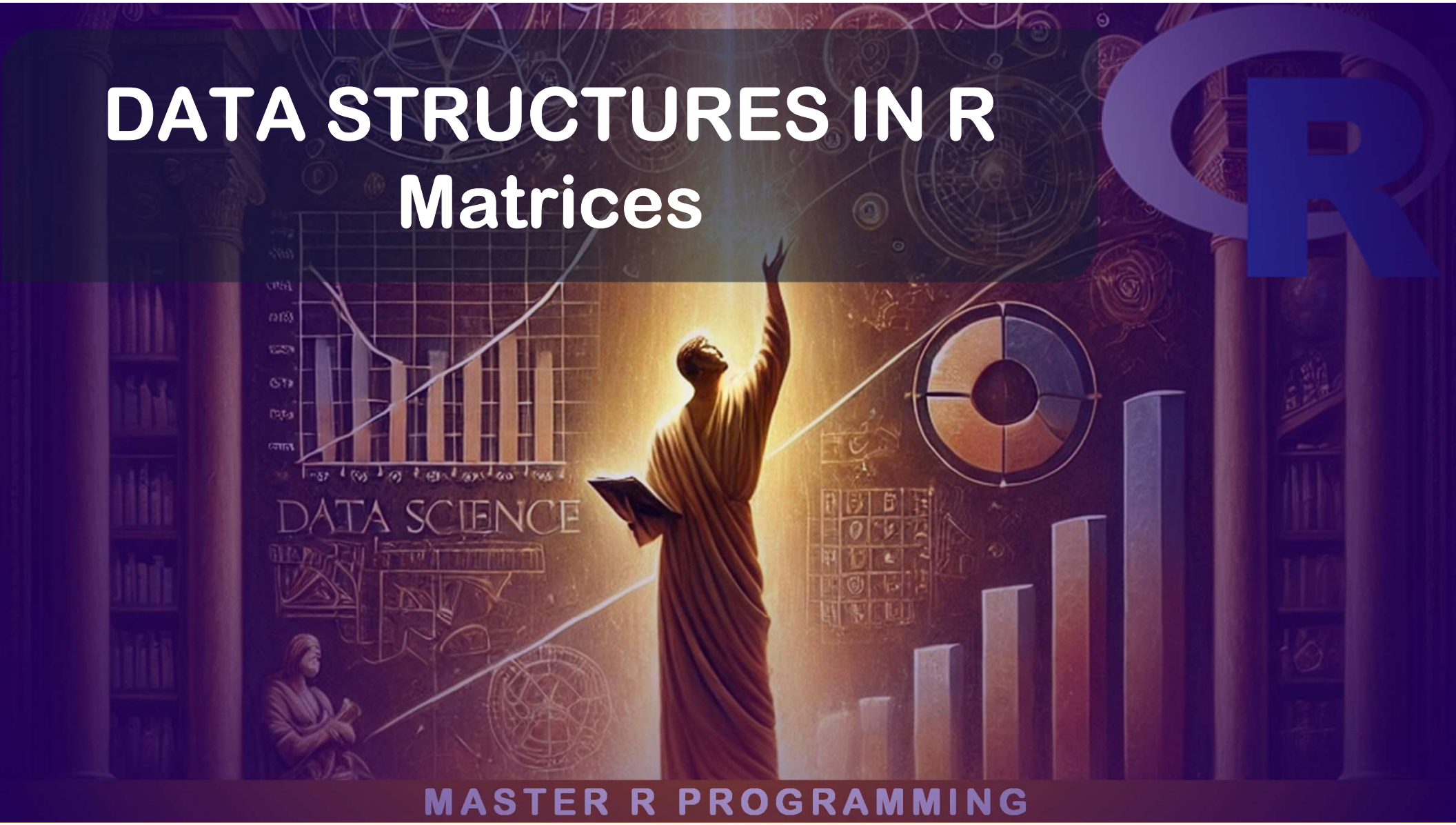
DATA STRUCTURES IN R

Matrices



Lesson Goal

- Learn to create matrices in R.

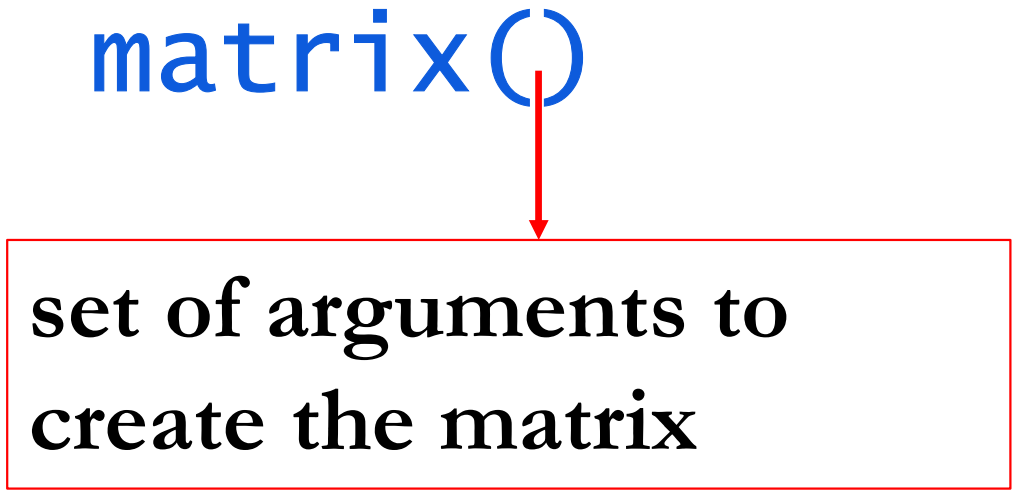
Matrices in R

- A matrix is a rectangular array of numbers arranged in rows and columns.
- The rows and columns define the **dimension** of the matrix; dimension is **m**-rows and **n**-columns (**m** × **n**).

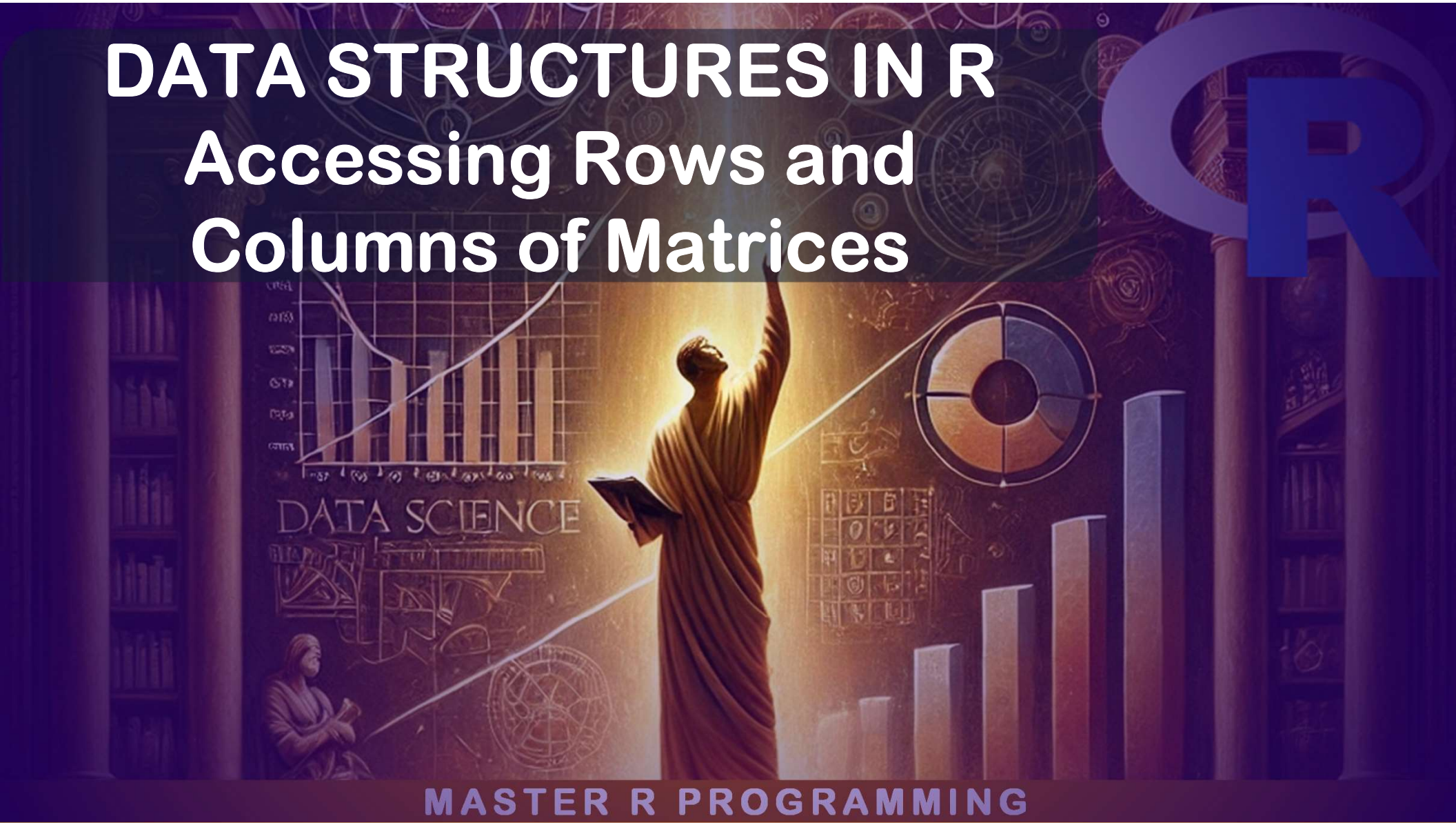
$$\underset{(2 \times 2)}{A} = \begin{bmatrix} 45 & -9 \\ 4 & 10 \end{bmatrix}$$

Matrices in R

- Create a matrix using:



DATA STRUCTURES IN R
Accessing Rows and Columns of Matrices

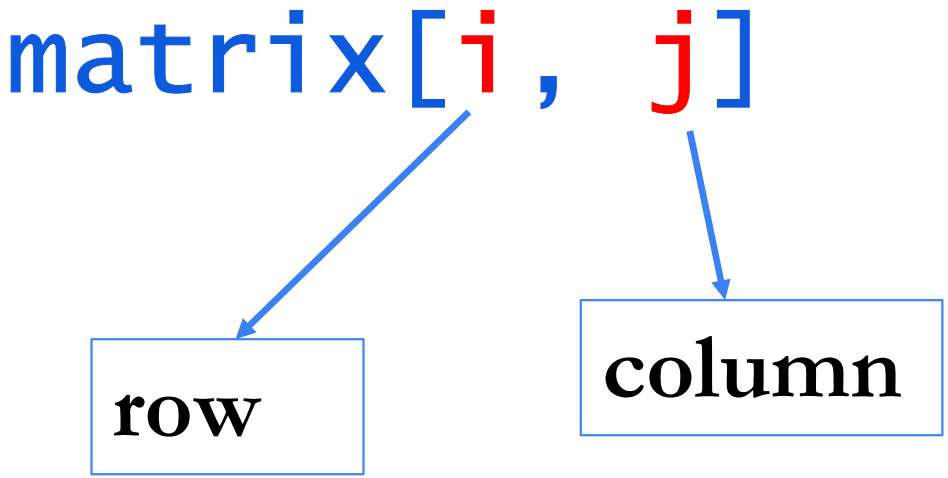


Lesson Goal

- Learn to access rows and columns of matrices in R.

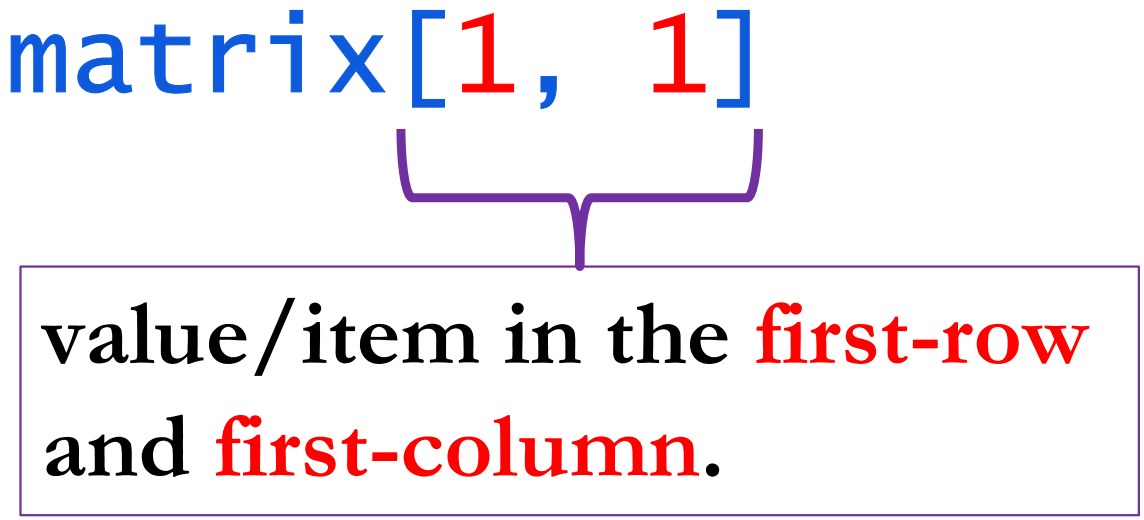
Access Rows and Columns of Matrices in R

- Access rows and columns of matrices using:



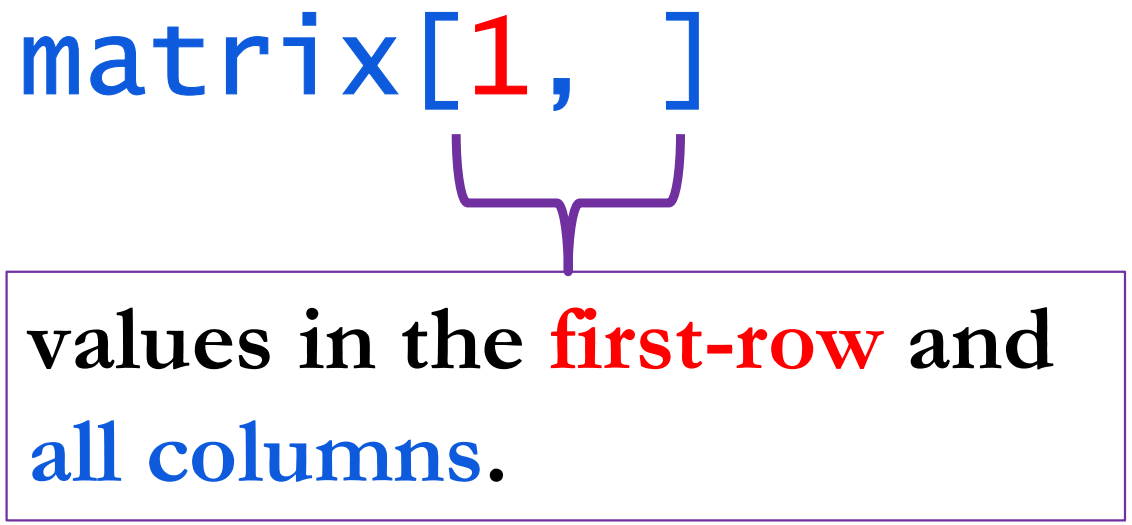
Access Rows and Columns of Matrices in R

- Example:



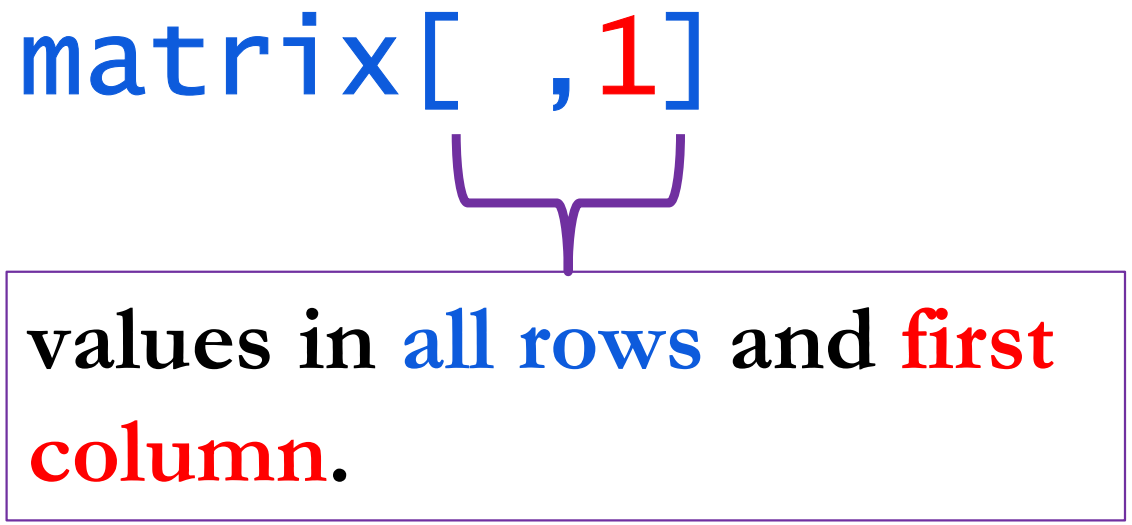
Access Rows and Columns of Matrices in R

- Example:

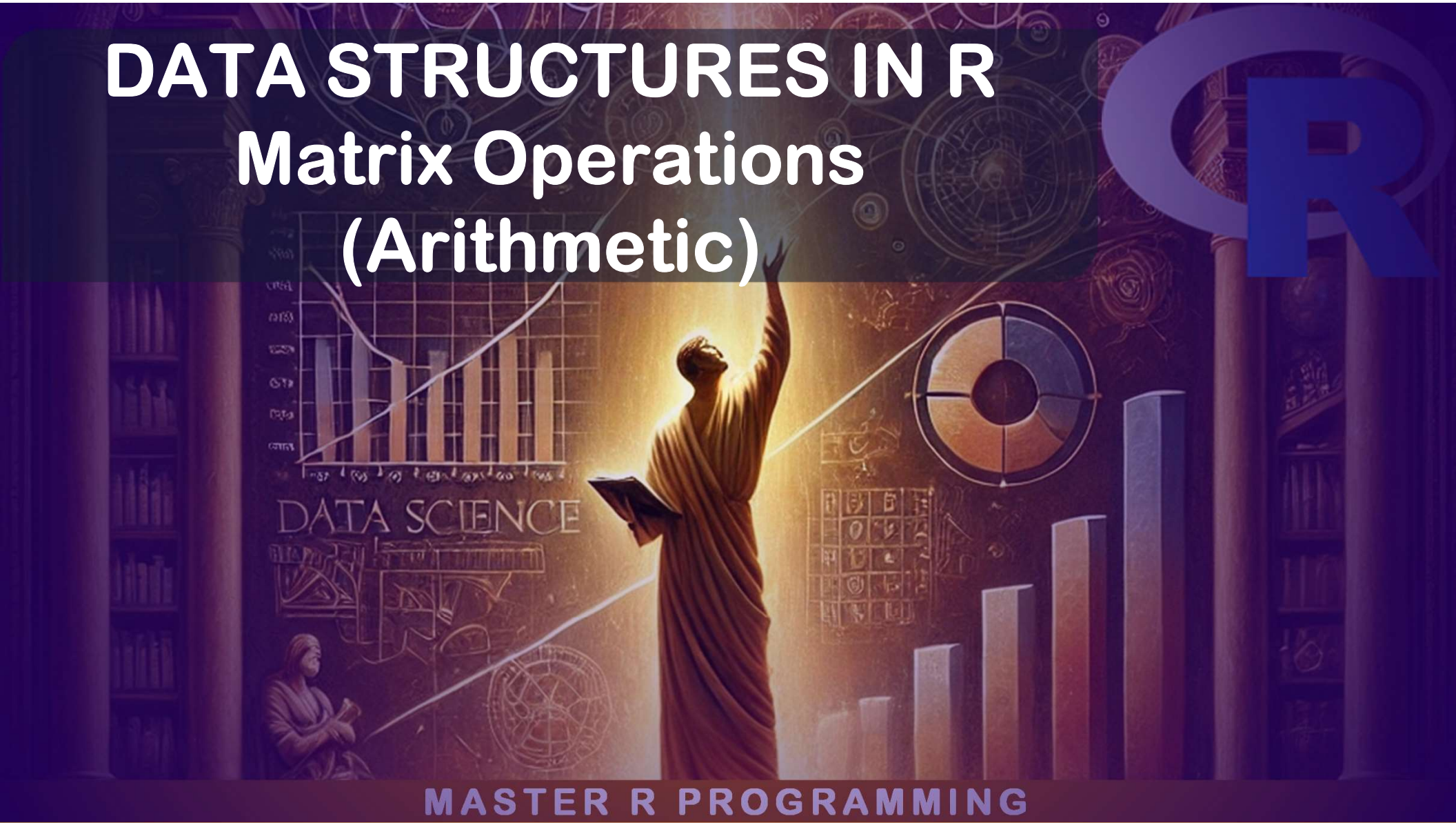


Access Rows and Columns of Matrices in R

- Example:



DATA STRUCTURES IN R
Matrix Operations (Arithmetic)



Lesson Goal

- Learn to perform arithmetic operations on matrices in R.

Arithmetic Operators

Description	Operator
Addition	+
Subtraction	-
Multiplication	*
Division	/
Exponent	** or ^
Modulo	%%
Integer Division	%/%

Matrix Operations (Arithmetic)

- **A word of caution**:
  - Using the arithmetic operators perform "element-by-element" operations in matrices, so the two matrices must have the same dimension.

Matrix Operations (Arithmetic)

- **Addition and Subtraction of Matrices**
  - For any given two matrices, **A** and **B**, addition and subtraction is possible only if **A** and **B** have the **same dimension**.

$$\underset{(2\times 2)}{\boldsymbol{A}} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \qquad \underset{(2\times 2)}{\boldsymbol{B}} = \begin{bmatrix} e & f \\ g & h \end{bmatrix}$$

$$\boldsymbol{A} + \boldsymbol{B} = \begin{bmatrix} a & b \\ b & d \end{bmatrix} + \begin{bmatrix} e & f \\ g & h \end{bmatrix} = \begin{bmatrix} a+e & b+f \\ c+g & d+h \end{bmatrix}$$

$$\boldsymbol{A} - \boldsymbol{B} = \begin{bmatrix} a & b \\ b & d \end{bmatrix} - \begin{bmatrix} e & f \\ g & h \end{bmatrix} = \begin{bmatrix} a-e & b-f \\ c-g & d-h \end{bmatrix}$$

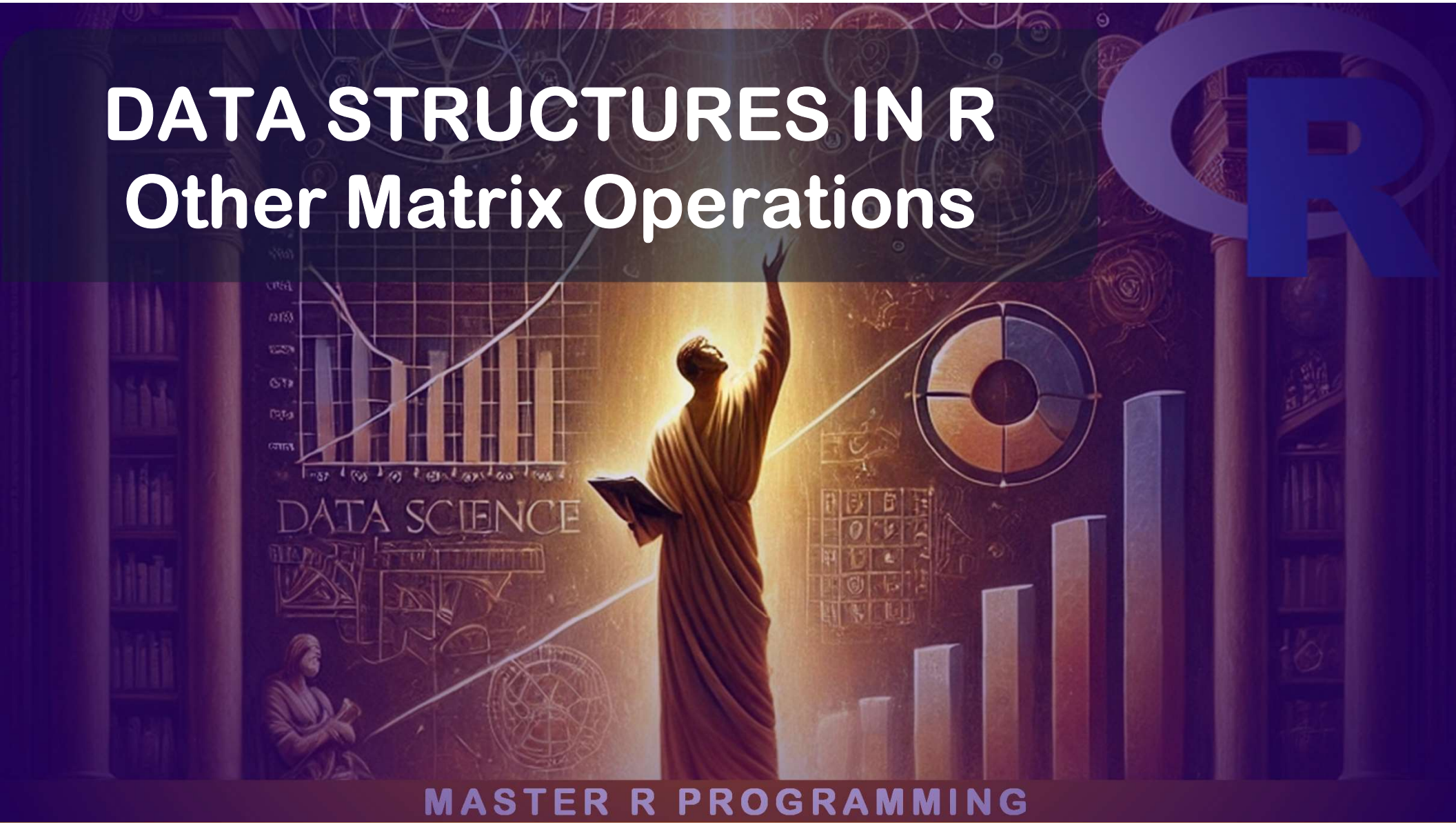
Matrix Operations (Arithmetic)

- **Multiplication of Matrices**
  - Two matrices, **A** and **B**, are "**conformable**" for multiplication if the **number of columns in A equals the number of rows in B**.

  - Multiplication operator for matrices in R is given by:

%*%

DATA STRUCTURES IN R
Other Matrix Operations



Lesson Goal

- Learn to perform other important operations on matrices.

Other Matrix Operations

- There are other matrix operations.
  - **Transpose**

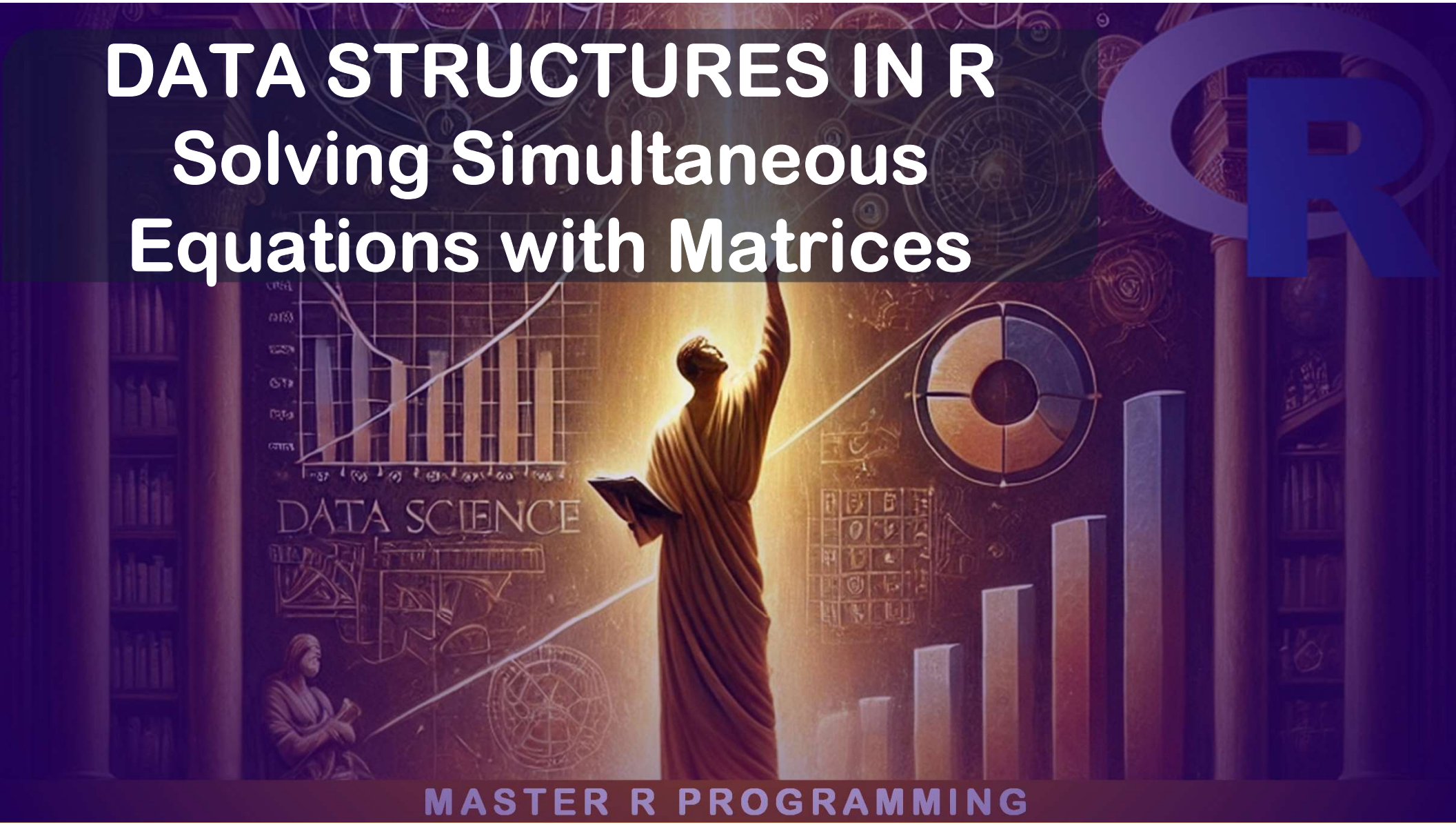
    `t()`
  - **Determinant**

    `det()`
  - **Inverse**

    `solve()`
  - **Eigenvalues and Eigenvectors**

    `eigen()`

DATA STRUCTURES IN R
Solving Simultaneous Equations with Matrices



Lesson Goal

- Learn to solve systems of linear equations with matrix inversion.

Simultaneous Equations with Matrices

- Systems of linear equations:

$$7x - 3y + 6z = 5$$
$$5x - 2y + 2z = 11$$
$$2x - 3y + 8z = 10$$

Simultaneous Equations with Matrices

- Systems of linear equations can be expressed in matrix form as $\boldsymbol{Ax = b}$, where:
  - $\boldsymbol{A}$ is the matrix of coefficients
  - $\boldsymbol{x}$ is the matrix of variables
  - $\boldsymbol{b}$ is the matrix of constants

$$\boldsymbol{7x - 3y + 6z = 5}$$
$$\boldsymbol{5x - 2y + 2z = 11}$$
$$\boldsymbol{2x - 3y + 8z = 10}$$

Simultaneous Equations with Matrices

$$7x - 3y + 6z = 5$$
$$5x - 2y + 2z = 11$$
$$2x - 3y + 8z = 10$$

$$\underset{A}{\begin{bmatrix} 7 & -3 & 6 \\ 5 & -2 & 2 \\ 2 & -3 & 8 \end{bmatrix}} \cdot \underset{x}{\begin{bmatrix} x \\ y \\ z \end{bmatrix}} = \underset{b}{\begin{bmatrix} 5 \\ 11 \\ 10 \end{bmatrix}}$$

Simultaneous Equations with Matrices

- The variables can be solved by matrix inversion using:

$$\boldsymbol{A}\boldsymbol{x} = \boldsymbol{b}$$

$$\boldsymbol{A}^{-1}\boldsymbol{A}\boldsymbol{x} = \boldsymbol{A}^{-1}\boldsymbol{b}$$

$$\boldsymbol{I}\boldsymbol{x} = \boldsymbol{A}^{-1}\boldsymbol{b}$$

$$\boldsymbol{x} = \boldsymbol{A}^{-1}\boldsymbol{b}$$

Solution