

University of Macerata
Mathematical Methods for Economics and Finance

Exam

September 13, 2023

Surname:

Name:

Student number:

Please, save your work in a Matlab script entitled **YourSurname_YourStudentNumber.m** and send it to mauromaria.baldi@unimc.it by the end of the exam.

Don't forget to write your surname, name and student number on each sheet you are submitting.

1. Consider the following matrix:

$$\mathbf{A} = \begin{bmatrix} 1 & 0 & 3 & 0 \\ 0 & 2 & 0 & 5 \\ 3 & 0 & 4 & 0 \\ 0 & 5 & 0 & 6 \end{bmatrix}.$$

State (both analytically and with Matlab) whether it is definite (positive or negative), semidefinite (positive or negative) or indefinite.

2. Sketch the domain of the following function:

$$f(x, y) = \frac{\sqrt[3]{x+y}}{2x-y} + \ln(4-x^2-y^2).$$

3. Consider the following function defined on \mathbb{R}^2 :

$$f(x, y) = xy^2 + x^3y - xy.$$

- a) plot its graph in Matlab
- b) find all the critical points
- c) for each critical point found at point b), perform the Hessian test to state, when it is possible, whether the point is a local minimum, a local maximum or a saddle point

- d) *(Optional) for each local minimum and local maximum, use the `fminsearch()` function in Matlab as a confirmation of the analytical computations.*
4. Determine the annual IRR for the following project: $\{(-100, 30, 80), (0, 2, 4)\}$ both analitically and by using Matlab.