Case Study 2: Exploring Types and Properties of Matrices

Ananya is working on a data science project that involves handling large datasets stored in tabular form. To represent and manipulate this data efficiently, she learns about matrices. She discovers the concept of types of matrices like zero matrices, identity matrices, and rectangular and square matrices. While coding, she faces a situation where understanding whether a matrix is invertible becomes critical. To deepen her understanding, she solves various conceptual and application-based problems involving the properties and types of matrices.

MCQ Questions:

1. Which of the following is a square matrix?

   (a) $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$

   (b) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

   (c) $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$

   (d) $\begin{bmatrix} 7 & 8 \end{bmatrix}$

   Answer: (b)
   Solution: A square matrix has the same number of rows and columns. Option (b) is a 2×2 matrix.

2. The matrix $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ is called:

   (a) Identity matrix

   (b) Symmetric matrix

   (c) Zero matrix

   (d) Scalar matrix

   Answer: (c)
   Solution: A zero matrix is a matrix in which all elements are 0. Option (c) satisfies this condition.

3. Which of the following is NOT a type of matrix?

   (a) Diagonal matrix

   (b) Null matrix

   (c) Column matrix

   (d) Rational matrix

   Answer: (d)
   Solution: "Rational matrix" is not a standard type of matrix. The others are valid matrix types.

4. For a matrix to be invertible, it must be:

   (a) A zero matrix

   (b) A square matrix with determinant not equal to zero

(c) A rectangular matrix

(d) A matrix with all non-zero entries

Answer: (b)
Solution: Only square matrices with non-zero determinants are invertible.

5. Which of the following matrices is a skew-symmetric matrix?

(a) $\begin{bmatrix} 0 & 5 \\ -5 & 0 \end{bmatrix}$

(b) $\begin{bmatrix} 2 & 3 \\ 3 & 2 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

(d) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

Answer: (a)
Solution: A matrix A is skew-symmetric if $A^T = -A$. Option (a) satisfies this condition.