Student Project Outline – CAS ML Innovation Project

Project Title
Estimating Solvency Ratios Using Machine Learning

CAS Participant & Company
Oliver Stoll, Actuarial and Risk Consulting Stoll GmbH
Data provided by a life insurance company (anonymous)

Project Idea
The goal is to approximate Solvency ratios (SII)[1] using machine learning models based on current market data. Insurance companies typically rely on complex simulations to recalculate these ratios, which is resource- and time-intensive. This project will explore whether ML models can provide fast, approximate solvency assessments based on synthetic scenario data.

Project Objectives
- Build and evaluate ML models that predict SII ratios from market parameters (such as interest rates, stock market)

- Compare different algorithms (e.g., regression, random forest, neural networks)

- Understand model behavior, especially in extreme scenarios

- Determine which variables most strongly influence the predicted SII ratios

Technical Tasks
- Explore and clean the dataset (1,000 synthetic economic scenario sets with corresponding SII ratios)

- Build a baseline ML pipeline (training, validation, evaluation)

- Experiment with model architectures and tuning

- Use SHAP values to assess model explainability and feature importance

- Analyze robustness, especially performance in tail scenarios (e.g., market crashes)

- Set up Python notebook using functions for reusable parts, in particular output plots, loss functions etc.

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[1] Here in the context of the European Solvency II framework, but the approach would equally work with the Swiss Solvency Test (SST)

Expected Outcomes

- Performance comparison of different ML models (e.g., error metrics, cross-validation)

- Visualization of key model diagnostics (e. g. learning curves)

- Identification of influential input features

- Documentation of code

- Project report and presentation

Timeline

- Kickoff: August 2025

- Project Duration: till mid October 2025, flexible and part-time

- Regular check-ins

- Final delivery: Python notebook including documentation; project report and PPT presentation

Why Join This Project?

This is a real-world data science challenge using structured financial data from the insurance industry. You will:

- Apply machine learning techniques in a highly relevant business context

- Work with real-world complexity, including interpretability requirements in regulated environments

- Implement best practices in data preprocessing, modeling, and validation

- Collaborate directly with a senior actuary for technical and industry insight

This project offers hands-on experience that bridges academic knowledge with practical impact—an ideal opportunity to sharpen your ML skills on a meaningful use case.