This approach helps investors minimize their exposure to any single asset or market sector, while

maximizing their overall returns.

Regarding to our project, we are planning to apply portfolio optimization to our strategy. It is important to carefully consider the data and assumptions used in the analysis, as well as any constraints on the portfolio. By using portfolio optimization, we aim to create a portfolio that is tailored to our investment goals and risk tolerance.

2 Objectives

The main objective of this project is to analyze the impact of the Finnish solvency requirements on optimal asset allocation, realized portfolio return and realized solvency ratio. The initial investment options include two baskets, equity index and bonds. The results are analyzed for different time horizons and asset return paths. Asset return paths are simulated from historical returns data. For example, geometric Brownian motion can be used to simulate asset returns paths for equities. Suitable models for simulating the return paths for different assets and optimizing the asset allocation under solvency requirement constraints shall be developed based on a literature study on existing solutions. Results' sensitivity to assumptions and model parameters will also be analyzed.

The goal for the model implementation is to be a clean and cohesive program, that can easily be easily run with different data and be expandable or adaptable to other similar problems with low effort. The code should be high quality including comments, and the development should be documented using version management.

3 Tasks

The main tasks of the project consist of literature review, data handling, development of the model, testing and reporting. In the first task, we conduct a literature review to find out the existing solutions to the research question of optimal asset allocation under solvency requirements. The papers were suggested to us by the contact person from Varma, Hamed Salehi, as well as other relevant papers.

Based on the literature review, we will choose an optimization model that finds the optimal asset allocation and formulate the constraints to take the solvency constraints into consideration. A simulation of return paths will be used to evaluate the performance of portfolios in comparison to each other. At the time of the project

plan submission, we have initially decided to select a stochastic optimization model which maximizes the expected value of the portfolio under uncertainty and solvency constraints.

We have decided to assign the coding tasks of the project as follows:

- Handling of data: Mikko
- Implementing the return path simulation: Oskar
- Implementing the stochastic optimization model: Vesa

When the coding tasks are finished and we are pleased with the initial results, we will validate our model and verify that the results and the model are correct.

If the task division is not equal, the tasks will be rebalanced. For example, if the implementation of the stochastic optimization model takes more time than anticipated, other team member's will help with the implementation.

After verifying the results and the model, we will report the results and draw conclusions based on the results. Reporting will be done through the course in the form of the project plan, interim report and final report.

4 Schedule

The tentative schedule is as follows:

1. Project initiation (completed)
2. Initial Client interaction (completed)
3. Literature review (completed)
4. Dividing tasks (1 week; deadline 10.2.)
5. Working on tasks (5 weeks; deadline 17.3.)
6. Validation of the model and verifying results (2 weeks; deadline 31.3.)
7. Writing of documentation and final report (5 weeks; deadline 5.5.)

Some tasks in the schedule might overlap and some tasks might take less time than expected. The schedule has sufficient buffer in the case of unexpected bumps regarding our project that take more time than expected. Overall, the scope of the project is well defined and we are confident that we will have enough time to finish the project in a sufficient way. The initial investment options include equities and bonds and we may broaden the baskets of investment options if we have enough time.

5 Resources

Our team consists of three mathematics and operations research major students with different backgrounds. The topic of the project is related to investment, optimization and problem solving. Our team members have a background in these topics. The contact person from Varma is Hamed Salehi, who will be of great help, as he has strong knowledge of portfolio management, mathematics and investment. The professor in charge of the project is Ahti Salo, from whom we will surely get help if needed and feedback over time. There is also a lot of necessary information on the Internet that we will need for our project.

6 Risks

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