

Università del Piemonte Orientale - DISEI
Business Intelligence for Finance (EC0149)

The following exercises are intended only as examples and do not constitute an exhaustive list of all the possible types of exam exercises.

Exercise 1. (COMPULSORY) Create the Matlab file **Exercise1**. In the file **Exercise1** solve points from (a) to (g).

- (a) Build a random square matrix A of dimension 3 and extract the square submatrix B of dimension 2, where $B = [a_{11}, a_{13}; a_{31}, a_{33}]$.
- (b) Use suitable Matlab commands to extract the diagonal of B .
- (c) Use suitable Matlab commands to transform the diagonal of A into the vector $v = [2, 2, 2]$.
- (d) Let $n = 5$. Generate a vector u of length 5 containing all the natural numbers from 1 to 5, then generate the vector v having as components the squared components of u (use suitable Matlab commands).
- (e) Generate the vector z whose i -th component is $z(i) = u(i) * \exp(v(i))$ through a **for** loop.
- (f) Compute the sum $s = \sum_{i=1}^5 u(i) * \exp(v(i))$ by using the Matlab commands.
- (g) In a file named **funEx1**, write a function that computes, for every n , $wn = \sum_{i=1}^n u(i) * \exp(v(i))$ through a **while** loop, and use this function to compute the previous sum from 1 to 5 in the file Exercise1. Check that you obtain the same result as in point (f).

Exercise 2. (a) Create the Matlab function **funEx2** which takes a vector x as an input and evaluates the following function:

$$y = f(x) = \begin{cases} 1 & \text{if } x \leq 3 \\ |x - 4| & \text{if } 3 < x \leq 7 \\ (x - 7)^2 + 3 & \text{if } x > 7 \end{cases}$$

by a **for** loop.

- (b) Create the Matlab file **Exercise2**. In the file **Exercise2** plot the graphic of the function defined in **funEx2** on the interval $[0,8]$, with a step of 0.1.
- (c) In the file **Exercise2**, define the same function as before by using @ and the logical operators (without a for loop) and overlap the graphs of the two functions to verify that they are identical, by using different colors and markers. Save the graph with the name **figureEx2**.

Exercise 3. Create the file **Exercise3** and in the file:

- (a) Plot the graphic of the following function:

$$y = f(x_1, x_2) = 2x_1^4 + 3x_1x_2 + 4x_2^2 - x_2$$

for $x_1, x_2 \in [-1, 1]$ (step 0.1).

- (b) Plot the graphic of the restriction of the function to $x_2 = 1/8$, that is

$$f(x_1, x_2 = 1/8),$$

and $x_1 \in [-1, 1]$.

- (c) By using the Matlab function **fminunc** find the minimum point of $f(x_1, x_2)$ starting from $x_0 = (1, 0)$. Can you improve the choice of the starting point? Justify your answer in the file.
- (d) Evaluate the gradient and the Hessian matrix at the minimum point. What are the properties that the gradient and the Hessian matrix should fulfill at the minimum point? Justify your answer in the file.