DETERMINANTS. METHODS OF CALCULATING DETERMINANTS

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Abstract: This article discusses the concept of determinants, their role and significance in mathematics, the fundamental properties of determinants, and various methods of their calculation. The methods analyzed include Sarrus' Rule, Laplace Expansion, and calculation through elementary transformations. Furthermore, information is provided about the practical applications of determinants in linear algebra, engineering, economics, and information technologies.

Keywords: determinant, matrix, algebra, minor, cofactor, Sarrus' Rule, Laplace Expansion, system of linear equations, mathematical modeling.

One of the most important branches of modern mathematics is linear algebra, in which determinants occupy a special place. The concept of a determinant is closely related to matrix theory and is widely used in solving systems of linear equations, finding the inverse of a matrix, and determining relationships among vectors. The theory of determinants emerged in the eighteenth century and was later developed by many mathematicians. Today, determinants are important not only in pure mathematical problems but also in physics, engineering, economics, and computer technologies.

A determinant is a numerical value associated with a square matrix that represents certain important properties of the matrix. Every square matrix has a determinant. Determinants are usually denoted by vertical bars or the symbol "det." The calculation of a second-order determinant is the simplest case. It is obtained by subtracting the product of the elements on the secondary diagonal from the product of the elements on the main diagonal.Determinants possess several important properties. For example, if two rows or two columns of a determinant are interchanged, the sign of the determinant changes. If two rows or columns are identical, the determinant is equal to zero. Furthermore, if all elements of a row or column are multiplied by the same number, the determinant is also multiplied by that number. These properties significantly simplify the process of determinant calculation.

One of the most commonly used methods for calculating third-order determinants is Sarrus' Rule. This method is based on rewriting the first two columns of the determinant and calculating the products along the diagonals. Sarrus' Rule applies only to third-order determinants and considerably simplifies calculations.

For higher-order determinants, Laplace Expansion is widely used. This method is based on expanding a determinant along a selected row or column and expressing it as a sum of lower-order determinants. Laplace Expansion is one of the fundamental techniques in determinant theory and enables complex calculations to be carried out step by step.Another effective method for calculating determinants is the use of elementary transformations. In this approach, various algebraic operations are performed on the rows or columns of a determinant until it is transformed into a triangular form. The determinant can then be easily found as the product of the elements on the main diagonal. This method is particularly convenient when dealing with determinants of large order.Determinants are also highly important in solving practical problems. In particular, determinants are used in Cramer's Rule for solving systems of linear equations. In addition, determinants are applied in geometry for calculating the area and volume of geometric figures, while in physics and engineering they are used in analyzing various mathematical models. The theory of determinants also serves as an important theoretical foundation in computer graphics, artificial intelligence, and data processing technologies.

Conclusion

Determinants are among the most important concepts in linear algebra and play a significant role in determining the fundamental properties of matrices. Various methods for calculating determinants, such as Sarrus' Rule, Laplace Expansion, and elementary transformation techniques, each offer their own advantages. A thorough understanding of determinant theory is essential for effectively solving mathematical problems, conducting scientific research, and comprehending modern technological processes.

References

1. Abdurahmonov A. Fundamentals of Higher Mathematics. Tashkent: O'qituvchi Publishing House, 2021.

2. Shodmonov T., Ergashev N. Linear Algebra and Analytic Geometry. Tashkent: Tafakkur Publishing House, 2020.

3. Elementary Linear Algebra. New York: Pearson Education, 2019.

4. Elementary Linear Algebra. Wiley, 2018.

5. Linear Algebra and Its Applications. Pearson, 2021.

6. Xolmurodov B. Theory of Matrices and Determinants. Tashkent: Fan Publishing House, 2022.