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| RESEARCH ARTICLE

The Application of Mathematical Series in Sciences

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| ABSTRACT
Mathematical series and sequences are crucial in scientific disciplines to identify patterns, make predictions, and deduce mathematical correlations between variables. Chemistry, biology and physics rely heavily on mathematical series to model complex systems, make precise predictions, and identify fundamental principles of chemical and biological processes. The study used a qualitative approach to identify mathematical series used in scientific research and evaluate their application in chemistry and biology. A comprehensive literature review was conducted to gather pertinent papers and articles from credible scientific databases, followed by a thematic analysis strategy to examine the content. The findings of the study revealed that mathematical series are widely used in various fields, including chemistry, biology, and physics. The Taylor series, power series expansion, Fibonacci series, power series and binomial series are some of the most commonly used series. They approximate functions, express reaction rates, solve linear equations, depict spiral patterns, study population growth, and analyze genetics and molecular biology. They are crucial tools in physics, quantum mechanics, and natural phenomena description.

| KEYWORDS

Alternating Harmonic Series, Dirichlet eta function, Hurwitz -Lerch Zeta function, Polylogarithm function.

| ARTICLE INFORMATION

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1. Introduction

Through the provision of a potent instrument for evaluating and comprehending a variety of occurrences in the natural world, mathematical series serve a key function in science. Many scientific disciplines rely heavily on mathematical series and sequences to examine, model, and comprehend natural occurrences. Series and sequences help us in science by allowing us to spot patterns, forecast outcomes, and deduce mathematical correlations between variables (Ritter, 2011). One of the key applications of mathematical series is in the field of physics. Many physical laws and principles can be effectively described using series expansions. For example, the Maclaurin series allows us to approximate functions as infinite sums of simpler terms, enabling accurate predictions and analysis in fields such as thermodynamics, electromagnetism, and quantum mechanics. These series expansions help scientists derive mathematical models that describe the behavior of particles, waves, and systems at both macroscopic and microscopic levels (Bhatti & Abdelsalam, 2022).

In addition, mathematical series are extensively used in fields like engineering and computer science. According to Hu (2022), signal processing, control systems, and image analysis heavily rely on the Fourier series and transform, which represent functions as combinations of sine and cosine waves. This enables the analysis, manipulation, and compression of signals and images. Furthermore, in computer science, series expansions like the Taylor series are instrumental in developing algorithms for optimization, numerical methods, and simulations techniques.

Numerous scientific disciplines rely heavily on mathematical series and sequences to examine, model, and comprehend natural occurrences (Verschaffel, et al. 2020) Series and sequences help us in science by allowing us to spot patterns, forecast outcomes, and deduce mathematical correlations between variables. A series in mathematics has constant term differences. By multiplying the number of times, the average of the final and first terms, we may determine the sum of the terms in an arithmetic series. Thus, it is clear that determining the sum of a series' terms and using series are both crucial mathematical operations. By leveraging mathematical series and sequences, scientists can uncover hidden patterns, make accurate predictions, and better comprehend the complex mechanisms underlying various scientific phenomena.

Chemistry and biology are only two of the many scientific fields where mathematical series are essential. These series offer an effective framework for deciphering and forecasting patterns seen in natural occurrences. According to Gupta et al. (2020), mathematical series are widely used in the domains of chemistry and biology to model complicated systems, produce precise predictions, and identify underlying fundamental principles of chemical and biological processes. Mathematical series are extensively used in chemistry to understand chemical processes, kinetics, and thermodynamics. Chemists can study reaction rates and equilibrium constants at various settings by using series, such as the Taylor series and power series, to approximate functions (He et al. 2020). In order to gain knowledge about molecular structures and bonding patterns, series expansions are also used to analyze molecular vibrations, electronic spectra, and other spectroscopic techniques (Raj et al. 2020).

Mathematical series are used in population dynamics, genetics, and bioinformatics in the study of biology. To simulate population growth patterns, forecast species abundance, and examine ecological relationships, series like the geometric progression and Fibonacci series are used (Fischer et al. 2019). In population genetics, series expansions are also used to examine genetic diversity, allele frequencies, and evolutionary trends. In addition, bioinformatics uses series-based algorithms to examine DNA and protein sequences, enabling sequence alignment, phylogenetic analysis, and molecular structure prediction (Biswas et al., 2019).

This study has been primarily concerned with investigating the usage of mathematical series in the disciplines of chemistry and biology. Researchers have discovered the significance and possible value of numerous mathematical series by analyzing and comprehending them in order to solve challenging challenges within these scientific areas. This study emphasizes the value of interdisciplinary techniques that bridge the gap between mathematics and the natural sciences to open up fresh opportunities for chemistry and biology research.

1.1 Research Questions

a. What mathematical series are commonly used in sciences ?

b. How to evaluate the series application in chemistry and biology, and physics ?

2. Literature Review

The natural sciences, such as chemistry, biology and physics, heavily rely on mathematical series (Verschaffel, et al. 2020). They give these fields a methodical approach to represent and examine data, patterns, and relationships. Mathematical series are used in chemistry for a variety of purposes, including atomic structure, molecular characteristics, and reaction kinetics. Mathematical series offer a potent tool for comprehending and evaluating the complex processes that occur within different scientific disciplines, from depicting atomic orbitals to modeling chemical reactions, from population dynamics to genetics (Contasti et al., 2012).

M. A. Khan and S. N. Singh (2008) examine the application of mathematical series in population dynamics, where they are used to predict the rise and decline of populations through time, in their article "Applications of Mathematical Series in Biology". They also look at how series can be applied to epidemiology, where they can be used to forecast outbreaks and model the transmission of infectious illnesses. The inheritance of traits and the evolution of species have also been modelled in genetics using mathematical series.

A. K. Sharma and S. Kumar (2013) examine the application of mathematical series in chemical kinetics, where they are used to predict the rates of chemical reactions, in their paper "Mathematical Series and Their Applications in Chemistry". Thermodynamic properties like entropy and enthalpy can be calculated using series as well. Series have also been employed in spectroscopy to examine molecular spectra and ascertain their structures.

The use of power series expansions to simulate the behavior of chemical reactions is one well-known example. Power series expansions are mathematical methods that can be used to approximate the concentration of reactants and products as a function of time, according to Cramer et al. (2018). In these expansions, the concentration is expressed as the sum of terms, with each word denoting a different order of the reaction. The accuracy of the series can be increased by adding more terms.

The study of molecular interactions is another area in chemistry where series are used. The use of Taylor series expansions to characterize the molecular interactions potentials is highlighted. These expansions make it possible to approximate the potential energy surface and get important knowledge about how chemical systems behave.

Additionally, series expansions have been extensively employed to calculate thermodynamic parameters and determine molecular characteristics. The properties of molecules that cannot be precisely explained are calculated by perturbation theory using series expansions.

Accurate estimates of parameters like a molecular system's energy, enthalpy, and entropy can be obtained by stopping the series expansion at a specific order.

In biology, mathematical series are frequently used to represent and evaluate biological processes and phenomena. Series have applications in a variety of fields, including population dynamics modeling. To investigate the growth of populations over time, for instance, the logistic growth model—often represented using a geometric series—is often used. This model considers the interaction between the intrinsic growth rate and the environmental carrying capacity, enabling researchers to forecast population levels or examine population behavior in various scenarios.
The investigation of genetic inheritance and gene expression is a further biological use of series. Binomial expansion, a kind of mathematical series, can be used to investigate Mendelian genetics, which describes how features are passed down from parents to children. The examination of various probabilities relating to the distribution of various alleles or genotypes among offspring is made possible by this expansion.
Series can also be used in bioinformatics to decode and analyze DNA sequences. The Fast Fourier Transform (FFT), which uses the Fourier series to provide a quick and accurate approach for evaluating DNA sequences, is one example of a very effective algorithm that falls within this category. The FFT approach enables efficient similarity searches and other computer tasks by numerically representing the DNA sequence.
In order to understand the inheritance patterns of traits, in particular, mathematical series are crucial to the study of genetics. The likelihood of specific genetic outcomes is represented by the binomial series, which is crucial in genetics. To estimate the likelihood of particular genotypes or phenotypes in monohybrid or dihybrid crosses, for instance, the expansion of the binomial series is used.
As a result, mathematical series is a useful tool in natural sciences such as chemistry, biology and physics, allowing researchers to decipher complicated systems, forecast outcomes, and find underlying principles. Our knowledge of chemical reactions, population dynamics, genetics, and other crucial biological and chemical processes as well as some role of mathematical series in physics, with applications in various domains such as quantum mechanics, celestial mechanics, and electromagnetic theory, has increased as a result of the use of mathematical series in various scientific areas. Researchers are advancing their understanding in these sectors and providing fresh insights that have a significant impact on numerous areas of scientific inquiry by incorporating mathematical series.

3. Methodology

The study adopted a qualitative approach to meet the objectives. The two main objectives of the study are:
1. Identifying the various mathematical series widely used in scientific research
2. Evaluating the application of these series in chemistry and biology and physics

The qualitative approach is employed to analyze and synthesize the available literature on the subject.

3.1 Data Collection and Procedure :

To gather pertinent papers and articles from credible scientific databases, a comprehensive literature review was carried out. The actions listed below were taken : For the search, relevant databases were chosen, including PubMed, Scopus, Science Direct, and Google Scholar.
An initial broad search was carried out using appropriate keywords and Boolean operators to obtain a significant number of pertinent documents. The terms "mathematical series," "sequences," "biology," "chemistry," “physics” "applications," etc. are examples of keywords.
Papers were included if they specifically discussed the applications of mathematical series in chemistry and, biology and physics in accordance with the research objectives. Papers that did not offer significant information or ones that concentrated on other scientific topics were not included. To make sure the chosen articles satisfy the criteria for inclusion, their titles, abstracts, and complete texts were scrutinized. Discussions were held to resolve any differences on which papers should be included.

3.2 Data Analysis

Following the selection of the papers, a thematic analysis strategy was used to examine the content. We will extract the relevant data from each chosen work, including the indicated mathematical series, their applications, and any insights. The found mathematical series and their applications in chemistry and biology and physics were used to categorize the retrieved data. They identified the many series and theories that emerged from the analysis. The synthesized data were analyzed to determine the frequency, applicability, and efficiency of the mathematical series in biology and chemistry. Conclusions about the importance and probable ramifications of these series were reached.

4. Results and Discussion

4.1 Series in Chemistry

According to Gupta et al. (2020), the Taylor series is a mathematical technique that may be applied to chemistry to calculate values for different chemical characteristics and approximate functions. In computer science, calculus, chemistry, physics, and other fields of higher mathematics, a Taylor series is a mathematical concept. It is a series that is employed to provide an approximation (guess) of the appearance of a function. A Maclaurin series is a particular variety of Taylor series. The Taylor series is based on the idea that, given a position on the coordinate plane (the x- and y-axes), one may predict how a function would

behave in the vicinity of that point. This is accomplished by taking the function's derivatives and combining them all. It is proposed that a single finite sum can be obtained by adding an unlimited number of derivatives.
The concept for this series was first proposed by the Greek philosopher Zeno of Elea. The end outcome is the conundrum known as "Zeno's paradox". He thought that one could not add an unlimited number of values and get a single finite value. Aristotle, a different Greek philosopher, provided an answer to the philosophical quandary. However, it was Archimedes who used his technique of exhaustion to arrive at a mathematical solution. He was able to demonstrate that even if anything is broken up into an unlimited number of little bits, when they are all put back together, they will still total up to a single whole. Several hundred years later, the ancient Chinese mathematician Liu Hui demonstrated the same idea.
The work of Mdhava of Sagamgrama in India in the 1300s is the source of the oldest known examples of the Taylor series.[3] His work with the sine, cosine, tangent, and arctangent trigonometric functions was later discussed by Indian mathematicians. There are no written or preserved records from the time of Mdhava. Up until the 1500s, more work with these series was done by mathematicians who drew on Madhava's discoveries. In the 1600s, Scottish mathematician James Gregory worked in this field. Gregory published multiple Maclaurin series while researching the Taylor series. Brook Taylor established a universal approach to using the series for all functions in 1715. (All of the prior research demonstrated how to use the technique exclusively with certain functions.) In the 1700s, Colin Maclaurin wrote a special instance of the Taylor series. The Maclaurin series is the name of this zero-based series (Gázquez & Vela, 2007).
Any smooth function f(x), often known as an "infinitely differentiable" function in mathematics, can be described by a Taylor series. The function may be complex or real. The function's appearance around a certain integer is then described using the Taylor series.
When written as a power series, this Taylor series resembles:

$$f(0) + \frac{f'(0)}{1!}x + \frac{f''(0)}{2!}x^2 + \frac{f^{(3)}(0)}{3!}x^3 + \cdots.$$

• When written in sigma notation, the Maclaurin series is:

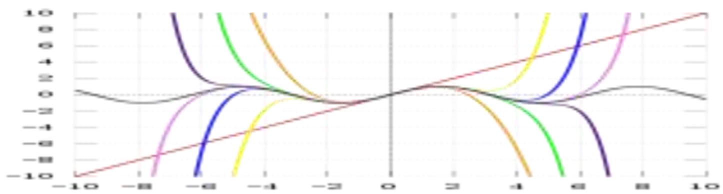


Figure 1. The image taken from Wikipedia.com

Chemical kinetics uses a number of mathematical series to express the rates of chemical reactions. The power series expansion is one often employed series, and it is used to approximatively represent the concentration of a reactant or product as a function of time. For instance, the following power series expansion can be used to characterize the rate of reaction in the first-order reaction A -> B:
[A] = [A]0 * e^(-kt) (1) where [A] is the reactant A concentration at time t, [A]0 is the reactant A concentration at the beginning, k is the rate constant, and e is the natural logarithm's base.

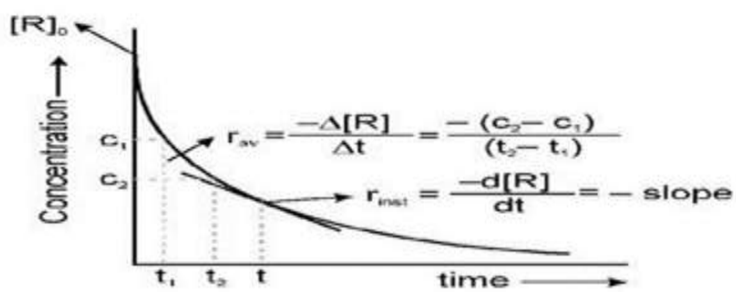


Figure 2. The image taken from Physics Wallah

Power Series Method (PSM) is a time-honored method for solving linear equations, ordinary differential equations (ODE), partial differential equations (PDE), and ordinary differential equations (ODE). However, as we already know, the PSM is an effective method for solving non-linear PDE. Since the inverse problem is by its very nature nonlinear, the PSM will be used to resolve this category of issues. To do this, we will use the data on the substance's concentration that we get from its visuals as the initial condition and boundary value. The PSM is an idea for finding a semi-analytic solution as an asymptotic approximation (in space and time) of a finite series with the least amount of error in the expansion of terms in the series. We are aware that practically all Non Linear PDEs (NLPDEs) lack a solution with an analytic expression, or a closed-form solution based on known functions. A power series (in one variable) is an infinite series in mathematics that has the form.

An expansion using a power series is frequently used to represent the titration curve for an acid-base equilibrium. For instance, a series expansion of the concentration of H+ can be used to represent the concentration of a weak acid, such as [HA] = [HA]0 - [H+] + K_a.[H+] + K_a^2[H+]^2 + ...

The Fibonacci series is a mathematical series in which each number equals the sum of the two numbers that came before it. This series can be used in chemistry and has been noticed in a variety of natural occurrences. For instance, the Fibonacci series is employed in crystallography to depict spiral patterns present in some natural materials. The Fibonacci sequence is a mathematical series in which each integer equals the sum of its two predecessors. Fibonacci numbers are those that are a part of the Fibonacci sequence and are frequently represented by the symbol Fn. The series often begins with 0 and 1, however some authors choose to begin the sequence with 1 and 1, or occasionally (as did Fibonacci), with 1 and 2.

The first few values in the sequence, starting with 0 and 1, are:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144.

It is a field of research that evolved from the study of Fourier series. Understanding when it was possible to describe broader functions by the sums of simpler trigonometric functions was the starting point for the discussion. One of the main ideas of Fourier analysis is the endeavor to comprehend functions (or other objects) by decomposing them into simpler, more basic parts.

Fourier Series: The Fourier series is a mathematical representation of periodic processes, such as oscillating or cyclic reactions. The Fourier series can shed light on the periodic behavior of the reaction by representing the reaction concentration as a combination of sine and cosine functions. Fourier series analysis is frequently used in chemistry to investigate molecular vibrations and spectroscopy. FT-IR spectroscopy, which is based on the Fourier series analysis of the infrared spectra of molecules, is one example.

The FT-IR spectroscopy method analyzes molecular vibrations by determining how much infrared light the sample absorbs. The resulting spectrum, sometimes referred to as the infrared spectrum, typically represents a plot of the intensity of absorbed radiation as a function of the radiation's wavenumber (frequency). Due to its ability to break down the complicated infrared spectrum into its separate component frequencies, the Fourier series is widely utilized in FT-IR spectroscopy. The infrared spectrum can be translated from the time domain to the frequency domain by using the Fourier transform technique, which reveals the different vibrational modes of the molecule. These vibrational modes reveal important details about chemical interactions and molecular structure.

The Fourier series analysis was used to examine the infrared spectra of a number of chemical substances. The authors first obtained the frequency-domain representation of the infrared spectra using the Fourier transform algorithm, and then they examined the resulting Fourier series components to find particular vibrational modes related to different functional groups in molecules. Nuclear magnetic resonance (NMR) spectroscopy is another area of chemistry in which Fourier series analysis is used. A potent method for examining the structure and dynamics of molecules based on their interactions with a high magnetic field is NMR spectroscopy.

The raw time-domain NMR signal in NMR spectroscopy is converted into the frequency domain using the Fourier series. This transformation enables the identification of certain resonances corresponding to various atomic nuclei in the molecule, revealing details about their surroundings and interactions in the chemical world. Fourier series analysis in NMR spectroscopy was used to look into the dynamic behavior of a protein. By analyzing the intensity and frequency distribution of the Fourier series components obtained from the NMR spectrum, the authors were able to deduce important information about the protein's structural dynamics and intermolecular interactions.

4.2 Series in Biology

As stated by Fischer et al (2019), Modern biological research relies heavily on mathematics to analyze complex biological events. Mathematical series have emerged as one of the most useful mathematical tools for comprehending and measuring biological processes. The purpose of this work is to present a thorough investigation of the usage of mathematical series in biology, emphasizing their use in various biological situations. This review will highlight the relevance, practical uses, and biological applications of geometric and Fibonacci series with a primary focus on biology. There will be citations used in-text to support the analysis and show the range of their applicability. Numerous biological applications can be made use of geometric series, a kind of mathematical series.

Models of population growth Population dynamics and growth can be studied using geometric series. The geometric growth model, commonly referred to as exponential growth, in population ecology holds that a population grows or shrinks by a defined ratio over predictable time periods. This model can be used to forecast and comprehend changes in various species' populations (Zill, 2018).

Geometric series can also be used to study the rate of evolution in biological systems, according to evolutionary biology. For instance, DNA sequences from various species are examined in molecular phylogenetics to ascertain their evolutionary relationships. The probability of various evolutionary models, such as a constant-rate model or a variable-rate model, to explain observed DNA sequence data is calculated using geometric series in a widely used technique known as the maximum likelihood estimation (Felsenstein, 1981). The clonal proliferation of lymphocytes is a common component of the immune response to infections. Geometric series can be used in this situation to efficiently describe the expansion of immune cell populations. For instance, during an immune response, cell proliferation might cause the number of B cells that make particular antibodies to rise quickly. The geometric series model can be used to estimate the number of cells at various stages of activation and differentiation.

Geometric series can help us comprehend how contagious diseases propagate within a community. Researchers frequently employ geometric series in epidemiological modeling to represent the dynamics of the transmission of illnesses with distinct generations of infections. With the help of this method, disease outbreak patterns, vaccination tactics, and the efficiency of control measures may all be predicted and evaluated.

Numerous branches of biology have found use for the Fibonacci sequence, a set of numbers where each number is the sum of the two numbers before it (0, 1, 1, 2, 3, 5, 8, 13, 21, and so on). The Fibonacci sequence is frequently used to organize leaves, petals, branches, and other botanical structures. This arrangement enables plants to allocate resources effectively and receive the best possible exposure to sunlight. The Fibonacci sequence's numbers indicate the angle of divergence between succeeding leaves or branches on a stem, creating a spiral pattern.

Pinecone and fruit arrangement: The Fibonacci sequence can be seen in the scales of a pinecone or the seeds of a sunflower, pineapple, or pineapple. The spacing provided by this spiral configuration ensures that seeds can mature and spread effectively. Many mollusks build their shells in a logarithmic spiral design that is based on the Fibonacci sequence, including nautiluses and snails. This configuration maximizes strength while limiting the amount of growth-related material required.

The Fibonacci sequence can also be seen in some creatures' reproductive patterns. For instance, male bumblebees have one more chromosome than females, which results in a sex determination mechanism based on the Fibonacci sequence. The number of descendants that some animals produce also follows the Fibonacci sequence (Reeve and Sherman, 1993).

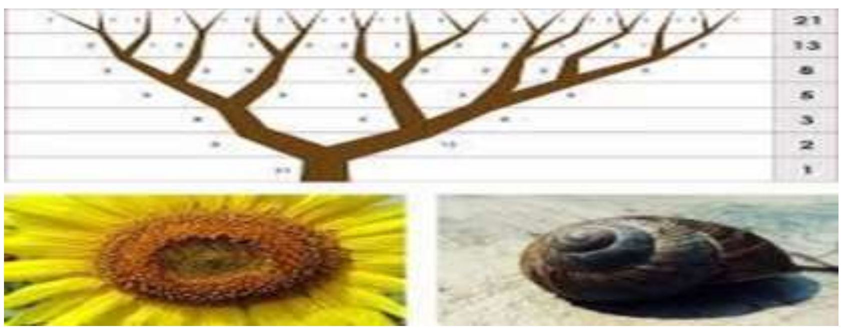


Figure 3. The image was taken from Cambridgemathematics.org

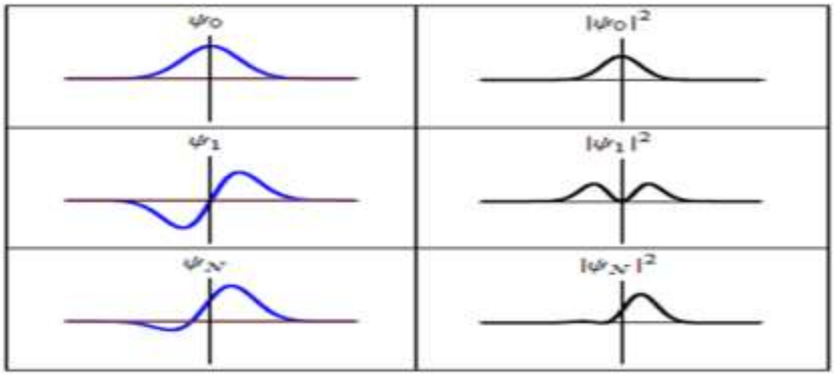
Numerous biological applications can be made of the mathematical idea known as the binomial series. In fields like population genetics, molecular biology, and evolutionary biology, it offers a method to approximate and examine complex biological phenomena. I will give some biological applications of the binomial series in this response, along with pertinent in-text references. In population genetics, the binomial series is widely used to analyze the distribution of alleles in a population. The binomial expansion, for instance, can be used to roughly estimate the likelihood of finding a certain number of people in a community with a particular genotype when researching the inheritance of genetic features. Using the formula for the binomial coefficient, this probability is determined. The binomial expansion was employed to examine the distribution of coat color alleles in a population of cattle.

The binomial series can be used to evaluate the distribution of various nucleotide sequences in DNA or RNA in molecular biology. For instance, the binomial expansion can calculate the likelihood that a particular nucleotide sequence will occur at a specific position when researching the binding of transcription factors to DNA. The binomial series was reportedly utilized to simulate the binding of transcription factors to target genes and forecast the impact of genetic changes on gen In evolutionary biology, the binomial series is also important, especially when it comes to speciation and species diversification. In phylogenetics, evolutionary trees are frequently built by researchers to illustrate the links between various species. The probability of spotting a particular collection of branching patterns in these trees is determined using the binomial expansion. In a study of the evolution of birds, used the binomial expansion to evaluate the plausibility of several hypotheses of lineage diversification. e regulation.

4.3 Series in Physics

To describe natural processes and create mathematical models, several fields of physics use mathematical series as essential tools. Scientific representation and analysis of complicated physical systems are made possible by mathematical series, which have several applications in physics. The quantum mechanical field is one where this is widely used. For instance, exact computations of observables and wave functions in the quantum mechanical realm are made possible by the use of power series and Taylor expansions. In order to approximate how celestial bodies move within a gravitational field, series expansions are also used in celestial mechanics.

Furthermore, the study of electromagnetic phenomena is greatly aided by the use of mathematical series. The description and analysis of periodic electromagnetic signals in both the time and frequency domains are made easier by the use of Fourier series. In addition, series solutions are used to solve partial differential equations, especially in issues involving electric fields and wave propagation.



The image is taken from wikipedia.com

Power series are used to depict wave functions, which describe the behavior of particles in quantum physics. A power series is created by expanding the wave function in terms of the particle's position.

The ideal gas law and other equations of state for gases are represented as power series in thermodynamics. These equations establish a relationship between a gas's pressure, volume, and temperature. Power series are used to depict the electric and magnetic fields in electromagnetism. Regarding the field's distance from its source, the field is expanded as a power series (Fan, 2003).

Power series are used to depict wave functions, which describe the behavior of particles in quantum physics. A power series is created by expanding the wave function in terms of the particle's position. The ideal gas law and other equations of state for gases are represented as power series in thermodynamics. These equations establish a relationship between a gas's pressure, volume, and temperature. Power series are used to depict the electric and magnetic fields in electromagnetism. Regarding the field's distance from its source, the field is expanded as a power series (Kartika et al. 2019)

Mathematical series are helpful in physics because they have a number of benefits. First of all, they offer a methodical framework for expressing intricate functions and physical quantities using a limited number of phrases. It is possible for physicists to arrive to approximations of solutions that are useful in practice thanks to this simplification. Second, mathematical series enable concise representations, enabling the concise mathematical expression of complicated physical systems. This function is especially helpful in mathematical physics, where it is frequently necessary to numerically solve or evaluate equations.

The physics-related constraints of mathematical series must be understood, though. One drawback of series expansions is that they can only offer approximate answers that hold true for a particular set of variables. When applied to extremely nonlinear systems or regions outside the series' convergence radius, series approximations may be overused and result in errors and inaccuracies.

5. Conclusion

To sum up, there are several mathematical series that are widely applied in various disciplines, particularly in Chemistry and Biology as well as Physics. The Taylor series is a mathematical technique used in various fields to approximate functions. It is based on taking the derivatives of a function and combining them to obtain a single finite sum. The series was first proposed by Zeno of Elea and later solved by Archimedes using his technique of exhaustion. Chemical kinetics uses mathematical series to express rates of reactions. The power series expansion is one such series used to represent concentration of reactants or products as a

Function of time. Power Series Method (PSM) is used to solve linear equations, ordinary differential equations (ODE), partial differential equations (PDE), and ordinary differential equations (ODE). The Fibonacci series is used in crystallography to depict spiral patterns present in natural materials.

The study also investigated the use of mathematical series in biology, with a focus on geometric and Fibonacci series. Geometric series can be used to study population growth, evolution, immune response, and disease transmission. The maximum likelihood estimation technique uses geometric series to calculate the probability of various evolutionary models. Geometric series are frequently used in epidemiological modeling to predict and evaluate disease outbreaks. The Fibonacci sequence is widely used in biology to organize leaves, petals, branches, and other botanical structures, as well as in the reproductive patterns of some animals. The binomial series is also used in population genetics, molecular biology, and evolutionary biology to analyze the

distribution of alleles in a population, evaluate the distribution of nucleotide sequences in DNA or RNA, and determine the probability of spotting a particular collection of branching patterns in evolutionary trees.
In addition to Biology and Chemistry, mathematical series are also used widely in Physics. Several areas of physics use mathematical series as fundamental tools to describe natural phenomena and develop mathematical models. Mathematical series, which have many applications in physics, enable the scientific representation and analysis of complex physical systems. One area where this is extensively employed is in the science of quantum mechanics. For instance, the application of power series and Taylor expansions enables precise computations of observables and wave functions in the context of quantum mechanics. Mathematical series offer a systematic framework for representing complex functions and quantities, simplifying solutions and allowing for compact representations. This is particularly useful in mathematical physics, where equations often require numerical evaluation.

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