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Different uses of mathematical models : A Study

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Abstract

A matrix is a set of integers arranged in a square. There are rows and columns in a matrix. A matrix's dimensions are determined by the number of rows and columns it contains. there are many kinds of rows and columns in matrices, as well as different types of null matrices, as well as different types of triangle matrices, as well as different sorts of antisymmetric matrices.

Key Words: Mathematical, Matrix, Integers, Diagonal etc

Introduction

Teaching and solving mathematical issues greatly benefit from the use of matrix theory. Studying the theory of matrix may aid researchers, practitioners, and students in solving a wide range of engineering, economic, and financial challenges.

"A rectangular array of m × n numbers (real or complex) in the form of m horizontal lines (called rows) and n vertical lines (called columns), is called a matrix of order m by n, written as m × n matrix. Such an array is enclosed by [ ] or ( ).

An m × n matrix is usually written as:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots\cdots & a_{1n} \\ a_{21} & a_{22} & \cdots\cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \cdots\cdots & a_{mn} \end{bmatrix}$$

In brief, the above matrix is represented by A = [aij] mxn. The number a11, a12, ….. etc., are known as the elements of the matrix A, where aij belongs to the ith row and jth column and is called the (i, j)th element of the matrix A = [aij].

Important Formulas for Matrices

If A, B are square matrices of order n, and I_n is a corresponding unit matrix, then

(a) A(adj.A) = | A | I_n = (adj A) A

(b) | adj A | = | A |n^{-1} (Thus A (adj A) is always a scalar matrix)

(c) adj (adj.A) = | A |$^{n-2}$ A

(e) adj (AB) = (adj B) (adj A)

(g) adj $(A^m) = (\text{adj } A)^m$, adj adj 0 = 0

(k) A is symmetric ⇒adj A is also symmetric

(l) A is diagonal ⇒adj A is also diagonal

(m) A is triangular ⇒adj A is also triangular

(n) A is singular ⇒| adj A | = 0”

Types of Matrices

Diagonal Matrix

Diagonal matrices are square matrices in which all components except those on the diagonal are 0. Examples of many types of diagonal matrices may be found here: Scalar matrixes are square diagonal matrices where each diagonal element is equal to one another.

Boolean Matrix

A boolean matrix is one in which all of its members are either 1s or 0s. Let's have a look at the matrix B as an example to better grasp this:

$$B = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

Stochastic Matrices

All the elements in a stochastic matrix are probabilities. All elements in a square matrix C are called left stochastic if and only if the sums of the values in each column are 1. Similarly, a right stochastic matrix is one in which all of the elements are non-negative and the total of the entries in each row is 1. Consider the following matrix C as an illustration:

$$C = \begin{bmatrix} 0.3 & 0.4 & 0.5 \\ 0.3 & 0.4 & 0.3 \\ 0.4 & 0.2 & 0.2 \end{bmatrix}$$

Transformation Matrix

The vector operator is a fundamental notion in matrix analysis and a useful mathematical tool in a wide range of applications. " We'll look at a new vector operator for the symmetric situation. Between the two vector operators, there is an entire class of transformation matrices that may be utilised to address a wide variety of issues. In order to highlight the relevance of these transformation matrices in control theory, this study will look at two examples. The Lyapunov functions may be computed using a formula devised by Qian Jiling.

Definition 1 (see [1]). $L_1 : C^{n\times m} \to C^{nm\times 1}$ is called a vector operator by column, if $L_1(X) = (x_{11}, x_{21}, \ldots, x_{n1}, x_{12}, x_{22}, \ldots, x_{n2}, \ldots, x_{1m}, x_{2m}, \ldots, x_{nm})^T$ for any $X = (x_{ij})_{n\times m}$.

Definition 2. $L_2 : W^{n\times n} \to C^{(n(n+1)/2)\times 1}$ is called a half vector operator by column, if $L_2(X) = (x_{11}, x_{21}, \ldots, x_{n1}, x_{22}, \ldots, x_{n2}, \ldots, x_{nn})^T$ for any $X = (x_{ij})_{n\times n}$, where $W^{n\times n} \triangleq \{X \mid X^T = X \in C^{n\times n}\}$.

Applications of Matrix Theory

"Matrix theory has various applications in decision sciences, particularly in applied mathematics, finance, and economics, since it is not only the base of mathematics and statistics, but also the cornerstone of all scientific disciplines.. Matrix theory has applications in four primary fields, including applied mathematics, statistics, finance, and economics. This section will cover these four topics in detail. Matrix theory's applicability to applied mathematics are first discussed.

- **Building up mathematical models**

Mathematicians use Matrix Theory to solve systems of equations, which is the most common use. Cramer's formula and the Newton technique of solving systems of equations are two of the most often used methods. the maxLik function was compared to Newton's procedure, and various applications in statistics and regression models with missing data were shown using this approach. the Newton approach in Decision Sciences and Education was briefly discussed. In addition, ubiquitous distributions' moment generating function, expectation, and variance were described, with applications in decision sciences. Newton technique was used to apply regression models in various applications and to examine optimum solution approaches in decision sciences: bisection, gradient, secant and Newton methods. On the other hand, some regression models used optim, nleqslv, and maxLik, which are useful functions in R programmed by the Newton method, to determine parameters.

- **Building up financial models**

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- **Building up statistical models**

Matrix theory may be used to solve many statistical issues, particularly in multidimensional contexts. Matrix theory has a wide range of applications in statistics. proposed the theory of random matrix and universal statistics for disordered quantum conductors with spin-dependent hopping, the matrix algebra helpful for statistics.

Applications of mathematical, economic, financial, and statistical models

A real-world issue may be solved by adopting some of the models developed using matrix theory in the preceding subsections of this article. It's possible to utilise the theory of matrix theory to solve real-world issues after developing the aforementioned models, such as economic, financial, and statistical models.

Applications of Matrix Theory in Education

Some of Vietnam's math contests, such as the National High School, College Entrance Exam, National Student Mathematics Olympiad, and others, use the Matrix Theory of Practical Mathematics as a major issue to solve. Teachers in secondary schools and college lecturers/professors may both benefit from teaching mathematical modelling. Mathematical Modeling exercises help students better grasp all of the challenges they meet in mathematics.

Mathematical Modeling capabilities for High School teachers

Preparing high school teachers to act as role models. He made the point that teachers in Vietnamese high schools are still unable to teach mathematical modelling, and that the facilities and equipment available to do so are not up to par. Because of this, it is imperative that Vietnamese High School teachers be given the opportunity to develop their skills and access better resources in teaching mathematical modelling. Research in this field has been extensive.

The capacity of Mathematical Modeling for High School students

the mathematical modelling ability of Vietnamese high school pupils. There is a lack of capacity for high school students in 18 Vietnam to do mathematical modelling, and most of the capability is at a low level. He also brought up the issue of the existing textbook curriculum's lack of consideration for the practical applications of mathematics. For high school students in Vietnam, a more effective technique to teach mathematical modelling is to educate students to solve real-world issues by using mathematical modelling as a tool for addressing real-world problems".

Conclusion

The theory of the matrix plays a critical role in the study of mathematics, both in the classroom and in addressing real-world issues. There are a wide range of applications for the theory of matrix, from engineering and econometrics to finance and economics and decision sciences.

This article begins with a review of matrix theory before moving on to applications. As a follow-up, we'll talk about how matrix theory may be used to build up models for a variety of different fields, including decision sciences, finance, statistics, and education. We'll also look at some real-world applications of matrix theory.

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