Analysis of a Life Insurance Contract with MATLAB

JF. Breton, Application Engineer
MathWorks, Inc.
What you will learn

- Quickly prototype a complex contract
- How to quickly develop an understanding the nuances of the behavior of a life insurance product
Variable Annuity product Analysis

- **Problem:**
  - Analyze behavior (risk) of a Variable Annuity with Guaranteed Minimum Withdrawal Benefits

- **Requirements:**
  - Perform scenario analysis of market and contract behavior
  - Analyze profitability and risk of contract
  - Perform a replicating portfolio analysis to capture or hedge contract risk
  - Summarize findings in a report for management
What is GMWB?

- Guaranteed Minimum Withdrawal Benefit
  - Investment Portfolio (Sub-Account), e.g. $100K
  - Withdrawal Rate, e.g. 10%
  - Rider Fee, e.g. 75 basis point
Analysis challenges in life insurance

- Significant technical expertise required
- Time required to conduct the analysis
- Lack of computing power
- Increased transparency
Optimizing for replication

- **Idea:** find a set of replicating instruments (a’s) that matches the NPV (l) of the cash flows under each scenario as closely as possible

- **Objective:** minimise the average error (regret) by the optimal choice of the weights \( w_k \)

- **Output:** optimal weight for each standard instrument

\[
\min_{w_k} \sum_{n=1}^{N} |e_n|
\]

such that

\[
l_n - \sum_{k=1}^{K} w_k a_{kn} = e_n , \quad \forall n = 1 \ldots N
\]
Key Takeaways

- Quickly prototype a complex contract with MATLAB interactive environment, numerous tools and built-in functions
- How to quickly develop an understanding the nuances of the behavior of a life insurance product
- MATLAB is not a black box and facilitates understanding
- Computational power and automated report generation