**Risk Management: Assignment 4**

***Financial Engineering***

*Credit Portfolio Single Factor Model*

**Instructions**

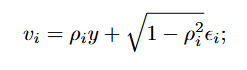
* **Delivery:** Sunday 6 April 24:00 to [financial.engineering.polimi@gmail.com](mailto:financial.engineering.polimi@gmail.com), with subject “RM: Assignment 4, Group #”;
* Deliver
  1. a **short** pdf document with the results. List the errors you’ve found.
  2. the code written in Python using your preferred IDE;
* Fill the gaps where appropriate and correct the errors (in case of incoherences between this document and the code, follow this document);
* Comment (in detail) the code and use explicative variable names.
* Use the data and the curve bootstrapped during the Risk Management: Assignment 0.

**Case Study**

It is January 31st, 2023 and the credit desk of Polimi Bank has 100 zero-coupon bonds with 2y maturity that pay €1Mln at maturity, issued by different corporations with initial rating Investment Grade.

Polimi Bank risk managers adopt the following credit portfolio model:

* Portfolio credit VaR with 99% confidence level and one year time horizon;
* Presence of default and migration risk;
* Two rating classes only (IG and HY);
* Single factor model:



* Recovery rate π = 40% for all issuers;
* One year transition matrix as in RM Assignment 2;

Given this framework, they ask the trading desk to:

1. Mark-to-market the portfolio;
2. Derive the 1y forward price of a zero-coupon bond with one year residual maturity, under the assumption that the rating of the issuer one year from now is investment grade;
3. Derive the 1y forward price of a zero-coupon bond with one year residual maturity, under the assumption that the rating of the issuer one year from now is high yield;
4. Execute a Monte-Carlo simulation with ρ = 15% using at least 1,000,000 scenarios and:
   1. Count the average number of defaults;
   2. Count the average number of downgrade events;
   3. Evaluate the 99% VaR by taking into account defaults only;
   4. Evaluate the 99% VaR by taking into account defaults and migrations.
5. Repeat the Monte-Carlo VaR calculation of point 4, by taking into account defaults and migrations with the following assumptions on the correlation: ρ = 0% and ρ = 30%;
6. Rank the VaRs in comparison to the baseline and discuss the following topics: the relevance of migration risk vs. default risk and the relevance of the level of correlation.
7. Assume that in case of a downgrade the recovery rate drops to 10% with the same probability of default as before. How would you modify the above framework in order to account for this additional risk? Support your discussion with numerical results.