

## Homework 7. Quantitative Methods for fixed Income Securities

1. Answer the following questions.
  - a. What do we mean by “replication pricing”?
  - b. What do we mean by “risk-neutral valuation”?
  - c. Why do we require a stock-price binomial tree or an interest-rate tree to price the stock or zero-coupon bonds correctly?
2. In November 15, 2017, we consider pricing a call option on “2s of November 15, 2032” using the binomial model with  $\theta = 0.004$  and  $\sigma = 0.01$ . The maturity of the option is 5 years, and the strike price is \$99. The current spot rate curve for **semi-annual compounding** is

$$\hat{r}(i/2) = 0.018 + 0.001 \times (i-1)/2, \quad i = 1, \dots, 60.$$

(Hint: make us of the Matlab codes supplied for the course.)

3. [Continued from Problem 1] Price the put option on the bond for the same maturity and strike price.
4. In November 15, 2017, the forward-rate curve for **semi-annual compounding** is

$$f(i/2) = 0.02 + 0.001 \times (i-1)/2, \quad i = 1, \dots, 60.$$

- a. Calculate and plot the discount curve.
  - b. Calculate and plot the spot swap rate curve.
  - c. Calculate the in-5-to-10 swap rate (i.e., the swap rate for the swap for the period from 5 to 15 years).
  - d. Calculate the value of the swaption on the in-5-to-10 **payer’s** swap (i.e., the maturity of the swaption is 5 years, and at the option’s maturity the underlying swap has a 10-year maturity) with the strike rate obtained in c, using the binomial model with  $\theta = 0.005$  and  $\sigma = 0.01$ .
5. [Continued from Problem 3] Price the swaption on the in-5-to-10 **receiver’s** swap for the same strike rate.