

University of Macerata
Mathematical Methods for Economics and Finance

Exam

June 09, 2023

Surname:

Name:

Student number:

1. You borrow \$ 1000 at $i = 11\%$, **simple** interest. You decide to repay the loan in **equal** payments at months 3, 6, and 9. Find the size of the payments.
2. In Matlab:
 - Store in the array v the multiples of 4 between 8 and 24
 - Remove the last element of v and store the result again in the array v
 - Store in the array $v1$ the first half of v and in the array $v2$ the second half of v
 - Create the matrix A having the arrays $v1$ and $v2$ as rows
 - Divide all the elements of the matrix A by 4 and store the result again in A
 - Subtract 2 from all the elements of the matrix A and store the result again in A
 - Let $f(x) = x \cos(x)$ and $g(x) = \sqrt{x} - \ln(1 + x)$. Make a plot in the same figure of f and g (possibly with different colors and labels along the axis) with x ranging from 0 to 20
 - Compute $f(A)$ and store the result in the matrix B
 - Compute $g(A)$ and store the result in the matrix C
 - Can we compute $B + C^T$? If so, store the result in the matrix D .

Please, save your work in a Matlab script entitled **YourSurname_YourStudentNumber.m** and send it by email to the teacher within the end of the exam.

3. Sketch the domain of the following function:

$$f(x, y) = \ln(x^2 + y^2 - 1) - \frac{\sqrt{4 - x^2 - y^2}}{x + y}$$

4. Consider the following unconstrained nonlinear programming problem:

$$\min_{(x, y) \in \mathbb{R}^2} f(x, y) = 2x^2 + y^2 - xy + x - y$$

- (a) Find all the stationary points of f .
 - (b) For each stationary point found say whether it is a local maximum, or a local minimum, or a saddle.
5. Find the points satisfying first order conditions to the problem consisting of the function $f(x, y, z) = x + y + z$ subject to the constraint $x^2 + y^2 + z^2 = 1$. Optional: can you prove the existence of a global maximum and minimum? If so, why?