Financial Risk Laboratory: 1. Pricing Risky Bonds

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Case 1 Risk Management

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Subject mail: Assignment 1 Group # RM

POLIMI Bank: Portfolio

The **Corporate Bond** desk of POLIMI Bank has the following stylized position on fixed rate bonds issued by the firm *Alpha* with rating Investment Grade (IG) and the firm *beta* with rating High Yield (HY)

- Long \$10m (notional) - IG bond with one year maturity and s/a coupon payments, annual coupon rate 5.0%, market price (dirty) 99.5705
- Long \$10m (notional) - IG bond with two years maturity and s/a coupon payments, annual coupon rate 5.5%, market price (dirty) 100.5420
- Long \$10m (notional) - HY bond with one year maturity and s/a coupon payments, annual coupon rate 4.5%, market price (dirty) 97.0445
- Long \$10m (notional) - HY bond with two years maturity and s/a coupon payments, annual coupon rate 4.75%, market price (dirty) 96.4160

Rating Transition Matrix

Students shall use a simplified rating transition matrix, with only two rating grades. See below:

	IG	HY	Def
IG	q_{11}	q_{12}	q_{13}
HY	q_{21}	q_{22}	q_{23}
Def	0	0	1

Legend: Investment Grade (IG), High Yield (HY), Defaulted (Def).

Transition probabilities are defined over a *one year* time horizon. Transition probabilities to the *Defaulted* state (q_{i3}) are one-year unconditioanl default probabilities[1].

[1] Denoted by the symbol *PD* in the BCBS documents

Questions, First Part

The management of *POLIMI Bank* asks the risk management department for the risk measures associated to each bond:

- Z-spread
- Hazard rate curve for each issuer
- Rating transition matrix

Your are therefore required to answer to the following questions

1. Derive the hazard rate curves for IG and HY issuers assuming piece-wise constant hazard rate (see example on the Matlab template) and assuming the recovery rate $\pi = 0.40$
2. Derive the Z-spread (four scalars, each one corresponding to a bond)

Discussion

Let now consider that the hazard rate $h(t, T)$ is a stochastic variable (as t changes)

Let us simplify the problem as follows:

- we evaluate only the hazard rate up to the one-year time horizon;
- we assume across this time horizon the hazard rate is constant, denoted by $h(t)$.

The survival probability is therefore :

$$P(t, T) = e^{-h(t)(T-t)} \quad T - t \leq 1 \tag{1}$$

Let us finally assume that the hazard rate takes discrete values and that it is associated to the Markov chain of the rating $R(t)$, i.e.

$$h(t) = \begin{cases} h_{IG} & \text{if } R(t) = IG \\ h_{HY} & \text{if } R(t) = HY \end{cases}$$

Questions, Second Part

1. Derive the market-implied rating transition matrix based on the available market data (ZC risk-free curve and risky bond prices)

It is not compulsory to deliver some Matlab code to answer the question above. If you decide not to deliver Matlab code, show your calculations in the one-page pdf document.

Case 2: Instructions

From course beep download:

- Ex01_template.m: Code template

Follow instructions on code template.
Deliver by email your Matlab code (*runExerciseRM1_GroupXX.m*) and a one–page document (pdf) with results and explanations.