Fintech in insurance: Liability modeling and liability driven investing

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fennia

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3,5

years

Charge of risk taking with Fennia Group Balance sheet

- Investing
- Customer Finance
- Reinsurance

Finance modeling Model IT

10

years

- Insurance company liability and market risk modeling
- Bank market risk modeling
- Pension company investment decision making modeling

Analyst Evli Bank

2

years

- Quantitative investment strategies
- Portfolio return and risk reporting

Msc. Tech 2007 / Systems and Operations Research
Chartered Financial Analyst (CFA)

Hobby: Mobile game development

Jetpack Fried Chicken 4+

Fly high. Don't get eaten.

Fintech in insurance ➔ Insurtech

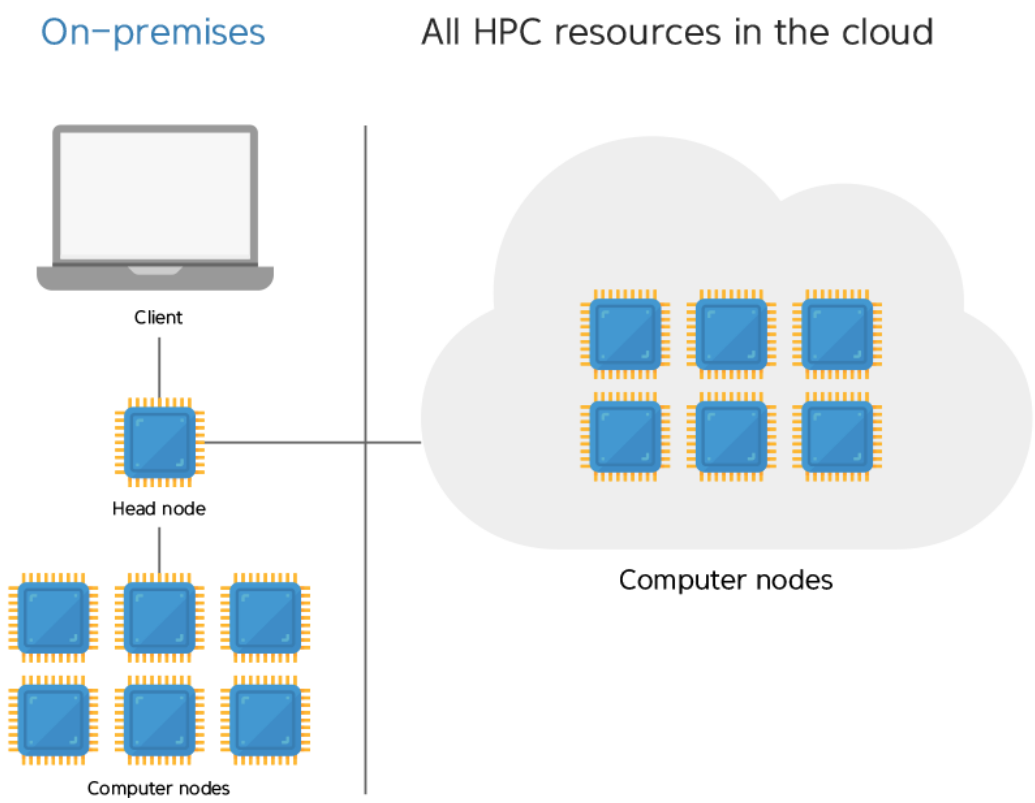
Examples of use cases

- Claim processing, Pricing, Fraud detection
  - Make unstructured information (documents, images, e-mails) machine readable
  - Assess historic claims data on patterns and trends
  - Automate claims handling actions and decisions
  - Use AI to price insurance policies
  - Detect fraudulent claim reports

- Risk management and actuarial modeling
  - High performance computing to simulate large contract portfolios
  - Intelligent proxy models for risk management

Distributed Computing

- Distributed computing is splitting task to multiple independent tasks that can be completed in parallel
- Typical workstations have already 2-16 computing cores in CPU
- On premise computing clusters used to be the best way to distribute tasks to individual cores
- Now cloud services offer a very cost-effective option for distributed computing



Case: Liability valuation and risk analytics in life insurance

- **Challenge 1:** Solvency II regulation demands companies to calculate market consistent value of liabilities including all contract level options and guarantees

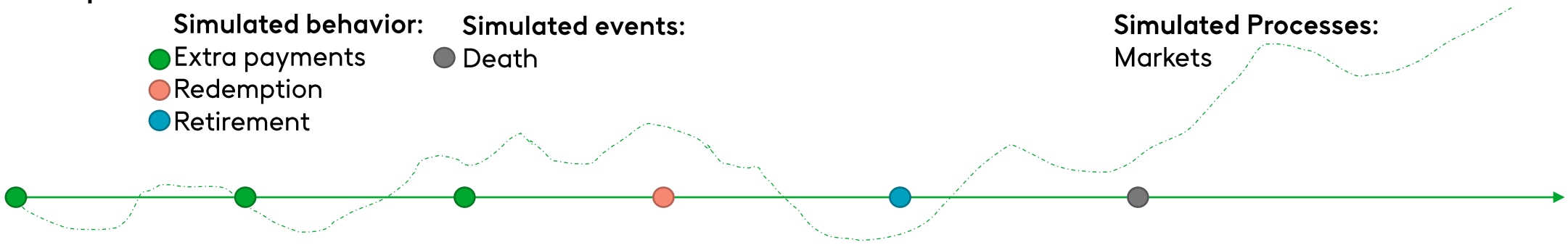
- Typically, a portfolio of hundreds of thousands to millions life insurance contracts
  - 60 + year projection
  - 20 + different cash flows for each contract (fees, costs, profit participation, …)
  - Customer claim (death, disability) and behavior (payments, redemptions, retirement) modeling
  - Nested structure (company pays benefits to policy holders based on yearly investment and insurance business return)

Solution: Full stochastic simulation using distributed computing

- Full simulation of all terms and conditions in policy level
- 1 000 + scenarios
- Unmatched accuracy – no need to simplify contract terms or group policy data
- How to make simulation fast enough?

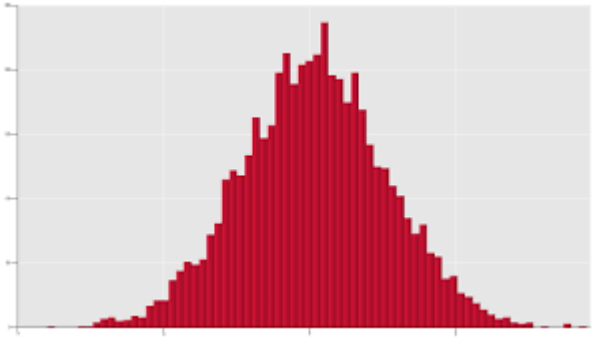
Case: Liability valuation and risk analytics in life insurance

- **Example: One contract and one simulation**



Simulated Cash flows:
Fees, Costs, savings accumulation, pension payments, ...

Full probability distribution of all contracts and simulations



Making contract by contract possible

Example of 10 000 scenarios and n computing nodes

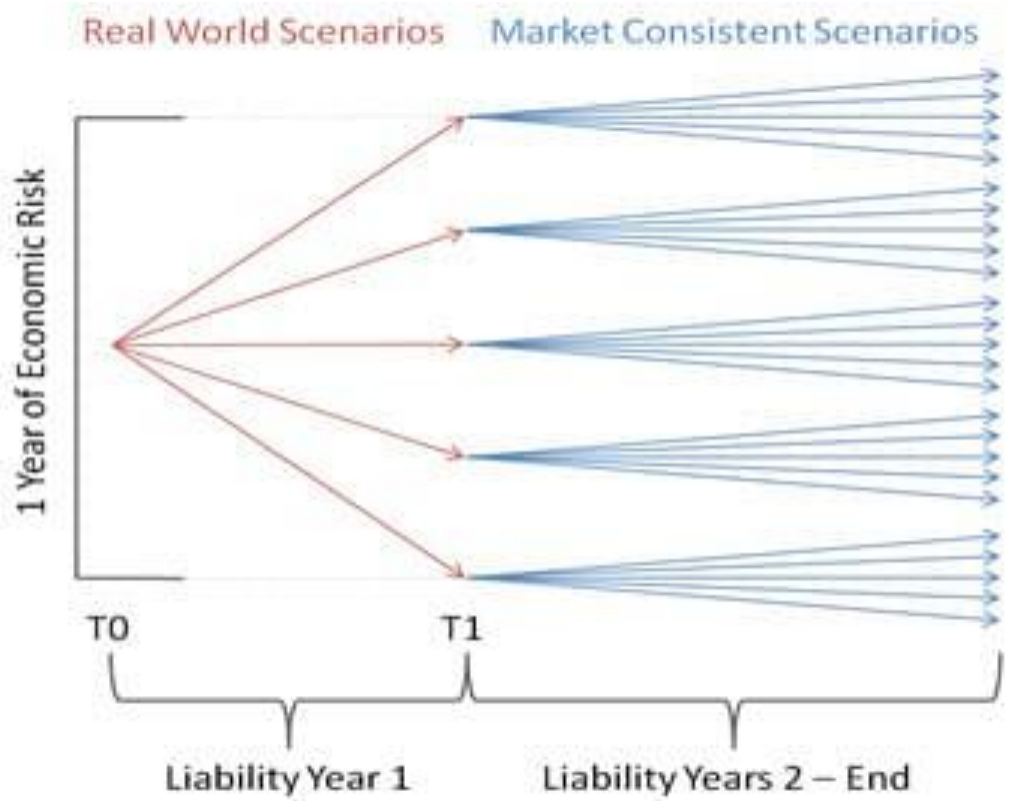
	Traditional systems Designed for deterministic modeling	Our approach Designed for stochastic modeling
Design	**Split scenarios to cluster nodes** Loop through contracts	**Split contracts to cluster nodes** Run all scenarios simultaneously for each contract
Model is run	**10 000 times** With full overhead for each scenario	**1 time** All scenarios are run simultaneously in memory and model logic and overhead run only once
One node handles	**All contracts** Close to impossible to use real data of millions of contracts	**1/n of policies** Any number of contracts can be handled with distributed computing

Challenge 2: risk analytics

- Full stochastic simulation can provide accurate value of liabilities for regulatory calculation and few stress scenarios

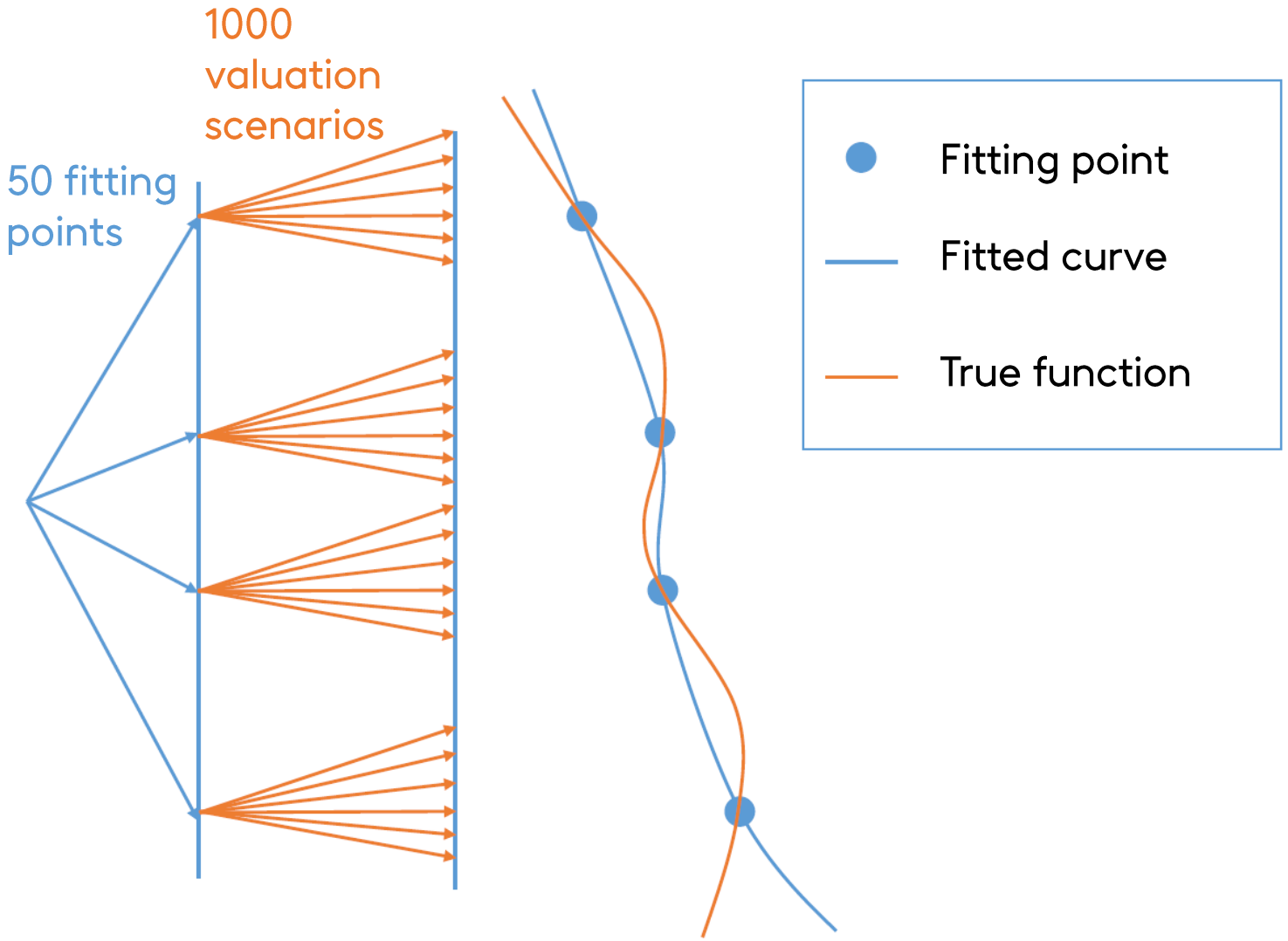
- For risk analytics and investment planning we need to know how liabilities behave in thousands of risk scenarios
    - Not feasible to run full liability valuation in all risk scenarios (nested stochastic simulation)

- **Solution: Proxy modeling**
- Fast model to model liability value changes with respect to selected risk factors, e.g.
    - Interest rate curve and volatility
    - Equity return and volatility
    - Actuarial assumptions – mortality and lapse behavior
- How to fit the model?



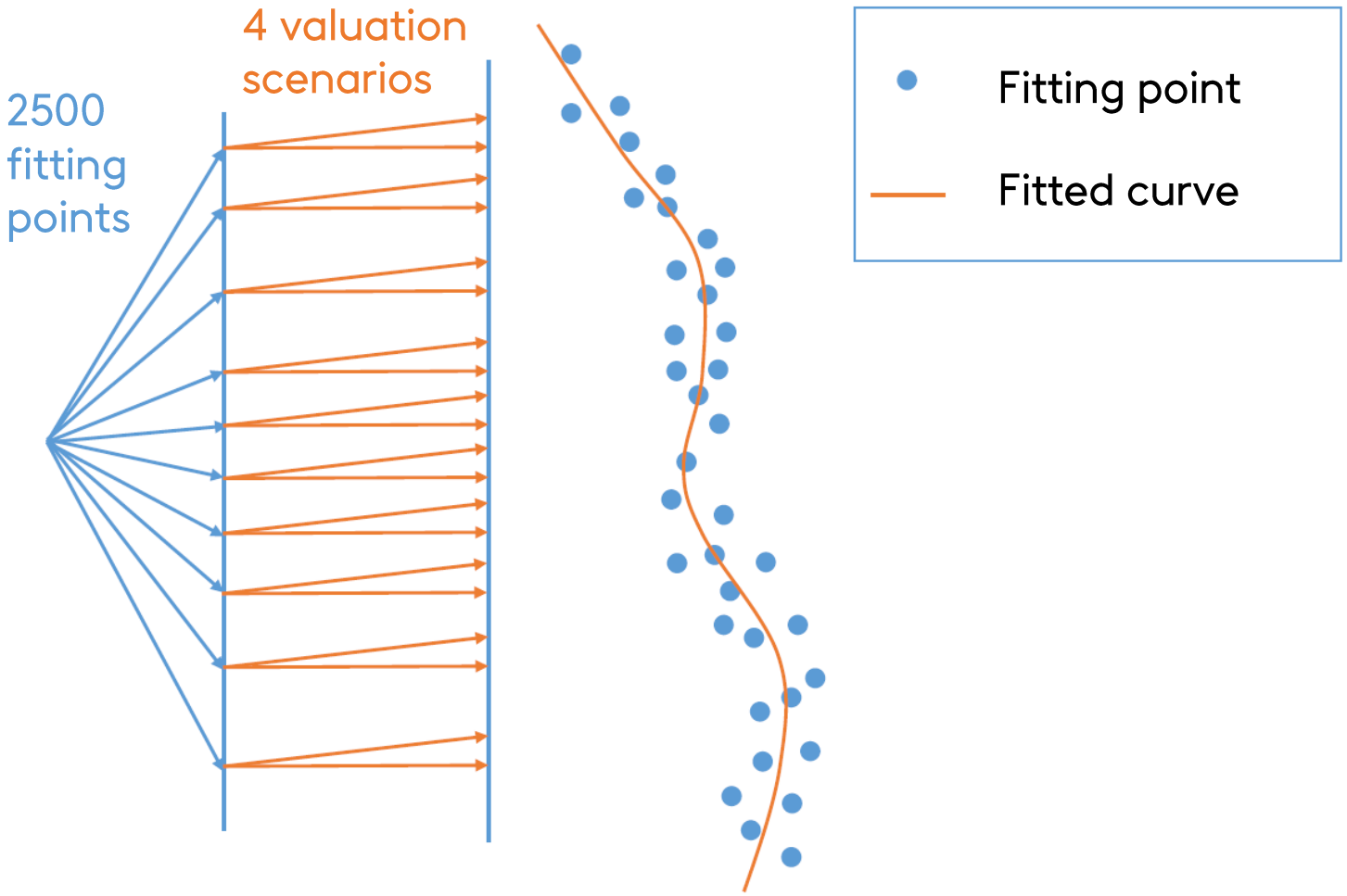
Traditional Way: Regression analysis

- Traditional way is to calculate small number (50) of accurate fitting points and fit a predefined polynomial function
- Computationally heavy and not guaranteed to find the true value function
- ➔ typically poor fit even with 50 x 1000 = 50 000 fitting scenarios



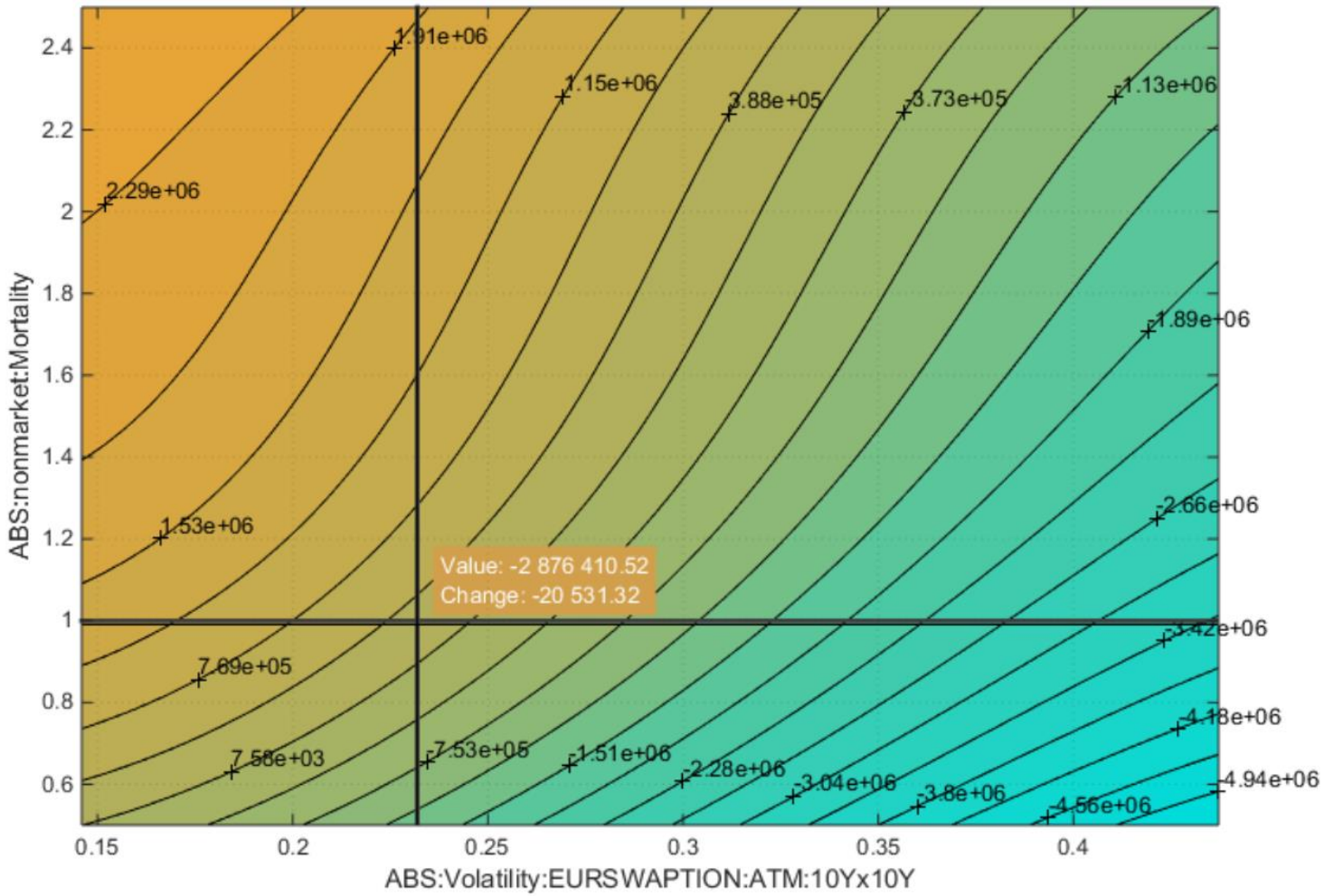
Least Squares Monte Carlo

- With least squares Monte Carlo we select thousands (typically 2500) fitting points
- And calculate a very inaccurate liability value in each point few (typically 4) valuation scenarios
- Highly inaccurate values are however excellent fitting points - errors are independent and have zero expected value
- ➔ very good fit with just 2500 x 4 = 10 000 fitting scenarios



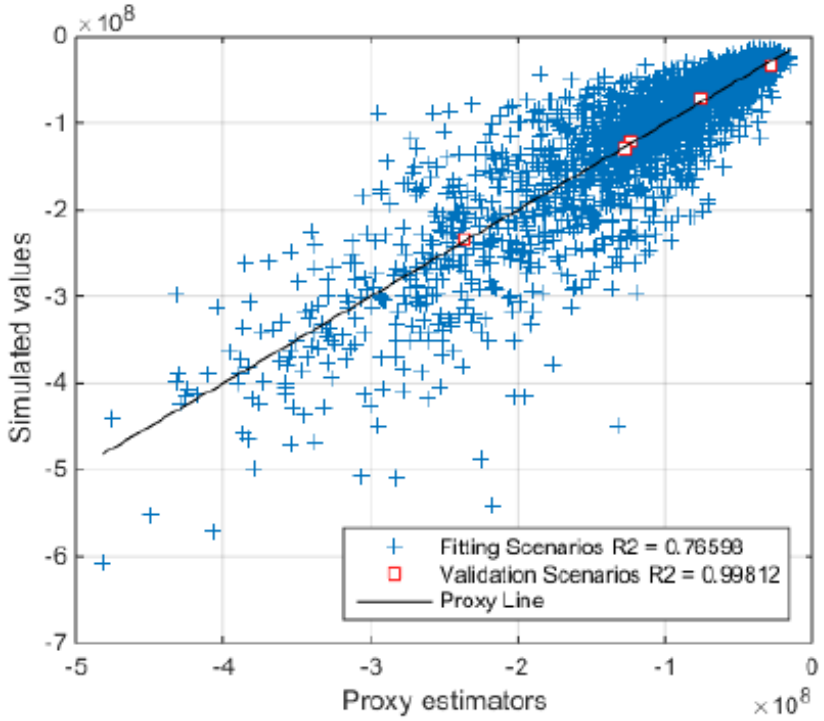
The result

- With proxy model, liability sensitivities can be analyzed simultaneously with multiple risk factors
- For example, joint sensitivity to changes in interest rate volatility (EUR Swaption) and expected mortality
- Together with asset portfolio – whole balance sheet sensitivity can be analyzed



Validation

- To be able to trust the proxy model in decision making, it needs to be validated
- Typically, by selecting small number of points where proxy value is compared to true heavy valuation
  - Target R2 close to 1

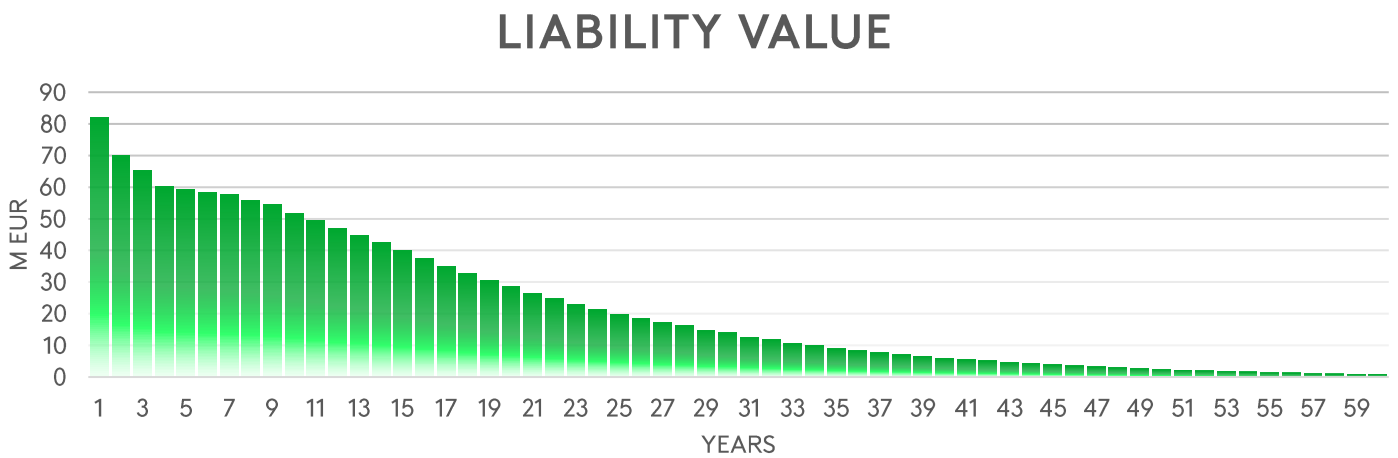


Summary: Liability modeling

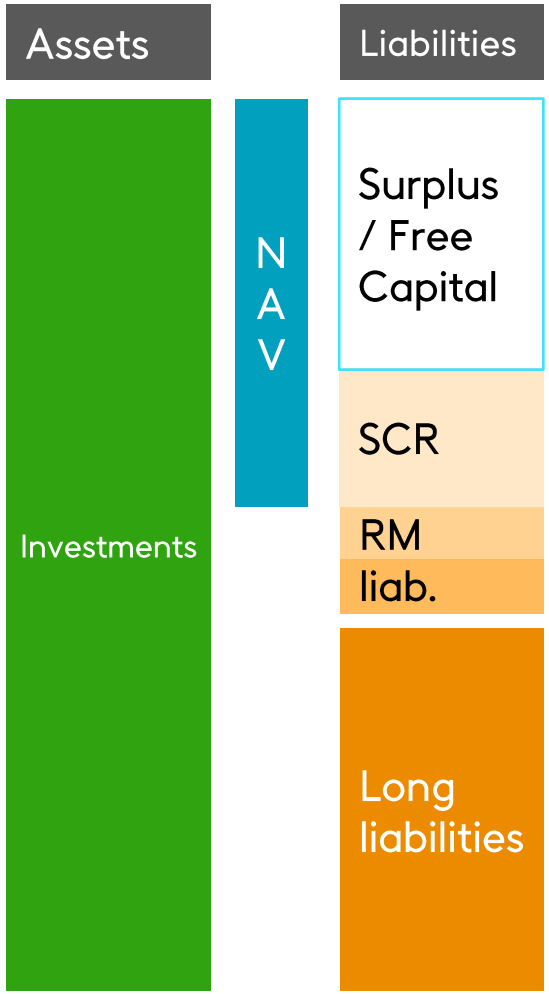
ALM

We get liability cash flow profile and market sensitivities from liability modeling.

<u>How to invest to make sure we are able to pay out the future cash flows for policy holders?</u>



Why do we invest in insurance company?



3. Generate surplus

The part of investments that exceeds minimum level forms group's risk-taking capacity. By taking managed risks within capacity, we can grow our solvency and generate excess returns for strategic purposes

2. Ensure solvency

In addition to long liabilities, investments must always match other (short) liabilities, risk margin and solvency capital requirement (SCR)

1. Cover liability return requirement

Both life and non-life companies have long liabilities that consist of cash flows estimated by actuaries

- Mandatory traffic and workers compensation in non-life and voluntary pension in life
- Ability to pay out the future cash flows determines the return requirement
- Present value of liabilities is determined with market interest rates and changes in rate level have big impact in solvency
- Life insurance liabilities can also have more complex market sensitivities