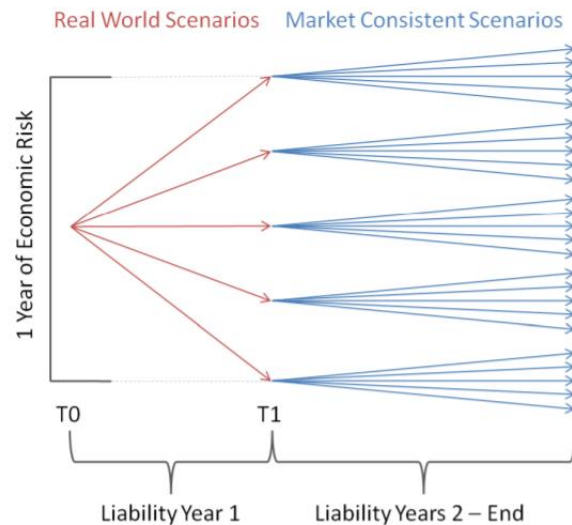


Moody's Analytics proxy modeling business

Motivation for proxy modeling

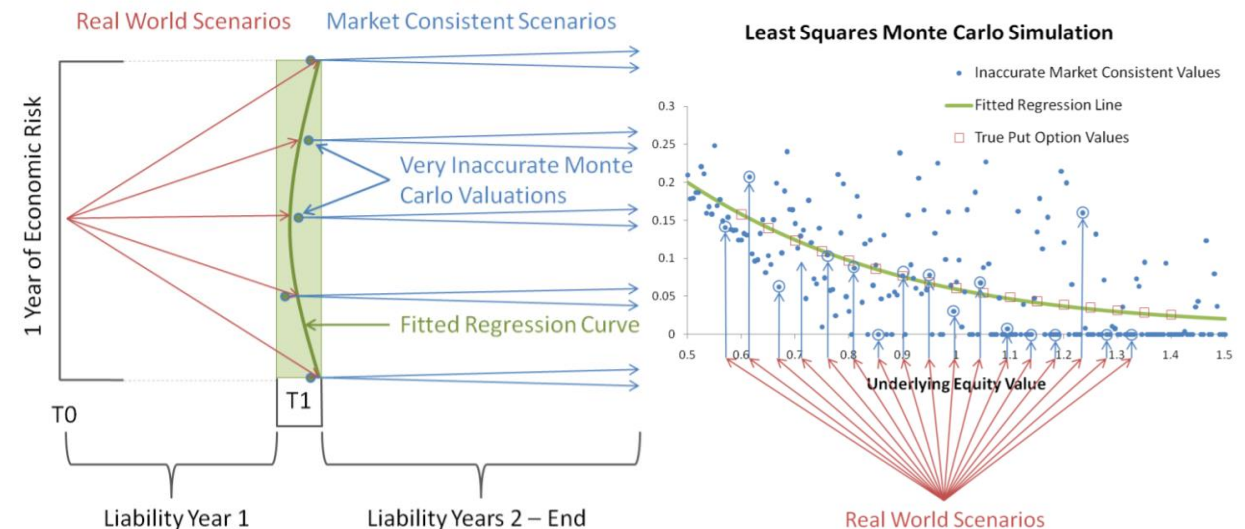
1-year VaR capital use case

‘Brute force’ nested simulation



Requires ~ **1,000,000 x 10,000** nested scenarios to be run through the actuarial cash flow model

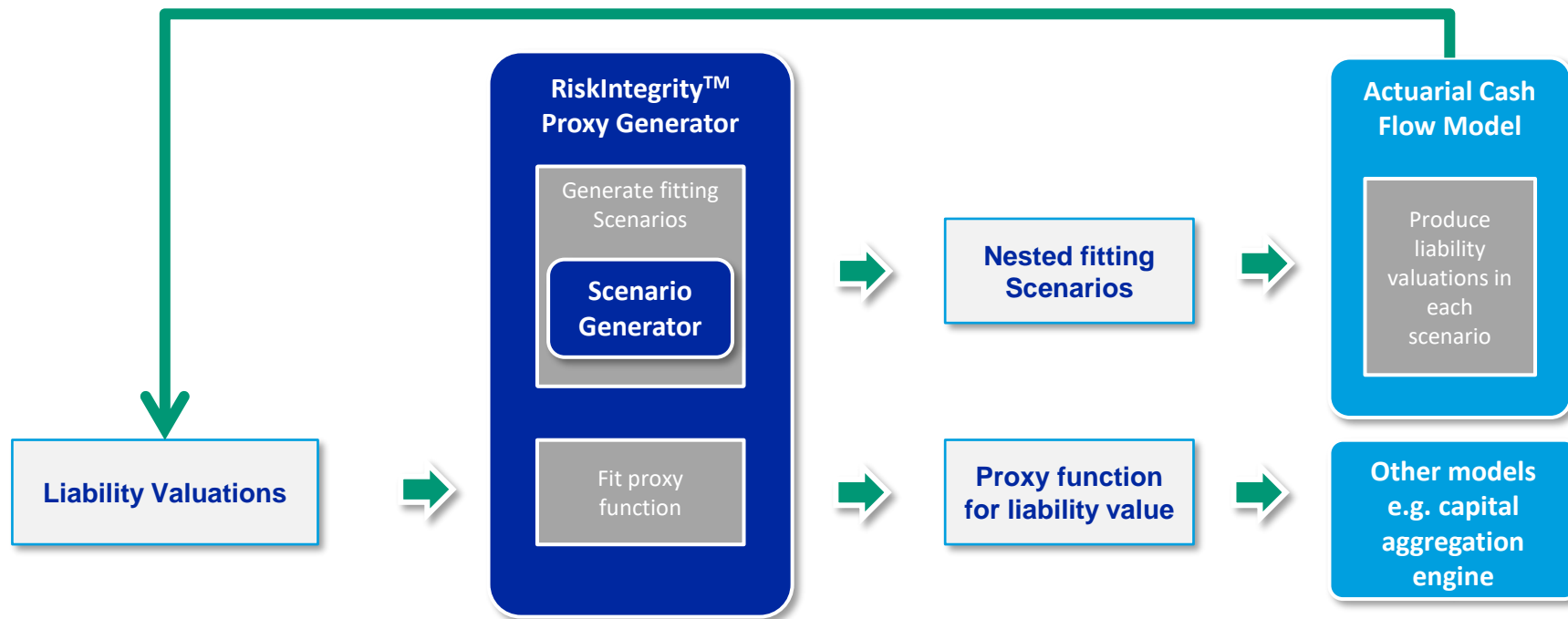
Proxy modeling



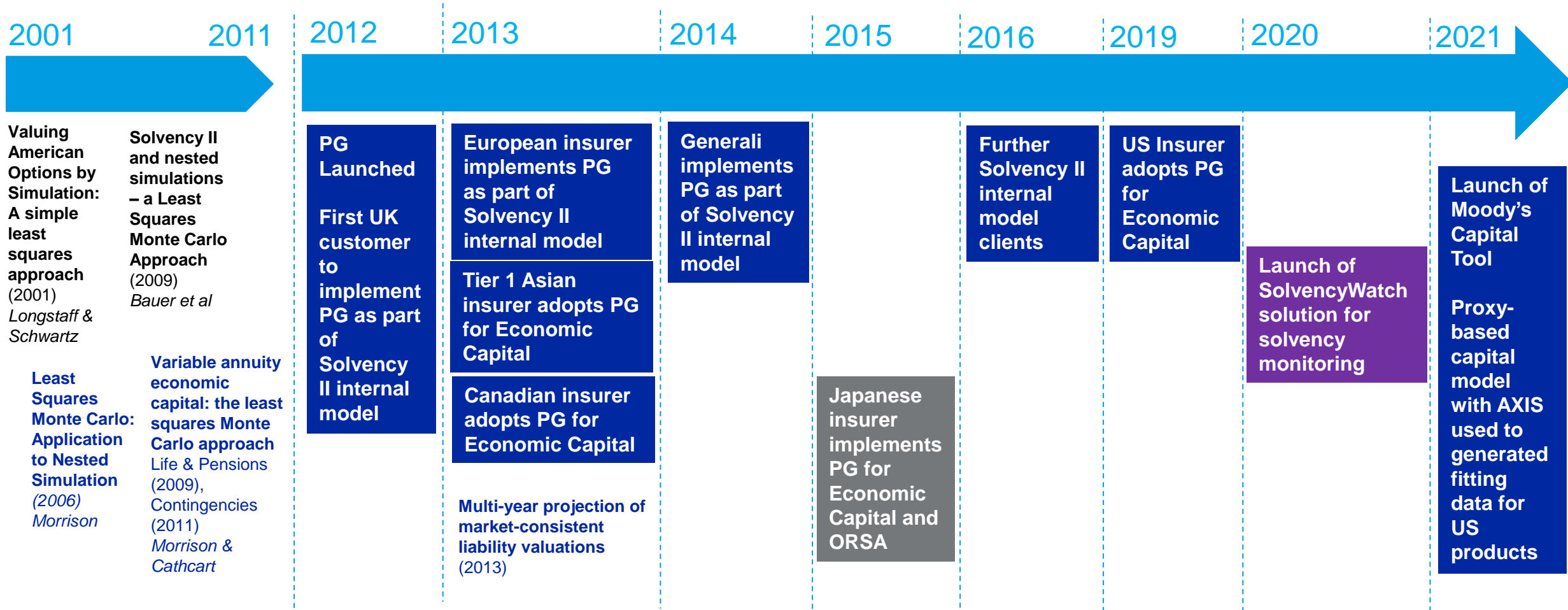
Fit/train a proxy model on a much smaller set of nested scenarios (e.g. **100,000 x 2**)

What does Proxy Generator (PG) do?

And how it interacts with other software

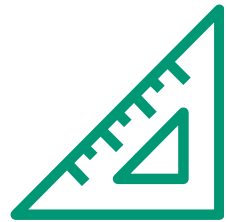


Evolution and adoption of Proxy Generator



Further applications of proxy models

Dimensions of the problem and solution



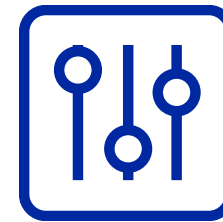
Metric being proxied

- Market-consistent values of liabilities
- Market values of assets
- Sensitivities e.g. Greeks
- VaR
- CTE
- Cash flows
- ...



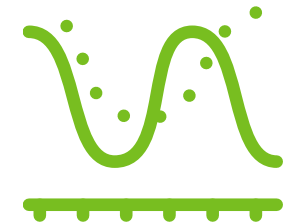
Type of scenario

- 1-year real-world
- Multi-period real-world e.g. 'planning' scenarios
- Actual market movements
- 'What-if' stresses
- ...



Proxy model inputs

- Market risk factors
- Non-market risk factors
- Assumptions e.g. asset allocation
- ...



Functional form

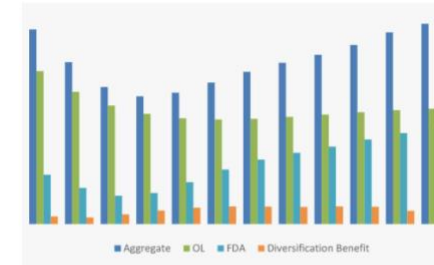
- Polynomials
- Neural networks
- ...

'Classical' 1-year VaR capital use case

Proxy modeling research & consultancy

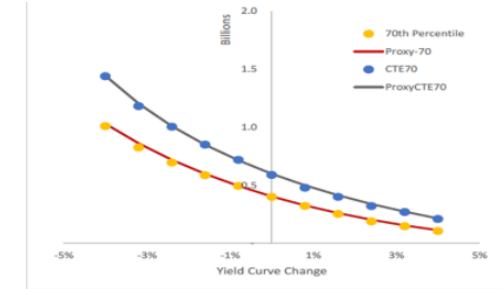
Example projects

- » Proxy methods for **run-off CTE capital projection**: A life insurance case study (2016)
 - Research project with New York Life
- » Fitting proxy functions for Conditional Tail Expectation: Comparison of Methods (2018); Fast projection of reserve and capital requirements with proxy functions (2018)
 - Example training data generated using AXIS
- » Proxy methods for **hedge projection**: Two variable annuity case studies (2015)
 - inc research project with Thrivent Financial
- » Deep learning the cash flow model (2020)
 - **Proxy cash flows directly**
 - Example training data generated using AXIS



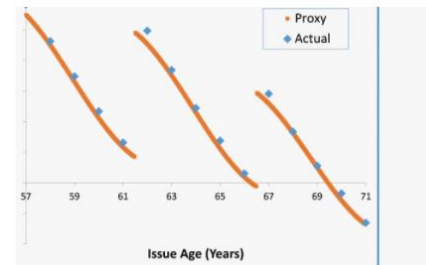
WHITEPAPER

Proxy Methods for Run-off CTE
Capital Projection: A Life Insurance
Case Study



WHITEPAPER

Fitting Proxy Functions for
Conditional Tail Expectation:
Comparison of Methods



WHITEPAPER

Proxy Methods for Hedge Projection:
Two Variable Annuity Case Studies



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Deep-Learning the Cash Flow Model

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