University of Macerata
Mathematical Methods for Economics and Finance

Exam Simulation

May 08, 2024

1. Financial mathematics:
   - We have 500 euro today and we want to invest this amount for 6 years with simple interest rule. For the first 3 years it is applied the interest rate of 8% while for the last 3 years it is used $i_4 = 0.01$. Determine the final value of the investment.
   - Consider 1000 euro disposable at time $t = 2$ and a montly interest rate of 0.5% with the exponential interest rule. Determine the equivalent amount of money at times $t = 1.5$ and $t = 6$.
2. In Matlab:
   - Define the vector $\mathbf{v}$ as the vector whose elements are the integer numbers from 1 to 20.
   - Set the elements in odd position equal to -1 and store the result again in the vector $\mathbf{v}$.
   - Set the elements in even position equal to the respective elements of the array of integers ranging from 10 to 1 and store the result again in the vector $\mathbf{v}$.
   - Starting from the vector $\mathbf{v}$, form four vectors $\mathbf{v}_1$, $\mathbf{v}_2$, $\mathbf{v}_3$, and $\mathbf{v}_4$, where $\mathbf{v}_i$ (with $i \in \{1, 2, 3, 4\}$) is the$i$-th quarth of the vector $\mathbf{v}$.
   - Create the matrix $\mathbf{A}$ whose rows are the vectors $\mathbf{v}_1$, $\mathbf{v}_2$, $\mathbf{v}_3$, and $\mathbf{v}_4$.
   - Create the matrix $\mathbf{A}$ whose columns are the vectors $\mathbf{v}_1$, $\mathbf{v}_2$, $\mathbf{v}_3$, and $\mathbf{v}_4$.
   - Let $\mathbf{C}$ be the matrix $\mathbf{A}$ without the first row and the first column.
   - Let $\mathbf{D}$ be the matrix $\mathbf{B}$ without the last row and the last column.
   - Compute $\mathbf{E} = \mathbf{C} + \mathbf{D}^T$.
   - Let $f(x) = \sqrt{|x|}\cos x$ and $g(x) = \frac{x^2}{e^x}$. Create a subplot with the graph of f in the first subplot and the graph of g in the second subplot. The two graphs should be in the interval $[-6, 6]$.

- Is it possible to compute $f(\mathbf{D}) + g(\mathbf{E})^T$? If so, store the result in a new matrix $\mathbf{F}$.

3. Graphically sketch the domain of the function

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

4. Consider the function

$$f(x, y) = e^{2x-3y}.$$

After graphing the function, find the second-order Taylor polynomial of f centered at $\mathbf{x}_0 = (1,\, 0)$.

5. Manually find the eigenvalues of the following matrix:

$$\mathbf{C} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -2 & 1 \\ 1 & 2 & 1 \end{bmatrix}.$$

Moreover, find an eigenvector associated to each eigenvalue. Finally, check your results in Matlab.