Norwegian University of Science
and Technology
Institutt for matematiske fag

MA0002 Brukerkurs
Matematikk B
Vår 2022

Oppgavesett 3

1 Solve the system of linear equations and sketch the two graphs in one coordinate system to explain the solution.

$$\begin{aligned} 2x + 3y &= 6 \\ x - 4y &= -4 \end{aligned}$$

2 Given (for a real number a) the system

$$\begin{aligned} -2x + 3y &= 5 \\ ax - y &= y. \end{aligned}$$

(a) Find the solution to the system of linear equations in terms of a.

(b) For which values of a are there no solutions, exactly one solution, and infinitely many solutions?

3 (a) Given the functions

$$f_1(x, y) = 3 \cdot x - y\,, \quad f_2(x, y) = -5 \cdot y\,.$$

We define the vectors $\boldsymbol{f} = \begin{pmatrix} f_1(x,y) \\ f_2(x,y) \end{pmatrix}$ and $\boldsymbol{u} = \begin{pmatrix} x \\ y \end{pmatrix}$.

Find a matrix $\mathbf{A}$ such that

$$\boldsymbol{f} = \mathbf{A} \cdot \boldsymbol{u}\,.$$

(b) Given the set of linear equations

$$\begin{aligned} 5 &= 5 \cdot x_1 + 9 \cdot x_2\,, \\ 0 &= 4 \cdot x_1 - 6 \cdot x_2 - 4 \end{aligned} \tag{1}$$

and the vector $\boldsymbol{x} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$.

Find a vector $\boldsymbol{b} \in \mathbb{R}^2$ as well as a matrix $\mathbf{B} \in \mathbb{R}^{2\times 2}$ such that (1) can be written as

$$\mathbf{B} \cdot \boldsymbol{x} = \boldsymbol{b}\,.$$

4 The live expectancy of a particular mammal of which we solely consider the females is always less than two years. Only a third survive their first year and become one-year-old individuals. Furthermore, the under-one-year-olds get on average $\frac{5}{3}$

offspring, while the older individuals get 12 each year. At the beginning, the colony consists of 120 individuals under one year and 80 individuals over one year.

Determine the Leslie-matrix of the above described system and use matrix-vector-products to find the number of individuals in the two age groups after one and two years.

5 Zachary wants to buy fish and plants for his aquarium. Each fish costs 2.30$; each plant costs 1.70$. He buys a total of 11 items and spends a total of 21.70$. Set up a system of linear equations that will allow you to determine how many fish and how many plants Zachary bought, and solve the system.

6 Let $\mathbf{A} = \begin{pmatrix} -1 & 2 \\ 0 & -3 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 0 & 1 \\ 2 & 4 \end{pmatrix}$.

Find $-2 \cdot \mathbf{A} + 3 \cdot \mathbf{B}$.

Innleveringsfrist: Søndag, 6. februar (digitalt som én pdf via Blackboard)