

FINAL PROJECT - SII

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

ASSETS

- there is a single fund made of equity (80%) and property (20%), $F_t = EQ_t + PR_t$
- at the beginning ($t=0$) the value of the fund is equal to the invested premium $F_0 = C_0 = 100,000$
- equity features
 - o listed in the regulated markets in the EEA
 - o no dividend yield
 - o to be simulated with a Risk Neutral GBM ($\sigma=20\%$) and a time varying instantaneous rate r
- property features
 - o listed in the regulated markets in the EEA
 - o no dividend yield
 - o to be simulated with a Risk Neutral GBM ($\sigma=10\%$) and a time varying instantaneous rate r

LIABILITIES

- contract terms
 - o whole Life policy
 - o benefits
 - in case of lapse, the beneficiary gets the value of the fund at the time of lapse, with 20 euros of penalties applied
 - in case of death, the beneficiary gets the maximum between the invested premium and the value of the fund
 - o others
 - Regular Deduction, RD of 2.20%
 - Commissions to the distribution channels, COMM (or trailing) of 1.40%
- model points
 - o just 1 model point
 - o male with insured aged $x=60$ at the beginning of the contract
- operating assumptions
 - o mortality: rates derived from the life table SI2022 (https://demo.istat.it/index_e.php)
 - o lapse: flat annual rates $l_t=15\%$
 - o expenses: constant unitary (i.e. per policy) cost of 50 euros per year, that grows following the inflation pattern
- economic assumption
 - o risk free: rate r derived from the yield curve (EIOPA IT without VA 31.03.24)
 - o inflation: flat annual rate of 2%

Other specifications:

- time horizon for the projection: 50 years.
In case of 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 and property ones are stochastic.

QUESTIONS

1. code a Matlab/Python 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
 - Market equity
 - Market property
 - Life mortality
 - Life lapse
 - Life cat
 - Expense
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?
 - For the base case only
 - i. calculate the Macaulay duration of the liabilities;
 - ii. calculate the sources of profit for the insurance company, deriving its PVFP
 - iii. check the magnitude of leakage by verifying the equation $MVA = BEL + PVFP$ (i.e. $MVA=BEL+PVFP+LEAK$)
 - iv. sense check the PVFP using a proxy calculation, based on the annual profit and the duration of the contract
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

- send one email with object “[SII project] - GROUP XX”, attaching the .pdf doc and .xlsx file
- the .pdf document shall be named “GROUP_XX_SII_project.pdf” and organized as follows
 - o cover with group number and full names of the participants
 - o index
 - o original text of the project
 - o a summary tables showing the results, as follows

Results	MVA	BEL	BoF	d_BoF	dur_L
BASE					
IR_up					
IR_dw					
...					
...					
...					
...					
...					
...					
BSCR					

- o section with specifications of all the formulas adopted for the calculations
 - any comment on martingale tests, number of scenarios adopted and time step selection is welcome
 - subsections (one per each risk) that recall the results under discussion and provide comments on the outcomes
- o section that illustrates the deterministic calculations and provides comments on the results
 - subsection for the questions related to the base case only
- o section with the answers to the open questions
- o annex with the Matlab/Python code embedded (no need to share the code)
- the excel workbook shall be named “GROUP_XX_SII_project.xlsx”, containing the deterministic projections and a summary tab providing the results in the same format of the table above
- every deviation from this scheme will be penalized