Numerical Methods for Financial Mathematics.

Exercise Handout 1

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Exercise 1

Write a class FloatAndDouble with a method computeBiggestEpsilon that takes two double numbers x and x_0 as arguments, computes the biggest $\epsilon = 2^{-n}$ such that $|x - x_0| > \epsilon$ and returns n and ϵ . In a main method, let $x = 3 \cdot 0.1$ be of type double and $x_0 = 0.3$ be a float. Check that $x_0 \neq x$. Call the method above for x and x_0 . Repeat the analysis by now declaring x_0 to be of type double.

Exercise 2

Write a class McLaurinCosine with a static method which approximates $\cos(x)$ for $x \in (0, \pi)$ by means of a McLaurin series expansion, i.e.,

$$\cos(x) \approx \sum_{k=0}^{n} \frac{(-1)^k x^{2k}}{(2k)!},$$

taking as arguments x itself and the order n. In the computation of the expansion, store here the factorial as an int.

Also write a method which takes as argument an integer value maxOrder and prints the absolute difference between your approximation and the value returned by Math.cos(double x), for increasing order from 1 to maxOrder. In a main (this can also be part of the class McLaurinCosine) call this last method for x = 3 and maximum order 15. What does it happen here? Try to get what's the problem and to fix it.

Optional: you might consider to implement now the approximation of cos(x) also for values of x not in the interval $(0, \pi)$, basing on the implementation of the method you have written.

Exercise 3

Write two methods floatHarmonicSumForward and doubleHarmonicSumForward which compute the harmonic sum

$$1 + \frac{1}{2} + \dots + \frac{1}{N},$$

using single precision (float) and double precision (double) respectively, and compare the result that you obtain. Write two more methods floatHarmonicSumBackward and doubleHarmonicSumBackward that still compute the harmonic sums but going backwards, i.e.

$$\frac{1}{N} + \dots + \frac{1}{2} + 1.$$

Compare the results with the ones obtained going forward. What did it happen?