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Golden Ratio and Fibonacci Quadratic Equation in Business and Finance

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Abstract

The Golden Ratio and Fibonacci quadratic equation provide powerful insights into financial decision-making. From stock market analysis to business growth strategies, these mathematical principles offer practical applications in the financial world. By leveraging it, finance and investors can enhance their forecasting, optimize risk assessment, and improve financial outcomes. The existence of this Fibonacci sequence is not coincidental since it has been properly developed and maintained. There are more possibilities to study the mathematical properties of the Fibonacci numbers in the contemporary mathematics curriculum. Research into Fibonacci numbers facilitates the investigation of the existence of the Fibonacci sequence in God's beautiful essence. In short, God's dominance over humans is illustrated by the Fibonacci numbers and sequence.

Keywords: Fibonacci Quadratic Equation; Golden Ratio; Financial Decision-Making; Forecasting Accuracy; Mathematical Principles.

Introduction

There are several ideas in mathematics that have applications in various mathematical domains. The "Fibonacci sequence," which Leonardo Pisano created in the thirteenth century, is one of these ideas. His suggested Fibonacci number and sequence makes it abundantly evident that mathematics may be related to a wide range of seemingly unconnected topics.

Numerous disciplines, including discrete mathematics, number theory, and geometry, can benefit from its extraordinary properties. By definition, Fibonacci sequence begins with either 0 and 1 or 1 and 1, and any number after the sum of the two numbers. The finest illustration of any recursive series is the Fibonacci sequence. There are many mathematical problems that use this sequence.

Fibonacci problem: Assume that on January 1st, two rabbits—a male and a female—are born. Assuming that each month has the same number of days and rabbits begin to birth young just two months after birth, that is, that each pair produces another pair (one male and one female) at two months of age, and that mixed pairs are produced each month after that, with no rabbit dying in between There are many mathematical problems that use this sequence.

Fibonacci Solution

0,1,1,2,3,5,8,13,21,34,55,89,114 are Fibonacci number. Thus, after one year, 114 pairs of rabbits will be produced Then, Fibonacci sequence and Fibonacci numbers will be recursively defined as:

$f_{n+2} = f_n + f_{n+1}$ where n> 0 or n = 0.

Uses for the Fibonacci series

The spiral hexagon seen on the pineapple, the rows of pinecones, the seed heads, the petals growing on various flowers like sunflower, the starfish, the shells seen on snails and nautiluses, the spiral galaxies, and the chambers of vegetables and fruits like apples, lemons, Chile, and so on are all examples of natural objects that can be connected to the Fibonacci sequence (Kumar, & Sahani, 2024,2025).

Properties of Fibonacci series

When you sum up the Fibonacci numbers from odd indices, the result will be f_{2n} . For example, if you take the Fibonacci numbers from f_1 , f_2 , f_3 , f_4 ,⋯ ⋯ , f_{2n-1} , f_{2n} and add them up, the total will equal f_{2n}.

For example: 1+2+5+13= f_8 =21 that is accurate.

$f_{2n-1} - 1$ is the sum of the Fibonacci numbers from even indices, or from Fibonacci sequence f_1 , f_2 , f_3 , f_4 , f_5 , f_{2n-1} , f_{2n} yield numbers at even indices and add them, their addition will be equal to number to $f_{2n-1} - 1$. For example: 1 +3 + 8 = 12= f_7 - 1.

Golden Ratio: Addition of all $\frac{f_n}{f_{n-1}}$ crops golden ratio as : 3/1+ 5/3 + 8/5 + 13/8 gives $\frac{Golden\ ratio}{2}$.

Golden Ratio

Euclid originally referred to the golden section and golden ratio in his book Elements circa 300 B.C. The issue of dividing a line into golden sections was put forth by Euclid. He suggested that the ratio of the smaller portion with bigger part of the entire segment is equal to the larger part to the entire segment length where a unit segment is separated into two lengths. For instance: The golden ratio may be described as follows if the segment's total length is x +y, with x representing the bigger component and y the smaller part: $\frac{(x+y)}{x} = \frac{x}{y}$.

The golden ratio is unscientific. Due to its frequent appearance in geometry, the golden ratio greatly captivated the Greeks. The proportion of the pentagram's lines is an example of the Golden Ratio in geometry. When all the sides of a pentagon are equal, the diagonals that meet divide each other in the golden ratio, also known as the divine ratio. It is used in the proportions of many of the world's most magnificent architectural constructions. Throughout history, several artists have employed the golden ratio in their creations because they have found it to be both advantageous and aesthetically beautiful (Dunlap, 2003).

Origin of Fibonacci

Around 1175 A.D., Leonardo Pisano, an Italian mathematician, was born in Pisa into a merchant family (Dunlap, 2003). Fibonacci was educated by the Barbarian Mohammedans since his father, Bonacci, had a diplomatic position in the North African city of Bugia. As a kid, Fibonacci traveled the Mediterranean with his father, exposing him to cutting-edge mathematical theories and notions from many different nations.

His passion for mathematics was stoked by his travels, and in 1200 A.D., he returned to Italy to produce Liber Abaci, or the Book of the Calculations. This work made Fibonacci one of the most well-known mathematicians of his era by introducing the Arabic number system to Europe.

The Fibonacci sequence (series) was derived from the book's answer to the dilemma of a single pair of rabbits' offspring. Thus, the formula $f_n = f_{n-1} + f_{n-2}$ when n>3 or n =3 defines the Fibonacci sequence. Two prior Fibonacci numbers are added together to create each Fibonacci number.

Conceptualizing the Fibonacci Quadratic Equation

The Fibonacci sequence is mathematically defined as

$$f_n = f_{n-1} + f_{n-2}$$

where $f_0 = 0$ and $f_1 = 1$.

Fibonacci quadratic equation emerges from ratio of consecutive Fibonacci numbers. The Golden Ratio (φ) is derived as

$$x^2 - x - 1 = 0$$

Solving gives x = $\frac{a \pm \sqrt{5}}{2}$

The positive root, roughly 1.618, is the Golden Ratio and appears in numerous financial models and economic behaviors (Charran, 2011).

Other names of Golden ratio

The terms "golden mean," "divine proportion," "golden section," "extreme and mean ratio," and "golden number" are other names for the golden ratio. The golden ratio is commonly used to calculate distance ratios in geometric designs such as the decagon, pentagram, pentagon, and dodecahedron. For example, a rectangle with sides in the ratio 1: x may be defined as the special number x such that the sides of the new rectangle have proportions of 1: x when the previous rectangle is divided into a new rectangle and a square. Such a rectangle is known as a "golden rectangle."

Golden Ratio, Human Body, and Fibonacci sequence

Our human body serves as an example of divine proportion. For instance, numbers 2, 3, 5, and 8 produce the Fibonacci ratio of 1.618. Each part of our index finger is larger than the one before it, as can be seen when we look at its dimensions.

Golden Ratio in Nature

One of the most fascinating things about the Golden Ratio and the Fibonacci sequence is how frequently they appear in nature. One of the fundamental laws of the universe that many natural objects follow is the Golden Ratio. For example: Petal arrangements for flowers.

The number of petals on any flower always follows the Fibonacci sequence. For example, a three-petaled flower follows the Fibonacci sequence. A buttercup is formed of five leaves. To optimize exposure to sunlight and other factors, each flower petal is positioned at 1.618034 turns (out of a 360-degree circle). Another illustration of the Fibonacci sequence is the whirling pattern that leaves on plant stems produce. The Fibonacci sequence is also visible on animal bodies; for instance, the Divine ratio is seen when viewed from the top of the head to the navel and from the navel to the floor (Gizmodo, 2015).

Fibonacci sequence and Golden Ratio in Business Finance

Fibonacci sequence and the Golden Ratio have long been associated with natural patterns, art, and architecture. However, these mathematical concepts also have significant applications in business finance. Understanding the Fibonacci quadratic equation and its implications can help financial analysts, traders, and business strategists optimize decision-making, risk assessment, and financial forecasting.

Stock Market Analysis: The Fibonacci retracement levels of 23.6%, 38.2%, 50%, 61.8% are used in technical analysis to forecast. Traders use those retracement levels to time market entry and exit points.

Investment Strategies: Portfolio managers use Fibonacci-based techniques to optimize asset allocation.

The Golden Ratio is often applied in balancing risk and return in investment portfolios.

Revenue Growth and Forecasting: Many business growth models follow exponential trends similar to Fibonacci sequences. Companies use Fibonacci projections to predict sales growth, revenue patterns, and financial cycles.

Pricing Strategies: Businesses use Fibonacci pricing techniques to structure discounts, markups, and profit margins. The aesthetic appeal of the Golden Ratio influences product pricing, particularly in luxury goods and branding.

Risk Management and Decision-Making: Financial analysts use Fibonacci-based models to assess risks in economic downturns. Predictive modeling incorporates Fibonacci ratios to evaluate market volatility and trend reversals.

Conclusion

In the end, the Fibonacci sequence is applicable to many facets of nature and the environment in addition to other areas of mathematics. We may conclude that there are many spirals, Fibonacci numbers, Fibonacci sequences, and the golden ratio in nature. They are everywhere. Because the Fibonacci sequence and Golden Ratio are employed in many areas both within and outside of mathematics, research on them helps us understand how they are applied in things like nature, human and animal anatomy, and art, among other things.

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