

# THE IMPORTANCE OF SILVER RATIOS

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## Abstract

This scientific article is devoted to the study of the mathematical, scientific and practical significance of the silver ratios. The article, first of all, provides detailed information about the mathematical structure of the silver ratios and its historical development. The silver ratio is a quantity that expresses the ideal relationship between two numbers, and its specific properties are widely used in the fields of art, architecture, physics and biology. The article also pays special attention to the role of the silver ratio in creating geometric and aesthetic balance. This ratio is considered, in particular, as a necessary basis for understanding beauty, symmetry and order in nature and human activity.

**Keywords:** Silver ratio, chain fraction, positive irrational, symmetry, chord, aesthetics, engineering.

## KUMUSH NISBATLARNING AHAMIYATI

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## Annotatsiya

Ushbu ilmiy maqola kumush nisbatlarining matematik, ilmiy va amaliy ahamiyatini o'rganishga bag'ishlangan. Maqolada, avvalo, kumush nisbatlarning matematik tuzilishi va uning tarixiy rivojlanishi haqida batafsil ma'lumotlar keltirilgan. Kumush nisbat — bu ikki son orasidagi ideal munosabatni ifodalovchi miqdor bo'lib, uning o'ziga xos xususiyatlari san'at, arxitektura, fizika va biologiya sohalarida keng qo'llaniladi. Maqolada shuningdek, kumush nisbatning geometrik va estetik muvozanatni yaratishdagi rolga alohida e'tibor qaratilgan. Bu nisbat, ayniqsa, tabiatda va inson faoliyatida go'zallik, simmetriya va tartibni tushunish uchun zaruriy asos sifatida qaraladi.

**Kalit so'zlar.** Kumush nisbat, zanjir kasr, musbat irratsional, simmetriya, akkord, estetika, muhandislik.



**Аннотация**

Данная научная статья посвящена изучению математического, научного и практического значения соотношений серебра. В статье, прежде всего, представлена подробная информация о математической структуре соотношения серебра и его историческом развитии. Отношение серебра — это величина, которая представляет собой идеальное соотношение между двумя числами, и его свойства широко используются в области искусства, архитектуры, физики и биологии. В статье также уделяется внимание роли соотношения серебра в создании геометрического и эстетического баланса. Это соотношение рассматривается как необходимая основа для понимания красоты, симметрии и порядка, особенно в природе и человеческой деятельности.

**Ключевые слова:** Серебряное сечение, цепная дробь, позитивная иррациональность, симметрия, аккорд, эстетика, инженерия.

**Introduction**

Geometry and art use different proportions to find beauty and harmony. Mathematical ratios such as the golden ratio, silver ratio, and bronze ratio represent aesthetic harmony and are reflected not only in art, but also in nature, architecture, and design. These proportions are based on numerical and geometric relationships, which are perceived by humans as the most natural and pleasing to the eye.

All elements of metallic ratios are positive quadratic irrational numbers, which are positive solutions of the following quadratic equations.

$$x^2 - px - 1 = 0 \quad (1)$$

$p = 1$ , the positive irrational root of the equation gives us the golden ratio.

The golden ratio  $[\ ]$  has been studied in the literature. In this article we  $p = 2$  let's look at the case, i.e

$$x^2 - 2x - 1 = 0 \quad (2)$$

Eq  $x$  as for  $x$ , we have the following expression  $x = 2 + \frac{1}{x}$ .

We can express this expression in the form of a chain fraction:

$$x = 2 + \frac{1}{2 + \frac{1}{2 + \frac{1}{2 + \dots}}} \quad (3)$$

The positive irrational root of the equation:  $x = 1 + \sqrt{2}$  gives the silver ratio.

The silver ratio has a value of 2.41421356 and represents the geometric harmony of the second degree. The silver ratio is not as popular as the golden ratio, but it is also used to create many geometric shapes, such as rectangles, pentagons, and floral shapes.

**Place in mathematics**

The role of the silver ratio in mathematics is manifested in the following main areas:



### 1. Trigonometry

- The silver ratio occurs in some trigonometric functions, particularly measurements between angles. This ratio is used when placing a square inside a circle or studying symmetrical figures inside a circle.

### 2. Irrational numbers

- The silver ratio is a form of irrational number in mathematics. SHE IS  $\sqrt{2}$  Since it is based on , it represents numbers that continue indefinitely but have a logical relationship.

### 3. Fibonacci sequence and fractions

- Like the golden ratio, the silver ratio follows Fibonacci-style sequences. For example, images created by juxtaposing squares use the silver ratio.

### Importance in practice

The Silver Ratio helps to provide balance, symmetry and beauty in many practical areas:

#### 1. Architecture and design

- The silver ratio is widely used in architecture to design buildings. In some historical and modern buildings, this ratio is used to determine the dimensions of the facade or interior space. It gives balance and harmony to buildings.
- Example: Japanese temples (Horyu-ji) and traditional teahouses (chashitsu).

#### 2. Art and aesthetics

- The silver ratio is used to define the ratio of elements in works of visual art. This ratio creates a pleasing and natural look. For example, in painting or graphic design, more harmonious compositions are created by taking into account the silver ratio.

#### 3. Physics and engineering

- The silver ratio is used in the manufacture of optical lenses and in the modeling of wave motion. This ratio is useful when studying the symmetry of light or sound waves.

#### 4. Music theory

- In music, the silver ratio is sometimes used to organize chords and sound sequences. It helps to place the sounds in the same comfortable rhythm.

#### 5. Technology

- The silver ratio is used in some areas of engineering and technology, such as in screen design or determining the proportions of devices. It helps to create ergonomic shapes that are comfortable for the human eye.

### The natural beauty of the silver ratio

The silver ratio is also found in nature. For example:

- In Symmetry of Crystals and Minerals.
- In the location of the leaves or flowers of some plants.



- In the geometric structures of living organisms.

### Conclusion

The role of the silver ratio in mathematics and its importance in practice is based on the fact that it provides balance and harmony in various fields. Through this ratio, humans are able to create aesthetically appealing, scientifically accurate and functional structures. The use of the silver ratio in architecture, art, physics and other fields proves how vast the possibilities of this relative number are.

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