

Computational Finance and FinTech – Exercises 6.1

Exercise 1. Write a function that calculates the replicating portfolio (x, y) for an arbitrary claim $\Phi(Z)$ in a one-period model. Use `np.linalg.solve`.

Test your function on the example from class, where $r = 5\%$, $S_0 = 100$, $u = 1.2$, $d = 0.8$, and the claim under consideration is a call option with strike price $K = 105$.

Exercise 2. Write a function that calculates the risk-neutral probabilities and test your function on the example from class, where $r = 5\%$, $S_0 = 100$, $u = 1.2$, $d = 0.8$.

Exercise 3. A stock price is currently trading at €40. It is known that at the end of one month it will be either €42 or €38. The risk-free interest rate is 8% per annum with continuous compounding (verify first that this is the same as a monthly interest rate of 0.6689%).

- (a) What is the value of a one-month European call option with a strike price €39?
- (b) Explain how the seller of the option can hedge their exposure.
- (c) Explain how one could make an arbitrage profit if the option traded in the market for €2.
- (d) Calculate the option price via the risk-neutral expectation.

Exercise 4. Assume a CRR model with annual price jumps. Today's stock price is $S_0 = 100$ and assume an annualised volatility of 33%. Let $r = 5\%$ p.a.

Determine the price of a call option with strike $K = 105$ and maturity $T = 3$.

(Hint: Import the package `scipy.stats`.)