VALUATION OF VARIABLE ANNUITIES USING GRID COMPUTING
AXA LIFE EUROPE HEDGING SERVICES (ALEHS)
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Structure

- Variable annuities
- ALEHS liability valuation software (MoSes. Tower Perrin)
- The run time issue
- AXA grid server solution
- Conclusion
Variable annuities

• Life insurance product providing future payment (ex: retirement)
• Exposed to the market stock risk
• Bring guarantees to the policy holder
• Difficult to value and hedge
  – Financial risk
  – Actuarial risk
Variable annuities

- Valuation of the variable annuities

Option Value = CF(+) – CF(-) = PVCharges - PVClaims

Amount in euro

Guarantee

Account value

claims

Time
ALEHS liability valuation software (MoSes)

- The Moses structure
- The asset part (The economic scenario generator)
- The liability valuation part
- Standalone vs Grid mode
ALEHS liability valuation software (MoSes)

• The MoSes structure

ASSET PART:
The economic scenario generator (ESG) module

LIABILITY PART:
The valuation module
ALEHS liability valuation software (MoSes)

- **The asset part**
  - Projection of Equity returns, rates … for Monte Carlo Simulation

- **The liability valuation part**
  - Customization per product/country
    - Product feature (GMxB configuration)
    - Actuarial assumption (Mortality, Lapse configuration)
    - Policies
    - Run settings (scenario, policies, shock configuration)
ALEHS liability valuation software (MoSes)

- The Standalone mode

Number of iteration = Number of policies * Number of scenario

Expected time of the whole run (for a given shock)
ALEHS liability valuation software (MoSes)

- **The Master/Worker mode**

Number of workers (tasks) used

Split strategy (Scenario or policies)

Number of iteration = (Number of policies * Number of scenario) / Number of workers

* Number of scenario) / Number of workers
The run time issue

- The main parameters impacting the run time
  - The number of policies in the contract
  - The maturity of each contract
  - The number of invested funds
  - The number of scenario for the Monte Carlo simulation
  - The number of “shocks” for greek calculations
The run time issue

Greek calculation Loop
{
    Policy Loop
    {
        Scenario Loop
        {
            Maturity Loop
            {
                Invested Fund Loop
                {
                    // Application Code
                }
            }
        }
    }
}
The run time issue

- ALEHS strategies to reduce the runtime
  - Reduce the I/O access during the projection
  - Compression of the number of policies
  - Variance reduction strategy (Monte Carlo)

=> Must rely on a powerful grid computing technology
• ALEHS uses DataSynapse GridServer technology to parallelize a MoSes program.

AXA Grid Infrastructure (129 servers)
• 2 strategies to dispatch one MoSes program in the grid
  – Dispatching by scenario (Number worker = Number scenario / range of scenario per worker)
  – Dispatching by policies (Number worker = Number of policies / range of policies per worker)

• Execution time # (Standalone execution time) / Number of workers
Conclusion

• Variable annuities' hedging using Monte Carlo simulation is highly time and IT consuming

• Algorithmic and Numerical methods can help reducing the run time but …

=> A large grid infrastructure as well as a powerful grid computing middleware is necessary to price these products on a daily basis.
THANK YOU