Seminar 1- Introduction to the course and review of main mathematical terms

Program of the Seminar:

1. Rules and Demands for the Course (attached files)
2. Introduction to the Econometrics discipline
3. Review of terms
    a. Matrix algebra
    b. Differentiations

Practical tasks:

1. Write down an arbitrary column vector and create its transposition.
2. Carry out a scalar product of the vector. What is the result of the operation?
3. Carry out following operations and decide if the product will be a vector or a scalar.

$$\begin{matrix}3\\2\\4\end{matrix} - 5 + 3\begin{matrix}7\\1\\2\end{matrix} =$$

4. Write down an arbitrary matrix of 2*3 and another matrix of the same size. Carry out their addition.
5. If possible, carry out an addition of the following matrices:

$$\begin{matrix}1 & 4\\5 & 7\end{matrix} + 2\begin{matrix}3 & 5 & 7\\2 & 1 & 3\end{matrix} =$$

6. Determine the matrix size of the following operations:

3x5 x 5x2 =
2x3 x 2x3 =
2x1 x 1x5 =

7. Determine the resulting matrix size and if possible, carry out the product of the matrices:

a) $A = \begin{matrix}3 & -1 & 0\\2 & 3 & 1\end{matrix}$ x $B = \begin{matrix}5\\1\\2\end{matrix}$

b) $A = \begin{matrix}4 & 3\\2 & 6\end{matrix}$ x $B = \begin{matrix}2 & 4\\4 & 2\end{matrix}$

c) $A = \begin{matrix}3 & 1 & 2\\-1 & 2 & 4\end{matrix}$ x $B = \begin{matrix}1 & 4 & -1\\0 & 3 & 1\end{matrix}$

8. Verify, if the commutative rule of multiplication (*AxB* = *BxA*) applies also for matrices (on the example of 7b).

9. Carry out multiplication of *AxB* and *BxA* and derive the rule for multiplication of square matrices.

$$A = \begin{matrix} 3 & 0 & 1 \\ 2 & 1 & 0 \\ 2 & 0 & 1 \end{matrix} \qquad \text{x} \quad B = \begin{matrix} 3 & 2 & 1 \\ 1 & 0 & 2 \\ 3 & 1 & 0 \end{matrix}$$

10. Carry out the inversion of the matrices and make a proof that your result is correct.

a) $A = \begin{matrix} 3 & 2 \\ 1 & 3 \end{matrix}$ $\qquad A^{-1} =$

b) $B = \begin{matrix} 1 & 4 & 5 \\ 3 & 2 & 5 \\ 4 & 3 & 5 \end{matrix}$ $\qquad B^{-1} =$

c) $C = \begin{matrix} -1 & 3 \\ 4 & -2 \end{matrix}$ $\qquad C^{-1} =$

11. Calculate the rank of the following matrices:

a) $A = \begin{matrix} 0 & -3 & 1 & 0 \\ 0 & 0 & 2 & 1 \\ 2 & 3 & -1 & 0 \\ 3 & 2 & 1 & -4 \end{matrix}$ $\qquad B = \begin{matrix} 1 & 0 & 2 & 3 \\ -1 & 2 & 6 & 7 \\ -1 & 1 & 2 & 2 \\ -2 & 1 & 0 & -1 \end{matrix}$

12. Carry out the derivatives of the following functions:

a) $y = 2x^3 + 3x + 6$

b) $y = \sqrt{x} + 2\sqrt[2]{x^3}$

c) $y = 4x\left(2 + 5x^2\right)$

d) $y = \left(x^5 + 3x^2 - 2\right)^4$

e) $y = \dfrac{2x^3 + 3}{3x^2}$

f) $y = \dfrac{x^2 - 1}{x^2 + 1}$

g) $y = e^{5x}$

h) $y = xe^{4-x}$

i) $y = \ln x^2$

j) $y = (\ln x)^2$

k) $y = \ln\left(x^2 + 3x + 4\right)$