

Dr. B. B. Hegde First Grade College Kundapura

Department of Mathematics

Seminar 2021-22

Date : 17/01/2022

Name : Abhijith

Roll No. : SC20001

Topic : Sequences

Class : II B.Sc.

Brief Report :

In mathematics, a **sequence** is an enumerated collection of objects in which repetitions are allowed and order matters. Like a set, it contains members (also called *elements*, or *terms*). The number of elements (possibly infinite) is called the *length* of the sequence. Unlike a set, the same elements can appear multiple times at different positions in a sequence, and unlike a set, the order does matter. Formally, a sequence can be defined as a function from natural numbers (the positions of elements in the sequence) to the elements at each position.

Examples :

The prime numbers are the natural numbers greater than 1 that have no divisors but 1 and themselves. Taking these in their natural order gives the sequence (2, 3, 5, 7, 11, 13, ...). The prime numbers are widely used in mathematics, particularly in number theory where many results related to them exist.

Subsequences :

A **subsequence** of a given sequence is a sequence formed from the given sequence by deleting some of the elements without disturbing the relative positions of the remaining elements. For instance, the sequence of positive even integers (2, 4, 6, ...) is a subsequence of the positive integers (1, 2, 3, ...). The positions of some elements change when other elements are deleted. However, the relative positions are preserved.

Bounded :

If the sequence of real numbers (a_n) is such that all the terms are less than some real number M , then the sequence is said to be **bounded from above**. In other words, this means that there exists M such that for all n , $a_n \leq M$. Any such M is called an *upper bound*. Likewise, if, for some real m , $a_n \geq m$ for all n greater than some N , then the sequence is **bounded from below** and

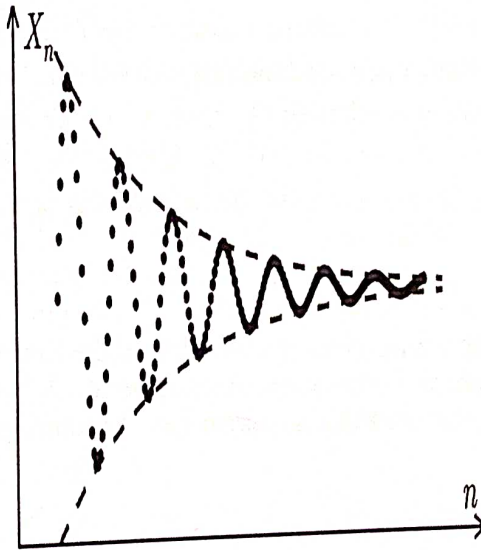
any such m is called a *lower bound*. If a sequence is both bounded from above and bounded from below, then the sequence is said to be **bounded**.

Increasing and decreasing:


A sequence is said to be *monotonically increasing* if each term is greater than or equal to the one before it. For example, the sequence is monotonically increasing if and only if $a_{n+1} \geq a_n$ for all $n \in \mathbb{N}$. If each consecutive term is strictly greater than ($>$) the previous term then the sequence is called **strictly monotonically increasing**. A sequence is **monotonically decreasing**, if each consecutive term is less than or equal to the previous one, and **strictly monotonically decreasing**, if each is strictly less than the previous. If a sequence is either increasing or decreasing it is called a **monotone** sequence. This is a special case of the more general notion of a monotonic function.


Terms **nondecreasing** and **nonincreasing** are often used in place of *increasing* and *decreasing* in order to avoid any possible confusion with *strictly increasing* and *strictly decreasing*, respectively.

The plot of a Cauchy sequence (X_n) , shown in blue, as X_n versus n . In the graph the sequence appears to be converging to a limit as the distance between consecutive terms in the sequence gets smaller as n increases. In the real numbers every Cauchy sequence converges to some limit.




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Date : 28/01/2022

Name : Nagashree

Roll No. : 4803

Topic : Vector Space

Class : III B.Sc.

Brief Report :

A **vector space** or a linear space is a group of objects called vectors, added collectively and multiplied ("scaled") by numbers, called scalars. Scalars are usually considered to be real numbers. But there are few cases of scalar multiplication by rational numbers, complex numbers, etc. with vector spaces. The methods of vector addition and scalar multiplication must satisfy specific requirements such as axioms. Real vector space and complex vector space terms are used to define scalars as real or complex numbers

Difference between Vector and Vector Space :

A vector is a part of a vector space whereas vector space is a group of objects which is multiplied by scalars and combined by the vector space axioms.

Vector algebra is one of the essential topics of algebra. It studies the algebra of vector quantities. As we know, there are two types of physical quantities, **scalars and vectors**. The scalar quantity has only magnitude, whereas the vector quantity has both magnitude and direction. Learn about Magnitude Of A Vector here.

Algebra is a significant subject in Maths where we use universal symbols or letters to signify the quantities, numbers and variables. These symbols are later used in many expressions, equations and formulae, to perform algebraic operations. It has many branches.

In essence, vector algebra is an algebra where the essential elements usually denote vectors. We perform algebraic operations on vectors and vector spaces. This branch has rules and hypotheses based on the properties and behaviour of vectors.

Addition of Vectors : Let us consider there are two vectors P and Q, then the sum of these two vectors can be performed when the tail of vector Q meets with the head of vector A. And

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during this addition, the magnitude and direction of the vectors should not change. The vector addition follows two important laws, which are;

- **Commutative Law:** $P + Q = Q + P$
- **Associative Law:** $P + (Q + R) = (P + Q) + R$

Subtraction Of Vectors :

Here, the direction of other vectors is reversed and then the addition is performed on both the given vectors. If P and Q are the vectors, for which the subtraction method has to be performed, then we invert the direction of another vector say for Q, make it -Q. Now, we need to add vector P and -Q. Thus, the direction of the vectors are opposite each other, but the magnitude remains the same.

- $P - Q = P + (-Q)$

Multiplication of Vectors :

If k is a scalar quantity and it is multiplied by a vector A, then the scalar multiplication is given by kA. If k is positive then the direction of the vector kA is the same as vector A, but if the value of k is negative, then the direction of vector kA will be opposite to the direction of vector A. And the magnitude of the vector kA is given by |kA|.

Dot Product :

The dot product is often called a scalar product. It is represented using a dot(.) between two vectors. Here, two coordinate vectors of equal length are multiplied in such a way that they result in a single number. So basically when we take the scalar product of two vectors, the result is either a number of a scalar quantity. Suppose P and Q are two vectors, then the dot product for both the vectors is given by;

- $P \cdot Q = |P| |Q| \cos \theta$

If P and Q are both in the same direction, i.e. $\theta = 0^\circ$, then;

- $P \cdot Q = |P| |Q|$

If P and Q are both orthogonal, i.e. $\theta = 90^\circ$, then;

- $P \cdot Q = 0$ [since $\cos 90^\circ = 0$]

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Seminar 2021-22

Date : 06/06/2022

Name : Pratheek

Roll No. : 4806

Topic : Numerical Analysis

Class : III B.Sc - MPC

Brief Report :

Numerical analysis is the area of mathematics and computer science that creates, analyzes, and implements algorithms for solving numerically the problems of continuous mathematics. Such problems originate generally from real-world applications of algebra, geometry and calculus, and they involve variables which vary continuously; these problems occur throughout the natural sciences, social sciences, engineering, medicine, and business. During the past half-century, the growth in power and availability of digital computers has led to an increasing use of realistic mathematical models in science and engineering, and numerical analysis of increasing sophistication has been needed to solve these more detailed mathematical models of the world.

Numerical Method

Numerical methods are techniques that are used to approximate mathematical procedures. We need approximations because we either cannot solve the procedure analytically or because the analytical method is intractable (an example is solving a set of a thousand simultaneous linear equations for a thousand unknowns).

Types of Numerical Methods :

There are different numerical methods for solving different types of problems. Some of the basic numerical methods are-

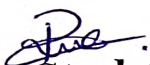
- Taylor Series method
- Euler method
- Runge Kutta methods (RK-2 and RK-4)
- Shooting method
- Finite difference methods

Numerical Methods for Solving Partial Differential Equations :

- Finite difference method
- Method of lines
- Finite element Method
- Finite Volume method
- Gradient discretization method
- Spectral method
- Multigrid method

Applications :

Numerical analysis, area of mathematics and computer science that creates, analyzes, and implements algorithms for obtaining numerical solutions to problems involving continuous variables. Such problems arise throughout the natural sciences, social sciences, engineering, medicine, and business.


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Seminar 2021-22

Date : 14/06/2022

Name : Lakshmikanth

Roll No. : SC21014

Topic : Double integral

Class : I B.Sc - MC

Brief Report :

Definition :

In mathematics, double integral is defined as **the integrals of a function in two variables over a region in \mathbb{R}^2 , i.e. the real number plane.** The double integral of a function of two variables, say $f(x, y)$ over a rectangular region can be denoted as:

$$\iint_R f(x, y) dA = \iint_R f(x, y) dx dy.$$

Learning of objects :

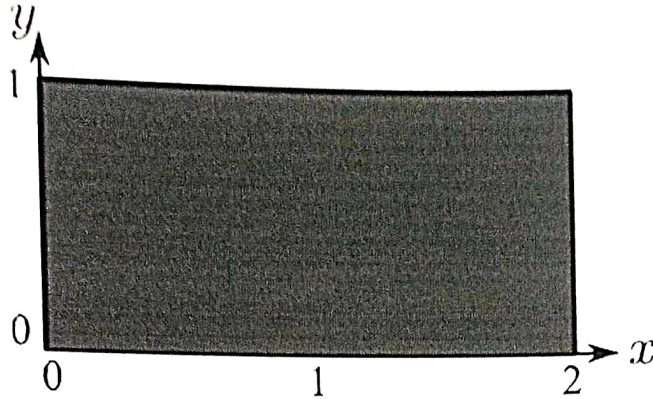
- Recognize a function of two variables and identify its domain and range.
- Sketch a graph of a function of two variables.
- Sketch several traces or level curves of a function of two variables.
- Recognize a function of three or more variables and identify its level surfaces.

Example :

Compute the integral

$$\iint xy^2 dA \text{ over the region}$$

D where D is the rectangle defined by $0 \leq x \leq 2$ and $0 \leq y \leq 1$ pictured below.



Solution: We will compute the double integral as the iterated integral. We first integrate with respect to x inside the parentheses. Similar to the procedure with

To double check our answer, we can compute the integral in the other direction, integrating first with respect to y and then with respect to x . The only trick is to remember that when integrating with respect to y , we must think of x as a constant.

$$\iint_D xy^2 dA = \int_0^1 \int_0^2 xy^2 dx dy$$

First we have to integrate with respect to x taking y constant over the interval 0 to 2.

Next we have to integrate with respect to y over the interval y .

The solution we get $\frac{2}{3}$.

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