Fibonacci Sequence

A sequence of numbers in which each number is the sum of the preceding two.

A Fibonacci sequence is a sequence of numbers in which each number is the sum of the two preceding numbers (e.g., 1, 1, 2, 3, 5, 8, 13). Patterns exhibiting the sequence are commonly found in natural forms, such as the petals of flowers, spirals of galaxies, and bones in the human hand. The ubiquity of the sequence in nature has led many to conclude that patterns based on the Fibonacci sequence are intrinsically aesthetic and, therefore, worthy of consideration in design.[1]

Fibonacci patterns are found in many classic works, including classic poetry, art, music, and architecture. For example, it has been argued that Virgil used Fibonacci sequences to structure the poetry in the *Aeneid*. Fibonacci sequences are found in the musical compositions of Mozart's sonatas and Beethoven's Fifth Symphony. Le Corbusier meshed key measures of the human body and Fibonacci sequences to develop the *Modulor*, a classic system of architectural propotions and measurements to aid designers in achieving practical and harmonious designs.[2]

Fibonacci sequences are generally used in concert with the golden ratio, a principle to which it is closely related. For example, the division of any two adjacent numbers in a Fibonacci sequence yields an approximation of the golden ratio. Approximations are rough for early numbers in the sequence but increasingly accurate as the sequence progresses. As with the golden ratio, debate continues as to the aesthetic value of Fibonacci patterns. Are such patterns considered aesthetic because people find them to be more aesthetic or because people have been taught to believe they are aesthetic? Research on the aesthetics of the golden ratio tends to favor the former, but little empirical research exists on the aesthetics of *non-golden* Fibonacci patterns.[3]

The Fibonacci sequence continues to be one of the most influential patterns in mathematics and design. Consider Fibonacci sequences when developing interesting compositions, geometric patterns, and organic motifs and contexts, especially when they involve rhythms and harmonies among multiple elements. Do not contrive designs to incorporate Fibonacci sequences, but also do not forego opportunities to explore Fibonacci relationships when other aspects of the design are not compromised.

See also Aesthetic-Usability Effect, Golden Ratio, and Most Average Facial Appearance Effect.

[1] The seminal work on the Fibonacci sequence is *Liber Abaci* [Book of the Abacus] by Leonardo of Pisa, 1202. Contemporary seminal works include *The Geometry of Art and Life* by Matila Ghyka, Dover Publications, 1978 [1946]; *Elements of Dynamic Symmetry* by Jay Hambidge, Dover Publications, 1978 [1920].

[2] See, for example, *Structural Patterns and Proportions in Virgil's Aeneid* by George Eckel Duckworth, University of Michigan Press, 1962; and "Did Mozart Use the Golden Section?" by Mike May, *American Scientist*, March-April 1996; and *Le Modulor* by Le Corbusier, Birkhauser, 2000 [1948].

[3] "All That Glitters: A Review of Psychological Research on the Aesthetics of the Golden Section" by Christopher D. Green, *Perception*, 1995, vol. 24, p. 937–968.

Le Corbusier derived two Fibonacci sequences based on key features of the human form to create the *Modulor*. The sequences purportedly represent a set of ideal measurements to aid designers in achieving practical and harmonious proportions in design. Golden ratios were calculated by dividing each number in the sequence by its preceding number (indicated by horizontal lines).