Martin Luther University Halle-Wittenberg
Professor Dr. O. Holtemöller

Problem Set 1

Advanced Macroeconomics

Winter 2025/26

Get Started

Open Octave or Matlab, create a new file getstart.m and write a code for the following operations:

1. Matrices
   (a) Enter a matrix with numerical values:

$$A = \begin{pmatrix} 16 & 3 & 2 & 13 \\ 5 & 10 & 11 & 8 \\ 9 & 6 & 7 & 12 \\ 4 & 15 & 14 & 1 \end{pmatrix}$$

   (b) Calculate the sum per column.
   (c) Transpose the matrix.
   (d) Calculate the sum per row of the matrix.
   (e) Display the diagonal of the matrix.
   (f) Calculate the sum of the diagonal elements.
   (g) Calculate the sum of all elements in the 4th column.
   (h) Use the colon operator to display
      - the numbers from 1 to 10.
      - numbers backwards from 100 to 50 in steps of 7.
      - elements 1 to 4 of the 4th column of matrix A.
      - elements 1 to 4 of the last column of matrix A.
2. Expressions
   (a) Define a variable with the number of students in the course.
   (b) Define a variable $aa = 2 + 2$ and use it for the following calculations:

i. $bb = aa - 1$
ii. $cc = aa \times bb$
iii. $dd = cc/aa$
iv. $ee = aa^3$
v. $ff = (aa + bb)cc$
vi. $gg = (1 + \sqrt{5})/2$
vii. $hh = \ln(gg)$
viii. $ii = \exp(hh)$

3. Working with matrices

   (a) Matrix generation

   - Generate a matrix Z with 2 rows and 4 columns filled with zeros.
   - Generate a matrix F with 3 rows and 3 columns filled with fives.
   - Generate a matrix N with 10 random whole numbers between 0 and 9.
   - Generate a 4×4 matrix R random numbers given the normal distribution.

   (b) Element-wise operation

   - Do an element-wise exponentiation of N with exponent 2.
   - Do an element-wise multiplication of A with A.

   (c) Create a concatenated matrix B of fourfold dimension of matrix A.

   (d) Create a matrix $X = A$ and delete the second column.

   (e) Linear algebra

   - Add matrix A' to matrix A.
   - Multiply matrix A' with matrix A.
   - Calculate the inverse of matrix R.
   - Multiply the inverse by the original matrix.
   - Define a matrix v with 4 rows and 1 column (column vector), consisting of ones.
   - Multiply matrix A by v.

4. Arrays

   - Build a 10×3 table with different numerical values. Create first a column vector n with values from 0 to 9. Then, apply a formula using the respective element of n (n^2 and 2^n, e. g.) to fill the other two columns with numerical values.
   - Build a table that contains values of a variable x in the first column and its logarithm base 10 in the second column.

- Create a matrix

$$D = \begin{pmatrix} 72 & 134 & 3.2 \\ 81 & 201 & 3.5 \\ 69 & 156 & 7.1 \\ 82 & 148 & 2.4 \\ 75 & 170 & 1.2 \end{pmatrix}.$$

  Calculate mean μ and standard deviation σ of every column.
- Expand the scalar 8.5 by an element-wise operation as $B = A - 8.5$.
- Set the elements B_{12} to B_{23} to zero.
- Define a vector

$$x = [2.1, 1.7, 1.6, 1.5, \text{NaN}, 1.9, 1.8, 1.5, 5.1, 1.8, 1.4, 2.2, 1.6, 1.8],$$

  and display all finite values of the vector.
- Keep only the elements of x that are finite numbers.
- Keep only the elements of x that absolutely deviate less than 3 standard deviations from the mean (remove outliers).
- Redefine the matrix B as $B = A$. Overwrite all numbers in B that are not prime with zeros.
- Define a row vector k with the position of all elements in A that are prime. Display those elements of A. After that, set them to NaN.

5. Controlling Input and Output

   - Create a vector $x = [4/3, 1.2345 \exp(-6)]$ and display it using different formats.
   - Create a magic 10×10 matrix A and suppress the output.
   - Enter a long statement with line brake.

6. Graphics

   - Create a plot of $y = \sin(x)$. Add axis labels and a plot title.
   - Create a plot with several functions $\sin(x)$, $\sin(x - 0.25)$, and $\sin(x - 0.5)$ and aadd a legend.
   - Open a separate figure window for your sinus function.
   - Clear an existing figure object for a new plot.
   - Create a plot with several subplots. You can choose $\sin(x)$, $\cos(x)$, $\ln(x)$, and $\exp(x)$, for example.
   - Discover and try other features of plot settings.

7. Programming

- Define $a = 1$ and $b = 2$. Using the if-statement, check if a is greater, equal, or smaller that a. Display the result of the check in the command window.
- Write a for-loop to display values of n from 1 to 10 in the command window.
- Create a structure containing name and year of birth of famous economists.
- Write a separate function and use it to quickly calculate x^2.
- Create a so-called anonymous function for x^2.

8. Environment Identification

   - Check whether you are using Octave or Matlab.
   - Note: This is useful since in some cases, commands differ between Octave and Matlab. In such cases, you can use an if condition where first the environment is checked, and after that you can run the respective command.