Industrial Applications of Matrices

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ABSTRACT

In this paper, my aim is to create awareness of the applications and uses of matrices in Industries, Business and economics. In early phase the matrix were used to solve linear simultaneous equations, now matrices are used almost in every field of science, engineering, commerce Industries, Business and many more.

Key Words: *Applications, Cultivation, Column, Matrix, Production, Row.*

Matrices in commerce, Industries, Business and Economics

Matrix is an arrangement of data (for our convenience) in rows and columns, the idea of such arrangement came from the study of linear simultaneous equations in around 300 B.C. and now the idea is extended and it is used in almost every area of engineering, science, business, Economics, agriculture, cryptography and many more.

The following examples will explain how matrix can be used in different fields.

1. Production and yield of three farmers for three different crops (in tones) can be represented as fallows

$$\begin{array}{cc} & \begin{array}{ccc} \textit{Rice} & \textit{wheat} & \textit{pulses} \end{array} \\ \textit{Farmers} & \begin{bmatrix} 40 & 50 & 30 \\ 30 & 40 & 10 \\ 25 & 35 & 5 \end{bmatrix} \end{array}$$

2. Number of employees in a factory can be represented as

$$\begin{array}{cccc} A & B & C & D \\ \end{array}$$
$$\begin{bmatrix} 4 & 20 & 2 & 1 \end{bmatrix}$$

A-Peons B-Production Workers C-Assistant account D-senior account

3. The production (in Million tons) of Rice, wheat and pulses in last five years can represented as

$$\begin{array}{ccccc} 2015 & 16 & 17 & 18 & 19 \\ \end{array}$$
$$\begin{bmatrix} 4 & 5 & 5 & 5 & 6 \\ 3 & 4 & 4 & 5 & 4 \\ 1 & 2 & 2 & 3 & 3 \end{bmatrix}$$

4. Sales of three different books (say A B C) in year 2018 can be represented as

$$\begin{bmatrix} 20 \\ 25 \\ 30 \end{bmatrix}$$

5. The aggregate production of Rice and wheat from two different cities(A & B) in last ten years is given by

$$\begin{bmatrix} 50 & 40 \\ 30 & 35 \end{bmatrix}$$

If the production in first year is

City A City B

$$\begin{bmatrix} 5 & 4 \\ 3 & 3 \end{bmatrix}$$

Find the production of rice for last 9 years

Solution:

Given that the aggregate production of Rice and wheat in last ten years is

$$\begin{bmatrix} 50 & 40 \\ 30 & 35 \end{bmatrix}$$

Hence production for 9 years will be

$$= \begin{bmatrix} 50 & 40 \\ 30 & 35 \end{bmatrix} - \begin{bmatrix} 5 & 4 \\ 3 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 45 & 36 \\ 27 & 32 \end{bmatrix}$$

Hence the production of rice for last nine years is 45 and 36 respectively in city A and city B.

6. Cost of cultivation of sugarcane, cotton and onion per acre are respectively 40, 20, and 30 (in thousand rupees), Mr. kamaji cultivated sugarcane in 10 acre, cotton in 2 acre and onion in 1 acre, Mr. Ramaji cultivated sugarcane in 5 acre, cotton in 3 acre and onion in 2 acre and Mr. Balaji cultivated sugarcane in 1 acre, cotton in 1 acre and onion in 1 acre, Find the sum of money spent by these persons individually.

Solution:

Let A, B and C denotes cultivation of Sugarcane, cotton and onion respectively

Then the cultivation of Mr. Kamaji, Mr. Ramaji, and Mr. Balaji (row wise) will be represented as fallows

$$P = \begin{array}{c} \begin{array}{ccc} A & B & C \end{array} \\ \begin{bmatrix} 10 & 2 & 1 \\ 5 & 3 & 2 \\ 1 & 1 & 1 \end{bmatrix} \end{array}$$

The cost of cultivation (in thousand rupees) will be represented as

$$Q = \begin{bmatrix} 40 \\ 20 \\ 30 \end{bmatrix}$$

*By matrix multiplication we have A*B* $= \begin{bmatrix} 10 & 2 & 1 \\ 5 & 3 & 2 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 40 \\ 20 \\ 30 \end{bmatrix}$

$$= \begin{bmatrix} 400 + 40 + 30 \\ 200 + 60 + 60 \\ 40 + 20 + 30 \end{bmatrix}$$

$$= \begin{bmatrix} 470 \\ 320 \\ 90 \end{bmatrix}$$

Hence amount spend by
Mr. Kamaji is Rs. 0.47 million
Mr. Ramaji is Rs.0.32 million
and Mr. Balaji is Rs. 90 thousand

7. In production of three different 'alloy steel' A,B and C mixtures of iron ore, chromium, and nickel are mixed together in following proportion

In A: 70%, Iron ore (by weight), 15% chromium (by weight) and 3% nickel (by weight)

In B: 65%, Iron ore (by weight), 10% chromium (by weight) and 5% nickel (by weight)

In C: 60%, Iron ore (by weight), 12% chromium (by weight) and 4% nickel (by weight)

Find the requirement of each material for production of 100 tons of alloy A, 200 tons of alloy B and 50 tons of alloy C

Solution:

By matrix multiplication, the requirement of each material for the production of 100 tons of alloy A, 200 tons of alloy B and 50 tons of alloy C can be calculated as fallows,

$$= \begin{bmatrix} 100 & 200 & 50 \end{bmatrix} \begin{bmatrix} 70 & 15 & 3 \\ 65 & 10 & 5 \\ 60 & 12 & 4 \end{bmatrix} = \begin{bmatrix} 23000 & 4100 & 1500 \end{bmatrix}$$

Hence requirement of Iron ore, chromium and nickel (by weight) will be respectively 230 ton, 41 ton, and

15 ton.

8. In furniture manufacturing aluminum, brass and copper are used to manufacture three different types of furniture's A, B and C, the requirement of metals (in Kg) for each type of furniture is given below

	Furniture type A	*Furniture type B*	*Furniture type C*
Aluminum	*0.5*	*0.5*	*1*
Brass	*1*	*1.5*	*2*
Copper	*1.5*	*1*	*0.5*

Determine the number of furniture of each type which can be manufactured using, 6.5, 14.5and 8 Kg of Aluminum, Brass and copper respectively.

Solution:

Let x, y, and z denotes number of Furniture A, Furniture B, and Furniture C respectively then from given information we have

$0.5X+0.5y+z = 6.5$

$X+1.5y+2z = 14.5$

$1.5X+y+0.5z = 8$

Using matrices we have

$$\begin{bmatrix} 0.5 & 0.5 & 1 \\ 1 & 1.5 & 2 \\ 1.5 & 1 & 0.5 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} 6.5 \\ 14.5 \\ 8 \end{bmatrix}$$

Say $[P][Q] = [R]$

Now consider the augmented matrix S=$[P/R] = \begin{bmatrix} 0.5 & 0.5 & 1 & 6.5 \\ 1 & 1.5 & 2 & 14.5 \\ 1.5 & 1 & 0.5 & 8 \end{bmatrix}$

Now by $R_1 \longleftrightarrow R_2$

$$\begin{bmatrix} 1 & 1.5 & 2 & 14.5 \\ 0.5 & 0.5 & 1 & 6.5 \\ 1.5 & 1 & 0.5 & 8 \end{bmatrix}$$

by $R_2-(0.5)R_1$, $R_3-(1.5)R_1$

$$\begin{bmatrix} 1 & 1.5 & 2 & 14.5 \\ 0 & -0.25 & 0 & -0.75 \\ 0 & -1.25 & -2.5 & 13.75 \end{bmatrix}$$

By $R_3-(1.25/.25)R_2$

$$\begin{bmatrix} 1 & 1.5 & 2 & 14.5 \\ 0 & -0.25 & 0 & -0.75 \\ 0 & 0 & -2.5 & -10 \end{bmatrix}$$

This is equivalent to the following system of equations

$x + (1.5)y + 2z = 14.5$
$-0.25y = -0.75$
$-2.5z = -10$

Which gives $z = 4$, $y = 3$ *and* $x = 2$

Which means 'two' Furniture of type A, 'three' Furniture of type B and 'four' Furniture of type C can be made from given quantity of metals.

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