## Computational Finance and FinTech – Exercises 7

Exercise 1. Write functions that calculate the Black-Scholes price, delta, gamma and vega of a European call option.

Compute the price and sensitivies of a call option with parameters  $S_0 = 100$ , K = 100, T = 1,  $\sigma = 20\%$  and r = 5%. Give an interpretation of the sensitivities.

**Exercise 2.** Create a plot of the call price surface as a function of time t and stock price  $S_t$ . Parameters you could use: K = 100, T = 1,  $\sigma = 20\%$  and r = 5%.

**Exercise 3.** Use Monte Carlo simulation to price a **compound option**. A compound option is an option on an option, e.g. a call option to acquire a call option. The option to be priced is a call on a call with the following parameters:  $S_0 = 100$ ,  $\sigma = 20\%$ , r = 5%,  $T_1 = 1$ ,  $T_2 = 2$ ,  $K_1 = 10$ ,  $K_2 = 100$ . Set the simulation interval to n = 100,000 and calculate a 95%-confidence interval.

(Hint: The analytical price of the option is 8.8465.)

## Exercise 4. (optional)

This is an exercise in backtesting. Load the data from tr\_eikon\_eod\_data.csv (see Chapter 5 on Financial Time Series and Problem Set 3). Create a data frame with discrete returns. Now run the following two trading strategies, each with an initial investment of 100 EUR:

- Buy-and-hold: Invest half of the investment amount in each Apple and Amazon and hold it.
- Constant mix: Invest half of the investment amount in each Apple and Goldman Sachs and rebalance the portfolio each day to maintain weights of 50%.

Plot the portfolio values in a time-series graph.