FBA | QUANTITATIVE FINANCE
RESEARCH GROUP

Financial Engineering

Homework 5

Due at 07:00 pm (Korea Standard Time) on Saturday, March 18.

Submit one file: written solutions with executable Python code

Problem 1. Reproduce the payer-swaption lattices in the Coursera Lecture. Now experiment with different values of b (but re-calibrating each time so that the spot rate curve remains unchanged) to see how sensitive the swaption price is to the particular value of b that you choose. (Among other things, this should highlight the importance of calibrating models correctly and understanding whether or not your model is appropriate for the problem at hand. For example, we know that option prices are sensitive to volatility and since b is a volatility parameter in the BDT model, it is clearly important to calibrate it accurately. In fact we may wish to choose and calibrate a separate bi for each time period. If we were pricing a swaption where the underlying swap expired after 10 years instead of just 10 months we would also want to consider whether or not a model that cannot, for example, incorporate mean-reversion should be used for such a task.)

Problem 2. Price the payer-swaption in the Coursera Lecture but now assume that it may be exercised at any time, $t \in \{2, 3, \cdots, 9\}$, and that the fixed rate in the underlying swap contract is now set at 11.65%. If exercised at time t then the first cash flow occurs at t + 1 based on the short rate prevailing at time t. (Such an instrument is called a Bermudan swaption.)

Problem 3. Construct a short lattice for periods (years) 0 through 9 with an initial rate of 6% and with successive rates determined by a multiplicative factor of either $u = 1.2$ or $d = .9$. Assign the risk-neutral probabilities to be .5.

(a)   Using this lattice, find the value of a 10-year 6% bond.

(b)   Suppose this bond can be called by the issuing party at any time after 5 years. (When the bond is called, the face value plus the currently due coupon are paid at that time and the bond is canceled.) What is the fair value of this bond?

(c)   Use the forward equation to find the spot rate curve for the lattice.

Problem 4. What is the expected number of cards that need to be turned over in a regular 52-card deck in order to see the first ace?

Problem 5. Solve the corresponding leetcode problem below and register the solution on GitHub.

https://leetcode.com/problems/two-sum/

https://github.com/fbaquant/leetcode-challenge/issues

Problem 6. Solve the corresponding leetcode problem below and register the solution on GitHub.

https://leetcode.com/problems/valid-palindrome/

https://github.com/fbaquant/leetcode-challenge/issues