TIØ4140 Project Evaluation and Financing

Exercise 3: Swaps, and option valuation

Posted: Monday, January 27, 2025, Morning.
Deadline: Tuesday, February 4, 2025, 23:59.
Grading: Approved / Not approved.

N.B.:

- *To get "Approved", you should attempt to solve all mandatory tasks and have **70%** correct.*
- *Remember to write down the **main solution steps**!*

Overview of Tasks

- **Mandatory Tasks:** The following problem from McDonald (2013):
  - **Ch. 10** Swaps 2
  - Programming of Binomial options: Valuation of European and American options
  - From other source
- **Voluntary Tasks:**
  - **Ch. 10** Swaps 5

Mandatory Tasks

- **Problem from McDonald (2013):**

10. 2. Suppose that oil forward prices for 1 year, 2 years, and 3 years are $20, $21, and $22. The 1-year effective annual interest rate is 6.0%, the 2-year interest rate is 6.5%, and the 3-year interest rate is 7.0%.

a. What is the 3-year swap price?

b. What is the price of a 2-year swap beginning in one year? (That is, the first swap settlement will be in 2 years and the second in 3 years.)

- **Programming of Binomial pricing of European and American options**

This task is to construct in **Python** a program for valuing European and American options on stocks using the Binomial Model. For this question, both user defined functions and sub routines are accepted. For **both tasks**, also briefly comment on what you do in your code via another document in text format.

a. Write a program that gives the value of **European** calls/puts on stocks paying continuous dividends using the Binomial Model.

b. Write a program that gives the value of **American** calls/puts on stocks paying continuous dividends using the Binomial Model.

Hint: You can use your code for pricing European options as a basis for pricing American options.

- **Problem from other source**

The volatility of a non-dividend-paying stock whose price is $78, is 30%. The risk-free rate is 3% per annum (continuously compounded) for all maturities. Calculate values for u, d, and p when a 2-month time step is used. What is the value a 4-month European call option with a strike price of $80 given by a two-step binomial tree. Suppose a trader sells 1,000 options (10 contracts). What position in the stock is necessary to hedge the trader's position at the time of the trade?

Voluntary Tasks

- **Problem from McDonald (2013)**

  10.5 Consider the same 3-year swap. Suppose you are a dealer who is paying the fixed oil price and receiving the floating price. Suppose that you enter into the swap and immediately thereafter all interest rates rise 50 basis points (oil forward prices are unchanged).

  a. What happens to the value of your swap position?
  b. What happens if interest rates fall 50 basis points?
  c. What hedging instrument would have protected you against interest rate risk in this position?

References

McDonald, R. L. (2013). *Derivatives markets*. 3rd. ed., New International Edition. Pearson Education.