FINANCIAL MATHEMATICS

The Financial Mathematics department developed several software products to market maturity this past year. Today, products are available in all priority research areas, which extends the department's profile and attracts new project partners.

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The Department of Financial Mathematics has accomplished a successful year 2016. The change in the head of the department at the end of 2015 has proven effective and four new research fellows have been employed to cope with all the research and industrial projects. In the long-term project for the "Produktinformationsstelle Altersvorsorge gGmbH" (PIA), which started in 2015, the department modelled, simulated, and classified state-subsidized pension tariffs ("Basisrente", "Riesterrente") with their specific properties for exemplary customers. Since 1st of January 2017 this classification is a necessary condition for each state-subsidized pension tariff in Germany. The department was successful in simulating all requested tariffs before the end of the year.

Beyond that a first project for the energy industry has been finished. The developed risk management software evaluates different types of risk indicators for a medium-sized energy supplier using factor models for electricity, gas and CO_2, which all have been developed in-house. Furthermore, a method for the calculation of a "guaranteed claim" used in loss projection in the public health sector has been established.

MAIN TOPICS

- Mathematics for the Financial Industry: asset-liability management, chance-risk classification, …
- Mathematics for the Energy Industry: risk management, model development, …
- Data Science for the Controlling: loss projection with statistical methods, fraud detection, rating, …
- Development of individual software solutions in the named fields

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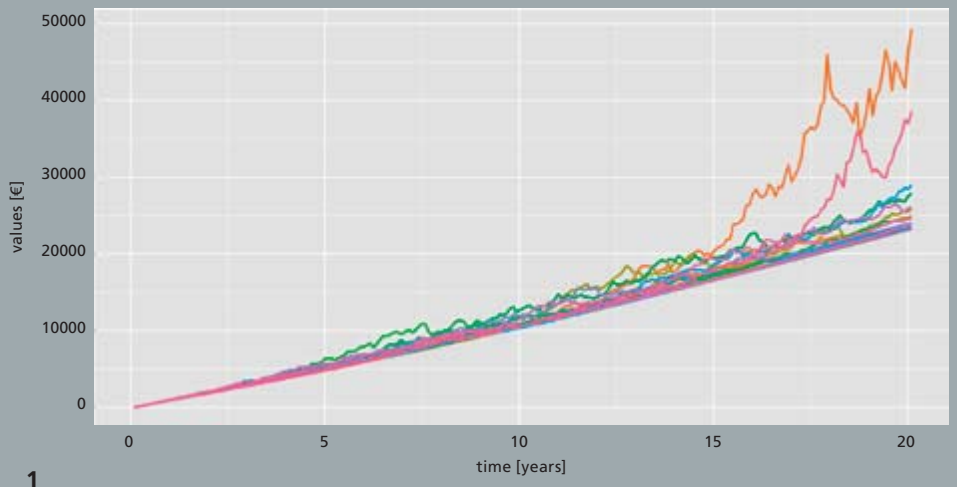

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CLASSIFICATION OF PRIVATE PENSION PRODUCTS FOR THE PIA

1 *Development of wealth of a 20 years contract under different scenarios*

Since 2002, private pension products are supported by state subsidies in Germany. Two common forms of these payments are the Riester and Rürup pension schemes. Since 2017, according to the law for improvement of old age provision (AltvVerbG), all state subsidized private pension products in Germany must be classified according to their return risk profile. For every single product, a key information document must be provided, that contains this return risk class. The German Federal Ministry of Finance (BMF) assigned the task of determining this classification to the Produktinformationsstelle Altersvorsorge gGmbH (PIA). This organization fulfills administrative and official duties entrusted by the Federal Ministry of Finance and engaged the Department of Financial Mathematics in 2016 to classify approximately 600 private pension products.

For the classification, we simulate 10 000 possible market scenarios for the entire period of the annuity payments based on a market model, i. e. a model for the interest rates and stock prices. In each scenario we calculate the individual wealth of the contract at the end of the saving period. The wealth distribution defines the classification into one of five return risk classes. The simulation takes into account the type of contract (classical life insurance, bank savings plan, fund savings plan, static or dynamic hybrid products with several assets), investment decisions of the management (rebalancing between assets with different risk profiles), and included costs. Complex hedging strategies and options are also taken into account. For the classification the law requires four prototypical customers, each investing 100 € per month over 12, 20, 30, and 40 years.

The heart of the market model is a Hull-White interest rate model with two stochastic factors. This model allows to adequately portray recent phenomena of the interest rate development, such as negative interest rates and decorrelation of long- and short-term interest rates. A further stochastic factor models the stock market using a Black-Scholes model with stochastic interest rate. In order to keep simulation times small, we generate the scenarios on a monthly basis, which also corresponds to the frequency of the contributions of the policyholder. However, to simulate e. g. hedging by daily rebalancing, the monthly simulation requires the development of approximate trading strategies.

Since January 1st, 2017, every state subsidized pension product comes with a product information sheet which shows an return risk class determined by ITWM. Currently, more than 600 pension products have been classified. In the future, the return risk classes will be reviewed annually on the basis of latest market data.

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RISK MANAGEMENT FOR ENERGY UTILITIES

1 *Risk assessment for the power industry*

Energy utilities are subject to a manifold of risks. For the management, it is essential to be able to control them. Depending on the risks, their assessment and reporting occur either automatically or manually.

Often the risk management decisions are based on complex and confusing calculations in spreadsheets. Even if standardized solutions for risk management are available on the market, they are usually unlikely to fulfill specific and individual demands. They also require a transition to the format of the risk controlling software. In general, these products come at high integration costs. The Financial Mathematics department of Fraunhofer ITWM has developed an individual software package for risk management for a medium-sized energy supplier. Due to its architecture, it can be run independently of the portfolio management (PFM) system and has low integration costs.

The software is able to assess complex and business-specific risks. Furthermore, it is neither for the model selection nor for the calibration bound to the restrictions of spreadsheet risks analysis. At this point, the software profits from the rich experience and expertise in financial mathematical modelling of Fraunhofer ITWM. Depending on the risk category, standard approaches are often insufficient or are based on heuristics.

Depending on the commodity (electricity, gas, CO_2…) different models are used to evaluate the market risk. The software can also take correlation between the commodities into consideration. The market data is daily updated and the parameters are automatically calibrated. According to the risk, the software provides different methods.

Apart from calculating Value-at-Risk, Profit-at-Risk and the Mark-to-Market, it is also possible to monitor hedging strategies. Every method allows a scenario-based valuation, such that the software is compatible with simulation methods from third parties. (e. g. consumption forecasts). Sometimes, it is not possible to get a closed solution with the chosen risk method. In this case, the evaluations are based on Monte-Carlo simulations.