

University of Macerata
Mathematical Methods for Economics and Finance

Exam

December 20, 2023

Surname:

Name:

Student number:

Please, save your work in Matlab in a file entitled:

YourSurname_YourStudentNumber

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. You invest an amount of money, let's say w_0 , at an annual interest rate of $i = 0.1$, following a simple interest rule. After three months, you change your mind: you withdraw the invested amount, taking into account the accumulated interest, and reinvest it for an additional nine months. This time, the interest is compounded at the same rate, $i = 0.1$. At the end of this combined period, you have a total of 1000 euros.

Now, the questions are:

- (a) What is the initial amount of money, w_0 ?
- (b) What is the intermediate amount of money after the first three months?

2. In Matlab:

- Save into the array v the integers from 1 to 16.
- Split this array in four equal-size arrays named v_1 , v_2 , v_3 , v_4 , where v_1 is the first quarter of v , v_2 is the second, etc.
- Form the matrix A having the vectors v_1 , v_2 , v_3 , and v_4 as rows.
- Form the matrix B having the vectors v_1 , v_2 , v_3 , and v_4 as columns.

- Store into the matrix C the difference between the matrix A and the matrix B .
 - Store into the matrix D the transpose of the matrix C .
 - Form the matrix E equal to the matrix D and then set all the elements in the third row equal to 1.
 - Delete from the matrix E the last row and the last column.
 - Consider the functions f and g such that $f(x) = (x - 1)^2$ and $g(x) = x \sin(x)$. Compute $F = f(E)$ and $G = g(E)$.
 - Draw a 1×2 plot with the function f in the left subplot and the function g in the right subplot.
3. Find the eigenvalues of the matrix

$$A = \begin{bmatrix} 1 & 6 \\ 5 & 2 \end{bmatrix}.$$

For each eigenvalue, find a corresponding eigenvector. Optional: for each eigenvalue, find a corresponding normalized eigenvector.

4. Let $f(x, y) = (8x^2 - 6xy + 3y^2) e^{2x+3y}$. Find and classify its stationary points. Optional: use the `fminsearch` command in Matlab to check possible local minimum points. How would you use the `fminsearch` to check local maximum points?
5. Optional: provide a graphical proof of the first-order conditions for a two-variable continuous and differentiable function $f(x, y)$ to be maximized under the constraint $h(x, y) = c$, where h is another continuous and differentiable function.