Head Assist. Prof. Vladimir Krastev, PhD

Academic course assignment on Mathematics for Economists

(distance learning)

This edition is intended for the students that are studying in English on undergraduate programs of economic specialties. It includes two cases of coursework assignments. Students with odd faculty numbers have to solve the case 1 and students with even faculty numbers have to solve the case 2 of the assignments.

Academic course assignment

Case 1

Problem 1. The following two matrices are given:

$$A = \begin{pmatrix} -2 & 6 & 3 \\ 1 & 3 & -2 \\ -3 & -5 & 4 \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} -5 & 3 & 4 \\ -1 & 1 & 2 \\ 3 & -2 & -1 \end{pmatrix}.$$

a) Find the product $A \times B$; *b*) Find the matrix $3A - 2B$.

Problem 2. A company is manufacturing the products Π_1, Π_2 and Π_3 using the resources R_1, R_2 and R_3. The consumption rates of the resources in notional units and the expected profit in BGN per unit quantity of each product are given in the table.

Resources	Products		
	Π_1	Π_2	Π_3
R_1	4	2	3
R_2	1	6	5
R_3	3	1	1
Profit	5	8	10

During the planning horizon, 720, 1200 and 360 notional units of the resources can be provided respectively. The products Π_1 and Π_2 must be kitted, each kit must include 3 units of product Π_1 and 5 units of product Π_2. A contract has been signed for shipment of 30 units of the product Π_3. Due to the storage impossibility, the provided quantity of the resource R_3 must be completely utilized.

Construct a linear optimization model for finding a profit maximizing production plan of the company.

Problem 3. Solve the transportation problem given by the transportation cost matrix C, the quantities available a_i and the demands b_j:

$$C = \begin{pmatrix} 3 & 7 & 8 \\ 3 & 10 & 6 \\ 2 & 3 & 5 \end{pmatrix}, \qquad \begin{array}{ll} a_i: & 110,\ 40,\ 30, \\ b_j: & 80,\ 40,\ 60. \end{array}$$

Problem 4. The data from observations on the dependence of the quantities x and y are presented in the following table:

x	1	2	3	4	5	5	6	6
y	9	5	11	7	3	5	3	5

Using the least squares method, find the linear function $y = ax + b$ that best fits to the dependence of y on x.

Academic course assignment

Case 2

Problem 1. The following two matrices are given:

$$A = \begin{pmatrix} 3 & -2 & 1 \\ -5 & 2 & 3 \\ 4 & 3 & -2 \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} 1 & 2 & -1 \\ -2 & -3 & 3 \\ 4 & 3 & -2 \end{pmatrix}.$$

a) Find the product $A \times B$; *b*) Find the matrix $3A - 2B$.

Problem 2. A company is manufacturing the products Π_1, Π_2 and Π_3 using the resources R_1, R_2 and R_3. The consumption rates of the resources in notional units and the expected profit in BGN per unit quantity of each product are given in the table.

Resources	Products		
	Π_1	Π_2	Π_3
R_1	3	2	4
R_2	1	3	2
R_3	2	5	2
Profit	2	4	6

During the planning horizon, 900, 500 and 700 notional units of the resources can be provided respectively. The products Π_2 and Π_3 must be kitted, each kit must include 3 units of product Π_2 and 2 units of product Π_3. A contract has been signed for shipment of 50 units of the product Π_1. Due to the storage impossibility, the provided quantity of the resource R_1 must be completely utilized.

Construct a linear optimization model for finding a profit maximizing production plan of the company.

Problem 3. Solve the transportation problem given by the transportation cost matrix C, the quantities available a_i and the demands b_j:

$$C = \begin{pmatrix} 2 & 7 & 5 \\ 2 & 4 & 6 \\ 1 & 3 & 3 \end{pmatrix}, \qquad \begin{array}{ll} a_i\colon & 50,\ 70,\ 70, \\ b_j\colon & 40,\ 20,\ 130. \end{array}$$

Problem 4. The data from observations on the dependence of the quantities x and y are presented in the following table:

x	2	2	3	3	4	5	6	7
y	7	10	4	9	7	11	12	12

Using the least squares method, find the linear function $y = ax + b$ that best fits to the dependence of y on x.