# Assignment 1

Due date: Monday, September $29^{th}$, 12:30 pm.

## Exercise 1

Consider a non-dividend-paying stock with current value $S = 100$. Under the risk-neutral measure, the stock follows a jump-diffusion process

$$\frac{dS}{S} = (r - \lambda^Q \gamma)\, dt + \sigma\, dW_t + \gamma\, dN_t.$$

Assume the following parameters:

- $\gamma = -0.08$, i.e., the stock price is subject to downward jumps of 8%;
- $\lambda^Q = 0.2$, i.e., an average of 1 jump every 5 years (under $Q$);
- $\sigma = 0.2$; and
- $r = 0.04$.

Your task is to compute the value of a call option at the following expirations:

$$T = 0.02,\ 0.08,\ 0.25,\ 0.5,$$

that is, approximately 1 week, 1 month, 3 months, 6 months, with strike prices

$$K/S = 0.8,\ 0.9,\ 1.0,\ 1.1.$$

For every expiration $T$, plot the Black–Scholes implied volatility of the option as a function of strike $K/S$.

### Instructions for the submission

Please produce a short report explaining your work. Do not include a cover page, but ensure that your group name and the names of the group members are clearly indicated. Any mathematical derivations ought to be included in the report.

For this assignment, your report must include four clear figures showing the implied volatility as a function of strike, for each expiration. Turn on gridlines for your figures; e.g., in python using `plt.grid()`.

Please do not include extensive listings of code in the report. You must submit your code separately. This code must run and produce the same results shown in your report!

Ask your tutor if you have any questions.