

Computational Finance

Computer Lab 1

The aim of the Lab is to get acquainted with the Python programming language. Try to solve the problems by consulting the document "Python commands needed for this course" if necessary. If you run into trouble, please ask for help immediately!

Exercises:

1. Compute first 30 Fibonacci numbers, which are defined by equations

$$f_0 = 1; f_1 = 1; f_i = f_{i-1} + f_{i-2}, i \geq 2.$$

2. Generate $n = 20$ values from the standard normal distribution and store the values in a vector \mathbf{x} . Compute the values of the vector \mathbf{y} defined by

$$y_0 = x_0; y_{n-1} = x_{n-1}; y_i = \frac{x_{i-1} + x_i + x_{i+1}}{3}, i = 1, 2, \dots, n-2.$$

3. Define a function $g(x) = \sin(2x) + \frac{\cos(x)}{2x}$. Plot the graph of the function for $1 \leq x \leq 10$ by using the values of the function at 101 points.
4. Write a function **simpleMax(f,a,b,n)** that computes approximately the maximal value of the function f over the interval $[a, b]$ by evaluation it at the points $a, a + h, a + 2h, \dots, b$, where $h = \frac{b-a}{n}$. Use the function **simpleMax** to compute approximately the maximal value of the function g from the previous exercise for $x \in [1, 3]$ in the case $n = 200$ (answer should be 1.1794485797597516).
5. Write a function **Simple2dMax(f,a,b,m,c,d,n)** which computes approximately the maximum of a function of 2 variables by computing the maximal value at the points

$$x_i = a + ih_1, y_j = c + jh_2, i = 0, \dots, m, j = 0, \dots, n,$$

where $h_1 = \frac{b-a}{m}$, $h_2 = \frac{d-c}{n}$. Test correctness of the function by computing the maximal value of $u(x, y) = x^2 + xy - 2y^2$ over the unit square $0 \leq x \leq 1, 0 \leq y \leq 1$ in the case $m = 10, n = 20$ (the answer should be 1.125).

6. Extra problem. Use the function **np.meshgrid()** for implementing the function **Simple2dMax()** without any **for** cycles.