**FINAL PROJECT - SII**

Consider a simplified insurance company whose assets and liabilities sides are characterized as follows:

ASSETS

* there is a unique fund all made of equity, Ft = St
* at the beginning (t=0) the value of the fund is equal to the invested premium F0 = C0 = 100,000 (mathematical reserve at the start)
* equity features
  + listed in the regulated markets in the EEA
  + no dividend yields
  + to be simulated with a Risk Neutral GBM (sigma=25%) and a time varying instantaneous rate r

LIABILITIES

* contract terms
  + whole Life policy
  + benefits
    - in case of lapse, the beneficiary gets the value of the fund at the time of lapse, without penalties applied (no profit, if we had penalties we would have profit)
    - in case of death, the beneficiary gets the maximum between the 110% of the invested premium and the value of the fund
    - when a benefit is paid to the beneficiary, a fixed cost of 20 euro is applied reducing the paid benefit
  + others
    - Regular Deduction, RD of 2.00% (cost applied, no rebates, no external costs)
    - Commissions to the distribution channels, COMM (or trailing) of 1.40% (margin is 0.6%, you can double check the PVFP)
* model points
  + just 1 model point
  + male with insured aged x=60 at the beginning of the contract
* operating assumptions
  + mortality: rates derived from the life table SI2021 (https://demo.istat.it/index\_e.php)
  + lapse: flat annual rates lt=15%
  + expenses: constant unitary (i.e. per policy) cost of 50 euros per year, that grows following the inflation pattern
* economic assumption
  + risk free: rate r derived from the yield curve (EIOPA IT without VA 31.03.22 (no volatility adjustment, usually not applied to unit-link in real life but for segregated funds and term life… Also matching adjustment can only be don if Riemann check is ok)), supposing linear interpolation of the zero rates and using the formula DFt+dt = DFt \* exp[‐rt\*dt]
  + inflation: flat annual rate of 2%

Other specifications:

* time horizon for the projection: 50 years. (check how much volume left)

In case there still was an outstanding portfolio in T=50, let all the people leave the contract with a massive surrender

* the interest rates dynamic is deterministic, while the equity one is stochastic

QUESTIONS

1. code a Matlab script to compute the Basic Solvency Capital Requirement via Standard Formula and provide comments on the results obtained. The risks to be considered are:

* Market Interest (up and down)
* Market equity
* Life mortality
* Life lapse
* Life cat
* Expense (inflation and costs increase)

1. Calculate the Macaulay BEL duration in all the cases and provide comments on the results obtained
2. Split the BEL value into its main PV components: premiums (=0), death benefits, lapse benefits, expenses, and commissions
3. Replicate the same calculations in an Excel spread sheet using a deterministic projection. Do the results differ from 1? If so, what is the reason behind?
4. Open questions:
   * what happens to the asset and liabilities when the risk-free rate increases/decreases with a parallel shift of, say, 100bps? Describe the effects for all the BEL components
   * what happens to the liabilities if the insured age increases? What if there were two model points, one male and one female?

DELIVERABLES

* one .pdf document named “GROUP\_XX\_SII\_project.pdf”, organized as follows
  + cover with group number and full names of the participants
  + index
  + original text of the project
  + 2 summary tables (one for A and one for B) with the results obtained

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Results | MVA | BEL | BoF | d\_BoF | dur\_L |
| BASE |  |  |  |  |  |
| IR\_up |  |  |  |  |  |
| IR\_dw |  |  |  |  |  |
| … |  |  |  |  |  |
| … |  |  |  |  |  |
| … |  |  |  |  |  |
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| … |  |  |  |  |  |
| BSCR |  |  |  |  |  |

* + section with specifications of all the formulas adopted for the calculations
    - subsections (one per each risk) that recall the results under discussion and provide comments on the outcomes
  + section that illustrates the deterministic calculations and provides comments on the results
  + section with the answers to the open questions
  + annex with the Matlab code embedded
* one excel workbook named “GROUP\_XX\_SII\_project.xlsx” with the deterministic projections

and a summary tab containing the results of the table above.