

Homework 1: Preliminary programming

Due date: August 14, 2024

The objective of this homework is to get used to a programming environment. You can choose to work with Matlab or Python. You will submit the codes as individual files. The results will be submitted as a single pdf file.

Q 1. Consider a univariate function $f(x) = \frac{-0.1x}{(1+0.1x)(1+0.05x)}$. Plot a graph of this function for $x \in [0, 30]$.

Q 2. Consider a univariate function $f(x) = \cos^2(x) + 0.1x$. Plot a graph of this function for $x \in [-5, 5]$.

Q 3. Consider the following multivariate function:

$$f(x) = (x(1)^2 + x(2) - 11)^2 + (x(1) + x(2)^2 - 7)^2 \quad (1)$$

Plot a contour plot of this function for $x(i) \in [-6, 6]$.

Q 4. Given a multivariate function $f(x)$, write a code to compute its gradient and Hessian at a point. Use center difference formula to compute numerical derivative. You can test the code using the function given in eq. (1). At point $(1, 2)$, the following answer is expected.

$$\begin{aligned} \nabla f &= \begin{bmatrix} -36 & -32 \end{bmatrix}^T \\ \nabla^2 f &= \begin{bmatrix} -22 & 12 \\ 12 & 26 \end{bmatrix}^T \end{aligned}$$

Q 5. Given a symmetric matrix, write a code to determine its definiteness using Gauss elimination-based approach. Use this code to determine if the Hessian obtained in the above question is positive definite or not.