The Fibonacci Sequence: Origin, Applications and Myths

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Abstract

The Fibonacci Sequence and the "Golden Ratio" are two popular terms in modern day mathematics. Their applications range from flower petals and the pyramids of giza to even human anatomy and famous paintings. This paper studies the origins and properties of the Fibonacci sequence and Golden Ratio. It describes the Sequence's applications in nature. It also looks at the myths surrounding the Golden Ratio and Fibonacci Sequence and examines the facts regarding those.

THE FIBONACCI SEQUENCE AND ITS ORIGINS

Known as "nature's universal rule" or "nature's secret code", the Fibonacci sequence is a sequence where each number in the sequence is the sum of the two numbers that precede it. This sequence is: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, and so on. The mathematical equation describing this sequence is: Xn+2= Xn+1 + Xn. The golden ratio, represented by the greek letter phi (ϕ) is approximated by the Fibonacci numbers. The value of the golden ratio is about 1.618 and it is obtained by dividing the sum of two successive numbers in the series by the larger number. The higher the fibonacci numbers taken are, the closer their ratio gets to 1.618. There are many rumours and assumptions surrounding the fibonacci sequence, and to what extent they are true will be examined later in the paper.

Some say the Fibonacci Sequence was discovered by Leonardo Pisano Bogollo (whose nickname was Fibonacci) but ancient Sanskrit texts using the Hindu-Arabic numeral system have mentioned the sequence centuries before Leonardo Of Pisa. Fibonacci was a member of an important Italian trading family in the 12th and 13th century and had travelled across the Middle East and India and was captivated by the mathematical ideas he encountered on his travels. In 1202 he published "Liber Abaci" - a book written for tradesmen, it laid out Hindu-Arabic arithmetic useful for tracking profits and losses, remaining loan balances etc. In one place in the book, Leonardo of Pisa introduces the sequence with a problem involving rabbits. He poses the following question: If a pair of rabbits is placed in an enclosed area, how many rabbits will be born there if we assume that every month a pair of rabbits produces another pair and that rabbits begin to bear young two months after their birth?

- In the beginning no rabbits will be born, as the initial pair will not have time to be pregnant and give birth = 0.
- In the first month one pair of rabbits will be born = 1.
- Again in the second month one pair of rabbits will be born as the new rabbits would not be matured to bear young ones = 1.
- In the third month two pairs of rabbits will reproduce (one pair will not be ready) therefore two pairs of rabbits would be born = 2.
- In the fourth month three pairs of rabbits would reproduce and 2 pairs of rabbits would not be ready, so three pairs of rabbits will be born = 3.
- In the fifth month five pairs of rabbits will reproduce and three would not be ready, so we can say that five pairs of rabbits will be born = 5.

If we were to pose the question: After a year, how many rabbits would one have? The answer is 144, and the formula used to get this answer is the Fibonacci Sequence.

FIBONACCI SEQUENCE IN NATURE

The Fibonacci Sequence can be found in a number of places in nature. On a sunflower's head the seeds are packed in a certain way so that they follow the pattern of the fibonacci sequence. This spiral helps them with survival by preventing the seeds of the sunflowers from crowding themselves out. Number of flowers in many petals are also fibonacci numbers. Examples:

- White calla lily: 1 petal
- Lily, iris: 3 petals
- Buttercup, wild rose: 5 petals
- delphiniums : 8 petals

Pinecones or cauliflowers also show fibonacci spirals.

MYTHS SURROUNDING THE FIBONACCI SEQUENCE

The Fibonacci sequence is a beautiful teaching tool but it is not the "secret code" or "nature's law" as it is perceived to be. Humans are pattern observers, we tend to look for patterns. The golden ratio can definitely be found in some types of plant growth like the spiral arrangement of leaves and petals on some plants, or the seeds or sunflowers that exhibit the fibonacci spiral, but there are just as many plants that do not follow this rule. In fact, the nautilus seashell, a frequently cited example of Fibonacci sequence, does not grow new cells according to the sequence at all. There is a lot of misinformation about the golden ratio and much of it can be attributed to a book written by a German psychologist Adolf Zeising. He said that the proportions of the human body were based on the golden ratio. This sprouted many other theories like the "golden rectangle" or the "golden triangle" and people began to look for them in the dimensions of the pyramids of Giza, Leonardo Da vinci's painting "Vitruvian Man" or the Parthenon. These claims might be appealing at first but they are uncritical in their approach. All these claims, when tested, are measurably false. We can find such instances only because of our ability to recognise patterns.

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